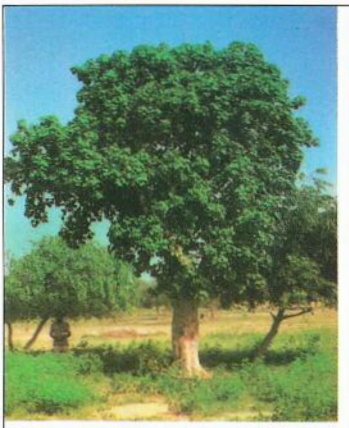
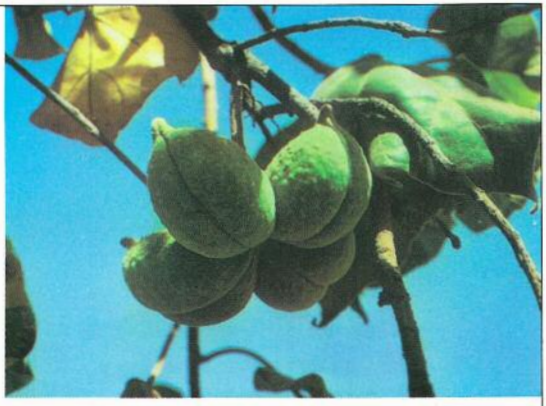
Hans-Jürgen von Maydell

TREES AND SHRUBS OF THE SAHEL

Their characteristics and uses





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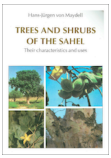
Arbres et arbustes du Sahel - Leurs caractéristiques et leurs utilisations
by Hans-Jürgen von Maydell

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TREES AND SHRUBS OF THE SAHEL

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CONTENTS

PREFACE TO THE FIRST EDITION

Trees and shrubs play a significant role in maintaining the natural ecosystem and in preventing and combatting desertification in the Sahel. They provide a multitude of useful products for the people of the region. Thus not only foresters but also farmers, herdsmen, urban and regional planners and decision-makers at all levels should know more about them.

The identification of the many different woody species that may occur is not always easy. A few botanists, experienced foresters or other people may be available to help. Appropriate facilities exist in well-equipped institutes, but these are not always accessible when needed in the field. The lack of a practical field guide has thus become evident. This book is intended to go beyond descriptions of botanical characteristics and provides some basic information on site requirements and ecology, silvicultural techniques and traditional as well as potential uses. Information from project-related fieldwork was compiled and finally arranged in the form of this book.

The data gathered has been drawn partly from references, as indicated, but mainly comes from experience gained in particular from forestry projects within the framework of technical cooperation between the Federal Republic of Germany and Sahelian countries.

Many institutions and individuals have contributed - the German Federal Ministry for Economic Cooperation, the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) and the German Federal Ministry of Food, Agriculture and Forestry financed research and fieldwork in Burkina Faso and Senegal. The Federal Research Centre for Forestry and Forest Products, Hamburg, supported editorial work by making staff and funds available. The governments of Burkina Faso and the Republic of Senegal, in particular their national forest services, rendered valuable assistance. Numerous forestry institutes and international organizations supplied basic data. To mention only four of them, the Centre Technique Forestier Tropical (CTFT) in Nogent-sur-Marne, France and the Institut d'Élevage et de Médecine Vétérinaire des Pays Tropicaux (IEMVT) in Maisons-Alfort, France with their institutes in Senegal and Burkina Faso, the International Council for Research in Agroforestry (ICRAF) in Nairobi, Kenya and the Forestry Department of the FAO in Rome, Italy. Special thanks are due to the then team leaders of the forestry projects in Burkina Faso and Senegal, Peter Ed. Weinstabel and Christian Dering with their staff, as well as to Prof. Dr. Wolfgang Zech, from the University of Bayreuth, Monsieur Piot of the CTFT in Ouagadougou, Mrs. Sabine Klug, Dipl.-Biol., for reviewing and supplementing the manuscript, and to all the foresters working in the Sahel - among them particularly Mr. Gnoumou in Djibo, Burkina Faso. A considerable number of the photos were taken by my daughter, Uta von Maydell. Members of the "Sahel team" of the Institute for World Forestry of the Federal Research Centre for Forestry and Forest Products, especially Dr. K.F. Panzer, have untiringly

contributed towards the work to be completed. To all those named here, and to the many not mentioned, I should like to express my sincere thanks.

Hamburg, February 1981 H.-J. von Maydell

PREFACE TO THE ENGLISH EDITION

In recent years there have been many requests for an English version of "Arbres et arbustes du Sahel". The translation took some time. A thorough revision of the entire French text showed that much additional information had been collected since the completion of the first manuscript in February 1981. Hence, rewriting several chapters of the book became inevitable. The present edition corresponds to the state of our knowledge in 1986. I would greatly appreciate further comments, corrections and suggestions and I shall try to pass them on to all those who are interested and engaged in fieldwork in the Sahel.

It is a privilege to express my particular gratitude to the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) in Eschborn for generously providing the funds for the English edition. I would also like to thank Dr. K.F. Panzer for translating the main part of the text and for his stimulating contributions. Miss Cordelia v. Klot-Heydenfeldt and Miss Gabrielle v. Tiesenhausen have helped with translations and proofreading. I also gratefully acknowledge the support of many colleagues and friends who assisted with criticism and suggestions. Last but not least, I am indebted to Mrs. E. Kaufmann and Mrs. E. Bollhorn, who graciously undertook the task of typing with enthusiasm and never-ending patience.

Hamburg, April 1986 H.-J. von Maydell

My first acquaintance with Professor von Maydell dates back to the mid-seventies, after the dreadful drought. We were then drafting the Senegal-German project on silvopastoral management and afforestation in Northern Senegal. That project was essentially based on a common conviction I am strongly sharing with the author: The existence of significant possibilities of local species that can help to solve the manyfold problems of rural development in the Sahel. Professor von Maydell's book is all about this potential.

The last ten years in Sahelian forestry have been marked by efforts to associate and involve people in all phases of development and project life. This commitment is, however, likely to remain just wishful thinking, if it is not backed by appropriate tools. The knowledge of the people's environment, their traditions, culture and needs ranks very high among these tools.

"Trees and shrubs of the Sahel" is, therefore, a long awaited, and timely contribution. Indeed, one of the foremost difficulties facing young foresters in the Sahelian countries is a rapid introduction to and good knowledge of the local species. In addition, the need to train more and more rural development extensionists has brought into the scene people from farther south and from cities who have not been initially blessed with a natural knowledge and total immersion in local conditions. For the ever increasing number of these young professionals a field-guide was urgently needed and I am convinced that "Trees and shrubs of the Sahel" goes very far in filling the gap. The 114 species described herein are those the forester, the pastoralist or the plain extensionist are most likely to deal with or be questioned about. My standing question to young foresters who complained to me about not having much to do in their area of service was whether they just knew the species, trees and shrubs growing in their vicinity. The answer often was an uneasy hesitation or silence which I took for a definite "no". With this book they now have a new tool helping them to solve their tasks more efficiently.

I do hope that practice will respond to the first step made by Professor von Maydell, and others from abroad or in the Sahelian subregion will follow. Our local trees and shrubs deserve first priority in Sahelian forestry and agroforestry. As pointed out in the book more research is needed for better utilisation of the food and medicinal potentialities of many species. Genetics, plant improvement and propagation, social sciences and technology are further fields requiring joint efforts.

This English edition will be highly appreciated in the English speaking African countries. It provides basic knowledge on identification, conservation and propagation and a multiple use of the trees and shrubs in the Sahelian and Sudanian subregions.

El Hadji Sène
Former Director of Forests of the Republic of Senegal, Coordinator of FAO's International Year of the Forest activities

INTRODUCTION

Geographically, the Sahel Zone as defined in ecological terms stretches over more than 6,000 km in an east-west direction from the Atlantic coastline of Senegal to the Red Sea and the Indian Ocean. Covering the transitional zone between semi-deserts to the north with less than 100 mm of rain per year and the open woodland savanna to the south, where annual precipitation exceeds 600 mm, the region extends in a north-south direction over several hundred kilometres, thus comprising about 3 million square kilometres. Within this vast area environmental factors such as local climate, soils, topography, water availability and vegetation vary considerably. The same holds true for the socio-economic and political systems encompassing some 300 ethnic groups living in the zone, and the various countries whose territory falls partly within the Sahel proper.

Water is the dominant constraint on subsistence and development. Rains generally fall between the end of June and early October. There is, however, a great variation in quantity between individual years and periods of several years and, even more importantly, in seasonal and spatial distribution. Thus a single rainfall may yield over 150 mm and result in almost disastrous floods and erosion, whereas rains which come too early or too late with long dry periods in between severely impede plant growth. So life, and in particular land use, has to be carefully adapted to these unpredictable but decisive climatic fluctuations and their effects on flora, fauna, and man.

Temperatures are high but generally not a real problem for tree growth. By contrast winds, especially the "harmattan", in combination with high radiation values result in very high potential evapotranspiration rates, which not only prohibit the growth of many woody species but also keep other trees small and with a stunted growth typical of many xerophytes.

Although the extremely harsh macroclimatic conditions, in particular the dry season of 8 - 10 months, generally preclude the formation of closed forests, trees and shrubs are encountered as essential elements of the landscape almost everywhere. If one looks closer, one soon discovers that they play a very important role in the functioning of the ecosystem, in traditional land use systems and, in fact, in the daily life and subsistence of millions of nomadic herdsmen and sedentary farmers as well as urban dwellers. Trees and shrubs provide firewood and timber, food, forage and medicines as well as a number of other ancillary products. They have protective and beneficial effects on crop and range lands, and are used not only to halt environmental degradation and ultimately desertification, but also for the amenity of villages and towns. Trees and shrubs are amongst the few renewable resources of the region which contribute to employment and income and, last but not least, they are a basic element of African life and culture.

During the past decades population growth and the increased

demand for forest products (particularly firewood), arable land and pastures have resulted in excessive land use practices. Starting with a devastating exploitation of the woody vegetation, the alarming rate of deforestation results in accelerated degradation of once productive sites and ends with irreversible desertification. This is most evident around towns, villages, deep-well stations and near roads and cattle trails. In other words: destruction is concentrated precisely in those areas where demand for forest products and protective functions is particularly high. This situation is aggravated by repeated droughts causing a state of near-permanent strain in many parts of the Sahel. In a vicious circle, scarcity leads to further destruction of flora and fauna by people who are desperate. This is followed by losses of soil fertility, reduction of water reserves decreasing productivity of herds and farms, which results, finally, in further impoverishment of the rural population. Desertification thus causes migration of the "rural poor" to already crowded urban centres or emigration to other countries, a grave development in political and human terms.

For this reason not only foresters and all others responsible for the management of natural renewable resources in Sahelian countries, but also national and international development and research agencies are urged to undertake all possible efforts to protect, improve, extend, and where necessary, re-establish the woody vegetation in order to secure the supply of its products and the benefits so vital to people in the Sahel. Foresters in particular must plant those trees and shrubs best suited to meeting the demand, to improving the quantity and quality of yields through genetic selection, to silvicultural operations and rationalized harvesting, and to practising forest management not as an end in itself but specifically for the benefit of the people and their environment.

The decision as to whether, when, how many and where trees are to be maintained, planted or naturally regenerated, will have to be primarily demand-oriented. At a second level, the administrative, financial, personnel and technical framework will have to be defined. Adequate organization and execution of the relevant projects, in particular afforestation, silviculture, utilization and marketing, come third in order of priority. All this has to be achieved under the constraints resulting from unfavourable site conditions, minimum site requirements of the selected species, a very limited knowledge of silviculture in the region, lack of time, money, etc.

It is very important to be constantly aware of the fact that forestry in the Sahel is not the dominant land use but is inevitably interwoven with animal husbandry, rainfed agriculture and village or urban life, thus assuming a significant, but predominantly supportive function. Within this concept, indigenous trees and shrubs suitable for multiple uses should have priority over fast-growing exotics which exclusively yield timber. People are familiar with them and their products. Local trees and shrubs are usually well adapted to resisting climatic

extremes, pests, diseases and traditional forms of land use. They are also a valuable genetic resource for other semi-arid regions, and a living testimony to the adaptive potential of plants in a marginal environment. Hence, they deserve more attention and promotion than in the past.

Although some exotic trees may offer greater advantages under specific conditions, they should be introduced with caution and on condition that they fit into the existing ecosystems and yield products and benefits which cannot be obtained otherwise. They should on no account be the forester's quick and only response to solving afforestation problems. In particular, large-scale plantations should be restricted to emergency situations, or to meeting acute demand such as urban fuelwood needs.

It is thus the main objective of this book to focus attention on the wealth, variety and multiple use potential of the indigenous trees and shrubs of the Sahel, and to underline their significance for the survival and well-being of more than 100 million people living in the Sahel countries.

1. GENERAL REMARKS ON THE BOTANICAL DESCRIPTIONS

Botanical names and synonyms

Confusion is frequently caused by the use of different botanical names for trees and shrubs of the Sahel. Discrepancies result mostly from the fact that the relevant books were published over a period of approximately 100 years, and in many different countries and languages. This in itself has led to a great variety of terms. In addition, on the basis of new facts lengthy disputes occasionally arise between botanists on the final taxonomy of plants. This book does not attempt to present the very latest state of knowledge in this field. The names used here have been chosen as "key" or "indicative" names. A list of all botanical names, including synonyms, is given in Appendix I to assist the reader in identifying the trees and shrubs.

Families

In general, attribution to botanical families does not pose a problem. Where changes have taken place in recent years (e.g. Balanites aegyptiaca from Zygophyllaceae to Balanitaceae) a reference to the relevant species has been given. For the Papilionaceae the new term Fabaceae has been used. As to the rank within the systematic order of families and genera, several diverging concepts exist; here the families are listed in alphabetical order.

The list of families and genera is contained in Appendix II.

Vernacular names of trees and shrubs

The number of languages and dialects spoken in the Sahel is so large that agreement with local people on the names of trees and shrubs frequently poses considerable difficulties. I have therefore decided to list at least the most important tree names in the languages spoken by several major ethnic groups in Senegal and Burkina Faso.

However, even within one language different names exist for the same species, or similar species are described by the same name where appearance or uses are similar. Furthermore, individual authors have written down the names as they were pronounced, so that considerable differences in spelling may occur.

The collection of names listed in Appendix III derives from comprehensive questioning and double checking in the field as well as from standard literature. Only those names have been listed for which agreement has been established with at least three sources i.e. in two publications and one oral source in the field, or from three regionally different questionnaires.

Botanical descriptions

The trees and shrubs of the Sahel and adjoining regions have been described in numerous, although often not easily accessible, scientific publications. These are mainly used by research institutions or international organizations in identifying the woody vegetation for their scientific work or specific forestry projects.

This book has been written primarily to assist practising foresters, agriculturists, livestock experts, general land use planners, etc., who work with shrubs and trees in the field. Starting with a short botanical profile, including colour photographs, the botanical abstract summarizes the content of the relevant literature, where possible supplementing it with personal field observations.

The botanical terminology in English, French and German in Appendix IV may be useful for the evaluation of botanical literature.

References

Aubréville (1950), Berhaut (1967), Berhaut Vol. I-VI (1971-1979), Dale/Greenway (1961), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo/Adam (1974), Palmer/Pitman (1972), Sahni (1968), Terrible (1975).

2. DISTRIBUTION AND SITE REQUIREMENTS

Geographical range

All tree and shrub species presented here have been found in the Sahel of Burkina Faso and/or Senegal. They are known, however, to exist in the Sahel from the Atlantic coast to the eastern limits of the Republic of Chad. Several species are found beyond this range within the Sudan and Guinea savanna zones, in East Africa and even in the semi-arid regions of South Africa, North Africa or in the Near and Middle East. Other species have been introduced from outside Africa, but have adapted so well to the Sahel that they have become a familiar element of the countryside and are no longer considered "exotic".

The flora of the Sahel by its ecological definition and the adjacent Sudan savanna zone belongs to the Palaeotropis and has, in principle, the same taxonomic structure (families, genera and species). It is important to note that north of the Sahara, in the Holarctis, the structure is entirely different, and there is practically no penetration of holarctic families or species into the Sahel following spreading desertification and in spite of some trials to introduce for instance Mediterranean tree and shrub species.

Geographical distribution depends largely on the quantity and distribution of rainfall between June and October. The number of species for instance, decreases from south to north from more than 120 in the range of the 600 mm isohyet to some 30 species in the zone of the 200 mm isohyet, i.e. 300 - 400 km further north. In addition, from west to east several well-defined areas of distribution exist. It is noteworthy that one species may occur in several non-contiguous areas but be missing in-between these. Several very closely related species grow either in the east or in the west of the Sahel, occasionally forming botanical varieties or varieties specific to the site, while other species have very restricted ranges.

The planting of tree and shrub species outside their actual range may be very successful, but should be carefully tested on a small scale prior to extension. The phytosanitary and ecological risks involved are much greater than with native species. On the other hand, experience gained in the Sahel of West Africa and many other semi-arid tropical regions supports the assumption that so far only a few of the existing opportunities for successful cultivation of exotic species have been realized.

Site requirements

In the Sahel, the vegetation reacts strongly, and often with long-term effects, to human interference, particularly to changes in environmental conditions, showing an outstanding degree of resilience. Resilience refers to the probabilities of qualitative changes, and these decisive changes are characteristic of the

Sahel, as outlined above. An ecosystem with high resilience can vary considerably but springs back to its former structure if conditions return to "normal". Resilience describes a kind of plasticity around an average, based on tolerance of extreme conditions, ability to recover rapidly and special distribution patterns over space and time.

Success in the cultivation, protection and management of trees and shrubs depends to a considerable extent on site requirements specific to the species concerned corresponding with the actual site conditions. This necessitates careful site studies and subsequent site classification, as well as adequate knowledge of the site requirements of individual species. In practice, however, such knowledge is frequently not available and must consequently be replaced by subjective empirical judgement.

A basic distinction must be made between the economic and the natural site. The economic site, occasionally also called the socioeconomic site, comprises all social and economic factors having an effect on land use, particularly on forestry. This includes population density, distribution and structure, infrastructure (in particular transport conditions), buying and selling markets, working conditions, income, regional planning, etc. Salient factors in the Sahel are the traditional location and activities of the ethnic groups, the distances from urban centres, market-places, water resources or settlements, as well as the extent of the network of roads and trails. A further important factor is whether sites are located within the range of sedentary agriculture (irrigated or rain-fed agriculture), or of transhumant or nomadic livestock management.

The natural site defines an area with characteristic conditions with regard to climate, relief, soil, water availability, vegetation cover and fauna. These factors largely determine which tree or shrub is likely to grow, as well as estimates of potential productivity of species, stand types and management forms, and which is likely to resist environmental stress.

The yield potential (including forest products and services) of a site is essential for forest planning and management. Very little is known, however, about the annual biomass or wood increment of natural stands and plantation forests in the Sahel. Average figures such as 0.2 m^3 of wood per year per hectare may be misleading as increment depends largely on site, species, age structure and silvicultural treatment. By using shorter rotations, changing stand densities (spacing), using selected fast-growing plant material, etc., considerable improvements can be achieved. However, reliable data are not yet available. As a rule of thumb, the annual net production, i.e., the harvestable volume or sustainable yield in kg from a properly managed forest in the Sahel corresponds to the annual rainfall in mm recorded. Hence with 300 mm up to 300 kg of wood (including branchwood), with 600 mm up to 600 kg or 1 m^3 can be expected, with optimal silvicultural management, as maximum yields. All figures exceeding these estimates will depend on extraordinary prerequisites or

inputs (such as irrigation or fertilizer application).

Similar sites can be grouped within site types which are characterized by comparable growth conditions, yields, utilization potentials, risks and reaction to interference. Fundamental studies for site classification have been carried out by O.R.S.T.O.M. and C.T.F.T. (see also GIFFARD 1974 A, TERRIBLE 1978 and TOUTAIN 1977). A typical association of site types is called a growth district, and the association of growth districts within larger physiogeographical units is termed a growth region.

Very little is known about the silvicultural possibilities and limitations for conserving the existing vegetation, or of establishing tree and shrub plantations on particular sites in the Sahel. Some species obviously have a considerable ecological amplitude ("elasticity"), while others occur only on typical sites and under very specific conditions. Frequently biological and ecological factors are influenced by the effects of former or present land use practices. As some of the species described below are rarely found in the Sahel but are quite frequent in the Sudan savanna to the south, it may be assumed that under the pressure of excessive land use they had no chance to regenerate. This assumption is corroborated by the occurrence of some of the endangered species on relict sites in the Sahel. On the other hand, a number of species from subhumid zones penetrate far into the arid region and survive on sites where the availability of ground water is secured, e.g. around depressions and along seasonal watercourses.

An attempt to allocate certain species to defined site types is thus almost exclusively based on information from literature, sporadic local expertise and the author's own observations. These indicate the present geographic range, but this does not mean that better conditions may not exist elsewhere.

Prevailing site conditions can be improved by:

(a) subsoiling of compacted surfaces;
(b) irrigation/drainage;
(c) fertilizer application, mulching;
(d) protective measures against fire, erosion, wind;
(e) protection against harmful biotic agents (e.g. fungi, insects, wild animals and livestock), fencing;
(f) changing species combination and densities of plant and animal populations.

The scope and intensity of such measures generally decrease with distance from population centres because of limited funds, constraints on labour input, and generally lower site productivity. Conditions in urban gardens and horticultural lots can be optimized as in oases, while in sparsely populated and extensively managed "open ranges" the existing state of natural marginality and/or man-made degradation has to be accepted as a fact which can only be changed by long-term efforts to stop environmental degradation and engage in sustained natural resources management.

Moreover, although there are good reasons for some optimism, the fact that there are definite limits to a sustained increase of biomass production in the Sahel must not be overlooked. This is evident from many research findings of the UNESCO MAB Program and other ecological projects. Total phytomass production on a given site cannot be increased substantially by simply changing the species combination. On the other hand, it is possible to modify the proportion of above ground to underground vegetation (e.g. the root to trunk ratio) and to increase the quantities utilizable for man and livestock within the total biomass production. This appears to be an opening and a challenge for both research and practical field work. Further limits are imposed by lack of funds, manpower and other economic and social constraints.

For millenia, nature has responded to abiotic site factors with the adaptation of plants to the environment. In the way they adapt, plants fall into the following broad categories:

- ephemeral plants with extremely short life cycles. These are predominantly herbaceous, i.e. non-woody. However, many perennial woody plants produce extremely resistant seeds, or regenerate from root suckers in a similar way, which allows them to "disappear" over longer periods if unfavourable conditions prevail;

- xerophytic plants which have the ability to resist drought by physiological adaptation, e.g. by developing specific root systems, leaf forms, protective coats or chemical components. Most woody plants of the Sahel fit into this category.

- There are also subcategories, such as the salt-tolerant halophytes, the sand-tolerant psammophytes, the gypsophytes growing in gypsum soils, and pterophytes that are able to grow on rocks.

Another form of physiological adaptation is that of the so-called C_4-plants which can close their stomata during the day, thus reducing water loss from inner tissues. Carbon dioxide is fixed over night as malic acid, while the stomata are open. Carbon dioxide is then converted within the cells, through photosynthesis during daylight.

Those trying to optimize phytomass production through skilful management of trees and shrubs should bear in mind these and other important ecological and plant physiological facts concerning available sites in the Sahel.

References

Aubréville (1950), Barth (1977), Berhaut Vol. I-VI (1971-1979), Bille (1977), Boudet (1977), Bourlière (1983), Giffard (1974 A), Knapp (1973), von Maydell (1978), Michel (1973), Pallier (1978), Poupon (1979), Schiffers (1971 + 1976), Terrible (1978), Toutain (1977), Touzeau (1973).

3. PROPAGATION, ESTABLISHMENT AND SILVICULTURAL MANAGEMENT

With the exception of about ten "exotics",*) few tree and shrub species have been planted to any noteworthy extent in the Sahel. Reliable data on natural regeneration or forest plantations, seed collection and treatment, vegetative propagation, site preparation, planting techniques, plant spacing, species combinations, resistance and protection, silvicultural management, and other questions relating to forestry and agroforestry or single tree planting are difficult to obtain. Part of the experience available, moreover, is only valid for specific sites and is not necessarily applicable to other locations or to different tree and shrub species. There is very little evidence on the economical feasibility of afforestation. Cost factors with a strong influence are generally

- the cost of land/opportunity costs,
- cost of establishment,
- infrastructure (buildings, roads, fencing, firebreaks, etc.),
- maintenance costs (for infrastructure),
- silvicultural costs/management costs,
- exploitation/multiple use costs,
- administration costs.

There are still very few cost-benefit analyses.

Consequently further careful investigation is necessary in each specific case. What has been found to be successful in one place may not be feasible elsewhere. Conversely, failure in one project does not necessarily mean that a species or technique will not prove suitable under similar or slightly modified conditions.

There are, no doubt, a few fairly well-established afforestation techniques for large-scale government or foreign aid forestry projects. But these are often too rigid and expensive to be adapted to a variety of site conditions or to specific management targets as in village woodlots or agroforestry systems. A fuelwood plantation certainly requires different silvicultural and harvesting techniques than a natural forest reserve, a forage-shrub plantation, or an area with fruit trees within an agroforestry enterprise. However, it would be possible to choose the same tree or shrub species for all these management goals, if different stand structures, rotation periods, etc. are selected and an adequate treatment is applied.

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*) such as Albizia lebbeck, Anacardium occidentale, Azadirachta indica, Cassia siamea, Casuarina equisetifolia, the eucalypts, Leucaena leucocephala, Mangifera indica, Parkinsonia aculeata and Prosopis juliflora

Long-term forestry planning should be based on the concept of gradual transition from pioneer forest to intermediate stands and finally to a (sub-)climax forest, or possibly development into an agroforestry land use system, each requiring particular silvicultural operations. Research and practical experience are still needed before even basic silvicultural practices in the Sahel can be regarded as firmly established. Afforestation practices from the Sudan savanna zones are not necessarily transferable to the Sahel.

Stand types and stand forms

The horizontal arrangement of stands is largely determined by management goals, by site conditions and by general land use planning. Projects in which the emphasis is on forestry (afforestation, management of natural forests) should aim at continuous lots of 20 - 50 ha of nearly quadratic size. Besides securing a stable stand climate, they offer advantages for mechanized forest operations, facilitate control and surveillance and optimize the relation between cost and benefit (e.g. if fencing is required). Not all trees and shrubs are suitable for large-scale cultivation. In agroforestry projects and for roadside planting, single trees, clusters, rows and strips may be best suited to the purpose.

The vertical stand structure may incorporate a pioneer forest stage or include remnants of the previous natural vegetation. Two-storeyed stands could be interesting, e.g. if timber (two rotation periods) and fuelwood (one rotation period) are combined, or with coppice-with-standards systems. In Gonsé, Burkina Faso, some promising results have been obtained with Acacia nilotica var. adansonii under a shelter of Eucalyptus camaldulensis, and in the greenbelt of Ouagadougou with a natural regeneration of Azadirachta indica under various local and exotic species. In general, however, all the trees of the Sahel are typical light demanders and difficult to grow even under a light shelter. This is common with most plant species growing on adverse soils (e.g. with water or nutrient deficiency), whereas on good sites even the same species will thrive in the shade. In spite of noteworthy research efforts, in particular by CTFT and its field stations, reliable guidelines for spacing or the degree of final stocking are rare. Basic values determined so far for Eucalyptus camaldulensis cannot be applied to other species. Hence, much silvicultural research remains to be undertaken.

Management forms and productivity

Many trees and shrubs in the Sahel regenerate well by coppicing or from root suckers. In view of the generally short rotation, prevailing use, or existing monetary limits, the coppice-with-pollards or coppice-with-standards management systems may prove most appropiate. Naturally wood lots with sufficient and suitably distributed trees or shrubs for coppicing are a prerequisite for this.

Coppicing exploits the potential of many tree and shrub species to produce one or more successive tree crops after the previous crop has been harvested. There is very little information available on the coppicing mechanism and the coppicing potential of woody species in the Sahel, although there is evidence that this could basically help to improve yields, to reduce rotation periods and risks and to economize the management of single tree plantations as well as of closed forest estates.

The coppicing potential obviously depends on
- the genera and species,
- site conditions,
- quality (health) of the preceding stands,
- cultivation techniques (soil preparation, weed control, slash-and-burn, etc.)
- rotation and/or intercropping,
- the vitality (the remaining root system has an advantage for the sprouts' growth as compared with the survival of seedlings)
- season of cutting (preferably during the dry season),
- stump diameter (potential may decline with larger trees),
- stump age (potential may decline with age),
- stand density.

As propagation by direct seeding or by transplanted seedlings from nurseries implies many risks and (generally) high costs, more experience should be gained with coppice systems in the Sahel.

Where species do not coppice, re-establishment of stands requires direct seeding or planting. With short rotation periods (up to 10 years) clear-felling will dominate in plantations. Elsewhere (e.g. in urban greenbelts, amenity plantations, protective forests) shelterwood or selection cuts (cutting individual trees or groups of clusters) will be of advantage. As observed in the field and stated by many authors, the lifespan of Sahelian trees and shrubs is rather short. With the exception of Adansonia digitata and a few other species, most trees live hardly more than 30-35 years. Their annual increment as compared to the growing stock is rather high (as is generally the turnover of the primary biomass, i.e. the fraction exchanged during a year). Total net annual wood increment in natural forests may approach 2 % of the growing stock volume which is a common rule for light-demanding species in natural stands, depending on site (rainfall, soil type), species, etc., but is still very low in absolute

figures, i.e. in the range of 0,2 per ha and year since the growing stock rarely exceeds 10 m^3/ha. Since the bulk of wood increment is produced between the 5th and 15th year, this is an indicator for optimizing rotation periods. Increment in plantation forests may range between 1.5 and 3,5 m^3 per year per hectare on adequate sites and exceed 10 m^3 with irrigation and fertilizing. Irrigation, however, is generally limited to agricultural projects with small woodlots, windbreaks, etc.

Establishment

Natural regeneration is insufficient or even impossible where trees and shrubs for seed production do not grow close enough, where a change of the species structure is intended, or where short-term mass-production is required. The regeneration of still well-structured stands (but also of many degraded areas) through coppicing or direct seeding has great potential which should be used more intensively. Natural regeneration has the considerable advantage of lower costs and simple follow-up operations. A further advantage of the natural regeneration system is that endangered soils remain essentially undisturbed. Hence, as a measure against desertification, natural regeneration is an important management tool, but requires a period of at least 4 - 6 years and will generally not work without protective fencing.

Artificial regeneration and afforestation require intensive site preparation, i.e. the removal of undesirable vegetation, gridwise subsoiling with a ripper to a depth of 70 cm according to the intended spacing, or the digging of large planting holes (single tree planting), later optional fertilization and, where applicable, also irrigation. These measures are expensive, but may be the precondition for optimizing the volume and value production of plantations.

Seed collection and seed treatment

In general, there are no major problems in procuring seeds. This holds true for the exotic species, for which a certain guarantee is generally given with regard to provenance and quality. If seeds are obtained locally, special care must be taken to avoid the collectors performing seedcollection on nearby, easy-to-reach trees with poor growth and of bad quality, or which are fruiting too early or too late because of diseases, pests or bad genetic properties. This would inevitably result in a negative selection. The training of personnel and supervision are thus essential. In some instances, e.g. with Acacia senegal and Acacia tortilis, the collection of pods not yet mature, has proved effective in avoiding bruchid attack and the need for presowing treatment. (DORAN et al. 1983).

With regard to the storage and treatment of seeds many suggestions are available from practical experience, but there are still considerable gaps in our knowledge which require further research and field trials.

A few keywords may help to draw attention to questions that are of vital interest to the practitioner. These include (see GOOR and BARNEY, 1976, pp. 53-99):

a) Collecting seeds
   - age of parent trees/shrubs
   - season of seed maturity
   - selection and demarcation of seed trees/shrubs
   - harvest forecast/demand forecast
   - periodicity of seed years
   - harvesting techniques
   - statement of origin, date of collection, etc.
b) Transport
c) Extraction of seeds from pods, etc.
   - separation
   - air/kiln drying
   - cleaning (removal of impurities, injured seeds, wings)
d) Grading of seed qualities;
e) Number of seeds per kg, or weight of 1,000 seeds *)
f) Sanitation (protection against insects and fungi)
g) Storage (protection against moisture, light; regulation of temperature)
h) Trade
i) Germinability tests
j) Treatment against seed dormancy.

With regard to seed dormancy, which is of great importance when one is dealing with many species in the Sahel, five main categories may be distinguished:

1. Embryo dormancy
2. Seed-coat dormancy
3. Induced or secondary dormancy
4. Immature embryo
5. Double dormancy, combining two or more of the above types.

Dormancy caused by seed coats can be overcome by:

a) Collecting seeds which have passed through the gastro-intestinal tract of animals (preferably of goats)
   Examples: Adansonia, Azadirachta, Balanites.

b) Immersing seeds in 4 to 10 times their volume of boiling water (or preferably water at 60° to 90° C, to avoid losses). The same seeds may even be boiled for 5-10 minutes, and allowed to soak in the gradually cooling water for 12 to 24 hours.

c) Soaking in concentrated sulphuric acid. This technique requires the availability of commercial grade sulphuric

*) Appendix VI gives a preliminary list of seed weights. Appendix VII shows colour photos of the fruit or seeds of 70 species as an identification aid.

acid (95 %, 36 N), acid-resistant containers, wire containers and screens, as well as abundant water for rinsing seeds at the end of the treatment. Safety precautions are essential, because the acid is dangerous to people, materials, plants and animals. Water must never be added to the acid (danger of explosion)!

The optimum soaking period will depend on the species. It is usually in the range of 20-60 minutes, but soaking for 120 minutes has given very good results for Acacia nilotica and Acacia tortilis in tests at the CSIRO Seed Centre, Australia. (DORAN et al. 1983).

d) Mechanical piercing, chipping etc. or injuring the testa with a needle, knife, clipper or with abrasive paper is used for small quantitites of some seeds with good results.

For hard or immature embryos and embryo dormancy a cold-wet pretreatment (stratification) should be tested. Other promising techniques include microwave irradiation, which appears to have many advantages.

Propagation

With regard to optimum techniques for tree planting in the Sahel, opinions vary widely and are often controversial. Direct seeding or the use of seedlings grown in a nursery, plantation with potted plants (most common) or with bareroot seedlings, vegetative propagation by cuttings, striplings, stumps, coppicing, root suckers etc. are applied more or less sporadically. There is little information available on the immersing of plant material and clippings. A list - rather incomplete - of tree and shrub species, and their propagation methods is given below:

Propagation by cuttings, stumps or striplings

Albizia lebbeck
Azadirachta indica
Cassia siamea
Commiphora africana
Dichrostachys cinerea
Erythrina senegalensis
Euphorbia balsamifera
Ficus spp.
Guiera senegalensis
Khaya senegalensis(striplings)
Moringa oleifera
Prosopis juliflora
Tamarindus indica
Tamarix senegalensis
Ziziphus mauritiana

Direct seeding

Acacia albida
Acacia nilotica var.adansonii
Acacia senegal
Acacia tortilis
Albizia lebbeck
Anacardium occidentale
Azadirachta indica
Balanites aegyptiaca
Borassus aethiopum
Butyrospermum parkii
Cassia siamea
Hyphaene thebaica
Leucaena leucocephala
Moringa oleifera
Securidaca longepedunculata
Tamarindus indica

Naked root tree planting

Azadirachta indica
Cassia siamea
Eucalyptus camaldulensis
Parkinsonia aculeata

Planting in containers, polythene pots etc.

Acacia albida
Acacia nilotica
Acacia senegal
Acacia seyal
Albizia lebbeck
Anacardium occidentale
Azadirachta indica
Butyrospermum parkii
Cassia siamea
Casuarina equisetifolia
Eucalyptus camaldulensis
Khaya senegalensis
Leucaena leucocephala
Mangifera indica
Moringa oleifera
Parkia biglobosa
Parkinsonia aculeata
Prosopis juliflora
Tamarindus indica

Species which (on suitable sites) will regenerate naturally from seeds if protected against fire and livestock

Acacia albida
Acacia laeta
Acacia macrostachya
Acacia nilotica var.adansonii
Acacia senegal
Acacia seyal
Acacia tortilis
Azadirachta indica
Balanites aegyptiaca
Boscia senegalensis
Calotropis procera
Cassia siamea
Combretum spp.
Commiphora africana

Dalbergia melanoxylon
Dichrostachys cinerea
Diospyros mespiliformis
Grewia spp.
Guiera senegalensis
Khaya senegalensis
Lannea spp.
Maerua crassifolia
Mitragyna inermis
Piliostigma spp.
Prosopis juliflora
Pterocarpus spp.
Sclerocarya birrea
Sterculia setigera
Terminalia spp.
Ziziphus mauritiana

Species which coppice easily or develop root suckers

Acacia seyal
Acacia tortilis
Azadirachta indica
Cassia siamea
Casuarina equisetifolia
Dichrostachys cinerea
Diospyros mespiliformis
Eucalyptus camaldulensis
Khaya senegalensis
Mitragyna inermis
Parkia biglobosa
Phoenix dactylifera
Piliostigma spp.
Prosopis juliflora
Salvadora persica
Sclerocarya birrea
Stereospermum kunthianum
Tamarindus indica
Ziziphus mauritiana

Nursery practice

The establishment and maintenance of a nursery requires comprehensive planning. This concerns the selection of a proper site, the general layout and development. Soils, water availability, shelter, etc., competing land uses, proximity to labour, customers, and forestation sites have to be considered, buildings erected and seedbeds, roads, pipelines, etc. laid out. A management plan, listing the different targets and the related timetable, must be designed. Initial growth of the different seedlings varies considerably. And transplantation always involves extraordinary stress and risk for the young plant. To obtain high survival rates and "normal" growth rates, the seedlings should be of optimum size and in good health. Field planting should be concentrated at the beginning of the rainy season. Rain which falls too early or too late, long dry intervals between initial and subsequent rains etc. diminish survival rates. Seedlings developing a long tap-root need especially careful timing. They will generally suffer either from paring or from severely bent and entangled roots. The roots of some species require pruning to ensure fast growth.

The seeding time depends also on viability. Ideally, a seedling should be approximately 25 to 35 cm high and have a well developed root system when planted at its final site. This means that most Acacia seeds should be sown approximately 4 to 5 months earlier in the nursery; Eucalyptus camaldulensis and Prosopis juliflora require only 4 months, whereas Azadirachta indica may need 2 years, and Khaya senegalensis as much as 3 years.

Management and protection of newly established plantations

Weeding to avoid competition for light, water and soil nutrients is essential in most forest plantations in the first two years. In the Sahel less care is devoted to stand treatment. This is certainly due to lack of experience to date and may also be a consequence of relatively high establishment costs and short rotations. Moreover fast biomass (e.g. for fuelwood) is preferred to quality timber production. In natural forest stands, site protection and the maintenance of a woody vegetation and/or

utilization have often been the only targets. If, in the future, the treatment and stand improvement of natural growth and plantation areas is to be developed with more emphasis on the economics of forest management, more attention has to be devoted to silviculture. This takes time and requires better extension and training to achieve general acceptance among foresters and the rural population. Research and practical testing are needed to improve the hitherto limited knowledge of adapted techniques. These efforts should concentrate on:

- tending of plantations, e.g. weeding, thinning, pruning (green and dead branches)
- regulation of stand density, basal area, structure
- enrichment planting
- establishment of two-storeyed forests
- establishment of mixed forests
- introduction of optimal silvicultural management and regeneration systems (periodic method by area or by volume, management by individual trees, coppice with standards, etc.)

Furthermore, cheap and simple technologies for tending operations compatible with the environment have to be developed. This includes the mechanical or chemical control of competing grasses and herbs, and the control of aggressive tree and shrub species. With adequate caution, an investigation should be undertaken into the conditions under which controlled grazing and browsing of sheep, cattle and goats could not only be tolerated but would also be advantageous as a management tool.

Forest protection, including the prevention of fire and destructive grazing, has not yet received the necessary attention. The establishment of fire-breaks and/or carefully maintained fences may be very expensive, but is indispensable if plantations or natural regeneration are to survive. Rodents have occasionally caused severe damage. Immediate action is needed to control sudden increases in the rodent population.

Insects and fungal infections have not yet occurred on a large scale because extensive monospecific forest areas are still rare. However, this may change with further afforestation programmes with only one exotic species such as Eucalyptus camaldulensis.

Termites are a problem, but generally only where annual precipitation exceeds 500 mm. Poison may be required to avoid losses but increases costs, environmental risks and health problems.

Generally, natural ecosystems are more resistant to calamities than plantations. So the establishment of more and larger man-made plantations will increase the risks, of which the following deserve special attention:

(a) abiotic damage, e.g. through strong wind, excessive rainfall, flooding, erosion and sedimentation, drought, temperature extremes, irradiation, etc.;
(b) damage by plants, e.g. fungi, weeds, parasitic plants;

(c) damage by animals, e.g. insects, rodents (rats, mice, rabbits), birds, game, livestock;
(d) damage caused by people, e.g. man-made fires or excessive use of natural resources (e.g. for fencing, firewood, lopping for forage, etc.) causing changes of site/environmental conditions.

These risks exist at any time and place, singly or in combination, and have various, sometimes synergic consequences. They may affect the storage of fruit and seeds in the nursery, field trials of individual trees or entire stands, younger and older plantations at different times of the year. The products of the trees and shrubs (wood, edible parts, etc.) may be diminished in value or even destroyed. Forecasts are extremely difficult to make, as can be seen from these few examples selected at random.

Prophylactic measures have to be planned where natural resistance is not sufficient. These may include:

(a) physical methods
mechanical protection (e.g. wire-fences, welded wire mesh guards, thorny branches, clay walls, fire-breaks, ditches, windbreaks) mechanical protection of seeds (heat/cold treatment, drying, vacuum, etc.);

(b) biotechnical methods
defence by means of sound, light, etc.
chemical means such as hormones, pheromones, repellents, deterrents, baits, phagodeterrents, phagostimulants;

(c) biological methods
self-destroying methods, promotion or import of useful animals, microbiological counter-measures (e.g. bacteria), biological counter-measures (e.g. against weeds);

(d) cultivation methods
soil preparation (e.g. subsoiling), fertilization, species selection, planting techniques, stand composition and structure, harvesting techniques;

(e) chemical methods
application of rodenticides, insecticides, nematicides, herbicides, fungicides.

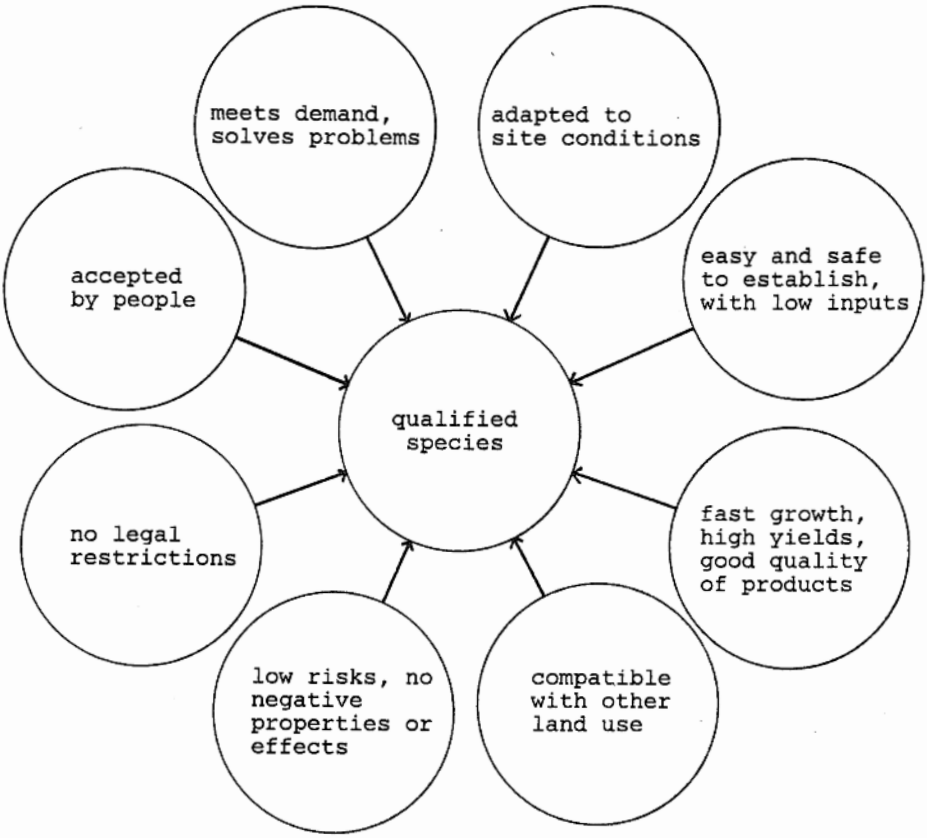
The poorer the sites and the larger the area under monoculture, the higher the risks. Are local or exotic species more prone to damage? This is difficult to determine because only few local species have so far been planted in pure or dense stands, while plantations with exotic species often occupy privileged sites or enjoy specific care and high inputs. As a rule, however, woody plants under stress tend to be favourite subjects of so-called secondary damage, and prevention is cheaper than control, restauration or re-establishment.

Summarizing the above, the planting of tree species should be

promoted which
- are adapted to the prevalent site conditions,
- can supply valuable products and/or protect the environment,
- will contribute to reducing risks in land use and do not themselves cause (new) risks,
- can be managed at a low cost by applying simple and safe techniques,
- are compatible with the traditions and customs of the African way of life.

The diagram below summarizes the main criteria to be considered:

Relevant criteria in the selection



- meets demand, solves problems:
  this is the key to all further efforts in planning and organizing forest activities in the Sahel. Forestry has to be demand-oriented, especially under the marginal site conditions of the region and the general socioeconomic stress situation. "Forests for People", the theme of the 8th World Forestry Congress, should always be in the mind of those practising forestry in the Sahel.

- adapted to site conditions:
  detailed studies of climate, soils, water regime etc. are desirable, including site classification; results should be recorded in maps supplemented by aerial photography. From these data the most appropriate sites can be chosen. Site conditions should closely match the site requirements of the selected species;

- easy and safe to establish, low inputs:
  seeds of selected quality should be available, vegetative propagation should be tested, species allowing direct sowing preferred. Keeping costs for establishment and maintenance low deserves special attention (e.g. reducing the cost of protection, pesticides, fertilizer etc.);

- fast growth, high yields:
  refers mainly to exotics but to some extent also to local species. Multiple uses are important, including suitability for intercropping in agroforestry;

- compatible with other land use:
  concerns agroforestry management but also mixed stands within the forest. The selected species should not negatively affect buildings, roads, communication installations, etc., and should not attract insects, fungi, birds, rats, etc., or be harmful to agricultural crops;

- low risks:
  refers partly to the same problems; but in addition, trees should be resistant to pests, fire, etc.; no severe loss after establishment and during the rotation period; should not develop into an aggressive "weed" once introduced into the country.

- no legal restrictions:
  phytosanitary regulations, laws protecting endangered plants, etc. have to be observed as well as land tenure regulations;

- accepted by people:
  acceptance by people naturally requires extension and practical demonstration. Newly introduced species should not violate traditional (religious) or other taboos.

The choices of species

As stated previously, a number of exotic woody species, such as those originating from regions outside the Sahel or even Africa, have been successfully introduced and are now essential components of rural and urban ecosystems. More species may be introduced when necessary, but with caution in order to avoid failures and undesirable effects.

Basically, priority should be given to the cultivation of local trees and shrubs because:

- this involves less risk, at least from an ecological point of view;
- they are known and traditionally accepted by the people whom they will have to serve;
- they have already been shown to grow and yield timber and other products under the prevailing site conditions (on a larger scale and over longer periods than in any trial plots);
- seeds are readily available, including a choice of varieties and site-provenances, and including vegetative propagation material;
- the African forester should feel a high degree of responsibility for maintaining and improving the indigenous vegetation of his home region.

There are a number of further reasons for using local species. One of them deserves special attention: The full use (or use potential) of many local plants is not yet sufficiently known or statistically recorded. It may well be that the replacement of today's "weedy species" by exotics will result in deficiencies which may impair or even threaten the survival of man and his livestock. Hence "in situ" germ plasm conservation deserves special attention.

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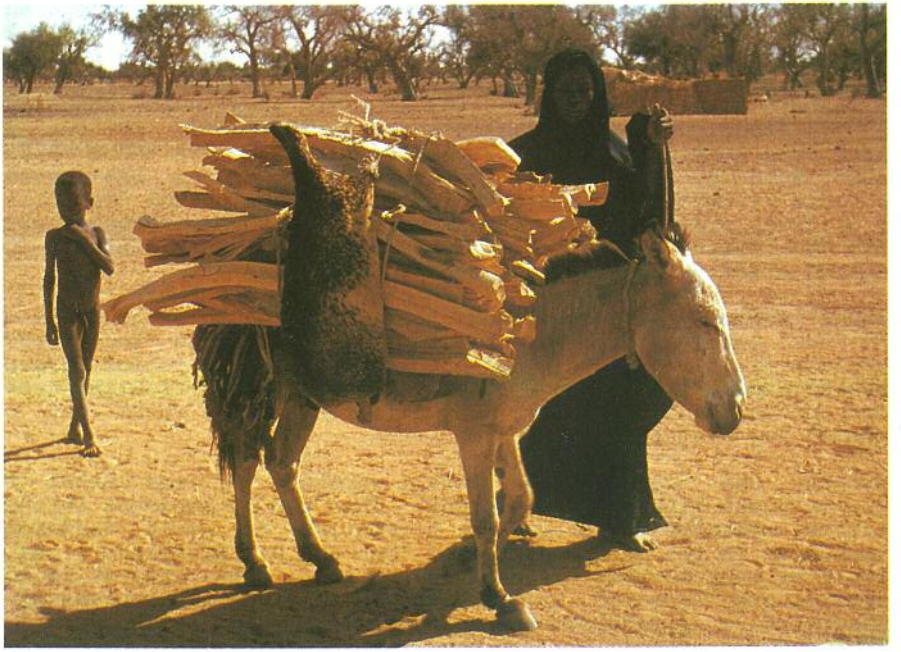
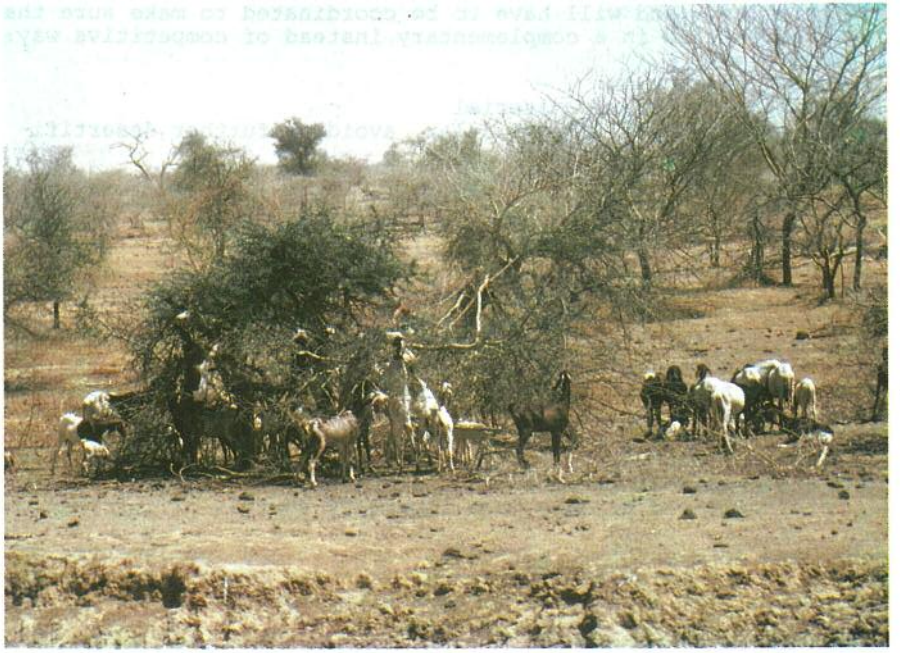




4. MULTIPLE USE OF TREES AND SHRUBS

In order to assure the success of forestry under the marginal conditions prevailing in the Sahel, it must be carefully adapted to the biological, technical, and economic structures, functions and interactions which make up the sensitive local systems of rural and urban life. Forest policy will thus have to be determined both by the natural resources potential and the socio-economic dynamics which have a direct influence on the feasibility of every project. Even more important, however, forestry will have to orient its objectives and its management concepts to meeting existing and future demands.

Demand is highly subjective and closely related to basic needs on the one hand and the way of life and expectations for future development of individuals and specific ethnic and social groups on the other. It is man who sets the value of particular trees and shrubs, and there are many different scales which can be applied for evaluation.

Forestry can increase the overall capacity of the Sahel to sustain human life and the ecology. This can be achieved through various measures which must be harmonized to avoid dangerous imbalances in the entire system of "Man and his Biosphere". As a result of many serious mistakes in the past, the forester is now increasingly expected to take the initiative in implementing integrated rural development programmes.

For the majority of people in the Sahel the following objectives have priority, and will have to be coordinated to make sure that they are realized in a complementary instead of competitive way:

(1) food supply
(2) energy production
(3) availability of raw material
(4) the environment, in particular avoiding further desertification
(5) socioeconomic development.

The information gathered in this book on existing or potential uses of trees and shrubs and their contribution to integrated land use concepts is based on these main concerns of the people living in the Sahel. This information is neither complete nor in all cases fully applicable. Many facts and data have been obtained in the course of 10 years of field studies, but may reflect the subjective replies of the people contacted. Regional as well as individual differences will have to be considered, and in fact tremendous heterogenity has been encountered. Visits to traditional markets, the experience of foresters and experts from different national services, missions, international organizations etc. as well as repeated discussions with farmers, herdsmen, craftsmen and traders were important sources of information.

Facts and data gathered were also compared and supplemented with studies of the relevant literature. The most important references have been listed at the end of each paragraph or chapter.

The aim of this book is to demonstrate that all the woody plants of the Sahel assume significant functions within ecological systems, and for human subsistence and welfare. Not a single one is useless. Very little has been statistically recorded on their multiple uses. So policy and project decision-makers at various levels may not be adequately informed and consequently underestimate the significance of trees and shrubs for development in the Sahel.

4.1 Fuelwood and charcoal

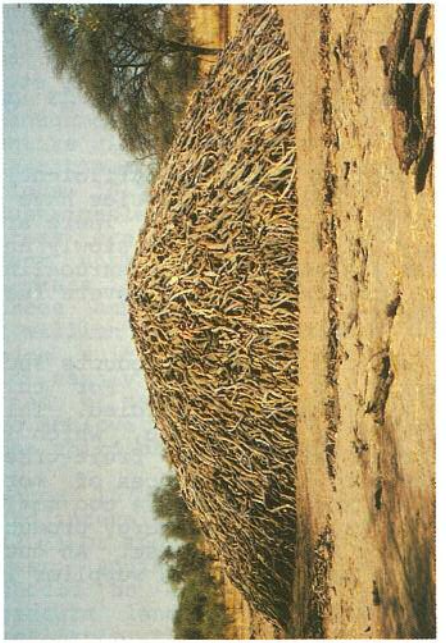
In many parts of the region fuelwood supplies have become extremely difficult to obtain and have consequently been given priority over other targets. However, a more differentiated analysis of the situation and future trends would appear to be necessary. Whereas to people in urban centres this presents enormous problems, in most rural areas a fuelwood shortage is not yet evident. Future demand will be directly correlated with population growth. For economic reasons, technical developments (energy-saving, alternative energy sources) will only become effective in the medium to long term, if at all.

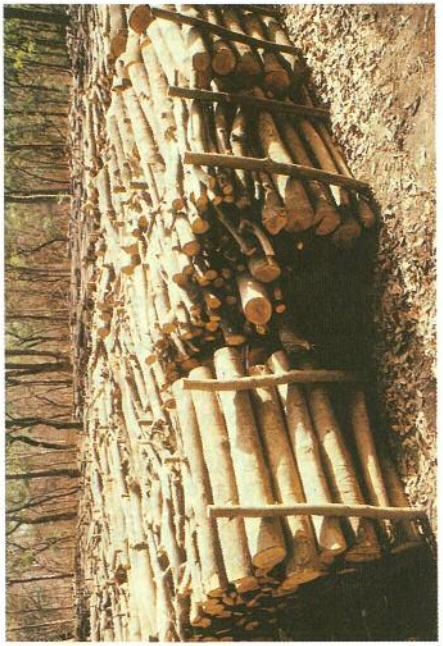
An impressive summary of the fuelwood trends in 5 Sahelian countries, Burkina Faso, Senegal, Niger, Mali and The Gambia, was presented by the FAO "Document de Synthèse" at a conference held in Dakar, 18-27 July, 1984, at which the following figures were recorded:

	1982	2000
Rural population (+2% per year)	20,400,000	29,150,000
Urban population (+3% per year)	25,550,000	37,900,000
Rural firewood consumption, m^3	15,300,000	21,862,000
Urban firewood consumption, m^3	3,862,000	6,562,000
Total firewood consumption, m^3	19,162,000	28,424,000
Annual firewood *) consumption above annual increment, m^3	3,183,000	13,349,000

*) These figures are based on the assumption that there will be a net annual increment of 0.3 m^3 in natural woody vegetation and 2.0 m^3 in forest plantations. The plantations are expected to increase from 54,000 ha in 1982 to 350,000 ha in the year 2000, which appears optimistic. The deficit in the firewood balance for 1982, in the order of 3.2 million m^3, is forecast to grow to 43 million m^3 in 2030.

FUELWOOD





The average consumption in private households, according to surveys in Burkina Faso and Senegal, is estimated to be 1 kg of fuelwood per day, or 360 kg per year, per person for cooking only. Within villages, however, approximately the same quantity will have to be added for small-scale industries such as bakeries, breweries, blacksmiths, or for dyeing and tanning etc. This totals 500 - 750 kg, or the equivalent of 0.7 - 1.0 m^3 or 1.4 - 2.0 steres, per capita, per year.

All tree and shrub species may be used as fuel if sufficiently dry. However, burning properties vary widely. Some species have a high caloric value and burn without smoke or sparking. There are species that burn easily and quickly while others burn slowly and with a small flame. Various species are suitable for charcoaling (generally the heavy ones). So even when faced with a severe fuel shortage, people are amazingly selective.

A number of species are valuable for food or fruit products such as Butyrospermum, Mangifera, Parkia and the palms. For this reason they are only used for fuel after the tree has died. This is impressively evident in the vicinity of Ouagadougou, which is surrounded by relatively well-stocked parklands of fruit-trees while firewood is transported to the city over distances of more than 100 km. Some species are growing too slowly, are too small in size, or are so rare that their contribution to energy production is negligible, though this is not always the case. An outstanding example of a small shrub as a major fuelwood supplier is Grewia bicolor in the Ferlo of Senegal.

For improving the energy supply of rural and urban regions, the following strategies can be recommended:

(a) Increasing production

This could be achieved by establishing fuelwood plantations. In selecting the species, site conditions, estimated increment, calorific value, resistance to damage, cost of exploitation, anticipated effects on soils and water management, alternative land uses, multiple use of the trees and shrubs, rotation cycles and regeneration should be considered.

Whereas natural bushland in the Sahel will hardly yield more than 0.2 m^3 of fuelwood per year per hectare permanently, intensively managed plantations on the same sites may offer sustainable yields of 1 - 3 m^3, i.e. 5 to 15 times as much. To supply a village of 1,000 people, while maintaining the growing stock and woody species diversity, 5,000 ha of natural bushland would be required, ideally within a distance of not more than 5 - 6 km from the centre. 30 trees of different size and quality per hectare can be considered as a fair to good average for Sahelian natural vegetation. 5,000 ha would thus correspond to 150,000 trees or 150 trees per person, needed to supply firewood, if people are not too selective with regard to firewood use.

In practice, however, the tree and shrub vegetation in the vicinity of a village is already strongly degraded or has been converted to fields. Walking distances for women and children thus become longer and longer and result in a heavy burden for all those who do not have a donkey or cart for transportation.

On the assumption that a village afforestation lot with proper management yields 2 m^3 per year per hectare, the demand for the entire village could be covered by 500 ha of plantation. Assuming that the entire fuelwood demand will have to be met from plantations, 0.5 ha per person would thus have to be managed in a sustainable manner. If a spacing of 5 x 5 m is envisaged, 400 trees are needed per hectare, and allowing for losses of 25 per cent until maturity, even 500 trees. If a rotation period of 5 years is anticipated, every individual would have to plant 50 trees annually (and a sub-region within the Sahel with, say, 1 million people 50 million trees or an area of 100,000 ha). So much suitable land is rarely available, and labour and funds are not easily allocated for fuelwood production. A combined utilization of natural wood resources and plantation forests is easier to achieve. This could be based on a concept where approximately one third of the demand is to be met by the plantation.

Hence 167 ha should be planted for the village with 1,000 people and intensively managed for fuelwood. This is 1,667 m^2 (40 x 42 m) or about 66 trees per person every 5 years, or 13 trees per year. Adding 3 trees for afterplanting, a total of 16 trees should be envisaged. If this is done on individual farm or pasture land on an agroforestry basis, it appears much more realistic than 100,000 ha of fuelwood afforestation to be established by the forest services and/or foreign aid projects per every one million people. This shows the enormous importance of involving rural people in afforestation programmes.

For small village plantations established through private or community self-help activities, i.e. without paying for wages, land etc., a capital investment of about 125 US $ per ha would be required. This is needed to cover the costs of seedlings, equipment, fencing, etc. If large-scale forest plantations are established, and wages, experts, nurseries, overheads, etc. must be paid, the costs, depending on site and other conditions, may be ten times higher, i.e. up to 1,250 US $ per hectare.

b) Saving wood and energy

The common way of using fuelwood is extremely wasteful. Adequate preparation of fuelwood, e.g. sufficient drying and splitting of large diameter pieces, but also simple protective measures against insects and fungi (by carbonization, for example) could help to avoid unnecessary energy losses. This particularly concerns the traditional cooking facilities of which there are three kinds:

(1) Open-fire cooking on "three stones" or a metal-ring with three legs. The three stones are arranged in the form of an

equilateral triangle to provide a firm hold for a large cooking pot, especially when stirring millet porridge. A wind protection, such as clay-bricks, is seldom used. The fire is kindled in the centre of the three stones with millet straw or other dry plant residue, and fueled with branchwood 4-8 cm thick or split logs of up to 1.5 m in length. These pieces of wood are placed under the kettle in such a way that only the tops are burning. Between one and three warm meals are prepared daily, consisting mostly of a pap of ground millet and a sauce prepared with leaves, fruit and occasionally meat or chicken.

The following two cooking facilities are used in commercially operated kitchens in markets for the preparation of grilled meat:

(2) A flat mound of sand, 1-2 m in diameter and up to 0.5 m in height, is built up. The charcoal fire in the middle of the mound is surrounded by sticks or skewers (brochettes) with pieces of meat on them.

(3) A sort of gridiron or wire mesh is placed on a semicircular wall of clay-bricks, approximately 1.5 m in diameter, serving as a grill for larger cuts of meat.

These open fires all have in common a very low energy efficiency: The three-stone open fire uses between 5 and 10 percent of the heat produced. If open fires were replaced by simple and very cheap (price equivalent to a family's weekly fuelwood consumption) stoves, fuelwood consumption could be reduced by one third, i.e. to 180 kg/year per person. By using stoves, by the more efficient use of fuelwood, and in part also by a change in eating and cooking habits, fuelwood consumption in the rural areas and villages could be effectively cut back. This would substantially reduce the pressure on the natural tree and shrub vegetation so vital in providing other forest products and environmental protection and help to avoid high afforestation costs.

(c) Substitute sources of energy

At present only limited possibilities are seen in the Sahel for substituting other sources of energy for wood. Due to the lack of fuelwood, cow dung, straw and other agricultural waste is also used. Kerosene, bottled gas, biogas, electricity, wind and solar energy may gain importance in supplying industrial enterprises and urban households. However, for technical and financial reasons they will not find widespread use in rural areas. The supply to deficit areas from wood excess areas, e.g. the proposal to supply the capital of Burkina Faso, Ouagadougou, with firewood and charcoal from tropical rainforests of the Ivory Coast, requires equally careful evaluation. Over a limited distance, depending on accessibility, such a "balance" is already being attempted, however, a number of financial, technical, organizational and administrative obstacles have yet to be overcome.

Charcoal is a special form of substitution for fuelwood. Within rural Burkina Faso, charcoal plays an insignificant role and is mainly used for the preparation of tea. It is, however, the preferred fuel in urban areas of Senegal and The Gambia.

A considerable part of the energy contained in wood is lost during the coaling process. Charcoaling can be economically justified where an excess of wood with suitable dimensions and a high specific gravity (0.7 - 0.9) is available and where consumer markets are not too far away.

In the Sahel, simple earth or pit kilns, or locally manufactured metal kilns are mainly used, achieving a yield of 15-20 % on a weight basis. By-products such as tars and acetic acid are generally lost. Charcoal is used for cooking and by local craftsmen such as blacksmiths and silversmiths, but could also be utilized for other purposes.

As fuelwood and charcoal will continue to be the prime energy source, and the future demand must be expected to increase, an appropriate choice of tree species for natural regeneration and plantation is important. In view of the production costs the selection of species should aim at short rotations of approximately 5 years.

Trees and shrubs suitable as fuelwood or for charcoal:

+ important, intensively used
o rarely or occasionally used
- not used
. no information

	fuelwood	charcoal
Acacia albida	o	o
Acacia ataxacantha	o	.
Acacia dudgeoni	o	o
Acacia ehrenbergiana	o	.
Acacia gourmaensis	o	.
Acacia laeta	+	+
Acacia macrostachya	o	.
Acacia macrothyrsa	o	.
Acacia nilotica	+	+
Acacia pennata	o	.
Acacia polyacantha	o	o
Acacia senegal	+	+
Acacia seyal	+	o
Acacia sieberiana	o	o
Acacia tortilis	+	+
Albizia chevalieri	o	.
Albizia lebbeck	o	o
Anacardium occidentale	o	+
Anogeissus leiocarpus	o	+
Azadirachta indica	+	+

	fuelwood	charcoal
Balanites aegyptiaca	+	+
Bauhinia rufescens	o	.
Borassus aethiopum	o	o
Boscia angustifolia	o	o
Boscia salicifolia	o	.
Boscia senegalensis	o	-
Butyrospermum parkii	o	o
Cadaba farinosa	o	.
Calotropis procera	o	o
Capparis corymbosa	o	-
Cassia siamea	+	o
Cassia sieberiana	o	.
Casuarina equisetifolia	o	o
Celtis integrifolia	o	.
Combretum aculeatum	o	o
Combretum glutinosum	+	o
Combretum micranthum	o	o
Combretum nigricans	o	o
Commiphora africana	o	o
Crateva adansonii	o	o
Dalbergia melanoxylon	o	o
Dichrostachys cinerea	o	o
Diospyros mespiliformis	+	+
Eucalyptus camaldulensis	+	+
Ficus gnaphalocarpa	.	-
Ficus iteophylla	o	-
Ficus platyphylla	.	-
Gardenia sokotensis	o	.
Gardenia ternifolia	o	.
Grewia mollis	o	.
Guiera senegalensis	o	o
Hyphaene thebaica	o	+
Khaya senegalensis	o	o
Lannea acida	o	o
Lannea microcarpa	o	o
Leucaena leucocephala	o	.
Maerua crassifolia	.	-
Mangifera indica	o	.
Maytenus senegalensis	o	o
Mitragyna inermis	+	.
Moringa oleifera	o	.
Parkia biglobosa	o	.
Parkinsonia aculeata	o	o

	fuelwood	charcoal
Phoenix dactylifera	o	-
Piliostigma reticulatum	o	o
Piliostigma thonningii	o	o
Prosopis africana	+	+
Prosopis juliflora	+	+
Pterocarpus erinaceus	+	+
Pterocarpus lucens	+	+
Sclerocarya birrea	+	o
Securidaca longepedunculata	o	o
Securinega virosa	o	o
Sterculia setigera	o	-
Stereospermum kunthianum	.	-
Strychnos spinosa	o	.
Tamarindus indica	o	+
Terminalia avicennioides	o	o
Terminalia macroptera	o	+
Ximenia americana	o	o
Ziziphus mauritiana	o	o
Ziziphus mucronata	o	o
Ziziphus spina-christi	o	.

Trees and shrubs for fuelwood or charcoal which are suitable for planting or natural regeneration:

First column: value as source of energy (calorific value)
Second column: multiple use (besides fuelwood)
Third column: plantation (natural regeneration, fast growth, yield under Sahelian conditions)

1 = very good; 2 = medium, satisfactory; 3 = low rating, unsatisfactory

Acacia laeta	1	2	2
Acacia nilotica var.adansonii	1	1	1
Acacia nilotica var.tomentosa	1	1	1
Acacia senegal	1	1	2
Acacia seyal	2	1	2
Acacia sieberiana	2	2	2
Acacia tortilis	1	1	2
Anogeissus leiocarpus	1	2	3
Azadirachta indica	2	1	1
Balanites aegyptiaca	1	1	3
Boscia angustifolia	1	2	3
Cassia siamea	1	2	1
Combretum glutinosum	1	2	2
Combretum micranthum	2	1	3
Combretum nigricans	2	3	3
Dalbergia melanoxylon	2	2	3
Dichrostachys glomerata	2	2	3
Diospyros mespiliformis	1	1	3

Eucalyptus camaldulensis	1	2	1
Grewia bicolor	2	2	3
Grewia mollis	2	2	3
Guiera senegalensis	1	1	2
Khaya senegalensis	1	1	2
Lannea acida	2	1	3
Lannea microcarpa	2	1	3
Mitragyna inermis	2	2	2
Piliostigma spp.	2	2	3
Prosopis africana	1	1	2
Prosopis juliflora	1	2	1
Pterocarpus erinaceus	1	1	3
Pterocarpus lucens	1	2	2
Sclerocarya birrea	2	2	2
Securidaca longepedunculata	2	2	3
Tamarindus indica	1	1	3
Terminalia avicennioides	2	2	2
Terminalia macroptera	1	3	2
Ximenia americana	1	1	3
Ziziphus mauritiana	1	1	3

The following conclusions can be drawn:

a) For plantations with the prime objective of fuelwood/-charcoal production the following species are recommended:
   Acacia nilotica var. adansonii
   Acacia nilotica var. tomentosa
   Acacia seyal
   Acacia tortilis
   Azadirachta indica
   Combretum glutinosum
   Eucalyptus camaldulensis
   Prosopis juliflora

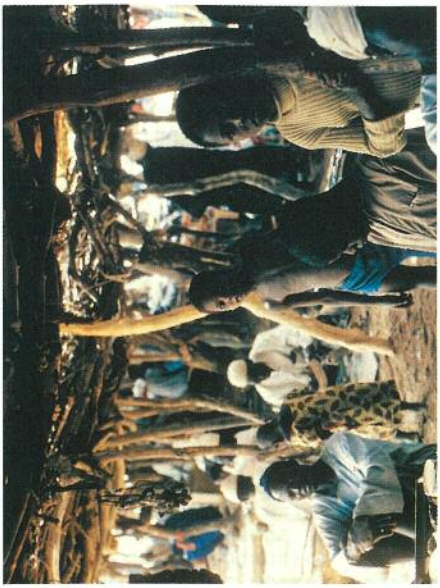
b) For intensive promotion of natural regeneration (possibly with enrichment plantings) the following species are recommended:
   Acacia laeta
   Acacia seyal
   Acacia tortilis
   Anogeissus leiocarpus
   Balanites aegyptiaca
   Combretum glutinosum
   Combretum micranthum
   Combretum nigricans
   Diospyros mespiliformis
   Grewia bicolor
   Mitragyna inermis
   Pterocarpus erinaceus
   Pterocarpus lucens
   Sclerocarya birrea
   Terminalia macroptera

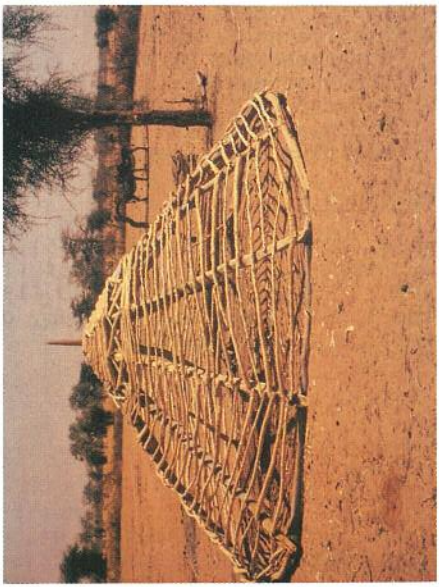
c) The following species, primarily planted for other uses, also produce fuelwood/charcoal:
Acacia senegal
Azadirachta indica
Butyrospermum parkii
Khaya senegalensis
Tamarindus indica
Ximenia americana
Ziziphus mauritiana

References:

Arnold (1978), Bertrand (1975), CILSS (1978), Delwaulle (1973), Doat (1977), Doat and Petroff (1975), Doran et al (1983), Earl (1975), Eckholm (1975), FAO (1981, 1983 A,B,C), Gern, Jacobs, Evans (1980), National Academy of Sciences (1980, 1983), Uhart (1975), U.N.E.P. (1976).

LOCAL WOOD USE





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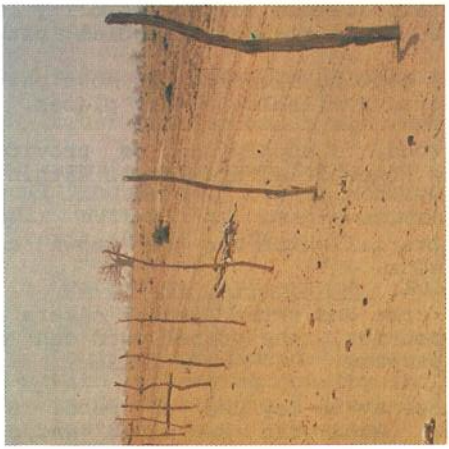
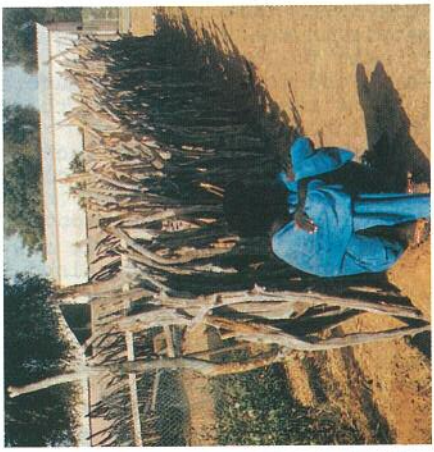




4.2 Timber

Only very few raw materials are available to the majority of people in the Sahel. Among these, wood assumes a special place for the following reasons:

(a) Wood is the one raw material growing naturally in most parts of the Sahel. It is, therefore, available in many places.

(b) Where there is a lack of wood, a supply can be provided through individually planted trees or afforestation within a few years.

(c) Wood is a renewable raw material which can be grown and harvested with sustained yields.

(d) The considerable number of tree and shrub species offers a diversity of technical properties, the proper wood can be selected for a particular purpose.

(e) People are familiar with the day-to-day use of wood. By simple low-cost measures, wood can be saved and/or improvements in quantity and quality may be attained, independent of exterior help.

(f) Until now wood has generally been (and still is) a "free" or "non-monetary" product requiring nothing except labour for collection and transport.

(g) While producing wood, trees and shrubs also fulfil important protective functions. In addition, they provide a multitude of non-wood products.

"Timber" in the Sahel cannot be compared with timber in humid tropical forest regions. Trees of large dimensions, producing industrial wood in the proper sense, are very rare. Occasionally a few short logs suitable for sawing may be obtained. Most logs of larger dimensions are roughly hewn and then used for the manufacture of mortars, boats or wooden bowls. Equipment for the production of sawn wood is virtually nonexistent. The demand for sawn timber in larger cities may justify investments on a small scale for simple saws and woodworking machinery.

The greatest demand for timber of large dimensions, in Sahelian terms exists in the construction sector. This includes residential building, which, depending on ethnic and traditional origins, comprises a number of dwelling types requiring considerable quantities of timber for the construction of walls and roofs. In addition, roof construction for shading in front of houses ("hangars"), within courtyards, and in village or market places, and storage sheds and other farm buildings requires large quantities of poles.

The following three grades are mainly used for buildings:

- strong posts of up to 2.50 m in length and 15 cm in diameter, forked at the upper end, for supporting traverse beams;

- poles of different lengths and diameters;

- brushwood for walls and roofing.

Few species of the Sahel are capable of producing timber for local "industrial" use in construction, furniture making, etc. Their suitability can be assessed according to general grading criteria (GOETZ, 1983):

- Decorative appearance: Subject to colour, structure and lustre of the wood.

- Density: Measured in g/cm^3 at specified moisture content. With increasing density the wood is generally more resistant to deformation and breakage. Hardness increases and the wood lasts longer. However, shrinkage and swelling may be more pronounced, and the wood will be more difficult to process and season.

- Dimensional stability: For specific purposes, such as furniture making, there should be as little change in the shape and dimensions of wood as possible.

- Natural durability: This is the resistance to fungal or insect attack and is very important under Sahelian conditions as it helps to save wood. Untreated wood used for many specific purposes will only last for three to five years (construction, fencing, etc.). But theare marked differences between species. Sapwood (the outer layers of wood which in the growing tree contain living cells and reserve material such as starch) generally has a lower durability than heartwood (the inner core of the woody stem or thick branches).

- Resistance to termites: Some species have toxic or repellent chemical substances such as the tannins in the heartwood that generally prevent attacks by termites.

- Seasoning: Dry wood is generally more durable and is easier to use than freshly cut timber.

- Preservative treatment: So far local timber has not been chemically treated. However, the potential for improving durability through the application of simple techniques is available.

- Processing: The ease of processing depends mainly on wood density. Other factors may be mineral deposits that blunt tools, interlocked grain preventing smooth surfaces, or various cell inclusions such as gum, resin, and latex.

- Strength properties: Resistance to deformation and breakage. The different types of strength are important for technical uses of the wood. High density woods often have better strength properties than low density woods.

- Surface finishing: Wooden surfaces may be protected by coatings of paint, varnish, lacquer, etc. against dirt and moisture. The ease and durability of such treatments differs among wood species.

Of the species included in this book the following have a potential for local use. Their properties can be summarized as follows:
1 = very good, high; 2 = moderate; 3 = low, unsatisfactory;
4 = no information.

DE = Decorative appearance, D = Density, DS = Dimensional stability, N = Natural durability, R = Resistance to termites, S = Seasoning, PR = Processing, ST = Strength, SF = Surface finis

Species	DE	D	DS	N	R	S	PR	ST	SF
Bombax costatum	3	3	3	4	3	2	2	3	2
Borassus aethiopum	1	1	1	1	1	2	3	1	4
Diospyros mespiliformis	1	2	2	3	3	3	3	2	1
Khaya senegalensis	1	2	2	2	2	1	1	2	1
Parkia biglobosa	4	2	2	4	4	2	2	4	2
Prosopis africana	1	1	1	1	1	2	4	2	4
Pterocarpus erinaceus	1	2	1	1	1	2	2	1	1
Vitex doniana	3	3	1	3	3	3	1	3	4

The preceding table indicates that Borassus aethiopum, Khaya senegalenis, Prosopis africana and Pterocarpus erinaceus have the best properties and can be used for various purposes if available in adequate sizes and quantities.

In addition to the "industrial construction assortment", smaller quantities of round or split wood are used for door and window frames etc. Imported lumber bought in the city, or recycled boards, can occasionally be found in a variety of applications.

The same situation applies to furniture. Chairs and beds are manufactured from poles, "recycled" boards, split wood, plaited branches and wickerwork. Although living-rooms and courtyards are not well equipped with furniture, the volume of wood used for this purpose is quite significant particularly if market stands in the villages are included.

Household, farming and kitchen implements as well as equipment for hunting, fishing or transportation vary greatly in design and testify to the ingenuity of Sahelian craftsmen. By contrast, objects of art,including koran-boards and other cult instruments,

are, with a few local exceptions, made with very little wood.

Of particular importance for total wood use are the fences raised around houses, courtyards, stables, gardens and fields. Occasionally strong posts and poles are used, but in the main large quantities of thorny brushwood are employed. In northern Senegal an average consumption of 30 - 40 (max. even 100) kg of wood per metre of fence was measured. A standard compound is protected by 100 m of fence. 100 m of fence would thus require 350 kg of woody material which lasts for 5 years, i.e. an annual replacement of 70 kg. If the fencing of fields is included, this figure can easily exceed 700 kg or the equivalent of 1 m^3 per year.

Investigations undertaken by WEISSE (1980) in northeastern Burkina Faso have shown that the population has particular preferences for certain species which may differ locally depending on the availability and quality of the wood.

From the evaluation of interviews, local tests, and from the relevant literature the following list of trees and shrubs has been compiled. The demand for timber in the Sahel is thus much higher than assumed and probably amounts to at least 0.1 m^3 per year per person as an average of all different ethnic groups.

Timber-producing trees and shrubs.

S = structural uses
T = tools, etc.
A = arts, crafts
F = furniture
Fe = fences
O = other

\+ very important
o less important
\- not used
. no information

	S	T	A	F	Fe	O
Acacia albida	o	+	o	o	+	o
Acacia ataxacantha	-	.	-	-	o	o
Acacia dudgeoni	o	o	-	-	o	-
Acacia macrostachya	-	o	-	-	o	o
Acacia macrothyrsa	-	o	-	-	-	o
Acacia polyacantha	o	+	o	o	+	o
Acacia senegal	o	o	o	o	o	o
Acacia seyal	+	o	-	o	+	o
Acacia sieberiana	+	o	o	o	+	o
Acacia tortilis	o	o	-	o	+	-
Albizia lebbeck	o	-	o	o	-	-
Annona senegalensis	o	o	o	.	-	.
Anogeissus leiocarpus	+	o	o	o	o	.
Azadirachta indica	o	o	.	o	o	.
Balanites aegyptiaca	+	+	o	o	+	o
Bauhinia rufescens	-	-	-	+	o	o
Bombax costatum	o	+	o	+	-	o
Borassus aethiopum	+	.	o	o	o	.
Boscia angustifolia	-	o	-	o	-	o
Butyrospermum parkii	o	o	-	o	-	o
Calotropis procera	o	o	-	-	-	o
Cassia siamea	o	.	.	o	-	-
Cassia sieberiana	o	o	.	.	-	-
Casuarina equisetifolia	o	o	.	o	-	o
Combretum glutinosum	o	o	o	o	o	o
Combretum micranthum	o	o	.	o	o	.
Combretum paniculatum	-	o	-	-	-	o
Commiphora africana	o	o	o	o	o	o
Dalbergia melanoxylon	o	o	+	+	o	o
Dichrostachys cinerea	.	o	.	.	o	o
Diospyros mespiliformis	+	+	o	+	o	o
Erythrina senegalensis	-	-	-	-	-	o
Eucalyptus camaldulensis	o	+	-	.	o	.
Ficus vogelii	o	o	o	-	-	o

Gardenia ternifolia	o	o	.	-	o	o
Grewia bicolor	o	o	-	-	o	o
Grewia mollis	o	-	-	-	-	o
Grewia villosa	.	-	-	-	-	o
Hyphaene thebaica	+	o	o	.	o	o
Khaya senegalensis	o	+	o	o	-	o
Lannea spp.	o	o	o	o	-	o
Leucaena leucocephala	o	o	.	o	o	o
Maerua crassifolia	.	o	.	.	.	o
Mimosa pigra	-	-	-	-	o	o
Mitragyna inermis	o	o	o	o	.	o
Parkia biglobosa	.	o	o	.	-	.
Phoenix dactylifera	o	.	o	o	o	o
Piliostigma spp.	o	o	o	.	o	o
Prosopis africana	o	o	o	o	+	o
Prosopis juliflora	.	.	-	o	+	o
Pterocarpus erinaceus	o	o	o	+	o	o
Pterocarpus lucens	o	o	.	o	o	o
Sclerocarya birrea	o	+	o	o	o	.
Securidaca longepedunculata	o	o	.	.	o	o
Securinega virosa	-	-	-	o	-	o
Stereospermum kunthianum	o	o	.	.	-	.
Tamarindus indica	o	o	+	+	-	o
Terminalia macroptera	o	o	-	o	-	o
Vitex doniana	.	o	-	.	-	o
Ziziphus spp.	o	o	.	o	o	o

Timber-producing trees and shrubs, including those producing brushwood for fencing, which are suitable for planting or natural regeneration

First column: Quality, frequency of use
Second column: Multiple use (besides timber)
Third column: Plantation/natural regeneration, fast growth, high yield of timber/brushwood
1 = very good; 2 = medium, satisfactory; 3 = low rating, unsatisfactory

Acacia albida	2	1	2
Acacia laeta	2	2	2
Acacia nilotica	1	1	1
Acacia polyacantha	2	2	2
Acacia senegal	2	1	2
Acacia seyal	2	1	2
Acacia tortilis	2	1	2
Annona senegalensis	2	1	3
Anogeissus leiocarpus	1	2	3
Azadirachta indica	1	1	1
Balanites aegyptiaca	1	1	2
Bombax costatum	2	2	2
Borassus aethiopum	1	1	3
Cassia siamea	2	1	1
Dalbergia melanoxylon	1	2	3
Diospyros mespiliformis	1	1	3
Eucalyptus camaldulensis	1	2	1
Hyphaene thebaica	2	1	3
Khaya senegalensis	1	1	2
Lannea spp.	2	1	3
Leucaena leucocephala	2	1	2
Mitragyna inermis	1	2	2
Parkia biglobosa	2	1	2
Piliostigma spp.	2	2	3
Prosopis africana	1	1	3
Prosopis juliflora	2	2	2
Pterocarpus erinaceus	1	2	3
Pterocarpus lucens	2	2	3
Sclerocarya birrea	1	1	2
Tamarindus indica	1	1	3
Vitex doniana	2	2	2
Ziziphus mauritiana	2	1	2

The following species are recommended for:

a) Plantations with timber production as the prime objective:
Acacia nilotica
Acacia seyal
Azadirachta indica
Borassus aethiopum
Dalbergia melanoxylon
Eucalyptus camaldulensis
Pterocarpus erinaceus
Sclerocarya birrea

b) Intensive promotion of natural regeneration aiming at timber or brushwood production:
Acacia laeta
Acacia polyacantha
Acacia tortilis
Anogeissus leiocarpus
Balanites aegyptiaca
Bombax costatum
Combretum spp.
Dalbergia melanoxylon
Diospyros mespiliformis
Mitragyna inermis
Prosopis africana
Sclerocarya birrea
Terminalia macroptera
Vitex doniana

c) Other uses (however these species primarily produce timber):
Acacia albida
Acacia senegal
Acacia seyal
Azadirachta indica
Balanites aegyptiaca
Borassus aethiopum
Butyrospermum parkii
Cassia siamea
Hyphaene thebaica
Khaya senegalensis
Lannea spp.
Parkia biglobosa
Phoenix dactylifera
Tamarindus indica
Ziziphus mauritiana

References:
Bolza, Keating (1972), Dahms (1979), FAO (1965, 1967, 1974) Giffard (1974A), Götz (1983), Goor, Barney (1976), Irvine (1961), Weisse (1980).

4.3 Trees and shrubs for food

Hunger and malnutrition are among the major problems throughout arid zones. The Sahel, one of the world's permanent climatic and ecological stress regions, has not been able to produce the food necessary for the subsistence of its population for more than a decade. In fact, the per capita production has been constantly decreasing. Consequently a great effort will have to be made to increase and improve the local food supply. All natural resources will have to be mobilized to meet the increasing demand. This includes trees and shrubs and their significant contribution of food and fodder. They occupy substantial areas of potential crop and pasture grazing land, and produce a great variety of leaves and fruit suitable for human consumption.

When one visits one of the countless weekly markets or the rural and urban households where preparation of food takes place, the important role of tree and shrub ("forest") products in the daily food supply immediately becomes evident. Several of these products are even processed and sold in the cities for local consumption or as export goods in the form of canned fruit, syrups, nuts, gum arabic, etc.

The contribution of these "forest" products to the actual food supply in the Sahel is thus evident, but there are few reliable statistics available on quantities, qualities, market values, seasonal and local disparities, etc. Furthermore, products in demand in one region or specific ethnic group may not be used by others. Some of the woody plants are therefore still underexploited whereas others are endangered by excessive or destructive harvesting practices.

A particular advantage of food products obtained from trees and shrubs lies in their seasonal availability, i.e. fresh leaves just before or at the beginning of the rainy season. Dried leaves, fruit or seeds can be stored for times when food is generally scarce. In addition, these products are readily available and generally occur everywhere. This is of special importance to nomadic or transhumant people.

The following parts of trees or shrubs may be used, subject to the species and local demand patterns: roots, apices, stems and young shoots, bark, leaves, inflorescences, flowers, fruits, seeds, seedlings, sap. This alone demonstrates the great variety of resources trees and shrubs provide.

According to BECKER (1984) the average potential yield of edible wild plants is in the range of 15 % of the total leaf and fruit production in the Sahel. This amounts to 23 kg of edible parts in the Sahara-Sahel, 45 kg in the typical Sahel and 90 kg in the Sudano-Sahel per hectare per year, woody and annual plants included. If these figures are correlated with the (average) population density of 10 persons per km^2, a theoretical amount of some 450 kg of edible wild plants would be available per year per

person, of which 360 kg are leaves and 90 kg fruits (4 : 1 ratio), i.e. 1 kg of leaves and 250 g of fruit per day per capita. If the contribution of the woody plants to total edible phytomass production is empirically estimated to be one fifth, about 250 g per day per person could be taken as an indication of the potential quantitative contribution of trees and shrubs to local food supplies in many parts of the Sahel. These figures are of course subject to wide variation, depending on sites, species composition, rainfall, land use and the nutritional patterns of the people concerned. Obviously, only a small part of this potential is being realized under the presently prevailing conditions.

It is surprising that only a few of the food-producing trees or shrubs have been cultivated, such as the "exotics", cashew (Anacardium sp.), mango (Mangifera sp.), Moringa oleifera and the date palm. With all other species efforts are limited to conserving a few old individual trees or small stands originating from natural regeneration, such as Adansonia digitata, Butyrospermum parkii, Parkia biglobosa, Lannea spp., several palms, Tamarindus indica, Ximenia americana and Ziziphus mauritiana. From the forester's point of view, a number of these species are promising for village afforestation and in the future deserve more attention for food production and multiple use.

It is evident that intensive research and testing at various levels should be undertaken to increase and improve food production from trees and shrubs in the Sahel. This includes selection and breeding, as well as the cultivation and management of the relevant species. But improved methods of harvesting, drying, storing, processing, marketing and utilization should also be explored. Products should be tested for acceptability if newly introduced (new plant products, new cultivars) and if processed by new methods.

Prior to any extension work, however, careful biochemical analyses, carried out according to international standards, should be made to prove that the food concerned has no toxic or noxious components or side effects. Especially children should be warned not to "test" new, unknown parts of plants and they should be carefully informed on what should or should not be eaten, as well as how and when such parts should or should not be eaten.

Trees and shrubs producing edible parts

L = leaves, shoots
F = flowers
FS = fruit, seed
GE = gum, other exudations
O = other parts

+ = very important
o = less important
- = not used
. = no information

	L	F	FS	GE	O
Acacia albida	-	-	o	-	-
Acacia macrostachya	-	-	o	o	-
Acacia nilotica	-	-	o	o	-
Acacia polyacantha	-	-	-	o	-
Acacia senegal	-	-	-	o	-
Acacia seyal	-	-	-	o	-
Acacia sieberiana	-	-	-	o	-
Adansonia digitata	+	o	+	o	o
Albizia chevalieri	o	-	-	-	-
Anacardium occidentale	o	-	+	-	-
Annona senegalensis	o	o	+	-	-
Anogeissus leiocarpus	-	-	o	o	-
Azadirachta indica	o	o	o	-	-
Balanites aegyptiaca	o	-	+	o	-
Bauhinia rufescens	-	-	o	-	-
Bombax costatum	-	o	o	-	-
Borassus aethiopum	o	o	+	+	+
Boscia angustifolia	-	-	o	-	o
Boscia salicifolia	o	-	-	-	o
Boscia senegalensis	o	-	+	-	o
Butyrospermum parkii	.	-	+	-	-
Cadaba farinosa	+	-	-	-	-
Capparis corymbosa	o	-	-	-	-
Cassia siamea	o	-	-	-	-
Celtis integrifolia	+	-	o	-	-
Combretum aculeatum	-	-	o	-	-
Combretum micranthum	+	-	-	-	-
Combretum nigricans	o	-	-	-	-
Crateva adansonii	+	-	o	.	-
Dichrostachys cinerea	-	-	o	-	-
Diospyros mespiliformis	-	-	o	-	-
Euphorbia balsamifera	o	-	-	-	-
Feretia apodanthera	o	-	-	-	-
Ficus spp.	o	o	o	.	o

	L	F	FS	GE	O
Gardenia erubescens	-	-	o	-	-
Gardenia ternifolia	-	-	o	-	-
Grewia bicolor	-	-	o	-	-
Grewia flavescens	-	-	o	-	-
Grewia mollis	-	o	o	-	o
Grewia tenax	-	-	o	-	-
Grewia villosa	-	-	o	-	-
Hyphaene thebaica	o	-	+	-	-
Lannea acida	o	-	o	o	-
Lannea microcarpa	o	-	+	o	-
Leucaena leucocephala	o	o	o	o	-
Maerua angolensis	o	-	-	-	-
Maerua crassifolia	o	-	o	-	-
Mangifera indica	+	-	+	-	-
Maytenus senegalensis	-	-	o	-	-
Moringa oleifera	o	o	+	-	o
Parkia biglobosa	o	-	+	-	-
Parkinsonia aculeata	-	o	o	-	-
Phoenix dactylifera	o	-	+	-	-
Piliostigma thonningii	o	-	o	-	-
Prosopis africana	-	-	o	-	-
Prosopis juliflora	-	-	o	-	-
Pterocarpus lucens	o	-	-	-	-
Sclerocarya birrea	-	-	+	-	-
Securinega virosa	-	-	o	-	-
Sterculia setigera	-	-	o	+	-
Strychnos spinosa	o	-	+	-	-
Tamarindus indica	o	o	+	-	-
Vitex diversifolia	-	-	o	-	-
Vitex doniana	o	-	o	-	-
Ximenia americana	-	-	+	-	-
Ziziphus mauritiana	o	-	+	-	-
Ziziphus mucronata	-	-	o	-	-
Ziziphus spina-christi	-	-	o	-	-

Trees and shrubs with edible parts suitable for planting or natural regeneration

First column: Value as foodstuff, nutritional value, vitamin content

Second column: Multiple use (besides food)

Third column: Plantation/natural regeneration, fast growth (early, regular) and high yield

1 = very good; 2 = medium, satisfactory, 3 = low rating, unsatisfactory

Adansonia digitata	1	1	3
Anacardium occidentale	1	2	1
Annona senegalensis	1	1	2
Balanites aegyptiaca	2	1	2
Borassus aethiopum	1	1	2
Boscia senegalensis	2	3	2
Butyrospermum parkii	1	2	2
Cadaba farinosa	1	1	2
Combretum micranthum	1	2	2
Ficus gnaphalocarpa	2	2	3
Hyphaene thebaica	1	2	2
Lannea spp.	1	2	3
Leucaena leucocephala	2	1	2
Mangifera indica	1	1	1
Moringa oleifera	1	2	1
Parkia biglobosa	1	2	3
Phoenix dactylifera	1	1	2
Sclerocarya birrea	2	1	2
Sterculia setigera	2	2	2
Tamarindus indica	1	2	3
Ximenia americana	1	2	2
Ziziphus mauritiana	1	2	2

Conclusions drawn from this preliminary evaluation:

a) The following species are recommended for plantations with the prime objective of producing food:

Adansonia digitata
Anacardium occidentale
Borassus aethiopum
Butyrospermum parkii
Cadaba farinosa
Hyphaene thebaica
Lannea spp.
Mangifera indica
Moringa oleifera
Parkia biglobosa
Phoenix dactylifera
Tamarindus indica
Ximenia americana
Ziziphus mauritiana

b) Suitable for intensive promotion of natural regeneration:

Annona senegalensis
Boscia senegalensis
Combretum micranthum
Sclerocarya birrea
Sterculia setigera

c) The following species, individually or for afforestation can also produce valuable foodstuffs:

Acacia senegal
Acacia seyal
Balanites aegyptiaca
Bombax costatum
Celtis integrifolia
Crateva adansonii
Diospyros mespiliformis
Ficus gnaphalocarpa
Ficus spp.
Leucaena leucocephala
Maerua crassifolia
Pterocarpus lucens
Strychnos spinosa

References

Becker (1984), Bruecher (1977), Cannell and Jackson (1985), FAO (1985), Giffard (1974A), Grubben (1977), Hall, Cannell and Lawton (1979), Irvine (1961), Martin and Ruberte (1979), National Academy of Sciences (1977, 1979), Ohler (1979), Oomen, Grubben (1978), Pigden et al (1980), Rehm, Espig (1984), Ruthenberg (1976), Samson (1980), Sène (1985), Szolnoki (1985), Terra (1973).

4.4 Forage trees and shrubs

Animal husbandry is the principal form of land use in the Sahel. Forage trees and shrubs thus play an important role by:

- providing livestock with protein, vitamins and minerals, crude fibres, etc., especially for surviving the long dry season;

- providing shelter, improving the local climate, soils, water availability and the growth of fodder grasses and herbs;

- providing various products for the herdsmen and their animals such as fuelwood, wood for building and fencing, various foodstuffs, dyes and tannin, fibres, and pharmaceuticals for human and veterinary medicine.

Hence forest policy in the northern part of the Sahel should essentially aim at serving animal husbandry and at harmonizing nomadic or sedentary pastoralism with the vital interests of maintaining a potentially productive and diversified vegetation and environmental stability. This can be accomplished through:

(1) Protection of the existing woody vegetation against destructive exploitation and bushfires;

(2) promotion of natural regeneration on selected sites with support and/or enrichment of known valuable forage species;

(3) establishment of forage plantations;

(4) improved concepts of silvo-pastoral and agro-silvo-pastoral land use systems.

Although there are frequently conflicts and obviously detrimental feedbacks between forestry and animal husbandry, both forms of land use could be compatible.

From the pastoral point of view, browse should represent at least 20 % of livestock diet during the dry season and ideally reach 30 %, which corresponds to 200 - 2000 browse trees/shrubs of all sizes per hectare. Variations occur, depending on herd structures (especially animal species) and on grass/herb cover productivity (le Houerou 1980 B). It is therefore in the interest of the herdsmen and of government livestock services to maintain or to (re-)establish an adequate and potentially productive woody vegetation on pasture land. Moreover, there is evidence that the exploitable biomass production per unit area can be substantially increased in quantity and improved in quality if a tree cover of 5 to 25 per cent, averaging about 10 per cent, is maintained. The percentage depends on the site, species composition and management practices.

From the forester's point of view, animals can help to reduce competition between grass and young trees for water and nutrients. If the woody vegetation is sensitive to browsing (i.e.

in newly established plantations), the grass can be cut by herdsmen to feed their flocks. A number of local tree species are known to germinate only, or better, after their seeds have passed through the digestive tracts of ruminants. Livestock, now replacing former game populations, must assume this role in the ecosystem to aid natural regeneration. Finally, undesirable underbrush and low branches can be controlled by allowing a certain number of goats to browse in plantations. Grazing and browsing also reduce the risk of bushfires.

Most trees and shrubs in the Sahel serve as browse plants. To assess their differing value the following questions must be answered:

(1) Is the forage quality sufficiently high?

(2) What is the actual or potential forage production per unit area?

(3) How is availability and nutritional value seasonally distributed? Can the forage be stored?

(4) Does browsing compete with other uses?

(5) What are the possibilities of regeneration, cultivation, sustained yield, and resistance to drought, pests, and browsing?

From research findings much is known about the forage trees and shrubs of the Sahel. One of the main sources of information is the International Livestock Centre for Africa in Addis Ababa (ILCA), and especially the book edited by le Houerou (1980 A) containing 55 papers by experts on this subject.

Close correlation exists between forage production, nutritional value and site conditions, seasonal differences, the age of plants or parts of plants, as well as many other factors. It is also important that we should know to what extent yields can be improved by irrigation, fertilizing, or through breeding and selection. Many questions remain to be answered, presenting a challenge both to forestry and livestock researchers.

There is an almost endless discussion about whether, and to what extent certain plants or plant parts are palatable. Palatability, obviously, depends on a variety of factors including taste, the availability of other plants, the availability of water, the season, the age, health and the nutritional state of the animals, etc.

Plants believed to be completely unsuitable as forage have been recorded elsewhere as being intensively browsed and vice versa. Animals under stress may be less selective in their diet than others. Hence (specific) field observations should be interpreted with caution.

To assess the nutritive value of browse plants, information is needed on their basic chemical composition, indicating the content of
- crude protein
- crude fibre
- total minerals (ash residues)
- total fat
- silica
- the macroelements : P, Ca, Mg, K and Na
- the microelements, e.g. Cu, Zn
- nitrogen-free extract (mainly carbohydrates).

All figures are given in percentage of dry matter (DM). From these chemical data the feed value can be calculated by identifying
- net energy (NE)
- digestible protein (DP)
- nutritional ratio
- minimum maintenance requirements.

It should be noted that the nutritive value is totally independent of palatability (e.g. Boscia senegalensis is almost unpalatable but very rich in protein). Detailed information on this is given by le Houerou in his paper "Chemical composition and nutritive value of browse in tropical West Africa" (le Houerou 1980 A, pp.261-289).

There is doubt as to the quantity of edible ligneous matter per unit area. This is generally related to the lack of a definition of browse products (see Bille 1980; Hiernaux 1980). A distinction between total biomass, net productivity, accessible biomass (for a specific animal population), etc. will have to be made. The biomass from woody perennials includes leaves, sprouts, branches, fruits/seeds, flowers and bark with a wide range of intraspecific and interspecific variation, and is dependent on site, age, utilization and other factors. A rough guideline that can be applied for overall estimates: the productivity of consumable dry matter from browse plants in the Sahel and Sudan savannas is in the region of 1 kg per hectare multiplied by the number of mm of annual rainfall (le Houerou 1980 A), similar to that of wood (see p. 9 above). Thus, for the Ferlo in northern Senegal, with rainfalls of between 150 and 350 mm yearly, 150 - 350 kg of dry matter from browse plants may be expected as long as the relevant ecosystem has not yet been severely damaged by human interference or livestock. By means of improved silvo-pastoral management it should be possible to increase forage production at considerable rates. This appears especially promising with forage plantations. In comparison to monocultures mixed cropping seems to have advantages with regard to forage supply, ecological aspects and lower economic risks. Moreover, it is unlikely that any specific woody perennial in an open range would be browsed exclusively.

When planning silvo-pastoral management and forage production, the establishment or maintenance of adequate forage reserves for wild animals will have to be provided for. In specific areas, such as game reserves, this may even be given priority. The

prospects of future higher productivity in game management (see Unasylva Vol. 29, (1977) no. 116 and Riney 1979) should be assessed. This will, as a rule, require supportive activities to improve browsing facilities.

Finally, the potential for beekeeping in natural woodlands and open bush, and in forest plantations as well, should be investigated. Yields could be increased enormously if the emphasis was shifted from the occasional use of bees to intensive bee-cultivation. The most promising trees and shrubs for honey and wax production should, therefore, be identified and promoted. It is important to note that the production of honey is not deleterious to the existence of the plants but is, on the contrary, necessary for their propagation by means of pollination by the bees. Furthermore, beekeeping never competes with other uses of the trees and shrubs. In fact it can begin earlier than many other harvests, thus contributing to cash income and the food supply before other yields occur. A comprehensive directory of world honey sources has been compiled by Crane, Walker, Day (1984).

Forage trees and shrubs

L = leaves, twigs
F = flowers
FS = fruit, seeds

C = cattle
S = sheep
G = goats
C = camels
WA = wild animals
B = bees

\+ very important, very palatable
o less important
. no reliable data
\- not important, not palatable

	Parts consumed			Species of animals					
	L	F	FS	C	S	G	C	WA	B
Acacia albida	+	o	+	o	+	+	+	+	o
Acacia ataxacantha	o	.	.	-	-	.	-	.	.
Acacia dudgeoni	o	.	o	.	.	.	.	.	.
Acacia ehrenbergiana	o	.	.	.	.	o	.	.	.
Acacia gourmaensis	o	.	+	.	o	o	o	.	+
Acacia laeta	+	o	+	o	+	+	+	+	.
Acacia macrostachya	o	.	o	.	o	o	.	.	.
Acacia macrothyrsa	+	.	.	.	.	.	.	.	.
Acacia mellifera	+	+	+	o	+	+	+	+	+
Acacia nilotica var. adansonii	+	o	o	o	+	+	+	.	.
Acacia nilotica var. tomentosa	+	o	+	+	+	+	+	.	.
Acacia pennata	o	.	o	+	.	+	.	.	o
Acacia polyacantha	-	.	o	.	.	.	.	.	.
Acacia senegal	+	o	+	o	+	+	+	.	+
Acacia seyal	+	o	+	+	+	+	+	+	o
Acacia sieberiana	+	+	+	+	+	o	+	+	+
Acacia tortilis	+	o	+	o	+	+	+	+	+
Adansonia digitata	+	o	.	+	+	+	.	.	.
Albizia chevalieri	o	.	o	.	.	.	.	.	.
Albizia lebbeck	o	o	o	.	.	.	.	.	o
Anacardium occidentale	o	+	o	.	.	.	.	.	o

	L	F	FS	C	S	G	C	WA	B
Annona senegalensis	o	.	o	.	.	.	.	.	.
Anogeissus leiocarpus	+	.	-	+	+	+	o	.	.
Azadirachta indica	o	o	o	.	.	o	o	.	o
Balanites aegyptiaca	+	.	+	+	+	+	+	+	.
Bauhinia rufescens	+	.	+	o	+	+	+	+	.
Bombax costatum	-	o	-	.	.	o	.	.	.
Boscia angustifolia	+	.	.	+	+	+	.	.	.
Boscia salicifolia	o	.	o	.	.	.	.	.	.
Boscia senegalensis	o	.	o	-	o	o	.	.	.
Butyrospermum parkii	o	o	o	.	o	o	.	.	o
Cadaba farinosa	+	o	+	+	.	+	+	o	.
Cadaba glandulosa	+	.	.	+	o	+	.	.	.
Calotropis procera	o	-	o	-	-	o	-	-	.
Capparis coymbosa	.	-	.	-	-	o	-	o	.
Capparis decidua	o	.	.	.	+	+	.	o	.
Capparis tomentosa	o	-	.	-	-	o	o	o	.
Cassia siamea	o	o	.	.	.	.	.	.	o
Celtis integrifolia	+	-	.	.	.	.	.	.	.
Combretum aculeatum	+	.	+	+	+	+	.	+	.
Combretum glutinosum	o	-	.	o	.	o	.	.	-
Combretum micranthum	o	.	.	o	o	o	.	o	.
Combretum nigricans	o	.	.	.	.	.	.	.	.
Combretum paniculatum	o	.	.	.	.	.	.	.	.
Commiphora africana	+	-	-	.	o	+	+	.	-
Crateva adansonii	o	.	.	o	o	o	.	.	.
Dalbergia melanoxylon	o	.	+	o	o	o	.	.	-
Dichrostachys cinerea	+	o	+	o	o	o	o	.	o
Diospyros mespiliformis	o	o	o	.	.	.	.	.	o
Entada africana	o	.	o	o	.	.	.	.	.
Erythrina senegalensis	o	.	.	.	.	o	.	.	.
Eucalyptus camaldulensis	o	o	-	.	.	o	.	.	+
Euphorbia balsamifera	o	.	-	.	o	o	.	.	.
Feretia apodanthera	+	.	o	+	+	+	o	.	.
Ficus gnaphalocarpa	o	.	+	o	+	+	.	.	.
Ficus ingens	.	.	o	.	.	.	.	.	.
Ficus iteophylla	o	.	o	.	.	o	.	.	.
Gardenia aqualla	o	o	o	o	o	o	.	.	o
Gardenia erubescens	o	.	o	.	.	.	.	.	o
Gardenia ternifolia	o	o	o	-	-	o	-	-	o
Grewia bicolor	+	.	o	+	+	+	o	+	.
Grewia flavescens	o	.	o	.	.	.	.	.	.
Grewia mollis	o	.	o	.	.	.	.	.	.
Grewia tenax	+	.	o	o	+	+	+	o	.
Grewia villosa	o	.	.	o	o	o	.	.	.
Guiera senegalensis	+	+	o	o	o	+	+	o	+
Hyphaene thebaica	o	.	o	o	o	+	+	.	.

	L	F	FS	C	S	G	C	WA	B
Khaya senegalensis	+	-	.	+	+	+	+	.	.
Lannea acida	.	-	.	.	.	.	.	.	.
Lannea microcarpa	.	-	.	.	.	.	.	.	.
Leptadenia pyrotechnica	o	.	.	-	.	o	o	.	.
Leucaena leucocephala	o	o	.	o	o	o	.	-	+
Maerua angolensis	+	.	.	+	+	+	o	+	.
Maerua crassifolia	+	+	o	+	+	+	o	+	o
Mangifera indica	o	+	o	o	o	o	.	.	+
Maytenus senegalensis	o	.	o	o	+	+	+	o	.
Mitragyna inermis	o	o	-	o	o	+	o	.	o
Moringa oleifera	o	o	o	o	o	o	.	.	o
Parkia biglobosa	.	o	.	.	.	o	.	.	o
Parkinsonia aculeata	o	o	o	.	o	o	.	.	o
Phoenix dactylifera	o	-	+	o	+	+	+	.	.
Piliostigma reticulatum	o	.	o	o	o	o	o	.	.
Piliostigma thonningii	o	.	o	o	o	o	o	.	-
Prosopis africana	o	.	o	o	o	o	.	.	.
Prosopis juliflora	o	+	+	o	+	+	.	.	+
Pterocarpus erinaceus	+	.	o	+	+	+	o	.	.
Pterocarpus lucens	+	.	o	+	+	+	+	o	.
Salvadora persica	+	o	.	+	+	+	+	.	.
Securidaca longepedunculata	o	.	o	.	.	.	.	o	.
Securinega virosa	o	.	.	.	o	o	o	.	.
Stereospermum kunthianum	o	.	.	o	o	o	o	.	.
Strychnos spinosa	o	.	o	.	.	o	.	o	.
Tamarindus indica	+	o	o	o	+	+	o	-	+
Tamarix senegalensis	o	.	.	o	o	+	o	o	.
Terminalia avicennioides	o	.	-	o	o	o	o	.	-
Vitex doniana	o	o	o	o	o	o	.	o	o
Ximenia americana	.	.	o	.	o	o	.	.	.
Ziziphus mauritiana	o	o	+	.	+	+	+	+	o
Ziziphus mucronata	o	o	o	o	o	+	o	o	o
Ziziphus spina-christi	o	o	o	o	o	o	o	o	o

Toxic or unpalatable tree and shrubs

Species	Parts	Remarks
Adenium obesum	whole plant	toxic effect on heart and nerves
Calotropis procera	whole plant, latex	toxic effect on heart. Latex irritates skin, mucous membranes, eyes
Capparis tomentosa	flowers, fruit, roots	alkaloids dangerous to camels; plant is avoided by other animals
Euphorbia balsamifera	twigs, leaves, latex	injures eyes and mucous membranes. Avoided by animals. Sheep feed on fallen leaves
Leucaena leucocephala	leaves, pods	mimosine, toxic for non-ruminants if fed in large (above 10 % of the diet) quantities, and to ruminants, unless the appropriate stomach bacteria have been introduced
Tamarindus indica	leaves	problematic only for sensitive animals such as horses and pigs

Trees and shrubs for forage production

First column: Forage value (palatability, nutritive value)

Second column: Multiple use (other than forage)

Third column: Cultivation/natural regeneration. Fast growing, high yielding

1 = very good, important
2 = less satisfactory
3 = poor, unimportant

Acacia albida	1	1	2
Acacia laeta	2	2	2
Acacia nilotica	2	1	1
Acacia senegal	2	1	1
Acacia seyal	1	1	2
Acacia sieberiana	1	2	2
Acacia tortilis	1	2	1
Adansonia digitata	1	1	3
Balanites aegyptiaca	1	1	2
Bauhinia rufescens	1	2	2
Boscia angustifolia	1	3	2
Boscia salicifolia	1	3	2
Cadaba spp.	1	2	2
Combretum aculeatum	1	3	2
Commiphora africana	1	2	2
Crateva adansonii	1	3	2
Dichrostachys cinerea	1	3	1
Feretia apodanthera	2	3	2
Guiera senegalensis	2	2	1
Grewia spp.	1	2	2
Khaya senegalensis	1	1	3
Leucaena leucocephala	(2)*	1	1
Maerua ang. spp.	1	3	2
Prosopis juliflora	2	1	1
Pterocarpus lucens	2	2	2
Salvadora persica	1	3	2
Tamarindus indica	1	1	3
Ziziphus spp.	1	1	2

*) potentially dangerous, especially to non-ruminants.

Thus a preliminary evaluation results in:

a) Species, suitable for forage plantations
Acacia albida
Acacia seyal
Acacia tortilis
Balanites aegyptiaca
Bauhinia rufescens
Cadaba farinosa
Leucaena leucocephala
Maerua spp.
Prosopis juliflora
Salvadora persica

b) Natural regeneration/enrichment to improve browsing:
Acacia laeta
Acacia seyal
Acacia sieberiana
Acacia tortilis
Balanites aegyptiaca
Bauhinia rufescens
Boscia angustifolia
Cadaba spp.
Combretum aculeatum
Dichrostachys cinerea
Feretia apodanthera
Grewia spp.
Guiera senegalensis
Maerua spp.
Salvadora persica
Ziziphus spp.

c) The following species, generally planted for other uses, can also produce valuable forage:
Acacia nilotica
Acacia senegal
Adansonia digitata
Khaya senegalensis
Mangifera indica
Phoenix dactylifera
Tamarindus indica
Ziziphus spp.

d) Species specifically recommended for honey production:
Acacia albida
Acacia senegal
Acacia seyal
Acacia tortilis
Azadirachta indica
Eucalyptus camaldulensis
Prosopis juliflora
Ziziphus spp.

The selection of species for forage production depends on site conditions, the composition of herds and the potential of the plants and land for other uses. Fodder that may be obtained during the dry season or which is suitable for storage may be of particular value.

References
Ajayi (1978), Asibey (1978), Bartha (1977), Benoit (1977), Bille (1978, 1980), Boudet/Duverger (1961), Boudet (1975, 1977), Crane et al (1984), Derbal et al (1959), Game as food (1978), Goehl (1975), Grouzis (1979), Hiernaux (1980), le Houerou (1978, 1979, 1980 A+B), Kmoch (1964), Masson (1980), Nebout/Toutain (1978), Poupon (1979), Riney (1979), Riviere (1977), Toutain (1977, 1978A, 1980), Toutain/Piot (1980), Touzeau (1973), Vos (1978), Wickens (1980 B).

4.5 Medicinal trees and shrubs

"Traditional medicine needs to be evaluated, given due recognition and developed so as to improve its efficacy, safety, availability and wider application at low cost, according to WHO reports. It is already the people's own health-care system and is well accepted by them. It has certain advantages over imported systems of medicine in any setting because as an integral part of the people's culture, it is particularly effective in solving certain cultural health problems. It can and does freely contribute to scientific and universal medicine. Its recognition, promotion and development will secure due respect for a people's culture and heritage."
(AYENSU, 1983)

Medicinal and poisonous plants, including a multitude of woody species, have always played an important role in African life. Traditions of collecting, processing and applying plants and plant-based medications, long and carefully maintained by individuals with a profound knowledge, have been handed down from generation to generation. The value of this ethno-medicine and traditional pharmacology is now increasingly recognized in modern human and veterinary medicine.*)

Besides a few eminent expert herbalists, many other people have a spezialized knowledge in this field. Not all records

*) Traditional medicine is a term customarily used in a very broad sense to cover three main groupings: (i) folk medicine, both magic and ritual; (ii) traditional medicine proper, which is a comprehensive and rational body of theory and practice in an empirical pharmacological tradition held together by fundamental concepts of natural philosophy that incorporate the phenomena of health and illness; (iii) modern traditional medicine, which combines ancient diagnostic and herbal medicines with modern instruments and adjuvants.
(UNIDO, 1983 A); see also ATTISSO (1978).

however, should be considered reliable; some may even be dangerous. Others may be superficial, based on wrong assumptions or merely superstition. The almost overwhelming amount and variety of information on the curative, preventive or poisonous woody plants of the Sahel may thus be divided into various categories:

- comprehensive and in-depth
- specific and in-depth
- broad but superficial
- specific but superficial, i.e. some useful knowledge exists;
- misleading but harmless
- false and dangerous.

In African culture the combination of religion and magic with medicine is widespread and these may not always be separated. Supernatural elements and psychology play a prominent role in local medicine.

Medicinal plants, collection, treatment and dosage i.e. the pharmaceutical preparation, and the form in which the medicament is administered to the patient, differ widely according to region and traditional practices. Some plants in common demand may be kept in stock and sold at markets. This helps to overcome seasonal shortages and to improve local supplies. Many plants or parts thereof are, however, only gathered immediately before use. The composition of different remedies from the parts of one or many plants is intended to improve efficacy and healing power and often determines what is "good medicine".

The remedies can be applied in different forms such as extracts, decoctions, infusions, ashes, instillations, etc. The following are common:

a) Preparation of compound powders from dry parts of one plant or several plant drugs and from ashes by using small mortars or grinding stones;

b) solid preparations such as pills and pellets, sometimes using gum, clay or kaoline as binding material;

c) extraction of the desired remedies by pressing, boiling or soaking. Hot or cold water, alcohol, milk and various other solvents may be used. In this way, orally administered liquid preparations such as tisanes, broths, medical syrup and liquid mixtures are obtained.

d) preparations for applications to the skin or mucosae such as ointments, liniments, lotions, foamlotions and baths, inhalants, enemas, etc.
Application is frequently percutaneous, by rubbing or covering (including poultices), by washing or baths, occasionally complemented by massages.

Compared to modern medicine, the doses applied in local ethnomedicine are extremely imprecise. The therapeutic benefit has

therefore often been questioned.

It is essential to distinguish between preventative, palliative, healing, restorative, strengthening and stimulating effects. More research is needed on the long-term effects of specific remedies. Very little is known about how extensively medicinal and poisonous plants are used. This includes current production, distribution patterns, overall economic importance and significance in social life. Taking into account the serious health problems of people and livestock, medicinal uses of trees and shrubs in the Sahel may prove to be of a greater importance for many people than fuelwood, timber, food, forage and various raw materials.

In order to investigate further the medicinal uses of Sahelian trees and shrubs, the following suggestions may be considered:

- Projects for the mutual transfer of medical knowledge should become part of bilateral cultural agreements. This would promote the process of learning and understanding and is clearly in the interest of a holistic concept of medicine. The catalogue of plant drugs used in traditional medication in the Sahel is by no means complete, despite the large amount of data already obtained. The same applies to the collection of recipes or techniques for preparing medicines. Both a traditional and an official pharmacopoeia or code of medicines should be issued in due course.

- The investigation of traditional therapies should be intensified with the objective of increased efficiency by taking advantage of technical progress. Risks could be reduced through the analysis of so far unknown or insufficiently known secondary and long-term effects. From hitherto prevailing empiricism the path followed will have to lead to standardized experiments in clinical pharmacology.

- Tests should be undertaken to increase the content of desired components in plants through breeding, selection and intensive cultivation or through the improvement of production, processing and marketing. At all events it is important to ensure the survival of valuable species in their natural habitat ("in situ" gene conservation).

- In addition to human medicine, ethno-veterinary medicine should be promoted, particularly in a region where animal husbandry is the principal economic activity, as it is in the northern Sahel.

Research should lead from the composite drug to pure, isolated ingredients. Accordingly the following steps are necessary:

- Botanical studies and studies of the literature;

- phytochemical studies (determination of the major group of chemical compounds and production of extracts for pharmacolo-

gical and toxicological experiments);

- pharmacodynamic and toxicological studies leading to the preparation of standardized forms of dosage;

- pharmacotechnical research.

Information on poisonous plants is quite controversial. Obviously, many plants or parts thereof are poisonous when eaten in larger quantities, when combined with specific chemical agents (e.g. alcohol), with other plants, or if spoilt.

Poisons from woody plants are mainly, if not exclusively, used for hunting. This includes the application of fish-poisons, obtained from various parts of plants and occasionally mixed with those of other plants. Their chemically active components, rotenone, deguelin, theophrosin, etc., are very powerful and effective even if diluted one million times. They paralyse fish, which float to the surface of the water and can easily be collected.

Most other poisons are, by a long tradition, used to increase the efficiency of arrows. Instructions for the preparation of arrow poisons, often connected with magic, are secrets handed down from generation to generation within a selected group of experts. Most important and widely used throughout the Sahel is the sap of Calotropis procera, containing 6 highly toxic cardenolides. It is interesting to note that even insects such as the locust Poekilocarpus bufonius Klug, use Calotropis glycosides as a "chemical weapon". They feed on Calotropis and when attacked spray a poisonous secretion from a certain gland (NEUWINGER 1974).

Therapy using entire plants, parts thereof or extractives is called phytotherapy. In the more stringent sense a distinction is made between phytopharmaca with well-defined effective components and controllable effects and phyto-therapeutica where only certain indications of success exist.

Arguments against the use of traditional phytotherapy include:

- The complexity of effective agents caused by the concentration of several main, accessory and associated remedies from different plant parts and as a consequence of differing origin, growth, storage, and processing conditions. Such medicine represents a natural, but an inconsistent mixture;

- a spectrum of indications ranging too far should always be regarded with suspicion;

- the extremely subjective approach in evaluating success;

- the frequently excessive demand for raw material resulting in the need not only for transport and storage facilities, but also for land and various resources to be allocated to sustained production. It should be pointed out that the majori-

ty of active chemical substances are in the roots and bark of trees and shrubs to protect the plants from being eaten by animals. Extensive harvesting of that material will necessarily severely damage or even destroy the plants and may, as already recorded from some regions, lead to the extinction of the species concerned.

A worldwide classification of the various diseases, disorders, injuries, and causes of death has been made by the World Health Organization of the UN (WHO). All recorded uses of medicinal woody plants in the Sahel can be divided accordingly into 17 main categories which represent the latest revised version by the WHO (WHO 1977):

1. Infections and parasitic diseases
2. Neoplasms
3. Endocrine, nutritional and metabolic diseases and immunity disorders
4. Diseases of the blood and blood-forming organs
5. Mental disorders
6. Diseases of the nervous system and sense organs
7. Diseases of the circulatory system
8. Diseases of the respiratory system
9. Diseases of the digestive system
10. Diseases of the genitourinary system
11. Complications of pregnancy, childbirth and the puerperium
12. Diseases of the skin and subcutaneous tissue
13. Diseases of the musculoskeletal system and connective tissue
14. Congenital anomalies
15. Certain conditions originating in the perinatal period
16. Symptoms, signs, and ill-defined conditions
17. Injury and poisoning

In the following table, all veterinary diseases have been put into one group and listed under no. 18. A further breakdown into specific diseases, etc., according to the general decimal classification system of the WHO, is not attempted in this book to avoid potentially dangerous misinterpretation. Some more specific information may be obtained from the species descriptions. It should however be pointed out that a great variety of diseases and disorders has been placed under each of the above 17 groups. Thus, for example, under category 1 (infections and parasitic diseases), we encounter cholera, typhoid and paratyphoid fevers, various bacterial infections, food poisoning, dysentery, tuberculosis, anthrax, leprosy, whooping cough, tetanus, meningitis, smallpox, herpes, measles, yellow fever, viral hepatitis, rickets, malaria, trypanosomiasis, syphilis and other venereal diseases, yaw, schistosomiasis (bilharziasis), helminthiasis, and toxoplamosis. This is merely a random list of the most frequent and commonly known diseases in group 1.

Important:

In the following table an attempt has been made to outline some of the ethno-medicinal uses of trees and shrubs in the Sahel. No details on specific applications, on quantities, doses etc. are given as these might encourage indiscriminate use by people who do not have the necessary knowledge of diagnosis and therapy.

It must, moreover, be stressed that the classification of information concerning traditional medicine, herbalism, and pharmacology may not always be fully reliable because:

- the diagnosis may have been misleading;

- for many diseases, disorders etc. the causes may originate from several of the groups cited above;

- records of successful treatment are highly subjective and may be based on reasons other than the use of the recorded plants. These may include an independent healing process, other remedies, and physical or psychological impacts, etc.

Medicinal Uses of Trees and Shrubs (continued)

Woody species	Classification of diseases, disorders, injuries (WHO), veterinary applications																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Acacia albida	+			+	+	+	+	+	+	+	+		+					
A. ataxacantha	+							+	+			+					+	
A. dudgeoni									+									
A. ehrenbergiana												+						
A. gourmaensis	+							+	+									
A. macrostachya	+								+								+	
A. macrothyrsa									+			+					+	
A. mellifera										+								
A. nilotica	+			+		+		+	+	+		+						+
A. pennata	+							+	+	+		+	+				+	
A. polyacantha	+								+								+	
A. senegal	+			+	+	+		+	+			+						
A. seyal	+			+		+		+	+			+				+		
A. sieberiana	+			+		+	+	+	+	+		+	+					
A. tortilis	+											+						+
Adansonia digitata	+					+	+	+	+	+		+					+	+
Adenium obesum	+											+				+		
Albizia lebbeck	+						+		+			+						
Anacardium occid.			+				+		+	+								
Annona senegal.	+					+	+	+	+			+					+	+
Anogeissus leioc.	+				+				+			+					+	+
Azadirachta indica	+						+		+	+		+	+				+	+
Balanites aegypt.	+				+	+		+	+	+			+			+	+	+
Bauhinia rufescens	+					+	+		+			+						
Bombax costatum	+				+		+					+				+		
Borassus aethiopum			+		+			+	+			+					+	
Boscia angustif.							+		+	+			+					+
B. salicifolia	+				+		+		+			+					+	+
B. senegalensis	+				+		+		+			+					+	+
Butyrosperum parkii						+						+					+	+
Cadaba farinosa	+							+	+			+	+				+	
Calotropis procera	+				+	+		+	+	+		+					+	+
Capparis corymbosa					+												+	
C. decidua	+	+					+		+			+	+					
C. tomentosa	+					+										+	+	
Cassia siamea	+			+				+	+	+	+							+
C. sieberiana	+				+		+		+	+		+				+	+	+
Celtis integrif.	+				+		+			+	+	+	+				+	
Combretum aculeat.	+					+		+	+	+							+	
C. glutinosum	+			+	+		+	+	+	+		+	+			+	+	+
C. micranthum	+					+		+	+	+		+				+	+	+
C. nigricans	+							+	+				+			+		+
C. paniculatum									+							+		
Commiphora afric.	+					+			+	+		+					+	
Crateva adansonii	+					+			+				+			+		

Woody species	Classification of diseases, disorders, injuries (WHO), veterinary applications																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Dalbergia melan.	+							+	+							+		
Dichrostachys cin.	+							+	+	+		+	+					
Diospyros mesp.	+				+	+		+	+		+	+					+	+
Entada africana	+								+		+						+	
Erythrina seneg.	+		+	+				+	+	+	+	+				+	+	+
Eucalyptus camal.								+										
Euphorbia bals.	+								+	+	+	+					+	+
Feretia apodanth.	+											+					+	
Ficus capensis	+			+	+	+	+	+	+	+	+		+				+	+
F. gnaphalocarpa	+							+	+								+	
F. ingens												+					+	+
F. iteophylla	+					+		+										+
F. platyphylla	+			+				+	+	+							+	
F. thonningii	+							+	+	+							+	
F. vogelii	+							+	+								+	
Gardenia erubesc.	+				+				+									
G. ternifolia	+						+	+	+				+				+	+
Grewia bicolor	+								+	+								
G. flavescens					+				+									
G. mollis	+								+	+							+	
G. tenax	+																	+
G. villosa	+																	
Guiera senegal.	+				+			+	+	+	+					+		+
Hyphaene thebaica	+									+								
Khaya senegalensis	+				+	+			+	+		+					+	+
Lannea acida	+		+	+		+	+		+	+	+	+						
L. microcarpa	+																	
Leptadenia pyrot.	+					+				+								
Leucaena leucoc.	+					+												+
Maerua angolensis	+				+				+				+		+			
M. crassifolia	+								+			+						
Mangifera indica	+		+	+			+	+	+				+					
Maytenus seneg.	+				+	+		+	+	+	+	+					+	
Mimosa pigra	+		+			+	+	+									+	
Mitragyna inermis	+				+	+			+	+			+				+	
Moringa oleifera	+		+	+	+					+		+	+					

Woody species	Classification of diseases, disorders, injuries (WHO), veterinary applications																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Parkia biglobosa	+		+			+	+	+	+	+	+					+	+	
Parkinsonia acul.	+					+												
Phoenix dactylif.	+				+	+	+	+	+	+	+							+
Piliostigma retic.	+		+					+	+	+		+					+	
P. thonningi	+					+		+	+		+	+	+					
Prosopis africana	+					+		+	+	+		+	+					
P. juliflora												+						
Pterocarpus erin.	+						+		+		+	+				+		
Pterocarpus lucens	+								+									
Salvadora persica	+			+				+	+	+			+			+		+
Sclerocarya birrea	+					+			+								+	+
Securidaca longep.	+			+	+	+	+	+	+		+	+	+			+	+	+
Securinega virosa	+				+			+	+	+		+	+			+		
Sterculia setigera	+							+	+	+								+
Stereospermum kun.	+				+		+	+	+	+							+	
Strychnos spinosa	+					+		+	+	+							+	
Tamarindus indica	+		+	+	+	+	+	+	+			+				+	+	
Tamarix senegal.						+		+										
Terminalia avi.	+							+	+				+					
T. macroptera	+				+		+		+	+		+					+	+
Vitex diversifolia									+			+						
V. doniana	+						+		+	+		+					+	
Ximenia americana	+				+	+	+	+	+			+					+	
Ziziphus maurit.	+		+						+							+		
Z. mucronata	+				+				+	+		+						
Z. spina-christi	+		+														+	

Medicine-producing trees and shrubs suitable for planting or natural regeneration

First column: Importance as medicinal plant - regionwide - according to available information

Second column: Multiple use (besides medicinal use)

Third column: Growth and yield characteristics, etc.

1 = very good

2 = medium, satisfactory

3 = low rating, unsuitable

Acacia albida	2	1	2
Adansonia digitata	1	1	3
Annona senegalensis	1	2	2
Azadirachta indica	1	1	1
Balanites aegyptiaca	1	1	2
Boscia spp.	2	1	1
Calotropis procera	1	3	1
Combretum glutinosum	1	1	2
Combretum micranthum	1	2	2
Commiphora africana	2	2	2
Diospyros mespiliformis	2	1	2
Ficus capensis	1	2	2
Guiera senegalensis	1	2	1
Khaya senegalensis	1	1	3
Mangifera indica	1	1	1
Parkia biglobosa	1	1	2
Prosopis africana	1	1	2
Salvadora persica	1	2	3
Sclerocarya birrea	2	1	2
Securidaca longepedunculata	1	3	2
Securinega virosa	1	3	1
Sterculia setigera	2	1	2
Strychnos spinosa	2	2	2
Tamarindus indica	1	1	3
Ziziphus spp.	2	1	1

References:
Ake Assi et al (1977), Attisso (1978), Aubréville (1950), Ayensu (1983), Bannerman et al (1983), Berhaut Vol. I - VI (1971-1979), Bock (1981), Bognounou (1975), Bognounou/Ouedraogo (1975), Dalziel (1937), Giffard (1962 + 1974 A), Hallam (1979), Ibrahim et al (1984), Irvine (1961), Kerharo/Adam (1974), Kerharo/Bouquet (1950), Levingston/Zamora (1983), Neuwinger (1974), Pradilla (1978, 1981 and 1982), von Sengbusch/Dippold (1980), Sib (1976), UNIDO (1983 A), Wickens (1980 B), Zio (1976).

4.6 Utilization of raw materials

Raw materials are extremely scarce in the Sahel. Consequently trees and shrubs, ubiquitous and a potentially renewable resource, are of comparatively greater importance to local supplies than in many other regions of the world. This includes products other than wood. Some of these have been or will be replaced by manufactured and imported goods as they cannot compete with industrial products. Others are still urgently needed in order to safeguard future local supplies for a fast-growing population.

People make exclusive use of what is available from the existing natural vegetation. They have developed outstanding skills in doing so. So far, however, few breeding, selection, plantation, harvesting or processing techniques have been developed to improve production. People will have to become actively involved in such agrotechnical practices and sustained natural resources management in the future.

Of the many products derived from trees and shrubs only a few examples will be presented in this book. These may be grouped as follows:
- gums
- resins, latex and other exudantions
- tannins
- dyes
- saponins, ashes, salts, etc.
- fibres.

Gums are adhesive carbohydrate substances of vegetable origin, usually produced as exudantions from the bark of trees and shrubs. Most of them are soluble in water, others become mucilages through the absorption of water. It is generally understood that the formation of gums is a protective reaction of the plant against bacterial, insect or fungal attack, browsing, mechanical damage or general stress. Thus, the production of gum arabic, for example, increases if the trees suffer from unfavourable conditions; whereas rapid growth tends to reduce yields.

Gum arabic is the internationally best known forest product of the Sahel. It is the generic term for exudations of a number of Acacia species, primarily however of Acacia senegal, which assumes the leading role as far as quantity and quality of the

gum are concerned. Other gum-yielding species are Acacia laeta, A. nilotica, A. seyal, A. polyacantha, A. sieberiana and A. tortilis.

Gum arabic has been collected, used and traded for more than 4,000 years. Production, grading, and marketing as well as properties and applications have been extensively described, and commercial utilization, international trade and marketing summarized by CNUCED/GATT "Le marché de la gomme arabique - production, commercialisation et utilisation", 1978.

The outstanding property of gum arabic is its high water solubility. Solutions may attain a gum content of 50 %, while other natural gums rarely exceed 5 %. This extraordinary viscosity opens up a large spectrum of applications. Gum arabic is completely non-poisonous, odourless, colourless and tasteless. Consequently it does not alter the smell, colour or taste of substances to which it has been added.

Gum arabic is mainly used in the food industry, particularly in the manufacture of cakes and sweets where it prevents the cristallization of sugar and gives a special lustre to the surfaces. Gum arabic is also an effective emulsifier allowing a homogeneous distribution of fats in different products. Gum arabic is widely used in Europe and the U.S.A. for diet pastry and low calory sweets. In deep-frozen milk products gum arabic prevents the crystallization of sugar and water, in beer it is used as a foam stabilizer, in wine as a purifying agent, and in liqueurs to achieve an oily consistence. It is also used to thicken soft drinks.

Equally numerous are its applications in the pharmaceutical and cosmetic industries. These include face masks, hair strengtheners, skin cream and ointments as well as the coating of pills, etc. Gum arabic is also used for high-quality glues (e.g. for stamps and envelopes), for colours, in dyes, as a pelletizing agent, as a binder in explosives, in the ceramic and smelting industries, in lithography, in the plastic and textile industries, and as a fixing agent and emulsifier in the perfume industry.

Average annual exports in the years 1968 - 1980 fluctuated between some 30,000 t and slightly above 50,000 t of which 80 to 90 % originated from the Republic of the Sudan. The production of other Sahelian countries varied between a few hundred and a maximum of 2,000 t/year. The total production is not precisely known since a considerable part of the harvest is being used within the producing countries for local food and medicine.

Apart from the above-mentioned acacias, Sterculia setigera also plays an important role as a producer of gum. Most of this is directly used in households for the binding of sauces. The quantity harvested, for which the forest administration collects a fee, is officially estimated at 30,000 to 40,000 kg per year in Senegal. This could partially be exported to Europe and North

America as a substitute for gum arabic in the food, cosmetics, and pharmaceutical industries. Sterculia gum is presently supplied mainly by India under the trade name of gum karaya.

The production of other gums, resins, saps and latexes of various trees and shrubs is rather sporadic and serves primarily to satisfy individual or local needs. Here again, the main applications are in the food and medicinal sectors.

Resins, related to terpenes and essential oils, are versatile chemical compounds, exuded by a number of trees and shrubs in the Sahel. As with gums, the formation is generally a result of natural or man-made injuries of the bark. Initially fluid, these secretions gradually convert to a soft product, soluble in appropriate media such as oils and organic liquids, however, unlike gums, not in water. Natural varnish resins can be recognized by their translucence, by their brittleness and conchoidal fracture, and by their yellow or brown coloration. Under heat they generally melt or burn and give off an aromatic odour.

Tannin is the generic name for plant products used for converting rawhide into leather. They occur in the roots, wood, bark, leaves or fruit of many Sahelian tree and shrub species. Besides their main applications in the manufacture of leather, there is a wider range of other uses such as a mordant in the dyeing of cotton with basic dyes, in local medicine mainly as an astringent, for the manufacture of glues, and as an additive to various food products. Tannin has also been used to prepare inks and as an antidote for metallic, alcaloidal, and glycoidal poisons. The most important raw materials for tanning in the Sahel are the immature pods of both varieties of Acacia nilotica. These pods are traded on local markets and are favoured by commercial and private tanneries.

Dyes are colour-producing substances that occur in many plants. Natural dyes have been known and used for several thousands of years, and although they are being increasingly replaced by synthetic dyes, they still play a role in local crafts. As very specific affinities between various dyes and plant or animal fibres exist (different fibres reacting differently to solutions of colouring matter), the method of dyeing has to vary accordingly.

Minerals, predominantly plant ashes, have many uses. Most common are the production of potash and salt for seasoning.

Saponins are water-soluble substances known as glycosides, used to lower the surface tension of water (causing foam), so that they are widely used as soap substitutes. They are also used as fish-poison. Fish killed by saponins may be eaten because the poison is not absorbed by the intestines. Injected into the blood stream, however, saponins are toxic to all warm-blooded animals including man, because they destroy red blood cells. Saponins may be extracted from the roots, bark as well as other parts of trees

and shrubs.

Numerous fibres and fillers may be obtained from trees and shrubs, particularly bark (phloem) fibres used for cordage and wickerwork of various types. Preferred species are Adansonia digitata, several acacias (e.g. Acacia tortilis), Calotropis procera, Grewia and Piliostigma species. These fibres are competing to a certain extent with commercial binding materials because they are easily produced. Trees and shrubs may, however, be seriously injured or even killed by prevailing harvesting practices.

Bombax costatum yields kapok fibres, but demand is declining. The palm trees, in particular Borassus aethiopum, produce leaves which are used for mats and baskets, as material for binding and for wickerwork.

References:

Adamson and Bell (1974), Aubréville (1950), Berhaut Vol. I - VI (1971-1979), CNUCED/GATT (1978), Giffard (1974 A), Irvine (1961), Sahni (1968).

Raw-material-producing trees and shrubs

+ very important
o less important
- not utilized
. no information

	gums	tannins	dyes	ash/salts saponins	fibres
Acacia albida	o	o	-	.	o
Acacia ehrenbergiana	o	.	.	.	o
Acacia dudgeoni	.	.	-	.	o
Acacia gourmaensis	.	.	.	.	o
Acacia laeta	o	.	-	-	o
Acacia macrostachya	o	.	-	-	.
Acacia macrothyrsa	o	.	-	-	.
Acacia mellifera	.	.	-	-	o
Acacia nilotica	o	+	o	-	-
Acacia pennata	.	o	-	-	o
Acacia polyacantha	o	o	o	o	.
Acacia senegal	+	o	.	.	o
Acacia seyal	+	o	.	.	o
Acacia sieberiana	o	o	.	.	o
Acacia tortilis	o	o	.	.	o
Adansonia digitata	o	.	o	o	+
Adenium obesum	o	-	-	-	-
Albizia chevalieri	.	o	.	.	o
Albizia lebbeck	o	o	-	o	o
Anacardium occidentale	o	o	o	.	-
Annona senegalensis	-	-	.	o	o
Anogeissus leiocarpus	o	o	o	o	-
Azadirachta indica	o	-	-	o	-
Balanites aegyptiaca	.	.	.	o	.
Bauhinia rufescens	-	o	.	.	o
Bombax costatum	-	-	-	.	+
Borassus aethiopum	-	-	-	o	+
Butyrospermum parkii	.	.	.	o	-
Cadaba glandulosa	.	.	.	+	-
Calotropis procera	o	-	.	.	+
Cassia siamea	-	o	-	-	-
Cassia sieberiana	-	o	.	-	-
Casuarina equisetifolia	-	o	o	-	-
Celtis integrifolia	-	-	.	.	o
Combretum glutinosum	o	-	+	-	-
Combretum micranthum	-	-	.	.	o
Combretum nigricans	o	o	o	.	.
Commiphora africana	o	-	.	.	-
Crateva adansonii	o	.	o	.	-

	gums	tannins	dyes	ash/salts saponins	fibres
Dichrostachys cinerea	o	.	.	.	o
Diospyros mespiliformis	o	.	.	.	-
Entada africana	.	o	-	-	o
Eucalyptus camaldulensis	o	o	-	-	-
Euphorbia balsamifera	o	-	.	-	-
Ficus capensis	.	o	.	-	o
Ficus platyphylla	o	o	o	-	o
Ficus thonningii	.	.	.	-	o
Ficus vogelii	o	.	.	-	.
Gardenia erubescens	-	-	o	-	-
Gardenia ternifolia	-	-	o	-	-
Grewia bicolor	-	-	-	.	o
Grewia mollis	-	-	-	o	o
Grewia tenax	-	-	-	-	o
Grewia villosa	-	-	-	-	o
Hyphaene thebaica	-	-	o	.	o
Lannea acida	o	.	.	-	o
Lannea microcarpa	o	.	.	-	o
Leptadenia pyrotechnica	-	-	.	.	o
Leucaena leucocephala	o	.	.	.	.
Maerua crassifolia	.	.	o	.	.
Mangifera indica	-	.	o	.	-
Maytenus senegalensis	-	-	.	o	-
Mitragyna inermis	-	.	o	.	.
Moringa oleifera	o	.	.	.	o
Parkia biglobosa	o	o	o	o	-
Phoenix dactylifera	-	-	.	o	o
Piliostigma reticulatum	o	o	o	o	o
Piliostigma thonningii	o	o	o	o	o
Prosopis africana	o	o	.	.	-
Pterocarpus erinaceus	o	o	o	.	.
Salvadora persica	-	-	.	o	.
Sclerocarya birrea	.	o	o	o	o
Securidaca longepedunculata	+	o	.	o	.
Securinega virosa	o	.	+	.	.
Sterculia setigera	+	.	.	.	o
Stereospermum kunthianum	-	-	o	.	-
Tamarindus indica	.	o	o	o	-
Terminalia avicennioides	-	-	o	.	-
Terminalia macroptera	-	-	o	.	-
Vitex doniana	-	-	o	o	.
Ximenia americana	-	o	.	.	-
Ziziphus mauritiana	-	o	.	.	-

4.7 Protective and soil improving functions of trees and shrubs

It is generally accepted that forestry makes a substantial contribution towards slowing down or combatting desertification. These expectations are based in part on general observations, experience, or assumptions but only in exceptional cases on scientific investigations. Particularly after the UN Conference on Desertification of 1977 in Nairobi as well as subsequent meetings numerous publications dealing with the beneficial roles of trees and shrubs have been published.

There is no doubt that woody plants have favourable effects on the environment in semiarid regions. However it must be said that during the past years expectations have been set too high and a realistic assessment has frequently been lacking. Under particular circumstances stands of trees and shrubs may even have detrimental effects.

The simplest proof of the protective function of a tree is shade. Anybody who has been exposed to extreme heat can appreciate the benefit of tree shade. At the beginning of the dry season one can frequently observe that the grass is still green within the enlarged perimeter of the crown projection of trees and shrubs, while exposed sites are already dry. Under certain trees not only grass, but also agricultural crops, such as millet and ground nuts grow higher, more vigorously, and give better yields than elsewhere. Where trees have been destroyed during the last two or three years, green "islands" frequently indicate where they stood before. Where they have died, the remaining vegetation, animals and finally also the topsoil gradually disappear.

Investigations in Sahelian countries during recent years have helped to broaden our understanding of this process. The shade of trees alone has a beneficial influence on the environment in addition to wind protection and the humus forming litter. Between 9:oo a.m. and 5:oo p.m. the temperatures inside shaded areas 1 m above the ground are about 5^{o} C below, and at soil surface up to 15^{o} C below temperatures outside shaded areas. It is correct to speak of "the nutrient-pumping" effect of trees because water-soluble minerals from deeper soil layers can only be reached by the roots of trees. They are stored in the leaves and recycled after leaf-fall and decomposition. Moreover, several tree and shrub species have a nitrogen fixing potential which will however strongly depend on mutual feedbacks between environmental factors, biological factors, the natural population of symbiotic microorganisms like Rhizobium, Frankia and endomycorhizal or ectomycorhical fungi, pests and diseases, nutritional factors of the given site, and the relevant plant species or cultivars, plant societies. Acacia species (A. albida, A. nilotica, A. senegal, A. seyal, A. sieberiana, and A. tortilis), Prosopis spp., Leucaena leucocephala and Casuarina equisetifolia are among those woody species generally considered to have a potential for symbiotic nitrogen fixation, provided appropriate symbiotic microorganisms are available or have been inoculated. Animals gathering in the shade of trees add to the often observed

nitrogen and mineral enrichment of the top soil nutrients.

This rough outline indicates that there are various reasons for positive effects, and these may not necessarily apply to all trees and shrubs.

For Acacia albida research results confirm the beneficial effects. Comparative studies and detailed information on most other species are not yet available.

But trees and shrubs also compete with annual plants for water, nutrients and light. Their specific root systems are an indication of the protective or competitive potential of individual species. An extensive lateral root system means strong competition for other flat rooting plants like cereals, grass, groundnuts, beans and cowpeas, but is effective in fixing the soil against water and wind erosion. A single, deep-reaching taproot takes almost nothing away from these crop plants, but such a root system is obviously ineffective for dune fixation. In addition, trees (e.g. eucalyptus) and shrubs may turn out to be such intense consumers of nutrients that site conditions become considerably impaired over a longer period of time.

Trees consume more water than other plants, hence there is a danger that they lower the groundwater table where dense stands are planted. The water consumption of trees depends on species, age, and size, crown form, and density of foliage. A stand of trees cannot increase rainfall, but may have an important influence in that soil humidity is maintained for a longer period and is released more slowly (by run-off and direct evaporation) than on bare surfaces. This is an important factor, particularly in the southern Sahel where the environmental problem is not so much a deficiency of rain, but high seasonal fluctuation of water availability.

Differentiation is also recommended with regard to wind protection. This can only be obtained through high trees or hedges over an effective distance corresponding to 10 or 20 times the tree or hedge height. Extensive literature is available on the structure of shelter-belts suitable in other semiarid regions. It is important to know at which time of the year shelter-belts are most needed. For year-round wind protection only evergreen species can be used. Frequently, however, fields and gardens only need to be protected during the rainy season. This means that there are several alternatives to be considered.

The following recommendations are made for the selection of trees and shrubs suitable for protective and soil-improving measures in connection with maintaining or improving the water budget, soils, vegetation, fauna, and human life and activities.

Trees and shrubs for protective functions and soil improvement

S = shade
E = erosion control, dune fixation etc.
N = nutrient enrichment, improvement of soil structure
W = wind protection
WB = improvement of water budget
O = other positive effects (e.g. fire protection)

\+ very important
o less important, limited to specific locations
\- not suitable, ineffective
. no information

	S	E	N	W	WB	O
Acacia albida	+	-	+	o	o	o
Acacia nilotica var.adansonii	+	o	o	o	o	.
Acacia nilotica var.tomentosa	+	.	o	o	o	.
Acacia senegal	.	+	o	.	o	.
Acacia seyal	o	o	o	.	o	.
Acacia sieberiana	+	.	.	.	.	.
Acacia tortilis	o	o	.	.	.	.
Adansonia digitata	+	.	.	o	.	o
Albizia lebbeck	o	.	.	o	.	.
Anacardium occidentale	o	+	.	o	.	.
Azadirachta indica	+	o	o	+	o	o
Bauhinia rufescens	-	o	o	o	.	.
Cassia siamea	o	.	.	+	.	.
Cassia sieberiana	o	.	.	o	.	.
Casuarina equisetifolia	o	+	o	o	.	.
Celtis integrifolia	o	-	-	.	.	.
Combretum micranthum	.	o	.	o	.	.
Dichrostachys cinerea	-	o	o	-	.	.
Diospyros mespiliformis	+	o	.	.	.	-
Eucalyptus camaldulensis	o	.	-	o	-	.
Euphorbia balsamifera	-	o	.	o	.	-
Ficus platyphylla	+	-	-	.	.	o
Ficus thonningii	+	-	-	-	.	.
Ficus vogelii	+	-	-	-	.	.
Khaya senegalensis	+	.	o	o	.	o
Leucaena leucocephala	o	o	+	+	o	.
Mangifera indica	+	.	o	o	.	o
Mitragyna inermis	o	o	.	.	+	.
Parkia biglobosa	+	.	o	.	.	.
Parkinsonia aculeata	-	o	o	+	.	.
Phoenix dactylifera	o	.	.	.	.	.

	S	E	N	W	WB	O
Piliostigma reticulatum	o	o	.	o	.	-
Piliostigma thonningii	o	o	.	o	.	.
Prosopis juliflora	o	o	o	+	.	.
Pterocarpus erinaceus	.	.	.	o	.	.
Tamarindus indica	+	o	o	o	.	.
Tamarix senegalensis	-	o	.	o	.	.
Ziziphus mauritiana	o	o	.	o	.	.
Ziziphus spina-christi	o	o	.	o	.	.

Tree and shrub species with protective or soil improving effects suitable for natural regeneration or planting

First column: quality of protection/of soil improvement
Second column: multiple use (besides protection/soil improvement)
Third column: planting/natural regeneration, fast growth

1 = very good; 2 = medium, satisfactory; 3 = low rating, unsatisfactory

Acacia albida	1	1	2
Acacia nilotica	2	1	1
Acacia senegal	1	1	1
Adansonia digitata	2	1	3
Albizia lebbeck	2	2	1
Anacardium occidentale	1	1	1
Azadirachta indica	1	1	1
Casuarina equisetifolia	(1)	3	2
Diospyros mespiliformis	2	1	3
Eucalyptus camaldulensis	2	1	1
Euphorbia balsamifera	2	3	2
Khaya senegalensis	2	1	2
Leucaena leucocephala	1	1	1
Mangifera indica	2	1	1
Parkia biglobosa	2	1	3
Parkinsonia aculeata	1	3	1
Piliostigma spp.	2	2	2
Prosopis juliflora	1	2	1
Tamarindus indica	2	1	3
Ziziphus spp.	2	1	1

The results of this classification indicate that:

a) For plantations aiming primarily at soil protection/soil improvement the following are suitable species:

   Acacia albida
   Acacia senegal
   Anacardium occidentale
   Azadirachta indica
   Casuarina equisetifolia (only in coastal regions)
   Leucaena leucocephala (southern fringe of the Sahel only)
   Parkinsonia aculeata
   Prosopis juliflora

b) The desired environmental effects may be obtained with most species through natural regeneration. Equally important are technical problems such as where, how, and when to protect or improve. While the above-mentioned constraints should be kept in mind, every tree, shrub or stand theoretically has an effect beneficial to the immediate environment.

c) The following species, planted primarily for other uses, can - as a side effect - contribute effectively to soil protection and soil improvement:

   Acacia albida
   Acacia senegal
   Adansonia digitata
   Anacardium occidentale
   Azadirachta indica
   Mangifera indica
   Parkia biglobosa
   Tamarindus indica

References

Barbier (1978), Delwaulle (1977, 1978, 1979), Hall et al (1979), Le rôle des arbres au Sahel (1980), Le Sahel (1974), Séne (1978).

4.8 Trees and shrubs suitable for amenity planting

The selection of species to be planted as structural elements within human settlements, irrespective of their potential production and beneficial effects on soil, the water budget or land use, is more attractive and impressive for most people than conventional afforestation or the natural "bush" vegetation.

In settlements almost everywhere several species are found which are partially

- remnants of the natural vegetation (some carefully protected, others mutilated or in bad condition);

- plantations of the forest administration or result from public tree planting programmes such as the "tree day";

- planted by local inhabitants.

The selection of species may be quite random (those naturally available or from tree nurseries), or selection may be dependent on a particular objective or site.

Azadirachta indica is the typical amenity tree that may be encountered almost everywhere. Other species such as Acacia albida, Adansonia digitata, Albizia lebbeck, Calotropis procera, Cassia siamea, the Ficus species, Khaya senegalensis, Mangifera indica, Moringa oleifera, Parkia biglobosa, Parkinsonia aculeata and Prosopis juliflora are more frequent in the immediate vicinity of settlements and occasionally within villages and towns themselves, than in the open landscape. Several of these species thrive only in regions with at least 500 to 600 mm annual precipitation or with irrigation.

Selection criteria for the planting of trees and shrubs in and around settlements, along roads, etc. are shade and suitability as a hedge or as an ornamental border for streets, squares or riverbanks. Equally important are multiple uses such as the production of fruit and leaves for food or forage. Arguments against the use of a particular species may refer to thorns or poisonous saps or that it attracts insects, causes damage with roots, or that it stands leafless for an extended period.

The following list has been compiled taking into consideration certain ethnic and regional preferences, and particular suitability or ease of planting. However, arguments in favour of or against planting may be found for each species. The large selection presented here may provide an opportunity for further diversification, and hence for environmental improvement in and about settlements and urban centres.

VILLAGE PLANTATION

Trees and shrubs for amenity planting around homes and settlements and along roads

+ = very important, frequently used
o = less important, occasional use
- = not used
. no information

	shade	amenity	hedges	roadsides riverbanks
Acacia albida	+	o	.	o
Acacia macrostachya	-	.	+	.
Acacia nilotica var.adansonii	o	o	.	o
Acacia nilotica var.tomentosa	o	o	.	o
Acacia senegal	.	.	o	.
Acacia seyal	o	.	o	.
Acacia sieberiana	o	o	.	.
Acacia tortilis	o	.	o	.
Adansonia digitata	+	o	-	.
Adenium obesum	-	+	o	.
Albizia lebbeck	o	+	-	+
Anacardium occidentale	o	o	o	o
Anogeissus leiocarpus	o	.	-	o
Azadirachta indica	+	o	-	+
Balanites aegyptiaca	o	.	o	o
Bauhinia rufescens	-	o	o	.
Bombax costatum	o	o	-	+
Borassus aethiopum	o	o	-	.
Butyrospermum parkii	o	o	-	.
Cassia siamea	o	+	o	+
Cassia sieberiana	.	+	.	o
Casuarina equisetifolia	o	o	o	+
Celtis integrifolia	+	.	-	.
Combretum aculeatum	-	o	o	-
Combretum micranthum	-	o	o	-
Combretum paniculatum	-	+	o	-
Commiphora africana	.	.	+	o
Diospyros mespiliformis	+	o	-	.
Erythrina senegalensis	o	+	o	o
Eucalyptus camaldulensis	o	o	-	+
Euphorbia balsamifera	-	o	+	+
Ficus spp.	+	o	-	o
Gardenia ternifolia	.	o	-	.
Khaya senegalensis	+	o	-	+
Lannea spp.	o	o	-	o
Leucaena leucocephala	o	+	+	o

	shade	amenity	hedges	roadsides riverbanks
Mangifera indica	+	o	-	+
Mitragyna inermis	o	+	-	+
Moringa oleifera	o	o	o	o
Parkia biglobosa	+	o	-	o
Parkinsonia aculeata	-	o	+	o
Phoenix dactylifera	o	o	-	-
Piliostigma spp.	o	o	.	.
Prosopis juliflora	.	.	+	o
Pterocarpus erinaceus	o	o	-	.
Sclerocarya birrea	o	.	-	o
Securidaca longepedunculata	o	o	.	.
Sterculia setigera	+	o	-	o
Stereospermum kunthianum	o	+	-	.
Tamarindus indica	+	+	-	o
Ximenia americana	-	o	o	-
Ziziphus mauritiana	o	.	+	.
Ziziphus spina-christi	o	.	o	.

Trees and shrubs for amenity planting

First column: suitability
Second column: multiple use (besides amenity planting)
Third column: reliability of planting, fast growth, resistance, longevity

1 = very good; 2 = medium, satisfactory; 3 = low rating, unsatisfactory

				main use
Acacia albida	1	1	3	shade
Acacia macrostachya	2	2	1	hedges
Acacia nilotica	1	1	2	amenity
Adansonia digitata	1	1	3	shade, cultural, amenity
Adenium obesum	2	3	2	ornamental: Note: poisonous!
Albizia lebbeck	1	2	1	roadsides, yards; ornamental
Anacardium occidentale	2	1	1	shade, hedges
Azadirachta indica	1	1	1	shade, compounds, roadsides, amenity
Bauhinia rufescens	1	2	1	hedges
Bombax costatum	2	2	2	roadsides, shade
Cassia siamea	1	2	1	roadsides, hedges, compounds, amenity
Cassia sieberiana	1	2	2	ornamental
Casuarina equisetifolia	2	3	2	roadsides, hedges, dunes
Commiphora africana	1	2	1	hedges

Diospyros mespiliformis	1	1	3	shade
Erythrina senegalensis	2	2	2	ornamental
Eucalyptus camaldulensis	2	2	1	roadsides, shade
Euphorbia balsamifera	1	2	1	hedges, roadsides
Ficus spp.	1	2	2	shade, amenity
Khaya senegalensis	1	1	3	roadsides, shade, amenity
Mangifera indica	1	1	2	roadsides, shade, amenity
Mitragyna inermis	1	2	2	riversides, ornamental
Moringa oleifera	2	1	1	ornamental, compounds
Parkia biglobosa	1	1	3	shade, roadsides, amenity
Parkinsonia aculeata	1	2	1	hedges, ornamental
Prosopis juliflora	1	2	1	hedges, roadsides
Sclerocarya birrea	2	1	2	roadsides
Sterculia setigera	1	2	2	shade, ornamental
Stereospermum kunthianum	1	2	2	ornamental
Tamarindus indica	1	1	3	shade, ornamental, compounds
Ximenia americana	2	1	2	hedges
Ziziphus mauritiana	1	1	2	hedges, shade

The following species should be considered as:

a) <u>shade trees (Note: some are deciduous.):</u>
   Acacia albida
   Adansonia digitata
   Azadirachta indica
   Cassia siamea
   Eucalyptus camaldulensis
   Ficus thonningii
   Khaya senegalensis
   Mangifera indica
   Parkia biglobosa
   Sterculia setigera
   Tamarindus indica

b) <u>amenity trees:</u>
   Albizia lebbeck
   Cassia siamea
   Cassia sieberiana
   Erythrina senegalensis
   Moringa oleifera
   Parkinsonia aculeata
   Stereospermum kunthianum
   Tamarindus indica

c) <u>hedges:</u>
   Acacia macrostachya
   Bauhinia rufescens
   Cassia siamea
   Commiphora africana
   Euphorbia balsamifera
   Parkinsonia aculeata
   Prosopis juliflora
   Ziziphus mauritiana

d) roadside, riverbank, yard trees:
Albizia lebbeck
Anacardium occidentale
Azadirachta indica
Bombax costatum
Cassia siamea
Casuarina equisetifolia
Eucalyptus camaldulensis
Khaya senegalensis
Mangifera indica
Moringa oleifera
Parkia biglobosa
Prosopis juliflora
Sclerocarya birrea
Tamarindus indica

References
Andresen (1974), Doolittle (1969), Giffard (1974A), Grey, Deneke (1978), Goor, Barney (1976), Irvine (1961).

4.9 The role of trees and shrubs in African culture

Big and old trees have always been admired and revered by people everywhere and have been a part of their religious or cultural heritage. In a region where the tree and shrub vegetation is generally rather low, stunted and scattered, tree giants attract even more attention. It is not surprising then, that the Baobab, Adansonia digitata, one of the biggest and oldest living creatures, has always been greatly respected by people in the Sahel and attributed with being the source of supernatural powers and spirits. The multiple uses made of this tree have further ensured its special place in African culture. Only a few other trees approach the significance of the Baobab, such as Acacia albida, the big Ficus species and perhaps also Celtis integrifolia or Khaya senegalensis. Further species are generally esteemed with particular regard to their use as food, medicine or poison, as in the case of Annona senegalensis, the palms, mango, Butyrospermum parkii and Parkia biglobosa.

This species-related cultural significance is also reflected in legends, arts and crafts, religious rites, and in the selection of burial grounds, assembly places, and comparable sites. Many individual trees attain a particular status of reverence or taboo as a result of important events such as accidents, warfare, peace treaties, or other agreements.

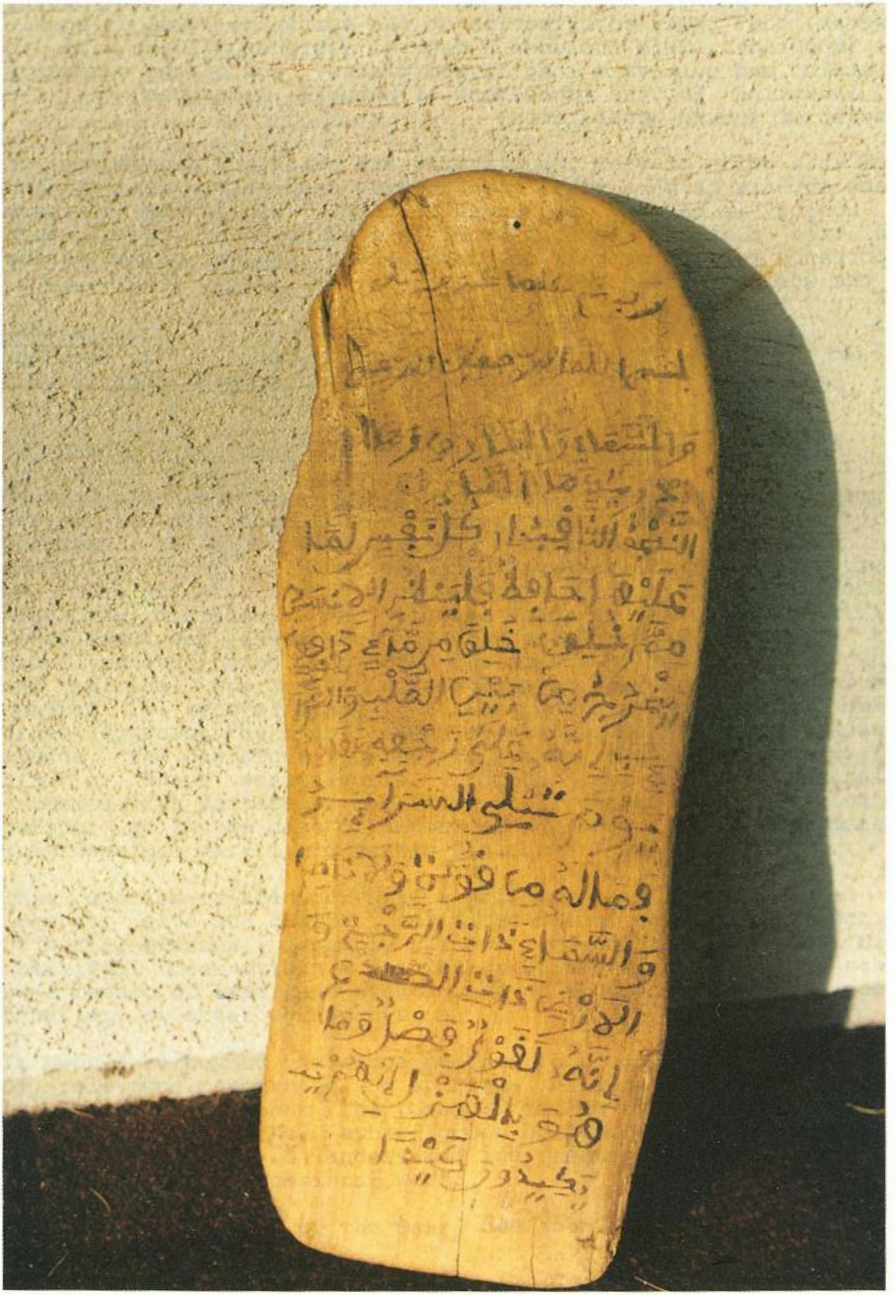
It would be beyond the scope of this book to mention everything of relevance concerning the spiritual dialogue between man and his living environment. The forester coming from the outside, for example from another ethnic group or from a foreign country, should endeavour to understand and respect these ties when performing his professional work.

The trees and shrubs of the Sahel can help in reducing or halting

desertification and there can be no doubt that, if properly used, they will be able to perform this function. This refers primarily to the biological, ecological and technical aspects. It appears, however, that their contribution at the spiritual level is equally important. This includes a general awareness of the need to maintain and cultivate long-living plants, and of the necessity of investing in the management of natural resources for the benefit of future generations.

From this point of view the planting and sustained management of trees appears to be a vital step towards responsible land use and an ecology in harmony with human culture. This is why forestry and tree planting in the Sahel is considered to be of such importance for the overall development and survival of man in one of the world's stress regions.

CULTURAL USE



4.10 Multiple uses of trees and shrubs - Summary table -

+ main use
o use known, but less important
- no use
. no information

1 = fuelwood
2 = timber
3 = food
4 = forage
5 = medicines
6 = raw materials
7 = protective functions
8 = amenity
9 = cultural

	1	2	3	4	5	6	7	8	9
Acacia albida	o	o	o	+	o	o	+	o	+
Acacia ataxacantha	o	o	-	o	o	o	-	.	-
Acacia dudgeoni	o	o	-	o	o	o	-	-	-
Acacia ehrenberg.	o	.	o	o	o	o	-	-	-
Acacia gourmaensis	o	.	-	o	o	o	-	-	-
Acacia laeta	+	o	-	o	.	o	-	-	.
Acacia macrostachya	o	o	o	o	+	o	-	o	.
Acacia macrothyrsa	o	o	o	o	o	o	-	-	-
Acacia mellifera	o	o	-	o	.	o	-	.	-
Acacia nilotica	+	o	o	o	+	+	o	o	.
Acacia pennata	o	-	-	o	o	o	-	-	-
Acacia polyacantha	o	o	o	.	o	o	-	-	.
Acacia senegal	+	o	o	+	o	+	+	-	.
Acacia seyal	+	+	o	+	o	o	o	o	.
Acacia sieberiana	o	o	-	o	o	o	o	o	-
Acacia tortilis	+	o	-	+	o	o	o	o	.
Adansonia digitata	-	o	+	+	+	o	o	+	+
Adenium obesum	-	-	-	-	+	o	-	o	o
Albizia chevalieri	o	o	o	o	.	o	-	-	-
Albizia lebbeck	o	o	-	o	o	o	o	+	-
Anacardium occiden.	o	-	+	o	o	o	+	o	-
Annona senegalensis	.	o	+	o	+	o	-	-	o
Anogeissus leiocar.	+	+	o	o	o	o	-	o	.
Azadirachta indica	+	o	o	o	+	o	+	+	o
Balanites aegyp.	+	+	+	+	o	o	-	o	o
Bauhinia rufescens	o	o	o	+	o	o	o	o	.
Bombax costatum	.	o	o	o	o	+	-	o	-
Borassus aethiopum	o	+	+	o	o	o	-	o	o
Boscia angustifolia	o	o	o	+	o	.	-	-	-
Boscia salicifolia	o	-	o	o	o	-	-	-	-
Boscia senegalensis	o	o	+	o	o	-	-	-	-
Butyrosper. parkii	o	o	+	o	o	o	-	o	+
Cadaba farinosa	o	-	o	+	o	-	-	-	-
Cadaba glandulosa	.	.	.	o	.	o	-	-	-
Calotropis procera	o	o	o	o	+	o	-	-	.
Capparis corymbosa	o	-	o	o	o	.	-	-	-
Capparis decidua	.	o	o	o	o	.	-	-	-
Capparis tomentosa	.	-	o	o	o	.	-	-	-

	1	2	3	4	5	6	7	8	9
Cassia siamea	+	o	-	o	o	o	o	+	-
Cassia sieberiana	o	o	-	.	+	o	o	+	-
Casuarina equiseti.	+	o	-	-	o	o	+	o	-
Celtis integrifolia	o	o	o	o	o	o	o	o	-
Combretum aculeatum	o	o	o	+	+	-	-	o	o
Combretum gluti.	+	+	o	.	+	o	-	-	-
Combretum micran.	o	o	+	.	+	o	o	o	o
Combretum nigricans	o	o	o	-	o	o	-	-	-
Combretum panicu.	.	o	o	-	o	-	-	o	-
Commiphora africana	o	o	-	o	o	o	.	+	+
Crateva adansonii	o	o	o	o	o	o	-	-	-
Dalbergia melanoxy.	o	+	-	o	o	-	-	-	+
Dichrostachys cin.	o	o	o	+	+	o	o	o	-
Diospyros mespili.	+	+	o	o	+	o	o	o	-
Entada africana	.	o	o	o	+	o	-	-	-
Erythrina sengalen.	.	-	-	o	+	-	-	o	o
Eucalyptus camaldu.	+	+	-	o	o	o	o	+	-
Euphorbia balsamif.	-	-	o	.	+	o	o	+	.
Feretia apodanthera	-	o	o	o	o	-	-	-	-
Ficus capensis	-	o	o	.	+	o	-	o	+
Ficus gnaphalocarpa	.	o	o	o	+	-	-	o	o
Ficus ingens	-	-	.	.	o	-	-	-	o
Ficus iteophylla	o	.	o	o	o	-	-	o	-
Ficus platyphylla	.	.	o	.	o	o	o	+	.
Ficus thonningii	.	.	o	.	o	o	o	+	o
Ficus vogelii	.	o	o	.	+	o	o	+	.
Gardenia aqualla	.	.	.	o	.	.	.	.	.
Gardenia erubescens	-	o	o	o	o	o	-	-	-
Gardenia sokotensis	o	.	-	.	.	-	-	-	-
Gardenia ternifolia	o	o	o	.	o	o	-	o	o
Grewia bicolor	.	o	o	o	o	o	-	-	-
Grewia flavescens	-	o	o	.	o	o	-	-	-
Grewia mollis	o	o	o	.	o	o	-	-	-
Grewia tenax	-	-	o	o	o	o	-	-	-
Grewia villosa	-	o	o	o	o	o	-	-	-
Guiera senegalensis	o	o	-	o	+	-	-	-	-
Hyphaene thebaica	o	o	+	o	o	+	-	o	+
Khaya senegalensis	o	+	-	o	+	o	o	+	o
Lannea acida	o	o	o	o	o	o	-	o	-
Lannea microcarpa	o	o	o	o	o	o	-	o	-
Leptadenia pyro-technica	o	-	o	o	o	o	-	-	-
Leucaena leuco-cephala	o	o	o	+	o	o	+	+	-

	1	2	3	4	5	6	7	8	9
Maerua angolensis	o	o	o	+	o	-	-	o	-
Maerua crassifolia	.	o	o	+	o	o	-	-	-
Mangifera indica	o	o	+	o	+	o	.	+	o
Maytenus senegalensis	o	o	o	.	o	o	-	-	-
Mimosa pigra	.	o	-	-	o	-	-	-	-
Mitragyna inermis	o	o	-	o	o	o	o	+	o
Moringa oleifera	o	o	+	o	+	+	o	o	-
Parkia biglobosa	o	o	+	o	+	o	o	o	+
Parkinsonia aculeata	o	-	o	o	o	-	+	+	-
Phoenix dactylifera	o	o	+	o	+	+	o	o	+
Piliostigma reticulatum	o	o	o	o	o	o	o	o	-
Piliostigma thonningii	o	o	o	o	o	o	o	o	-
Prosopis africana	+	+	o	o	+	o	.	-	-
Prosopis juliflora	+	o	o	o	o	.	+	+	-
Pterocarpus erinaceus	+	+	o	+	+	o	o	o	o
Pterocarpus lucens	+	o	o	o	o	-	-	-	-
Salvadora persica	o	o	o	+	o	+	-	-	-
Sclerocarya birrea	+	+	o	o	+	o	-	o	-
Securidaca longepedunculata	o	o	-	o	+	o	-	o	+
Securinega virosa	o	o	o	o	+	o	-	o	-
Sterculia setigera	o	o	o	o	+	o	-	o	+
Stereospermum kunthianum	.	o	-	.	o	o	-	+	-
Strychnos spinosa	o	o	o	o	+	-	-	-	-
Tamarindus indica	o	+	+	o	+	o	o	+	+
Tamarix senegalensis	.	-	-	o	o	.	o	-	o
Terminalia avicennioides	o	o	-	o	o	o	-	-	-
Terminalia macroptera	o	o	-	.	o	o	-	-	-
Vitex diversifolia	.	.	o	.	o	.	-	-	-
Vitex doniana	o	o	o	o	o	o	-	-	-
Ximenia americana	o	o	+	.	o	o	-	o	-
Ziziphus mauritiana	o	o	+	o	+	o	o	+	.
Ziziphus mucronata	o	o	o	o	o	o	-	-	-
Ziziphus spina-christi	o	o	o	o	o	.	o	o	-

The preceding summary table indicates that of the more than one hundred Sahelian tree and shrub species described in this book not a single one is used for only one purpose. Multiple uses are known for every one of them.

These are vital facts which must not be overlooked when decisions are made for land use planning, in particular concerning the elimination, transformation or conservation of existing woodlands, and afforestation or individual plantings of trees and shrubs.

It is simply not true that the role of trees and shrubs is limited to supplying fuelwood or to sand-dune stabilization. Yet, the manifold alternative uses are not sufficiently recognized, except by the local population that depends on these species. Scientific investigations are still rare and statistical records almost non-existent. In this sense the preliminary work undertaken here merely provides information on obvious questions and facts, frequently still incomplete, and often not as accurate as would be desirable, but hopefully a basis on which to build.

At a conference in Dakar in 1979 the fact was stressed that during the rainy season trees and shrubs contribute nearly 5 % and towards the end of the dry season nearly 45 % of total forage, amounting to at least 25 % on an annual average. This, among other indications, makes it clear that without trees and shrubs life in the Sahel in the traditional form would never have been possible. Today the problem is not only to overcome quantitative, but also qualitative difficulties in creating adequate supplies for the present generation and future generations.

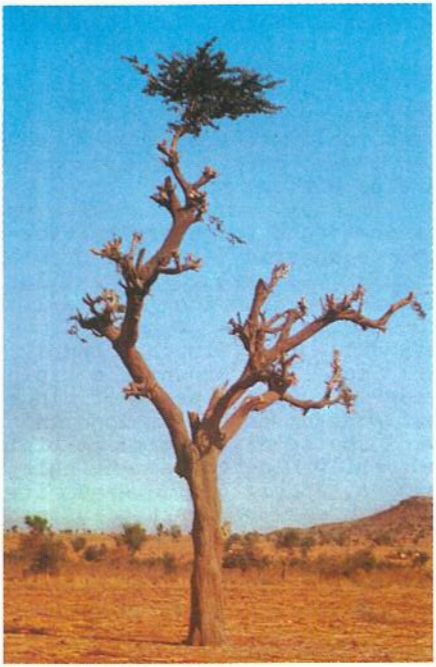
The interrelationships mentioned apply not only to animal husbandry but to all other sectors including the cultural identity of the population and their image of themselves. Evaluation of the different forms of uses, based on many independent sources, is necessarily subjective and more or less influenced by chance. Furthermore, it must be remembered that established practices and traditions, the natural and the economic aspects, and obviously also the availability of particular plants cause considerable differences. "The Sahel" is anything but homogeneous and must be interpreted holistically as a system composed of many interacting components with distinctive cause-effect relationships. One-sided interference could have catastrophic consequences. Such developments can be avoided, at least as far as forestry activities are concerned, if the structures and dynamics of both nature and human development are recognized as being of equal importance.

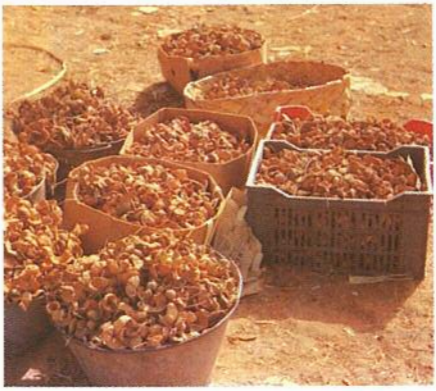
ACACIA ALBIDA

5. TREES AND SHRUBS

- their characteristics, silviculture and uses -

ACACIA ALBIDA





Acacia albida Del.

Synonyms: Acacia gyrocarpa Hochst., Acacia leucocephala, Acacia saccharata Benth., Faidherbia albida (Del.) A. Chev.

Family: Mimosaceae

Description: Large tree, attaining heights of 15 - 25 m occasionally. Diameters may reach more than 1 m. Old trees form a wide semispheric crown, younger trees, on the contrary, have an inverse conical crown.

Branches and twigs are characteristically light grey to whitish, with staggered, angular growth between the leaf axles. Spines stipular, straight, in axillary pairs. They are swollen at the base, up to 5 cm long with a light brown tip.

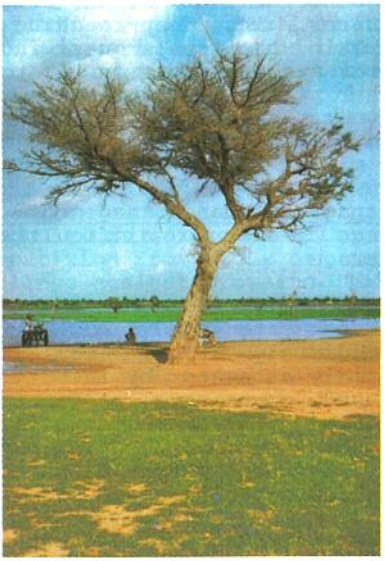
Bark dull grey, rough, deeply fissured with age. Slash fibrous, pink to light brown. The bipinnate leaves are distinctive blue-green with 3 - 12 pairs of pinnae, each carrying 6 - 23 pairs of leaflets, up to 12 mm long and 5 mm wide, partially overlapping. Even the seedlings produce bipinnate leaves immediately and can be easily identified by this feature. Differing from other species, Acacia albida sheds its foliage during the rainy season, but is green during the dry season.

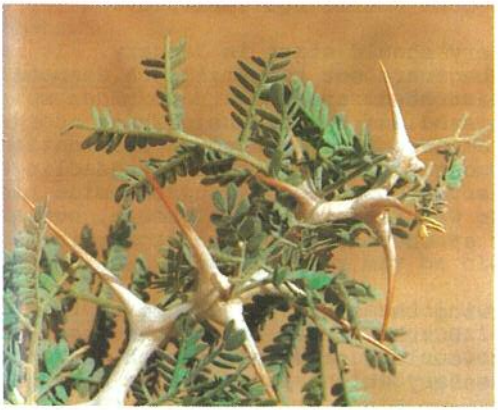
Further characteristics are: no gland on the petiole, but glands between all pinna pairs, stamen filaments shortly conate at the base, anthers large, eglandular. The inflorescences, axillary dense spikes, are 7 - 10 cm long and appear approximately 2 months after the leaves. They are cream-coloured and very fragrant. Pods are typically bright orange to reddish-brown, 10 - 15 cm long and 2 - 3 cm wide, resembling dried apple-rings because of their twisted form ("apple-ring tree"). They are indehiscent and are shed approximately 3 months after flowering. Each pod contains 10 - 20 shiny, darkbrown seeds, characterized by a small tubercle.

Distribution: All over Africa from South-Algeria to Transvaal, from Senegal to Somalia, preferring the semiarid zone with annual rainfalls between 400 - 900 mm. Scattered occurrence beyond the Nile valley to Syria, Lebanon, Israel and Yemen.

Site requirements: Acacia albida is very adaptable, growing under precipitation of less than 300 mm up to 1,800 mm and survives extended dry periods (even of several years), as well as several weeks of inundation. It is found in the Near East with average monthly winter temperatures of only 6° C while tolerating daytime temperatures of over 40° in the Sahel and South Africa. Although a species of the alluvial plains it is found at 270 m below sea level near the Dead Sea as well as at altitudes of up to 2,700 m (Djebbel Marra) in the Sudan. The tree has no particular soil structure or nutrient requirements but demands a relatively high ground water table which must be reached by the taproot before height growth can begin.

ACACIA ALBIDA





Permanently moist soil horizons should be found preferably at depths between 2 and 10 m. The tree is, therefore, often encountered on sites fringing perennial or seasonal water courses. The deep-reaching roots (sometimes more than 20 m) explain the tree's quasi-independence of precipitation, surface water and nutrients in the topsoil. Therefore, competition with other plants, in particular with cultured plants, does not exist. Favourable sites for plantations in the Sahel are alluvial flats and fossil dunes with deep, mineral-rich loamy sands, particularly millet fields in the vicinity of settlements.

Propagation and management: Seed collection within the natural range poses no difficulties. About 11,500 seeds/kg is the average.

Pods, collected under the trees, are crushed in a mortar in order to separate the seeds. This operation should take place immediately after collection because pods and seeds are rapidly attacked by insects. The seeds can be stored in simple, closed containers protected against humidity and light, and treated with an insecticide. Because they are covered by a waxy impermeable cuticle, they may retain viability for several years. But the best germination results have been obtained in Senegal with hand-peeled seeds sown immediately after harvest.

Treatment of the seeds before seeding is recommended. The most simple of the many procedures is boiling the seeds for 5 minutes, and subsequent slow cooling. Another method is to pour boiling water over the seeds and soak them for 24 hours. Good results have also been obtained by soaking in 66 % sulphuric acid for 4 - 5 minutes and subsequently rinsing with water. Scarification of seeds is reported to produce up to 95 % germination within 8 days.

Direct seeding is advantageous because it is economical and there is no risk of damaging the quickly developing taproot by transplanting. On the other hand, it has the disadvantage of a relatively high mortality rate of the seedlings, and for this reason cannot be recommended before the method is improved.

Raising of plants in the nursery should start in January. It is essential that the polythene bags are not too small. A diameter of 8 cm and a length of at least 30 cm are required. The substrate should consist of 50 % sand and 50 % humus. Three seeds are inserted approximately 1 cm deep into each pot. Germination takes place irregularly after one to several weeks. Seedlings must be protected from excessive sun and wind and should, in time, be singled out. Regular watering increases growth, but an accumulation of stagnant water at the bottom of the bag or in the seedbed below must be avoided.

Between 3 to 7 months after sowing the seedlings should be transplanted to the final location. Further delay brings the risk of root deformation in the bag (curling or spiral growth at the bottom). A cut may become necessary which, however, may endanger the survival of the seedlings.

As with most trees in the Sahel planting time begins immediately after the first rainfalls. Opinions diverge on the methods of site preparation. Planting holes of 1 m^2 and at least 50 cm depth, spaced 5 m apart, are recommended in regions receiving at least 600 mm annual precipitation. In more arid zones and where plantations are established on former fields (millet or groundnut) with sandy soils, superficial loosening of the top soil by traditional tillage may be sufficient. Spacing should be at least 10 x 10 m in the Sahel proper.

Under very dry conditions, on nutrient-poor sites, watering and the application of 150 g NPK and of 100 g Ammonia sulphate per planting hole may improve starting conditions for the seedlings. It is equally important to avoid competition from weeds or crop plants, and to protect the small seedlings against browsing. This is expensive if each plant must be protected individually. Permanent surveillance is necessary, and damaged fences etc. must be repaired instantly. Acacia albida is well-known to farmers nearly everwhere because of its usefulness. However, although they are prepared to protect larger trees, the necessity of nursing the trees during the first years is not adequately understood. Greater understanding must be brought about through incessant instruction and encouragement.

Measurements from Senegal indicate that the trees can reach a height of 10 - 50 cm after 6 months, 20 - 80 cm after a year, 70 - 200 cm after 2 years, 100 - 290 cm after 3 years and 160 - 450 cm after 5 years. Under particularly favourable site conditions, height growth may be even faster, such that after 4 years 6.50 m and after 7 years 10.50 m are attained. But this is an outstanding exception. Usually initial growth is rather slow.

Acacia albida coppices and when regenerated by this method height growth is considerably more vigorous than after seeding. Natural regeneration from seeds is possible, but requires efficient protection against livestock. Seeds taken up by domestic or wild animals contribute effectively to the spread of the tree. Transplanting of wildlings cannot be recommended because of the long roots.

Diseases, pests: Pods, seeds and young plants as well as the wood are attacked by different insects; young plants in the nursery and in plantations may be killed by locusts and rats.

Uses: Acacia albida is a typical multipurpose tree, appreciated and often actively protected by the population. It is occasionally even called the "miracle tree" of the Sahel. In some regions the tree plays a significant role in tribal customs and traditional law. Its uses may be classified as follows:

(A) Site improvement by shedding nutrient-rich leaves at the beginning of the vegetation period (rainy season). This is supplemented by a concentration of animal dung under the canopy because livestock assembles under the tree crown

during the dry season to pick up pods or in search of shade. The tree is in foliage during the dry season, providing shade during this time of the year, but causes no light competition during the vegetation period of field crops because the tree is leafless at this time. Investigations particularly in the Republic of Senegal have shown that under Acacia albida the content of organic matter to a depth of 120 cm was considerably higher than on open ground. Soil moisture in the top soil within the crown projection area was higher throughout the whole year and in particular during the dry season. Because nutrients are taken up by the taproot from deep soil layers, competition for nutrients with annual plants does not take place. But nutrients from deeper soil layers contribute to fertilization of the top soil when leaves are shed. Hence, millet and groundnuts grown under Acacia albida give up to threefold higher yields than on comparative lots, and the protein content of crops is higher. In Senegal the additional nutrient quantities made available by Acacia albida with 150 m^2 crown-area, correspond to 183 kg CaO; 39 kg MgO; 19 kg K_2; 75 kg N; 27 kg P_2O_5 + 20 kg S per hectare.

(B) Forage production: A. albida is the most important forage tree of the Sahel. Leaves and young shoots, frequently obtained by lopping, have a high feed value and are browsed by livestock. Annual yields may range about 10 to 25 kg per tree.

The pods are even more important: in March, according to Toutain (1980), they have a feed value of 0.77 UF, at a moisture content of 10 % and a content of 70 g digestible protein per kg of dry matter. This is twice the value of good savanna-grass or groundnut straw. The corresponding values of green leaves are 0.88 UF and 103 g. (1 UF = forage unit corresponds to the feed value of 1 kg barley.)

Between February and May, during the critical supply period in the Sahel and Sudan zones of Africa, the pods fall to the ground and are eaten by livestock or collected, stored and sold. Large trees may produce about 120 - 140 kg in good years (measurements made in Bambey/Senegal), some trees even more. Thus, 20 adult trees per ha could yield up to a maximum of 2,500 kg pods with a feed value of more than 1,500 forage units (equivalent to more than 1,500 kg of barley) which is frequently more than can be produced on the same sites and in years with unfavourable rainfall by agricultural activities. Estimates from Niger and Senegal lead to the conclusion that on range lands with Acacia albida, twice as many head of cattle may be kept as on other lands. A realistic average production, however, of about 20 - 30 kg of pods per fully developed, adult tree per year may be calculated for large populations under the conditions of 400 - 600 mm annual rainfall. Last but not least, the flowers provide good pollen for bees.

(C) The wood is bright yellow, relatively soft and easy to work.

Because of its large dimensions it is used by the rural population for the manufacture of various tools and implements, including mortars, bowls and kitchen utensils, oil presses, drums, boats, dugout canoes, furniture, joinery, interior fittings, boxes, shutters, light carpentry, light structured works, saddles and benches. It is of medium weight (specific gravity 0.58 to 0.71), but not very resistant to insects or fungi and for this reason is only occasionally used for construction purposes. Several months of water storage are said to increase natural resistance. Wood of Acacia albida is less suitable as fuelwood or for charcoal. The thorny branches are widely applied for fencing.

(D) Further uses.
The bark contains 20 - 28 % tannin. Wood ashes are used in the production of soap. Seeds are eaten in times of famine.
Medicinal uses have been recorded as follows:
bark: febrifuge, haemorrhage, cough, pneumonia, kidney diseases, vomiting, diarrhoea, postpartum complications, psychological disorders, ophthalmia;
leaves and gum: haemorrhage, diarrhoea, ophthalmia;
various parts: influenza, heart tonic, toothache, rheumatism.

References:
Aubréville (1950), Baumer (1983), Berhaut Vol. IV (1975), Brenan (1959, 1983), C.T.F.T. (1973, 1978), Delwaulle/Mialhe (1974), FAO (1956), Felker (1978), Geerling (1982), Giffard (1964, 1968, 1969, 1971, 1974A, 1974B), Hallam (1979), le Houerou (1980A), Irvine (1961), Jung (1966), Lebrun (1968), v. Maydell (1975), National Academy of Sciences (1979), Palmer/Pitman (1972), Poulain/Dancette (1968), Prost (1971), Radwanski/Wickens (1967), Sahni (1968), Toutain (1980), Touzeau (1973), Wickens (1969), Weber (1977).

ACACIA ATAXACANTHA
(Photo K. Neumann)

Acacia ataxacantha DC.

Family: Mimosaceae

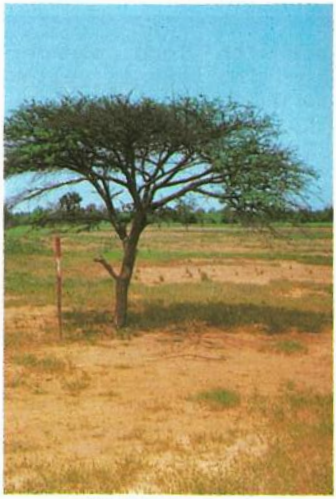
Description: A scrambling shrub or climber with long slender branches, very similar to Acacia macrostachya. The bark is yellow-brown, the slash light brown. Young shoots puberulous or pubescent, at length glabrous, grey-brown, with lenticels. Prickles not axillary but dispersed on stem and branches, clawshaped, recurved, about 1 cm long. Leaves 5 - 14 cm long, bipinnate with 8 - 15 pairs of pinnae. Rachis 8 - 15 cm long with a substipulate gland near the base. 20 - 40 pairs of linear, subfalcate leaflets. Flowers dense, subsessile in axillary white spikes. Pods thin, linear, not reticulate, 6 - 10 cm long, reddish-brown.

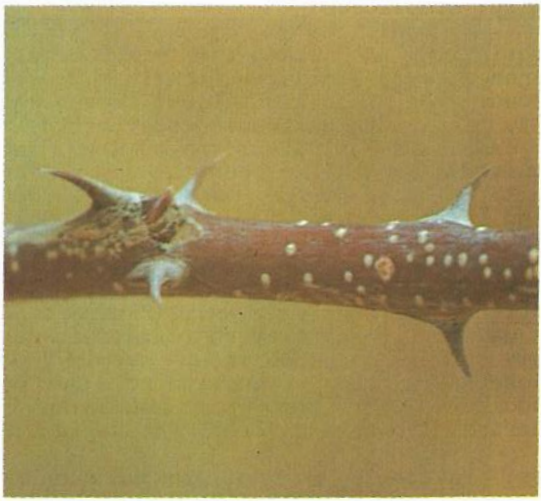
Distribution: Occurs in West, East and South Africa, particularly in gallery forests or on ferralitic duripan soils with sandy-loamy cover and good water supply. Occasionally forms dense thickets in the transition zone between Sahel and Sudan zone, associated with Combretum micranthum. Spreads quickly after clearing of bush and forest vegetation. Often on termite mounds.

Uses: Palatable but not browsed much by livestock. Used for hedges and as fence-building material. The long shoots are cut for walking stickes, bows, poles, etc. Strong ropes can be manufactured from the bark fibre. Several applications in ethnomedicine, such as for syphilis, boils, helminthiasis and in the treatment of wounds, toothache, headache and diseases of the respiratory system.

References: Berhaut Vol. IV (1975), El Amin (1973), Geerling (1982), Irvine (1961), Kerharo a. Adam (1974), Touzeau (1973).

ACACIA DUDGEONI





Acacia dudgeoni Craib ex Holl.

Synonyms: Acacia senegal (L.) Willd. var. samoryana (A.Chev.) Roberty, Acacia samoryana A. Chev.

Family: Mimosaceae

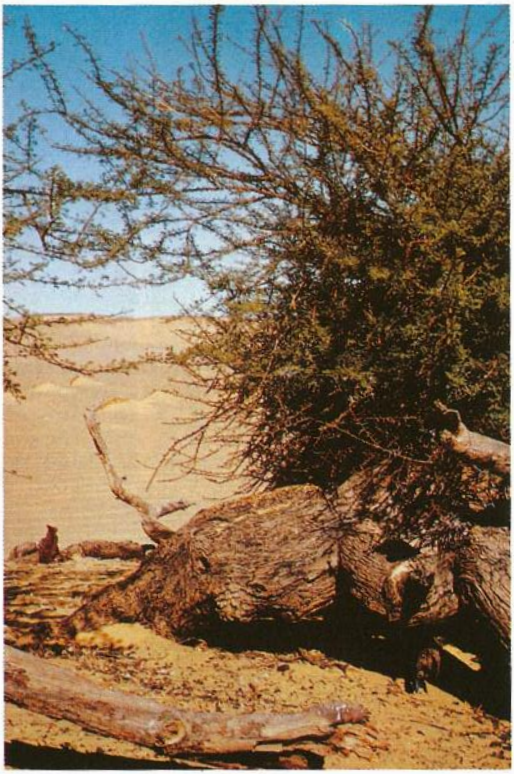
Description: Small tree or shrub, very similar to Acacia senegal and Acacia laeta except for its reddish-brown branches with large grey lenticels. Young shoots and leaves pubescent. Slash red, striated, bark brown or grey, scaly. Prickles in triplets, intermediate prickle recurved inwards, the other two to the point of the shoot, dark reddish-brown, later grey, length 0.5 cm. Leaves 3 - 7 cm long, with up to 20 pairs of pinnae, with 20 - 30 pairs of leaflets each. Flowers white, in racemes, 3 - 5 cm long. Rachis pubescent. Pods bright brown, flat, 3 - 8 cm long, 1.5 - 2.5 cm wide, glabrous.

Distribution: Widespread but not gregarious, between Mali and the northern parts of the Ivory Coast, Ghana, Togo and Benin, in the eastern part of Senegal, and especially in central Burkina Faso. Develops hybrids with Acacia senegal and Acacia laeta, but generally needs considerably more rainfall (800 mm - 1500 mm). Not a typical Sahelian species, but with limited occurence on a few favourable sites.

Uses: Acacia dudgeoni does not produce commercial gum. Leaves and pods are palatable for cattle and especially goats. A resistant bast fibre is obtained from the long lateral roots. The wood is occasionally used for tool handles, as fuel and for charcoal. The only medicinal use recorded is for diarrhoea.

References: Aubréville (1950), Berhaut Vol. IV (1975), Geerling (1982), Irvine (1961), Kerharo a. Adam (1974).

ACACIA EHRENBERGIANA
(Photo K. Neumann)



Acacia ehrenbergiana Hayne

Synonym: Acacia flava (Forsk.) Schweinf.

Family: Mimosaceae

Description: Small tree or shrub, often with typical bundles of opposite twigs and diverging stems. Bark green-brown, shining like varnish, and coiling up when detaching. Numerous white, horizontal lenticels. Slash outside green, inside red. Brown branches with up to 6 (8) cm long axillary spines in pairs, straight, white, pubescent. Small leaves with 1 to 2 (up to 4) pairs of pinnae, each with 8 to 10 (12) pairs of leaflets. To be distinguished from the very similar Acacia seyal by the following characteristics: the spines are longer than the leaves, which never have more than 4 pairs of pinnae, and the powdery coat of the bark is missing. 1 - 5 small, globose, yellow flowers, 1 cm in diameter, axillary, on leafy peduncles. Pods narrow, slightly twisted and 7 - 10 cm long, bright red when young.

Distribution and site requirements: South and north of the Sahara. Being highly resistant to droughts, it often indicates the tree growth limit. Still flourishing with 50 mm of annual rainfall on sandy soils and with 150 mm on clay. Grows favourably with 300 - 400 mm of annual rainfall on slopes and in dry river beds. Coarse and stony soils, gravel preferred. Main distribution (often gregarious) in Mauritania, Niger, Chad, Sudan.

Uses: The twigs are pollarded for livestock in the dry season and browsed by goats, camels and sheep. The gum is inferior to gum arabic; it is used as an emollient in local medicine. Bark fibres are used to make ropes.

References: Aubréville (1950), Berhaut Vol.IV (1975), CNUCED/GATT (1978), El Amin (1973), Geerling (1982), Touzeau (1973).

ACACIA GOURMAENSIS

Acacia gourmaensis A. Chev.

Family: Mimosaceae

Description: Shrub or small tree with many small (short) branches. The bark is thick and corky, vertically fissured; slash reddish. Twigs dark grey with small, crooked, sharply pointed (claw-shaped) prickles, axillary and in pairs.

Can be distinguished from the similar Acacia laeta or from Acacia mellifera (which is found further to the east), by the leaves, which bear 3 - 4 pairs of pinnae and only one pair of elliptic, petioled leaflets each. The leaves are roseate when young, later turn to light green and reach a length of 3 - 7 cm. Flowers in short axillary spikes (like "bottle-brushes"), cream-white, 3 - 5 cm long. Small, flat pods, hairless, yellow-brown, reticulate, like parchment, generally containing only 1 or 2 seeds.

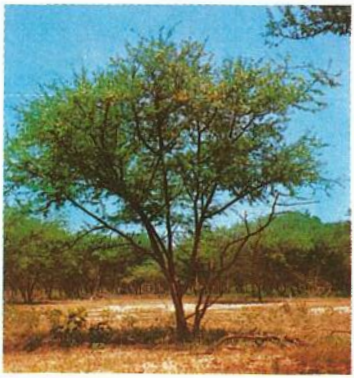
Distribution and site requirements: In Burkina Faso, in the southern Sahel and neighbouring Sudan savannas, Ivory Coast, Ghana, Niger, Nigeria and Togo. Requires from 600 - 1250 mm annual rainfall and prefers humose, loamy soils, but also prospers on "sols ferrugineux" and lateritic sites.

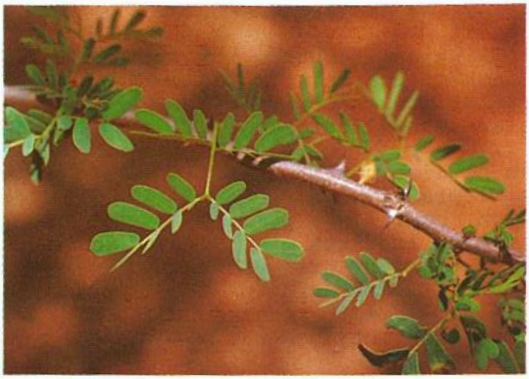
Uses: Fibres of roots and inner bark are used for various kinds of wickerwork. Young shoots, leaves and fruit serve as forage for goats, sheep and camels. The flowers provide good bee-forage.

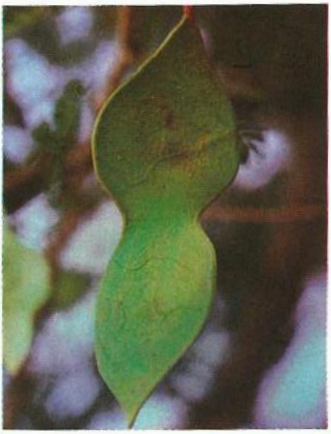
Medicinal uses for cough cures, malaria and hepatic disorders.

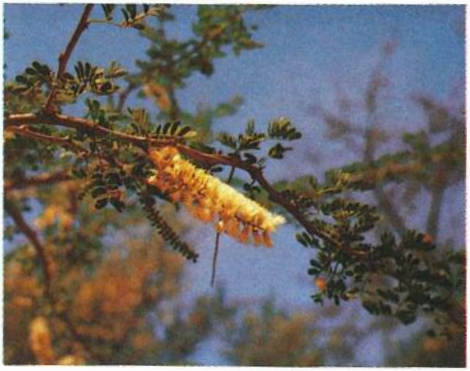
References: Aubréville (1950), Geerling (1982), Irvine (1961).

ACACIA LAETA









Acacia laeta R.Br. ex Benth.

Synonym: Acacia trentiniani A. Chev.

Family: Mimosaceae

Description: A shrub or small tree with grey-green bark which seems to be black when seen from a distance. Slash pink. Distinguished from the very similar A. senegal and A. dudgeoni (also from A. gourmaensis and from A. mellifera in the east of the Sahel) by the leaves. These are bipinnate with 3 - 5 pairs of fairly large pinnate leaflets and 2 - 5 pairs of pinnae. The leaflets are clearly separated from each other and are asymmetric.
Generally, only 2 claw-shaped, recurved black prickles, sometimes with a third, intermediate prickle which is curved towards the top. Where the intermediate prickle is missing, there is often a leaf in its place.
Flowers: very fragrant, white or cream, in 3 - 8 cm long spikes, pedunculate, bundled in triplets. The pods are generally apiculate, in contrast to A. senegal, but aside from this feature, difficult to distinguish. Blossoms towards the end of the rainy season.

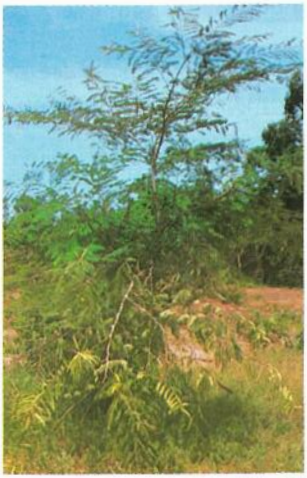
Distribution: Similar to A. senegal, but scarcely seen west of the line Timbuktu - Mopti, absent in Senegal and Mauritania. Grows associated with A. senegal, eastwards to the Red Sea and the Indian Ocean, but in pure stands in parts of Niger and in Burkina Faso. Otherwise usually associated and evidently producing hybrids with A. sengal.

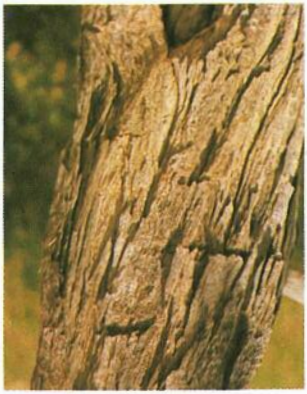
Site requirements: Preferably on recent, stony or rocky sites, on laterite and "glacis", on soils far from ground water and of very different texture; but prefers sandy-loamy substrates which are neutral or slightly alkaline. A. laeta is very resistant to drought and generally prospers with annual rainfalls between 250 and 750 mm.

Propagation: 8,500 - 10,000 seeds per kg (slightly bigger than the seeds of A. senegal). As with all other Acacias they should be soaked in hot water or treated with concentrated sulphuric acid before seeding. Natural regeneration is hardly to be seen in pure stands, but occurs on neighbouring open spaces. Direct seeding is possible. For cultivation in nurseries, see A. senegal.

Uses: Production of gum is said to be inferior to Acacia senegal in quality and quantitiy, which may be due more to the provenance than the species as a whole (in Chad, the gum is known under the commercial name Kittir Azarack.) The gum is edible. Leaves and pods are browsed by livestock. The wood is used for local construction (poles) and as fence posts. It is an excellent fuel and makes good charcoal. Branches used for fencing, the stem-bark for ropes.
References: Aubréville (1950), C.T.F.T. (1978), Geerling (1982), Giffard (1966, 1974 A, 1975), Sahni (1968).

ACACIA MACROSTACHYA





Acacia macrostachya Reichenb. ex Benth.

Family: Mimosaceae

Description: A sarmentose shrub, occasionally a small tree. Very similar to Acacia ataxacantha, discernible by its upright habit, the longer, light green leaves and a smaller number of prickles. Bark light brown and torn when older. Slash red-white, striated. Rachis 12 - 20 cm long, covered with tiny prickles, rusty-pubescent. Prickles claw-shaped and recurved, red-brown, dispersed on the branches. Twigs crinite when young. Big sessile gland at the bottom of the petiole. Leaves bipinnate, alternate, with 20 - 30 pairs of pinnae, up to 5 cm long, each with 35 - 50 pairs of leaflets, light green, 4 - 6 mm long, 1 mm wide. Flower a cream colored spike, 7 - 8 cm long, solitary or in clusters at the axil; peduncles pubescent. Pods very similar to A. pennata, flat, redbrown, reticulate, slightly corrugated, apex apiculate, about 8 - 15 cm long and 1.2 - 2 cm wide, containing 7 - 8 flat, circular brown seeds.

Distribution: Common all over the southern Sahel and the neighbouring Sudan-Savanna; Burkina Faso, Senegal, Nigeria, Chad.

Site requirements: Prospers even on obdurate, skeletal or argillaceous soils, crustaceaous, lateritic detritus, on eroded slopes and sandy soils. Often associated with Combretum micranthum. Occasionally forming thickets.

Uses: The branch wood is used for fencing (occasionally hedges are planted), in larger sizes as fuel. The gum is edible. In some regions, the seeds are boiled and consumed as a vegetable. Leaves and young shoots are most variably used. They serve as forage with limited value, but mainly for medicinal uses to treat gastrointestinal disorders, as an anthelmintic, for toothache, etc. and antidote for snakebites. It is said that large quantities of leaves eaten after a snake bite inhibit the poison's dispersion in the blood. Bark and roots are also medicinally used.

References: Aubréville (1950), Berhaut Vol. IV (1975), Geerling (1982), Hallam (1979), Irvine (1961), Touzeau (1973).

Acacia macrothyrsa Harms

Synonyms: Acacia buchanani Harms, Acacia dalzielii Craib, A.prorsispinnata Stapf

Family: Mimosaceae

Description: A shrub or a tree, up to 15 m high, with grey-brown, scaly bark. Slash dark red or brown. Twigs yellow to brown, pubescent or glabrous. Prickles are either missing or axillary in pairs, straight or slightly curved, short (about 1.8 cm), wrinkled on the top side and brown-grey. The very large leaves are typical, with more than 20 pairs of pinnae and up to 50 pairs of leaflets. The whole leaf reaches a length of 30 - 60 cm and hangs down. Flowers in big (30 - 50 cm) long, upright panicles. The globose heads are yellow or orange and have a diameter of about 1 cm. Pods narrow (up to 2 cm), long (up to 16 cm), and flat. They contain about 8 seeds.

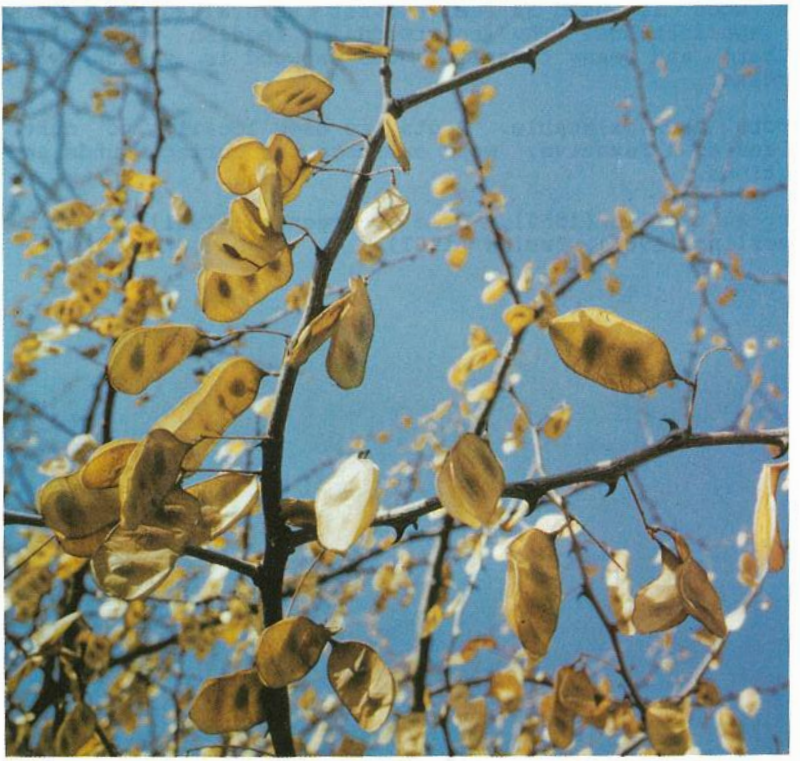
Distribution and site requirements: Acacia macrothyrsa is widespread in tropical Africa but rarely found in the transition zone from the Sahel to the Sudan savanna, because it generally needs more than 1,000 mm of annual rainfall. Grows on plain, gravelly soils and is occasionally associated with Combretum species.

Uses: The wood is used as fuel and for several other, less important applications. The heartwood is reddish with black streaks, hard and easy to split, the sapwood is yellow with orange streaks.

Young shoots are palatable. Roots are used locally to cure diarrhoea and as a laxative, wood extracts for curing wounds and skin infections.

References: Aubréville (1950), Dale a. Greenway (1961), El Amin (1973), Geerling (1982), Irvine (1961).

ACACIA MELLIFERA



Acacia mellifera (Vahl) Benth.

Synonyms: Acacia senegal (L.) Willd. ssp. mellifera (Vahl) Roberty, Mimosa mellifera Vahl

Family: Mimosaceae

Description: A shrub, exceptionally up to 9 m high, with a smooth, grey-brown bark and white lenticels. Can be distinguished from the very similar A. gourmaensis and A. laeta by its leaves: Has only 1 - 2 pairs of pinnae with 1 - 2 pairs of leaflets, obliquely ovate to obovate. Develops flowers and leaves simultaneously at the beginning of the rainy season. Prickles axillary, in pairs, claw shaped and recurved, grey with black tips. Flowers in cream-coloured, hanging spikes. Pods flat, parchment-like, reticulate with blunt top, generally containing 3 seeds.

Distribution: From east of Lake Chad to the Arabian Peninsula.

Site requirements: Prefers loamy soils and often forms impenetrable hammocks, occasionally associated with A. senegal, A. laeta and A. seyal. Grows in and alongside wadis, in East Africa up to 1,500 m above sea level.

Uses: Camels and goats browse the leaves which are very rich in protein, taking them from the shrubs or from the ground. In Sudan, baskets are made of the roots and serve for collecting gum arabic. The bast fibres are used for wickerwork. The wood is taken for building huts, the branches for fencing. The wood is also used as fuel and for charcoal. A. mellifera can be planted for live fences and hedges. In ethno-medicine applied to cure genitourinary diseases.

References: Aubréville (1950), CNUCED/GATT (1978), Dale a. Greenway (1961), El Amin (1973), Geerling (1982), Giffard (1966), Sahni (1968).

ACACIA NILOTICA VAR. ADANSONII

Acacia nilotica var. adansonii (Guill. et Perrott.) O. Ktze.

Synonyms: A. scorpioides (L.) W.F. Wight var. adstringes Bak.; A. arabica Willd., A. adansonii Guill. et Perrott.; A. adstringens (Schum. et Thonn.) Berhaut; Mimosa nilotica L.; Mimosa scorpioides L.; Mimosa arabica Lam.

Acacia nilotica var. tomentosa (Benth.) A.F. Hill

Synonyms: A. scorpioides (L.) W.F. Wight var. pubescens (L.) A. Chev.; A. arabica Willd. var. tomentosa Benth.; Mimosa arabica Lam.; Mimosa nilotica L.; Mimosa scorpioides L.

Note: Acacia nilotica belongs to the African acacias which have been and still are the object of disagreement concerning their taxonomy, especially their classification into subspecies and varieties. At present, 9 subspecies/varieties are recognized.

Family: Mimosaceae

Description: Both varieties can be distinguished from each other by their pods and site requirements. In general, however, they are so similar that they can be treated as one.

Trees with a dense spheric crown, up to 20 m high and dark grey, sometimes almost black bark (especially on var. tomentosa). Older trees develop a thick, fissured bark. The slash is grey-pink, exuding a reddish gum.

The paired, axillary spines are quite thin, light grey, up to 10 cm long and straight. Leaves grey-green with a bluish shimmer, bipinnate, with 3 - 6 pairs of pinnae and 10 to 30 pairs of leaflets. The leaflets are about 4 to 5 mm long and tomentose. Rachis with a gland at the bottom of the last pair of pinnae.

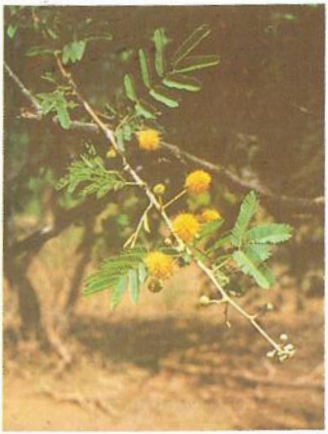
Flowers in luminous gold-yellow globose heads; axillary or whorly, on 2 - 3 cm long peduncles at the end of the branches. The pods of both varieties are indehiscent. Pods of var. adansonii are slightly curved and 10 - 15 cm long, slightly constricted between the seeds, tomentose and light grey when dry.

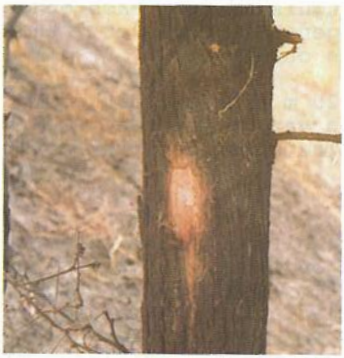
Var. tomentosa has pods which are deeply constricted between the seeds ("pearl string") and are more or less glabrous.

Distribution: In the Sahel and the adjoining Sudan savanna from the Atlantic Coast to East Africa and across the Arabian Peninsula to India.

Site requirements: Var. adansonii prefers deep sandy-loamy soils, e.g. on fossil dunes or abandoned millet fields. Also on loamy, lateritic or calcareous sites. Long foliation during the dry season (until end of February) indicates a high ground water table.

ACACIA NILOTICA VAR. TOMENTOSA





Var. tomentosa prefers clay, alluvial soils and tolerates long, periodical inundations. A tree that prospers on depressions and river beds, on the banks of seasonal ponds.

Both varieties grow with annual rainfalls between (100) 250 and 1000 mm and tolerate temperatures of more than 50° C, but no frost.

Propagation and management: Seed collection and storage is not difficult. Seeds have a long viability but must be protected against insects. Their weight varies considerably, between 4,000 and 7,500 seeds per kg. Pretreatment is necessary as with all other acacias. Sowing in polythene pods in March/April or, preferably, in situ.

Careful weed control in plantations is necessary. Var. adansonii should be protected against inundations and stagnant water during the first years. Seedlings may drown in their planting holes after heavy rainfalls.

A high rate of germination and quick growth make A. nilotica very useful for afforestation and enrichment planting, even under a shelter of Eucalyptus camaldulensis.

Uses: The wood is hard and heavy. Especially the redbrown, sometimes dark striated heartwood is highly esteemed as fuelwood or for charcoaling. It is used for poles, house and boat construction, water piping and all kinds of agricultural or household implements. In the Sudan and in northern Senegal, it is regarded as first-class timber. Dries well, but blunts tools by its high content of silicea. Except for knots easy to work, durable and quite resistant to termites. The heartwood cannot be impregnated.

Roasted seeds serve as spice. In some regions, young pods are eaten as a vegetable. They serve, as well as leaves and shoots, as forage for goats, sheep and camels, occasionally also for cattle. In some parts of India, A. nilotica is said to be the most important forage tree. One tree can produce up to 80 kg of pods per year. It is emphasized that old pods and leaves have a low palatability. But the seeds are a very valuable forage, especially for cattle, said to improve milk production and quality.

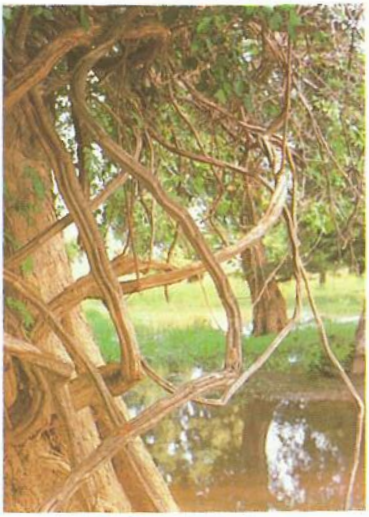
Tannin which is of great importance in the Sahel, has its highest quality when produced from green pods. They contain about 30 % of tannin (not more than about 15 % when mature; the bark has over 20 %). Seeds must be removed from the pods for the manufacture of high-quality leather.

Black, red or yellow dyes are produced from the pods as well as from the gum. Ink is made from the pods. The gum is of a lower quality than that of A. senegal. It is supposed that the first gum arabic for trade was taken from A. nilotica (var. tomentosa?).

Various medicinal uses are recorded, such as: Bark, leaves and gum to treat haermorrhage, colds, diarrhoea, scurvy, dysentery, ophthalmia; roots to cure toothache, as a diuretic; pods, seeds, roots for dysentery, syphilis; various parts to heal different infections, scurvy; as astringent for ophthalmia, for oral and throat infections.

References: Aubréville (1950), Berhaut Vol. IV (1975), Brenan (1983), C.T.F.T. (1978), El Amin (1973), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo/Adam (1974), Palmer/Pitman (1972).

ACACIA PENNATA



Acacia pennata (L.) Willd.

Synonyms: Mimosa pennata L., Acacia erythrocalyx Brenan

Family: Mimosaeae

Description: A sarmentose shrub or vine climbing up to 10 m high into neighbouring trees. Very prickly. Slash reddish. Leaves alternate, bipinnate, rachis 15 - 25 cm long with 10 - 20 pairs of pinnae. These are 4 - 6 cm long and bear 30 - 60 pairs of tiny, asymmetrically-shaped leaflets. A small, crooked prickle beneath the petiole of each (or each second) pair of leaflets. Numerous prickles are dispersed on branches and twigs, outside the leaf axils. They are small, brown and recurved. The twigs are grey, sometimes dark brown to blackish, glabrous or pubescent. Bigger sprouts often square, twisted. Lenticels in lines, grey. Flowers in big, open panicles with white, globose heads, later turning to yellow. Peduncles glabrous. Buds violet to blackish. Pods flat, brown, 10 - 15 cm long and 2 - 3 cm wide, containing 8 - 10 seeds.

Distribution: Widespread from humid to semiarid Africa.

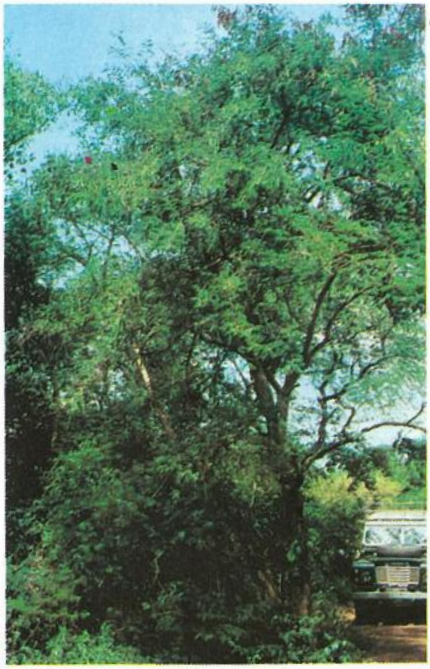
Site requirements: In the Sahel it grows preferably at water-holes or on periodically inundated plains, also on termite mounds; forming thickets on river banks.

Uses: Leaves are browsed by cattle and goats. Flowers for honey-production.

Various medicinal uses. E.g. for rheumatism, dermatitis, chest complaints, stomach disorders, as an antidote for snake bites; dried leaves for dressing wounds. Leaf-juice is given as an enema, for orchitis and to control herpes and blotch. A leaf decoction is applied as a febrifuge. The leaves are also used as a fish poison. Small sticks without bark are used as tooth-brushes/chewingsticks, the crooked prickels as fish-hooks. Long branches are twisted and used as ropes and for wickerwork. The bark contains tannin. Occasionally, walking sticks are cut from straight stems.

References: Aubréville (1950), Berhaut, Vol. IV (1975), Geerling (1982), Irvine (1961).

ACACIA POLYACANTHA



Acacia polyacantha Willd. var. campylacantha (Hochst. ex A. Rich.) Brenan

Synonyms: Acacia caffra Willd. var. campylacantha Aubrév., Acacia campylacantha Hochst. ex A. Rich., Acacia catechu Willd. var. campylacantha (Hochst. ex A. Rich.) Roberty, Acacia catechu Oliv., Acacia suma Benth.

Family: Mimosaceae

Description: A tree, up to 15 m high. Twigs with paired, axillary prickles, curved like claws. The prickles are brown with a black tip, on older wood solitary and on a swollen base. Bark ash-grey to yellowish, with brown scales and black knots in the place of former leaves and thorns. Slash redbrown with white streaks. Leaves up to 25 cm long with 10 - 40 pairs of pinnae bearing 35 - 60 pairs of leaflets each. Leaflets 4 - 5 mm long and 1 mm wide. Petiole broadening to 5 mm at the base, with a large gland before the first pair of pinnae. Rachis pubescent with a small gland at the base of the second or third pair of pinnae, occasionally with small, solitary spines. Flowers in axillary, cream-white racemes, 8 - 12 cm long, in pairs or in triplets, large and tufted. Pods 10 - 15 cm long, up to 20 mm wide, flat, dark brown. Containing 5 - 9 seeds which are visible through the transparent wall.

Distribution: All over tropical Africa; several varieties in different regions.

Site requirements: Prefers sites with a high ground water table. Generally solitary in the Sahel. Indicates eutrophic and fresh soils, but occasionally also prospers on stony slopes and compact soils.

Growth: Copious natural reproduction, good germination, quick juvenile growth.

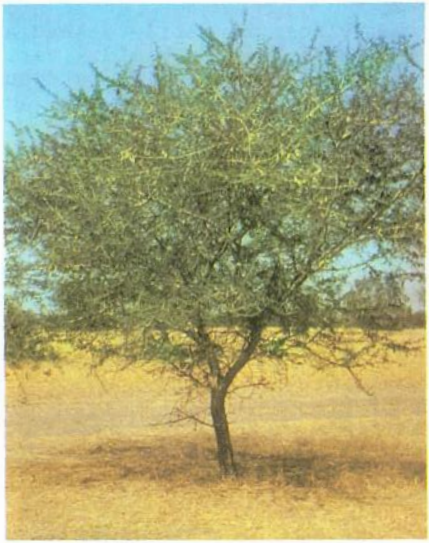
Uses: The wood is hard and durable. Sapwood white, heartwood red with blackish streaks. Difficult to saw or plane but easy to polish. Various applications for agricultural implements, poles, handles, wheels.

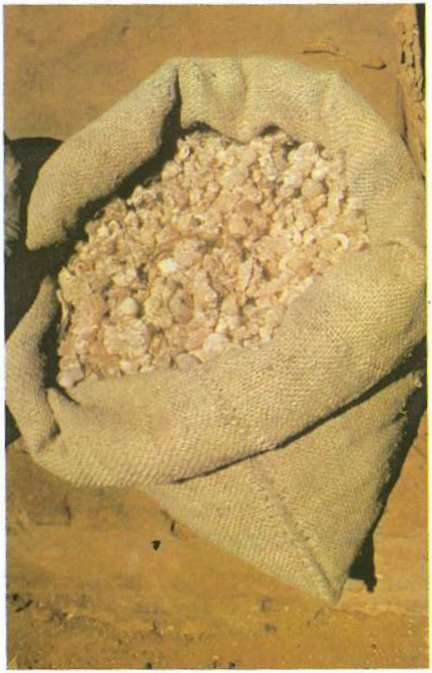
Makes good fuel and charcoal. Gum edible, used as an adhesive and for the treatment of new textile fibres. Bark and pods contain tannin. Heartwood chips are used for tanning and dyeing. The wood ashes give a salt substitute.

The root is used to cure venereal diseases and to prepare an antidote for snakebites. Bark decoction for dysentery and gastro-intestinal disorders. A tonic is made from the roots.

References: Aubréville (1950), Berhaut Vol. IV (1975), Dale/ Greenway (1961), El Amin (1973), Geerling (1982), Irvine (1961), Kerharo/Adam (1974), Sahni (1968), Weber (1977).

ACACIA SENEGAL





Acacia senegal (L.) Willd.

Synonyms: Acacia verek Guill. et Perrott., A. rupestris Stokes, A. trispinosa Stokes, Mimosa senegal L.

Family: Mimosaceae

Description: Tree (or shrub) of 2 - 6 m, occasionally up to 8 m in height, with umbrella-shaped crown. Very branchy with many upright twigs, wider spreading in the upright part. Bark light grey to light brown, smooth on young, very scaly on older trees. Slash mottled red and white. Prickles in triplets, black, curved like claws. Leaves small, grey-green, bipinnate, 3 - 6 pairs of pinnae with 10 - 20 pairs of leaflets each. Leaflets 3 - 6 mm long and 1 - 2 mm wide, ovate. Flowers pedunculate white spikes, clustered in pairs or triplets at leaf axils, 3 - 8 cm long, very fragant. Pods 7 - 10 cm long, 2 cm wide, flat and thin, mostly pointed at both ends, containing 3 - 6 flat, round light brown seeds. Both a tap root and lateral roots will be developed, depending on site conditions.

Distribution: Typical tree of the Sahel from Senegal to the Red Sea, varieties occurring in East and South Africa. Essentially limited to the area between 11° and 16° northern latitude.

Site requirements: Acacia senegal is very drought resistant and grows with annual rainfalls between 100 and 800 mm, mainly between 300 - 400 mm, with a dry period of 8 - 11 months. Tolerates very high daily temperatures, dry winds and sandstorms but no frost. Prefers sandy soils, e.g. "sols bruns rouges sub-arides, sols ferrugineux tropicaux". Fossil dunes are very suitable, but Acacia senegal grows also on slightly loamy sands, "sols bruns argileux", on sandstone, "grès argileux" and even on skeletal soils (lithosols). Although generally soils should be well-drained there are exceptions, e.g. (region of Kayes, South-Kordofan, East Sudan) where A. senegal grows also on heavy clay soils with approximately 800 mm of annual precipitation. The best sites have pH 5 - 8. Altitudes (in the Sudan) vary from 100 - 1700 m above sea level.

Propagation and management: Seed maturity differing regionally between end of November and February. Up to 18,000 seeds per kg; viability with careful storage until the end of the dry season. Pretreatment necessary as with all acacias. So far predominantly cultivated in polythene pots in the nurseries. Direct seeding has prompted good results and considerable savings. During the first two years weed competition must be efficiently controlled, and the plantation must be protected from fire and livestock. With wide spacing (10 x 10 m) agricultural intercropping is possible, e.g., millet, beans or groundnuts. Not only Acacia senegal, but also the agricultural crops profit from soil preparation (subsoiling). As of the fourth or fifth year, controlled grazing, preferably by sheep, can be permitted. The rotation period should be 20 years, warranting an optimum production of gum arabic. Subsequently agricultural use over 5 years, e.g. with small

farmers or cooperative enterprises is beneficial to the soil. Natural regeneration is rarely observed in old stands but occurs on open ground. Young plants are occasionally damaged by insects and rats, seeds often attacked by insects; livestock and fire frequently destroy seedlings and young plants.

Uses: Acacia senegal produces nearly 90 % of the commercial gum arabic. The quality of the gum is superior to that of any other acacias. It has also advantages over all other natural hydrocolloids due to its high solubility in water. Solutions with as much as 50 % gum content can be obtained. It is an important export product. Quantities produced depend largely on climatic factors. While the average export of the years 1965/75 was nearly 60,000 t/year it dropped during the drought years, e.g. 1975 = 21,000 t and 1978 - 1981 to about 40,000 t. Nearly 90 % of all exports come from the Republic of Sudan (esp. Kordofan).

Yields vary considerably from tree to tree and from year to year, starting with about 50 g and ranging from 100 g to 1,000 g during the productive period. With dense stocking (in Kordofan 500 - 2000 trees/ha), an average of 250 g per tree is obtained, in the Western part of the Sahel this will drop to about 100 g. Harvesting is partly performed sporadically and on an irregular basis by nomadic herdsmen but partly also in intensively managed plantations ("gum gardens") where trees are regularly "tapped". Tapping is normally done once a year, starting in October, at the end of the wet season. Too intensive tapping of young trees may kill the tree. Gum collection may follow about 4 weeks later and can be continued every two or three weeks for up to 8 times, depending on soil type and the genetic quality of the trees. Leafless trees are said to give better yields. Stimulation by small fires at the tree's base is occasionally practised, but is dangerous (may expand to uncontrolled bushfires) and detrimental to the tree itself, and should be prohibited by all means. Yields can be increased by using improved tools for tapping, by using trained and experienced people, and possibly by using chemical stimulants. In general, harvesting can start in the fifth year after planting and may be continued for 15 years with good yields. Gum arabic has been used for at least 4,000 years and its applications today are manifold. The local population uses an important part of the annual production for the preparation of meals, in human and veterinary medicine but also as a cosmetic or in crafts.

Bark, leaves and gum of Acacia senegal are used to treat gastritic disorders, haemorrhage, ophthalmia, colds, diarrhoea, as an emollient, astringent, and especially the gum, as an aphrodisiac. Further uses of Acacia senegal include nectar for bees and forage for livestock, in particular the pods, but also leaves and young shoots. The fodder value is very good:
Crude protein 22 % DM (13 - 29)
Net energy 5.8 (4.8 - 7.6) MJ kg DM
Digestible protein/FU 206 (87 - 305)
P 0.20 (0.10 - 0.30) (le HOUEROU 1980A, p. 90)

The wood is in demand as fuelwood and for charcoal production although the yields per unit area are not sufficient to plant Acacia senegal for fuelwood production only. Ropes are manufactured from root bark fibres.

An important factor is soil stabilization through the widely extended lateral root system and - possibly - soil improvement through nitrogen fixation as well as mineral enrichment from leaf litter. The opportunity for using Acacia senegal in agroforestry systems must be pointed out and has proved to be very efficient in the Republic of Sudan and in northern Senegal.

Before starting new large-scale afforestation projects with Acacia senegal, comprehensive pre-investment and feasibility studies will have to be made. Factors which require special attention are:

- physical factors such as climate, soils, water balance, topography;

- biological factors such as diseases and pests, especially insect and rodent (rats!) attacks, browsing by livestock and game;

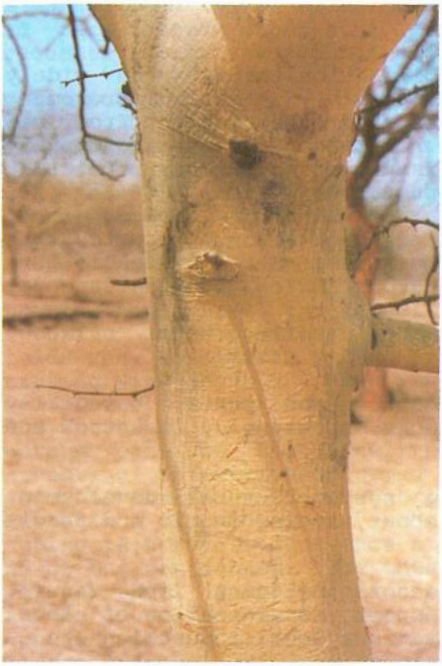
- human land use, e.g. land use systems, rural development programmes, migration, income, labour, socioeconomic and traditional constraints;

- infrastructural and political factors including land tenure, rural development policies, transport, organization of local trade and export, pricing and taxation, local industries etc.

- marketing, i.e. the whole range of structures (traditional and modern) required to collect, store, transport, grade, sell (export) gum arabic; market forecasts. These are very important with regard to the demand trends, competition of other producers and, finally to potential substitutes.

References: Adamson, Bell (1974), Anderson (1985), Aubréville (1950), Berhaut Vol. IV (1975), Bille (1971), Brenan (1983), CNUCED/GATT (1972, 1978), Dering, Wilke a. Zech (1978), Depierre (1969), El Amin (1973), Ferlin (1981), Geerling (1982), Ghosh/Purkayaetha (1962), Giffard (1966, 1973, 1974 A, 1975), Grosmaiere (1957), Irvine (1961), Kane (1971), Körl (1943), National Academy of Sciences (1979), Obeid/Seif el Din (1970, 1971), Philip (1975), Poupon (1976), Rehm/Espig (1984), Sahni (1968), Tandia (1977), Vassal (1969), Weber (1977).

ACACIA SEYAL



Acacia seyal Del.

Synonyms: Acacia stenocarpa Hochst. ex A. Rich., Acacia hockii De Wild.

Family: Mimosaceae

Description: Numerous varieties of this species have been described by several authors in different regions. The small to medium-sized tree, reaching a height of 17 m and a stem diameter of 60 cm under favourable conditions, develops a characteristic, umbrella-shaped crown. The bright green bark is covered with either a pale grey-green or rust-red, powdery coat. Rust-red and green stems often stand close together. Older trees develop typical dark-grey ross, coiled up at the margin.

The slash is bright red, mottled, and exudes (as do cracks and other lesions) a yellowish gum. Twigs with many small, reddish glands and paired thorns at leaf axils. Thorns up to 7 cm long, narrow, straight, pointed and light grey. The dark green leaves have 4 - 12 pairs of pinnae and 10 - 22 pairs of leaflets. Rachis up to 8 cm long. Flowers in shining yellow globose heads, 1.5 cm in diameter, on peduncles about 3 cm long; two or three together at the leaf axils. Pods slightly curved, indehiscent, light brown in maturation, 10 - 15 cm long and 1 cm wide at the bottom, containing 6 - 10 seeds each.

Distribution: A typical tree of the African semiarid zones, from Senegal across the entire Sahel to the Sudan and Egypt. East Africa from Somalia to Mozambique and westwards to Namibia with different varieties, e.g., var. fistula in East Africa.

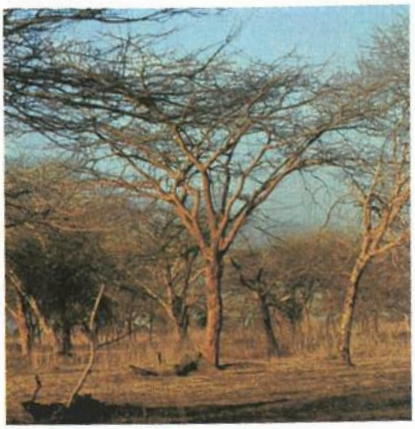
Site requirements: Requires annual rainfalls of 250 - 1000 mm. Flourishes on heavy clay soils, tolerates periodical inundations or desiccation with cracking of the upper soil layers. Also on stony soils in plains, but generally not on slopes and hill tops. Often at the base of hills or especially near river beds ("marigots") at lowland sites, on humose soils in valleys, beside waterholes and on low ground.

Propagation and management: Up to the present, mostly natural reproduction, which is impeded by browsing cattle. Further losses through bush fires, inundations and through grass and weed competition, such as from Cassia obtusifolia. Only few attempts at cultivation. Seed obtained without difficulties. Approximately 20,000 to 22,000 seeds/kg. Pretreatment of the seeds, as with other acacias.

On favourable sites fast juvenile growth (more than 1 m per year), maximum height reached after 8 - 10 years. Stem form may be decisively improved by selection. Coppices abundantly.

Uses: Leaves, young shoots and pods are a valuable forage. In times of shortages, herdsmen cut down branches or even entire crowns. Trees with topped crowns are a common sight in the Sahel.

ACACIA SEYAL



Lopping is common practice (pruning of small branches provides the best forage), and damage to the trees can be kept low if restricted to the end of the dry season.

Le HOUEROU (1980A, p.90) records an excellent fodder value of both the pods and the leaves:
Crude protein 18.5 % DM (11 - 29)
Net energy 6.5 (3.9 - 7.6) MJ kg DM
Digestible protein/FU 153(67 - 237)
PO 27 (0.14 - 0.34)
Acacia seyal should be promoted in the future to improve silvo-pastoral systems in the Sahel. 5.5 kg of bark per day should be enough for a cow to produce 4 - 5 l milk. The bark is also an important forage for game.

Besides forage, Acacia seyal produces a gum which, though of inferior quality compared to A. senegal, is traded in the Sudan under the name "Talh" and makes up 10 % of the annually exported gum arabic (i.e. 3000 - 6000 t). The gum is also mixed with the pulp of Balanites aegyptiaca fruit to produce a syrup. Use as fuelwood differs from region to region. In Chad it is considered the best fuelwood, in parts of Burkina Faso it is less sought after because it burns too quickly, but is generally said to make good charcoal. For construction, poles of a medium size with forks at a height of 2 - 3 m are especially in demand. Insects attack the wood but durability may be improved by water-storage. Branches are used for fencing.

The pods and bark contain tannin (about 20 %). The smoke of Seyal-wood is said to be particularly insect repellent.

Bark, leaves and gum are used in local medicine for the treatment of haemorrhage, colds, diarrhoea, gastrointestinal disorders, jaundice, biliary diseases, syphilis, headaches, as an emollient, astringent, and for burns and ophthalmia.

References: Aubréville (1950), Berhaut Vol. IV (1975), CNUCED/GATT (1978), C.T.F.T. (1978), El Amin (1973), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo a. Adam (1974), Toutain (1980), Touzeau (1973), Wickens (1980 B).

ACACIA SIEBERIANA

Acacia sieberiana DC.

Synonyms: Acacia verugera Schweinf., Acacia singuinea Guill. et Perrott., Acacia nefasia Schweinf., Prosopis dubia Guill. et Perrott.

Family: Mimosaceae

Description: One of the biggest umbrella-shaped acacias of Africa, reaching up to 25 m height and a diameter of 60 cm. The bark is strongly fissured, yellow to cream-coloured on young trees and twigs, scaly on old trees. Slash red. Thorns axillary and in pairs, straight, white, up to 6(12) cm long, on old twigs also short or absent.

Leaves bipinnate, rachis 6 - 12 cm long, 10 - 25 pairs of pinnae with 15 - 50 pairs of leaflets on each. Flowers cream-colored or light-yellow globose heads (diameter 1.5 cm) on peduncles, groups of 3 - 6 at the axils. Flowers and foliation at the end of the dry season. Pods thick, woody, glabrous, brown or reddish brown in maturity, shining like varnish, straight or slightly curved. Variable in length and width (2 x 15 to 20 cm). The big seeds are embedded in a yellow-greenish pulp.

Distribution: In the entire Sahel and other semiarid regions in Africa with varying botanical characteristics. Various varieties and local races exist.

Site requirements: Prefers heavy soils but grows as well on sandy sites. Especially suited for river banks, low ground etc. Replaces A. nilotica to the south of its natural range. Rainfalls between 400 and 800 mm are necessary.

Propagation and management: Ca. 4,500 seeds per kg. Pretreatment as with other acacias. Boiling of the seeds has resulted in 60 % germination. Not yet cultivated except in a few test situations.

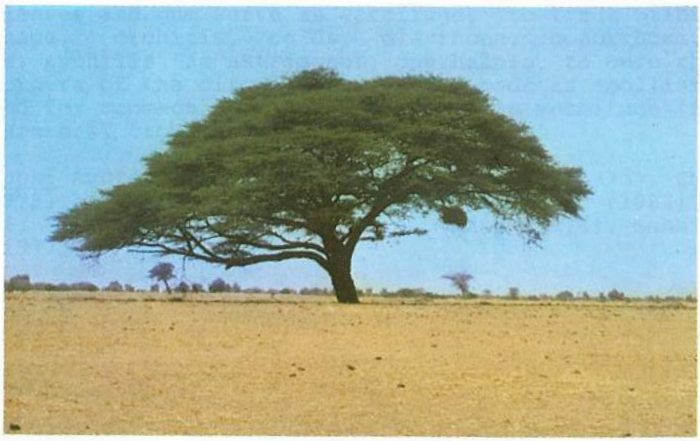
Uses: The wood is moderately hard and appears to be resistant to termites, but is destroyed by other insects. It is easy to work and used for tool-handles and mortars. May be used for fuel and charcoal. The branches are used for fencing. Occasionally A. sieberiana has been planted as hedges or windbreaks, and as a shade tree in villages.

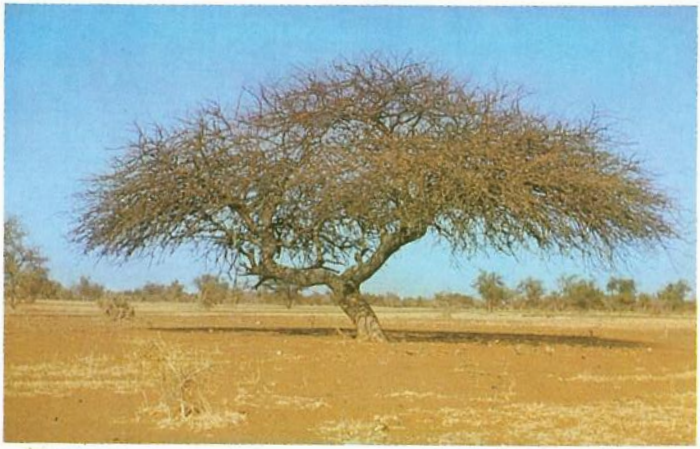
The pods, abundantly produced at the beginning of the dry season, serve as forage for livestock (esp. sheep) and wild animals (esp. elephants). They are, like the young shoots and leaves at the end of the dry season, rich in nutrients. In the Sudan, the pods are collected for fattening sheep. The flowers are good for bee-farming and hives are often placed in the trees. The tree yields a gum of good quality which was locally used to make ink. Bark and pods contain tannin, the bark serves to make a cordage-fibre.

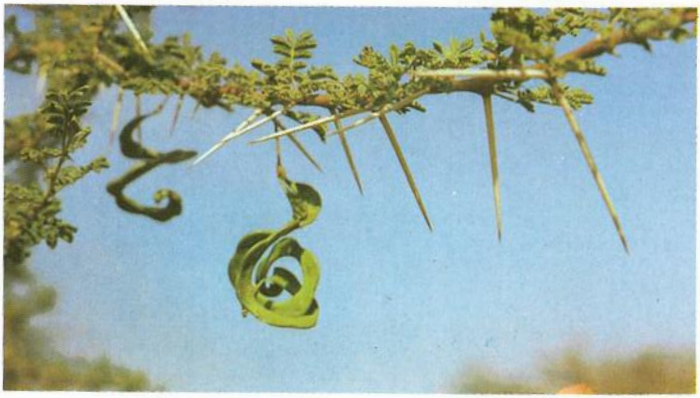
Various applications in local medicine, generally in combination with other woody plants:
bark, leaves and gum serve as vermifuge, to treat bilharziosis, haemorrhage, orchitis, colds, diarrhoea, gonorrhoea, kidney troubles, syphilis, as astringent, ophthalmia, to cure rheumatism and disorders of the circulatory system; pods as emollient; roots are used for stomach complaints, acne, as vermifuge (for tapeworm), urethral troubles, oedemata, dropsy.

References: Aubréville (1950), Berhaut Vol. IV (1975), CNUCED/-GATT (1978), Dale a. Greenway (1961), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo a. Adam (1974), Sahni (1968), Weber (1977).

ACACIA TORTILIS







Acacia tortilis (Forsk.) Hayne ssp. raddiana (Savi) Brenan

Synonyms: Acacia tortilis Hayne, Acacia fasciculata Guill. et Perrott., Acacia raddiana Savi, Acacia tortilis Hayne var. pubescens A. Chev.

Several subspecies are distinguished by different authors. Brenan (1983) states: "A. tortilis is a widespread and variable species within which few subspecies are recognized. Their geographical ranges are generally distinctive, though there is some overlap in ssp. tortilis and ssp. raddiana. The latter is sometimes treated as a distinct species but is generally regarded as a subspecies. The subspecies are separated by the presence or absence of pubescence on the pods, their width and differences in the crown are distinctive in ssp. raddiana."

Family: Mimosaceae

Description: Tree of medium height (8 - 10 m), occasionally up to 20 m, with hemispherical or umbrella-shaped crown and hanging branches. Occasionally bush growth. Stem and branches dark brown, in the juvenile phase red-brown with light grey lenticels. Thorns axillary, paired, straight, 2 - 10 cm long, white. In addition also short prickles outside of leaf axils, paired, recurved. Having thorns and prickles is a typical feature of this species.

Leaves bipinnate with 2 - 5 pairs of pinnae and 6 - 15 pairs of leaflets each, dark green. Flowers white to pale yellowish in globose heads, about 1 cm in diameter, on peduncles up to 3 cm long, axillary, very fragrant.

Pods of typical spiral growth, 10 - 15 cm long and 5 mm wide, green in the juvenile stage, light brown when mature, containing up to 10 oval, brown seeds with a dark oval depression on both lateral surfaces.

Distribution: Tree of the arid and semiarid regions south and north of the Sahara; from Senegal to East Africa and to southern Arabia. Subspecies and varieties in the Near and Middle East and in South Africa. Most famous representative of the species, even mentioned in former world maps, has been the "tree of Teneré" in the Republic of Niger.

Site requirements: Forms open, pure stands on glacis, on blown-out eroded sites, skeletal soils, lateritic gravel, etc. Frequently on "sol ferrugineux tropical plat", prospers well on deep alkaline soils, on sandy loam, occasionally also on fossil dunes. Intolerant of inundations, will not colonize recent dunes. Often found at the rim of temporary or permanent waterholes and around wells. A particularly drought-resistant species, growing with annual precipation of 50 - 1,000 mm, under extended drought and very high daily temperatures; resists night temperatures of 0° C. Very often A. tortilis indicates the tree limit towards the desert.

ACACIA TORTILIS

Propagation and management: A. tortilis is a pioneer species. It regenerates well by seed and coppicing. 15,000 - 20,000 seeds per kg are the average. Seeds should be pretreated before sowing to increase the rate of germination. Under normal conditions the seeds can be stored for a long time but must be protected against insects. Juvenile growth depends on the site, but is frequently slow due to marginal site conditions. On good sites and with careful selection of seeds, growth can be considerably improved. On shallow soils wide spacing must be observed because of root competition (at least 10 x 10 m). The far-reaching roots may also endanger adjoining agricultural or tree plantations. Suppression of weed competition is essential; unprotected plants are strongly browsed by livestock. Plantations as well as natural regeneration demand at least 3 (preferably 5) years of protection.

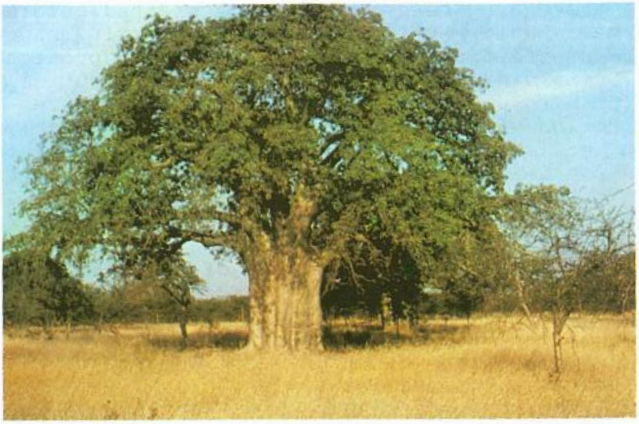
Uses: A. tortilis produces excellent fuelwood and charcoal with a high caloric value. Poles and posts are used for construction and fences, although large diameters and long pieces are scarce. Thorny twigs are preferred for fences; inner bark fibres serve for cordage. The bark contains tannin. The leaves, remaining on the tree for a remarkably long time, the young shoots and especially the pods, when shed or shaken down, are a valuable forage for all domestic and many wild animals. Leaves and pods have a high nutritive value:
Crude protein 16 % DM (13 - 19)
Net energy 6.1 (3.6 - 7.6) MJ kg DM
Digestible protein/FU 132 (69 - 173)
P 0.20 (0.12 - 0.26)
(le HOUEROU 1980 A, p. 90)

In India A. tortilis has been planted on large areas for the stabilization of dunes. Of 228 species tested over 15 years in the semiarid regions of Rajasthan, A. tortilis was found to be the most suitable species for supplying fuelwood, timber and fodder. On a 10-year rotation individual trees produced 80 - 100 kg fuelwood per year. Acacia tortilis is sometimes preserved or planted for amenity.

Medicinal uses include extracts from leaves and bark as vermifuge and against dermatological disorders and skin infections. Leaves are used together with cow peas (Vigna unguiculata) for oedema and allergic dermatosis.

References: Aubréville (1950), C.T.F.T. (1978), Berhaut Vol. IV (1975), Brenan (1983), Geerling (1982), Giffard (1974 A), Goor a. Barney (1976), Kaul (1970), Mariaux (1975), National Academy of Science (1979), Sahni (1968).

ADANSONIA DIGITATA



Adansonia digitata

Synonyms: Adansonia baobab Gaertn., Adansonia situla (Lour.) Spring., Adansonia sphaerocarpa A. Chev., Adansonia sulcata A. Chev., Adansonia somalensis Chiov.

Family: Bombacaceae

Description: Adansonia digitata, the baobab, is a well-known tree almost everywhere in tropical Africa. It has a mighty trunk which can reach a diameter of 2 - 6 (10) m, with a girth of more than 20 m. Its crown, and especially the branches, resemble large roots when the tree has shed its leaves during the dry season. This may be the reason why the baobab is called Africa's "Upside-down-tree", believed to receive its strength from heaven. A number of other names or metaphors are used, such as "vegetative elephant", "prehistoric plant monument", "abode of the gods". Many people in Africa express deep religious veneration for this outstanding tree.

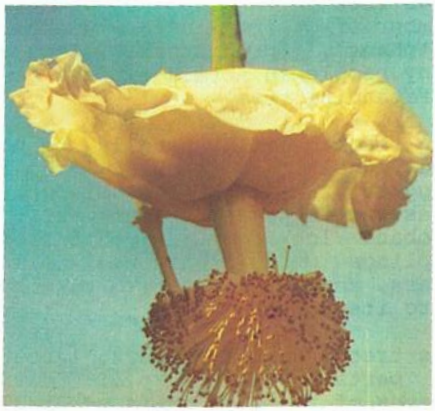
The baobab will usually be no more than 20 m tall. Some individual trees reaching 20 to 30 m have been found. One of the biggest trees in the Préfecture of Kédougou in Senegal was measured to have a diameter of 6.7 m and a girth of 21 m. Young baobabs look completely different and are not easily recognized. Saplings often retain their simple seedling leaf form for many years, and even the stem resembles "a bottle, with twigs fixed into its cork".

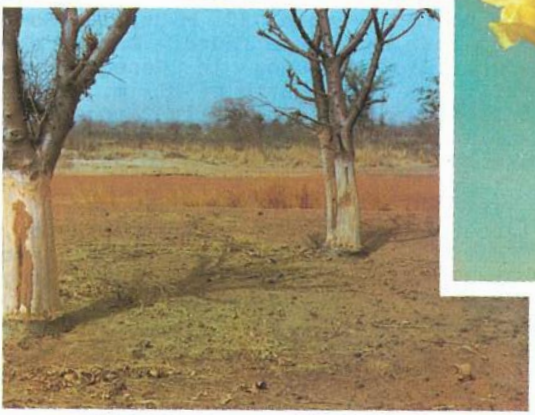
The tree's bark is smooth, about 2.5 cm thick, silvery-grey or, in parts, nearly purple. Leaves of young trees and the first leaves of the season are generally simple; mature trees have long petioled, palmate leaves with 3 to 7 (9) lanceolate leaflets, brilliant above and pubescent beneath when young. The petiole is up to 15 cm long and densely pubescent when young. Single leaflets may measure 5 x 15 cm or more.

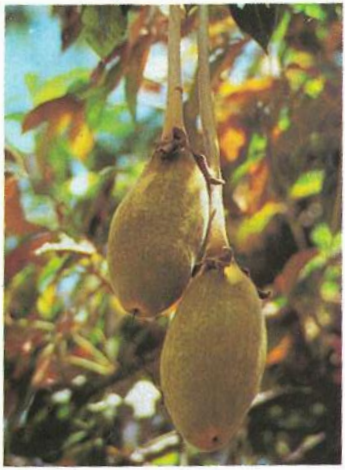
Before the rainy season begins solitary, pendulous, creamy-white flowers, 15 - 20 cm wide, develop on a long peduncle which may stretch to 1 m when carrying fruit. Flowers bloom for about 24 hours and turn brown when old or plucked. Pollination is done by bats (Eidolon helvum) and other small mammals, possibly also by wind. Fruits differ in shape among the varieties from oblong and slender to globose or ovoid, measuring 12 - 40 cm in length, 7 - 17 cm in diameter. A velvety brownish-green tomentum covers their husk. The shell of the husk is approximately 0.5 - 1 cm thick, filled with a white to roseate pulp, divided longitudinally by fibrous septa into about 10 chambers, containing a great number of kidney-shaped, black-brownish, redbrown incrusted, hard seeds with the size of small beans.

Distribution: Semiarid to subhumid tropical Africa south of the Sahara. Does not grow in moist tropical forests. Introduced to many parts of the tropics. Several varieties of the genus Adansonia exist on Madagascar and in Australia.

ADANSONIA DIGITATA







Site requirements: Grows with (100) 250 to 1000 (1500) mm of annual rainfall on many different soils but obviously develops best on calcareous substrates and on deep, sufficiently moist soils. Does not tolerate seasonally inundated depressions with heavy clay soils. Frequently associated with villages or as a witness of former settlements, having been planted and protected by people who settled close to these useful trees. In some regions, such as in Senegal (Thiès, Kédougou), it forms almost "closed" stands. May be found up to 1,500 m above sea level in East Africa.

Propagation and management: As most of the species in semiarid and subhumid regions, the baobab is a light-demanding tree. As a trunk-succulent, its high resistence to drought and fire is characteristic. Seeds: 2,000 - 3,000 per kg; under normal conditions viable for several years. Should be treated before seeding. Best results are obtained by immersing the seeds in boiling water, removing them immediately and cooling them down to outdoor temperatures. Acid treatment could by tried, whereas scarification apparently fails to increase germination rates. In nature, the passing through the digestive tract of large mammals such as elephants breaks seed dormancy. Seeds to be put into polythene bags in February/March. The germination period is apparently extremely variable, between 3 weeks and half a year. To be planted as isolated trees only, such as in or near settlements.

Statements on growth vary considerably. It is noted that young trees are rarely found. One reason for this is the intensive browsing of young plants by livestock and the excessive use of leaves for food by people. On favourable sites fast growth in height and diameter may occur: 2 m of height in 2 years and 12 m in 15 years have been measured.

The maximum attainable age is presumed to be between 1,000 and 3,000 years. Age determination is difficult on standing trees although the baobab forms growth rings. Moreover, fluctuation of the girth (the diameter can rapidly swell or shrink by about +-2 cm) has been recorded due to variation of water content in the succulent trunk.

No serious pests or diseases of the baobab are known. Young trees are damaged by browsing or fire, bigger ones receive damage to the branches from elephants. Old trees are sometimes destroyed by lightning or storms. Several insects are known to attack the wood, fruit and young shoots; fungi and virus diseases are recorded from time to time. The baobab, on the other hand,is often a host to many noxious crop insects.

Uses: The baobab is not only the biggest but also one of the most useful trees of the Sahel. This is generally recognized and traditionally expressed through voluntary protection and veneration. Some people call the tree "mother of the Sahel".

More than thirty different uses are known, of which only a few

can be mentioned here:
Young leaves give a tasty spinach, young dried leaves, sometimes pulverized, are used as a thickening ingredient in many dishes, especially sauces. It has been estimated that several thousands of tons of fresh and dried leaves are consumed annually in the Sahel. BAUMER mentions "baobab orchards around villages" in Niger and Nigeria, but the trees in many other places are also regularly harvested for leaf-vegetable. The following results have been obtained from chemical leaf analyses: 100 g fresh leaves contain 23 g dry matter, 3.8 g crude protein, 2.8 crude fibres, 400 mg calcium and '50 mg of ascorbic acid. They produce 69 cal. Apparently, the crude fibre content and the taste of the leaves differs between individual trees. Flowers are eaten raw. Flour produced from the seeds contains up to 48 % protein and 2 % vitamin B 1. It has been used as baby food. Partly fermented, it tastes like almond. Seeds contain 15 % oil and are eaten fresh or roasted. They are occasionally ground to flavour soups or used as a substitute for groundnuts. Pressed or dried and powdered, the fruit pulp provides a refreshing drink when dissolved in water or milk. It is rich in vitamin B 1 and C (up to 375 mg per 100 kg). The pulp is used by herdsmen to curdle milk.

Young sprouts and the roots of young plants are consumed like asparagus but considered to be more a famine food.

The leaves are a favourite forage which may be of great importance especially at the beginning of the rainy season, when herbaceous forage is not yet available. Herdsmen climb the trees for lopping. At the beginning of the dry season animals feed on fallen leaves, which have a high forage value (1 FU or 110 g digestible protein per kg of dry matter (Toutain 1980). Small ruminants also eat the fruit pulp.

The bark from the lower part of the stem of younger trees and of the roots can be removed to produce a valuable fibre for cordage, fishing-nets, baskets, mats and cloth. These fibres are extremely resistant. The trees are not seriously damaged, and even after repeated use the bark regenerates and can be stripped again some years later.

The spongy and very soft wood has limited uses. It is not easy to work, especially to cut. Having a high water content, in cases of extreme water scarcity it is chewed by man and animals. In some places it is used for light canoes, trays and floats for fishing-nets. Fruit husks may be used for fuel, dishes, vessels, etc., and when powdered, as a tobacco substitute. Old trees very often have natural or artificial caves, in which up to 10,000 l water may be stored for months or even years (Sudan) without getting foul if properly covered. Hollow trunks may also serve as grain-stores, shelter, stables or even as tombs. If the tree has broken down by age or lightning, the decaying wood is spread on the fields as compost.

From the roots a red dye can be produced. The ashes are used as fertilizer or in soap-making. The bark yields tannin. Smoke from

burning fruit pulp is an insect repellent. A shade tree and an outstanding landmark, the baobab often serves as a preferred place for markets, meetings or other social events.

It is remarkable that nearly every part of the plant has one or several uses in local medicine (compare esp. Kerharo and Adam 1979). These can be summarized as follows:

bark
- fevers
- infections
- antiperiodic
- wound disinfection
- toothache (mouthwash)
- arrow poison antidote
- diaphoretic

fruit
- malaria
- febrifuge
- smallpox
- measles
- dysentery
- wound disinfection
- eye lotion
- general fatigue of children

seeds
- antidote for strophanthin (cardiotonic)
- dental disorders

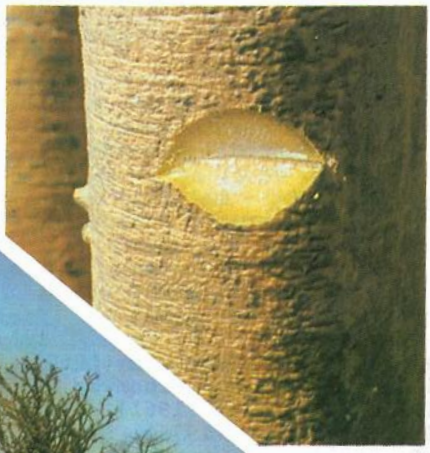
various parts
- malaria
- hepatic infections
- sores
- amenorrhoea
- astringent
- expectorant

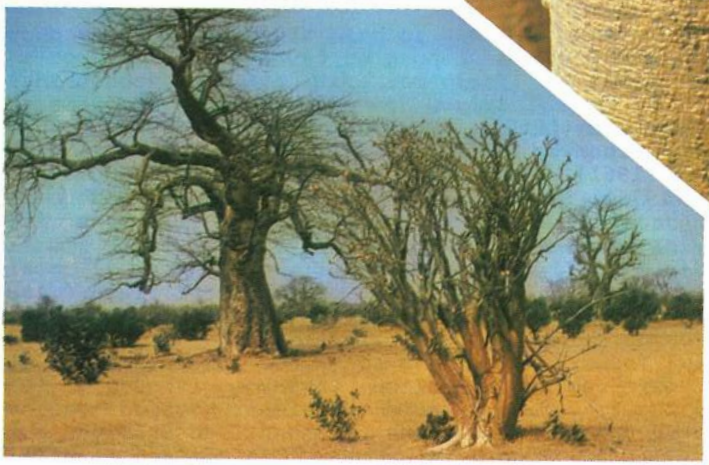
leaves
- Guinea worm sores
- insect bites
- prophylactic against fever
- asthma
- coughs
- diuretic
- kidney and bladder diseases
- dysentery
- diarrhoea
- gastroenteritis
- ulcers
- inflammation
- colics
- fatigue
- poultices
- diaphoretic

roots
- malaria
- smooth skin for babies

References: Aubréville (1950), Baumer (1983), Berhaut Vol. II (1974), Dale a. Greenway (1961), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo a. Adam (1974), Palmer/Pitman (1972), Touzeau (1973), Sahni (1968), Weber (1977), Wickens (1980 A,B, 1982).

ADENIUM OBESUM





Adenium obesum (Forsk) Roem. et Schult.

Synonyms: Adenium arabicum Balf.f., Adenium coetaneum Stapf, Adenium hongehl A.DC., Nerium obesum Forsk.

Family: Apocynaceae

Description: Succulent plant of 1 - 4 m in height with stumpy short stem ("elephant foot") and light brown smooth bark, similar to a "dwarf baobab". When cut, immediate, strong exudation of a transparent or white latex. Strong upright branches, stem diameter at the base up to 1 m. In the rainy season leaves form terminal upright rosettes, sessile or subsessile, obovate to lanceolate, leathery and glabrous. The top side is distinctively darker or bluish green. General appearance and especially the leaves very variable.

Flowering during the leafless stage at the end of the dry season; flowers are large, strikingly pink red, in fascicles of 3 - 5. Fruits paired, grey or pale brown, long and narrow (15 - 25 cm by 1 - 2 cm), with small seeds, bearing a whitish tuft of hair at each end.

Distribution: In the northern Sahel from Senegal to the Sudan, towards the south into the Sudan zone, northeast and central Africa, Arabia.

Site requirements: On very dry, partly heavy and endurated soils, frequently between dunes. Occasionally associated with Boscia senegalensis or Acacia seyal. Grows from sea level to 2,100 m altitude on high sites on gravel and between rocks. Sometimes develops a fleshy taproot.

Uses: Occasionally planted for its decorative value, for hedges and live fences. Caution must be observed since the latex is very poisonous (heart poison adenin, similar to digitalin), harmful also to the eyes and causing very severe diarrhoea, which may be lethal. Used as a component of arrow poisons as well as for poisoning jakals and hyaenas with baits. Pounded roots are used as fish-poison.

Numerous medicinal uses of the latex and roots, e.g. against boils, caries, venereal diseases, etc.

References: Aubréville (1950), Berhaut Vol. I (1971), Dale/Greenway (1961), Irvine (1961), Kerharo/Adam (1974), Plaizier (1980), Seignobos (1980).

ALBIZIA LEBBECK

Albizia chevalieri Harms

Family: Mimosaceae

Description: Shrub or tree up to 6 m (rarely up to 12 m), with umbrella-shaped crown and corky, grey bark; slash dark redbrown. Branches pubescent with white lenticels. Leaves with 8 - 12 pairs of pinnae, each with 20 - 40 pairs of leaflets. The leaflets are approximately 1 cm long, 2 - 3 mm wide, occasionally slightly curved, both sides greyish pubescent, apiculate. Rachis also pubescent with a large gland at the petiole. Flowers in the form of globose heads on approximately 5 cm long axillary petioles. Pods 10 - 15 cm long, 2 - 2.5 cm wide, flat, containing 7 - 10 seeds each.

Distribution and site requirements: Grows in the southern Sahel and the adjacent Sudan zone from Senegal to southwestern Chad, from Mali to northern parts of Benin and Nigeria. Not frequent, generally solitary, on alluvial terraces, on sufficiently moist sites, sandy soils.

Uses: Leaves and fruit make good fodder. The pale yellow wood of medium weight is used as fuel and occasionally for construction. The bark contains tannin, young shoots are edible. Fine roots serve as threads for reparing calabashes.

References: Aubréville (1950), Berhaut Vol. IV (1975), Irvine (1961), Weber (1977).

Albizia lebbeck (L) Benth.

Synonyms: Acacia lebbeck (L.) Willd., Mimosa lebbeck L.

Family: Mimosaceae

Description: Only a small tree in the Sahel, but under higher precipitation up to 30 m high, up to 2 m in diameter, mostly with a deep-seated crown and a short bole. Bark grey to violet-grey with big, striking, red to rust-brown lenticels. During the dry season mostly densely covered by the typical light brown, sand-colored flat pods by which it can be identified from far-off. Leaves bipinnate with 2 - 4 pairs of pinnae attached to the 10 - 20 cm long rachis, each with 4 - 10 pairs of leaflets, blunt at both ends, oblong-obovate, 3 cm long; petiole 3 - 5 cm, with large gland at the base, small glands at the lower side of the rachis. Flowers greenish-yellow to white, fragant, globose heads. Pods up to 30 cm long remaining on the tree for fairly long time, typically rattling in the wind ("woman's tongue"); containing 6 - 10 seeds.

Distribution: Originating presumably in India, frequent in tropical Asia and northern Australia, today cultivated all over the tropics.

Site requirements: Seems suitable for the southernmost parts of the Sahel, requiring at least 600 mm annual precipitation. Being a surface rooting plant, it permanently demands a high ground water table. Prefers "black cotton soils", but grows also on sandy or lateritic soils in particular in the coastal region. Tolerates up to 0.11 % salt and a pH value of 8.7. Can be planted at altitudes of up to 1,500 m.

Propagation and management: Propagation by cuttings or coppicing. Seeds: 8,000 - 10,000/kg, strongly attacked by insects and should be harvested early. After thorough drying of pods, seeds are easily removed and, if well aerated, can be stored under room conditions for 4 - 5 years. Pretreatment of seeds with boiling water and soaking for 24 hours is necessary. Direct seeding is possible, provided weed competition is prevented. Rapid height growth (over 1 m/year), particularly in row or individual planting. Frequently used in courtyards, along streets, canals and as shade trees over agricultural crops. Seedlings are attacked by termites, bitten by rodents, wild and domestic animals, and must be carefully protected. The wood is attacked by various insects.

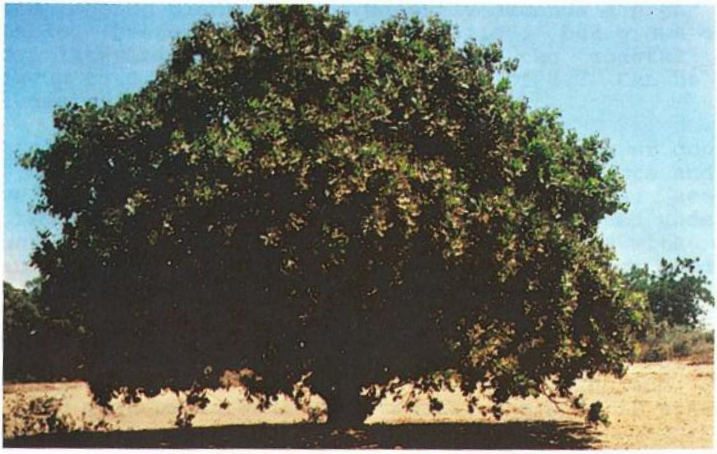
Uses: The most important function of this tree in the Sahel is for shade and amenity. In subhumid regions it is also used for shelterbelts or as a shade tree for various agricultural crops, including tea and coffee plantations. The root nodules are able to actively fix nitrogen, and the foliage is used for mulching and as green manure.

Stems have a wide sapwood; the heartwood is brown with dark streaks and makes a good veneer and carpentry wood ("Indian walnut"). It is difficult to saw, moderately durable and seasons well. Otherwise the wood is frequently used as fuel. Leaves, flowers and, to a lesser extent, pods provide fodder; root fibres are used for wickerwork. Locally the red gum substitutes for gum arabic. The finely pounded bark contains saponin and can be used as soap. Its tannin content (5 - 15 %) is relatively low.

Medicinal uses include the flowers for boils; bark and seeds for diarrhoea, dysentery and haemorrhoids; the seed-oil to treat leprosy.

References: Aubréville (1950), Berhaut Vol. IV (1975), Giffard (1974 A), Goor and Barney (1976), Irvine (1961), Kerharo and Adam (1974), Krüssmann (1976/78), Little (1983), National Academy of Sciences (1980).

ANACARDIUM OCCIDENTALE



Anacardium occidentale L.

Family: Anacardiaceae

Description: Evergreen straggly shrub or tree of medium height, up to 15 m, with large, hemispherical crown which often reaches down to the ground. Leaves alternate, 10 - 20 cm long and up to 15 cm wide, oblong to obovate, thick and leathery, glabrous and shiny, with prominent midrib and 12 - 20 lateral nerves, entire, reddish or pale green when young, later dark green. Flowers small, greenish or red-violet, in dense panicles. The fruit ("cashew nut") hangs on a stalk which has swollen to a fruit-like red or yellowish body resembling a pepper pod, called "cashew apple". This "apple" is of varying size, pulpy, juicy. The lateral root system is strongly developed and very expanded, supplemented by a deep-reaching taproot.

Distribution: The cashew nut originates in northeast Brazil and the Caribbean Islands. It was brought to other tropical countries by the Portuguese as early as 400 years ago and is thus one of the oldest cultivated tropical cash crops. Today it is planted all over the tropics, particularly in East Africa, Madagascar, West Africa and India. Plantations in Senegal, Mali and Burkina Faso have gained economic importance within Sahelian countries.

Site requirements: Very flexible with regard to climatic requirements. Annual rainfall between 500 and 4,000 mm. For optimum production a rainy season of 4 - 7 months with annual rainfall of 1,000 - 2,000 mm is required, but the cashew is very resistant to drought and will grow under less favourable conditions, such as in Senegal.

Prefers sandy, deep soils. Does not tolerate indurated horizons. Also grows on loose boulders or gravel provided this substrate is penetrable by the roots. Drought resistance and the soil volume accessible to the roots are closely correlated. Grows also on very poor, dry sites (e.g. coastal dunes) stabilizing the soil, but bears no fruit under these conditions.

Propagation and management: Natural regeneration through seed, root suckers and coppice. Seed germination is good on recently cultivated and burnt areas. For raising seedlings in nurseries, the seed should be scarified to promote germination. Cultivation on favourable sites in the southern part of the Sahel appears to be possible and attractive. Prior to establishing a plantation, a radical removal of stumps and roots and clearing of the areas is recommended. Watering is not necessary. Propagation by seeds (150 - 200 per kg); vegetative propagation by cuttings, grafts or layers. Outplanting of seedlings with naked roots is difficult, polythene pots should be used. Seeding at least 5 cm deep, 2 - 3 seeds per planting hole, early thinning required. In direct seeding spacing of 10 x 10 m to 15 x 15 m is recommended.

Weed control is extremely important during the first 3 years, fertilizer application can considerably improve growth and later

production of fruit. Yields are strongly correlated with the availability of soil nutrients, management and varieties planted. First crops can be expected 3 to 5 years after planting. Intercropping over the first 1 - 2 years is often practised but has limited prospects under Sahelian ecological conditions due to competition for moisture. Pruning is not recommended.

Several injurious insects, regionally different, threaten the plantations. In Africa, Mecocorynus loripus and Analeptes trifascieta, several Helopeltis spp., Coleoptera and the plant parasite Colletotrichum gloeosporiaoides, causing the Anthracnosis diseases, are known to damage the trees. Fire protection is indispensable. Rats may destroy newly established plantations entirely, thus weed (grass) control is important. Monkeys occasionally eat terminal buds or young plants.

Uses: The most important product of the tree are the "cashews", tasty nuts of worldwide commercial interest.

Ripe nuts are collected from the ground, detached from the apple, sun-dried and cleaned. Further processing can be done with simple local techniques or - today almost exclusively - in modern factories. This includes humidifying, grading of the nuts according to size, extraction of the cashew nut shell liquid (CNSL) by roasting or "cold" methods, decortication, cracking by pressure or centrifugal force, cutting or sawing; drying, peeling, re-humidifying and final grading and packing. (Ohler, 1966)

In the seventies the international trade amounted to 400,000 - 500,000 t. It can be expected that in the year 2,000 more than 1 million t will be traded. Largest producer countries are Mozambique, Tansania, Kenia and Madagascar. The share of India and particularly Brazil is increasing, but also yields from West Africa. Parts of Senegal offer good production and export opportunities. Estimated yields: 300 - 1,000 kg nuts per year and ha.

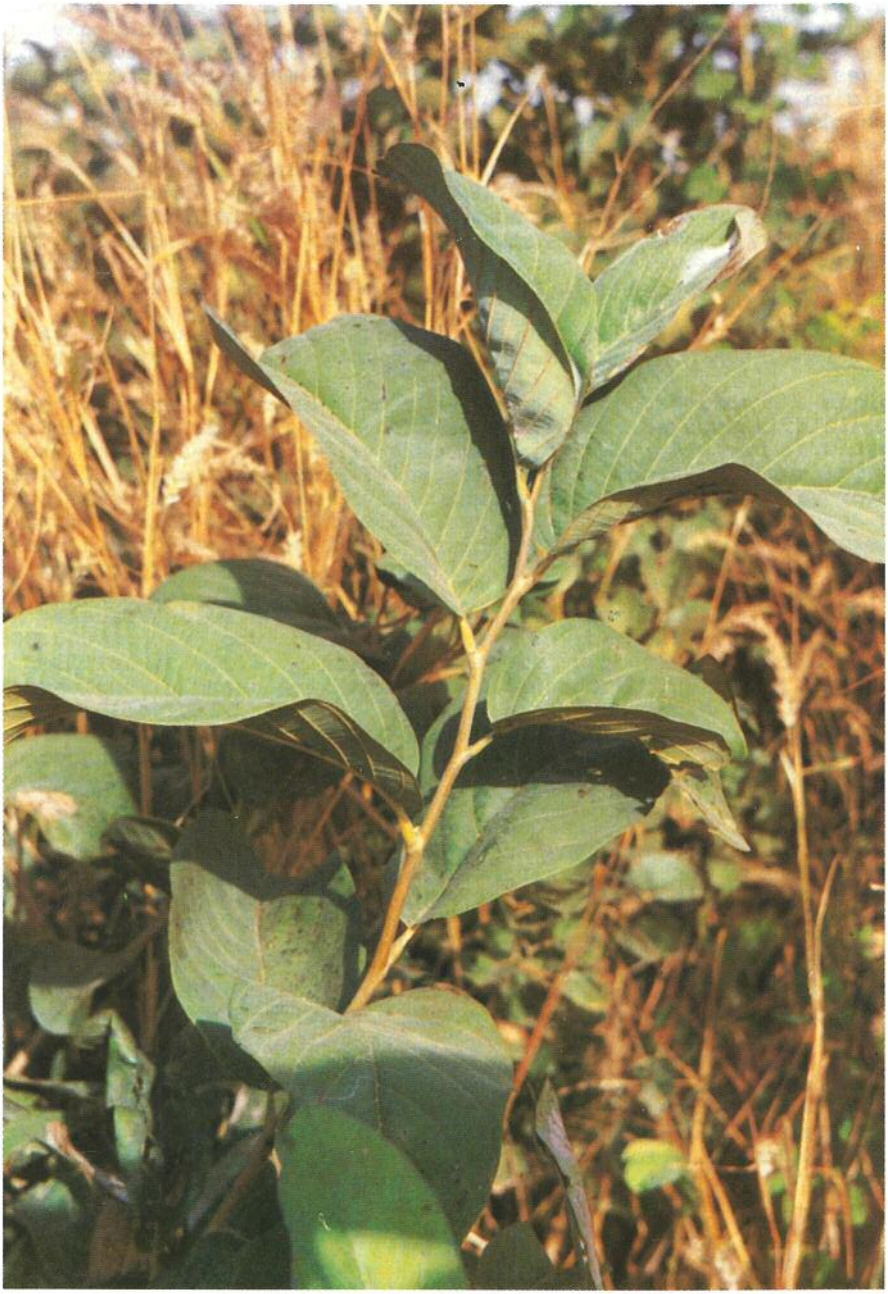
In addition to the nuts the "apples" are of particular importance. These swollen peduncles (hypocarp) are harvested, dried like figs for storage, immediately eaten or used for preparing beverages, jams, syrup, jellies or candied fruit, etc. They contain not only considerable amounts of vitamin C, but also calcium, iron and phosphorus. The yield of the fruit is about 5 to 10 times the weight of the nuts. However this extremely valuable secondary food product is not yet sufficiently utilized due to economic constraints although some progress has been made in recent years.

The nuts contain: water 5 %; protein 20 %; fat 45 %; carbohydrate 26 %; fibre 1.5 %; mineral matter 2.5 %. The shell (pericarp) contains approximately 50 % cashew-shell oil, a vesicant, composed of 90 % anacardic acid and 10 % cardol. The cashew apple contains: water 88 %; protein 0.2 %; fat 0.1 %; carbohydrates 11.6 %; rich in vitamin C. (Purseglove, 1968).

Young leaves and shoots are used as a vegetable. The liquid of the nut shells is suitable for numerous industrial applications and as an insect repellent. The wood is termite resistant and may be used for constructions, as fuel, for the manufacture of charcoal or extraction of tannin and dyes. The nut shell liquid, leaves, bark, roots, and juice of the "apples" are used in local medicine for various applications such as diabetes, gastro-intestinal disorders, weak bladder and high blood pressure.

Literature: Aubréville (1950), Berhaut Vol. I (1971), Giffard (1974 A), Goujoun et. al. (1973), Gorse (1962), Hallam (1979), Irvine (1961), Kerharo a. Adam (1974), Lefebvre (1968), Ohler (1966, 1967, 1979), Rehm/Espig (1984).

ANNONA SENEGALENSIS



Annona senegalensis Pers.

Synonyms: Annona arenaria Thonn. ex Schum., Annona chrysophylla (Boj.) R. Sillans, Annona senegalensis var. latifolia Oliv.

Family: Annonaceae

Description: Generally a shrub growing from numerous root-shoots, up to 1.5 - 2 m high, occasionally also a small tree (in East Africa up to 10 m high) with thick and smooth grey-silvery bark, rough and corrugated when old; slash pale pink. Young stems ferruginous, velvety to greyish tomentose. Large (up to 15 cm long and 10 cm wide) alternate leaves, ovate or oblong and entire, very fragrant when crushed, upper side pubescent, lower side distinctively brighter and with prominent venation. The yellowish, waxy flowers hang down from about 2 cm long peduncles, solitary, in pairs or triplets, at the lower side of the twigs. Size about 1.5 cm, bell-shaped.

Fruit up to 7 cm long and 4 cm wide, ovoid, pulpy, orange when ripe and characterized by numerous smooth elevations on the surface. Scent resembling pineapples. Many seeds are embedded in the yellow fruit pulp; about 25,000 seeds/kg.

Distribution: Within the entire semiarid to subhumid regions between Senegal and Sudan, southwards to the Guinea savanna; East Africa. Related species are found all over the tropics, in Senegal e.g. A. glauca, A. muricata, A. reticulata and A. squamosa.

Site requirements: Grows on very different soil types of varying origins: on stony soils, on river-banks, fallow land and along the coast. Mostly occurring as a single shrub in the understory of savanna woodlands with annual rainfalls of over 600 mm. From sealevel up to about 2,000 m in the mountains (in East Africa).

Propagation and management: Natural regeneration by seeds, root-suckers and coppicing. Seed germination is good on recently cultivated and burnt areas. For raising of seedlings in nurseries, the seeds should be scarified to promote germination. Cultivation appears to be possible and attractive.

Uses: The greyish wood is used for poles and hoe handles. Children like to eat the fruit as the fruit pulp is sweet. Fruit is collected from standing trees, sometimes stored for some days to ripen. Fruit lying on the ground is usually not edible. The flowers serve as a spice for various meals. Leaves are eaten by livestock, regionally they are prepared as a vegetable.

The wood ashes are added to chewing or snuff tobacco and used as a solvent for soap production. Bark fibres are taken for cordages and provide a yellow-brown dye.

The leaves are also used to fill pillows and mattresses. In Sudan a perfume is made from the boiled leaves. The bark is an

effective insecticide.

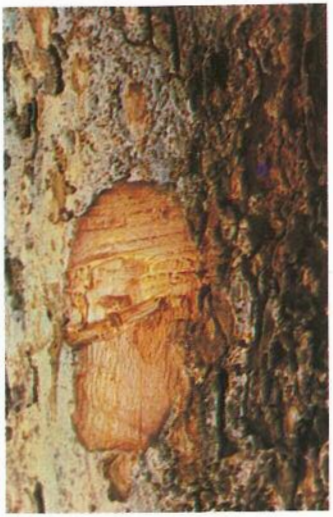
The greatest importance of A. senegalensis lies in its application in local medicine. The bark is used for the treatment of Guinea worm and other worms, diarrhoea, gastro-enteritis and snakebite, for mouthwash in case of toothache. Bark and leaves for respiratory infections.

Leaves for pneumonia and as a tonic for general well-being. Roots for stomach and veneral diseases. Various parts are applied in case of dermatological diseases and ophthalmic disorders.

HALLAM finally reports a recipe for obtaining a desired job: "To bring good luck in getting a job, the leaves from three stems should be picked on Thursday morning and using the right hand, thrown over the right shoulder keeping the eyes shut. Then one has to pick up only the leaves that have landed shiny side up and wash them. These leaves will then bring good luck".

References: Aubréville (1950), Berhaut Vol. I (1971), Dale a. Greenway (1961), FAO (1983 D), Geerling (1982), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo a. Adam (1974), Palmer/Pitman (1972).

ANOGEISSUS LEIOCARPUS



Anogeissus leiocarpus (DC.) Guill. et Perrott.

Synonyms: Anogeissus schimperi Hochst. ex Hutch.et Dalz., Conocarpus leiocarpus DC., Anogeissus leiocarpus var. schimperi (Hochst. ex Hutch.et Dalz.) Aubrév.

Family: Combretaceae

Description: A tall deciduous tree, up to 30 m high, with grey, yellowish, scaly, and, when old, blackish bark. Slash yellow, flamed, secreting dark colored gum. Twigs fine and weeping, brown, pubescent. Leaves solitary or alternate and typically arranged two on one side, two on the opposite side, ovate, 4 - 7 cm long, short petioled, base acute, tip mucronate, 4 - 8 lateral nerves. Underside of leaf slightly pubescent. Flowers during the rainy season, yellow-green to creamy-white, with red calyx and long stamina in globose heads on 5 - 10 mm long petioles in the leaf axles, sometimes in clusters. Fruit small, conelike, dark brown heads, breaking up easily into numerous two-winged seeds. Remaining on the trees for a long time.

Distribution: Africa between the isohyet of about 200 mm and the rainforest, from Senegal to Sudan and Ethiopia, in the south to Zaire.

Site requirements: Very large ecological amplitude, permitting a range from the southern limit of the Sahara to the northern limit of the rainforest. Prefers fresh soils, such as near seasonal lakes, in river valleys, often forming gallery forest, occasionally dense, closed stands. Originally widespread but strongly reduced and limited to the "relict" sites.

Propagation and management: Little coppice, very sensitive to fire. Seeds (140,000 - 150,000/1 kg) have short viability only and a low germination percentage. Very slow juvenile growth.

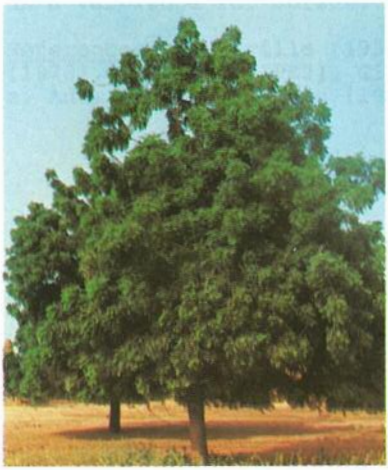
Uses: Valuable timber. Sapwood quite large, yellowish or light grey. Heartwood dark brown to nearly black, hard. Used as construction and working material, relatively resistant to termites and various wood-destroying insects. Difficult to work. Forked stems are used for poles and posts in house and bridge construction. Makes an excellent fuelwood and charcoal. In northern Nigeria and Burkina Faso the ashes are used for the preparation of goatskins. Bark, roots and leaves contain up to 17 % tannin. Leaves yield a yellow dye for skins and textiles, also with added bark. Gum only occasionally used, mixed with or as a substitute for gum arabic, locally as a food additive. It is of low quality, but can be used as glue or for the production of inks. Bark and root ashes are used for soap manufacture. Green and dry leaves are eaten by cattle, sheep and goats. Calices and fruits are used for the preparation of sauces or tea.

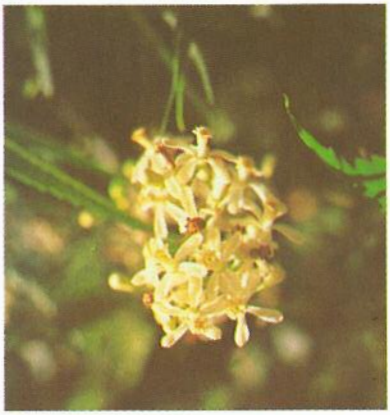
Various applications in local medicine. The bark serves as a taenicide, for fever and diarrhoea and for wound dressing. Gum as a laxative, seeds as a taenicide.

Various parts are applied as a tonic after jaundice, as an aphrodisiac, for dermatological disorders and for ulcers. Also used as a vermifuge for horses.

References: Aubréville (1950), Berhaut Vol. II (1974), C.T.F.T. (1978), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo a. Adam (1974), Touzeau (1973), Weber (1977).

AZADIRACHTA INDICA





Azadirachta indica A. Juss.

Synonyms: Antelaea azadirachta (L.) Adelbert, Melia azadirachta L. (not to be confused with Melia azedarach L.), Melia indica (A. Juss.) Brandis

Family: Meliaceae

Description: Small to medium-sized tree, 5 - 20 m high. An evergreen species which sheds its leaves only under extreme heat and drought for a short time. With its widely extended branches the tree forms an ovate to round crown on a straight smooth stem. The bark is of medium thickness and longitudinally and obliquely fissured, brown-grey; slash reddish brown. Leaves imparipinnate, alternate, 20 - 40 cm long on long slim petioles; 7 to 17 pairs of leaflets, alternate or opposite, 6 - 10 cm long, 1 - 3 cm wide, ovate or lanceolate, acuminate, uneven at the base, falcate, coarse, bluntly dented, glabrous, dark green. Flowers white, yellowish or cream-coloured, small, numerous. Arranged in up to 20 cm long, slim axillary panicles, honey-scented. The fruit is an ellipsoidal drupe, with one, rarely two, seeds; 1.2 - 1.8 cm long, green-yellow when ripe, with a thin cuticle and juicy fruit pulp.

Distribution: Originating from Northeast India and Burma; pantropic, in arid and semiarid regions as a shade tree and for parks, roadside planting, in villages, in cities almost everywhere in the Sahel, called by its Indian name, neem.

Site requirements: Very drought resistant, grows with 150 mm of annual rainfall, the optimum however, is between 450 - 750 mm. Has also been successfully planted in regions with up to 2,000 mm. Heat resistant but sensitive to cold. No particular site requirements; tolerates slight salinity. Grows better than other species on dry, stony and shallow, and nutrient-deficient soils without ground water contact. Optimum pH 6.2. Suitable for the improvement of degraded, nutrient-poor soils. Generally deep-rooted, neem also has lateral roots that may extend radially to 15 m. Intolerant to frequent inundation and lateritic outcrops.

Propagation and management: Propagation generally by seeds which should be sown immediately after maturity, i.e. December to the end of February. Seeds are best obtained from shed fruit, which is soaked. 1,600 - 1,700 seeds/kg. Fruit pulp must be removed by hand from the seed with subsequent air-drying. Intermediate storage in moist sand. Only swollen seeds should be used. 4 seeds per polythene pot, to be singled out afterwards. Direct seeding is possible as well as propagation by cuttings. Seeds should be slightly covered with soil, seedlings ought to be 30 - 50 cm high. Weeds do not affect growth. Neem is very resistant to competition and may become a noxious weed under favourable site conditions since the seeds are widely distributed by birds. Therefore abundant "natural" regeneration under old trees of various species may be encountered.

Azadirachta indica is a fast growing tree: two thirds of the height may be reached after 3 to 5 years. First lopping may start after the 5th year, fruiting from the 5th year on, the first timber crop after 5 - 7 years. Maximum yields reported from northern Nigeria amounted to 169 m^3 of fuelwood (Samaru project) per rotation (8 years) and ha, yields in Ghana were recorded between 108 and 137 m^3 per ha and rotation.

Neem is primarily suited for single tree plantations within compounds, villages etc., along roadsides, canals, markets and on fields with agricultural crops. It is less efficient in monoculture (plantation forests) under Sahelian conditions. Mixed plantations with more or less shade-tolerant species of trees, shrubs, other perennial plants and annual crops such as cotton, groundnuts, cowpeas, millet, sorghum and maize are recommended.

Uses: Cultivation and utilization of neem has a long tradition in India, where practically every part of the tree is used. The predominant function is for amenity and as a shade tree in courtyards, along roads and in parks, occasionally also as shelterbelts. It is impressive to see how neem has been accepted by the population of the Sahel and to what extent it is being planted through private initiative. However, not nearly as much use is made of the tree in the Sahel as in India.

Under the prevailing site conditions timber production is relatively high. The wood is heavy (specific gravity between 0.56 and 0.85) and is mainly used as fuel or for charcoal. In some regions (e.g. northern Nigeria) it is preferred to other species. In the Sahel the use for poles in house construction and fencing plays a particular role. Larger logs have a 5 - 10 cm wide pale yellow sapwood and pale to medium red heartwood which darkens afterwards. Freshly cut or split the wood has a strong smell. Logs of sufficient dimensions can be easily sawn, worked, polished and glued. However when drying, the wood often splits and warps, splits when nailed, so that holes must be prebored. The wood is resistant to termites and other wood-destroying insects even in exposed areas. In many countries it is therefore preferred for construction, for carts, agricultural tools and handles.

Leaves, with a protein content of 15 %, could be used as fodder for camels, sheep and goats. At a low fibre content they have a high nutritional value, comparable with leguminous leaves. However neem in West Africa, different from India, is generally ignored by livestock (which makes it easy to establish even within villages and courtyards). The seed cake is said to be toxic to sheep and other livestock. Experiments will show whether methanolic extraction will allow the use of the cake as cattle feed.

Sap from upper branches and from roots is fermented and drunk, flowers and young buds are cooked as a vegetable. The fruit may also be consumed in times of emergency. Another possibility, although not yet tested, would be the use of neem leaves as a

substrate for mushroom production. This has been recommended because of the high protein content and nematode-repellent effect. Under favourable Sahel conditions, the annual leaf biomass production may reach more than 10 tons per hectare.

A mature tree produces more than 20 kg of fruit corresponding to 10 - 15 kg of seeds per year. The seed kernels contain 45 - 60 % oil with a high sulphur content. This oil is so far only used in India to a considerable extent. It is obtained by drying the fruit in the sun, isolating the seeds and drying them again. The seeds are then pounded or crushed, the shells removed by winnowing. These shells do not contain oil but they are used as fuel. The oil is obtained by pressing or boiling the kernels. If the oil is extracted with diluted alcohol the bitter components can be removed. If purified, the oil can replace palm or coconut oil in soap manufacture, and if further refined, even edible oils. It is widely used for the manufacture of soaps and disinfectants as well as for lighting and as a lubricant for machinery.

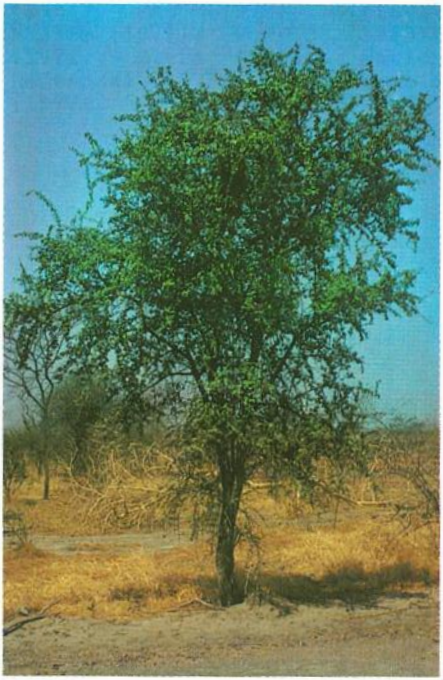
The oilcake is a good fertilizer and an effective insecticide so that after fertilizing of agricultural crops attack by termites and diverse insects is effectively reduced. The effect as an insecticide is attributed to the content of azadirachtin found in seeds and leaves and which even at low concentrations impedes feeding and moulting of larvae and caterpillars. Azadirachtin is particularly suitable, i.e. in the form of neem-seed powder, as a protective agent for the storage of grain. The bitter taste can be removed by washing the grain immediately before use. It is said that the insecticidal effect of azadirachtin is as good as DDT, however it is not toxic to man. The living tree also repels insects and is less subject to the attack of parasites than many other species.

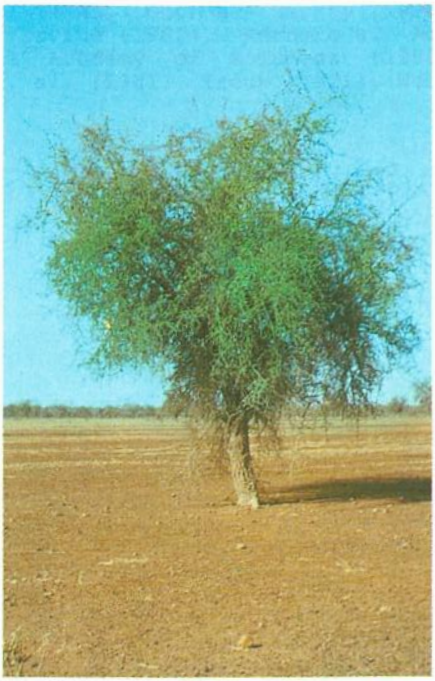
In northwest Nigeria neem is used on degraded agricultural land for soil amelioration in order to improve the pH value and to make available soil nutrients for commercial crops. It has also been found on experimental plots that under neem trees the soil was considerably more humid down to a depth of 30 - 120 cm during the dry season than on open ground. Hence neem is suitable for agroforestry land use and for rotation systems with periodical afforestation.

In ancient Indian Sanskrit scriptures almost all parts of the neem tree are described as medicinally effective. Many uses can be found in the Sahel. Bark, leaves, fruit, oil and sap help to cure various skin diseases, venereal diseases (syphilis), tuberculosis, etc. They are used as an antidote (scorpion or snake bites), antiseptic, astringent, anthelmintic, diuretic, tonic, antiperiodic and remedy against rheumatism and sprains. A decoction prepared from bark is said to be a febrifuge. Nimbidin and related compounds extracted from neem are used for creams, lotions, shampoos, hair tonic and toothpastes. (Booth 1984).

References: Aubréville (1950), Azadirachta indica. In: Bois et Forêts des Tropiques (1963), Berhaut Vol. VI (1979), Booth (1984), FAO (1977), Giffard (1974 A), Goor a. Barney (1976), Hallam (1979), Howaldt (1980), Irvine (1961), Kerharo a. Adam (1974), Mitra (1963), National Academy of Sciences (1980), Radwanski (1977), Schmutterer et. al. (1981), Troup (1921), Weber (1977).

BALANITES AEGYPTIACA





Balanites aegyptiaca (L.) Del.

Synonyms: Ximenia aegyptiaca L., Agialida senegalensis van Tiegh., Agialida barteri van Tiegh., Agialida tombuctensis van Tiegh., Balanites ziziphoides Mildbr. et Schlechter

Family: Balanitaceae (formerly placed in Zygophyllaceae)

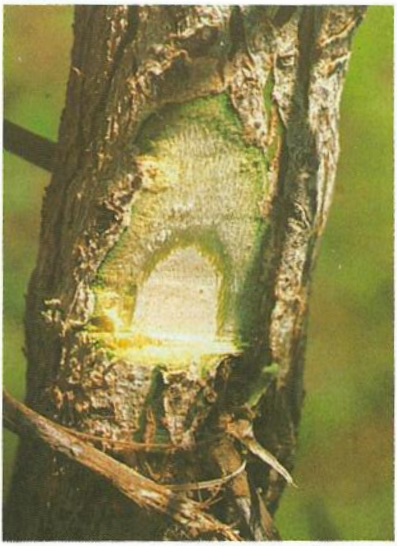
Description: A small to medium-sized semideciduous tree which attains a height of about 6 m (rarely 10 m) and a stem diameter of 30 cm. The crown is spherical or irregular (subject to site conditions, age and treatment). Bark smooth and green with young trees and branches, brown to grey, deeply fissured and corky with the trunk of old trees. Slash: outside light green, interior whitish. Thorns vigorous, up to 8 cm long, green with a brown tip, straight and directed forward, alternate, in the leaf axils. Branches dropping and very flexible, green with grey lenticels. The leaf consists of two leaflets on a short petiole and varies considerably in size. Leaflets 2 to 5 cm long and 1 to 2.5 cm wide, ovate to rhomboid, entire; nerves prominent. Flowers in small clusters, sometimes spikes, in the leaf axils, measuring about 1 cm in diameter and consisting of 5 small deciduous sepals, 5 petals, 10 stamens and a disc surrounding the ovary. No definite time of flowering but mainly between October and February. Fruit olive-shaped, elliptical drupe, 3 to 4 cm long, yellow when ripe at the end of the dry season. A leathery wrinkled epicarp covers the yellow-brown mesocarp, which is edible (astringent and bitter-sweet) and a hard-pointed woody endocarp surrounds the kernel.

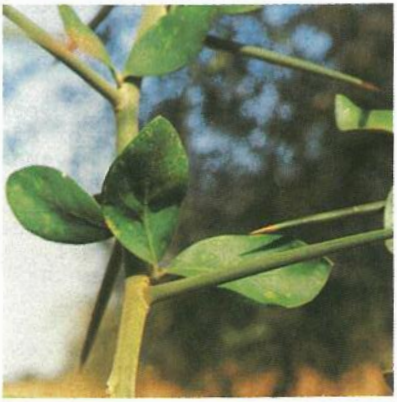
Distribution: Balanites aegyptiaca is found in most arid to subhumid tropical savannas of Africa, all over the Sahel and on many sites of the Sudan savanna, extending from the Atlantic coastline of Senegal to the Red Sea and Indian Ocean and the Arabian Peninsula. Balanites roxburghii Planch in India and Pakistan is considered to be identical. Small plantations have been established in Senegal, Niger, Chad and other African countries, in India and some Caribbean Islands.

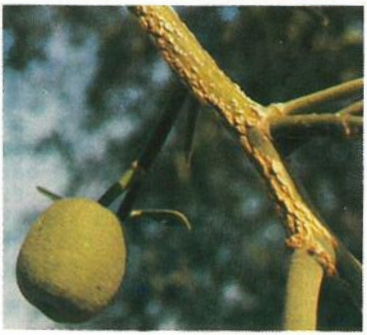
Site requirements: Ecologically a very flexible species. Due to its deep tap root and thick bark it is very drought-resistant and not damaged by grass fires. Grows on very different soils (sands, clay, cracking clay, alluvial soils, gravel, etc.) with annual rainfalls between 200 and 800 mm. Grows well in vallies and on river banks, in depressions, on the foot and slope of rocky hills, up to 1,500 m above sea level in East Africa. Usually found mixed with Acacia seyal, A. tortilis and other species (e.g. Sclerocarya birrea), but also forming almost pure stands.

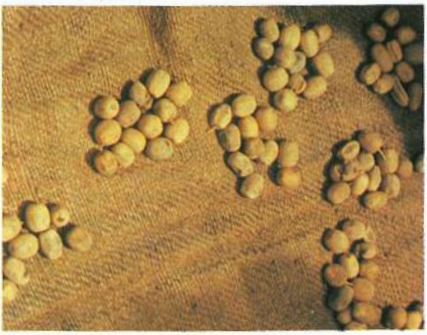
Propagation and management: Reproduction mainly by direct seeding but also by root suckers and cuttings. Seeds are easily available. A mature tree may yield about 10,000 pieces of fruit per year. These are consumed by birds and animals and the hard (indigestible) seeds thus widely dispersed. Seeds that have passed the intestinal tract of ruminants (goats!) germinate

BALANITES AEGYPTIACA









particularly well. They can easily be gathered in places where livestock is kept overnight. Other seeds should be soaked in hot water for 12 to 18 hours or scarified to overcome dormancy. Seed viability is rather good but damage may be caused by insect borers. Seeds differ widely in size and weight. 500 - 1,500 pieces/kg have been counted but up to 4,500/kg have been mentioned in subject literature. Direct seeding is recommended at the end of the dry season. Immediately covering the entire seed with soil is important to safeguard germination. Seedlings are intensively browsed by all herbivores. High grass competes for light and thus impedes regeneration. Grass fires can destroy young plants. Once successfully established, Balanites is very resistant to all damage and injuries, has a relatively slow growth but shows excellent persistence. First fruit yields may be expected after 5 to 8 years. The tree can attain an age of more than 100 years.

Uses: Balanites aegyptiaca is an extremely useful tree which has been utilized over thousands of years. Balanites fruit has been found in tombs of the 12th Egyptian dynasty and it is said that for approximately 4,000 years Balanites has been cultivated in Egypt. Surprisingly, this has not resulted in intensive breeding, management and industrial processing as for instance, with the date palm. In recent years more attention has been devoted to this valuable resource than during the past decades as can be seen from the UNIDO (1983 B) publication "Balanites aegyptiaca - an unutilized raw material potential ready for agro-industrial exploitation".

Although Balanites in the Sahel is by no means entirely "unutilized", more could and should be done to establish new, improved stands and to intensify utilization techniques. Thus the extensive resources which already exist may be considered for agro-industrial uses beyond present subsistence levels.

Balanites wood is pale yellow or yellowish brown, hard and tough, heavy (specific gravity 0.65), insect resistant, fine-grained. It saws and planes well and is widely used for tool handles, bowls, posts, mortars and pestles and many household and agricultural implements as well as for handicrafts. With a calorific value of 4,600 kcal/kg it makes excellent fuelwood and is highly esteemed for charcoal. The thorny branches are commonly used for fencing. Interplanting in hedges or live fences can be recommended using root cuttings.

Young leaves, sprouts, green thorns, and especially the fruits are eaten by all livestock and wildlife. Lopping is widely practised and the trees regenerate readily after lopping or heavy browsing although finally acquiring a dwarf-bush growth form. The nutritive value of leaves and twigs is as follows (le HOUEROU 1980A,p. 92):
Crude protein 15 % DM (6 - 24)
Net energy 6.1 MJ kg DM (5.5 - 6.2)
Digestible protein/FU 100 (20 - 236)
P 0.11 (0.03 - 0.20).

The fruit is eaten fresh or dried as "desert date", unripe as "Egyptian myrobalan". It has a slightly astringent taste and is purgative. The fruit can be processed to produce multipurpose intermediate products. The mesocarp of the fruit is a source of fermentation products (e.g. ethanol) and steroidal sapogenins or can be incorporated into animal feed. The cellulosic shell of the fruit is a source of fuel. The kernel is a supplement to food products (e.g. edible nuts, peanutbutter-like products). The crude Balanites oil is a source of edible vegetable oil or otherwise used in various industries (e.g. soap-making). The kernel-cake, after extraction of the oil, is a source of protein and carbohydrates for livestock. (UNIDO 1983 B).

The single fruit has an average weight of 10 to 15 g, of which about 50 % is the hard woody shell (endocarp), 30 % is the soft fruit flesh (mesocarp), 10 % the oil-seed (kernel) and up to 10 % the outer skin (epicarp) and other smaller parts. The mesocarp consists mainly of sugars (glucose, fructose, sucrose) which make up 68 to 72 %, whereas the kernel contains up to 50 % fixed oil and 26 - 30 % crude protein (UNIDO 1983 B).

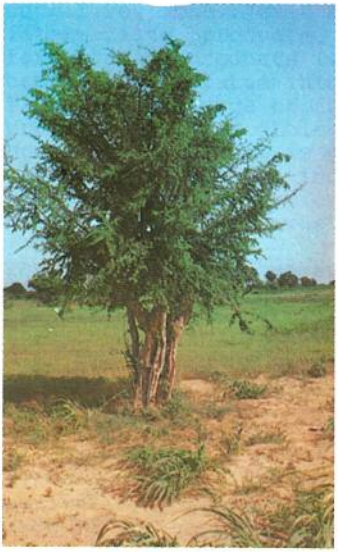
All parts of the plant, including the seed kernel, yield the sapogenins diosgenin and yamogenin, both of which are used in the partial synthesis of steroid drugs. A soap substitute is locally made of the saponins extracted from root barks and fruits.

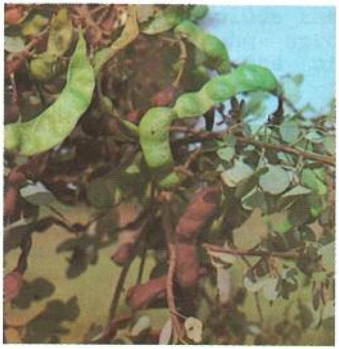
Other uses include the ground kernels for preparing a kind of bread, the young sprouts and leaves, occasionally eaten as a vegetable. Extracts of the fruit and bark are used to kill the freshwater snails that are intermediary hosts for schistosomiasis (bilharzia). They also kill the free-swimming life forms of this parasite and larvae of the waterfly harbouring the guinea worm (Dracunculus medinensis).

Many medical uses are known, including the bark and roots as laxatives or tranquillizers (for colics), the bark against stomachaches, sterility, mental diseases, epilepsy, yellow fever, syphilis, and as a vermifuge. Fruit and leaves, and especially the kernel-oil are applied for rheumatism, bark extracts for toothaches. A fish poison is obtained from a fruit extract.

References: Aubréville (1950), Baumer (1983), C.T.F.T. (1978), Dale a. Greenway (1961), Geerling (1982), Giffard (1974 A) Goor a. Barney (1976), Irvine (1961), Kerharo a. Adam (1974), NATIONAL ACADEMY OF SCIENCES (1983), Parameswaran a. Conrad (1982), Sahni (1968), Touzeau (1973), UNIDO (1983 B), Weber (1977), Wickens (1980 B).

BAUHINIA RUFESCENS





Bauhinia rufescens Lam.

Synonyms: Adenolobus rufescens (Lam.) Schmitz, Bauhinia adansoniana Guill. et Perrott., Piliostigma rufescens (Lam.) Benth.

Family: Caesalpiniaceae

Description: Shrub or small tree up to 8 m high. Bark grey, smooth, very fibrous and scaly when old. Slash pink. Twigs arranged in one plane like a fishbone, with 10 cm long thorn-like, lignified, lateral shoots. Leaves small, up to 2.5 cm long, glabrous, grey-green. Bilobed almost to the base. Lobes semicircular to ovate. In more humid regions Bauhinia is evergreen. Flowers greenish-yellow to white and pale pink, in few-flowered racemes. Petals (5) spatulate, 15 - 20 mm long, 10 stamens, filaments hairy at the base. Fruit aggregated, long, narrow pods, twisted, up to 10 cm long, glabrous, obliquely constricted, shining dark red-brown, with 4 - 10 seeds each. The pods remain on the shrub for a long time.

Distribution: In the entire Sahel and the adjacent Sudan zone from Senegal and Mauritania across North Ghana, Niger to Central Sudan and Ethiopia.

Site requirements: Very unassuming, on dry, sandy (fallow sites) stony, clayey and lateritic soils.

Propagation and management: Boiling of the seeds and slow cooling in order to improve germination (ca. 40 %). 9,000 - 10,000 seeds/kg. Little experience in management as yet, but it should be investigated with regard to the production of forage. Bauhinia regenerates quickly and abundantly after browsing.

Uses: The green (and dried) fruit as well as the leaves and shoots are a valuable forage, esteemed by many species of wild and domestic animals which may cause the extinction of Bauhinia rufescens in regions overstocked with livestock. The pods are said to be the most valuable forage for camels (Sudan). According to le Houerou (1980A, p. 89), the nutritive value is characterized by:
crude protein 13.5 % DM (11 - 17),
net energy 5.4 (3.2 - 7.1) MJ kg DM,
digestible protein/FU 0.19 (0.15 -0.27), and
digestible DM (leaves) 51 %.
The crude inner bark fibres serve as plaiting and binding material. The bark contains tannin. The light brown, fine-grained wood can be used for carpentry and wood-carving if sufficient sizes are available. Otherwise as fuel or for fencing.

An ornamental shrub, very suitable for hedges, protecting gardens, fields, compounds, and along roadsides.

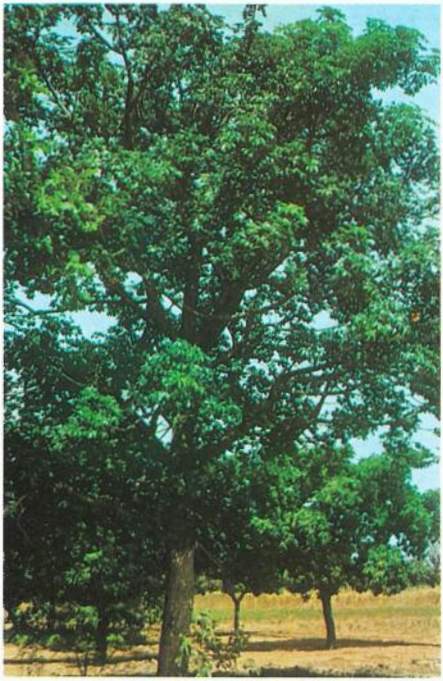
An extract from the roots is used as an astringent or antipyretic in local medicine. Leaves and fruit are applied for the treatment

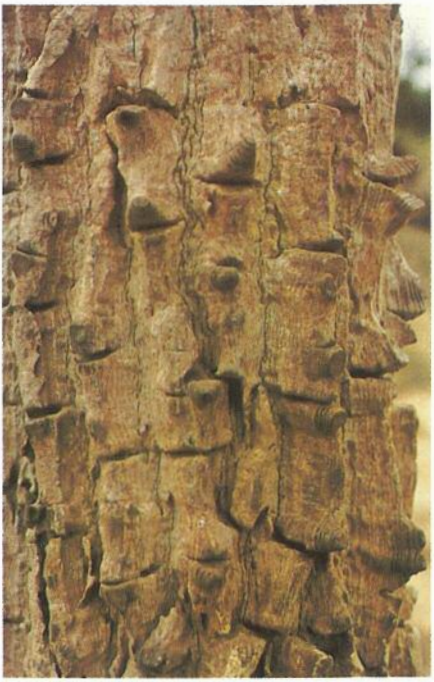
of diarrhoea, dysentery and ophthalmic diseases or as a tonic.

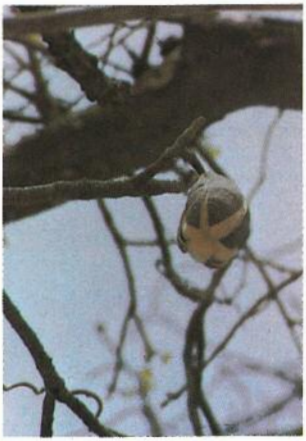
The bark of the roots (and the trunk) is used to cure chest complaints, syphilis and other venereal diseases, leprosy, diarrhoea, dysentery, and to reduce fever; the fruit against dysentery.

References: Aubréville (1950), Baumer (1983), C.T.F.T. (1978), Berhaut Vol. IV (1975), Geerling (1982), Giffard (1974 A), le Houerou (1980 B), Irvine (1961), Kerharo a. Adam (1974), Sahni (1968), Touzeau (1973).

BOMBAX COSTATUM







Bombax costatum Pellegr. et Vuillet

Synonyms: Bombax andrieui Pellegr. et Vuillet, Bombax buonopozense P. Beauv., Bombax houardii Pellegr. et Vuillet, Bombax vuilletii Pellegr.

Family: Bombacaceae

Description: A tree up to 25 m high, in the Sahel hardly over 6 m. Crown structure of young trees storied, becoming irregular and sturdy in older strees. Bark thick, grey-brown and corky, with typical conical, stout, sharp-pointed spines on stem and branches. Slash light red-brown. Leaves digitately compound, with 5 - 7 leaflets, 8 - 15 cm long, on long petioles (longer than the central stalk). Leaflets partly ovate, partly acuminate both ends, with 8 - 10 pairs of lateral nerves. Flowers (5 - 6 cm) solitary, deep red, orange or yellow, tulip-shaped, on long, glabrous peduncles. Calyx cup-shaped. Flowering after leaf-fall, approximately November to February. Fruit a dark-brown, ellipsoidal capsule, composed of 5 valves, dehiscent, 8 - 16 cm long and 3 - 6 cm wide, of variable shape. The valves are furrowed for about one third the distance from the top to the middle (species characteristic). Fruit contains white floss, called kapok and several small seeds.

Distribution: Tree of the savannas and dry woodlands from Senegal to Central Africa, from Guinea across Ghana and Nigeria to Southern Chad.

Site requirements: Preferably on cropland and close to settlements. Indicator plant for stony soils, supports dry lateritic soils. Very resistant to fire.

Propagation and management: Natural regeneration easy and abundant when sufficiently protected against fire and livestock. Fructifies, according to site and conditions, from about the 6th year on, but very irregularly. 17,000 - 27,000 seeds per kg. Difficult to plant in spite of vigorous root formation. Only planting of isolated trees recommended. Seeding in polythene pots in March/April. Cuttings have given good results.

Uses: Most important product are the kapok fibres. A tree bears up to 1,500 pieces of fruit with 5 - 8 g kapok in each. Under favourable conditions, 3 - 5 kg kapok per tree can be obtained from the 10th year on. Fibres are mainly used as filling, especially for pillows.

The wood is pale yellow to whitish with an orange lustre when newly felled. It soon turns grey when exposed to sunlight. There is no visible difference between heartwood and sapwood. The wood is very soft and weighs 350 - 450 kg/m^3 when air-dried. It is moderately solid, easy to season and not liable to major warping or shrinkage. Untreated, the wood is soon attacked and destroyed by insects and fungi. It is easy to work, however tools should be kept sharp in order to avoid a woolly surface. Nails and screws

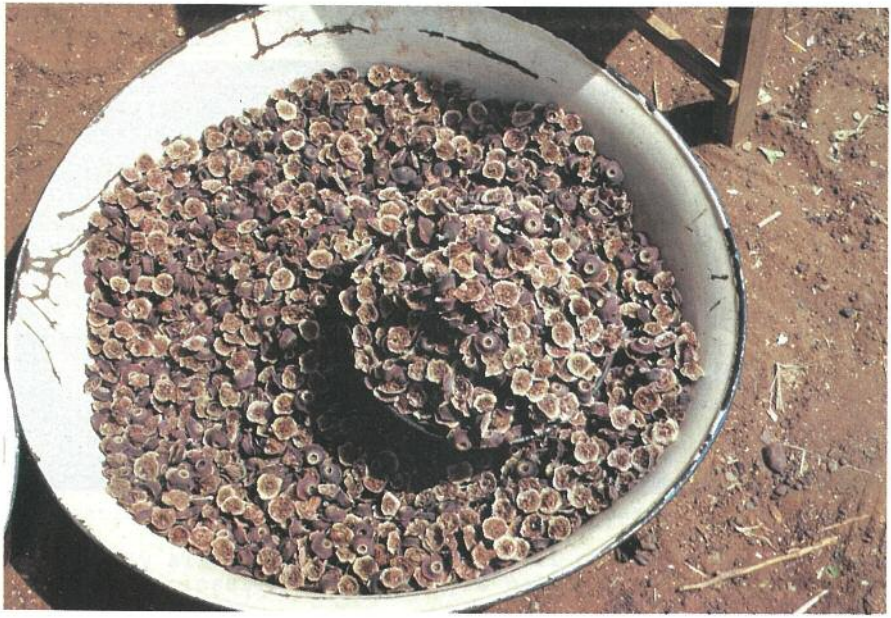
may be used but glueing is preferable to obtain stable joints. Main uses are sound insulation, radio cabinets, drums, crates, kitchen utensils, mortars, etc. Bigger logs (outside the Sahel) are used for dugout canoes.

Fallen leaves are eaten by livestock. Young fruit is cut, dried, and used for the preparation of meals; the calyx of the flowers is used in sauces. The bark yields a brown dye.

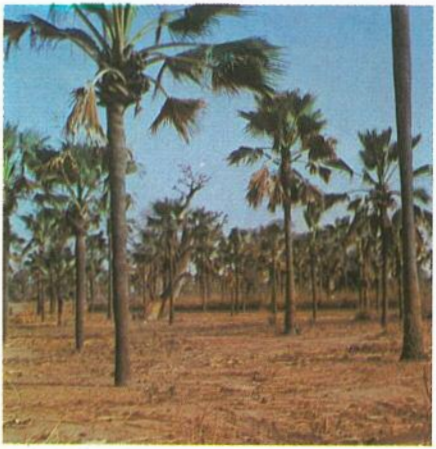
Various applications in local medicine. The bark is used for the treatment of skin diseases, yellow fever and headache, leaves and immature fruit as an emollient. Various parts for fever or to promote lactation; as a tonic for fatigue.

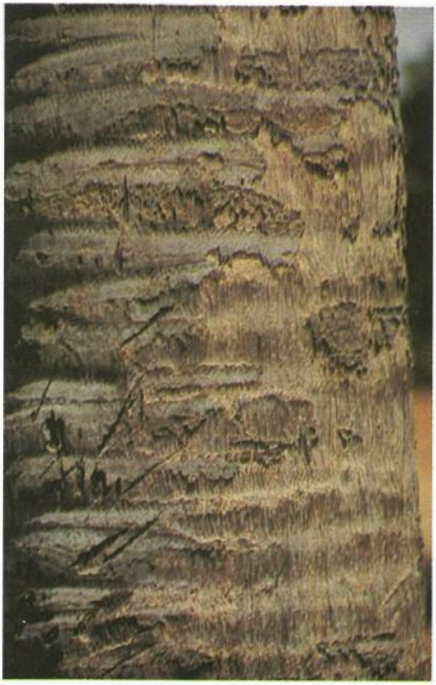
References: Aubréville (1950), Berhaut Vol. II (1974), Geerling (1982), Giffard (1974 A), Götz (1983), Irvine (1961), Touzeau (1973).

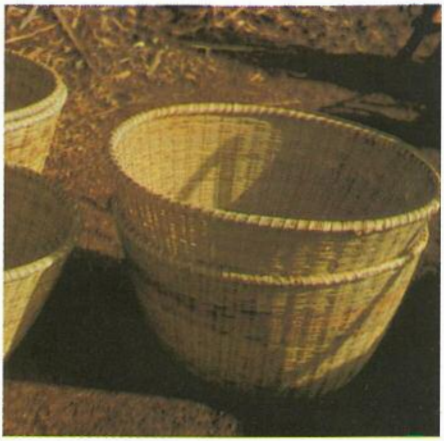
BOMBAX COSTATUM



BORASSUS AETHIOPUM







Borassus aethiopum Mart.

Synonym: Borassus flabellifer L. var. aethiopum Warb.

Family: Palmae

Description: The ron palm is a typical fan-palm with a tall straight bole which may attain a diameter of 60 cm. The stems of palms less than 20 years old are covered with dry leaf stalks, whereas stems of old palms have a smooth exterior, showing gradually fading leaf scars. A characteristic of the ron palm is a swelling of the trunk after an age of about 25 years. These swellings are more pronounced with female palms since their stems contain more water. The swelling appears at a height of 12 - 15 m above ground over a length of some 3 - 4 m and is repeated at a higher elevation after 60 and 90 years. The fan-shaped leaves are up to 3.6 m long, about 15 - 30 of them forming the crown. Flowers dioecious, greenish. Female flowers with an unbranched and shorter spadix. Fruit large (diameter about 20 cm), globose, orange to brown when ripe (but usually sold immature and thus green). In clusters weighing 25 - 50 kg. The yellowish or white oily and fibrous fruit pulp contains 3 kernels, 8 x 8 cm, brown and woody when ripe.

Distribution: Tropical Africa from Senegal and The Gambia to East and South Africa, throughout semiarid to subhumid regions. Important stands (partly closed palm forests) grow in the Dallol Maouri, Niger, in northern Nigeria and Benin. A relict stand is recorded from Trarza in Mauritania. Chad (Logone, N'Djamena) and the Sudan have widespread Borassus stands.

Site requirements: Borassus is very light-demanding and needs a high ground water table. It therefore prefers alluvial soils near watercourses, riverbanks, etc. and fertile agricultural sites. Tolerates seasonal inundation and prospers with an average of 800 mm annual rainfall (minimum of 200 mm in Mauritania due to ground water availability).

Propagation and management: Easy to propagate by seed. Germination after approximately one month. Three phases of growth can be recognized: a) from germination, which starts with the development of the first (subterranean) leaf, over the first 6 - 8 years. During this time a crown of some 20 leaves is built up, whereas the trunk still remains underground. The crown may measure 4 x 4 m. The very common cutting of young leaves seriously affects the growth of the palms. b) 8th - 20th year. The trunk grows rapidly above ground. c) Male and female inflorescences are produced. Dead leaf stalks are now shed and the trunk attains its smooth surface. The growth of the palms depends largely on the site, and plantations have not always been successful. Aiming at a final stand of 400 to 600 palms per ha, the rotation may differ between 60 and 140 years.

Uses: Nearly all parts are used. A Tamil poem in India lists 800 uses for the closely related palmyra palm, B. flabellifer. The

sap or "toddy", obtained by tapping the unopened inflorescence, contains up to 20 % sugar and is processed into sugar (about 50 kg per palm/year) or fermented and distilled as an alcoholic beverage. Tapping starts at about 30 years and may be continued for another 30 years. A single inflorescence yields up to 2 litres of sap per day. The oil-containing fruit pulp, the seeds and the starchy pith are of local significance as food. Immature seeds contain a sweet juice which is consumed like coconut milk and after hardening is like tender coconut meat. Seeds and seed shells are used in crafts. The wood is very highly esteemed in many parts of the Sahel and often considered to be the best structural timber. It is dark brown with irregularly alternating, light brown stripes of a striking appearance. Only the outer layer of the trunk between the base and the first swelling can be used. This layer is 7 - 10 cm thick on male and only 4 - 5 cm on female palms. Hence male palms are generally preferred. Their wood is very solid, hard and heavy (1,020 - 1,140 kg/m^3 air-dry). Seasoning presents no problems. The wood is resistant to termites, marine borers and fungi but difficult to work (especially to saw, plane or sand). It splits when nailed. On the other hand it can be split easily immediately after felling. Main uses are piles and roof beams, door and window frames. Whole trunks are used for bridge-building, piers and surfacing small jetties, telegraph poles, fence posts, and (in sections) for beehives.

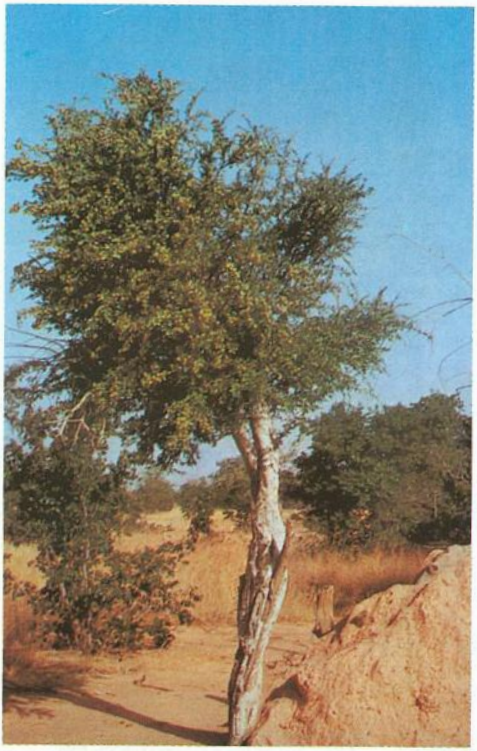
Leaves serve as thatch material for roofs and for plaiting, leaf fibres for the manufacture of nets; petioles for baskets, furniture, fences, light buildings, pounded petioles for washing. Ashes of male flowers make a good potash. The first (subterraneous) leaf has a thick fleshy growth and is highly esteemed as a vegetable (Hausa: mouroutehi). The tubrous portion of the first juvenile leaves are rich in starch. They are produced in home gardens in The Gambia by burying seeds. The terminal bud is also eaten, but its removal kills the palm and must be prohibited.

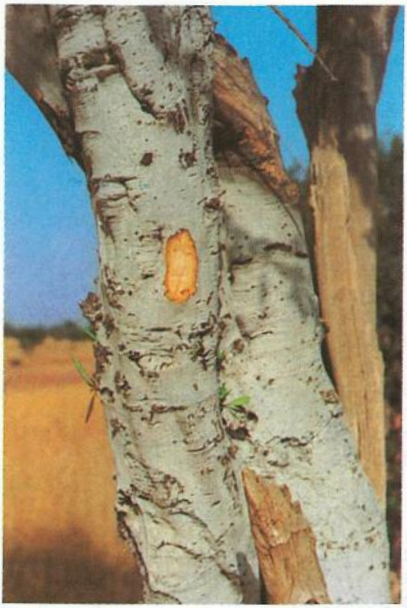
Various applications in local medicine. A root decoction is given to newly born, used as mouthwash, for respiratory ailments and asthma. Leaves as an aphrodisiac. Male flowers as a powder, and with shea-butter applied on scars. Floss of young leaves said to be haemenostatic; roots for respiratory disorders. The sap has a number of medicinal uses.

References: Chevalier (1938, 1949), Geerling (1982), Giffard (1967, 1974 A), Götz (1983), Irvine (1961), Kerharo a. Adam (1974), von Maydell/Götz (1985), Niang (1975), Palmer/Pitman (1972), Weber (1977).

BORASSUS AETHIOPUM

BOSCIA ANGUSTIFOLIA





Boscia angustifolia A. Rich.

Synonyms: Boscia tenuifolia A. Chev., Boscia patens Sprague et M.L. Green

Family: Capparidaceae

Description: A shrub or small tree, up to 8 m high, with strongly ascending branches, bark fissured, light grey and glabrous, slash yellow. Twigs covered with small, coriaceous leaves, in clusters of 3 - 10 on older branches, solitary on one year-old shoots. Evergreen and therefore easily identified from far-off during the dry season. Leaves lanceolate or linear, up to 7 cm long and 1.5 cm wide; mucronate, blunt or carved, reticulate, with a very close network of nerves prominent on both sides. Short petioles, pubescent at the base. Flowers 0.7 cm, in axillary or terminal racemes of about 7 cm in diameter, yellow-green, fragrant, four ovate sepals, 3 - 8 stamina; no corollate leaves. Fruit petioled, 0.7 - 1.3 cm in diameter, globose, reddish.

Distribution: A species of the Sahel-Sudan zone from the Atlantic to the Red Sea. Southern Gambia to northern Nigeria, east Sudan, East Africa.

Site requirements: Grows predominantely on very dry sites, hills, gravel and laterite; near waterholes and in dry river beds. Rainfall 200 - 400 mm.

Uses: Wood hard, used in carpentry and for water storage vessels. Formerly used for making charcoal for gunpowder. Fruit and seeds bitter but edible. The bark is scraped off and mixed with millet or added to soups. Pieces of boiled wood are used to sweeten milk. Leaves, shoots and bark are good forage for domestic and wild animals especially at the time of flowering and towards the end of the dry season. In local medicine the bark is applied for swollen feet, kidney pains and stiff neck, the roots for chest pains and the fruit as a laxative. Pounded leaves as a tonic for horses and camels.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. II (1974), Dale/Greenway (1961), Geerling (1982), Irvine (1961), Kerharo/Adam (1974).

Boscia salicifolia Oliv.

Synonym: Boscia powellii Sprague et M.L. Green

Family: Capparidaceae

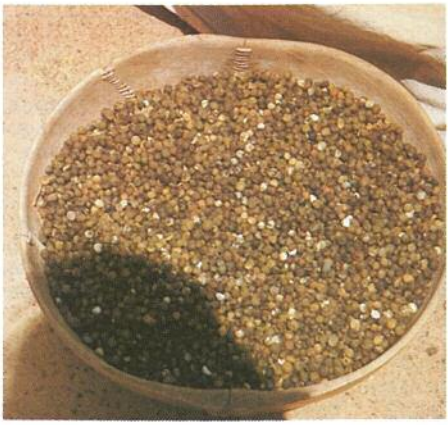
Description: Very similar to B. angustifolia but growing a little higher, evergreen. Branches drooping. Bark blackish or pale grey with many lenticels, fissured, scaly. Slash yellow. Branchlets with lenticels, pubescent when young, later glabrous. Leaves alternate, glabrous, coriaceous, linear or lanceolate, 8 - 12 cm long and 0.8 - 1.5 cm wide. Tip mucronate. Lateral nerves hardly developed. Midrib straw-colored, prominent on the lower face. Flowers greenish, 0.4 cm, in racemes, at the top of branches 7 - 10 cm in diameter. Fruit globose, 0.4 cm, warty. Often grows on termite mounds on sandy soils.

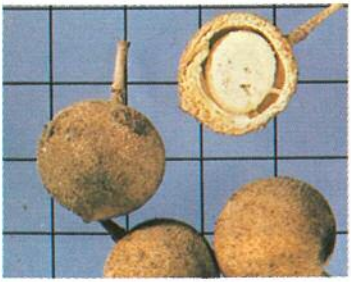
Distribution and site requirements: In the Sahelo-Sudanese zones but less common in West Africa (west of the first longitude west). Frequent in Burkina Faso (Gourma), Niger, Chad, Sudan, East Africa from Eritrea to Mozambique. Resistant to drought (200 - 400 mm rainfall).

Uses: Fuelwood. Leaves and roots (the latter fried) are occasionally eaten. Young wood and pounded bark are used for sweetening. Leaves, shoots and fruit browsed by domestic animals (camels, goats, sheep). Their feed value is considered to be among the best of browse plants in the Sahel with a crude protein content of about 20 %. Medicinal uses the same as with Boscia senegalensis.

References: Aubréville (1950), Baumer (1983), Berhaut Vol II (1974), Dale and Greenway (1961), Geerling (1982), Irvine (1961).

BOSCIA SENEGALENSIS





Boscia senegalensis (Pers.) Lam. ex Poir

Synonyms: Podoria senegalensis Pers., Boscia octandra Hochst. ex Radlk.

Family: Capparidaceae

Description: Evergreen shrub, up to 4 m high, sometimes a small tree with dark grey to black bark; leaves alternate, coriaceous, large (about 4 x 12 cm), ovate, with prominent bow-shaped lateral nerves. Upperside glabrous and dark green, underside bright and frequently pubescent. Flowers greenish-white to yellow-green in short, dense racemes, of unpleasant scent. Fruit globose, 1 - 2 cm in diameter, in small racemes. Surface warty and tomentose, green, brown-yellowish when ripe. Containing 1 or 2 seeds; 2,500 - 3,500/kg.

Distribution: In semiarid Africa from Senegal to Ethiopia. Typical Sahelo-Saharan species.

Site requirements: Grows even on very dry, rocky, clayey, stony and lateritic soils. Prefers sandy-clayey plains, fixed dunes, abandoned croplands and termite mounds. Rainfall 100 - 500 mm.

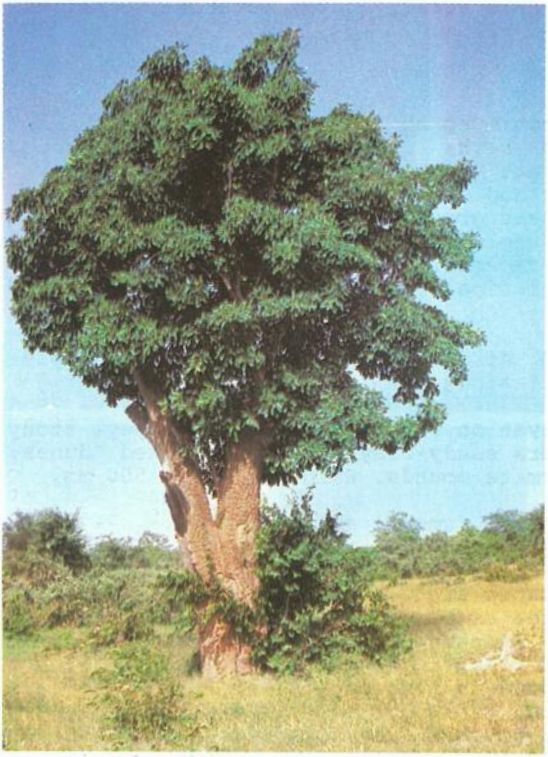
Uses: The wood is used for fuel (smoky) and for poles.

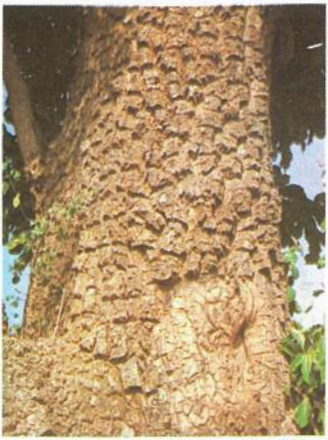
The seeds are an important food; they are dried and prepared like lentils. To remove their acid taste, they should be soaked in water for a week. Also used as flour. Roasted seeds as coffee substitute. The pulp of immature fruit is cooked for human consumption, the pulp of ripe fruits can be eaten raw. Young leaves are edible and prepared as a vegetable. As forage they are not much sought by cattle but eaten by goats and sheep. They are not very palatable but have a very high protein content (about 30 %). As foliage is abundantly available in many places where other forage is scarce (seasonally), processing of the leaves or breeding of more palatable strains should be tried (Baumer 1981). A sweet binder can be obtained by boiling pieces of wood in water.

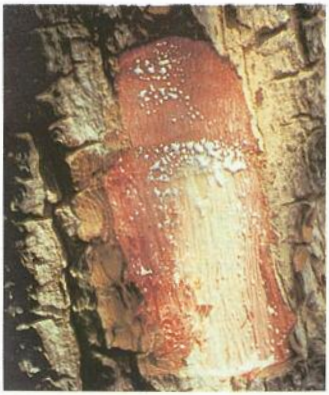
Various medicinal and veterinary (camels) applications. Roots serve as a vermifuge, leaves against bilharziosis and to protect grain in storage bins against bugs, against guinea-worm sores, haemorrhoids, intestinal complaints, headache, ulcers, colics and as an eye-lotion. Fruit for syphilis and various parts for jaundice and swellings.

References: Aubréville (1950), Baumer (1981 + 1983), Geerling (1982), Giffard (1974 A), Kerharo a. Adam (1974), Sahni (1968), Touzeau (1973).

BUTYROSPERMUM PARKII







Butyrospermum parkii (G.Don) Kotschy

Synonyms: Butyrospermum paradoxum subsp. parkii (G.Don) Hepper, Vitellaria paradoxa Gaertn., Bassia parkii G.Don

Family: Sapotaceae

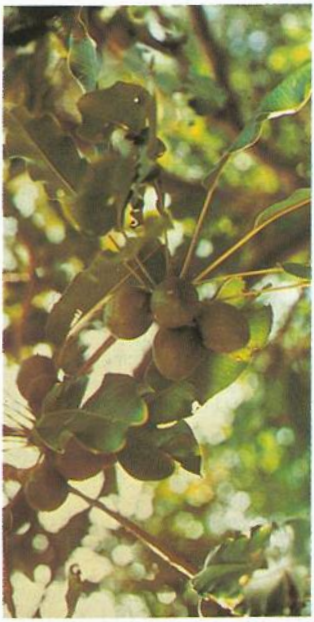
Description: Medium-sized tree, deciduous, 10 - 15 m (rarely up to 25 m) high, of gnarled growth with a round to hemispherical crown. The bark is conspicuously thick, corky, horizontally and longitudinally deeply fissured, protects older trees effectively against bush fires. Slash pale pink, secreting a white latex as do broken twigs or petioles. Leaves in large, dense fascicles spirally arranged at the ends of stout twigs. These are covered by thick bark, showing numerous leaf scars. Petioles 5 - 15 cm long, leaves oblong. Juvenile leaves rust-red and pubescent, later coriaceous, glabrous and dark green, shining, 12 - 25 cm long and 4 - 7 cm wide, leaf margin wavy and bent. At the time of flowering, December to March, the tree is nearly completely covered with green-yellowish flowers in terminal clusters of 30 - 40 each at the generally already leafless branch-tips. Leafing at the end of flowering season. Fruit 5 - 8 cm long and 3 - 4 cm wide, elliptic, a yellow-green or yellow berry with thick butter-like, mucous pericarp; containing generally only one oval or round redbrown seed (the "shea-nut"), surrounded by a fragile, shining shell with a large round, rough hilum on a broad base.

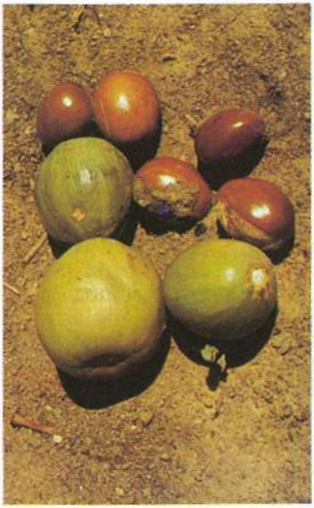
Distribution: In the southernmost parts of the Sahel and the adjacent Sudan and Guinea savannas. Not present in Senegal with the exception of sporadic trees in the extreme southeast, around Tambakounda, Casamance. Dense stands are found from Guinea to Mali, Burkina Faso and Niger, in the north of the Ivory Coast, Ghana, Togo and Benin up to northern Nigeria and Cameroon. East of this region scattered occurrence across Central Africa to Uganda. On the Adamaua plateau/Cameroon it ascends to 1,200 m altitude.

Site requirements: The shea-butter tree prefers dry and sandy clay soils with a good humus cover but also tolerates stony sites and lateritic subsoil although reacting with lower yields. Avoids swampy sites and flood plains inundated for any length of time, moist heavy loam soils or watercourses, prefers moderately fresh subsoil rich in humus. The extensive root system is essential to surviving the seasonal droughts of savanna climates. A light-demanding species of open sites, solitary in parkland savannas. Often associated with other trees, forming extensive pure stands over its principal ranges; grows with annual rainfall of 600 - 1,500 mm.

Propagation and management: The following information is based on trials carried out by the IRHO in Niangoloko, Burkina Faso. Seeding immediately after harvesting into seedbeds or polythene pots. Seeds differ considerably in size, between 150 - 300 seeds/kg. When planting, seeds should be covered by at least 5 cm of soil. Seedlings raised in pots should be outplanted after 14 -

BUTYROSPERMUM PARKII





24 weeks, plants raised in the seedbeds after 12 months as balled planting stock. Wide spacing, site preparation and elimination of weed competition as well as protection against fire and browsing are essential for high rates of survival.

Fire and livestock are presumably the main factors for insufficient natural regeneration. Difficulties in cultivation are aggravated by relatively slow juvenile growth which probably could be accelerated by adding compost and fertilizer. This is a significant argument in favour of planting shea-butter trees on land under agroforestry management. Where precipitation reaches 750 to 1,000 mm a final stocking of 30 - 50 trees per ha seems to be sustainable. In the Sahel proper, cultivation must be restricted to sites with particularly good groundwater conditions, along periodic water courses. The possibilities of propagation by cuttings or root suckers still have to be investigated.

First yields of fruit may be expected after 15 years but through genetic improvement and selection this period could probably be shortened and optimum production extended which generally is not attained before 25 - 40 years of age.

Shea-butter trees are attacked by several specific insects. The larvae of Cirina butyrospermi, Loranthus spp. and Anacridium moestum var. melanorhodon cause damage to leaves, larvae of Mussidia nigrioella and Ceratitis silvestrii parasitize the pulp of mature fruits. Pestalotia heterospora and Fusicladium butyrospermi are microorganisms causing leaf-mosaic-disease. With direct seeding on ground losses are incurred by rodents; storms may damage flowers and fruit.

Uses: The main product is shea-butter ("Karité"), which plays a important role in the economy of many regions, as in the Mossi plateau of Burkina Faso and in Mali. Nevertheless, considerable regional differences exist in the utilization of nuts, which is very extensive in some regions. As one of the few naturally occurring vegetable fat producing plants, cultivation and management of the shea-butter tree should be intensified beyond its role in a subsistence economy.

Several ways of producing shea-butter are known; the following is a procedure used by the Mossi of Burkina Faso:
The ripe fruit is collected under the trees during the rainy season, stored in deep pits, covered with earth and kept moist, causing it to ferment, which facilitates the removal of the fruit pulp.

After cleaning, the seeds (nuts) are boiled and dried for easier separation of the hard brown pericarp from the inner kernel or almond. This separation is achieved by pounding and crushing, while lighter shell particles are removed by shaking and winnowing. Moisture is reduced to approximately 10 % by air-drying to avoid germination or decomposition of the seeds. Now the kernels can be stored for months without spoiling. Further

exported. Within Africa shea-butter products are traded in the form of sun-dried nuts, oil in cans, indurated fat (shea-butter), margarine in tins or as a pounded mass (Kadanya).

The wood is hard, red, termite resistant and has various applications as timber. It makes good charcoal and fuelwood. Because of its high value as a fruit tree there is no felling for fuelwood even if demand is difficult to satisfy. This is clearly demonstrated in the outskirts of Ouagadougou/Burkina Faso.

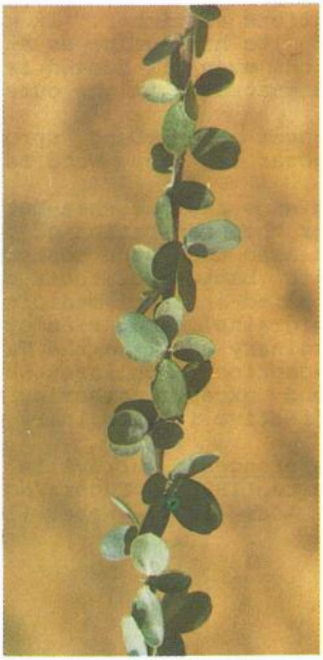
Leaves and young sprouts serve as forage, the flowers yield nectar for bees. Wood ash is used for dyeing.

In some regions shea-butter is used in medicines and particularly for the preparation of ointments for boils and skin diseases. It is also used as a cosmetic. Bark extracts are taken as a drink or bath because of their curative effect. Roots and root bark are applied in local medicine. Leaf decoctions are used for headaches (migraine) and as an eye-lotion. KERHARO/ADAM report an extraordinary use from the Tandanke in east Senegal: They give a bark decoction to children who are two years old and still refuse any food except mother's milk. Parts of the tree are said to be effective in veterinary medicine, especially for horses.

References: Aubréville (1950), Befico (1979), Bulletin Afrique Noire (1980), Esdorn/Nolde/Meyer (1943), Irvine (1961), Kerharo a. Adam (1974), Weber (1977).

CADABA FARINOSA

CADABA GLANDULOSA



Cadaba farinosa Forsk.

Synonym: Cadaba mombassana Gilg et Benedict

Family: Capparidaceae

Description: Low, evergreen, climbing shrub or occasionally a tree up to 5 m high. Bark (dark or yellowish) grey, strongly furrowed. Branches often rigid, pointed at their ends like thorns. Leaves small, on short petioles, along hairy twigs. Leaves 2 - 6 cm long, 0.8 - 2.0 cm wide, glaucous to whitish, oblong, base and apex rounded; midrib prominent. Flowers clustered at the tip of lateral branches or solitary, whitish to green-yellowish, 2 cm long. Fruit a pod on a long peduncle 5 - 6 cm long, rather straight; constricted between seeds, dehiscent, filled with a light yellow to orange-red pulp. Seeds black, comma-shaped, arranged in a single layer. Flowers and fruits appear at the end of the rainy season.

Distribution: Over the entire Sahel from Senegal to Sudan, Ethiopia and Somalia, in East Africa, from the Arabian Peninsula to India. Zaire, Angola. In the Aïr/Niger it ascends to 1,600 m.

Site requirements: Prefers heavy soils, but also grows on sandy soils in plains, on fixed dunes, on boulders and along the banks of periodically inundated depressions ("mares"). Frequently found at the foot or on the stumps of other trees, e.g. associated with Maerua spp., on termite mounds. 200 - 500 mm rainfall.

Uses: Bark, leaves and young twigs are edible. Dried leaves are used for flavouring, macerated flowers as a sweetener. Leaves also in couscous. Leaves, flowers and fruits are browsed by camels, cattle, sheep, goats and various wild animals. High protein content (30 %). Fuelwood. Several applications in local medicine: roots and leaves to treat anthrax (mostly with cattle), cough and rheumatism. Leaves to treat dysentery, colds, dermatological disorders and various internal diseases. Shoots for stomachache, wood ashes for general body pains.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. II (1974), Geerling (1982), Irvine (1961), Kerharo a. Adam (1974), Touzeau (1973).

Cadaba glandulosa Forsk.

Family: Capparidaceae

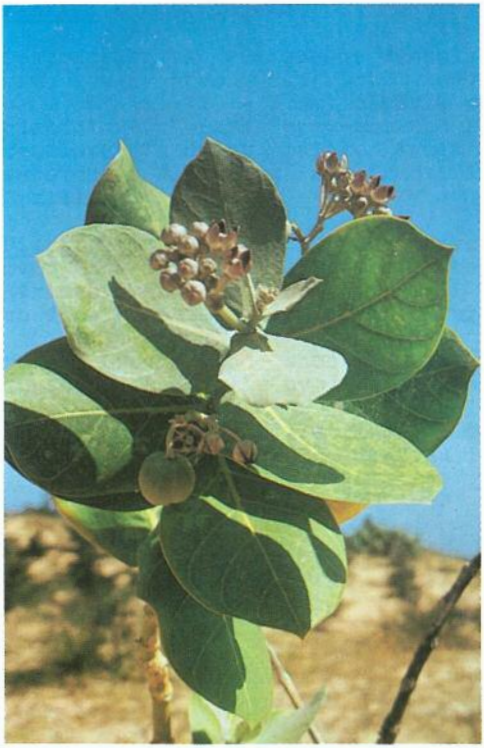
Description: An evergreen, densely branched shrub, about 1 m high with a very strong tap root. Leaves near-orbicular, alternate, very small (1 - 3 cm) clearly petiolate, very setaceous and glandulose. Bark grey-brown. Flowers yellow, 1 cm, with a setulose-glandular calix. Fruit red, rough, 1.5 x 0.7 cm, setulose. Flowering and fructification from December to March/ April.

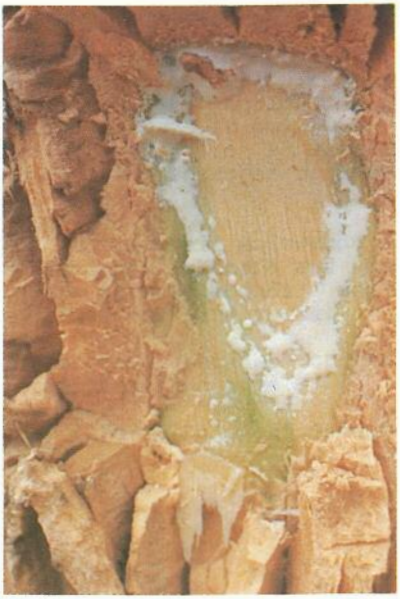
Distribution: From Burkina Faso and Central Mali eastward all over the Sahel up to northern Chad and across Ethiopia and East Africa to the Arabian Peninsula. Prefers termite mounds, medium to fine texture soils, often covered with stones and rocks.

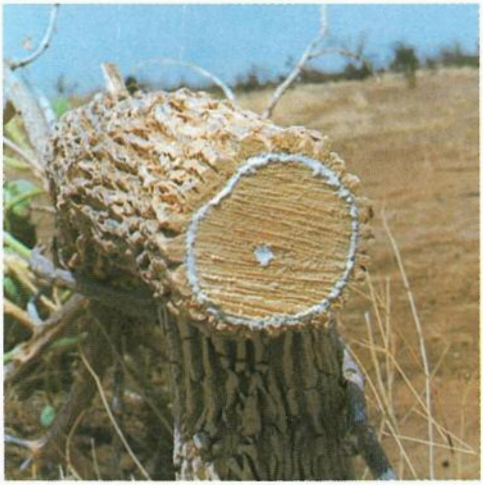
Uses: Leaves and shoots very much browsed because of salt content, especially by camels, small ruminants and game.

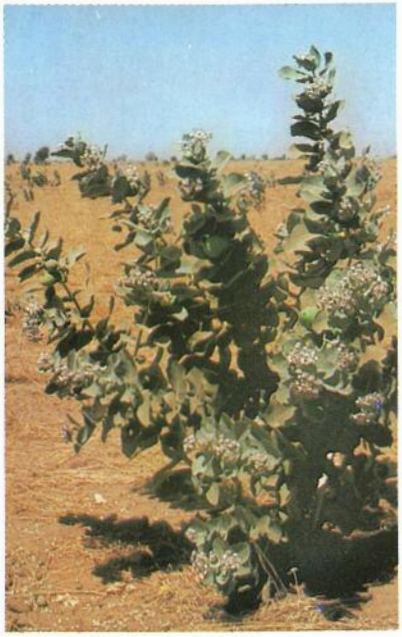
References: Aubréville (1950), Baumer (1983), Dale and Greenway (1961), Geerling (1982), Touzeau (1973).

CALOTROPIS PROCERA









Calotropis procera (Ait.) Ait. F.

Family: Asclepiadaceae

Description: A shrub, up to 5.5 m high, occasionally branchless to a height of 2.5 m. Bark fibrous, scaly, deeply fissured when old, grey to light brown. All parts of the plant exude a white latex when cut or broken. Leaves large, ovate, opposite, sessile, up to 30 cm long and 16 cm wide, greyish-green; base cordate, horizontally stretched. Young leaves and shoots white pubescent. Thick white midrib typical. Flowers in cymes at nodes, white and red brown, during the entire dry season. Corolla 2 - 3 cm, 5 petals, greenish with violet tips. Fruit green, ovoid, 10 cm diameter, fruit pulp thick and spongy. Numerous seeds, surrounded by silky white floss, with a fascicle of white hairs at one end.

Distribution: Entire Sahel, south and north of the Sahara, East Africa, Arabian Peninsula to India.

Site requirements: On fields and fallow land, typically on extremely degraded soils near settlements; in Pakistan up to 1,300 m above sea level. Prefers sandy soils. Sometimes forming pure stands.

Propagation and management: Has been cultivated in South America and on the Caribbean Islands for the production of fibres. Spacing 1.0 - 1.5 m. Early attempts of cultivation (at the beginning of this century) in East Africa failed because of insect pests.

Uses: The strong inner bark fibres produce a binding material and are processed into fabrics. When cultivated, yields of up to 500 kg of fibre per hectare and year are expected. The inner bark is stripped, soaked in water for 1 - 2 days and dried. Thereafter the fibre can be easily removed. However, excessive soaking decreases fibre strength. Seed floss can be used as a kapok substitute for stuffing cushions. It was formerly exported. Leaves and green fruit are eaten by goats, occasionally by sheep in times of need, rarely by cattle and other livestock (slightly toxic).

The latex has a caustic, biting taste. It contains calotropin, a glucoside with effects comparable to digitalin. It also contains calactin, calotoxin, uscharin and uscharidin. It is poisonous (cardiotoxic).

Numerous applications in medicine make Calotropis a valuable plant although it is generally regarded as a weed. It would be desirable to find out whether its uses may be intensified so that cultivation would be profitable. The bark is used as an aphrodisiac, laxative and poison antidote, for ointments and has an emetic effect.

Bark and wood stimulate lactation with cattle. Roots (extremely poisonous!) are applied for snakebite.

The latex is used for ringworm and for the treatment of Guinea worm blisters and scorpion stings, venereal sores and ophthalmic disorders; also as a laxative.

The twigs are applied for the preparation of diuretics, stomach tonic and antidiarrhoetics; for asthma. Various parts against leprosy and arthritis; as analgetic.

The latex is widely used for the production of arrow poison and as an additive to curdle milk; the leaves are said to purify water.

The very light wood provides a charcoal for special applications and is used for tinder or floats for fishing nets. Charcoal from the pith was used in gunpowder. In some places, poles of Calotropis are used for construction of light roofs. They are said to be termite resistant. Leafy branches are reported to deter ants.

References: Aubréville (1950), Berhaut Vol. I (1971), Dale and Greenway (1961), Geerling (1982), Giffard (1974 A), Hallam (1979), Irvine (1961), Touzeau (1973), Wazir/Shah (1977).

CAPPARIS DECIDUA

CAPPARIS CORYMBOSA

Capparis spp.

Family: Capparidaceae

Among the various species of Capparis growing in the Sahel, the following three deserve a mention. All three species are climbing shrubs with paired, claw-shaped spines, widely distributed in the Sahel up to East Africa. They grow on dry sites, preferably on sandy soils and along embankments.

1. Capparis corymbosa Lam.

Synonym: Capparis sepiaria L.

Description: Bark scaly and dark grey. Slash pale red. Corymbs of 10 - 15 white or cream coloured (pinkish) flowers at the end of the branches. Size of the single flower ca. 1.5 cm. Spherical red fruits of 0.8 to 1.5 cm diameter. Leaves alternate, generally pubescent, obovate, ovate or elliptic, 0.4 to 4 cm long. Leaf tips emarginate and mucronate, base rounded or subcordate. Spines less than 0.5 m long. This common species grows throughout the Sahel and Sudan savannas, preferably on termite mounds, often forming impenetrable thickets on clay soils of depressions and seasonally flooded areas with (iron) hardpans.

Uses: The roots are said to be (very) poisonous, while other parts may be noxious or at least unpalatable. However, leaves are eaten cooked in times of emergency. The fruits with an ether-like taste are considered to be an aphrodisiac. Bark and roots are applied for wound dressing. Dry branches make a good fuelwood.

2. Capparis decidua (Forsk.) Edgew.

Synonyms: Sodada decidua Forsk., Capparis aphylla Hayne ex Roth.

Description: Has very small leaves which only appear during the short rainy season. Flowers at the beginning of the dry season pink to red, solitary or up to 3 in the leaf axils, 1 to 1.5 cm in size. Bark smooth, green-yellow. Branches green-glaucous, vine-like, hanging in bundles. Spines in pairs, clawshaped, light brown, up to 0.5 cm long. Globose red fruits, about 1 cm in diameter, black when ripe and dry.

Distribution and site requirements: Grows in very arid regions of the northern Sahel and in the Sahara, in parts of the Sudan, East and South Africa (Natal), and from the Arabian peninsula to India. Sometimes forming rather dense stands. Prefers loamy clay, is very resistant to drought, grows with 100 mm of annual rainfall.

Uses: Fruits are said to be edible, and wood ash is used as a vegetable salt. Saddles, water pipes, etc. are made from the wood. Shoots and leaves are eaten by camels, sheep and goats.

Various uses in local medicine: roots and root bark for fever and rheumatism, bark for gonorrhoea and diarrhoea. Roots and leaves are applied in cases of enlarged spleen, jaundice and venereal diseases, fevers, rheumatism, boils and other skin diseases.

3. Capparis tomentosa Lam.

Synonyms: Capparis persicifolia A. Rich., Capparis puberula DC.

Description: Leaves always oblong and measuring 3 to 8 x 1.5 to 3 cm, greyish pubescent. Flowers solitary, up to 5 cm large, white or pink, at the axils of leaves at the end of branches. The globose fruits are yellow-orange and may attain a diameter of up to 6 cm.

Uses: Capparis tomentosa provides good camel forage but is said to be poisonous to other animals. However, in South Africa it is generally regarded as an important browse.

Leaves and fruits are edible. Bark and roots are applied in local medicine for leprosy, venereal diseases, ophthalmia, snake-bites, as a general panacea and for wound-dressing.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. II (1974), Irvine (1961), Dale a. Greenway (1961), Geerling (1982), Palmer/Pitman (1972), Touzeau (1973).

CASSIA SIAMEA

Cassia siamea Lam.

Family: Caesalpiniaceae

Description: Small to medium-sized evergreen tree, up to 5 m on favourable sites in the south Sahel, (in other zones up to 15 - 20 m), very often shrub-like branch-formation. Leaves bipinnate, alternate, rachis 25 - 30 cm long with a marked furrow, 8 - 13 pairs of leaflets of different size. Leaflets oblong, rounded at the base and at the apex, slightly retuse. Upper side dark green, shining, underside dull-green, shortly haired. Flowers yellow, up to 3.5 cm long, in dense racemes at the end of shoots and in the axils. Racemes 15 - 30 cm long. Glabrous, brown, slightly curved pods in dense clusters, up to 25 cm long with about 20 seeds.

Distribution: Originates in Southeast Asia, particularly South India, Burma, Sri Lanka, Indonesia, Malaysia. Today pantropical, cultivated from subhumid to semiarid regions.

Site requirements: Prospers with 1,000 - 1,500 mm of annual rainfall but grows also with barely 500 mm. Tolerates even extended drought, however in the Sahel only with sufficient soil water supplies and in the southernmost part if the roots have access to deep soil moisture. Requires deep soils which are sufficiently fresh, not too poor, not skeletal.

Propagation and management: Not suitable for large-area plantations in the Sahel. However used as fast-growing species in the Sudan and Guinea zones for the production of fuelwood and pole timber. Regenerates quickly and reliably from coppices (which are frequently more vigorous than first-generation growth). Rotation 4 - 7 years.

Propagated by direct seeding, stumps or nursery stock (which is superior). 35,000 - 40,000 seeds/kg. Under normal conditions, seeds remain viable for 2 - 3 years. Treatment of fresh seeds unnecessary, but older seeds must be scarified. Young plants are very fire-sensitive; various parasites may damage the root system.

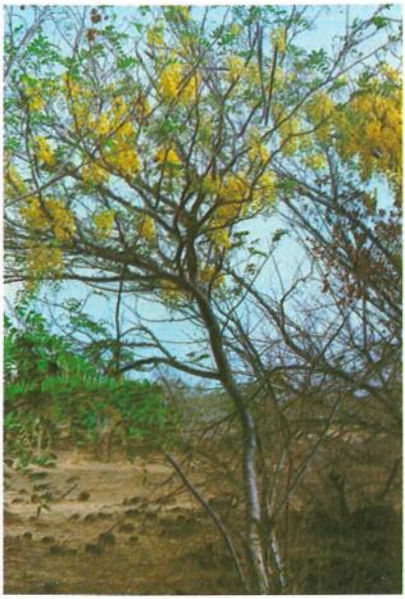
Uses: Cultivated all over the tropics as fuelwood. Wood heavy (specific gravity 0.6 - 0.8) and hard, but splits easily; rapidly attacked by insects. The heartwood is dark, almost black, with yellow streaks. With sufficient dimensions suitable for furniture (partridge wood) turnery, cabinet work. Poles, posts are widely used. Leaves are browsed by livestock but, like the pods and seeds, they are highly toxic to pigs (and possibly other non-ruminants). Leaves, bark and fruit contain some tannin.

Suitable for shelterbelt plantations but not as shade tree in agroforestry projects (root competition). In the southern Sahel used for roadside planting or in courtyards. In more humid areas widely distributed as ornamental species in gardens, for line planting, on public squares but also as village shade-tree and for wind-protection.

The heartwood has laxative, blood-cleaning properties and is used for a variety of ailments concerning the blood forming organs, digestive system and genitourinary disorders. It is also applied for herpes and rhinitis. Leaves are said to be poisonous. Where eaten, they are soaked in boiling water which is then discarded.

References: Cassia spp. (1960), Berhaut Vol. IV (1975), Giffard (1974 A), Irvine (1961), Kerharo a. Adam (1974), Little (1983), Weber (1977).

CASSIA SIEBERIANA



Cassia sieberiana DC.

Synonym: Cassia kotschyana Oliv.

Family: Caesalpiniaceae

Description: A deciduous tree, 10 - 20 m high. Bark dark grey to blackish and wrinkled with shallow vertical fissures and large reddish, horizontally arranged lenticels. Slash yellow to ochre. Rachis 20 - 30 cm, with 7 - 10 pairs of leaflets, of variable shape, not acuminate, 5 - 10 cm long, 2.5 - 5 cm wide. Leaves on the upper side weakly shining, underside with fine nerves; stipules deciduous. Flowers very handsome, bright yellow, in either upright or pendulous racemes, 30 - 50 cm long, during the dry season when the tree is leafless (February - May). Five sepals and five bracts each, petals elliptic 15 - 20 cm long, sepals 6 - 7 mm, green; 10 stamens. Fruit a cylindrical pod, very long (40 - 80 cm) dark brown or black, corky, transversally subdivided between the very numerous seeds, indehiscent; remains on the tree for a long time, breaking into segments. Maturity: September - February.

Distribution: In the southern Sahel and in the Sudan savanna from Senegal to Sudan and Uganda.

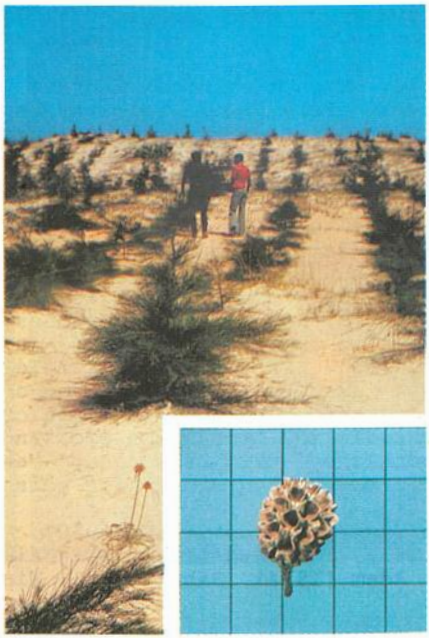
Site requirements: Prefers well-drained, humid soils (gallery forests) in regions with at least 500 mm of annual rainfall. Grows as a shrub on lateritic and very dry sites, often in groups.

Propagation and management: 7,000 - 16,500 seeds/kg. As with acacias, seeds have to be soaked in boiling water. Coppices.

Uses: The heartwood is pale pink, darkening when exposed to light. Very hard, termite-resistant. Many applications in local construction and for the manufacture of tools. Used for cabinet work, turnery, carpentry, furniture, wheel work, pestles, mortars, tool-handles.
Because of smoke only limited use as fuelwood. Occasionally used for shelterbelts and ornamental plantations. The latter should be particularly encouraged.
Various medicinal uses, for example, roots as a diuretic and vermifuge, for elephantiasis, leprosy, diarrhoea, haemorrhoids, dysentery and venereal diseases; when cut in pieces, macerated in water and honey for 3 days, a beverage for bilharziasis can be obtained. Leaves to treat fever, pleuritis, burns and ulcers or as a laxative; gum for wound dressing. Pods for fever, jaundice, stomachache, gonorrhea and ulcers, as a vermifuge, laxative or aphrodisiac, for wound dressing. Uses of various parts to cure toothache, skin diseases, varicose veins, etc. The roots are reported to contain a fish poison.

References: Aubréville (1950), Berhaut Vol. IV (1974), Geerling (1982), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo a. Adam (1974), Sahni (968), Wickens (1980).

CASUARINA EQUISETIFOLIA



Casuarina equisetifolia J.R. et G.Forst.

Synonym: Casuarina litorea L.

Description: Casuarina equisetifolia is a tree which may reach a height of 25(30) m under favourable conditions and approximately 6 to 12 m in the Sahel. Not only the foliage, but also form and shape resemble a conifer, which has occasionally caused confusion. The foliage consists of long "needles" which are actually modified branchlets. The leaves are very small scales and look like whorls of tiny teeth. Their number is used to identify the about 80 Casuarina species. C. equisetifolia has 6 - 8 such scale leaves in a ring. It is easy to pull the segments of the branchlets apart, which distinguishes them clearly from conifer needles. The shape of the branchlets and their thick waxy cuticle help the tree to resist drought and salt. Casuarina equisetifolia has very reduced male and female flowers (monoecious). The female inflorescence develops into a small (1 - 2 by 1 - 1.5 cm) woody "cone", which has beak-like valves, containing a great number of tiny winged seeds.

The root hairs of Casuarina, in combination with the actinomycete Frankia, form small nodules which are able to fix nitrogen actively. Two subspecies of Casuarina equisetifolia are recognized: ssp. equisetifolia, which is generally used for planting and has a tall stem, and ssp. incana, a rather small tree or shrub of local importance only outside the Sahel.

Distribution: The natural distribution of subspecies equisetifolia extends along the sea coasts from Malaysia to subtropical Australia, Melanesia, Micronesia, the Philippines and Polynesia. Wide distribution as an exotic in tropical/subtropical coastal regions. In Senegal, introduced in 1925, it is now extensively used to stabilize the coastal sand dunes between Dakar and St. Louis. Occasional planting in gardens, along roadsides.

Site requirements: The species grows well on deep sandy soils, tolerates calcareous and slightly saline sites (subspecies incana is highly salt tolerant: up to 550 m mol dm $^{-3}$ NaCl). It can withstand waterlogging for short periods, but growth is inhibited by compacted soil layers. In its natural habitat annual rainfall varies between 700 and 2,000 mm. Plantations in other parts of the world have been successfully established with a little as 200 - 300 mm, if ground water is available (not deeper than 3 - 4 m). This, for example, is the case in Senegal. Young trees are especially sensitive to competition from grass or plants for light. Casuarina equisetifolia, on the other hand, can exhaust soil moisture, lower the ground water table, and degrade soils by its thick litter of branchlets. The copious litter may even be toxic to (underbrush or nearby) plants.

Propagation and management: Propagation is generally by seeds, obtained from the cones which have been placed in the sun to dry. Seeds may be stored over two years at low temperatures (-7 to + 3°C and low humidity, less than 15 %) Their weight appears to

vary considerably between 600,000 and 1.4 million/kg (average about 650,000). Seedlings raised in nurseries may be planted bare-rooted, but ectomycorrhizae and endomycorrhizae significantly enhance the adaptability of the trees and their ability to grow in newly established plantations and on marginal sites. Thus, transplanting in polythene bags with inoculated soils with Frankia actinomycete is recommended for afforestation. In sand dune fixation, the following techniques should be considered (Andéké-Lengui and Dommergues 1983): A foredune (barrierdune) must be established one year before the plantations are initiated. Temporary sand stabilization is then achieved by building picket-fences or other shelter. Seedlings are planted 2 x 3 m after the first rains have totalled 30 - 40 mm. The earth in the plastic pouches has to be inoculated with Rhizobium. Initial growth is fast but subject to phosphorus availability.

Vegetative propagation by rootsuckers and possibly also by cuttings has generally not been successful. Casuarinas are not severely attacked by pests and diseases, but they are very fire-sensitive and also easily damaged by browsing.

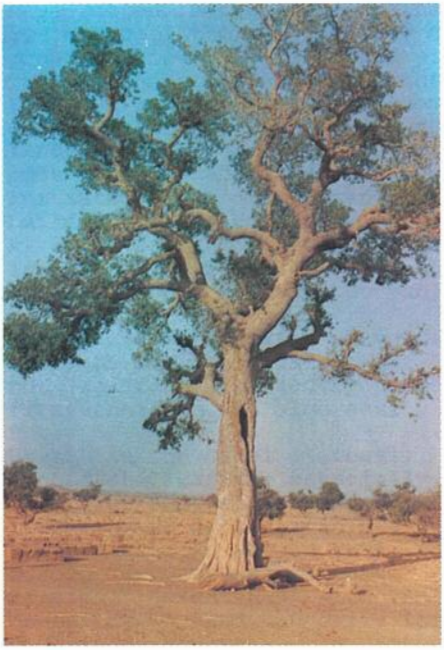
Uses: In the Sahel (Senegal), Casuarina is mainly used for sand dune stabilization, especially along the coastline (Niayes) up to the river Senegal estuary ("Langue de Barbarie"). Low branches, touching the ground, can often root and develop upright branches. Root suckering should be tried to improve stand densities. The strong network of lateral roots also helps to reduce soil erosion. Casuarinas with their wind resistance, rapid growth, dense crown and longevity form excellent shelterbelts. Alley cropping, however, can not be generally recommended, although some nitrogen fixation takes place, because of the tree's incompatability with many plant species. Swampy sites may be drained by Casuarina plantations.

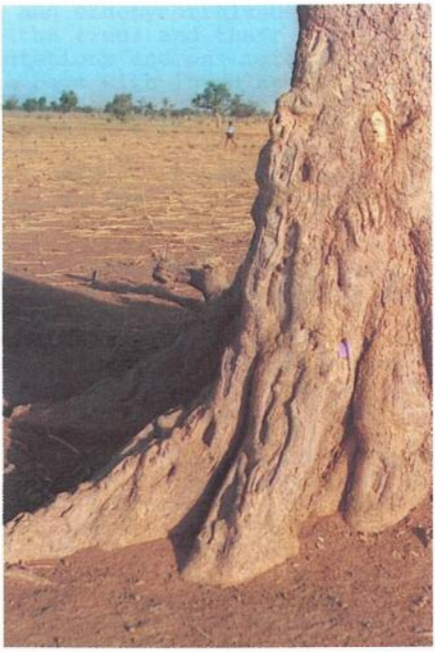
The wood, one of the hardest in the world, is heavy and difficult to saw. It tends to split, crack and warp as it dries. Posts are used for fencing, small utensils and for freshwater piling and bridge construction. The wood is susceptible to attack by dry-wood termites and not durable in the ground. It is an excellent fuel, due to its high specific gravity (0.8 to 1.2) and calorific value (5,000 kcal per kg). It splits easily and burns slowly with little smoke and few ashes. Charcoal yields are high, and charcoal made from stems, branches and roots is of good quality.

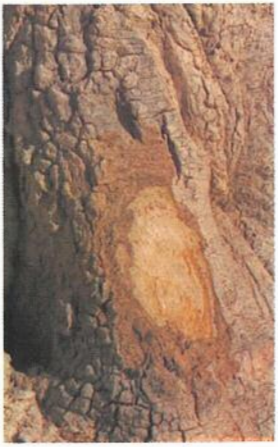
The bark contains up to 18 % tannin and a red dye. Many parts of the tree are used for medicinal purposes in Southeast Asia and Australia, but these have not yet been accepted by the people of the Sahel.

References: Andéké-Lengui a. Dommergues (1983), Baumer (1983), Berhaut Vol. II. (1974), Buffe (1962), Dale a. Greenway (1961), Giffard (1974 A), Goor a. Barney (1976), Irvine (1961), Kerharo a. Adam (1974), Little (1983), Maheut a. Dommergues (1959), Midgley et al. (1983), National Research Council (1984).

CELTIS INTEGRIFOLIA







Celtis integrifolia Lam.

Family: Ulmaceae

Description: A large tree, up to 25 m high, with a distinct bole which may attain a diameter of 1.5 m. Root collar frequently swollen or with small buttresses. Bark grey and smooth, on old trees scaly; slash cream-coloured and fibrous. Leaves alternate, obliquely ovate, asymmetric, acuminate. They are greyish pubescent (rough) with exerted palmate nervature beneath. Margin generally entire, sometimes serrate. Twigs green, covered with whitish-grey hairs. Numerous small monoecious flowers, greenish, in axillary clusters on one-year-old shoots. Flowering from February to April. Fruits ovoid or elliptical, about 1 cm long, fleshy and single-seeded. Seeds white, covered with a distinct white network. 4,000 to 10,000 seeds/kg.

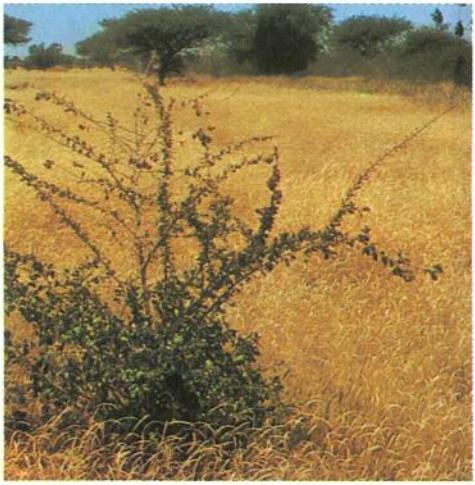
Distribution: In tropical Africa north of the equator from Senegal to East Africa, from 3 to 16 degrees northern latitude and on the Arabian Peninsula.

Site requirements: Requires annual rainfalls between 500 and 700 mm; in the Sahel preferably in gallery forests, depressions and around waterholes.

Uses: The pale yellow wood is easy to work but not very resistant. Its main advantages are the frequently large dimensions. Leaves are used in soups, sometimes together with those of Adansonia digitata. Fresh fruits, young leaves edible as salad or in combination with groundnuts. Leaves and shoots as forage during the dry season. Most trees are stunted by continous lopping which causes the false impression that the trees have predominantly small or open crowns. Inner bark fibres are used for the manufacture of mats. In local medicine, the bark is applied for rheumatism. Various parts of the tree serve to treat sterility, headache, boils, oedema and asthenia, for wound-dressing, as a vermifuge and as a remedy to facilitate delivery. The roots are applied to cure mental disorders.

References: Aubréville (1950), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo a. Adam (1974), Sahni (1968).

COMBRETUM ACULEATUM



Combretum aculeatum Vent.

Family: Combretaceae

Description: Generally a small climbing shrub, in areas with high livestock density frequently strongly stunted by browsing, hence only a few, lignified sprouts survive. Young leaves, nerves and inflorescences reddish pubescent. Leaves deciduous, small, alternate or opposite and of distinctly unequal size on the same branch (1 - 5 cm long, 0.8 - 3 cm wide), ovate or elliptic, apex rounded to acuminate, dark green. 4 - 6 lateral nerves; stipules pubescent, 0.3 - 1.0 cm; their bases develop into woody, recurved thorns permitting the branches to climb adjacent trees/shrubs. Flowers in small racemes, flower approximately 1.3 cm, pubescent; petals white, completely separate. Fruits yellow-brown, with five wings (species characteristic) size 2 by 2 cm; approximately 17,000 seeds/kg.

Distribution: Sahel, northernmost of tropical African Combretaceae, from the Atlantic to the Red Sea.

Site requirements: On sandy, stony and clayey soils of the Sahel zone, tolerates inundation; in the Sudano-Sahel zone on termite mounds.

Uses: Wood of sufficient dimensions for fuelwood or charcoal, shoots used for wickerwork, baskets, fish traps. Seeds edible.

Combretum aculeatum is a preferred browse of wild and domestic animals. Also fallen dry leaves are eaten. Stimulation of natural regeneration or cultivation for forage purposes should be tried. Rapid regeneration is possible from coppice, seeds (60 - 80 % germination) and root suckers. Le Houerou (1980 A, p. 89) gives the following figures of the feed value:
Crude protein 16 % (7 - 30 %),
minerals 10 %(7 - 12 %),
P 0,23 (0.10 - 0.50),
digestible protein per F.U. 137 (45 - 298),
net energy 5.6 MJ kg DM (4.6 - 6.3).

Various applications in local medicine. The roots are used to treat gonorrhoea, round worm, catarrh and gastric disorders, as a laxative and for wound-dressing. Leaves as a laxative and diuretic; the sap for ophthalmic disorders, an infusion from the twigs helps teething children. Various parts of the plant to treat leprosy and used as a fish poison.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. II (1974), C.T.F.T. (1978), Dale a. Greenway (1961), Geerling (1982), Giffard (1974 A), le Houerou (1980A), Irvine (1961), Kerharo and Adam (1974).

COMBRETUM GLUTINOSUM

Combretum glutinosum Perrott. ex DC.

Synonyms: Combretum etessei Aubrév., Combretum passargei Engl. et Diels, Combretum leonense Engl. et Diels

Family: Combretaceae

Description: A small tree or shrub, up to 12 m, to be identified by its big, thick leaves, whitish below, with 7 - 12 pairs of prominent secondary nerves and parallel tertiary nerves. Young leaves are covered with a glutinous secretion (dust-binder) which becomes glossy when dry. Twigs bear a typical tomentose cover, always perceptible with a magnifying glass, and a reliable identification feature. Leaves of variable shape, even on the same plant. Bark grey with a warted surface, slash red/pink, sapwood yellow. Small yellow-green inflorescences in axillary clusters (6 - 10 cm). Fruit four-winged, always without scales (species characteristic), somewhat viscid, 2.5 - 3.0 cm long, approximately 3 cm in diameter, green and spindle-shaped in the juvenile phase, light red when mature. 20,000 seeds/kg.

Distribution: From Senegal and the western Sahel to Cameroon; extends east to the Sudan. Abundant in the sands to the east of the Niger river and northern Nigeria.

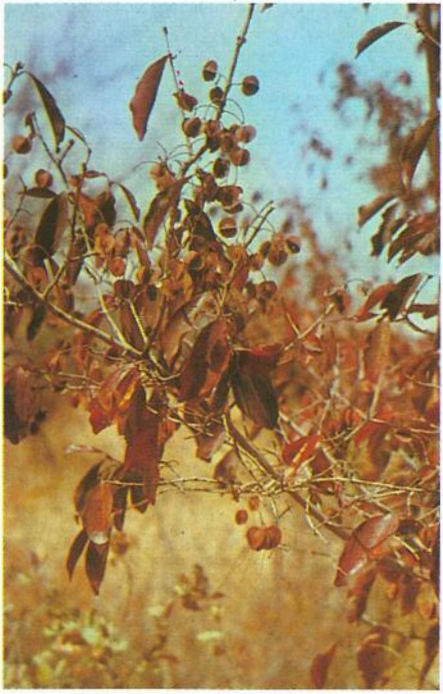
Site requirements: In the Sahel on dunes, in the Sudan-Sahel on skeletal soils, in the Sudan on laterite; colonizes fallow land, grows also along seasonally inundated depressions ("mare").

Uses: The wood is yellow, hard, heavy (900 kg per m^3) and relatively resistant. Used in hut construction, for tools; makes excellent fuelwood and charcoal. Plantations should be tried. Bark, leaf and root extracts produce a yellow dye which is commonly used. Ashes for fixing indigo-blue colouring. In times of dearth browsed by livestock.

A species with particularly many applications in local medicine. The bark is used to treat influenza and rheumatism, for wound dressing. Roots: as anthelmintic, for cough, gonorrhoea and gastric disorders. Leaves: for malaria, bleeding, haematoma, biliary diseases, headache, sores, rheumatism and colic, for wound-dressing and as a diuretic. Young shoots and bark as an aphrodisiac. Fruit and seeds for syphilis and boils; seeds for wounds and in veterinary treatments. A tea from dried leaves ("Rat") is commonly used in Senegal, The Gambia and other countries. From the tree's sap a drink is prepared for pregnant women. BAUMER (1983) records that a stem of Combretum glutinosum is often used as a calendar in the villages, and an incision is made in it every year.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. II (1974), C.T.F.T. (1978), Geerling (1982), Hallam (1979), Irvine (1961), Kerharo a. Adam (1974), Sahni (1968), Touzeau (1973).

COMBRETUM MICRANTHUM



Combretum micranthum G. DON

Synonyms: Combretum altum Perr., Combretum floribundum Engl. et Diels, Combretum raimbaultii Heck, Combretum parviflorum Reichb.

Family: Combretaceae

Description: A shrub, up to 4 m, as a tree under favourable conditions 10 m high. The brown-red, climbing branches may reach a length of 20 m. Slash reddish. Leaves alternate, shining light green when young, typically rust-coloured when mature (in the dry season). Leaf shape variable, oblong-elliptic, up to 10 cm long, acuminate, on the inner side single tufts of hair in the axils. Young twigs, leaves and inflorescences scaly. Midrib and petiole sometimes pubescent. 5 pairs of lateral nerves. Small white flowers in dense racemes (2 - 5 cm long). Fruit with 4 wings, brown, scaly, ferruginous, about 1.5 cm in diameter.

Distribution: Very frequent all over the Sahel, often forms dense, pure stands; from Senegal to Niger, The Gambia, Burkina Faso, Nigeria, Sudan. Successfully introduced into Vietnam in the 1950's.

Site requirements: On dry sites: sandstone, clay, laterite, crystalline rocks, on skeletal soils, on boulders in the Sudan zone. Often associated with Acacia machrostachya and Combretum nigricans. An indicator of extremely unfavourable (no longer cultivable) soils. In zones with sandy soils also found alonhe banks of seasonally inundated depressions ("mare"). Annual rainfalls between 300 and 1,500 mm, altitudes from sea level to 1,000 m.

Propagation by seeds and layering, 13,500 - 30,000 seeds/kg. The roots are very susceptible to termite attack.

Uses: In many countries the leaves are used and traded as tea (Kinkeliba of Senegal). It is refreshing and has curative effects. The seeds are edible.
The wood is used for fuel and, in the Sokoto/Nigeria, for charcoal, saplings for hut construction, basket manufacture and furniture, the inner bark fibres for binding and plaiting. Various medicinal uses: roots to treat sterility, fever and sores, as an eye-rinse, vermifuge and diuretic, for venereal diseases. Leaves as an antipyretic, diuretic and for various diseases such as yellow fever, hepatic disorder, etc., especially as a tea for all disorders of the respiratory system, then sweetened with sugar or honey. The bark for massages and the fruit in ointments. Various parts of the plant for malaria, beriberi, leprosy, cough, bronchitis, gastric disorders and diarrhoea, as a laxative and for wound-dressing.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. II (1974), Bognounou (1975), Geerling (1982), Giffard (1974 A), Hallam (1979), Kerharo a. Adam (1974), National Academy of Sciences (1983), Touzeau (1973).

COMBRETUM NIGRICANS

Combretum nigricans Lepr. ex Guill. et Perrott.

Synonyms: Combretum elliotii Engl. et Diels, Combretum lecananthum Engl. et Diels

Family: Combretaceae

Description: Several varieties, in the Sahel particularly var. elliotii (Engl. et Diels) Aubrév., with glabrous leaves. Small tree or shrub, up to 10 m, with a short bole; frequently spiral-grained, bark beige-brownish-reddish and warty. Leaves opposite, acuminate, elliptic, about 3 x 7 cm. Young branchlets and leaves slightly pubescent, with small, yellowish glands on the underside. Tufts of hair in the nerve axils. Flowers greenish-white, in axillary racemes, 3 - 5 cm long. Fruit reddish, four-winged, glabrous, scaly or sticky in the centre; of different size, approx. 2.5 cm in diameter.

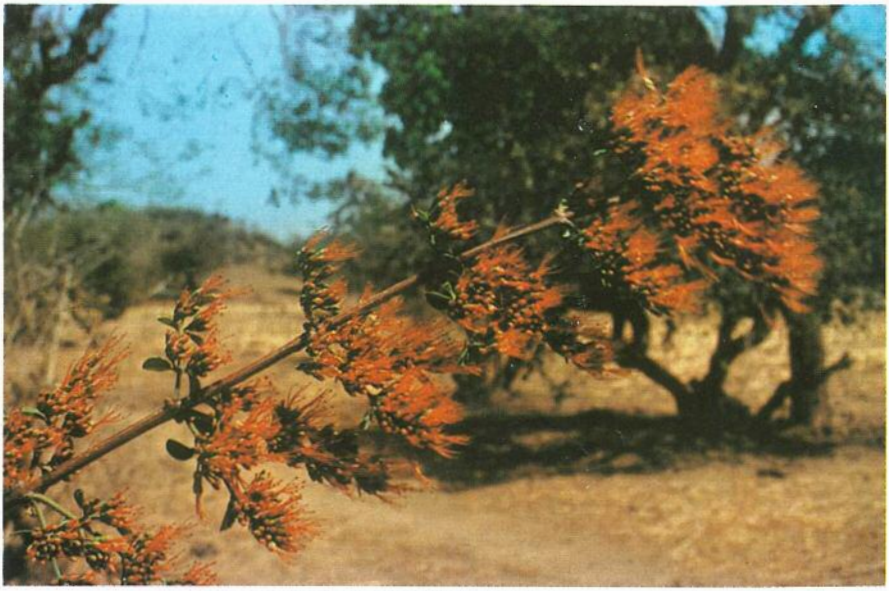
Distribution: Widespread from the Atlantic coast to the Red Sea, particularly in the Sudan and Guinea savannas, rarely in the Sahel.

Site requirements: Frequently on clayey, loamy or lateritic soils; skeletal soils.

Uses: The leaves are used for preparing a commonly known tea. The tree yields edible gum which is traded on local markets. It has good adhesive properties but is also used in tanning and leatherwash, for ink. Wood yellow, hard, relatively durable. Makes good fuelwood and charcoal, pestles for mortars. A fish and crocodile poison is obtained from leaves and branches. Leaves are said to be unpalatable for livestock. Leaves, branches, bark roots are used for internal ailments, and to cure rheumatism, headache, coughs, gastro-intestinal disorders and hepatic troubles.

References Aubréville (1950), Berhaut Vol. II (1974), Geerling (1982), Giffard (1974 A), Irvine (1961).

COMBRETUM PANICULATUM



Combretum paniculatum Vent.

Synonyms: Combretum ramosissimum Engl. et Diels, Combretum pincianum Hook, Combretum abbreviatum Engl.et Diels

Family: Combretaceae

Description: A climbing shrub with striking, flaming red flowers during the dry season. Bark brown-grey with small scales, slash light brown. Short stiff thorns on the branches; leaves broad and elliptic, alternate or in triplets, 10 x 20 cm, acuminate with short petioles; upper side shining, underside dull. Midrib pubescent on both sides. Flowers vermilion, in numerous panicles on the sprouts; calyx reddish green, pubescent, 4 - 5 mm, with four toothlets, exceeded by the numerous, red stamens, 10 - 12 mm long. Fruit pink or orange, up to 3 cm in diameter, four-winged, glabrous, sometimes in dense clusters.

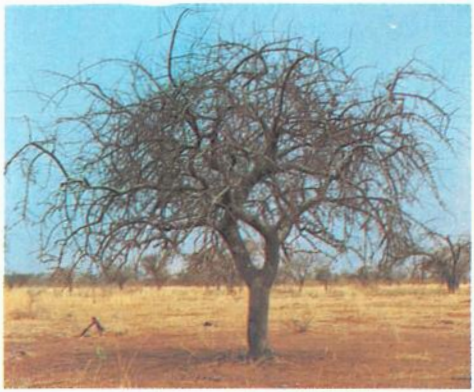
Distribution: Savannas and gallery forest, Senegal, The Gambia, Cameroon, Nigeria, Burkina Faso, East Africa, Central Africa. Only in the southern part of the Sahel.

Site requirements: Tolerates inundations; in river valleys and depressions, along water courses. Gallery forests.

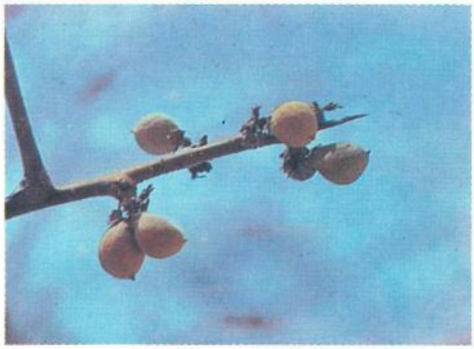
Uses: Flowers and young leaves are edible. Wood used for tool handles, plaiting work. Ornamental plant. Medicinal applications: for washing of sick children, infusions for stomachache etc. The roots are used for diarrhoea.

References: Berhaut Vol. II (1974), Geerling (1982), Hallam (1979), Irvine (1961), Kerharo a. Adam (1974).

COMMIPHORA AFRICANA








Commiphora africana (A. Rich.) Engl.

Synonyms: Heudelotia africana A. Rich., Commiphora pilosa Engl., Commiphora calcicola Engl., Balsamodendron africanum Arn.

Family: Burseraceae

Description: A deciduous shrub or small tree, 3 - 5 m (occasionally 10 m high). Strongly branched, dense spherical crown with bent main branches, giving rise to short, straight secondaries which are lignified and shaped like elongated thorns. Bark green or dark brown, peeling in papery scales; lesions secrete a light resin. Slash red. Young twigs densely tomentose, terminating in thorns. Leaves on long pubescent petioles, 3 to 5 foliate, approximately 4 x 2.5 cm, pubescent, fragrant when crushed. The upper surface of the leaves is waxy grey-green, the lower surface pale. The terminal leaflet is the largest, often ovate. Margin sinuate. Flowers at the end of the rainy season small, red, short axillary clusters, occasionally even on the thorns, prior to foliation. Calyx red, tubular, 4 mm. Fruit globose or elliptic up to 0.8 mm in diameter, red when mature. Fruit pulp very resinous; kernel white; approximately 8,000 seeds/kg.

Distribution: In dry forests, savannas and in the Sahel; occurring all over arid tropical Africa; not in the rainforest zone.

Site requirements: On sandy plains, but also on rocky slopes, boulders, clay soils, lateritic crusts, prefers calcareous soils; very low requirements for soil moisture. 200 - 800 mm of rainfall.

Propagation and management: Easy to propagate with cuttings; particularly suitable for live fences and hedges.

Uses: Root, leaves and fruits are edible. The leaves are also browsed by livestock (especially camels and goats at the end of the dry season when the tree comes into leaf). Commiphora africana is of outstanding importance for many nomadic herdsmen in the northern parts of the Sahel (see CLANET and GILLET, 1980).

For the Toubous, Dazas and Arabs in Niger and Chad "formations of Commiphora africana represent not merely a providential browse resource to be used only at a clearly defined moment of the season, but also determine all camel and goat movements before the onset of the rainy season".

Among the many advantages quoted by the herdsmen are that "the density of Commiphora africana stands mean that the animals hardly have to move to obtain their feed ration. When their appetites are satified they can lie down to ruminate under the shade of the trees, which, although limited, is valuable in these areas during the sultry months. A further advantage is the fact that the trees are concentrated, thereby preventing the camels,

which are always very difficult to supervise at this time of the year and are thus easily rustled,*) from wandering too far, since as soon as they scent the first smell of distant rain they head straight towards it, often covering twenty or thirty kilometers before stopping. Fetching them requires extensive journeys. Finally, "digi" grazings avoid the need for southward migration, thereby keeping the animals away from mosquitoes and flies, and thus from the diseases for which these insects act as vectors. Again from the point of view of disease prevention, the fact that each basin contains a single isolated colony of Commiphora africana prevents the joint utilization of this shrubland grazing by herds from other localities, each depression harbouring no more than one or two families of nomads with their livestock." (CLANET and GILLET 1980).

The nutritive value of the leaves (le HOUEROU 1980A, p. 88) is considered to have a good average with 8 - 14 % crude protein, 0.15 - 0.81 % phosphorus and an appreciable mineral content.

The soft but termite-resistant wood is used for bed frames, bowls and plates, saddles etc., for tooth cleaning, occasionally for fuel and charcoal. Fragrant pearl strings are made from the seeds. The resin, a component of myrrh (Myrrhe du Sénégal) produces a fragrant smoke, and is used as perfume in lotions for clothing, rooms, as an insecticide, a termite repellent, an antiseptic and for headache. Dried stems are carbonized and, with shea butter, used for vulnerary ointments.

Leaves and bark are used in local medicine for the treatment of wounds and dermatitis, sterility in men, pains, enteritis, intestinal disorders, colics, etc. Pounded and ground bark mixed with chalk is applied to scorpion bites and against leprosy.

Due to the easy multiplication by cuttings, some people (e.g. the Tuareg and Haussa) regard it as a symbol of immortality or call it "the tree of seven lives". As Commiphora africana is the first tree to come into new leaf at the end of the dry season, sensitively detecting increasing humidity in the winds, this is anxiously awaited by all herdsmen of the Sahel as an indication of forthcoming rains. Conversely, when the leaves turn a golden-yellow colour and fall, the rainy season comes to an end.

*) This may sound ludicrous, until it is remembered that 50 % of court cases still consist of livestock thefts.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. II (1974), Clanet a. Gillet (1980), C.T.F.T. (1978), Dale and Greenway (1961), Geerling (1982), Giffard (1974 A), le Houerou (1980 A), Kerharo a. Adam (1974), Palmer/Pitman (1972), Sahni (1968), Touzeau (1973).

CRATEVA ADANSONII

Crateva adansonii DC.

Synonyms: Crateva religiosa Forst.

Family: Capparidaceae

Description: A tree up to 10 m (16 m) high, stem diameters large. When old developing a round crown. Bark light red brown with marked grey lenticels, coming off in scales. Slash yellow, spotted. Leaves in terminal clusters, trifoliate, petiole approximately 7.5 cm long. Leaflets ovate-lanceolate, acuminate at the tip, 6 - 10 cm long, upper side smooth. Lateral leaflets asymmetric. Flowering January to April. Flowers white, in terminal corymbs, frequently 15 - 20, peduncles 3- 4 cm; calyx 4-lobed, 4 petals, 1.5 - 2.0 cm, bent to one side. Preceeded by one fascicle of long pale violet stamens. Fruits globose, yellow or light brown when ripe, 3.5 - 8 cm in diameter, hanging on a 6 cm long woody stalk. Pericarp yellow, thin, hard, fissured. 10 - 20 small seeds, dark brown, kidney shaped, embedded in a white, mealy, very sweet fruit pulp; mature in November. 7,000 - 7,500 seeds/kg, 1,000 seeds = 130 - 140 g.

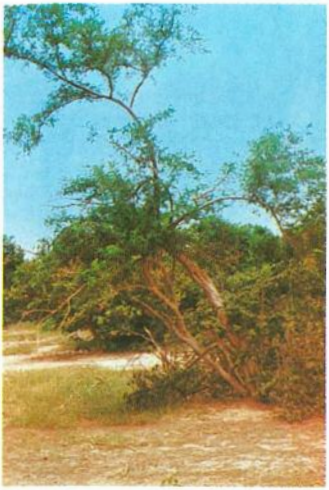
Distribution: All over the southern Sahel and the Sudan zone, frequent in valleys of the Senegal, Niger and Kanadougou rivers. Extends southwards into the rainforest zone. Found from Senegal to Nigeria, India and Burma in the east.

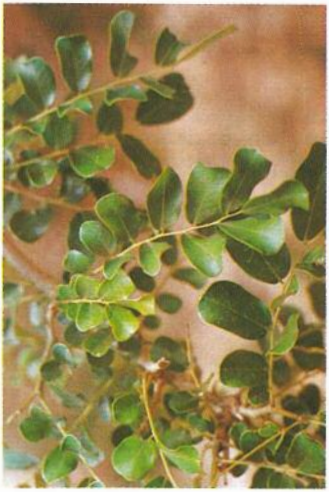
Site requirements: Needs much soil moisture; in the Sahel therefore, only along river banks and periodically inundated depressions. Likes deep sandy to loamy soils. In termite mounds.

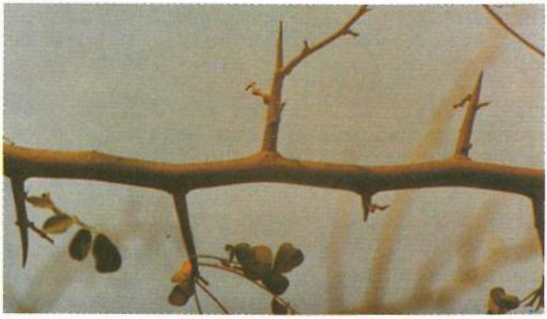
Uses: The wood is soft, yellow, strong-smelling when cut and only occasionally used in the Sudan for saddles, cart wheels, frames etc. It is also said to be suitable for shoe mouldings, fuelwood and charcoal. Leaves are eaten as a vegetable or seasoned. Fruits and seeds are occasionally eaten, mostly after being roasted. Livestock and game browse leaves and shoots. Like other Capparidaceae, Crateva has a high fodder value with a crude protein content of 15 - 25 % DM, phosphorus 0.12 - 0.25 % DM, net energy 5.9 - 6.9 MJ kg DM, digestible protein 130 - 210 g per kg DM, DP/FU 160 - 230 (BAUMER 1983). Trees are often lopped. The root is used to treat fever; dried and pounded roots are applied to swollen limbs. Leaves for headache, night-blindness and various eye diseases, yellow fever, jaundice and sterility in women. Bark extracts for stomach disorders., leprosy etc. Branches and leaves are cut to obtain a yellow dye, a reason why many trees are stunted. The tree contains a gum.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. II(1974), Dale a. Greenway (1961), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo a. Adam (1974), Sahni (1968).

DALBERGIA MELANOXYLON







Dalbergia melanoxylon Guill. et Perrott.

Family: Fabaceae (=Papilionaceae)

Description: A deciduous shrub or small tree, strongly ramified, 4 - 7 m high, occasionally over 12 m high. Bark light grey to brownish, thin, smooth, irregularly flaking; slash yellow white. Stem diameter rarely over 20 - 30 cm; branches white-greyish, smooth with straight white thorns. Leaves alternate, on older branches also clustered, imparipinnate. Rachis 4 - 7 cm, with 4 - 6 pairs of smooth leaflets, blunt and frequently emarginate, 1.0 - 3.5 cm long, 1 - 2 cm wide. Flowers white, sweetly fragrant, in slender, pubescent, axillary and terminal panicles, as long as the leaves, with 9 stamens, calyx slightly pubescent. Flowering from March to July. Pods flat, oblong, acuminate at both ends, glabrous, up to 5 cm long and 1.5 cm wide. Generally one, occasionally up to four seeds.

Distribution: In all semiarid to subhumid regions of Africa, frequently in Senegal and Mozambique, also Togo, North Cameroon, Chad, Burkina Faso, Mali, South Africa, India.

Site requirements: Needs sufficiently moist soils, preferably near waterholes or watercourses, also on skeletal soils.

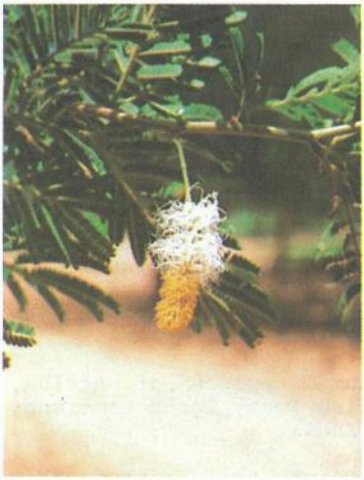
Propagation and management: Natural regeneration problematic. Cultivation with fresh seeds (approximately 16,000/kg). To be planted at the age of 5 months. After seven years up to 4 m high.

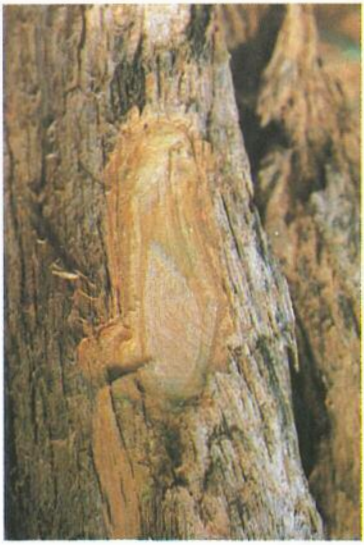
Uses: Sapwood yellow-white, forming a narrow ring which is sharply off-set from the dark brown-violet to black heartwood. The latter is almost homogenous, sometimes streaky, very dense, hard. It has a very fine, even texture and straight grain. Fresh-cut wood weights 1,300 = 1,400 kg per m^3, the air-dry weight is about 900 - 1,200 kg per m^3. It should be slowly (at least over 2 years) seasoned. Dry timber is difficult to work, blunts tools and has to be pre-bored before nailing or screwing. It is an excellent turning timber and finishes to a hard, heavy, brittle and somewhat fissile oily surface (Bolza/Keating 1972). Like ebony, it is primarily used for special applications such as musical instruments, inlays and arts (carving). Of all Sahel species it attains the highest price per volume or weight unit. Trade name: Grenadill.

Fruit is liked by livestock. Bark and roots, frequently in combination with baobab-fruits, are applied for diarrhoea and syphilis. Wood and other parts of the tree are used in magic rites. The smoke from burnt roots is used for headache and bronchitis.

References: Aubréville (1950), Berhaut Vol. V (1976), Bolza a. Keating (1972), Dahms (1979), Dale a. Greenway (1961), Geerling (1982), Giffard (1974 A), Kerharo a. Adam (1973), Sahni (1968).

DICHROSTACHYS CINEREA





Dichrostachys cinerea (L.) Wight et Arn.

Synonyms: Dichrostachys glomerata (Forsk.) Hutch et Dalz., Cailliea dichrostachys Guill. et Perrott., Dichrostachys nutans (Pers.) Benth., Dichrostachys platycarpa Welw. ex Oliv., Dichrostachys arborea N.E.Br., Mimosa glomerata Forsk., Mimosa nutans Pers., Mimosa cinerea L.
Several subspecies are distinguished.

Family: Mimosaceae

Description: A thorny shrub or tree, up to 4 m (7 m) high, with fine, acacia-like, pinnate leaves. Bark grey; on trees, forming a thick, vertically fissured ross, giving the impression of being "plaited". Bark very fibrous. Slash cream coloured to light yellow. Strong, up to 8 cm long, alternate thorns, which grow out of the branches and may therefore bear leaves at the base, almost at right angles, slightly recurved. Leaves bipinnate; rachis 4 - 8 cm, with 5 - 15 (19) pairs of pinnae, these bear 12 - 22 (9 - 41) pairs of leaflets each. Leaflets about 8 mm long and 2.5 mm wide; terminal pair of pinnae shorter, dark green, underside pale. Leaflets and petioles very tomentose, ciliate.

Twigs grey brown violet, with prominent light lenticels. Very characteristic flowers in bicoloured, cylindrical, dense, petioled pendulous spikes ("bottle brush"), 6 - 8 cm long, fragrant. Flowering from February to May (June), prior to or beginning with foliation. The terminal (in pendulous spikes the lower) flowers are hermaphroditic, with one pistil and 10 yellow stamens each. The upper flowers of a hanging spike are sterile, reddish or pale purple, with protruding staminodes. The narrow, yellow or brown pods are generally twisted or spiralled, in dense, stalked, intertwined clusters. About 4 black seeds per pod with a spot at one end.

Distribution: In the Sudan zone and the southern Sahel. Forms dense hammocks on lateritic soils in Senegal and the Republic of Sudan. In Ethiopian mountains up to 2,000 m above sealevel. Frequently in Togo, Nigeria, Cameroon, Ghana. Eastwards across Somalia to Yemen. In the south up to the Kalahari and Transvaal. Occurs in East Africa, penetrates clear-cut areas far into the rainforest zone.

Site requirements: Invades fallow land; difficult to eliminate because of root suckers. Grows everywhere on heavy clayey, loamy, and sandy soils. In the Sahel particularly along riverbanks; said to improve poor soils.

Propagation and management: Propagation by root cuttings very easy; root suckering; fireresistant. Approximately 39,000 seeds/ kg.

Uses: The wood is very heavy and hard, the sapwood light brown or yellow with dark streaks. Fine dark brown heart wood, presumably termiteresistant. Its utilization is limited due to its generally

small dimensions (walking sticks, handles, spears, poles, fences, etc., fuelwood and charcoal). The debarked roots are used for strong plaiting work (racks, baskets), bark fibres for various applications. Fruit and seeds are edible but are also a much sought fodder for cattle. Leaves and young shoots browsed by domestic animals.

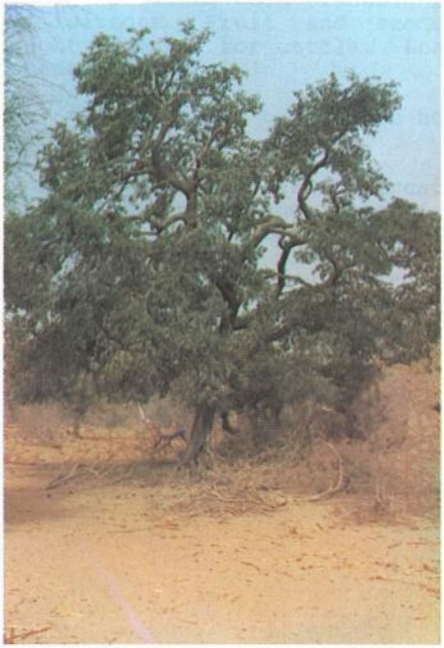
The flowers are a valuable honey source; the gum is of low quality.

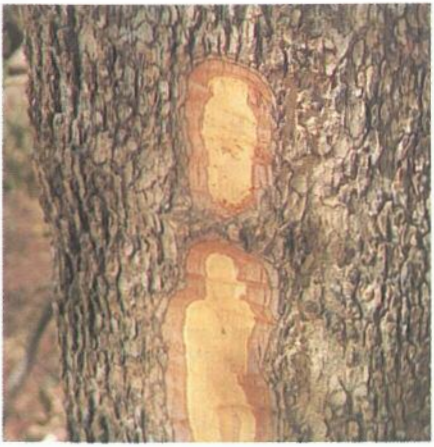
In local medicine: bark to treat dysentery, toothaches, elephantiasis, as a vermifuge, root infusions for snakebite, leprosy, syphilis, cough, etc., as an anthelmintic, purgative and strong diuretic. Leaves as diuretic and laxative, for gonorrhoea, boils; powder from leaves used in the massage of fractures.

The use of Dichrostachys as live fence or ornamental plant is limited, because of its root competition; very difficult to control, aggressive weedy character.

References: Aubréville (1950), Berhaut Vol. IV (1975), Dale a. Greenway (1961), Geerling (1982), Hallam (1979), Irvine (1961), Kerharo a. Adam (1974), Sahni (1968).

DIOSPYROS MESPILIFORMIS





Diospyros mespiliformis Hochst. ex. A. DC.

Synonym: Diospyros senegalensis Perrott. ex A.DC.

Family: Ebenaceae

Description: Small evergreen tree 12 - 15 m high, maximum 20 m in the Sahel (in the rainforest, however, up to 50 m with 60 cm trunk diameter). The stem has a black, wrinkled and finally scaly bark (with prominent large white spots), later turning brown and corky. On favourable sites, typical butt swellings reaching 1 - 2 m high on the stem. The crown is very branchy with dense foliage.

When the thin grey bark of branches is scraped off, a bright red-brown layer appears. Young branches are green; terminal buds acuminate, tomentose. Leaves up to 4 x 12 cm, short petioled, oblong-ovate, coriaceous. Prostrate small hairs on the underside of old leaves. Young leaves prominently reddish. Male flowers in peduncled panicles, white. Female flowers solitary in leaf axils. Flowering April/May. Mature fruit as large yellow berries, individually petioled, sessile close to the branch, approximately 2 - 3 cm in diameter. At the base, a 5-lobed calyx. Fruit containing 4 - 6 chocolate brown seeds. The fruit pulp is sweet, slightly acid, edible. Fruit matures from October to February; 2,400 - 3,200 seeds/kg.

Distribution: From West to East Africa, Zimbabwe, Zambia, Angola, South Africa, Yemen. Characteristic of tree savannas, particularly in Guinea and Nigeria, up to 1,250 m in the mountains.

Site requirements: On rocky soils, in the Sahel zone preferably along seasonal watercourses, in swamps. Grows well on red loam soils and loamy sands, termite mounds.

Propagation and management: Natural regeneration from seeds, coppice and root suckers. Germination may be delayed by low soil moisture and seed dormancy. For raising in nurseries, the seeds should be soaked in boiling water.

Uses: Fruit edible, either fresh or after drying. It is also used for the production of toffees and of beverages, sometimes fermented, similar to palm wine. Diospyros mespiliformis yields an ebony (Nigerian Ebony). The sapwood is at least four times as wide as the heartwood, white with a yellowish shine. It is very heavy, hard and brittle, decay and termite-resistant. Freshly cut/split heartwood is white, bright red or grey and darkens, assuming a dark brown color. Only after extended exposure of the cutting face, the wood turns almost black if originating from (dry) Savannas, however, not if originating from moist sites. It is said that exposed to heat, the wood blackens more quickly. The same effect may be attained by drying on the stump. The wood dries slowly with surface checks. Suitable for turning, cart-wheels; very durable, easy to plain and turn. Does not take nails; used in construction for benches, canoes, tools, combs and

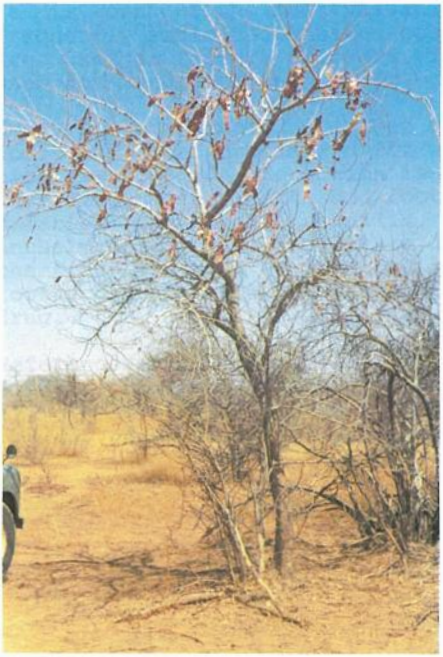
drums.

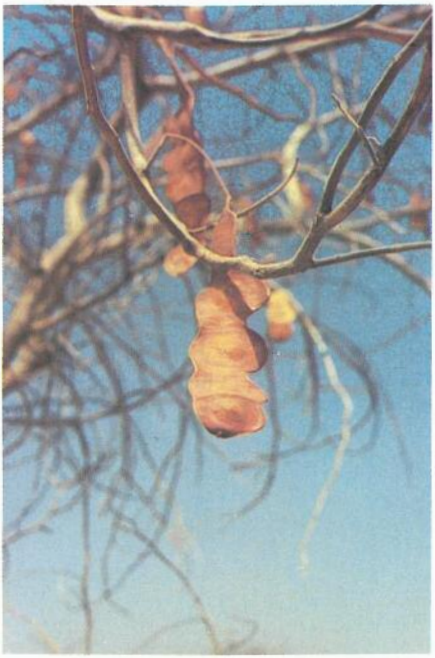
It is one of the most valuable luxury timbers and therefore frequently exploited. Makes good fuelwood and charcoal. Leaves are used as fodder, flowers yield good bee forage. The gum is used for mending pots.

Uses in local medicine: Leaf decoction as extraordinary remedy for fever and otitis and for wound dressing; haemostatic and cicatrizative. A decoction is used as a poison antidote and to cure toothache. Bark and roots for serious infections such as malaria, pneumonia, syphilis, leprosy, dermatomycoses, as an anthelmintic and to facilitate delivery, etc. Different parts of the trees are used against diarrhoea, skin infections, headache, toothache and similar pains, and as a psycho-pharmacological drug.

References: Aubréville (1950), Berhaut Vol. III (1975), Dahms (1979), Dale and Greenway (1961), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo a. Adam (1974), Palmer and Pitman (1972), Sahni (1968).

ENTADA AFRICANA





Entada africana Guill. et Perrott.

Synonyms: Entada sudanica Schweinf., Entada ubanguiensis De Wild., Entadopsis sudanica (Schweinf.) Gilbert et Boutique.

Some authors consider E. Africana and E. sudanica to be two separate species.

Family: Mimosaceae

Description: Small tree up to 7 m; bark brown-grey, transversally striped, scaly, slash fibrous, red or yellow-brown. Leaves bipinnate, alternate. Rachis 25 - 30 cm long with 2 - 9 pairs of pinnae, with 10 - 20 pairs of leaflets. Leaflets with emarginate or obtuse apex, asymmetric base, 2 - 3 cm x 0.6 - 1.0 cm. Flowers cream-white or reddish yellow, slightly scented, in axillary spikes, up to 15 cm long. Individual flowers small with 5 spatulate petals. Fruit a pod, 5 x 22 cm (15 x 35 cm), flat and fragile, red-brown on the outside; interior white, margin undulate. 12 - 15 seeds, breaking open with segments of the dry interior part of the pod. Seeds two-winged; approximately 4,000 seeds/kg.

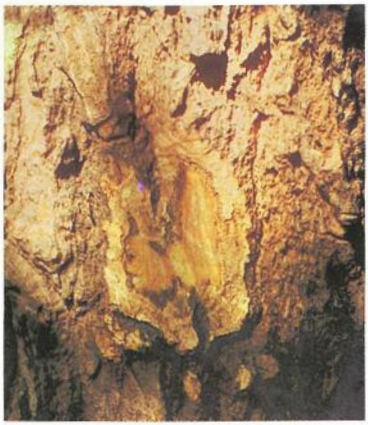
Distribution: Sudan zone, only exceptionally penetrating into the southern Sahel; in Burkina Faso, Ghana, Senegal, Cameroon, Zaire, Sudan.

Site requirements: On lower slopes or banks of swamps. On ground water-near sites; annual precipitation 600 - 1200 mm; very sensitive to bush fires, often mutilated by fire.

Uses: The leaves make good fodder. Bast fibres are used for bands, ropes, e.g. for the construction of storage bins. The bark contains tannin. The wood is soft and easy to work. Many medicinal applications: Tea prepared from leaves used as a stomach tonic; leaves have a wound-healing effect, they contain rotenol; the bark is said to have abortive effects; a root decoction as stimulating agent and tonic. The plant is said to have antidote effects against various toxic agents because of its emetic properties. Healing and fever-reducing beverages prepared from leaves, bark, roots and shoots. Also wood and seeds are used in medicine. A fish poison can be prepared from the leaves.

References: Aubréville (1950), Berhaut Vol. IV (1975), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo a. Adam (1974), Weber (1977).

ERYTHRINA SENEGALENSIS



Erythrina senegalensis DC.

Family: Fabaceae (= Papilionaceae)

Description: Shrub or small tree 6 - 7 m (up to 15 m), with thick, corky, bright bark; slash yellow. Leaves alternate, pinnate, in triplets. Leaflets ovate, the intermediate leaflets somewhat larger, 5 - 10 cm long, acuminate; apex obtuse; 5 - 7 lateral nerves. Petiole 3 - 6 cm, at the base of the leaflet petioles two glands each. Petioles and rachis prickly; short prickles dispersed over the branches. Flowers in long terminal racemes, 15 - 25 cm, on leafless shoots or at the beginning of flushing. Short flowering period. Long corolla, (4 - 5 cm) bright red, conate, hardly open, only stamens slightly protruding. Fruits thin pods, strongly bent or twisted, 8 - 15 cm long. Ovate seeds visible from the outside, bright red.

Distribution: West Africa from Senegal to Lake Chad, Cameroon, Gabon.

Site requirements: In Senegal frequently in the savanna; in settlements sometimes as hedges, also planted in gardens. In the field mostly very dispersed, solitary.

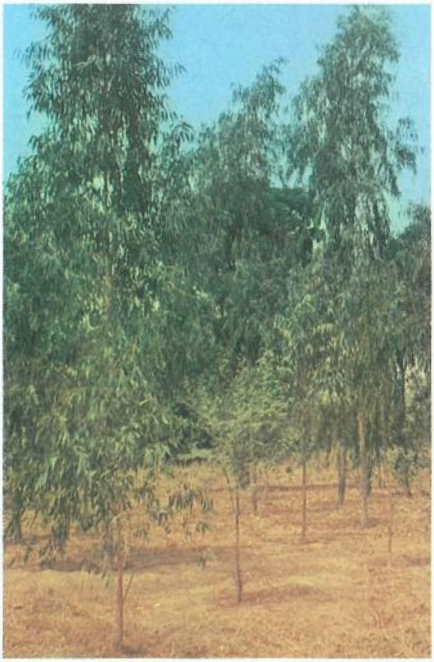
Propagation and management: Cuttings; branch cuttings are simply stuck into the ground, flower after a short time.

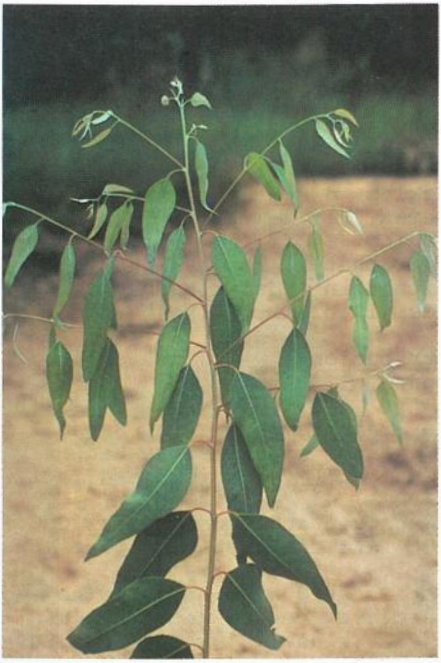
Uses: Planted as a hedge. The wood is without use, very quickly infested by pests. Medicinal use: Primarily for stomach disorders of all kinds, dysentery. Bark extracts also for malaria, bronchitis, amenorrhoea, sterility in women, fever, rachitis as well as liver and gallbladder ailments. Juice of leaves used for treating wounds. In particular bark and roots are used for various cures of gastro-intestinal disorders and as an anti-abortive, for leprosy, haemorrhoids and as a general tonic. The wood is chewed as an aphrodisiac.

Leaves are browsed by lifestock. The raw seeds are poisonous but are used as beads or for sacral purposes.

References: Berhaut Vol. V (1976), Geerling (1982), Hallam (1979), Kerharo a. Adam (1974).

EUCALYPTUS CAMALDULENSIS





Eucalyptus camaldulensis Dehnhardt

Synonym: Eucalyptus rostrata Schlecht.

Family: Myrtaceae

Description: High, evergreen tree, in the Sahel and in the adjoining Sudan zone up to 20 m, deeply branched, frequently with spiral grain but also with long straight boles. Bark whitish to light brown and thin, frequently typically peeling off in long strips, light cream coloured beneath. Ends of branches and leaves pendulous reddish. Leaves alternate, lanceolate, grey-blue, dropping, glabrous, giving off a strong scent when macerated. Flowers in numerous small umbels (clusters) with white globose flowers of approximately 1 cm diameter at the leaf bases. Fruit capsules approximately 5 - 8 mm, opening in 4 valves when mature, clustered at the end of slender stalks. Half round or eggshaped.

Distribution: As most eucalypts originating from Australia (there known as "River red gum"), widely distributed over the continent, so that provenance plays a particular role when ordering seeds. One of the first eucalypts planted outside its homeland, e.g. in Italy since 1803, used for afforestations in the tropics and subtropics for the last 100 years; in Africa since 1900. Today at least 500,000 ha of plantations of Eucalyptus camaldulensis exist outside of Australia, particularly in the Mediterranean region, in the subtropics and in semiarid regions.

Of all eucalypts tested so far only this species succeeded under Sahelian conditions. Nevertheless, it is more suitable for plantations in the Sudan zone and should not be planted in the Sahel on a large scale but rather on small favourable sites.

Site requirements: Grows from sea level to approximately 600 m altitude with precipitations over 250 mm. Best growth in Africa with precipitations between 700 and 1,200 mm. Tolerates a dry season of over 8 months, also grows on poor degraded soils (however not on calcareous soils which cause chlorosis) and tolerates short-term flooding. Prefers deep silt with clay subsoil. Salt tolerance varies with provenance.

Propagation and management: The literature on propagation and the cultural treatment of Eucalyptus camaldulensis is quite extensive and does not require a particular analysis here. Of great significance is the high coppicing potential (under Sahelian conditions presumably 3 - 4 rotations possible. There are approximately 200,000 to 1 million seeds/kg. As far as procurement of seeds and practical hints for planting are concerned it is recommended that the national forest services or research stations, e.g. the C.T.F.T. or representatives of international organisations, e.g. FAO, should be contacted.

As Eucalyptus camaldulensis is the species which has been cultivated for the longest time and most intensively in the Sudan zone there are no difficulties in obtaining the information

necessary for a particular project. Sensitive to termite attack during the initial 3 or 4 years after planting, especially if annual rainfall exceeds 500 mm.

Uses: Eucalyptus camaldulensis is primarily planted for fuelwood production. Fast growth and high volume yield (in the Sahel up to 2.0 m^3 per year and hectare, depending on soil moisture availability and nutrients, with irrigation even more than 5 m^3, and on optimal sites in Brazil more than 25 m^3 with 7 years rotation and subsequent regeneration by coppicing) are the advantages, together with its suitability for the production of charcoal. Timber as fence posts, poles for construction, for tools; wood with larger dimensions is generally not obtainable under Sahelian conditions. Sapwood pale red or yellowish, heartwood redbrown and heavy, hard. It is rather durable (and said to be sufficiently resistant to termites), easy to work but tends to warp and split when seasoned.

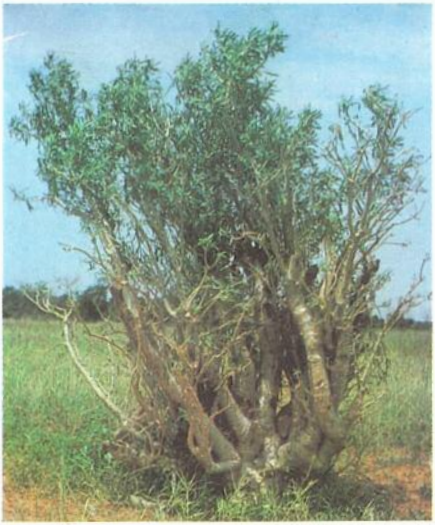
In addition to their use as fuelwood eucalypts are also planted as windbreaks and as ornamental trees along roads and canals. Their cultivation in gardens or in combination with agricultural crops cannot be recommended because of root competition. The species is a strong user of minerals and is therefore not suitable as a pioneer for recultivation of degraded land.

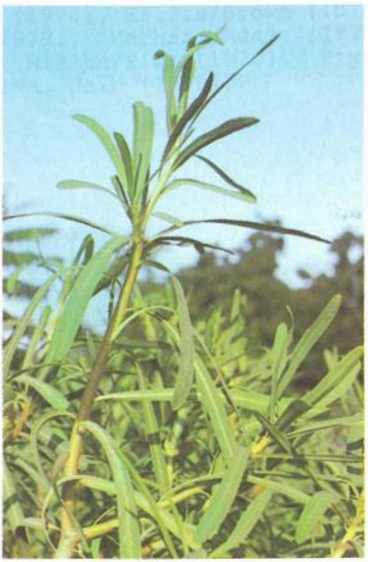
The essential oil contained in the leaves is used in the perfume industry and for medicinal applications, as is the red gum called "kino". Bark and wood contain between 10 - 14 % tannin, kino gum between 50 - 75 %. Eucalypt plantations provide good bee forage.

References: Augustin (1975), Eldridge (1975), Eucalyptus camaldulensis (1963), FAO (1977, 1979), Giffard (1974 A), Giordano (1960), Goor/Barney (1976), Grunwald (1974), Hillis/Brown (1978), Karschon/Deth (1967), Kaul/Chand (1979), Kerharo/Adam (1974), Kolar (1961, 1963), Little (1983), Mialhe/Piot (1979), Pryor/Byrne (1969), Quadri (1971), Rao, Shiva, Jain (1970).

EUCALPTUS CAMALDULENSIS

EUPHORBIA BALSAMIFERA





Euphorbia balsamifera Ait.

Synonyms: Euphorbia sepium N.E.Br., Euphorbia rogeri N.E.Br.

Family: Euphorbiaceae

Description: Shrub, up to 5 m, branching strongly. Bark smooth, light grey; slash yellow-green, exuding a white milky latex. Leaves terminal on shoots, rosette-like aggregated, oblong-spatulate, acute to obtuse, 2.5 - 5 cm long, up to 0.6 cm wide, light green to blue-green, sessile, generally deciduous. Flowers yellow-green at the end of the leafless branchlets, solitary, nearly sessile to shortly petioled. Calyx with 6 bracts, 12 - 15 mm long. Fruit: spherical tripartite capsules, 10 - 12 mm in diameter.

Distribution: From Mauretania through Mali and Niger to Lake Chad. Origin: Canary Islands.

Site requirements: Sandy soil; in the Sahel on loose sand or rocky sites. Drought tolerant.

Propagation and management: Propagation by cuttings, which should be at least 50 cm long, is easy. Grows rapidly into dense hedges; can also be planted at the end of the dry season (April/June) in trenches approximately 20 cm deep, spacing 5 cm, watering not necessary. Cuttings survive many months without water.

Uses: Hedges (windbreaks) planted from cuttings; live fences/-hedges for marking property lines on fields. Suitable for the stabilization of sand, not browsed by animals; however, it is said that goats eat fallen leaves. Young shoots are sucked by children, in Senegal also prepared as a vegetable. Many medicinal applications e.g. as a strong purgative, against amenorrhoea, latex occasionally used in dental care (put on dead teeth to facilitate their removal), also used for stimulating lactation. Exterior application to reduce pain after snake or scorpion bites. Roots and bark used as emetic and laxative. Latex is poisonous and harmful to the eyes. Used as a poison for criminal purposes but also as a fish poison, insecticide and disinfectant (occasionally for boils).

References: Aubréville (1950), Berhaut Vol. III (1975), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo and Adam (1974).

FERETIA APODANTHERA

Feretia apodanthera Del.

Synonym: Feretia canthioides Hiern

Family: Rubiaceae

Description: Shrub, 2 - 3 m high, with winding or twisted branches, rectangular to the stem axis. Bark reddish, flaking, light brown and deeply fissured when old. Young twigs hairy, reddish. Small elliptic or obovate leaves, mucronate, 4 - 6 cm long, 2 - 3 cm wide, nerves pubescent below when young; deciduous; flushing during or after flowering.

Flowers April to June, white, cream-coloured, or pink fascicules. Calyx pink; strongly fragrant, appearing together with new leaves at the end of young shoots. Flowers on long thin peduncles, hairy or glabrous, 5 - 10 mm long, in the upper section with two lanceolate bracts. Calyx glabrous with five lanceolate lobes. Fruit opposite, at the base of the leaved shoots of the same year, small few-seeded black berries, approximately 8 mm in diameter, on peduncles. Sepals at the tips persistent. Maturity August - October.

Distribution: In the southern Sahel from Senegal to Sudan, Kenya.

Site requirements: Frequently along the perimeter of waterholes, on clay soils, also on temporarily flooded sites. Often on termite mounds.

Uses: Dried leaves as a vegetable; green leaves as fodder but also when dry after leaf-fall particularly sought by sheep. The fodder value is generally considered low:
Crude protein 11 % DM (8 - 14)
Net energy 6.5 MJ kg DM (4.6 - 7.8)
Digestible protein/FU 87 (41 - 90)
P 0.14 (0,07 - 0,20) (le HOUEROU 1980 A, p. 92).
Whirled branches used as swizzle sticks. Flowers said to be consumed by snakes. Fruit for cosmetic face masks; roasted as a substitute for coffee, crushed with water for snakebite. The root decoction is used against leprosy, syphilis, gonorrhoea.

References: Aubréville (1950), Baumer (1983),Dale and Greenway (1961), Geerling (1982), le Houerou (1980A), Irvine (1961), Kerharo and Adam (1974), Touzeau (1973).

Ficus capensis Thunb.

Synonym: Ficus sur Forsk.

Family: Moraceae

Description: A small to medium-sized tree very similar to F. gnaphalocarpa, up to 6 m (in subhumid regions up to 25 m) high. Light grey bark and big (up to 15 x 25 cm), simple alternate leaves, brilliant shiny red when young, usually repand-dentate, ovate or elliptic, pubescent or glabrous beneath, apex obtuse to shortly acuminate, base cuneate or subcordate. Slash red or pink, darker with depth, exuding latex. The figs up to 5 cm in diameter, pear-shaped, smooth, hanging in racemes on old branches on the stem or even on the roots; reddish when mature. The small opening in the fig or receptacle, called the ostiole, is prominent.

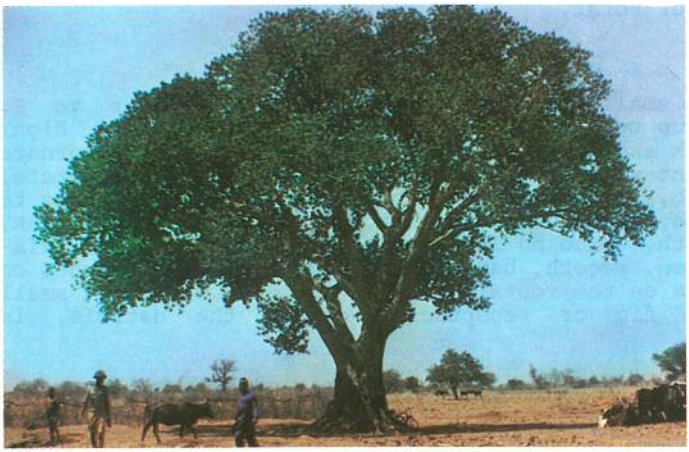
Distribution: All over Africa, however, only exceptionally at the southern rim of the Sahel. Because of its high productivity the tree is frequently considered a symbol of feminity. Prefers moist sites, near watercourses.

Uses: Fruit and young aerial shoots edible. In Sierra Leone the bark is used in the preparation of food. Leaves and fruit are said to stimulate the milk production of cows. The wood is suitable for several applications provided the stem has been debarked and dried prior to felling. In some regions bast fibres and tannin are used. Ficus capensis plays a significant role in local medicine, in particular with respect to fertility. Certain parts of the tree are used exclusively as a treatment for women (e.g. the fruits) others are used with children while a few have general applications. To mention only a few of the numerous effects and applications: Aphrodisiac, diuretic, sore muscles, headache, bronchitis, dysentery, eye infections, rachitis, fever, oedema, sterility in women, complicated birth, leprosy, epilepsy, lumbago, poison antidote, venereal diseases, to cure boils.

Many applications in magic, e.g. it is said that 100 crushed figs mixed with groundnut or grain and sown produce an exceptionally rich harvest.

References: Aubréville (1950), Berhaut Vol. VI (1979), Dale a. Greenway (1961), Geerling (1982), Hallam (1979), Irvine (1961), Kerharo and Adam (1974), Palmer and Pitman Vol. I (1972).

FICUS GNAPHALOCARPA



Ficus gnaphalorcarpa (Miq.) Steud. ex A. Rich.

Synonyms: Ficus sycomorus L., Ficus trachyphylla Fenzl

Family: Moraceae

Description: Large tree, very similar to F. capensis, up to 20 m (largest specimens in Africa up to 45 m!) and 1 m stem diameter with dense white hemispherical crown. Small pubescent branchlets in the young stages. Bark grey or yellowish, smooth, with a few scattered scales on old trees (the outer bark peels in papery flakes). Slash pale pink; heavy latex flow. Evergreen, regionally without leaves during the dry season. Strikingly large (5 - 15 cm), oval or ovate leaves with a scabrous surface. Margin generally toothed, sometimes entire, petioled. 5 - 7 pairs of yellow lateral nerves, the lowest pair originating at the leaf base. The figs are large (up to 6 cm) and red or orange (mature December/March), tomentose, peduncled, axillary at the end of branches but below the leaves. Leaf-base at the end of the fruit closed by bracts arranged like roof tiles. Receptacles at the base with three bracts at the same height. The uppermost of the bracteoles at the orifice face each other horizontally while the basal ones point downwards.

Distribution: In the Sahel, Sudan and Guinea savannas, from Senegal to Angola, East Africa, Egypt. On sites with a high ground water table. In Kenia up to 2,000 m elevation.

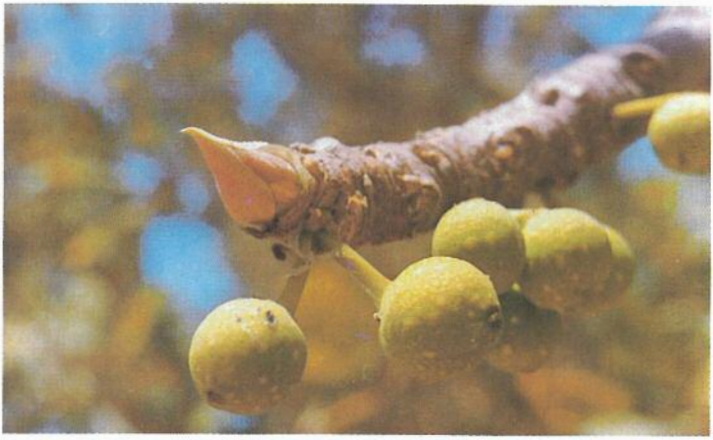
Site requirements: Prefers fresh nutrient-rich soils, particularly riverbanks and waterholes. Also sandy soils with shallow ground water level. Frequently at village perimeters or on market places as a shade tree. In gallery forests.

Uses: Ficus gnaphalocarpa (= F. sycomorus) was venerated as a holy tree of outstanding importance in ancient Egypt and is often mentioned in the Bible. The fruit drop when still immature. They are eaten particularly by goats and sheep, but also by cattle and birds. Mature fruits are edible fresh and are prepared with millet by some people. They can also be used for the preparation of an alcoholic beverage. Leaves are taken for soups and groundnut dishes; they are a much sought fodder. The tree is therefore lopped. The nutritive value of the leaves is as follows: Crude protein 9.0 % DM; Net energy 7.3 MJ kg DM P 0.14; Digestible protein/FU 45 (le HOUEROU 1980 A, p.91).

The wood is white and light, easy to work, not very durable. Ficus gnaphalocarpa has numerous applications in local medicine: Leaves are said to be effective against jaundice. They provide an antidote against snake bites. The latex is used for dysentery and chest diseases. Remedies from the bark for cough, throat infection and for chest pain: the roots have laxative and anthelmintic effects.

References: Aubréville (1950), Baumer (1983), Dale and Greenway (1961), Geerling (1982), le Houerou (1980 A), Palmer/Pitman Vol. I(1982), Irvine (1961).

FICUS INGENS



Ficus ingens (Miq.) Miq.

Synonyms: Ficus lutea Vahl, Ficus kawuri Hutch., Urostigma ingens Miq., Ficus katagumica Hutch.

Family: Moraceae

Description: Deciduous tree of medium height, 10 - 15 m; branches low, almost to the soil, pendulous. Occasionally a strangler. Frequently twisted on rocks or as a shrub. Bark scaly, grey-brown; slash pink, exuding latex. Characteristic long ovate leaves, apiculate, base cordate, not scabrous, entire. Glabrous, 8 to 15 x 6 to 10 cm. 3 - 5 pairs of lateral nerves. Young leaves red. Figs small (0.5 to 1 cm diameter) in pairs, axillary, sessile or very shortly pedunculate, glabrous or slightly pubescent, peduncle scabrous. Dry figs wrinkled. The base of the former flower at the end of the fruit is closed by imbricate bracts which overlap and are not infolded to make a pair.

Distribution: Semiarid Africa, advancing towards the north up to the Aïr Mountains. It is said that even in the central Sahara individual specimens grow on favourable sites (Hoggar-Oued In Deleï); also in Kenia and South Africa, Yemen.

Site requirements: Rocky slopes, preferring fissures in rocks.

Uses: The figs may be edible; a decoction from the roots is given to cows to increase milk production. Latex as disinfectant. Applications in magic.

References: Aubréville (1950), Berhaut Vol. VI (1979), Dale and Greenway (1961), Geerling (1982), Irvine (1961), Kerharo and Adam (1974), Palmer/Pitman Vol. I (1972).

Ficus iteophylla Miq.

Synonyms: Ficus bongoensis Warb., Ficus spragueana Mildbr. et Burret, Ficus dekdekena (Miq.) A. Rich., Urostigma dekdekena Miq., Ficus sassandrensis A. Chev.

Note: Some botanists consider F. iteophylla to be identical with F. thonningii.

Family: Moraceae

Description: Epiphyte or tree of medium height, up to 15 m, with short bole and spreading crown, occasionally with a flat top. Bark light grey, smooth or partly scaly. Leaves entire, strikingly narrow, lanceolate to ovate, glabrous. 4 to 10 x 1.5 to 3 cm. 8 - 10 pairs of lateral nerves. Figs small (8 - 12 mm), glabrous or pubescent, on long hairy peduncles, axillary; two basal bracts.

Distribution: Widely distributed over the Sudan-Sahel from Senegal to Kordofan; East Africa; south to the rain forest.

Uses: Fuelwood. Young branches as fodder; fruits edible. Bark extracts for baths to treat tuberculosis and for the treatment of nervous illness, paralysis and leprosy. The bark is also used in veterinary medicine.

References: Aubréville (1950), Berhaut Vol. VI (1979), Dale a. Greenway (1961), Geerling (1982), Irvine (1961), Kerharo and Adam (1974).

FICUS PLATYPHYLLA

Ficus platyphylla Del.

Synonyms: Ficus umbrosa Warb., Ficus bibracteata Warb.

Family: Moraceae

Description: Large tree up to 20 m, with stem diameters up to 2 m, wide, spreading crown. Stem bark sand-coloured, rusty on young trees and branches of old trees. Slash pink, with abundant latex flow. Very strong branches and very large (5 to 26 x 20 cm), dark green leaves on strong petioles, alternate, not scabrous, occasionally pubescent on both sides, oval-elliptic, cordate. Thick, hairy terminal buds.

Figs small (1 cm), red, from December to January. Occasionally warty, axillary on relatively long (2 - 2.5 cm) peduncles in fruit clusters at the ends of branches. Receptacles with two basal, opposite bracts; all bracteoles pointing downwards.

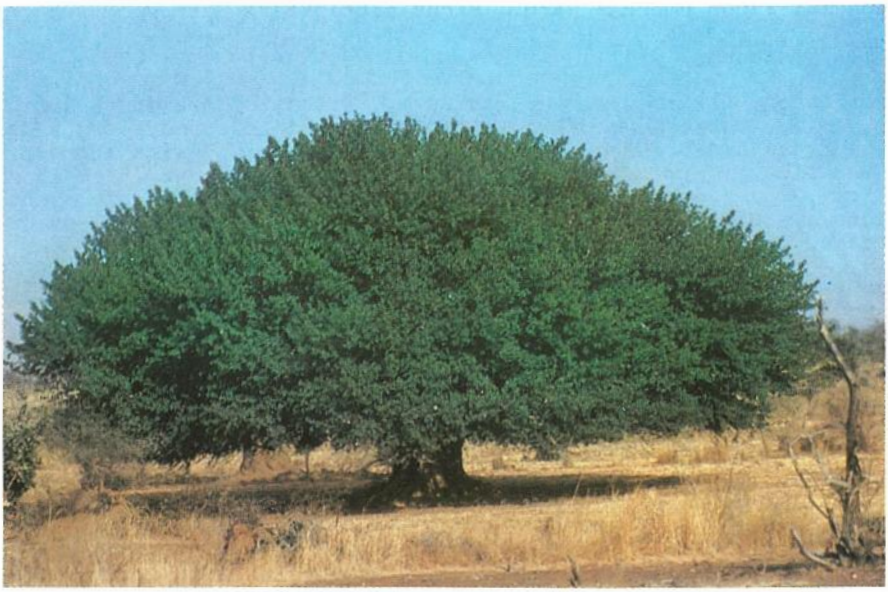
Distribution: In the Sudan savanna and in the southern Sahel from West to East Africa.

Site requirements: On embankments and in depressions, but also on sandy and lateritic soils.

Uses: Shade tree. Leaves produce a green dye. In Senegal and North Ghana the sweet, calcium and vitamin-rich figs are said to be eaten. The bast fibres are used for cordage and coarse textiles. Tannin is extracted from the bark. The latex is used as birdlime or for producing a "gutta" (80 % resin content), which is known as "balata" or "Red Kano Rubber". Used also for cleaning copper and to repair pottery. Few applications in local medicine, e.g. a bark decoction for leprosy and stomach pain. A decoction from leafy branch tips said to be an antidote against arrow poison.

References: Aubréville (1950), Berhaut Vol. VI (1979), Engler Vol. III (1915), Hallam (1979), Geerling (1982), Irvine (1961), Kerharo and Adam (1974).

FICUS THONNINGII



Ficus thonningii Blume

Note: Some botanists consider F. thonningii and F. iteophylla to be identical.

Family: Moraceae

Description: Tree of medium height, up to 15 m, with short bole and wide-spreading crown. Aerial roots dangling from the branches, may grow into "large arcades" after reaching the ground. Bark light grey, smooth. Slash pink. Profuse latex flow. Buds large and thick. Leaves not scabrous, alternate, entire, oval-elliptic, pointed at both ends, glabrous, 5 to 20 x 2.5 to 10 cm. 6 - 12 pairs of lateral nerces, not very prominent. On the underside clearly visible warts. Fruiting trees sometimes shed their leaves.

Numerous small, round, reddish figs, 0.6 - 1.2 cm, sessile in racemes, puberulous or glabrous. The ostiole is closed by imbricate bracts. Basal bracts with submembranous margins.

Distribution: In the savannas, frequently in villages as shade tree. In the juvenile phase generally epiphytic. Senegal to Cameroon, common in tropical Africa.

Site requirements: Mostly planted in villages, naturally between rocks in the savanna.

Propagation and management: Easy to propagate by cuttings.

Uses: Shade tree; in parts of Nigeria a sacred tree. Fruits not edible. Plaited ware and cloth prepared from bark (the tree recuperates after peeling). Fuelwood. Young branches as fodder. Medicinal applications: pulverized bark used for the treatment of wounds, a decoction for colds, throat pain, diarrhoea, as a tonic for rachitic children (as a bath). Bark from the roots and the stem are used to stimulate lactation. Latex to treat wound fever.

References: Aubréville (1950), Berhaut Vol. VI (1979), Dale a. Greenway (1961), Geerling (1982), Giffard (1974A), Irvine (1961), Kerharo and Adam (1974).

Ficus vogelii (Miq.) Miq.

Synonyms: Urostigma vogelii Miq., Ficus senegalensis Miq., Ficus pseudovogelii A. Chev.

Family: Moraceae

Description: A tree, 15 - 20 m or epiphytic, with oblong, elliptic, dark green, coriaceous leaves (10 - 22 cm), upper side shining, base retuse, rounded, short apex. Base tri-nerved, 4 - 5 lateral pairs of nerves. Petiole long (2 - 8 cm), with fine gland. Young branches stout and angular and covered with scaly bark, white-beige. Fruits round, sessile, in pairs axillary, 1.0 - 1.7 cm diameter, yellow-orange. Ostiole 2-lipped very slightly protruding, bracts all descending into receptacles.

Distribution: West, Central and East Africa. Very common.

Site requirements: In gallery forests.

Uses: Often planted in villages as "palaver tree". Fruits edible, also eaten by birds. Wood used for beehives; latex used for caulking canoes. Bark decoction as a cure for stomach disorders, dysentery, sterility and colds. Ash used in soap-making.

References: Berhaut Vol. VI (1979), Dale a. Greenway (1961), Hallam (1979), Kerharo and Adam (1974).

Gardenia aqualla (Schweinf.) Stapf et Hutch.

Family: Rubiaceae

Description: Deciduous shrub up to 2 m high; bark smooth, yellowish. Branches densely pubescent. Leaves whorled, pubescent on both sides, primarily on the underside; obovate to lanceolate, up to 6 x 2 cm, much bigger on young shoots and coppice, sessile. Flowering in May. Flowers white yellow, sessile, relatively small 2 - 4 cm, tube of the corolla straight, spread ends of petals, 1 - 2 cm. Calyx short (3 mm), calyx and corona hairy on the outside. Fruit ellipsoid, barrel-shaped, 4 cm, yellowish.

Distribution: In the Sudan savanna, particularly in shady depressions and on alluvial terraces. Senegal to Sudan and Uganda, Cameroon.

Uses: Leaves are browsed by livestock.

References: Aubréville (1950), Geerling (1982), Irvine (1961).

Gardenia erubescens Stapf et Hutch.

Synonyma: Gardenia triacantha var. parvilimbis F.N. Williams

Family: Rubiaceae

Description: Deciduous shrub, 1.5 - 2 m high, branchy almost to the base, bark pale yellow, slash yellow, young shoots tomentose. Leaves in whorls of three at the end of shoots, smooth or sparsely hairy, up to 12 cm long and 10 cm wide, of variable form, conical towards the petiole. Nerves visible on both sides, underside reddish, transparent. Flowers fragrant, white to yellow, solitary in the leaf axils, calyx densely tomentose, lobes thread-like, tube of the corolla approximately 5 cm long, six petals approximately 7 cm. Fruit: 3 - 5 cm long, ellipsoid, slightly bent, pale yellow when mature.

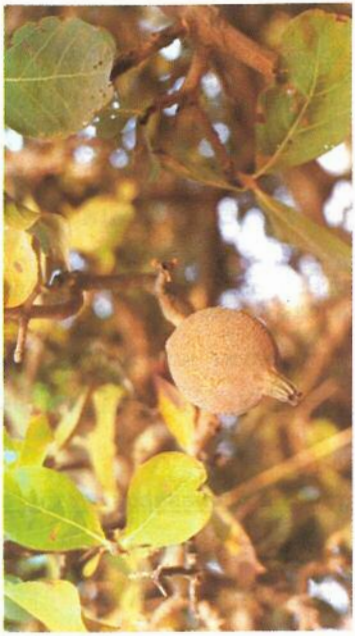
Distribution: Sudan zone, southern Sahel. No specific site requirements.

Uses: Leaves are browsed by livestock. Low feed value. Fruit edible, used for sauces and soups. The yellow, hard wood is used for small carvings (spoons).

Seeds yield a black dye, for cosmetic purposes. The bark is used for the treatment of infections of the intestinal tract (children), roots and leaves (internally and externally) for syphilis and gonorrhoea, as aphrodisiac.

References: Aubréville (1950), Geerling (1982), Irvine (1961), Kèrharo and Adam (1974).

GARDENIA TERNIFOLIA



Gardenia sokotensis Hutch.

Family: Rubiaceae

Description: Deciduous shrub, 1 - 2 m high. Slash dark yellow, branches grey. Leaves oblong elliptic, obtuse on both sides, 4 - 10 by 2 - 4.5 cm, pubescent. Flowers yellow on long thin petioles, in fascicles, axillary. Corona bell-shaped, 1.5 cm long, slightly pubescent, sepals linear, approximately 1 cm long, sticky as all buds. Flowering April - July. Fruit small, approximately 1 cm in diameter, pubescent.

Distribution: Common in the Sudan zone, sporadic in the southern Sahel.

Site requirements: In the bush or on termite mounds, mostly on gravelly soils, on very dry rocky sites, hills.

Uses: Not important as a forage plant; the wood is hard.

References: Aubréville (1950), Geerling (1982).

Gardenia ternifolia Schum. et Thonn.

Synonyms: Gardenia medicinalis Vahl ex Schum., Gardenia thunbergia Hiern, Gardenia jovis-tonantis Hiern

Family: Rubiaceae

Description: Small tree or shrub up to 5 m high, with intertwined branches and short twigs, which are very hard and thorny. Young bark with powder-like cover. Few leaves, approximately 12 cm long, coriaceous, glabrous, upright at the end of branches, lanceolate to ovate, margin undulate, 6 - 7 pairs of lateral nerves. Flowers 10 - 12 cm long, sweetly fragrant, cream-coloured or white, 6 (8 - 9) petals, with tubular base. Fruit very irregularly formed, round or oblong-elliptic, hard, up to 7 cm long, not fluted, pericarp fibrous, grey-green with distinct lenticels. Fruit persistent on the shrub for quite some time. Flowering: January - May.

Distribution: Senegal to Cameroon; frequent in the Sudan zone, sporadic in the southern Sahel.

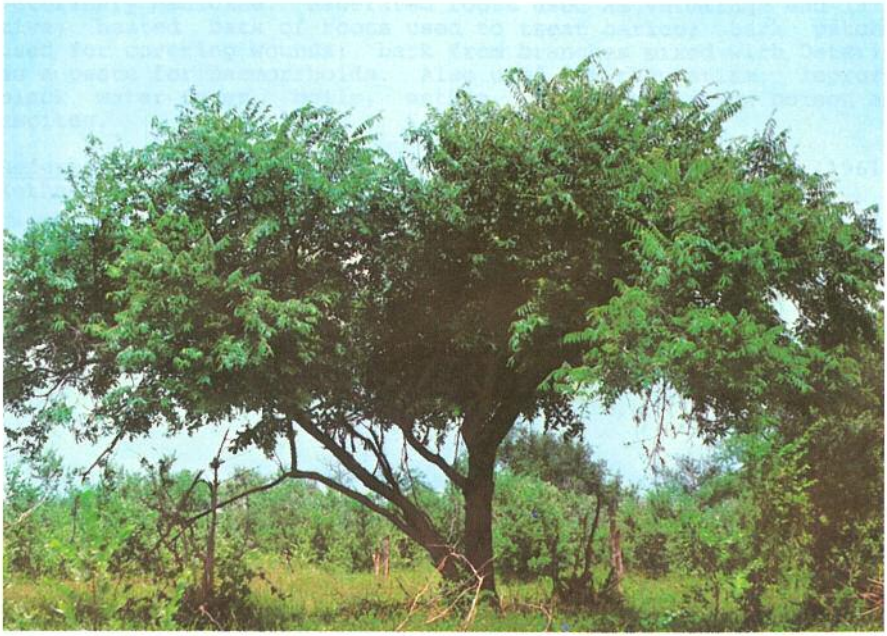
Site requirements: In savannas and in savanna forests; occasionally on poor, rocky or bouldery soils. Frequently on compacted soils but also on sands and laterite crusts with differently long periods of flooding.

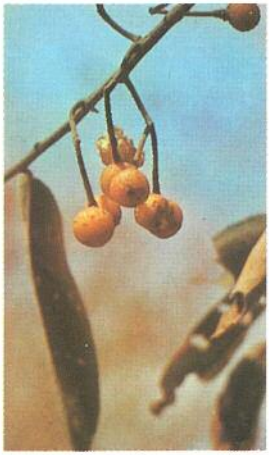
Uses: Fruit generally not edible. Wood light yellow or pale red, very hard, probably very resistant to insects; used for tool handles. In Angola and western Sudan branches are put on the roof as a protection against lightning. Wood ashes used for the manufacture of soap and as a decoction for dying. Branches used for

fencing. Cosmetic use of fruit (black dye), also a fish poison. Flowers have a decorative aspect. Many applications in human and veterinary medicine. Macerated roots used as vermifuge and laxative; heated bark of roots used to treat caries; bark patches used for covering wounds; bark from branches mixed with Detarium as a paste for haemorrhoids. Also used for rheumatism, leprosy, black water fever, boils, asthma, syphilis, arrow poison and ascites.

References: Aubréville (1950), Geerling (1982), Irvine (1961), Kerharo and Adam (1974).

GREWIA BICOLOR





Grewia bicolor Juss.

Synonyms: Grewia grisea N.E.Br., Grewia kwebensis N.E.Br., Grewia mossambicensis Burret, Grewia miniata Mast. ex Hiern, Grewia salvifolia Heyne ex Roth

Family: Tiliaceae

Description: Shrub or tree , 9 - 14 m high, with grey, fissured bark, sometimes scaly; slash yellow-brown. Young orange-brown branches with dark brown lenticels, softly pubescent, leaves variable, 1 - 8 cm long, finely dentate, obtuse or slightly acuminate, lanceolate to oval, upper side dark green, glabrous, underside typically white or grey-blue, tomentose. Lateral nerves hardly prominent. In the noon heat of the dry season the leaves hang down. Shining, small yellow flowers, in axillary cymes, sepals 0.8 cm long, calyx lobed.

Fruit: Approximately 5 mm in diameter, round, brown-yellow, later purple-black or brown, fleshy, pubescent when young, later smooth, about 15,000 seeds/kg. Flowers and fruits during the rainy season.

Distribution: Semiarid and subhumid tropical Africa, India.

Site requirements: Prefers calcareous soils, also on stony slopes and river banks; along water holes; on sandy soils of coastal areas. With sufficient rain also on sands, frequently in the Sahelian bush on skeletal soils which are moist during the rainy season. Grows with 200 - 800 mm of annual rainfall.

Uses: Fruit edible and locally used to make a drink ("madi" in Niger Haussa); important source of food for many birds. Use is made of bast fibres, of the wood for walking sticks, tool handles and bowls. Major fuelwood in northern Senegal, less elsewhere. Young shoots, fruits and leaves are browsed by livestock (including cattle) also when dry and fallen. The nutritive value of the leaves is average to good:
Crude protein 11 % DM (4 - 20)
Net energy 6.2 MJ kg DM (5.6 - 6.8)
Digestible protein/FU 77 (25 - 154)
P 0.14 % DM (0.09 - 0.20) (le Houerou 1980 A, p. 92)
Leaves used as "soap" for cleaning of clothes. Many medicinal applications. Bark against intestinal infections, as a vermifuge, for syphilis; as a diuretic and laxative.

References: Aubréville (1950), Baumer (1983), C.T.F.T. (1978), Dale and Greenway (1961), Geerling (1982), Giffard (1974 A), le Houerou (1980A), Irvine (1961), Kerharo and Adam (1974), Palmer/Pitman (1972), Touzeau (1973).

GREWIA FLAVESCENS

Grewia flavescens Juss.

Synonyms: Grewia guazumifolia A. Chev., Grewia pilosa Lam., Vinticena flavescens (Juss.) Burret

Family: Tiliaceae

Description: Climbing evergreen shrub with numerous pendulous branches (3 - 4 m long). These have a typical square cross section, are fluted, scaly, coarsely hairy. Leaves alternate, oblong, 7 by 4.5 cm both sides hairy, strongly acuminate towards the apex, base rounded, margins irregularly toothed short petiole. Inflorescence axillary with yellow flowers with 5 slender petals, 2 - 3 in corymbs. Fruit 12 mm in diameter, weakly bi- or quadrilobed or globose, hairy, brown when mature.

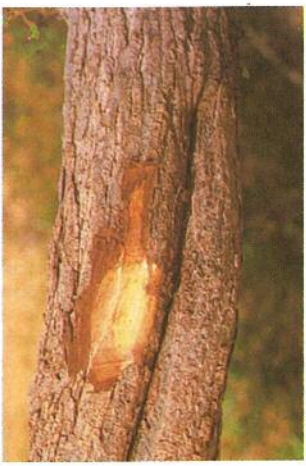
Distribution: All over semiarid and subhumid tropical Africa; Arabia to India.

Site requirements: On rocky hill tops, near water holes, on fissured clay soils but also on sand and lateritic crusts. Similar to Grewia bicolor.

Uses: Leaves browsed; fruit edible. Extracts from root bark used against diarrhoea and as aphrodisiac. Branches are used for bows, walkingsticks and for wickerwork.

References: Aubréville (1950), Geerling (1982), Kerharo and Adam (1974), Palmer/Pitman (1972).

GREWIA MOLLIS



Grewia mollis Juss.

Synonym: Grewia venusta Fres.

Family: Tiliaceae

Description: Very similar to Grewia bicolor (there are possibly hybrids) and difficult to distinguish in the common region of distribution.

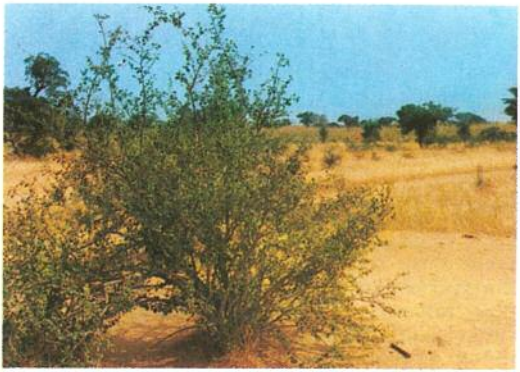
Shrub or tree, up to 7 m high, with dark, coarse bark, deeply fissured and scaling off when old. Slash reddish or yellowish and soapy. Branches applanate, pubescent when young. Leaves alternate, upper side medium to dark green or grey-green, underside somewhat lighter. Margins markedly dentate. Lateral nerves strongly prominent and branching towards the margin (in contrast to Grewia bicolor). With var. trichocarpa (Hochst. ex A. Rich.) Burret small star-shaped bundles of hair are found on the underside; underside otherwise glabrous. Flowers yellow, 2 - 5 in axillary fascicles. Fruit round, brown, later black, tomentose, approximately 5 - 8 mm in diameter, on peduncles; 5,000 fruits or 15,000 seeds/kg, respectively.

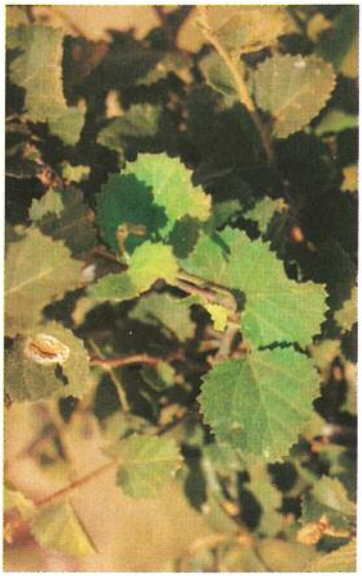
Distribution: In the Sudan and Guinean savannas, sporadically in the Sahel. From the Atlantic to East Africa. In Kenya up to 1,600 m elevation. South to the rain forest; very fire-resistant.

Uses: Flowers and fruit edible (dried flowers for sauces). Ground bark as a binder for soups, sauces or cakes (e.g. combined with bean flour in "k'ossaï" of the Haussas). Wood of high elasticity, used for bows and arrows; bark mucilage as hardener for loam floors and walls; bark fibres for ropes. A kitchen salt is obtained from the ashes of branches and roots. Various medicinal uses, similar to Grewia bicolor.

References: Aubréville (1950), Dale and Greenway (1961), Geerling (1982), Irvine (1961), Kerharo and Adam (1974).

GREWIA TENAX





Grewia tenax (Forsk.) Fiori

Synonyms: Grewia betulifolia Juss., Grewia populifolia Vahl

Family: Tiliaceae

Description: Small tree or shrub, up to 2 m high, with dark grey bark and minute white lenticels (which persist only for a very short period). Leaves small, 1.5 - 4.0 cm wide, dentate, wrinkly, glabrous or pubescent. Flowers white, solitary, axillary, 1.5 cm. Petiole 1 cm long. Fruit red when ripe, glabrous, smooth, between 1 and 4 lobes, the size of a maize kernel, 21,000 seeds/kg.

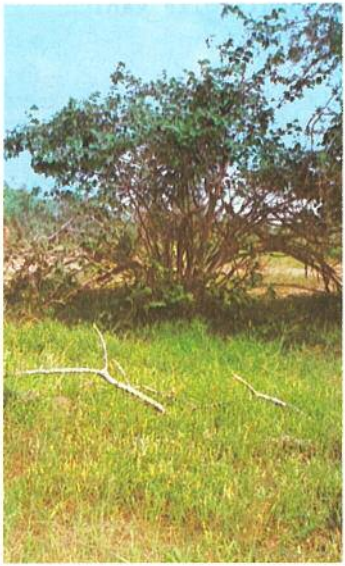
Distribution: The northernmost of the Grewia species of the Sahel; frequent in the transitional zone to the Sahara but also in the south of Morocco and Algeria. From the Atlantic through semiarid Africa; to Kenya, Somalia, Zambia, Botswana, Namibia, on the Arabian Peninsula and Iran to India.

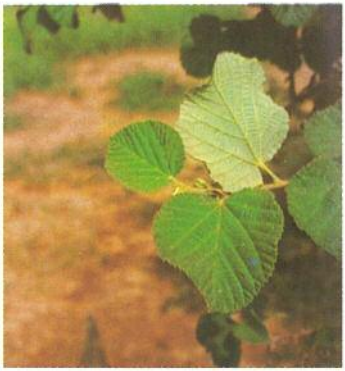
Site requirements: On rocky (latertic) and very dry sites, preferably on sandy embankments and depressions, on dark grey clay soil. Grows with annual rainfall below 200 mm but also with 1,000 mm (southern part of the Sudan).

Uses: Leaves are intensively browsed, even dry; fallen leaves are eaten by camels, sheep and goats. Bark for binding work in hut construction. The fruit is edible.

References: Aubréville (1950), Baumer (1983), Dale and Greenway (1961), Geerling (1982), Giffard (1974 A), Touzeau (1973).

GREWIA VILLOSA





Grewia villosa Willd.

Synonyms: Grewia corylifolia Guill. et Perrott.

Family: Tiliaceae

Description: Shrub, 2 - 4 m high; easily recognizable by its large round leaves, cordately constricted, pubescent on both sides; up to 12 cm wide, dentate. Nerves depressed on upper side, prominent on underside. Petioles 2 - 4.5 cm long. Flowers red (yellow and red-brown) on short, thick peduncles. Mature fruit more or less tomentose, globose, about 12 mm in diameter, containing 4 nuts with 1 - 2 seeds; 16,000 seeds/kg.

Distribution: From the Cap Verde Islands and Senegal to the Red Sea; Sahel and Sudan-Sahel, East Africa, South Africa, India.

Site requirements: In the Sahel on stony and rocky, ferruginous soils; on sands along the banks of the Nile, on periodically inundated land.

Uses: Fruit edible; ropes made from bast-fibres; wood for walking sticks; spear-shafts, bows. Bark extraction for gluing tobacco leaves in the Sudan. Bark also used for preparing medicines for syphilis and smallpox. Leaves eaten by livestock, very palatable.

References: Aubréville (1950), Dale and Greenway (1961), Geerling (1982), Irvine (1961), Palmer/Pitman (1972), Touzeau (1973).

GUIERA SENEGALENSIS

Guiera senegalensis J.F.Gmel.

Family: Combretaceae

Description: A shrub, up to 3 m high; bark grey, branches pubescent. Leaves grey-green, single or opposite; oval to oblong ovate, 2.5 - 6.0 by 1.5 - 3.5 cm. Apex round or mucronate, base rounded or cordate, pubescent on both sides; underside densely covered by black glands; lateral nerves fine. Flowers globose heads, yellow-greenish, resting on short axillary peduncles. Calyx of 5 lobes, densely covered by black spots, corolla of 5 petals and 10 filiform stamens. Fruit elongate, 3.5 cm, covered by silvery-pink hair, protruding from the end of a common peduncle, resembling the hairy legs of a spider.

Distribution: Senegal, The Gambia, Mali, Niger, Burkina Faso.

Site requirement: On leached soils, fallows; as underwood in low savanna forests; mostly on sandy soils; on very dry sites; indicative of overgrazing.

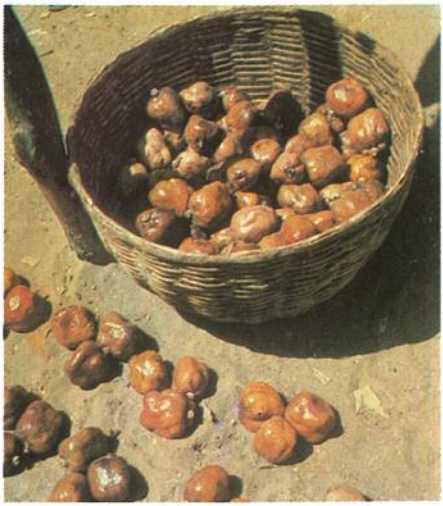
Propagation and management: Seeds dispersed by livestock and thus a typical plant of livestock trails; pioneer plant.

Uses: Leaves, shoots and fruit browsed by camels, less by other livestock. Leaves persist a long time into the dry season. Branches and particularly roots as fuelwood. Slim branches for plaiting work; mats for sand stabilization and fencing material (Senegal). The gum is marketed in Niger.

Numerous medicinal applications: leaves for various internal diseases, prevention of leprosy, dermatoses; as a tonic. Infusions as diuretic, for stomachache or cough. Possibilities of the commercial production of the tasty and curative tea should be investigated. Pounded leaves mixed with millet for diarrhoea; stimulate lactation. Decoctions and baths for colds and malaria. Roots and branches for dental care. A root decoction is used to cure diarrhoea, dysentery, etc. The bark too has many applications. In veterinary medicine bark is used to treat digestive disorders, and to increase lactation. The smoke from burning branches repels the flies from cattle corrals.

References: Aubréville (1950), Berhaut Vol. II (1974), Geerling (1982), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo and Adam (1974), von Sengbusch and Dippold (1980), Touzeau (1973), Weber (1977).

HYPHAENE THEBAICA



Hyphaene thebaica (L.) Mart.

Family: Palmae (subfamily: Borassoideae)

Description: Dioecious fan palm 10 - 15 m, easily recognized by its dichotomy of the stem forming up to sixteen crowns. The conspicuous fan-shaped leaves measure about 120 x 180 cm. Petioles more than 1 m long, with spiny margins, spines upwardly curved. Male spadices branched, surrounded by a spathe with a peduncle flattened towards the base, nearly 120 cm long. Male flowers solitary in pits of the spadix, spathe-bracts encircling the spadix, pointed, emitting the branches, the latter with stalk flattened next the axis. Branches of female spadices stouter, in the fruiting stage marked by densely tomentose cushions after the fall of the fruit. Fruit smooth, rectangular to cubical with rounded edges, approximately 6 x 8 cm, shiny, brown when ripe at the end of the dry season; about 120 g/piece fresh, 60 g when dry, containing one ivory-coloured seed each, approximately 2 - 3 cm.

Distribution: Hyphaene thebaica is one of the 11 species of the genus to be found in Africa. It grows from Mauritania to Egypt, from Senegal to Central Africa and east to Tanzania. Common in the Sahel and parts of the Sahara (oases, wadis, mountain ranges (e.g. Aïr) and very frequent in the Sudan.

Site requirements: An indicator of good soils, with a shallow ground water table, however, a frugal species itself with no particular site requirements. Does not tolerate stagnant water but a medium salt content of the soil. Optimal pH values 6.5 - 7.5; mostly on sand and dunes. Rainfall (50) 200 - 600 mm. Widely distributed near rivers and "mares", sometimes on rocky hills.

Propagation and management: Propagation by seeds, occasionally also from root suckers. After germination a single leaf is produced which is strip shaped. Fan-shaped leaves are produced 2 - 3 years after germination at ground level. At this stage a new leaf is produced every seven days. The stem is produced after 18 - 20 years. First fruiting after 6 - 8 years. Rotation approximately 60 years, very resistant to bushfires.

Uses: In Egypt, the doum palm has been cultivated since ancient times and has long been considered to be a sacred tree symbolizing masculine strength and to protect and supply people after death with shade, water and food. In arts in the period 1570 - 715 B.C. the fruit and wood of the palm are often displayed as a natural wealth of Nubia.

Leaf fibres are used for the manufacture of brooms, ropes, mats and baskets and coarse textiles. In particular in the Sahel ropes for wells are made from Hyphaene fibres. Leaves are also used for thatch, as a fuel and as a fodder. Root fibres are obtained after 2 - 3 days of soaking and beating of the roots; they are used for the manufacture of fishing nets. Young shoots produce tasty palm-cabbage and the hypocotyl is also edible. From the fruit (adult

palms produce annually up to 50 kg which take 8 - 12 months to mature) a tasty food, the pulpy mesocarp, is obtained. Sweet fruits have a thick, dark pericarp with an aromatic smell ("ginger bread palm"). Another fruit type has a thin, light and very dry pericarp with unpleasant taste. In these fruits the seed kernel is loosely embedded and rattles if one shakes the fruit which facilitates distinguishing tasty from bitter ones. Dry fruits are used to produce a black dye for leatherware. The very hard seeds (about 20 g each), called "vegetable ivory", are used for making buttons, pearls and various small carvings. Immature seeds when adequately prepared can be eaten. Wood of male palms is decorative and very durable, used in construction for houses, for fence posts, planks, boats, water-ducts and water wheels; also makes good charcoal for forges.

Only wood from mature male palms should be used. Wood from female palms has a light brown colour and loose fibrebundles. It tends to rot after a short time and to be attacked by termites. The selection of good timber follows the following empirical rules:

- "Wet" stems have 4 forks, "dry" stems only 3. The number of subsequent bifurcations is thus more important than length of the stem and diaméter.

- Mature male palms often show bark fissures in the forks from which a dark sap is exuded.

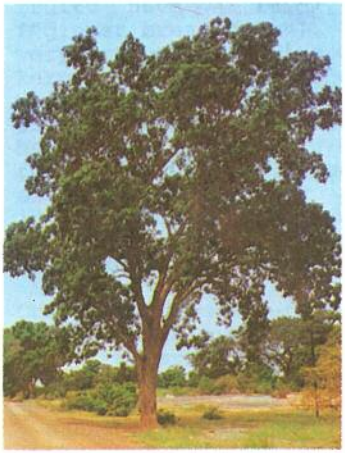
- Smooth logs are generally of good quality.

- Swellings of the stem generally indicate spongy (wet)wood.

In local medicine the roots are used to treat bilharzia, haematuria and other diseases. The terminal meristem is tapped for making palm wine.

References: C.T.F.T. (1978), Fanshawe (1950), Geerling (1982), Giffard (1966, 1974 A), Irvine (1961), Kerharo and Adam (1974), von Maydell/Götz (1985), Sahni (1968), Touzeau (1973).

KHAYA SENEGALENSIS



Khaya senegalensis (Desr.) A. Juss.

Synonym: Swietenia senegalensis Desr.

Family: Meliaceae

Description: Tree up to 30 m high, clear bole frequently up to 10 m, stem diameter exceeding 1 m, widely spread crown, no buttresses. On less fertile soils branches lower. Bark brownish to dark grey, scaly; slash red, exuding a reddish gum. Leaves paripinnate, up to 20 cm long at the end of the branches with 3 - 6 pairs of opposite or alternate leaflets; leaves are shed during the dry season but immediately replaced. Leaflets oblong or oblong-elliptic, apex acuminate, 7 - 12 cm long, 3 - 5 cm wide, underside grey, 8 - 10 pairs of lateral nerves. Flowers small, approximately 5 mm, white, insignificant, in panicles, 15 - 20 cm long, at the ends of branches together with young leaves. Flowering (December) February to March (April). Fruit globose, a woody capsule of 5 - 10 cm diameter, generally 4-valved (distinction from Khaya ivorensis, which is closely related but has 5 valves), bursting into 4 segments, seeds correspondingly arranged in 4 rows, brown, paper-thin.

Fruit mature from January to May, seeds brown, flat with thin margins (wings), dispersed by the wind; regularly fruiting.

Distribution: From Senegal to the Sudan and Uganda, south to the rainforest zone.

Site requirements: Prefers deep, fresh soils, moist alluvial soils, following watercourses and non-flooding depressions; grows also on very dry and shallow or lateritic sites with sufficient precipitation. Precipitation 650 - 1300 mm annually, distributed over 4 - 7 months.

Propagation and management: About 4,500 - 7,000 seeds/kg; around 60 seeds/fruit. Germination 90 % after 10 - 18 (30) days.

Seeds must be fresh, therefore early seeding (December/January) required. On good (moist) site initially rapid growth, even in the understory, depending on extent of root competition from neighbouring trees, depth, fertility, soil moisture and severity of insect attack. Buds destroyed by the larvae of Hypsipyla robusta (family: Pyralidae) and wilt. Continued attack over several years produces deep branching. Several protective measures have so far proven ineffective. For economic reasons the treatment with the insecticide GS 13 005 by Ciba-Geigy can only be practised on a small scale. Hence, solitary planting or groups and rows of trees are recommended in villages. In the savanna, where Khaya is relatively exposed, the tree often shows bad growth particularly if the leaves are cut for fodder or bark is removed for medicinal applications. Plantations in the Sahel restricted to special cases (e.g. village amenity planting).

As young trees do not cast much shade, removal of the rapidly

growing grass is essential. Propagates well from coppice, shoots and root suckers.

Uses: The wood is of medium weight (600 - 700 kg/m^3 when air-seasoned) and only moderately hard, it is one of the best of all African mahogany woods. The heartwood is moderately resistant to insects, fungi, and termites, the sapwood is occasionally attacked by longhorn beetles. The wood can be seasoned quickly and easily and can be worked with all types of power and hand tools without any particular problems. Sometimes rather woolly surfaces result from cutting edges. Planks or strips can be successfully nailed, screwed or glued to form stable joints. Finally, the surface can be varnished or stained without difficulty to produce a very attractive finish.

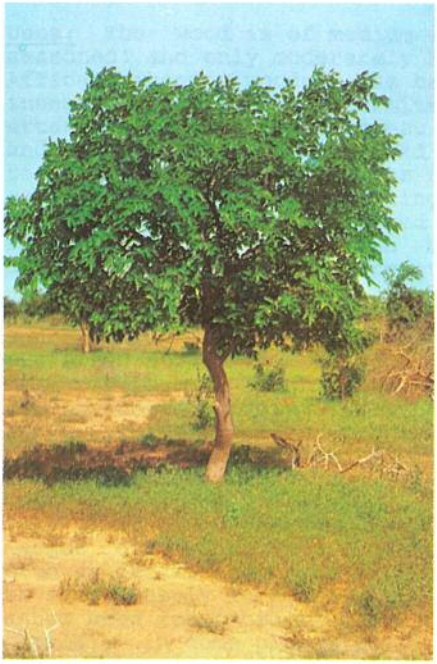
Because of its decorative appearance, the wood of Khaya senegalensis, also termed Dry Zone Mahogany, is the timber most preferred for furniture. In addition, its solidity and durability make it a much sought-after material for the construction of prefabricated buildings, for boat-building, turned wood products, prayer slates, mortars etc. Trees from the Sahel generally do not reach the dimensions and quality necessary for lumber or rotary veneer production.

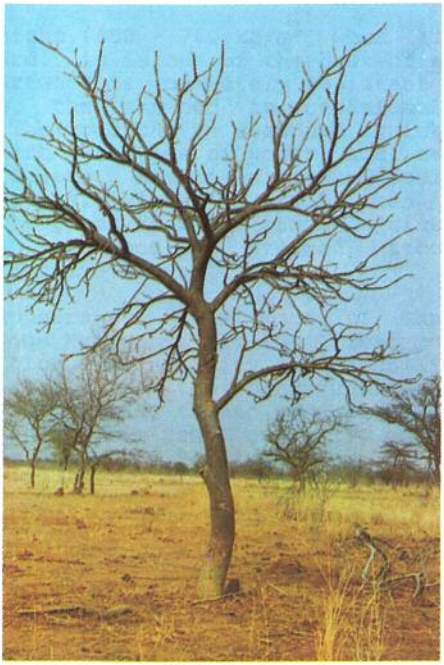
Only limited quantities are available for fuelwood and trees of larger dimensions are undesirable because of the difficulties with splitting and cross-cutting. Hence, even where fuelwood is in short supply larger diameter sections are not utilized. Wood ashes used for conserving millet seed, leaves as fodder (cattle, camels); in some places pollarding takes place every year. Young leaves contain 0.75 FU and 50 g of digestible protein/kg of dry matter. An arrow poison is obtained from parts of the tree.

Many medicinal applications, e.g. a bark extract used for treating jaundice, dermatoses, scorpion bite, allergies, infection of the gum, hookworm, bleeding wounds (disinfection), and as a laxative. Seeds and leaves for fever, headache; roots against sterility, for the treatment of mental illness, against syphilis and leprosy, as aphrodisiac; also used in magic.

References: Aubréville (1950), Berhaut Vol. VI (1979), Dahms (1979), Geerling (1982), Giffard (1974A), Götz (1983), Hallam (1979), Irvine (1961), Kerharo and Adam (1974), Touzeau (1973), Sahni (1968), von Sengbusch and Dippold (1980).

LANNEA ACIDA





Lannea acida A. Rich.

Synonym: Odina acida (A.Rich.) Oliv.

Family: Anacardiaceae

Description: Deciduous tree, 4 - 6 m high, with silvery-grey to dark thick bark, longitudinally fissured with older trees. Slash red, with yellow streaks, fibrous and sticky. Branches hairy when young, otherwise sticky. Leaves imparipinnate, alternate with 3 to 7 leaflets and a terminal leaflet of equal size or only slightly larger; length of leaflets 6 - 10 cm; occasionally with a red margin, not occurring in Lannea microcarpa, which is otherwise very similar. Flowers dioecious; male flowers fragrant in loose spikes, greenish to cream coloured, approximately 12 - 14 cm long, at the end of the branchlets. Female flowers shorter and thicker. Sepals ciliate (species characteristic). Fruit approximately 1.2 cm long, ellipsoid, in heavy, pendulous clusters red to dark purple, fruiting period short. Approximately 8,000 seeds/kg.

Distribution: In contrast to Lannea microcarpa also on the west coast of Senegal; in the Sudan-savanna of West Africa and in the southern Sahel; to Cameroon and the Central African Republic; sometimes protected on fields because of the edible fruit and the fibrous bark.

Site requirements: Tolerates dry soils, requires at least 600 mm precipitation or moist sites.

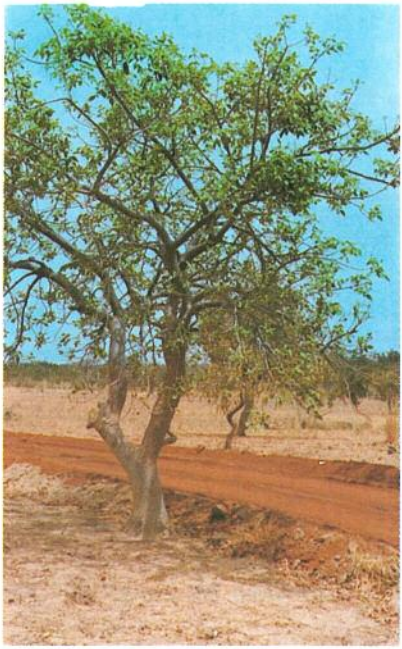
Propagation and management: Fruits are soaked, the seeds separated from the pulp and subsequently dried. Seeds are soaked again in warm water prior to seeding; good germination in plastic bags; above-average fire resistance.

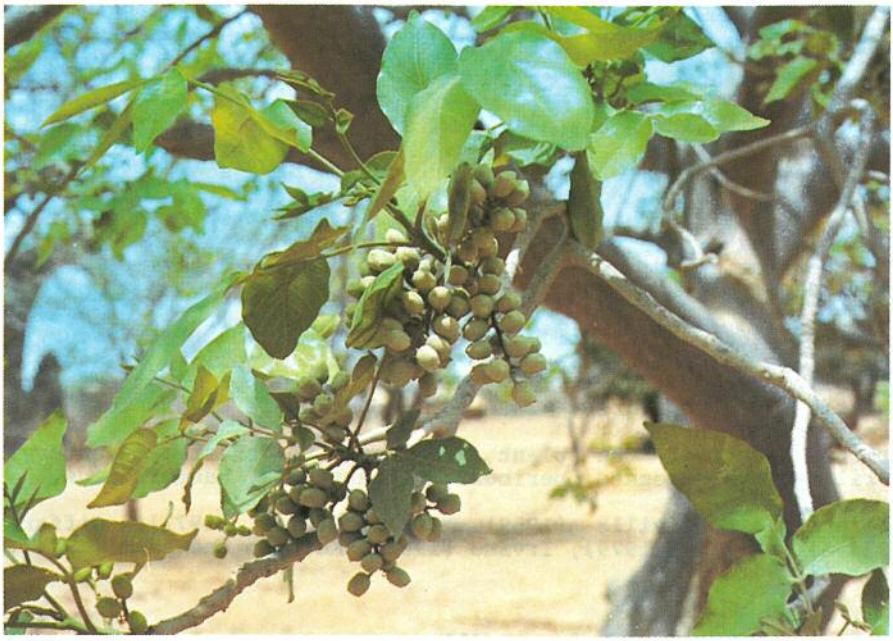
Uses: Leaves and fruit are available before the beginning of the rainy season. The fruit pulp has a slightly acid and resinous taste, it is eaten or used for preparing beverages, including fermented alcoholic drinks. Also young leaves and the soluble gum are eaten. The wood has various uses, e.g. for stools and planks, household and agricultural utensils, makes good firewood; bows are made from slender poles. The bark fibre is occasionally used for cordage; oil from the fruit for soap-making.

Many medicinal applications, e.g. leaves to treat scurvy, dysentery, blotches. Bark used as astringent, for stomach ailments, dysentery, caries, dermatoses, herpes, gonorrhoea, rachitis with children. The root decoction is given to women after childbirth.
Various parts of the plant are used to treat dysentery, sterility, eye diseases, beriberi, bilharziosis, haemorrhoids.

References: Aubréville (1959), Berhaut Vol.I (1971), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo and Adam (1974), Weber (1977).

LANNEA MICROCARPA





Lannea microcarpa Engl. et K. Krause

Synonym: Lannea djalonica A. Chev.

Family: Anacardiaceae

Description: Deciduous tree, up to 16 m high, diameter up to 50 cm, very similar to Lannea acida. Crown hemispherical, very dense, bark white-greyish, sweet-scented, smooth; wrinkly on old trees, falling off in small scales, very fibrous. Slash red with white streaks. Leaves stickier than those of Lannea acida, alternate, imparipinnate, generally not more than three pairs of folioles; margin never red! Leaflets ovate, acuminate, upper side with evenly distributed small, sticky gum spots, brightly shining, glaucous, pendulous, rachis and petiole reddish. Leaf-fall at the beginning of the dry season. Flowers in small racemes at the beginning of the rainy saison, preceding the leaves; green-yellowish, inconspicuous, sepals glabrous (species characteristic); male and female flowers separate. Fruiting in the rainy season, fruit ellipsoid, pale, a purple-black drupe, forming racemes similar to grapes. The fruit pulp is edible; approximately 5,000 seeds/kg.

Distribution: In contrast to Lannea acida not on the west coast of Senegal, but penetrating further south.

Site requirements: Needs deeper and fresher soils than Lannea acida, but frequently associated with it; above-average fire resistance.

Uses: The fibrous bark is used for ropes. Fresh fruits ("raisins") are edible and make a sweet beverage after cooking. Leaves edible; as forage exclusively for goats; leaves and flowers, fruits available prior to the rainy season. Gum soluble and edible. Wood white, not durable. Bark and leaves are used to prepare a remedy for diarrhoea.

References: Aubréville (1950), Berhaut Vol. I (1971), Giffard (1974 A), Irvine (1961), Kerharo and Adam (1974).

LEPTADENIA PYROTECHNICA

Leptadenia pyrotechnica (Forsk.) Decne.

Synonym: Leptadenia spartium Wight

Family: Asclepiadaceae

Description: Straight, broom-like shrub, 1 - 3 m high, leaflets, buds and branches opposite; translucent latex. Ascending cylindrical branches, rich green and glabrous; diameter at the end not more than 2 mm, internodes 10 - 15 cm. Flowers small, greenish-yellow, 4 mm, with 5 connate, spread petals, stellate, in cymes on peduncles 3 - 6 mm long. Fruit spindle-shaped, smooth husk, 6 - 8 cm long, 6 - 8 mm wide and obtuse. Seeds linear-ovate, 6 - 7 mm, with a tuft of hairs of 25 - 30 mm at the tip.

Distribution: Northern Senegal, Mauritania, Niger, Chad, Mali, Sahara, Arabia to Pakistan.

Site requirements: In the Sahel on dry, sandy soils and on dunes.

Uses: The dried pith has been used as a tinder. (Rotary friction on hard wood). Young twigs used as toothbrush. Flowers occasionally eaten raw by shepherds; leaves, young shoots and flowers used to flavour soups. Plant is browsed by camels, occasionally by sheep and goats, never by cattle. Bark fibres used for cordage and fishing nets, also in wickerwork.

Medicinal use: The sap is used as a rub for smallpox victims, seeds macerated for eye bath.

References: Aubréville (1950), Berhaut Vol. I (1971), Geerling (1982), Touzeau (1973).

LEUCAENA LEUCOCEPHALA

Leucaena leucocephala (Lam.) de Wit

Synonyms: Leucaena glauca (Moench) Benth., Leucaena latisiliqua (L.) W.T. G'Illis, Leucaena salvadorensis Standley, Acacia glauca Moench, Mimosa glauca L., Mimosa leucocephala Lam.

Family: Mimosaceae

Description: Leucaena leucocephala is an evergreen shrub or tree with alternate bipinnate leaves, composed of about 4 - 7 pairs of pinnae (4 - 10 cm long), each with 10 to 20 pairs of leaflets. These are less than 15 mm long, lanceolate. Both leaves and leaflets fold up in response to moisture stress, cool temperatures and darkness. The rachis has a gland at the terminal pair of leaflets. Rachis, young twigs and leaflets (below) are pubescent. The flowers are white, in globose heads of about 2 cm diameter. They emerge from the leaf axils at the end of the branches, single or in pairs. The pods are flat, 10 - 15 cm long and persisting on the tree after the seeds have been shed. A single pod contains 12 to 25 seeds.

Even seedlings develop a comparatively big taproot to resist drought. Lateral roots are less developed and tend to turn downward at a sharp angle. Water and nutrient competition with other (annual plants) is thus reduced. However, small lateral roots near the soil surface usually have nitrogen-fixing Rhizobium nodules.

It is very important to know that Leucaena leucocephala has a great number of varieties. These make selection, treatment and utilization difficult and have, in many cases, caused confusion. The varieties can be broadly classified into three main types.

A. Common or "Hawaiian" type. These are bushy varieties, up to 5 m high, which flower very early (4 - 6 months old) and almost all the year round. Yields in wood and foliage are low. They are mainly used for marginal land reclamation (as a pioneer species) but may become an aggressive weed due to their abundant seed production. Firewood, charcoal and shade/shelter are main uses.

B. Giant or "Salvador" type. Trees up to 20 m high, with big leaves, pods and seeds. Seasonal flowering and a very high overall biomass production have been recorded. These varieties have more recently been planted for large-scale wood production in Southeast Asia and elsewhere in the humid tropics.

C. "Peru" type. Trees or shrubs, sometimes tall (up to 15 m) with many branches and short stems. They produce a maximum of foliage and are therefore recommended for forage plantations.

Distribution: Originating from Central America, many varieties were spread throughout semiarid to humid zones of the tropics over the last hundred years, especially from Mexico to the

Philippines, Indonesia etc. Introduction into Africa about 1950 but widespread acceptance is still hampered by lack of the appropriate Rhizobium strains in African soils and, because of possible mimosine-poisoning of livestock, farmers remain reluctant to use the leaves for forage.

Site requirements: Average annual rainfalls of 400 - 800 mm, but tolerates dry seasons of 4 - 5 months. Leucaena is not very sensitive with regard to soils, but high yields can only be expected in areas with reasonably fertile and well-drained sites. Near-neutral or alkaline soils with a high moisture content are preferred. This generally excludes widespread cultivation under Sahel conditions. Agroforestry systems could offer local chances for further extension.

Propagation and management: The seeds have an impervious, waxy coat and should be treated similarly to Acacia seeds to ensure adequate germination. The best method is soaking in hot water (80° C) for about 3 minutes, then leaving the seeds in cold water for a day or two. Seeds are recorded to have a high viability (unless destroyed by insects or rodents) but should be planted as soon as possible because germination may fall below 50 per cent within less than half a year. Direct seeding is the cheapest way of establishment. The seeds should be put into deep furrows either by hand or common local equipment at the beginning of the rainy season. The furrows should be spaced at 3 m, seeds in the furrows 20 cm apart. Seed numbers per kg show a wide variation around 20,000/kg. The seeds should be covered by 1 - 2 cm of soil. They generally germinate after a week. On sites where Leucaena has never been grown before, seeds must be inoculated with the appropriate Rhizobium strains just prior to sowing.

The site should be carefully weeded before seeding and during the first growing season. However, Leucaena soon forms a dense canopy inhibiting competition by grass and other plants. 35 kg of nitrogen fertilizer per hectare promotes juvenile growth, calcium and phosphorus increase overall yields. Leucaena coppices well and may be lopped at short intervals. Forage can be harvested after one or two years, firewood after 3 to 4 years.

Uses: Leucaena aids neighbouring plants by providing foliage that rivals manure in nitrogen content. Soils can thus be improved through litter fall or by lopping and mulching. Because of its deep rooting habit, Leucaena acts as an excellent nutrient pump and is therefore recommended for green fallow and for reclaiming degraded soils. The Leucaena-Rhizobium partnership may fix about 100 kg of nitrogen/ha and more, depending on site conditions.

Leucaena foliage is palatable, digestible and nutritious to ruminants making it a promising browse plant for livestock production in semiarid zones. However, the amino acid "mimosine" contained in the leaves may be toxic to non-ruminants if fed in large quantities. Moreover, in the Sahel even ruminants lack the appropriate stomach bacteria to render mimosine harmless. Until these bacteria have been introduced successfully, Leucaena

foliage will have to be used with particular caution (less than 10 per cent of the daily feed intake).

Sprouts, flowers, leaves and green pods can be eaten as a vegetable. The gum is used for sauces. Seeds are roasted as a coffee substitute. In local medicine, seeds are used as a vermifuge, for gonorrhoea and defects of vision.

The wood may be used for poles, fence posts, simple furniture, for fuelwood or charcoal. The calorific value is acceptable for a fast growing tree, yields may be comparatively high. The species should, therefore, be tested for firewood plantations on small village lots, in urban green belts and on other selected sites.

Yields, recorded from subhumid zones, may exceed 30 m^3 of wood and 12.5 to 22.5 t of forage per year and hectare. This, however, cannot be expected under Sahelian conditions. Genetic improvement and selection may lead to Leucaena varieties and more productivity under Sahelian conditions.

References: Berhaut Vol. IV (1975), Kerharo and Adam (1974), National Academy of Sciences (1977).

Maerua angolensis DC.

Family: Capparidaceae

Description: Shrub or small tree, 5 - 6 (9) m high, bole rarely straight, bark smooth dark grey with white lenticels, slash outside green, center white. Branches pale yellow. Leaves alternate, light green, very variable in shape and size, generally smooth, suborbicular, ovate to lanceolate with broad, round base, apex mucronate. Long petiole of 1.0 - 3.0 cm. Flowers green-white, solitary or in corymbose racemes in the leaf axils on long peduncles 3.0 - 4.0 cm. Petals missing; 4 green sepals, 1.3 cm long, numerous stamens (white) 3.5 - 4 cm long, spread umbrella-shaped. Fruit 1.2 x 25 cm, straight or bent pod with constrictions between the up to 40 seeds embedded in fruit pulp.

Distribution: Southern Sahel and northern Sudan zones, to East Africa and south of the rainforest zone to Angola, Transvaal and Namibia.

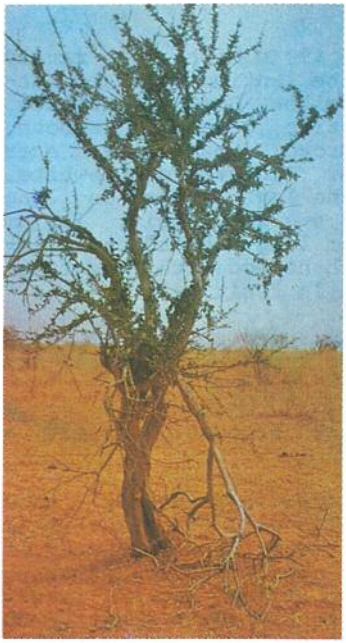
Site requirements: On sandy soils; not frequent, mostly a solitary shrub or tree.

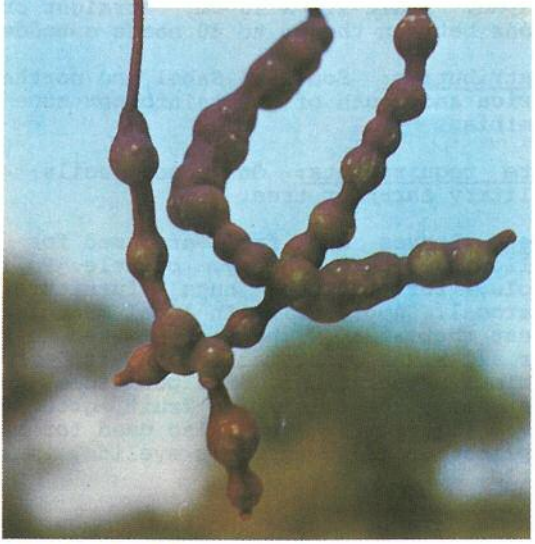
Uses: Leaves and fruit are used for soups and sauces. Wood yellowish, hard, heavy, brittle. Polishes well, used for small tools, for building huts, furniture; makes good fuelwood or charcoal. Application in local medicine: Decoction of leaves to treat rheumatism, the mash is used to rub ailing parts. Leaves for all kinds of stomach disorders, frequently as an additive to various preparations, for poultices, etc. BAUMER (1983) records that among the Fulani the fruit, ground with galena, is used as a love filter. It was also used for making an ointment which, applied on a young man's eyelids, makes him irresistible to girls.

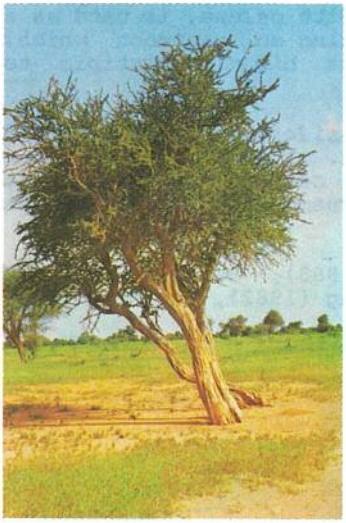
Leaves are palatable and browsed but considered by some herdsmen to be noxious or even toxic to livestock. This could be due to intraspecific variations or related to certain sites. Maerua angolensis is occasionally planted as ornamental shrub. Fruits said to be poisonous.

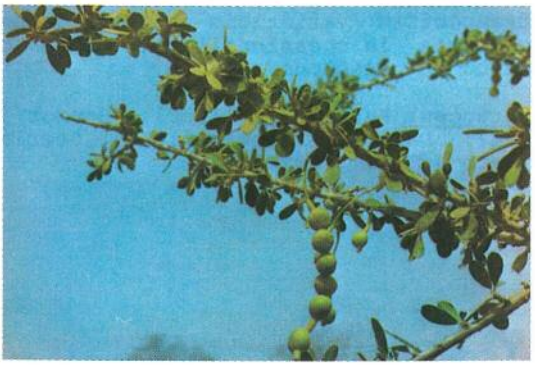
References: Aubréville (1950), Baumer (1983), Berhaut Vol. II (1974), Dale a. Greenway (1961), Geerling (1982), Irvine (1961), Kerharo a. Adam (1974).

MAERUA CRASSIFOLIA









Maerua crassifolia Forsk.

Synonyms: Maerua de-wailly Aubrév. e. Pellegr., Maerua rigida R. Br., Maerua senegalensis R.Br.

Family: Capparidaceae

Description: Small evergreen tree, 6 - 10 m high, stem diameter up to 25 cm, bole often stunted and twisted, with drooping sarmentous branches. Bark smooth, dark grey or brown, scaly when old. Leaves very variable, 1.2 - 2.0 cm, 0.4 - 1.0 cm wide, ovate, mucronate, short petioled, leathery, dark green, pubescent or glabrous, often in whorls on greyish, short shoots, Flowers February to March, solitary or 1 - 3 on leaved shoots, sweetly scented, light green with white stamens. Fruit brown, oblong pods, 5 - 10 cm, constricted between the seeds, pubescent, mature in April.

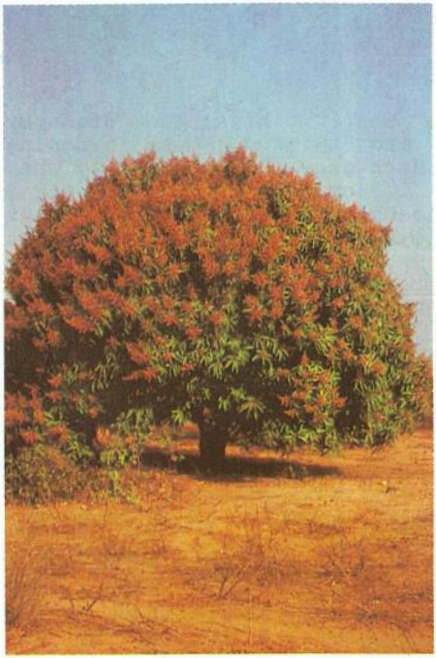
Distribution: North and South of the Sahara, from Morocco to Egypt and Arabia; in the semiarid zones of Senegal to Chad, Sudan, East Africa. Also reported from Iran and Pakistan.

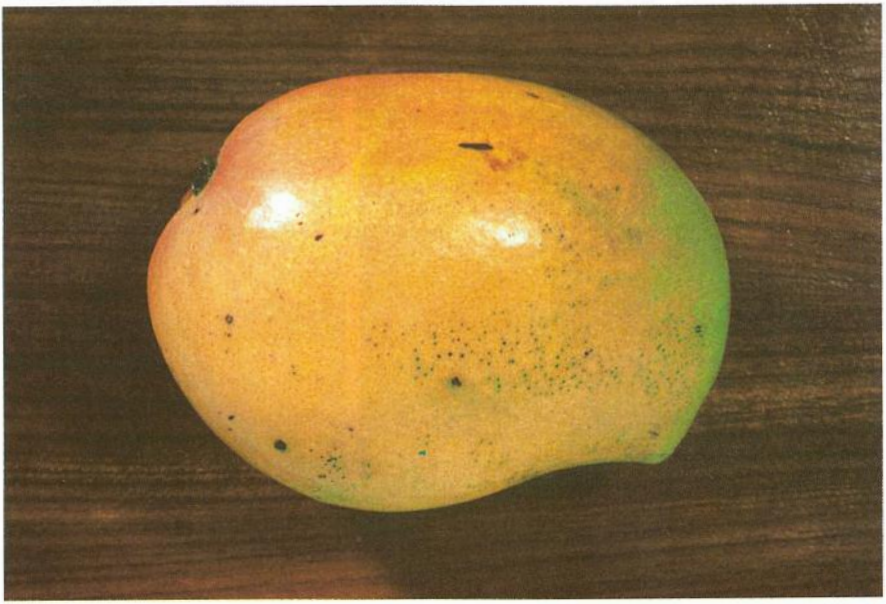
Site requirements: On dry sites, Sahel thorn-bush savanna. Quite frequent on sands, occasionally solitary. Extremely drought-resistant (100 - 400 mm annual rainfall, up to 11 months dry season).

Uses: Wood whitish, very hard, for tool handles, chariots for cattle troughs, weapons, ploughs etc., rarely as fuelwood. Smells very bad when burnt. The green branches are browsed by all domestic and wild animals. Camels are very fond of Maerua crassifolia, browsing leaves, flowers and fruit. The forage value of this species is very good, and it should be tried to promote natural regeneration or even to establish forage plantations within the Sahel. Fruits edible. Leaves for medicinal applications to treat stomach disorders, (they are also eaten in couscous). Bark used in water purification, the ash for preparing a black dye.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. II (1974), Dale a. Greenway (1961), Geerling (1982), Irvine (1961).

MANGIFERA INDICA





Mangifera indica L.

Family: Anacardiaceae

Description: Mango, the most widely known cultivated fruit tree in the Sahel and one of the most important tree crops of the tropics, is easily recognized by its large, even, dense, widely spread crown. In India and in the humid tropics heights of nearly 40 m and stem diameters of up to 1.50 m may be reached; but trees rarely exceed 10 m in the Sahel. The bark is brown and smooth when young, almost black and rugose when old. It exudes a resinous latex when damaged. The root network penetrates deeply (up to 8 m) into the soil, but the tree also has extensive shallow roots to profit from surface-near moisture and nutrients. Leaves are alternate, copper-coloured when young, tender, hanging perpendicularly from the branches. They are dark green when grown, leathery, glabrous and lanceolate, 12 - 30 cm long and 3 - 5 cm wide with a strong, light midrib and 15 - 20 equally light, lateral nerves. Short peduncle of not more than 5 cm. The mango tree is evergreen, but has a marked growth and vegetation cycle in the drier tropics. Flowers abundantly with terminal panicles, nearly 20 cm long. Each panicle may carry as many as 1,000 (200 - 6,000) small, whitish or reddish individual flowers, approximately 3 mm long. Male and female but also hermaphroditic flowers occur on the same inflorescence. The latter have five stamina in contrast to the male flowers. Most flowers are dropped prematurely so that only a few fruits are formed of which less than 1 % reach maturity. Nevertheless, over a thousand fruits may be found on a single productive tree. The weight of fruits varies according to variety but individual pieces may exceed 2 kg. They contain a large, flat stone in the juicy, yellow fruit pulp.

Distribution: The mango tree originates in India and the adjacent Southeast Asian region where even today numerous closely related species can be found. Early explorers brought the tree to other regions, such as East Africa in the 14th century and 200 years later Portuguese sailors brought the tree to West Africa. Today the species is cultivated in almost every tropical region but preferably in zones with a dry season because fruiting becomes irregular in other regions.

Site requirements: The mango tree has no particular soil requirements but tolerates neither stagnant water nor extended or frequent flooding; it grows well on deep, loamy-sandy and fresh, well-drained soils. Mango dislikes soils with a rocky sub-soil, compact clays and calcareous soils. Plantations require wind protection.

Propagation and management: The mango tree has been cultivated in India for at least 4,000 years as documented by Sanskrit scriptures. Fresh seeds germinate easily about 1 month after planting and can be raised in the nursery. However, this method of propagation is only suitable to produce stock, because it cannot be relied on to maintain the parental characteristics. New plantations require grafting with improved varieties and thus

careful training of the producers of seedlings on the village level to warrant successful growth. Stock plants should be raised in a partly shaded site in containers until about 60 cm height and about 1.5 cm diameter. Final planting distance 12 x 12 m or more. Young plants should be shaded when planted out. It is important to select the right type from the more than 100 varieties known, of which a few excel by size, taste and durability of fruit while others are particularly resistant to fungal diseases and noxious insects, in particular fruit flies, coccids and weevils. Leafhoppers are among the most important insect pests in many tropical countries. Others include tip borers, seed borers, fruit flies, scale insects, and mealybugs. With the extension of cultivation into the more arid parts and on less favourable sites in the Sahel, pests may gain in importance. Adequate control systems will thus be needed. The same applies to diseases such as anthracnose, although this occurs mainly under more humid conditions.

First yields can be expected after approximately 6 years. Regular watering of young trees during the first years may be necessary or at least recommendable in some regions. Mango trees may attain over 100 years of age.

Utilization: The main product of the mango tree is the fruit.
100 g of ripe fruit contain
80 - 85 g water
12 - 15 g carbohydrates (sugar)
0.6 g protein
0.1 g fat
50 - 63 calories
0.3 - 0.8 mg sodium
10 - 15 mg calcium
12 - 16 mg phosphorus
0.3 - 1 mg iron
10 - 20 mg potassium
10 - 17 mg magnesium
10 - 13 mg sulphur
10 - 20 mg vitamin C.

It is estimated that 5 million t of fruit are produced annually in over 1 million mango groves in India alone. World production is estimated to be 13.5 million tons.

In times of need the leaves are used as fodder; young trees must be protected against browsing. Old leaves, however, are toxic and may cause death of the animals if consumed in large quantities. Flowers are an excellent source of honey. The wood is of minor importance as trees may grow very old and the production of fruit predominates. However, when trees have to be cut the wood finds many applications. The sapwood is not clearly defined, straw to pale brown, whereas the heartwood varies between light pinkish-brown to dark brown. Texture medium-coarse, grain often straight, sometimes interlocked. The wood has no taste or odor. It saws, bores, mortises and glues well, but is susceptible to stain when in log form and during air-drying. The wood can be easily

impregnated, especially to prevent destruction by termites (BOLZA/KEATING 1982). It is used in the Sahel in interior construction, for cases, fuelwood and charcoal.

A yellow dye can be obtained from the leaves. In local medicine, the fruit prevents scurvy but may cause diarrhoea if eaten excessively or together with alcohol, milk or other beverages. Pulverized kernels are recommended for diarrhoea but are also said to be effective for hemorrhoids. Medicine for heart ailments, a vermifuge and medicine for treating dysentery are obtained from the flowers. Leaves for fever; they have also a diuretic effect. Because of a high tannin content leaf decoctions are used for treating mouth and throat infections but also taken for toothache. They are offered for asthma, gonorrhoea, dysentery and bronchitis. The bark finds many applications for dysentery, gonorrhoea, rheumatism, haemorrhoids etc.

Suitable also as a decorative roadside tree, the dense crown of the mango tree provides abundant shade but often harbours large numbers of mosquitoes. In the mythology of the South Asian people, in particular in India, the mango plays an important role as a symbol of benevolent spirits.

References: Berhaut Vol. I(1971), Bolza a. Keating (1982), Brücher (1977), FAO (1982), Irvine (1961), Kerharo and Adam (1974), Samson (1980), von Sengbusch and Dippold (1980).

MAYTENUS SENEGALENSIS

Maytenus senegalensis (Lam.) Exell.

Synonyms: Celastrus coriaceus Guill. et Perrott., Celastrus senegalensis Lam., Gymnosporia crenulata Engl., Gymnosporia senegalensis (Lam.) Loes., Gymnosporia dinteri Loes.

Family: Celastraceae

Description: Shrub or small tree, up to 6 m high and 15 cm stem diameter. Bark grey-brown, smooth, finely reticulate or even rough. Young branches reddish or grey-green, later grey, often pendulous. Thorns 5 - 10 cm long, axillary or terminal. Leaves simple, alternate or in fascicles, glaucous or green, often with reddish midrib, 1 - 4 cm, oblong, lanceolate or obovate, often widest above the midpoint of variable size. Petioles red; flowers small, cream-coloured to greyish or pink, in fascicles or panicles, axillary and on peduncles, generally dioecious. Flowering only a short time. Fruit small, smooth, a two-chambered capsule, round to pear-shaped, pink to red, 1 - 2 smooth, red-brown seeds.

Distribution: In semiarid Africa, Asia, southern Europe.

Site requirements: Open bush, savannas, coastal and dune regions, near swamps or river-banks. Occasionally in thickets, e.g. on coastal dunes (Senegal), on river-banks, on nearly all soils. No particular requirements, often propagating rapidly. Fast colonizer of fallow land; requires 700 mm annual precipitation or high humidity; several very similar Maytenus species with overlapping ranges.

Uses: Fruits and flowers said to be edible. Fruits used for yeast culturing. The wood is hard, durable and of fine grain; applications limited due to small dimensions. Larger pieces easy to saw and plane, but split on drying; for boxes, stools, platters, spears, axe handles, cattle bells, trinkets. Wood and leaf ashes used for the preparation of a vegetable salt. Leaves used as fish poison.

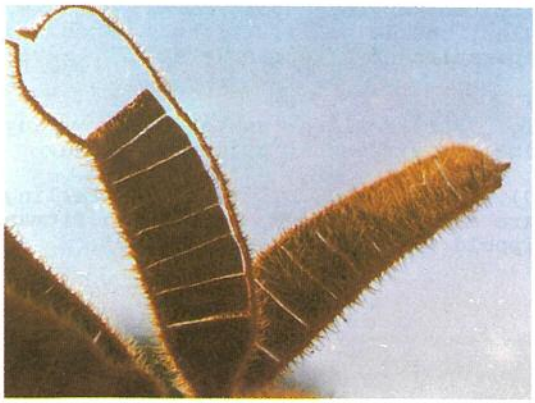
Medicinal applications, e.g. for healing snake bites. Many applications for roots in Senegal, a frequent object of trade.

References: Aubréville (1950), Berhaut Vol. II (1974), Geerling (1982), Irvine (1961), Kerharo and Adam (1974), Palmer and Pitman (1972), von Sengbusch and Dippold (1980), Wickens (1980 B).

MIMOSA PIGRA








Mimosa pigra L.

Synonym: Mimosa asperta L.

Family: Mimosaceae

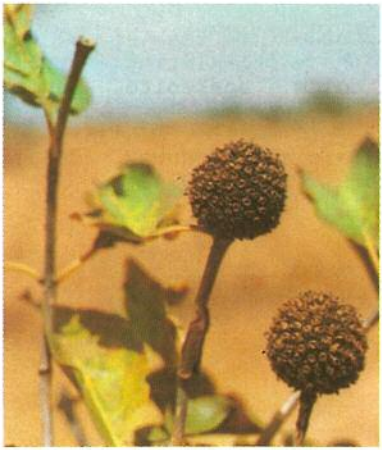
Description: Dense, bushy often creeping shrub, 1 - 2 m high; branches brown, twigs golden-brown, pubescent; spines on internodes, curved 0.7 cm. Leaves bipinnate, alternate, 5 - 12 pairs of pinnules of 3 - 8 cm length with 12 - 30 pairs of linear hairy leaflets, 4 - 7 mm long. Petiole inflated at the base, flanked by 2 alternate, recurved spines. Rachis 8 - 12 cm, pubescent to coarsely hairy, covered by fine, not lignified prickles, at the base of each pair of leaflets; between pinnules 2 opposite spines, 1 straight, 1 curved. Flowers white to pink, in globose heads, 15 cm in diameter, solitary, in the leaf axils. Fruit a flat pod, 5 - 7 cm long, covered with bristle, dense, brown hairs. The pods separate into segments. The outer rim of the pod persists like a frame. Frequently 5 - 10 pods on one peduncle.

Distribution and site requirements: The plant originated in Central and South America and has turned out to be an aggressive invader of large areas throughout the tropics, especially in Southeast Asia and Papua New Guinea. No active propagation is recommended for the Sahel. In many countries weed control of Mimosa pigra is attempted, using mechanical methods, natural enemies or herbicides. The plant is already widespred in Africa, e.g. on banks and near waterholes of the northern Sudan zone, on sites flooded for some time; forming impenetrable thickets. Senegal, Cameroon, Burkina Faso.

Uses: Not browsed by cattle; locally used for fencing around stables. Medicinal applications: Roots have stimulating effects. Extracts and decoctions as remedy for colds, snakebite, fever, toothache, eye diseases, obesity.

References: Berhaut Vol. IV (1975), Dale and Greenway (1961), Geerling (1982), Irvine (1961), Kerharo and Adam (1974).

MITRAGYNA INERMIS



Mitragyna inermis (Willd.) O.Ktze.

Synonyms: Mitragyna africana (Willd.)Korth., Nauclea africana Willd., Uncaria inermis Willd.

Family: Rubiaceae

Description: Shrub or medium to large tree (Burkina Faso), up to 16 m high, of dense spherical appearance. Bark smooth or scaly, grey, soft, slash light brown, fibrous, darkening under light. Leaves elliptic to conical, acute, rounded at the base or constricted, 6 - 9 cm long, 3.5 - 5 cm wide, underside somewhat hairy on the nerves. Young leaves red, stipule, small, lanceolate-oval, slightly descending. Leaf- fall in January, new shoots in June. Flowers cream-coloured, solitary terminal, or on short peduncles, strongly fragrant, globose heads of approximately 2 - 3.5 cm diameter. Five sticky petals, calyx surrounded by sticky or hairy bracts, stylus stigmatic. Flowering from May to September, i.e., during the rainy season. Fruit spherical, dark brown, persistant, diameter approximately 1.5 cm; composed of many small capsules with 2 valves, each containing numerous winged seeds.

Distribution: From the Sahel to the rainforest, in Ivory Coast, Togo and Benin. From Senegal eastward to the Sudan, sometimes forming pure stands.

Site requirements: In depressions, flooded for several months every year, near waterholes, river banks. Tolerates saline soils (near mangrove forests). Grows mainly on heavy clay, soils.

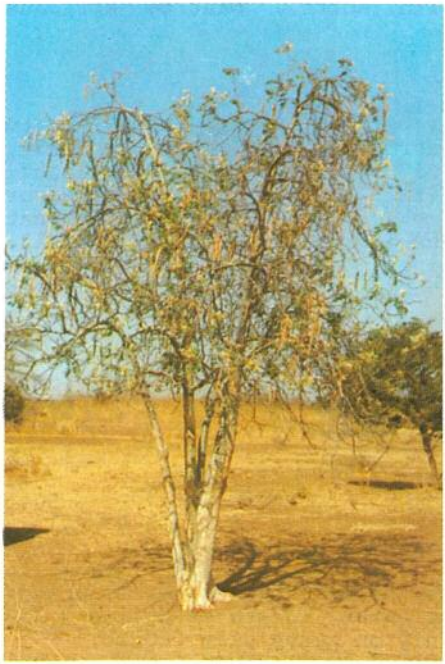
Propagation and management: Forms root suckers, coppices well.

Uses: Wood light brown, fine, easy to work, but difficult to split. Termite-resistant, durable in water. Wood for prayer-slates, different utensils and, if large enough, also for construction, furniture, ornamental work or firewood. Leaves and branches browsed by sheep, goats and camels, particularly during the dry season; leaves palatable but of low fodder value. Flowers sought by bees. In certain regions the appearance of the young, red leaves marks the beginning of the fishing season. Branches are used for plaiting weir-baskets. A yellow dye is occasionally produced from the bark.

Leaves and bark are used as a febrifuge; numerous other medicinal applications: for treating constipation, stomach disorders, dysentery, rheumatism, malaria, as a diuretic, for gonorrhoea, syphilis, leprosy, bilharziosis, jaundice, for the treatment of mental disorders, epilepsy. Applied in veterinary medicine, to treat infertility in cows; also in magic rites.

References: Aubréville (1950), Baumer (1983), Geerling (1982), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo and Adam (1974), Touzeau (1973).

MORINGA OLEIFERA



Moringa oleifera Lam.

Synonym: Moringa pterygosperma Gaertn.

Family: Moringaceae

Description: Small, fast growing, deciduous tree or shrub 7 to 8 m high, with light bark, large lenticels, and soft wood. Leaves imparipinnate, rachis 12 - 25 cm, pubescent, with 2 - 6 pairs of pinnules, 3 - 6 cm long, with 3 - 5 pairs of leaflets, 1 - 2 cm long, and a slightly larger terminal leaflet. The basal pair of the leaflets may be tri-pinnate. Leaflets obovate, pale green. Flowers during the dry season, in panicles, sweet-scented, cream-coloured; 5 petals unequal and slightly larger than sepals. Fruits in pods of triangular cross section, approximately 30 - 50 cm long or more, containing round, black (3-winged), oily seeds.

Distribution: Originating from Arabia and India, occurring today all over the tropics of the Old World; from South Asia to West Africa. Very common in parts of East and South Africa.

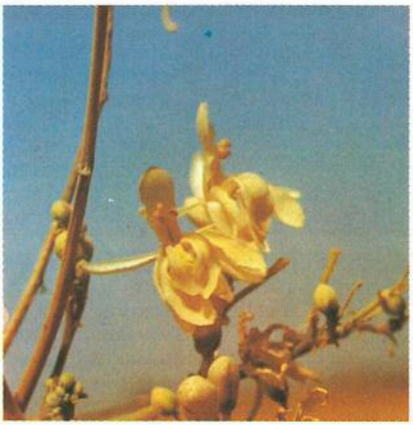
Site requirements: On stream banks or in the savanna. Mostly cultivated in home gardens, yards, on fields. Very drought-resistant; requires well-drained soils and a high ground water table where annual rainfall is below 300 - 400 mm.

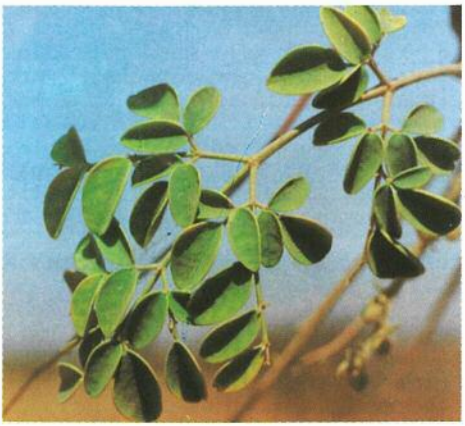
Propagation and management: Propagation by cuttings of more than 1 m length, planted in gardens with 4 m spacing. Direct seeding without problems, grows rapidly. The life span is about 20 years.

Uses: One of the very valuable multipurpose trees for semiarid areas. Young fruit, flowers and leaves (containing 5 - 10 % protein) eaten as vegetable. Leaflets easily removed from pinnule. Planted as a hedge, Moringa provides wind-protection, shade and support for climbing garden plants. The fruits of some varieties which are otherwise eaten like green beans, taste bitter and are only used as a condiment; they may be poisonous if eaten in larger quantities. The root tastes similar to horse-raddish and is eaten as a vegetable in East Africa. It is also used to make foul water potable. In medicine Moringa is used as a diuretic and to treat bladder and prostate ailments. The water purifying effect is mainly attributed to pounded seeds (in the Nile Valley), where the name of the tree is "Shagara al Rauwaq = tree for purifying). The seed powder is stirred in a bowl for approximately half an hour, the solution is then poured into the water container. It is also customary to suspend small bags with the powder in the water containers. The effect is attributed to the contents of flocculants acting on impurities in the water.

The seeds with a high oil content (up to 38 %) produce a sweet non-sticking oil used in the preparation of food, but in former times also for lubrication of watches. It does not turn rancid, is excellent in salads, can be used for soap-making, and burns without smoke. The seed cake is tasteless and after pressing

MORINGA OLEIFERA





unsuitable for feeding because of its saponin and alkaloid content, but it is very rich in protein and makes an excellent fertilizer. Roasted seeds are said to taste like groundnuts. Leaves and young shoots are browsed by lifestock, in particular by goats, camels and donkeys.

Flowers provide good honey. The bark has a coarse fibre and exudes a reddish gum ("Ben Gum"), used for seasoning and to cure diarrhoea. The bark is also used for tanning hides, and when beaten, produces a fibre for ropes. Young green leaves contain ascorbic acid.

Numerous medicinal applications of different plant parts are recorded, e.g. for treating ascites, anasarca, hydropsy, boils, as a diuretic, for diarrhoea, gonorrhoea, syphilis, scurvy, headache, yellow fever, beriberi, skin diseases, rheumatism, and for the treatment of epilepsy. There are some uses in magic rites (on tombs and graves, against hyaenas and witchcraft).

References: Aubrèville (1950), Baumer (1983), Berhaut Vol. VI (1979), Dale and Greenway (1961), FAO (1982), Hallam (1979), Irvine (1961), Kerharo a. Adam (1974).

PARKIA BIGLOBOSA

Parkia biglobosa (Jacq.) Benth.

Synonyms: Mimosa biglobosa Jacq.

Family: Mimosaceae

Description: Large tree, 15 - 20 m, with wide-spreading crown. Bark scaly, slash rust-coloured. Leaves dark green, bipinnate, 14 - 30 pairs of pinnules, nearly opposite, with 50 - 70 pairs of leaflets, 1 - 1.5 by 3 mm. Younger trees and root suckers have large leaves. Rachis greyish to light brown and pubescent. Flowering and maturing of fruit during the dry season. Easily recognized by the red or orange-coloured flower-balls, suspended on long peduncles (up to 30 cm), occasionally in racemes, about 5 - 8 cm in diameter. Slightly bent pods about 45 cm long and 2 cm wide, hanging in racemes at the clubshaped fruit base. The pods contain numerous black applanate seeds, embedded in a yellow fruit pulp containing saccharose.Mature pods open on the tree.

Distribution: Frequently (due to selective maintenance ?) the dominating species of the Sudan zone and of deciduous forests, often associated with Pterocarpus erinaceus, Acacia albida and other multipurpose trees. Closely related to and similar in the multiple use aspects of Parkia clappertoniana Keay of the more humid savanna from Ghana to Sudan; also in the transition zone to the Sahel. Cultivated in tropical America and the West Indies.

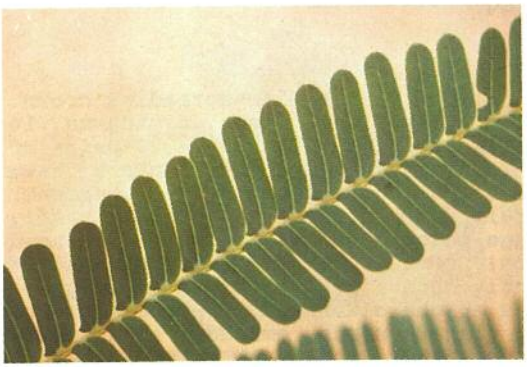
Site requirements: Near villages, on fields, fallow land with reduced brush. Prefers deep loamy sands; 500 - 700 mm annual precipitation.

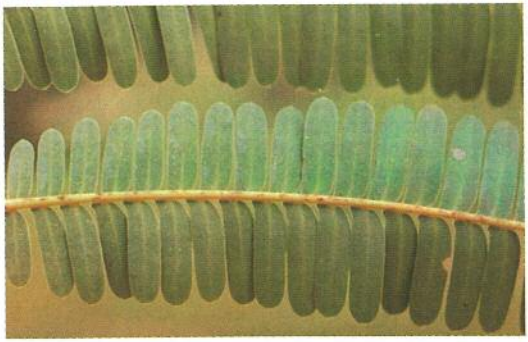
Propagation and management: Forms root suckers. About 5,000 seeds/kg. Boiling of seeds for approximately 3 minutes with subsequent cooling to improve germination. Seeding in plastic containers; outplanting after 10 - 14 weeks. Slow juvenile growth; 22-year-old trees may attain a stem diameter of 17 cm. Planting with 5 x 5 m spacing, later thinned to achieve a stand of 100 trees/ha after 8 - 10 years.

First fruiting after 8 years; at 15 - 20 years up to 25 - 100 kg pods per tree.

Uses: The fresh fruit pulp is sweet (up to 60 % sugar) and edible, can be fermented and processed into a refreshing drink. The fat and protein-rich seeds are processed to a tasty vegetable cheese (Soumbara) which is used as a seasoning for sauces and forms an important item of local trade, particularly in Burkina Faso and Mali. From the yellow fruit pulp of the pods a much used flour is obtained. Many medicinal applications of the leaves, e.g. for the treatment of burns; leaves without petioles for haemorrhoids. A mass obtained by pounding the leaves for 15 minutes is added to baths. The bark is used to treat serious colics with vomiting and for diarrhoea, sterility, bronchitis, pneumonia, leprosy, venereal diseases, caries, dermatoses, guinea-worm and filariasis, oedema, rachitis.

PARKIA BIGLOBOSA



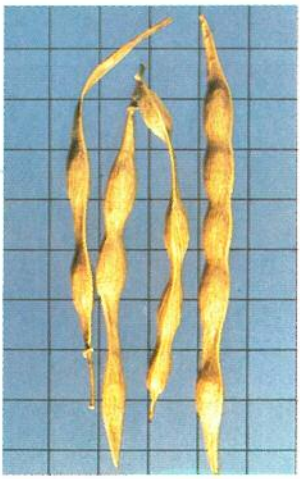


Seeds make a coffee-substitute. Fruit husks together with bark are used as a fish poison or for obtaining indigo. Tannin can be extracted from the bark, ashes are used in soap-making, for dye (indigo), and for the preparation of a snuff.

The wood is whitish to pale yellow, with hardly any difference between sapwood and heartwood, easy to nail, screw and glue. Specific gravity 0.58 - 0.64 g/cm^3 air-dry. Gives off an unpleasant smell when freshly cut. It is not resistant to decay or termites, but may be used as light structural timber for vehicle bodies, boxes, crates, barrels etc. Parkia biglobosa is a decorative shade and fruit tree.

References: Aubréville (1950), Berhaut Vol. IV (1975), Bolza and Keating (1972), Geerling (1982), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo a. Adam (1974), Weber (1977).

PARKINSONIA ACULEATA



Parkinsonia aculeata L.

Family: Caesalpiniaceae

Description: Shrub or tree up to 10 m, bark green. Long, very thin, pendulous branches with alternate, pinnate leaves. Primary rachis very short (3 - 4 mm), with 1 - 2 very long pinnae (15 - 35 cm). Therefore these resemble simple pinnate leaves in fascicles of 2 - 4; rachis of pinnae flat, with 20 - 30 pairs of nearly opposite leaflets, 3 - 10 mm long, ovate, glabrous. At the leaf base a stout thorn, 7 - 15 mm long with two non-lignified stipules. Numerous light yellow flowers in axillary 15 - 20 cm long racemes. Corona 25 mm, with 5 obovate petals, one sepal with red spots. Seeds mature in December/January. Pods nearly cylindrical, glabrous, yellowish, up to 18 cm long. Per pod 6 or more dark brown oval seeds. Pods often persist on the tree for several months.

Distribution: Native to tropical and subtropical America, occurs in nearly all semiarid tropical countries.

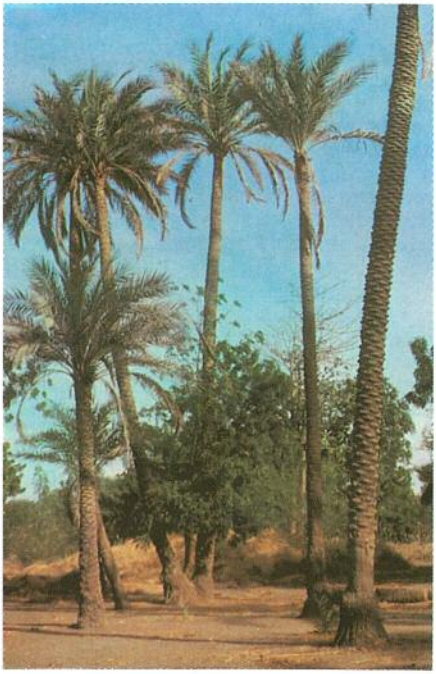
Site requirements: Poor gravelly or sandy soils. Moderately salt-tolerant, does not tolerate water-logging. Grows under 200 - 1,000 mm of precipitation, survives light frost.

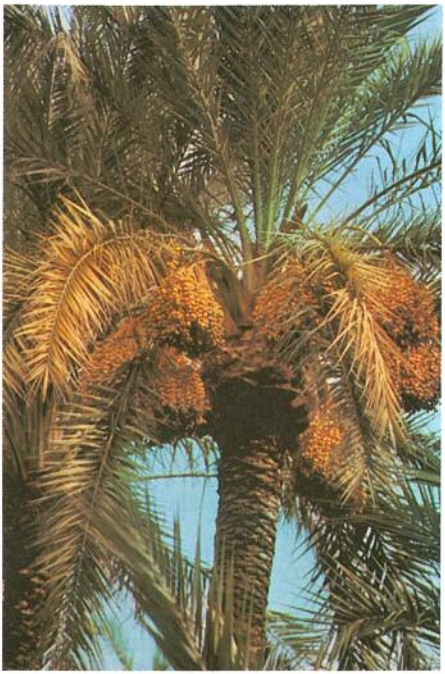
Propagation and management: Easily propagated by seeds; 12,000 seeds/kg. Pretreatment required: Seeds should be boiled for 3 minutes and allowed to cool down slowly to improve germination. If so treated, germination takes place within a few days (approximately 5). Grown in containers, outplanting after 6 - 10 weeks. Roots must be cut back. Suitable for recultivation. Root and shoot cuttings and air-layers have been successfully tried.

Uses: Frequently as windbreak and for decorative purposes. Forms inpenetrable hedges in gardens and parks. Produces a hard but low-grade fuelwood. Branches provide fodder for sheep and goats. The edible fruit pulp is sweet (up to 60 % sugar); the fruit and flowers are therefore particularly sought after by children. In local medicine: leaves, seeds, flowers and bark are used internally and externally as tea-like infusion for fever and atony, bark decoction for baths and ablutions. Shoots with leaves are soaked for 24 hours in water.

References: Aubréville (1950), Berhaut Vol. IV (1975), Giffard (1974 A), Irvine (1961), Kerharo a. Adam (1974), Little (1983), Weber (1977).

PHOENIX DACTYLIFERA





Phoenix dactylifera L.

Family: Palmae

Description: Phoenix dactylifera, the date palm, is a large dioecious feather palm, reaching 15 - 20 (30) m in height. It has a relatively thick stem (up to 1 m in diamter), covered with persistent leaf-bases. At the base of the trunk several suckers may occur. The leaves are pinnate, up to 7 m long. About 20 - 40 leaves form the crown, and about every month one of them is replaced by a new one. Male blossoms are pendulous, in large panicles of up to 12,000 flowers. Female blossoms occur on reaching sexual maturity in the 5th or 6th year. 10 - 12 female inflorescences are formed once a year. Fruits, the dates, ripen within 6 months after pollination. They are cylindrical, about 5 x 2 cm, and contain a single hard seed.

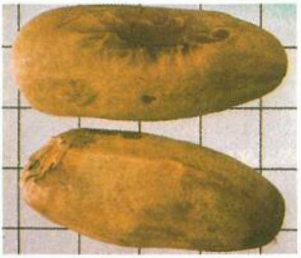
Distribution: The date palm originates in Mesopotamia and/or Egypt. These are the regions for which plantations have first been described and where fossil remains of cultivated dates, at least 6,000 years old, have been found.

Geographically, the present range of the date palm covers the deserts from the Atlantic coastline of Mauritania to India and from the Mediterranean Sea to about 15° in Africa. Date palms have also been cultivated in California and other arid areas to some extent. The main date-producing countries of the world are Iraq, Saudi Arabia, Egypt, Iran, Algeria, Pakistan, and the Sudan. In the Sahel, the date palm penetrates into its northern part, approximately as far as to the 300 mm isohyet, i.e. from Dakar/Senegal to Lake Chad - Khartoum/Sudan.

Site requirements: The date palm can stand great heat (+ 50° C) and frost (- 10° C) and grows mainly in lowland oases but also up to 1,500 m above sea level in the Tibesti. Rainfalls should be between less than 100 up to 300 mm. If they occur within the fructification period (January to June) they usually cause severe damage. The palm is rather flexible to different soils (sand, clay, even a certain salinity is tolerated), but a sufficient ground water supply or irrigation is essential. Thus, the date is not really adapted to desert climates but dependent on highly artificial oasis systems. Irrigation-water requirements amount to about 1.5 m^3 per palm tree per week as an average over the year, if the ground water table can be reached by the roots at a depth of about 2 m.

Cultivation: One of the oldest cultivated plants in the world; the propagation, cultivation and management of the date palm has been described for about four thousand years and has been developed into highly sophisticated systems. Propagation should make use of the trunk suckers which guarantee fast growth, high resistance, good fruit quality and a specific (early, medium to late) harvesting season. Propagation by seeds is possible but mainly practised outside the main fruit-producing oases. Inter-cropping with other fruit trees, perennial crops, cereals etc. is

PHOENIX DACTYLIFERA



common practice, and livestock can be kept as a further component of the date palm oasis systems. Pollination is very important, and pollen is sold on markets. First fruit yields may be expected 5 years after planting. Harvests will be highest at about 30 - 40 years and slowly decrease until an age of about 100 years.

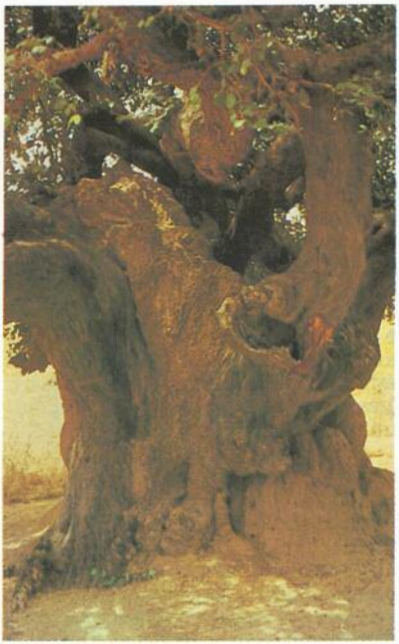
Uses: The main product of the date palm is its fruit, the date, of which about 2,700,000 t are produced worldwide annually. Widely varying in shape and quality according to the more than 1,000 cultivars and varieties, to site conditions and management, they provide basic food for millions of people, fruit exports and (the lower qualities) a valuable fodder for local use. An average palm tree in a well-managed oasis can produce about 60 - 70 kg of fresh dates per year, but yields in the Sahel usually remain below 30 kg.

The date can be processed into syrups, vinegar, date-wine, a meal (Mauritania), date-bread, etc. and to pure sugar and alcohol. Seeds are roasted to produce a coffee substitute. From felled palms the palm heart is extracted and consumed. The wood of the trunk is used for posts, for bridge-building and the construction of irrigation systems or ("keshba") for various construction works. Dry leaves ("djerid") are used as windbreaks or to stabilize sand and to provide shade. They are also used for thatch and as a fencing material. Dry leaf bases ("kernaf") provide fuel, brooms, and a variety of household utensils. The leaflets are woven into mats, baskets, fans, etc. and used for rope-making. The leaf-midrips provide a material for making furniture, crates, and agricultural implements. If the date palm is tapped, a sap can be harvested which is rich in sugar and minerals. It can be drunk fresh, reduced to sugar or palm wine, but the palm is seriously affected by tapping and only able to recover after many years. Under the harsh conditions of the desert environment the date palm is an excellent shade tree and an ornamental plant. Last but not least, there are many uses in local medicine. These include the treatment of mental disorders and the nervous system, ailments of the respiratory system, diarhoea, haemorrhoids.

Decoctions are used as a tonic to stimulate lactation, as a haemostatic and to control fever. From the seeds an ointment can be made to heal boils and to treat biliary, bladder, and kidney diseases. In addition, date products play a role in local crafts and in cosmetics, and almost as a matter of course, in cultural and traditional practices.

References: Brücher (1977), Dowson/Athen (1962), Irvine (1961), Knapp (1973), von Maydell/Götz (1985), Munier (1973), Rehm/Espig (1984).

PILIOSTIGMA RETICULATUM



Piliostigma reticulatum (DC.) Hochst.

Synonyms: Bauhinia reticulata DC., Bauhinia glabra A. Chev., Bauhinia glauca A.Chev.

Family: Caesalpiniaceae

Description: Evergreen shrub, occasionally a small tree with bushy, spherical crown. Few big old knotty trees can be found. Bark dark grey to brown, fibrous corky; slash dark red. Leaves grey-green, glabrous, 6 - 12 cm long, 4 - 8 cm wide; base retuse with about 9 palmate central nerves, apex bilobed, obtuse. Flowers dioecious, clustered in short hairy racemes, axillary, measuring 4 - 5 cm. Petals white with pink stripes. Fruit a long, hard, straight, but mostly twisted pod, glabrous or weakly pubescent, ligneous, brown, indehiscent, up to 25 cm long and 5 cm wide.

Distribution: From western Senegal to Chad and Central Africa; in East Africa (Ethiopia) up to 2,000 m above sea level.

Site requirements: In valleys, on fallow land, forming thickets. Various soils from sand to laterite and clay soils. Prefers the perimeter of waterholes, along temporary watercourses or on periodically flooded soils, but also on fresh sands.

Propagation and management: Seeds to be soaked over night in hot water. Low germination; 11,000 to 14,500 seeds/kg.

Uses: Drinks are prepared from the leaves and from pounded and boiled pods. The bark is used for cordage. Branches, leaves and pounded pods for cattle; sheep and goats prefer the pods. Shade tree. Bark contains up to 18 % tannin. Wood reddish, darkening to brown. Attacked by various insects and termites. Fuelwood. A red dye is obtained from the pounded roots, a blue dye from seeds and pods. Various applications in local medicine: The leaves (with a slightly acid taste) are said to be effective in curing colds if prepared as tea; the bark is astringent and has curative properties for diarrhoea and dysentery. Leaves and bark are used as a haemostatic, antiseptic and treatment for ulcers, boils, wounds and syphilitic cancer. Among other uses are medicines for treating coughs, bronchitis, malaria, hepato-biliary ailments, hydropsy, ascites, sterility, rachitis, kwashiorkor, etc.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. IV (1975), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo a. Adam (1974), Weber (1977).

Piliostigma thonningii (Schum.) Milne-Redh.

Synonyms: Bauhinia thonningii Schum., Bauhinia abyssinica Rich., Bauhinia pyrrhocarpa Hochst.

Family: Caesalpiniaceae

Description: Dense evergreen shrub, up to 6 m high, with twisted, very branchy stem, occasionally climbing. Bark vertically fissured or folded, very fibrous on the inside. Slash pink to dark chestnut-brown. Leaves 8 - 15 cm long, 6 - 10 cm wide, bilobed, cordate at the base, tip incised; lower side brown pubescent. Young leaves red, tomentose, developing folded about the midrib. The margins of the two lobes form an obtuse angle. Characteristic is the protruding reticulum on the lower side: 13 - 15 palmate, central nerves originating from the petiole. Flowers white, dioecious, fragrant, in tomentose racemes 10 - 20 cm long, terminal. Flowering December to June. Fruit similar to that of Piliostigma reticulatum, flat, woody, fissured, brown pods, 20 - 25 cm long, tomentose. They are indehiscent and remain on the tree for a long time.

Distribution: Occurs all over subhumid Africa, in tree savannas and gallery forests, also in secondary forests. In West Africa further south than Piliostigma reticulatum, to the rain forests.

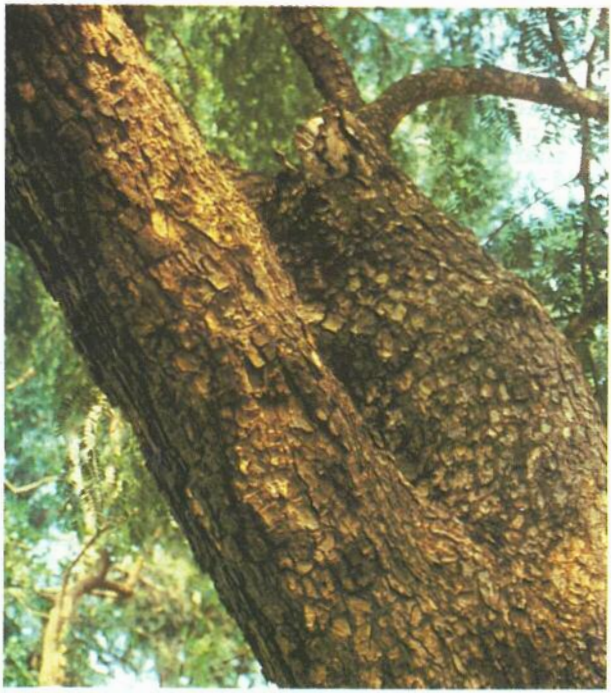
Site requirements: Prefers cultivated soils. On sites with assured water supply. Requires over 700 mm annual precipitation.

Propagation and management: Forms numerous root suckers. Approximately 8,500 seeds/kg. No cultivation has been observed.

Uses: The bark yields a red-brown dye after maceration; contains up to 18 % tannin. Inner bark is said to contain a gum swelling in water and therefore used for caulking. Bark fibres serve to make ropes and cloth ("pagne"). Water in which leaves have been boiled is used for cooking millet flour. Leaves as forage. Many medicinal applications, e.g. for coughs, on wounds, for eye-washes, as a vermifuge, against fever, dysentery, malaria, leprosy, blennorrhagia, haemoglobinuria, sore throat and tooth-ache, etc. similar to P. reticulatum. Pods and seeds yield a blue dye, roasted seeds a black colour. Pods and fruit pulp are eaten in the Chad, the seeds in the Sudan. Dried leaves are also edible; dried fruit is used in Nigeria to smooth pottery, ashes are employed in soap-making, dyeing and to obtain a cooking salt.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. IV (1975), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo a. Adam (1974), Weber (1977).

PROSOPIS AFRICANA



Prosopis africana (Guill., Perrott. et Rich.) Taub.

Synonyms: Prosopis oblonga Benth., Prosopis lanceolata Benth.

Family: Mimosaceae

Description: Tree, between 4 and up to 20 m high, with open crown. Foliage drooping, similar to that of Tamarindus indica, but lighter. Bark very dark, scaly. Slash orange to red-brown with white streaks. Leaves alternate, bipinnate. Rachis 10 - 15 cm long, with 3 - 6 pairs of opposite pinnae (5 - 8 cm long) 9 - 16 pairs of leaflets, oblong-lanceolate, 12 - 30 mm, shortly pubescent. A typical gland between pairs of pinnae and leaflets. Flowers green-whitish to yellowish, fragrant, in dense 6 - 10 cm long axillary spikes. Calyx pubescent but petals glabrous. 10 free standing stamens. Anthers with a small apical gland. Ovary villous. Flowering shortly prior to the rainy season. Pods dark brown, cylindrical, thick and hard, shiny, up to 15 x 3 cm with woody walls, compartmented. Seeds mature February to March. About 10 loose, rattling seeds per pod; 7,500 - 8,000 seeds/kg with a thin intramarginal line around.

Distribution: The only tropical African Prosopis species. Occurring from Senegal to Ethiopia in the zone between the Sahel and savanna forests. From Egypt and Sudan to Lake Victoria and the Oubangui.

Site requirements: Frequently on fallow land, on sandy clayey soils over laterite.

Propagation and management: Juvenile growth apparently varying with site and proveniences. Seeds must be pretreated with hot water; sown in bags, outplanting after 14 - 18 weeks; afforestation should be tried.

Uses: Wood hard, medium heavy to heavy, with fine grain. Sapwood narrow, light yellow to light brown, clearly distinguished from the dark red-brown heartwood. The latter assumes a dark wine-red colour after drying. Pleasant fragrance when freshly cut. The wood is difficult to saw and plane and blunts the cutting tools. It cannot be nailed without pre-drilling. It is, however, durable and easy to carve, turn and glue. Many uses over the entire area of distribution according to available dimensions. In Senegal preferably sought for arts and crafts. High value as fuelwood and charcoal. Due to overexploitation, Prosopis africana has disappeared from extensive parts of the southern Sahel and the adjacent Sudan savannas.

Bark and roots contain up to 18 % tannin. Young leaves and shoots are a much sought fodder towards the end of the dry season, consequently branches are frequently broken down or lopped. The pods are also eaten by cattle. Seeds are fermented and used as seasoning similar those of Parkia biglobosa. Pounded dry fruits are a fish poison.

Almost all parts of the tree are used in medicine: The leaves in particular for the treatment of head and toothache as well as various head ailments. Leaves and bark combined for rheumatism. Remedies for skin diseases, caries and fever as well as eye-washes are obtained from bark. The roots are diuretic, also used to treat gonorrhoea, tooth and stomachache, dysentery and bronchitis.

References: Aubréville (1950), Berhaut Vol. IV (1975), Burkart (1976), Dalziel (1973), Geerling (1982), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo a. Adam (1974), Sahni (1968), Touzeau (1973).

PROSOPIS JULIFLORA

Prosopis juliflora (SW.) DC.

Synonym: Mimosa juliflora Swartz

Attention! There are many closely related Prosopis species, such as P. chilensis, P. glandulosa and P. velutina, which have also been introduced into the semiarid areas of Africa and are now occasionally taken as P. juliflora. They have, however, slightly differing site requirements and their use potential may be different (BURKARD 1976). The species P. juliflora in itself has a great number of forms and varieties.

Family: Mimosaceae

Description: Evergreen (on arid sites also deciduous) tree up to 12 - 15 m high, frequently only a shrub. Bole short and crooked. Bark thick, rough, greenish-grey, fissured and scaly when old. Many thorns, 1.2 - 5 cm long, in pairs in leaf-axils or solitary, straight. Some forms also without thorns. Leaves alternate, bipinnate, rachis 3 - 6 cm long with 2 - 3 pairs of pinnae, each 7 - 15 cm long with 8 - 15 pairs of oblong, linear leaflets, glabrous or cilious, 1.5 - 5 cm long, 3 - 6 mm wide, terminal leaflet missing. Young branches green. Flowers in cylindrical spikes, 5 - 10 cm long, 1.5 cm wide, solitary or in clusters in the leaf axils. Individual flowers small, densely crowded, fragrant, gold-yellow. Fruits similar to bush-beans, yellow, 10 - 20 cm long; each pod with 10 - 20 hard seeds. Deep rooting species, (up to 35 m!), with lateral roots, which may strongly compete with other (annual) plants.

Distribution: Originates in northern South America, Central America, Mexico, Antilles, coastal regions. Cultivated all over the tropics, in the Sahel especially in Mauritania (Nouakchott), the transition zone to the Sudan savanna.

Site requirements: Suitable for dry sites because of deep rooting habit. Tolerates extreme heat; 150 - 700 mm precipitation, 0 - 1,500 m altitude. Sandy and rocky soils as long as root-growth is not impeded by crusts. Not on insufficiently drained sites; very suitable for dunes; tolerates salt and nutrient-poor soils.

Propagation and management: Because of the great genetic variability and possible confusion with other Prosopis spp., special care is required concerning the provenance of the seed. Fast growing on good sites, risk of uncontrolled spread (South of the United States). Prosopis juliflora is easily propagated by migrating cattle and wild animals. Seeds should be pretreated like Acacia seeds. They can be stored for 2 years. 8,000 - 15,000 seeds/kg. Abundant coppicing, root suckering. Final spacing in plantations 6 x 6 m (according to site conditions).

In nurseries sowing from April until the end of May. Germination is rapid and without problems; outplanting after 1 - 2 months. Takes well and grows fast (during the first year up to 1.50 m). Irrigation may be necessary during the first dry season (minimum:

10 l every 3 - 4 days). With too rapid growth risk of water deficiency.

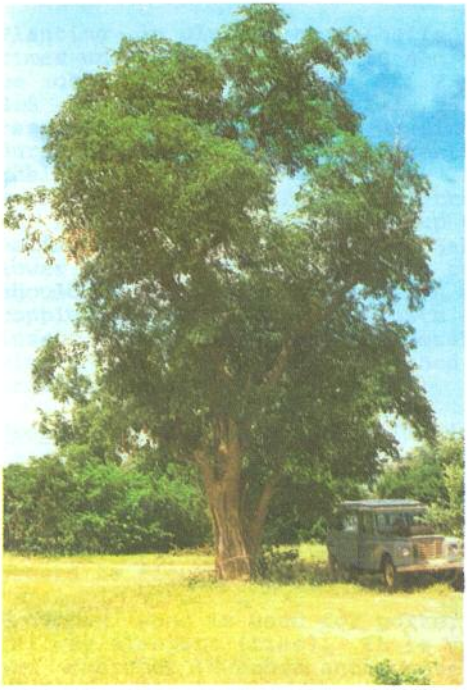
Planting in plastic bags (balled plants) gives, however, sometimes unsatisfactory results and is expensive. Better results may be obtained from cuttings of 2-year-old plants (diameter 1.5 - 2.5 cm, roots approximately 25 cm long). Direct seeding is recommended, but requires weeding. Fire protection is essential during the first 3 years. Thereafter P. juliflora is fairly fire resistant. Fruiting as of the 2nd - 4th year, often twice per year. The trees may grow more than 100 years old. Optimum yield of fruits have been recorded up to 30 - 40 t/ha, at 10 years estimated at 20 - 25 t. Under Sahel conditions, however, a much lower productivity will have to be assumed. Fuelwood plantations should be managed at a rotation of 7 - 15 years. Regeneration by coppicing. No particular pests are known. Pods are attacked by insect larvae. Risk of considerable damage by mice. Single trees with a fast growth are threatened by wind throw and long branches breaking down.

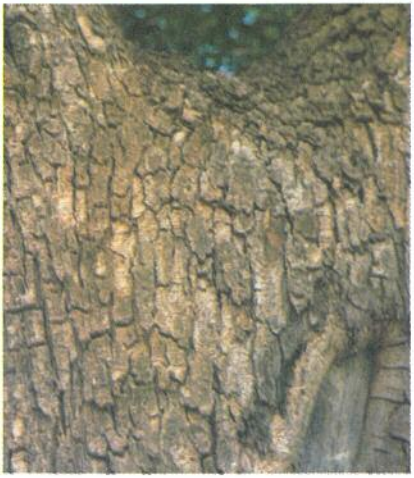
Uses: The pods are edible (Mexico, Indian people in the USA). Leaves and fruits as fodder for sheep, goats and donkeys. Some varieties have leaves with such a high tannin content that they are not palatable, at least for cattle. Pods are sweet and contain up to 27 % glucose and 17 % protein, hence they are valuable as fodder. After removal of seeds, the husks of pods are ground to flour for human consumption.

Prosopis wood is used for posts, light joinery, but also for railway sleepers (ties). It is very durable, makes good fuelwood and charcoal ("wooden anthracite"). Flowers give honey of best quality. The species is well-suited for hedges, windbreaks and for stabilization of dunes. It is said to improve the soil by nutrient pumping. The growth of a herbaceous layer may, however, be impeded by root competition and allopathic reactions. Macerated bark is occasionally used as antiseptic in the treatment of boils.

References: Baumer (1983), Berhaut Vol. IV (1975), Burkart (1976), Giffard (1974 A), Krüssmann (1977), Kerharo a. Adam (1974), Little (1983), Prosopis juliflora (1962), Touzeau (1973), Weber (1977).

PTEROCARPUS ERINACEUS





Pterocarpus erinaceus Poir.

Synonym: Pterocarpus angolensis DC., Pterocarpus echinatus DC.

Family: Fabaceae (=Papilionaceae)

Description: Medium-sized tree, 12 - 15 m (35 m), with a straight bole, buttressed when old. Oval or round high crown, giving little shade. Bark brown-blackish, very scaly. Slash brown (yellow) with red streaks, exuding a red, translucent gum which hardens rapidly.

Branches densely pubescent. Leaves alternate, up to 30 cm long, imparipinnate, up to 11 leaflets. These measure 5 x 10 cm. They are elliptic to oblong, shortly pubescent below, with many parallel lateral nerves. Tip shortly acuminate or retuse. Flowers in light yellow panicles, strikingly numerous when the tree is almost leafless in December to February and the neighbouring trees are also without foliage. Calyx ventrous, pubescent, 5 mm long, toothed, corolla short papilionaceous, 10 - 12 mm. Fruits first green (looks like foliage), then (December/January) papery, rounded, up to 7.5 cm diameter, persistent on the tree, with prickly hairs, surrounded by membrane-like wings. 3,500 seeds/kg.

Distribution: From Senegal to Gabon and Chad, in savannas; on favourable sites also at the southern limit of the Sahel. Benin, Togo, Nigeria, Cameroon, Central African Republic, Sudan.

Site requirements: On shallow and gravelly soils, on taluses, slopes, individually, in groups or in open stands, sometimes invading fallows. (500) 700 - 1,200 mm annual rainfall required.

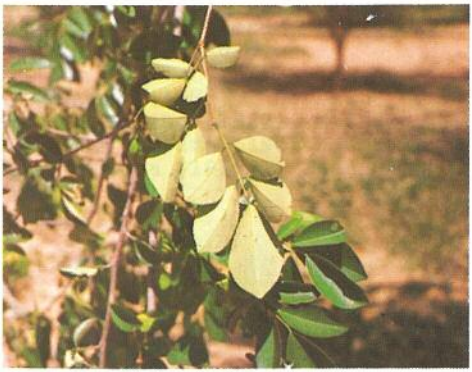
Propagation and management: Afforestation in Ghana and Senegal. Regenerates well.

Utilization: The red-brown wood is very hard and termite-resistant. Sapwood about 5 cm wide, light yellow, clearly separated from the heartwood. Annual growth-rings are clearly discernible. The wood is easy to work, very durable. It is used for construction work, joinery, furniture, poles, posts and many household applications, agricultural tools but also for xylophones and masks. Makes a good charcoal. Gum dries to a red resin ("kino"), which is used pulverized for satinizing of fabrics. For cosmetics, the powder is mixed with shea-butter and gives a dark purple colour. Roots and stemwood yield a dye. Roots are used for bows. The bark contains tannin. Leaves, containing up to 19 % protein, are lopped and traded as fodder in Burkina Faso and Mali. Their feed value is stated to be very good:
Crude protein 15 % DM (10 - 12)
Net energy 5.2 MJ kg DM (2.9 - 7.2)
Digestible protein/FU 135 (70 - 240)
P 0.15 (0.08 - 0.27). (le HOUEROU 1980 A, p. 90).
Dry leaves which have fallen to the ground are consumed by livestock.

In local medicine: Leaves as tea or bath for the treatment of fever. Bark for dysentery, for treatment of wounds. Bark with cola-nuts is a tonic, also applied to chronic boils. In addition, numerous other medicinal applications of different parts of the plant play a traditional role in cults and magic.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. V (1976), Bolza and Keating (1972), Geerling (1982), Giffard (1974 A), Götz (1983), le Houerou (1980 A), Irvine (1961), Kerharo and Adam (1974), National Academy of Sciences (1979), Touzeau (1973).

PTEROCARPUS LUCENS



Pterocarpus lucens Lepr. ex Guill. et Perrott.

Synonyms: Pterocarpus abyssinicus Hochst., Pterocarpus simplicifolius Bak.

Family: Fabaceae (= Papilionaceae)

Description: Deciduous shrub, 3 - 4 m, only occasionally a tree up to 12 m. Bark fissured and scaly; slash red-purplish, exuding a red, coagulating gum. Leaves alternate, almost opposite, imparipinnate. Petiole naked. Number of leaflets varying between 1 and 9, generally 5 - 7; form of leaflets very variable, oval-elliptic, rounded at the base. Flowers (January - June) yellow, with long peduncles, 8 - 15 mm, glabrous, in racemes. Pods glabrous, ovate, oblong, light brown, flat and papery thin, 5 x 2.5 cm, persistant (a prominent species charcteristic) with one seed only. 5,000 seeds/kg.

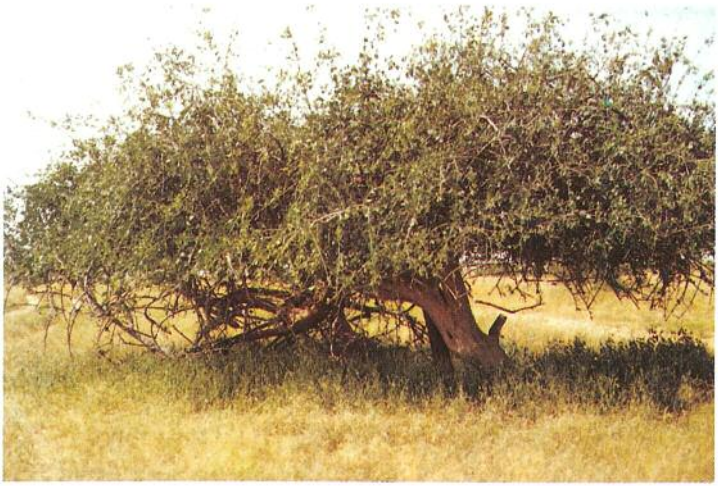
Distribution: Typical species of the Sudan-Sahel region; from Senegal to Sudan, Ethiopia, Central Africa, Ivory Coast, Guinea, etc. Characteristic for the "brousse tigrée" of the Sahel.

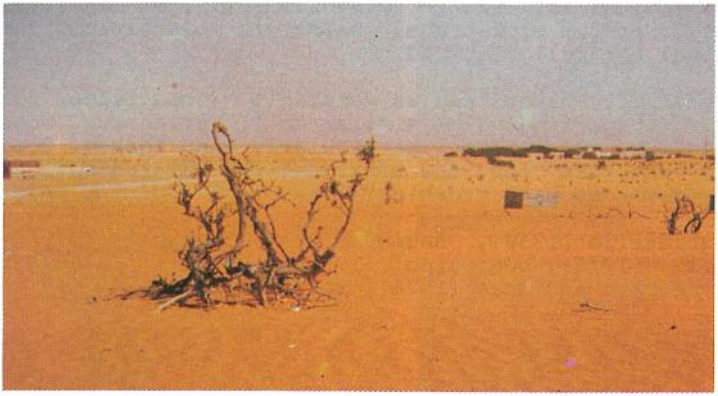
Site requirements: On dry sites, occasionally as mono-specific bush. Frequently on hills, stony, gravelly soils, on laterite, associated with Combretum micranthum, Dalbergia melanoxylon. 300 - 700 mm of annual rainfall required.

Uses: Fresh leaves for sauces and as vegetable. Good fodder for camels and goats with a feed value similar to P. erinaceus. Wood for tool handles, pestles, poles, particularly when forked. Good fuelwood. Bark extracts for the treatment of diarrhoea and dysentery. Leaves for stomach troubles.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. V (1976), C.T.F.T. (1978), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo and Adam (1974), Touzeau (1973).

SALVADORA PERSICA





Salvadora persica L.

Family: Salvadoraceae

Description: Evergreen shrub, 4 - 6 m (9.5 m), or small tree, with a short trunk, very branchy, occasionally climbing, with flexible drooping, green-white branches, intertwined. Bark whitish, smooth, slash green. Leaves opposite, thick to fleshy (succulent), glabrous, glaucous, with very small stipules, oval, rounded at the base, mucronate; appr. 3 x 7 with a short petiole. Leaves often attacked by a caterpillar (Colotis ephiae). Flowers yellow, small, glabrous, numerous in axillary or terminal panicles. Calyx short and 4-lobed. Corolla with 4 petioles, welded at the base, and 4 stamens. Flowers generally January-February. Fruits as round berries of approx. 6 mm diameter, red when mature (February to March), translucent.

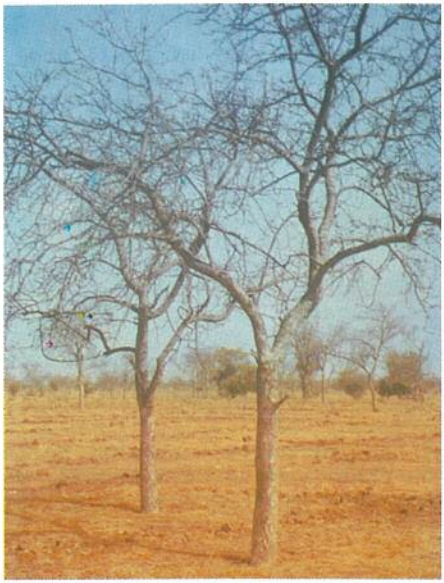
Distribution: In the northern Sahel into the central Sahara from the Atlantic to the Red Sea. Through Arabia to India; in East Africa, South Africa, Namibia.

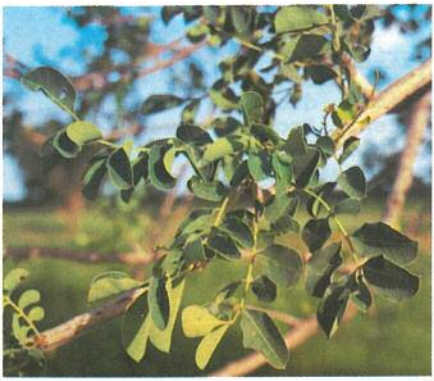
Site requirements: On clayey soils, saline soils, on the perimeter of waterholes, in valleys, on dunes, on termite mounds; on occasionally flooded clay soils. Extremely well-adapted to aridity. Rainfall less than 200 mm.

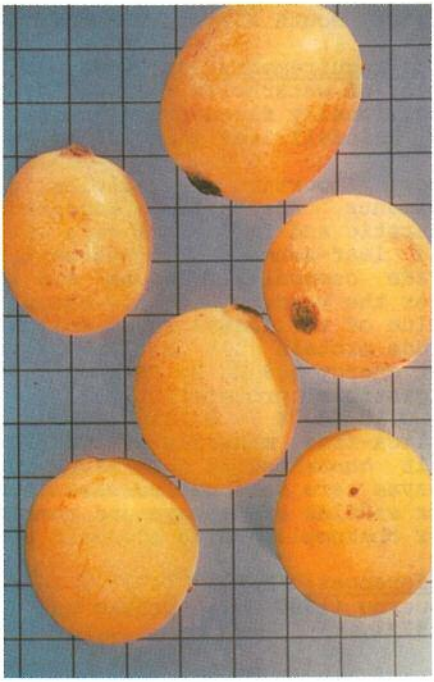
Uses: Important as medicinal plant for treating fever, liver ailments, rheumatism, gonorrhoea, bronchitis, asthma etc., as a diuretic and for dental care (fine shoots are chewed). From wood and leaf-ashes a kitchen-salt is produced which is a regional trade commodity. Leaves and the end of shoots are browsed all over the year by cattle, sheep, goats and camels. The nutrient value of the leaves is as follows (le HOUEROU 1980 A, p. 92):
Crude protein 13% DM (10 - 17),
Net energy 4.8 MJ kg DM (3.2 - 6.0),
Digestible protein/FU 137 (108 - 193),
P. 0.10 (0.08 - 0.13),
Silica-free minerals 29% DM (20 - 36).
Salt contained in the leaves influences the taste of milk, but leaves are said to increase lactation of cows. The wood is used for saddles of donkeys and camels, occasionally also as fuel and for charcoal. Fruits are said to be edible when cooked.

References: Baumer (1983), Geerling (1982), Giffard (1974 A), le Houerou (1980 A), Kerharo and Adam (1974), Sahni (1968), Touzeau (1973).

SCLEROCARYA BIRREA







Sclerocarya birrea (A. Rich) Hochst.

Synonyms: Poupartia birrea (A. Rich.) Aubr., Spondidas birrea A. Rich.

Family: Anacardiaceae

Description: Deciduous tree, up to 15 m high, with well formed light green crown. Very thick branches. Bark of branches silvery-grey, of the stem reddish-grey, scaly. Scales rolling up laterally before falling off. Slash reddish to dark red. Leaves alternate or in terminal rosettes, imparipinnate. Rachis 10 - 15 cm with 5 - 8 pairs of glabrous leaflets. Leaflets 2 - 3 cm long, alternate to opposite, elliptical, rounded at the base with a typical mucronate tip. Leaflets of coppice growth and in the juvenile stage reddish, frequently toothed, otherwise entire. Small dioecious flowers, yellow or greenish-reddish. Male flowers in terminal spikes. These are erect, 5 - 8 cm long. Female flowers on short (1 cm) peduncles, in clusters of about 3 at the end of the twigs. Sepals purple red. Flowers from January to April/May, appearing before the leaves. Fruit a glabrous yellow drupe, 3 - 4 cm diameter. Stone thick, fruit pulp fibrous. Fruits mature April/June.

Distribution: Tree of the Sahel zone and open dry savanna eco-systems with rather wide distribution from Senegal to East Africa and the Sudan. The closely related S. caffra grows in South Africa, Botswana etc.

Site requirements: Few specific requirements; on sandy or stony soils and on lateritic crusts. Occasionally in pure stands.

Propagation and management: Seeds should be soaked the night prior to sowing. 400 seeds/ 1 kg. Propagation by seedlings and cuttings, gregarious root suckering.

Uses: The wood is soft, medium light and has low strength properties. Sapwood narrow, not very clearly distinguishable from the grey to red-brown heartwood. Wood dries rapidly with severe distortion and a tendency to collapse, splits strongly. It is easy to work with well-sharpened tools and saws well when seasoned. Despite coarse grain and interlock, it does not rough up. Easy to turn, carve and polish. Holds nails, not easy to impregnate. As trees attain large diameters the wood is preferred for mortars, pestles, bowls and various local crafts, saddles, furniture and fencing. The fruit pulp has a pleasant acid taste. It is used for the preparation of a beverage or can be eaten fresh. The stone is oily and edible, occasionally sold on local markets. Stones contain up to 6% oil (1 t of fruit yields 60 l of oil). The ashes are used for dyeing. Branches are lopped for fodder although the leaves are said to be slightly poisonous. A strong fibre can be obtained from the bark, an ink is made from the light coloured gum mixed with soot and water. Bark (mainly root bark) decoctions are used to treat dysentery, toothache, infections, but also as a very important antidote in local

medicine. Together with butter applied as an ointment for headache and pains of the eyes. Bark decoction, usually mixed with parts of other medicinal plants, is also used as a lotion for children to treat malaria, various infections and as a laxative; further to treat syphilis, leprosy, hydropsy etc. Leaves, bark and roots are used externally (as a rub) and internally (beverage) for snakebite, toothache. If ripe (fallen) fruit is eaten in larger amounts, humans and animals may become intoxicated. Uses in veterinary medicine are recorded occasionally.

References: Aubréville (1950), Berhaut Vol. I (1971), Bolza and Keating (1972), Dale and Greenway (1961), Geerling (1982), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo and Adam (1974), Sahni (1968), Touzeau (1973), Weber (1977).

SECURIDACA LONGEPEDUNCULATA

Securidaca longepedunculata Fresen.

Synonyms: Securidaca spinosa Sim., Lophostylis pallida Klotzsch

Family: Polygalaceae

Description: Shrub or small tree, up to 7 m (10 m) high with an open crown. Bark thick, light yellow to grey and smooth, with small dark scales. Slash pale yellow or brown, fibrous. Roots very thick, smelling of thymol. Branches slim, upright or drooping, pubescent. Leaves alternate, 5 x 2.5 cm, oblong-lanceolate, dark green, coriaceous, pubescent below, on short petioles. Arranged more or less parallel to the branches. Flowers in terminal racemes on shortened lateral shoots, October to December, 5 sepals. 1 large, median and 2 smaller lateral petals, reddish to purple, strongly fragrant. Fruit with one large flat wing (5 cm) and one seed; 6,000 seeds/ 1 kg.

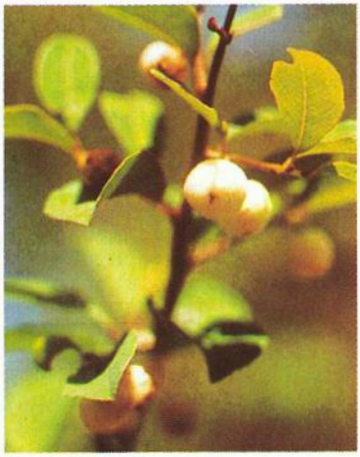
Distribution: In African savannas, gallery forests. From Senegal to Southwest Africa, East Africa up to 1,800 m a.s.l.

Site requirements: On sandy or rocky soils of moist savannas.

Propagation and management: Regenerates from seeds. Seeds persisting the longest time on the tree are said to be the best. Germination bad, seedlings difficult to plant because of the easily broken taproot. Prior to seeding, the seeds should be soaked in water. Direct seeding into sandy soils. Seeds should be covered with dry grass and watered until the beginning of the rainy season.

Uses: The bast contains a fibre which is particularly strong on young branches and used for ropes and fishing nets. The tree or shrub has a high ornamental value because of its fragrant flowers and is used as a hedge plant. Bark of roots or pounded seeds are used for washing and bleaching. Leaves are browsed. The wood is light yellow with markedly dark growth rings. Splits on drying, forms cup-shakes. Used for poles (resistant to rot and termites). Makes good fuel and charcoal. In Kenya, it is also used for bows. Seeds are rich in oil. The roots contain mucilage, tannin, saponin-related substances and aethyl salicylate.
Securidaca longepedunculata is of considerable medicinal importance (sometimes called "Mother of Medicine"). Application of several parts of the plant as an antidote against snakebite (the juice of cooked leaves is preferred), to treat diarrhoea, dysentery, as a vermifuge, for malaria, headache, bronchitis, stomachache, leprosy, venereal diseases, liver ailments, for the treatment of rheumatism, wounds, eye diseases, Guinea worm, for ear infections, as a laxative, etc. Securidaca is also used in cultic events and magic; decoctions splashed on the floor are said to drive bad spirits out of the house. Bark and roots are used to produce arrow poison.
References: Aubréville (1950), Dale and Greenway (1961), Geerling (1982), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo and Adam (1974), Palmer and Pitman (1972).

SECURINEGA VIROSA



Securinega virosa (Roxb. ex Willd.) Baill.

Synonyms: Fluggea virosa (Roxb. ex Willd.) Baill., Fluggea microcarpa Bl., Phyllanthus virosus Roxb. ex Willd., Securinega microcarpa (Blume) Pax et Hoffm.

Family: Euphorbiaceae

Description: Small evergreen or deciduous tree or shrub, up to 3 m (7 m) high. Leaves alternate, obovate or elliptic, base cuneate, 6 x 3 cm, however of a variable size, parchment-like, glabrous, of unpleasant smell when crushed. The short petioles are often reddish. Small dioecious, fragrant, inconspicuous, green-yellow flowers. Male flowers numerous in axillary fascicles on 5 mm long peduncles. Female flowers 1 - 5, whitish with a large rudimentary tripartite ovary. Flowering April - June. Fruits in small white berries, 4 - 9 mm on short axillary stalks. Seeds shiny.

Distribution: Sahel and Sudano-Sahel, in many countries of Africa; in coastal districts, in savannas, transition and secondary forests. Originally introduced from India, common in Asia, but also in Australia.

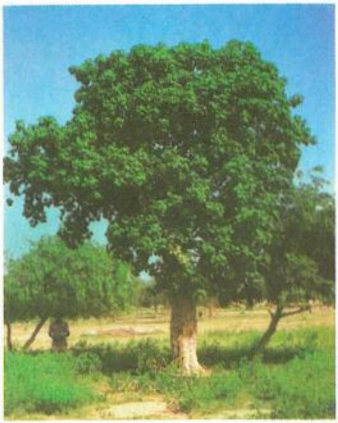
Site requirements: Frequently along the banks of waterholes, where the vegetation is dense and water supply secured; indicator for ground water.

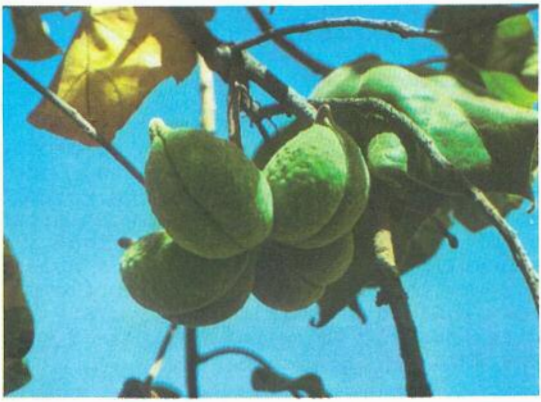
Uses: Fruits edible, bark is said to be poisonous. Many medicinal applications (one of the most important medicinal plants of the Sahel): leaf-decoction as a laxative, roots externally and as a decoction against internal diseases, macerated in palm-wine as a vermifuge, for venereal diseases, malaria, pneumonia, diarrhoea, simple boils, hydropsy, sterility; young shoots as aphrodisiac.

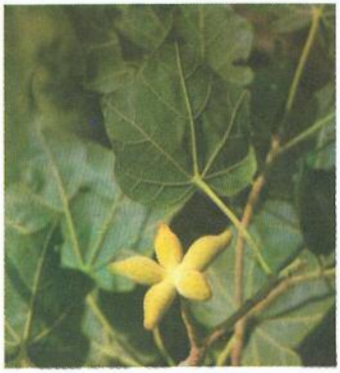
Wood whitish or reddish-yellow, durable. Makes good fuelwood and charcoal. Used for chair legs; branches for plaited floors in storage-bins; fish traps, fence-poles. Good hedge plant.

References: Aubréville (1950), Berhaut Vol. III (1975), Dale and Greenway (1961), Geerling (1982), Irvine (1961), Kerharo and Adam (1974), Palmer and Pitman (1972).

STERCULIA SETIGERA







Sterculia setigera Del.

Synonyms: Sterculia cinerea A. Rich., Sterculia tomentosa Guill. et Perrott.

Family: Sterculiaceae

Description: Deciduous tree of medium height, up to 16 m, with thick lower bole and large crown. In the Sudan and Guinea zones sometimes over 35 m high. From a distance, the stem appears very light. Bark grey to purple, flaking in oblong scales, exposing in patches a smooth, shiny light yellow bark looking as if "hammered". Slash meat-red with paler streaks, exuding a white gum and a watery sap. Small sharp buttresses. Branches velvety, with lenticels. Alternate, palmate leaves on 8 cm long petioles, digitately nerved and 3 or 5-lobed, cordate at the base. Ends of lobes terminating in tips. Leaves velvety, covered on both sides with stellate hairs. Nerves prominent on the underside. Flowers dioecious, dull red or yellowish-green at the beginning of flushing between February and April, in short terminal racemes on last year's shoots. Calyx 1 cm, widely campanulate with 5 lanceolate sepals, densely hairy on the outside. Fruits mature in December, with 3 - 5 boat-shaped seeds, grey to brownish on the outside, inside tomentose; forming a 3 or 5-partite star of 7 - 10 cm length and 5 cm diameter. Each part contains approx. 12 small elliptic grey seeds with a typical yellow aril.

Distribution: Frequently in Senegal, in the Sudan-Sahel and in the Sudan-Guinea zones. In Togo, eastwards to Sudan and Somalia, East Africa, also in Angola.

Site requirements: Colonizes fallow land; in Senegal good natural regeneration; 2,500 - 3,500 seeds/ 1 kg.

Uses: Exudates a highly water-soluble gum, traded locally and used for cooking in Senegal, particularly for binding sauces. At the beginning of the rainy season trees are carved for tapping the gum. GIFFARD (1974 A, p. 147) records annual yields between 20 and 45 t for the years 1965 to 1972 under the control of the Senegalese forestry department, but much more may have been utilised locally. He also gives the following information on the gum's composition: 7 to 12 % minerals, 2 % tannin, 15 to 17 % acetic acid, 42 % galacturonic acid, 14 % galactose and 15 % rhamnose. The potential for exports of the gum from the Sahel should be explored.

The wood is white and very soft, makes only a poor fuelwood and charcoal. Bark and leaves are used for medicinal purposes, e.g. to treat coughs and diarrhoea, as a diuretic, for fever, leprosy, syphilis. The bast is used for clothing. Seeds may be eaten and contain oil. Bark fibres are used for mats and ropes.

References: Aubréville (1950), Geerling (1982), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo and Adam (1974), Sahni (1968).

STEREOSPERMUM KUNTHIANUM

Stereospermum kunthianum Cham.

Synonym: Stereospermum dentatum A. Rich.

Family: Bignoniaceae

Description: Small tree, deciduous, however persistently green far into the dry season, up to 12 m (15 m) high, in the Sahel 5 - 6 m. Rarely with a straight bole, mostly forked, branches twisted. Bark thin, scaly. Slash light brown. Leaves imparipinnate, alternate. 3 - 4 (6) pairs of leaflets, almost opposite, oblong, shortly acuminate, slightly dentate, glabrous or pubescent, 6 - 10 cm long. Flowers long before flushing (during the dry season), beautiful pink or purplish (rarely white), bell-shaped, fragrant, 3 - 5 cm, drooping in panicles on long peduncles. Fruits paired pods, 25 - 30 cm (up to 60 cm), cylindrical, very narrow, spirally twisted, containing 2-winged seeds.

Distribution: Savanna regions of Africa, from Senegal to Zaire and East Africa.

Site requirements: Widespread, in particular on rocky and dry sites, likes sandy and clayey soils, on termite mounds; up to 2,000 m a.s.l.

Propagation and management: Seeds difficult to obtain. Easy to regenerate because seeds germinate immediately and without pretreatment. Outplanting after approx. 4 weeks. Propagation also by root suckering. Young shoots are very sensitive to bushfires.

Uses: Very ornamental tree. Leaves are only browsed by horses. Wood white with yellow or pink coloration, medium hard. Mortars are made from bole sections. In some regions rejected as fire-wood. Does not make good charcoal, as it disintegrates directly to ashes. Bark is used as a cosmetic (chewing imparts a red-brown colour to the lips). Medicinal applications: macerated leaves for baths to treat asthenia, exhaustion. Bark as a haemostatic, for treatment of wounds. Stem bark decoction for bronchitis, pneumonia, coughs. Roots and leaves for venereal diseases, respiratory ailments and gastritis.

References: Aubréville (1950), Berhaut Vol. II (1974), Dale and Greenway (1961), Kerharo and Adam (1974), Sahni (1968).

Strychnos spinosa Lam.

Synonyms: Brehmia spinosa (Lam.) Harv. ex D.C., Brehmia spinosa ssp. lokua (A. Rich.) E.A. Bruce, Strychnos lokua A. Rich., Strychnos laxa Solered., Strychnos buettneri Gilg, Strychnos spinosa var. pubescens Bak., Strychnos djalonis A. Chev., Strychnos emarginata Bak., Strychnos courteti Chev., Strychnos dulcis Chev., Strychnos gracillima Gilg, Strychnos volkensii Gilg.

Family: Loganiaceae

Description: Thorny shrub or tree, 4 - 5 (up to 9) m high, with extensive, frequently spherical crown, one- or multi-boled. Bark grey-brown, more or less scaly. Slash yellowish with green margin. Branches tender to stout, glabrous or hairy. Frequently reduced to thorns of various forms (paired, pale with black tips, slightly recurved). Leaves very variable, broadly obovate to sub-orbicular, up to 10 cm long, pubescent, opposite. Small, green-white flowers in terminal cymes, sepals externally pubescent, 5 mm long, corolla tubed, velvety on the inside. Fruits large, 5 - 10 cm diameter, spherical, green and sometimes with pimpels, light brown when mature, hard-shelled, containing many flat seeds.

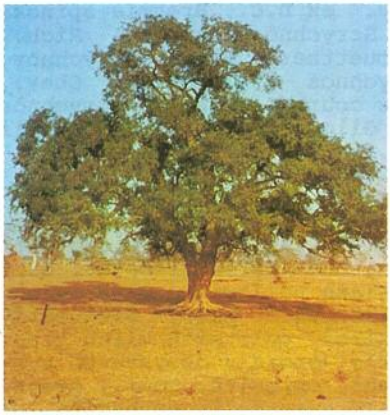
Distribution: Savanna forests all over tropical Africa, Madagascar.

Site requirements: Frequently on sandy soils along river-beds, on gravel and boulders. Very frugal, on slopes and tops.

Uses: The sweet-sour fruit pulp is edible. Leaves are also eaten, e.g. in Couscous, leaves and fruits are browsed by game. Medicinal applications: predominantly for gastrointestinal ailments, as a laxative. Ground roots with oil as a rub against flies. Treatment of snakebites, immature fruits as emetic. Leaves to treat headache, eye diseases, roots for fever, syphilis, as diuretic, as antiseptic. The wood is hard, yellowish-white, fine-pored. For posts, as fuelwood. Fruitshell as resonance board for musical instruments.

References: Aubréville (1950), Berhaut Vol. VI (1979), Dale and Greenway (1961), Geerling (1982), Irvine (1961), Kerharo and Adam (1974), Palmer and Pitman Vol. III (1972).

TAMARINDUS INDICA



Tamarindus indica L.

Family: Caesalpiniaceae

Description: Large tree up to 30 m high and 1 m diameter. Short bole. Deciduous in semiarid regions, otherwise also evergreen. Large, extensive crown. Bark grey, strongly fissured and scaly, smooth on branches. Slash pale pink, yellow at the ram. Leaves alternate, paripinnate. Rachis 7 - 12 cm long, with 9 - 12 pairs of leaflets. Leaflets rounded at base, approx. 6 x 18 mm, opposite. Flowers yellowish, with red stripes, in small terminal, glabrous racemes, 3 - 5 cm long, 5 - 10 together. Flowering December/May. Pods straight or slightly curved, indehiscent, flat cylindrical, 5 - 14 cm long and 2 - 3 cm thick, each with 1 - 10 dark brown seeds in a brown or red-brown fruit pulp. Mature in December to January. Individual trees may grow very old and remain productive even when more than 200 years old.

Distribution: Originally from Madagascar, East Africa. Today distributed in semiarid tropical Africa and in India. The capital of Senegal, Dakar, has been named after the local name for Tamarindus indica. It is assumed that Arabian seafarers and traders brought the seeds to Southeast Asia in very early times. Marco Polo mentions Tamarindus indica in the year 1298. In the Indian Brahmasamhita scriptures, the tree is mentioned between 1,200 and 200 B.C., in Buddhist sources from about the year 650. Seeds had been brought to the Caribbean and Central America by the time of their discovery. Today Tamarindus indica is cultivated in Florida and California, also in Australia.

Site requirements: The wide distribution of Tamarindus shows that it is a very adaptable species. Grows preferably in semiarid regions (with approx. 400 mm annual precipitation), but also in the monsoon region with more than 1,500 mm. A marked and extended dry season seems necessary for the formation of fruit. The tamarind does not penetrate into the rain-forest zone. It is very storm-resistant (because of the deep root system) and tolerates fog and saline air in the coastal districts, where it has proved its value for plantations. Occurs up to 1,500 m a.s.l. in mountain regions if it is sufficiently warm. No particular soil requirements, but has a preferance for deep alluvial soils. Swampy sites, stagnant water and dense rock , influencing the growth of roots, must be excluded. Otherwise, tamarinds grow on different soil types, preferring however deep and water-penetrable soils. In the Sahel mostly on banks or sites near ground water. A slight salinity is tolerated, pH should be about 5.5. No other plants are found below the tamarind, but the tree is occasionally associated with Adansonia digitata, which has similar site requirements. The tamarind is suitable for cultivation in gardens, courtyards or parks and even as a roadside tree, provided falling fruit does not constitute an accident risk.

Propagation and management: Tamarindus indica was already cultivated in ancient Egypt. It is striking that nearly all trees found in the Sahel originate from natural regeneration and that

applied genetic selection and planned cultivation have so far been absent. This may be an important research task for the future which could profit from experience gained with plantations in Florida, India and Mexico. Natural regeneration can be found sporadically. Seeds, transported by birds or mammals, germinate well under the shelter of other trees, particularly under the baobab or on termite mounds. Young plants are browsed by livestock. Propagation by seeds is well known; 2,000 - 2,500 seeds /kg. Seeds are taken from fresh, ripe pods. Germination percentage is high, while seeds from dried fruit do not germinate well. Germination occurs during the first 7 - 10 days after sowing and can be accelerated by soaking seeds for 24 hours in lukewarm water or by boiling for approx. 7 minutes with subsequent slow cooling. Seeds remain viable over a longer period if stored in dry sand in well closed vessels. Germination is best when seeds are covered by 1.5 cm loose sandy loam or by a mixture of loam and sand. The seedlings remain in seed-beds until transplantation, a minimum distance of 30 cm should be maintained to permit lifting with a sufficiently large root ball. As soon as the cotyledons break through, plants must be shaded until they reach a height of 35 cm. Seedlings should attain at least 80 cm before being transplanted to their final location at the beginning of the rainy season. Vegetative propagation of tamarinds has shown some encouraging results. Branch cuttings root rapidly on sandy subsoil. In particular, production is better, but also size and quality of the fruit are superior to fruit obtained from plants derived from seeds. Vegetatively propagated tamarinds do not attain the same size as seeded trees and smaller trees are easier to harvest. Tamarinds yielding exceptionally good fruit should thus be propagated vegetatively. Air-layered as well as stem-layered cuttings can be obtained. Branches of tamarind plants are induced to root as follows: At a distance of 15 - 30 cm from a fork a bark strip approx. 2.5 cm wide is peeled off around the entire branch. Phloem and cambium are removed and a lump of moist soil or loam is attached to this "wound" by means of a polythene or bast bandage. The development of roots demands a high degree of humidity. After 2 - 3 months sufficient roots have generally formed so that the rooted branch may be cut off and planted on its final site. Other methods of vegetative propagation (e.g. grafting) are frequently the best way to obtain a desirable plant quality. They should be applied to achieve higher yielding of more resistant varieties.

When establishing a pure plantation, spacing should be at least 13 x 13 m. As vegetatively propagated or improved tamarinds do not attain too large a size, denser spacing could be considered. Young tamarinds are very sensitive to denudation or lesion of their roots. They must be carefully treated for the transplanting operations and must be protected against drying out. It is therefore important that the root ball should be kept moist so that the soil remains attached to the ball. 3 - 4 weeks shading after planting and a post to which the tree can be attached during the first 4 years is helpful in attaining a straight bole. Where irrigation is possible it should be practised during the first dry season. A circle around the young plant should be cleared of

weeds and the soil should be loosened. Under sufficiently favourable growth conditions the first fruit may be produced between the 8th and 12th year. The tree may remain productive until it reaches old age, yielding up to 150 kg per tree or over 2 t per hectare per year.

Uses: Tamarindus indica is one of the most widely used trees in the Sahel and therefore deserves more attention in forestry projects.

A. Utilization of fruit: It is essential that the fruit mature on the tree because with premature fruit the pulp is acid and the fibres woody. Maturing of fruits through storage is not possible. Maturity can be recognized by a cinnamon- or dark brown color of the pods which become dry and fragile, separate from the fruit pulp and can be crushed with soft pressure between thumb and index finger. In contrast to immature fruit, the hydrated ripe fruit is comparatively light and sounds hollow on contact. The fruit is firmly attached to the branches. It is thus difficult to pluck by hand because it can be easily crushed. For clipping or cutting grafting-scissors or a similar tool, attached to a pole, could be used. Clipped fruit drops into a bag mounted below the scissors. This is a simple and inexpensive harvesting method. Fruit should not be beaten off the tree because of risk of crushing fruit and breaking off productive branches.

   Fruit not immediately marketed can be stored and protected against insects by various methods. A simple procedure is sun drying, but it is important that they should be kept under glass or a plastic sheet to prevent insect attack. In Asia and Egypt, the fruit is salted in a way similar to the preservation of cucumbers. It may also be pealed, mixed with sugar or salt and pressed into firm packages which are then stored in boxes or barrels in a cool, dry place. In India, where about 250,000 t are produced annually (3,000 t are exported), tamarind fruit is treated immediately after harvesting by removing shells, fibres and seeds which amount to 40 - 50% by weight. The pulp is compressed, stored and commercialized in mats made from palm leaves. On this small-industry scale tamarind fruit must be mixed with twice the quantity of water. Solid matter is removed by sieving, subsequent centrifuging and compression. If seeds are still contained in the fruit pulp, improper storage may cause heavy losses through insect attack. The fruit pulp is eaten fresh or used to produce refreshing drinks, jams and confections, for additives to chutney, curries, preserves, ice-cream and syrups and in condiments like Worcestershire and barbecue sauce.

B. Utilization of seeds: In some regions seeds are peeled and roasted or eaten boiled. The nutritional value is said to be low. Occasionally the flour obtained from ground seeds is added to meals. Ruminants are able to digest the carbohydrates so that seeds yield a good feed. The high (14 - 16 %) pectine

content is sometimes utilized industrially. In India approx. 60,000 t are produced annually and used in the food, wool and jute industries, but also in textiles, papermaking, printing and as additive to glues e.g. in combination with gum arabic. An oil can be obtained from the seeds.

C. Leaves and flowers: Leaves and flowers are browsed but can also be used for various food, e.g. in soups, salads etc. They are moderately palatable when fresh, but only to small ruminants. Average nutritive value (le HOUEROU 1980 A, p. 89):
Crude protein 11% DM (5 - 25),
Net energy 6.9 MJ kg DM (6.6 - 7.4),
Digestible protein/FU 81 (23 - 204),
P. 0.07 (0.04 - 0.10).
The nectariferous flowers furnish an abundant and high-quality honey. A yellow dye can be extracted from them, a red dye from the leaves.

D. Wood: The sapwood is white to slightly yellow, sometimes with red streaks. The heartwood is dark to purple-brown, in older trees occasionally with black stripes. It is tough, very hard, durable and termite-resistant; specific gravity: 0.93 g/cm^3 air-dry. May split on drying, blunts cutting-tools and is difficult to work; has good bending strength. It is used for: wheels, hubs, wooden utensils, agricultural tools, mortars, boat planks, toys, panels and furniture. In North America, tamarind wood has been traded under the name of "Madeira Mahagony". Although the tamarind is protected as a fruit tree, it makes good fuelwood and gives off much heat. Charcoal is of high quality and was used for the manufacture of gunpowder in former times. Wood ashes and bark are used for tanning of goat skins.

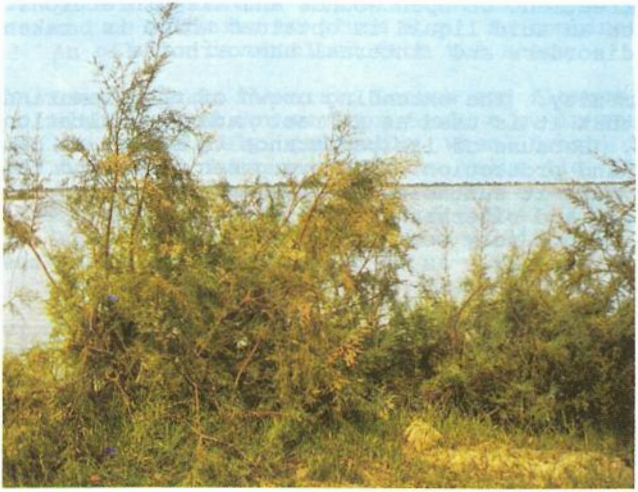
E. Medicinal applications: Already in Sanskrit records the tamarind was mentioned as a valuable medicinal plant. Through Hindi it became known in Arabian countries, and the Arabs conveyed their recipes to the Europeans. The American pharmaceutical industry processes annually about 100 t of peeled fruit, imported from the Antilles and from Mexico. Possibilities of preparation and application are so manifold that only a short list can be presented here. Ripe fruit is said to reduce fever. It is used against intestinal ailments, as a mild laxative, for healing biliary disorders and in case of poisoning. For infectious swellings, an application of fruit pulp or from ground leaves is recommended as an astringent remedy. The fruit is added to cardiac medicine or to blood-sugar reducing medicines. Its effectiveness against scurvy is proved. For throat infection, gargling with a decoction of fruit is said to be effective. The ashes of fruit shells are used as an alkaline substance in combination with other medications, e.g. to treat diarrhoea. A root decoction is said to lessen infections of the respiratory tract, and, combined with other remedies, even to help cure leprosy. The bark contains substances with astringent tonic properties. Pulverized bark ashes are used for colics and digestive disorders. A

decoction is used to treat infections of the gums, asthma and eye infections, while lotions and applications of ground bark are used for the treatment of open wounds and skin infections. From ground leaves an acid liquid is obtained which is taken for gallbladder disorders and internal haemorrhoids.

F. Protection and amenity: The extending crown of the tamarind offers shade so that it is used as a "rest and consultation tree" in villages. Because of its resistance to storms it can also be used as wind protection. The evergreen habit and the beautiful flowers make it suitable for ornamental planting in parks, along roads and riverbanks. It should be considered, however, that it is not very compatible with other plants. It is thus used for firebreaks, as no grass will grow under the trees.

References: Aubréville (1950), Baumer (1983), Berhaut Vol. IV (1975), Bolza and Keating (1972), Dale and Greenway (1961), FAO (1982), Geerling (1982), Giffard (1974 A), Hallam (1979), le Houerou (1980 A), Howaldt (1980), Irvine (1961), National Academy of Sciences (1979), Sahni (1968), Touzeau (1973).

TAMARIX SENEGALENSIS



Tamarix senegalensis DC.

Family: Tamaricaceae.

Description: Shrub, 2 - 3 m, branches profuse, pendulous, pale green. Leaves alternate, reduced to scales of 1 - 2 mm, more or less triangular, acuminate, glandulous. Very small white or pink flowers in terminal racemes of up to 20 cm length. Fruit a small conical capsule.

Distribution: In the coastal regions of Senegal, The Gambia and Mauritania, Cape Verde Islands, in the highlands of the Central Sahara, Niger, Chad. Tamarix aphylla L. (syn. T. articulata Vahl, T. orientalis Forsk.) is widespread through arid and semiarid areas in eastern Africa, the Sudan and Egypt.

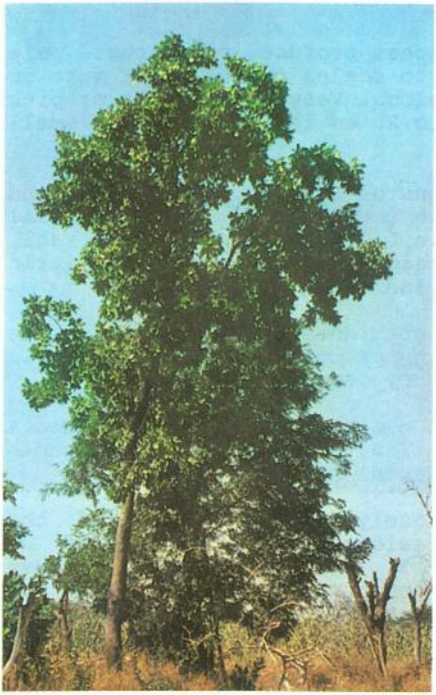
Site requirements: On sandy soils of high salinity, e.g. in the delta of the Senegal river, forming extensive pure stands. In dried river beds with ground water not deeper than 3 m.

Uses: The macerated fruit is a good medication for colds. Shoots with leaves for conjunctivitis. The Socé and Sérer people consider the entire plant to be a fetish plant.

Tamarix gallica L. is a very closely related species of the Mediterranean region which has occasionally been considered as identical with T. senegalensis. T. gallica is said to have furnished the manna that fed the children of Israel. The sap "exuding from punctures made by a small insect, collects along the branches in beads which crystallize and are sweet, aromatic and pleasant to taste." (Palmer and Pitman 1972, p. 1519). The droplets of this sap melt away in the heat of the sun and today are still collected by Bedouins before sunrise.

References: Aubréville (1950), Geerling (1982), Giffard (1974 A), Kerharo and Adam (1974), Knapp (1973).

TERMINALIA AVICENNIOIDES



Terminalia avicennioides Guill. et Perrott.

Synonyms: Terminalia dictyoneura Diels, Terminalia lecardii Engl. et Diel

Family: Combretaceae

Description: Shrub or small tree, up to 10 m. Crown extensive. Bark rough, thick, deeply fissured and corky, dark grey. Slash yellow, rapidly darkening. Terminal bud, young shoots, inflorescences, and fruits tomentose. Adult leaves mat green on the upper side, silvery-green below, rather narrow elongated, oblong-elliptic, obtuse, approximately 5 x 15 (up to 20) cm, alternate. Shoots and young foliage pink. Flowers axillary in long racemes, 10 - 12 cm, initially pink, then light green. Large (up to 6 cm), whitish, winged, mucronate fruits with a slight spine at the apex.

Distribution: From Senegal to Chad, in the Sudan zone and along the southern rim of the Sahel, Nigeria, Cameroon, Ethiopia.

Site requirements: On sandy sites of the southern Sahel zone and the adjoining savannas; south to the African rainforest. A typical (pioneer) secondary timber species. No particular site requirements, on lateritic soils of the Sudan-Sahel, 500 - 1,000 mm annual rainfall.

Uses: Wood hard, yellow-brown, durable. Construction timber, fuelwood, charcoal. A dye is obtained from the roots. Leaves as fodder for all livestock. Medicinal applications: Leaves to treat coughs; roots for syphilis and hydropsy. Ashes for rheumatism and infections of the joints.

Leaves yield a black, the bark a brown dye.

References: Aubréville (1950), Berhaut Vol. II (1974), Geerling (1982), Giffard (1974 A), Hallam (1979), Irvine (1961), Kerharo and Adam (1974), Touzeau (1973).

Terminalia macroptera Guill. et Perrott.

Synonyms: Terminalia chevalieri Diels, Terminalia suberosa Chev., Terminalia adamauensis Engl., Terminalia elliotii Engl. and Diels, Terminalia dawei Rolfe.

Family: Combretaceae

Description: Tree, up to 8 m (13 m) high, crown open spreading. Bole rarely straight. Easily recognized by the light green ("sea-green") foliage in upright fascicles and the large winged seeds. Terminal buds, young shoots, leaves, inflorescences (mostly), and fruit glabrous. Bark blackish, fissured, reddish when flaking off. Slash brown-yellow. Branches and leaves glabrous. Leaves alternate, very large (15 - 35 cm long, 5 - 12 cm wide), oblong to lanceolate, shortly pointed at the apex, 14 - 20 pairs of salient nerves. Central nerve prominent on both surfaces, pale or pink. Leaves subsessile. Flowers cream-yellow in axillary racemes, racemes up to 15 cm long, slightly pubescent. Calyx white with 5 teeth, grey hairs on the inside. 10 stamens. No sepals. Fruit 8 - 13 cm long and 3 - 4 cm wide, long elliptic, winged, pale green. Many galls on leaves and fruit.

Distribution: Widespread in Africa, from Senegal to Uganda, Zaire. Sudan and Guinea savannas. Only few sites in the southern Sahel.

Site requirements: On fresh soils, also with periodic flooding, on riverbanks, water holes in depressions with high ground water level. Often on termite mounds. On compacted soils. 700 - 1500 mm annual rainfall.

Uses: The wood is hard, light brown or yellowish, coarse, very durable, of pleasant look (in parts used as teak substitute) and termite-resistant. Sapwood narrow, yellow-grey, heartwood light brown. Specific gravity: 0.87. Suitable for carts, boats, tools, for construction, etc. but difficult to work. Yields an excellent charcoal. Black, shiny textile color is obtained from the leaves, and the roots yield a yellow dye. Extracts of the roots are used in human and veterinary medicine. Leaf decoction to treat hepatitis, ringworm and skin diseases. Shoots (decoction) to treat fatigue, depressions, fever, syphilis, as aphrodisiac. Leaves and roots have diuretic effects and are used for skin diseases. Seeds against headache, fruit galls for dysentery. Roots, bark and bark decoctions are applied to heal cuts and wounds; as a laxative and diuretic. Cosmetic use of wood ashes.

References: Aubréville (1950), Berhaut Vol. II (1974), Bolza and Keating (1972), Geerling (1982), Giffard (1974 A), Hallam (1974), Irvine (1961), Kerharo and Adam (1974).

VITEX DIVERSIFOLIA

Vitex diversifolia Bak.

Synonyms: Vitex simplicifolia Oliv., Vitex vogelii Baker.

Family: Verbenaceae

Description: Shrub or tree up to 6 m, with a scaly grey bark and a yellowish to grey-brown slash. To be distinguished from other West-African Vitex species by not having palmate, but undivided leaves. In the juvenile phase, they are (like buds and young shoots) densely tomentose, later this cover remains intact on the underside. Petioles reddish on the upper side. Flowers axillary in 10 - 15 cm long cymes, greenish with purple-violet sepals. Fruit oval, approximately 1.5 x 2.5 cm, green with marked white dots, later black, containing 3 seeds.

Distribution: In the Sudan and Guinea savannas, from the Ivory Coast to Central Africa, extending into the southern Sahel on sites near ground water or depressions.

Uses: The fruit pulp is edible; branches are used as "chew-sticks". Bark extracts for the treatment of skin diseases and toothache.

References: Aubréville (1950), Geerling (1982), Irvine (1961).

VITEX DONIANA

Vitex doniana Sweet

Synonyms: Vitex cuneata Schum. and Thonn., Vitex cienkowskii Kotschy and Peyr., Vitex umbrosa G. Don ex Sabine, Vitex paludosa Vatke, Vitex chariensis Chev.

Family: Verbenaceae

Description: Tree, up to 15 - 20 m high. Tallest and most frequent pan-African Vitex species, deciduous. Crown spherical, dark green. Bark pale brown to grey-white with long vertical, narrow fissures and sticky swellings, scaly, easy to remove. Slash very watery, brittle, grainy, yellow-white.

Leaves opposite, palmately fingered (5-partite, rarely 7-partite). Leaflets dark green obovate, rounded at the tip, acuminate or incised, of different form and arrangement, 10 lateral pairs of nerves. Always glabrous, below shiny; with long (15 cm) stalks, 15 x 10 cm. Flowers white or yellowish with blue-red centre, fragrant, in large brown hairy axillary cymes. Fruit green, glabrous, up to 3 cm, with small white dots, later yellow-brown, black when mature. Maturity from December to July. Fruits in large (approximately 1/3 of the fruit) fruit cups; containing 1 very hard nut, incl. 1 - 4 seeds.

Distribution: Pan-African, coastal savannas, secondary forests, dry forests, only single specimen found on favourable sites of the southern Sahel.

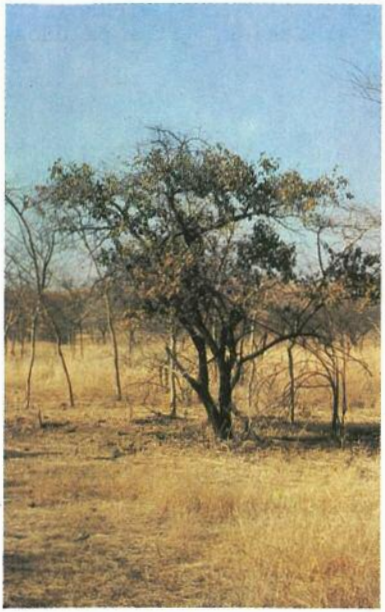
Site requirements: Frequently on fields, fallows, along river-banks on alluvial soils. Needs a high ground water table, occasionally planted around courts. In East Africa at altitudes up to 1,800 m a.s.l. Annual rainfall about 700 to above 2,000 mm.

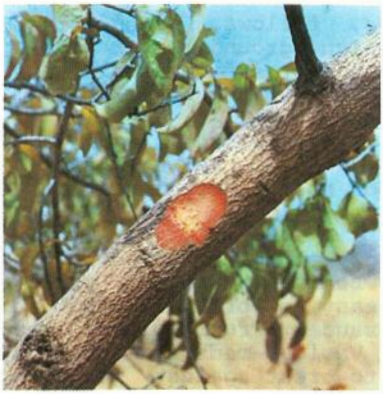
Propagation and management: Seeds to be soaked in warm water prior to seeding; 1,300 seeds/1 kg. Natural regeneration by seeds, coppice and root suckers. Seeds need a very long time to germinate.

Uses: Wood medium hard, but intensely attacked by insects. Suitable for light constructions, boats. White or yellow, darkening with age, fine texture, easy to work, but not to polish. Fruit edible; leaves used for sauces. Fruits give a sweet beverage; the pulp is said to be oily. Various medicinal applications, e.g. to improve fertility, to treat against jaundice, dysentery, asthenia, anaemia, stomachache, leprosy. Chewed leaves on wounds to improve healing. An ink is obtained from different parts of the plant; dye for fabric from bark and roots. Bark and ashes are used in soap-making.

References: Aubréville (1950), Bolza and Keating (1972), Dale and Greenway (1961), FAO (1983 D), Geerling (1982), Hallam (1979), Irvine (1961), Kerharo and Adam (1974), Weber (1977).

XIMENIA AMERICANA





Ximenia americana L.

Family: Olacaceae.

Description: Small tree or shrub, 4 - 5 (up to 8) m high. Occasionally semi-parasitic with haustoria. Bark dark brown-grey, scaly; slash pink. Branches glabrous, with lenticels. Thorns straight, very pointed, solitary in the leaf axils. Nearly or completely thornless in the north of the area of distribution, leaves are also thinner and more shiny. Leaves alternate, elliptic, narrow at the tip, glabrous. Underside mat, entire, folding about the mid rib. Leaf approx. 5 x 3 cm. Flowers greenish or cream-coloured in small racemes in the leaf axils, strongly fragrant. Fruit a drupe, large (2 x 3 cm), yellow, glabrous, containing a juicy pulp and one woody seed with an oily kernel.

Distribution: Pantropical, in all African savannas, gallery forests, along the coast, America, tropical Asia.

Site requirements: Understorey in dry forests, on riverbanks, mostly solitary, dispersed in open country. On gravelly-stony soils, on sands near the coast, on clay soils, around waterholes. Not in swampy areas. In East Africa at altitudes up to 2,000 m. Annual rainfall 300 - 1,250 mm.

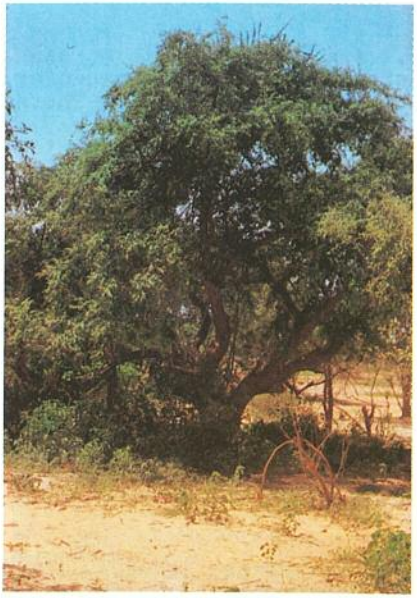
Propagation and management: Propagated by seeds, approx. 1,400 seeds/1 kg. Vegetative propagation probably possible; fruits on favourable sites in the 3rd year.

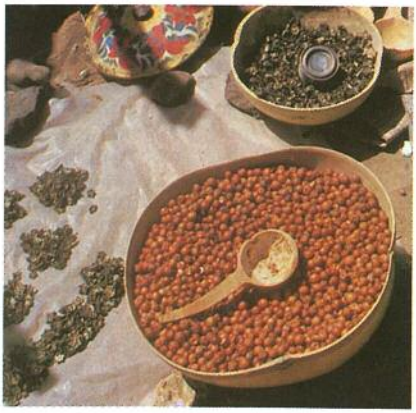
Uses: Fruitpulp edible and thirst quenching. It is sought by all herdsmen, although containing cyanic acid. Manufacture of beverages ("beer") in South Africa. Kernels taste like nuts; they are also used to manufacture a pomade. The oil (40 to 70 % of the kernel's weight) is used for preparing meals (Angola), for torches and for softening leather. It is pale yellow, viscous and non-drying, can be filtered and clarified. The garlic odour disappears after 1 - 2 days. Suitable for lighting and soap-making. Roots and bark contain 16 - 17 % tannin for the treatment of red leathers. The heartwood is reddish yellow or orange-brown, sharply distinguished from the yellow sapwood. It is very hard and heavy (specific gravity 0.95 air-dried). Fine, even texture, easy to work and polish, relatively durable. Mainly used as fuelwood and charcoal. Ximenia should be tested as a hedge plant.

Applications in local medicine: root decoction for the treatment of dysentery and haemorrhoids, as an emetic and laxative, for trypanosomiasis, fever, as antidote. Roots for leprosy, for the treatment of mentally ill. Numerous other applications of different parts, e.g. for the treatment of headache, toothache, infections of eyes and ears, oedema.

References: Aubréville (1950), Dale and Greenway (1961), FAO (1983 D), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo and Adam (1974).

ZIZIPHUS MAURITIANA





Ziziphus mauritiana Lam.

Synonyms: Ziziphus jujuba (L.) Lam., Ziziphus orthacantha DC.

Family: Rhamnaceae

All three Ziziphus species mentioned here are quite variable in their appearance (subject to sites and genetic variation), and hybrids may occur.

Description: Shrub or small tree, 4 - 5 m, up to 12 m. Has a strongly developed root system. Bark grey, slash brown to pale red. Branches pendulous, white-tomentose, of angular growth, alternate, very thorny with typical pairs of thorns: first thorn pointed and straight, the other recurved ("thumb-pointer"). Thornless varieties have been cultivated. Small, alternate, very variable leaves; tomentose below, ovate, finely serrate, upper side shiny. 3 prominent nerves originating from the leaf base. 1 or 2 pairs of secondary nerves. Flowers yellowish, approx. 4 mm, in axillary clusters of 3 - 5 flowers, sepals very small, stamens gold-yellow. Flowering October/January. Fruit 1 - 2 cm in diameter, round, brown-red with one relatively large yellow stone, containing 2 seeds.

Distribution: Originating in South and Central Asia; widely distributed in semiarid Africa and in the Mediterranean region. Sahel, Sudan savanna.

Site requirements: Tolerates great heat and drought; annual precipitation 150 - 500 mm. Does not tolerate high atmospheric humidity but extreme temperatures of -6° C to over 50° C. No specific soil requirements (sand, gravel, fields, banks of rivers and waterholes, etc.) but avoiding clay. Also on periodically inundated sites.

Propagation and management: Plantation is practised in southern France, North Africa, California, Florida. Soil must be worked to 40 cm depth prior to planting. Irrigation improves growth and production. Propagation by seeds which should be stratified 6 months prior to seeding. The stones (cleaned from the pulp) should be cracked mechanically to obtain the seeds. About 7,000 seeds/1 kg. Germination is rather slow and variable, because many stones are empty. Transplanting (about 2 - 3 month after germination) not always successful. Cuttings develop a vigorous root system. Scions are used with good success. Coppicing is excellent. Spacing, depending on the site, 5 x 5 m, with irrigation also 3 x 3 m but final stands with 80 to 100 trees only. May be planted as hedges. Weeding and frequent soil loosening (hoeing) necessary. Fertilizer application: 100-120 kg P 20 - 120 kg N and 20 - 50 kg K per ha. Fruit production as of the 4th year, full production between the 10th and 12th year. Pruning and shaping of the tree in the dry season has a positive effect on fruiting in the next season.

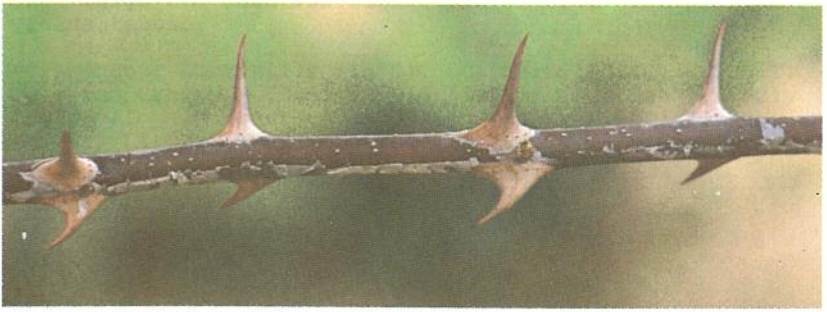
Many parasites attack fruit and leaves.

Uses: Fruits are eaten fresh or dried. Yields range from 80 - 130 kg per tree and year. The food value of the fruit pulp is close to that of bananas and of special importance because it can be made available in times of food scarcity. Fresh fruits contain about 25 - 30 % sugar and starch and up to 2.5 % protein. Their calorific value is about 100 (140) calories per 100 g. The dried fruit pulp is pounded and pressed into small cakes or used as a floury meal or the paste as a condiment. It contains much vitamin A and C. Crushed fruits yield a refreshing beverage, intoxicating if fermented. Young leaves are added as a vegetable to couscous and soups. Leaves and fruits are browsed by livestock. The nutritive value of the leaves is as follows (le HOUEROU 1980 A, p. 91):
Crude protein 15.5 % DM (11.1 - 26,4)
Net energy 6.6 MJ kg DM (5.5 - 7.3)
Digestible protein/FU 109 (67 - 221)
P 0.16 (0.13 - 0.21)
The shrub is suitable for windbreaks and hedges. In local medicine bark decoctions are used to treat colics, but there are many other applications, e.g. for venereal diseases, intestinal infections, treatment of kwashiorkor and liver ailments. In Ethiopia a fish poison is obtained from the fruits.

Wood generally has too small dimensions, but otherwise of good quality; specific gravity 0.71. The red-brown heartwood is easy to work and to polish, termite-resistant. Beds and boats (dhows) in East Africa, spoons, posts, household utensils, fuelwood. Rods and twigs are used for wickerwork in roofs and for fences. Bark yields tannin.

References: Aubréville (1950), Baumer (1983), C.T.F.T. (1978), Dale and Greenway (1961), FAO (1982), Geerling (1982), Giffard (1974 A), le Houerou (1980 A), Irvine (1961),Kerharo and Adam (1974), Little (1983), Touzeau (1973).

ZIZIPHUS MUCRONATA



Ziziphus mucronata Willd.

Synonym: Ziziphus mitis A. Rich.

Family: Rhamnaceae

Description: Climbing shrub, rarely a tree, up to 9 m high, stem diameter of up to 25 cm. Bark grey-brown. Branches dark brown to blackish and slightly pubescent drooping. Thorns paired, mostly one straight, the other one recurved. Leaves alternate, asymmetric, glabrous, (except the petiole), broadly ovate, acuminate, slightly dentate, 3 - 8 x 2 - 6 cm. Three basal nerves, 3 pairs of secondary nerves. Inflorescences greenish, on short peduncles. Flowers hermaphrodite. Fruits round with a large kernel. Cuticle of the fruit shiny and brittle (up to 2 cm diameter), dark red-brown. Prominent in particular when leaves have already been shed.

Distribution: Pan-African in the semiarid regions; Arabic Peninsula.

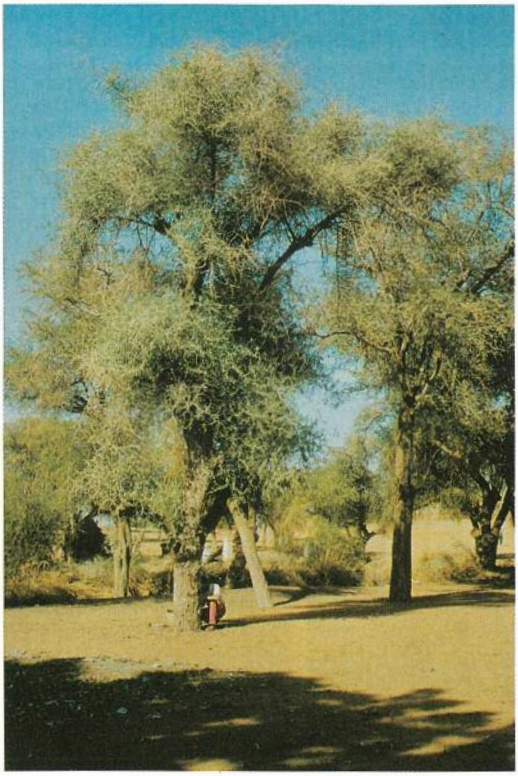
Site requirements: Prefers embankments, flooded plains etc., often on or near termite mounds, on boulders, hilltops. Very adaptable to different soils.

Propagation and management: Easy to propagate by seeds, rapid juvenile growth (approx. 1 m per year).

Uses: Fruits are said to be of lower food value than those of Ziziphus mauritiana; they are chewed to alleviate toothache, used as coffee substitute and in times of food-shortage prepared as a pap. Livestock (particularly goats) and game eat fresh fallen or chopped down fruits. In some regions the flowers are preferred by bees. The wood, generally of small dimensions, is yellowish to pink, light, tough and elastic, termite-resistant but not very durable. Used for bows, in hut construction, for tools, charcoal, fuelwood. Branchwood for fences. The bark contains 12 - 15 % tannin. Many medicinal applications, e.g. for treating enuresis, liver disorders as a consequence of bilharziosis, syphilis, leprosy, mental disorders, worm infections, dysentery, and other infections.

References: Aubréville (1950), Geerling (1982), Giffard (1974 A), Irvine (1961), Kerharo and Adam (1974), Palmer and Pitman Vol. II (1972).

ZIZIPHUS SPINA-CHRISTI
(Photos: S. Miehe (above) and K. Neumann (below))



Ziziphus spina-christi (L.) Desf.

Synonym: Ziziphus amphibia A. Chev.

Family: Rhamnaceae.

Description: Shrub (var. microphylla), 4 - 5 m, or (rarely) a tree, up to 10 m high (var. spina-christi). Many intertwined branches, forming an impenetrable thicket. Bark deeply fissured and scaly, whitish brown or pale grey. Branchlets nearly white, glabrous. Slash reddish. Paired, unequal thorns: one straight, one recurved. Leaves alternate, smooth, ovate-lanceolate, vary greatly in size (less than 1 to 9 cm long), margin slightly dentate, strongly 3-nerved from the base. Flowers small (2 mm), pale yellow, in short axillary cymes. Fruits subglobose, fleshy, brownish or red, approx. 20 mm in diameter. Ziziphus spina-christi is evergreen in wet sites but sheds all leaves during the dry season where less water is available.

Distribution: Sahara and Sahel, from Senegal to the Sudan and Arabia.

Site requirements: Along the banks of "marigots", on periodically inundated sites. 50 - 300 mm annual rainfall.

Uses: Leaves are occasionally browsed by livestock (sheep, goats). Ornamental tree; often planted in settlements as a shade-tree and because of its edible fruit. The wood is used for tool handles, posts, furniture, carpentry and turning work. Yields good firewood and charcoal. Branches are lopped for fencing. Powder from charred thorns against snakebite. Medicinal applications for bandages to treat scab, for blood purification. It is said to have an anaesthetic effect ("Boisson de bastonnade"). The name "spina-christi" derives from the legend that the crown of Jesus Christ was made from branches of this Ziziphus species.

References: Aubréville (1950), Geerling (1982), Kerharo and Adam (1974), Sahni (1968), von Sengbusch and Dippold (1980).

Appendixes

ALPHABETICAL LIST OF BOTANICAL NAMES AND SYNONYMS

A

Acacia adansonii Guill. et Perrott. = A. nilotica var. adansonii
Acacia adstringens (Schum. et Thonn.) Berhaut = A. nilotica var. adansonii
ACACIA ALBIDA DEL.
Acacia arabica Willd. = A. nilotica var. adansonii
Acacia arabica Willd. var. tomentosa Benth. = A. nilotica var. tomentosa
ACACIA ATAXACANTHA DC.
Acacia buchanani Harms = A. macrothyrsa
Acacia caffra Willd. var. campylacantha Aubrev. = A. polyacantha var. campylacantha
Acacia campylacantha Hochst. ex A. Rich. = A. polyacantha var. campylacantha
Acacia catechu Willd. var. campylacantha (Hochst. ex A. Rich.) Roberty = A. polyacantha var. campylacantha
Acacia catechu Oliv. = A. polyacantha var. campylacantha
Acacia dalziellii Craib = A. macrothyrsa
ACACIA DUDGEONI CRAIB EX HOLL.
ACACIA EHRENBERGIANA HAYNE
Acacia erythrocalyx Brenan = A. pennata
Acacia fasciculata Guill. et Perrott. = A. tortilis
Acacia flava (Forsk.) Schweinf. = A. ehrenbergiana
Acacia glauca Moench = Leucaena leucocephala
ACACIA GOURMAENSIS A. CHEV.
Acacia gyrocarpa Hochst. = A. albida
Acacia hockii De Willd. = A. seyal
ACACIA LAETA R. BR. EX BENTH.
Acacia lebbeck (L.) Willd. = Albizia lebbeck
Acacia leucocephala = A. albida
ACACIA MACROSTACHYA REICHENB. EX BENTH.
ACACIA MACROTHYRSA HARMS
ACACIA MELLIFERA (VAHL) BENTH.
Acacia nefasia Schweinf. = A. sieberiana
ACACIA NILOTICA VAR. ADANSONII (GUILL. ET PERROTT.) O. KTZE.
ACACIA NILOTICA VAR. TOMENTOSA (BENTH.) A.F. HILL
ACACIA PENNATA (L.) WILLD.
ACACIA POLYACANTHA WILLD. VAR. CAMPYLACANTHA (HOCHST. EX A. RICH.) BRENAN
Acacia prorsispinnata Stapf. = A. macrothyrsa
Acacia raddiana Savi = A. tortilis
Acacia ruprestris Stokes = A. senegal
Acacia saccharata Benth. = A. albida
Acacia samoryana A. Chev. = A. dudgeoni
Acacia scorpioides (L.) W.F. Wight var. adstringens Bak. = A. nilotica var. adansonii

Acacia scorpioides (L.) W.F. Wight var. nilotica (L.) A. Chev. = A. nilotica var. nilotica
Acacia scorpioides (L.) W.F. Wight var. pubescens (L.) A. Chev. = A. nilotica var. tomentosa
ACACIA SENEGAL (L.) WILLD.
Acacia senegal (L.) Willd. ssp. mellifera (Vahl) Roberty = A. mellifera
Acacia senegal var. samoryana Roberty = A. dudgeoni
ACACIA SEYAL DEL.
ACACIA SIEBERIANA DC.
Acacia singuinea Guill. et Perrott. = A. sieberiana
Acacia stenocarpa Hochst. ex A. Rich. = A. seyal
Acacia suma Benth. = A. polyacantha var. campylacantha
ACACIA TORTILIS (FORSK.) HAYNE SSP. RADDIANA (SAVI) BRENAN
Acacia trentiniani A. Chev. = A. laeta
Acacia trispinosa Stokes = A. senegal
Acacia verek Guill. et Perrott. = A. senegal
Acacia verugera Schweinf. = A. sieberiana
Adansonia baobab Gaertn. = A. digitata
ADANSONIA DIGITATA L.
Adansonia situla (Lour.) Spreng. = A. digitata
Adansonia somalensis Chiov. = A. digitata
Adansonia sphaerocarpa A. Chev. = A. digitata
Adansonia sulcata A. Chev. = A. digitata
Adenium arabicum Balf. f. = A. obesum
Adenium coetaneum Stapf. = A. obesum
Adenium honghel A. DC. = A. obesum
ADENIUM OBESUM (FORSK.) ROEM. ET SCHULT.
Adenolobus rufescens (Lam.) Schmitz = Bauhinia rufescens
Agialida barteri Van Tiegh. = Balanites aegyptiaca
Agialida senegalensis Van Tiegh. = Balanites aegyptiaca
Agialida tombouctensis Van Tiegh. = Balanites aegyptiaca
ALBIZIA CHEVALIERI HARMS
ALBIZIA LEBBECK (L.) BENTH.
ANACARDIUM OCCIDENTALE L.
Annona arenaria Thonn. ex Schum. = A. senegalensis
Annona chrysophylla (Boj.) R. Sillans = A. senegalensis
ANNONA SENEGALENSIS PERS.
Annona senegalensis var. latifolia Oliv. = A. senegalensis
ANOGEISSUS LEIOCARPUS (DC.) GUILL. ET PERROTT.
Anogeissus leiocarpus var. schimperi (Hochst. ex Hutch. et Dalz.) Aubrév. = A. leiocarpus
Anogeissus schimperi Hochst. ex Hutch. et Dalz. = A. leiocarpus
Antelaea azadirachta (L.) Adelbert = Azadirachta indica
AZADIRACHTA INDICA A. JUSS.

B

BALANITES AEGYPTIACA (L.) DEL.
Balanites ziziphoides Mildbr. et Schlechter = B. aegyptiaca
Balsamodendron africanum Arn. = Commiphora africana

Bassia parkii G. Don. = Butyrospermum parkii
Bauhinia abyssinica Rich. = Piliostigma thonningii
Bauhinia adansoniana Guill. et Perrott. = B. rufescens
Bauhinia glabra A. Chev. = Piliostigma reticulatum
Bauhinia glauca A. Chev. = Piliostigma reticulatum
Bauhinia pyrrhocarpa Hochst. = Piliostigma thonningii
Bauhinia reticulata DC. = Piliostigma reticulatum
BAUHINIA RUFESCENS LAM.
Bauhinia thonningii Schum. = Piliostigma thonningii
Bombax andrieui Pellegr. et Vuillet = B. costatum
Bombax buonopozense P. Beauv. = B. costatum
BOMBAX COSTATUM PELLEGR. ET VUILLET
Bombax houardii Pellegr. et Vuillet = B. costatum
Bombax vuilletii Pellegr. = B. costatum
BORASSUS AETHIOPUM MART.
Borassus flabellifer L. var. aethiopum Warb. = B. aethiopum
BOSCIA ANGUSTIFOLIA A. RICH.
Boscia octandra Hochst. ex Radlk. = B. senegalensis
Boscia patens Sprague et M.L. Green = B. angustifolia
Boscia powellii Sprague et M. Green = B. salicifolia
BOSCIA SALICIFOLIA OLIV.
BOSCIA SENEGALENSIS (PERS.) LAM. EX POIR.
Boscia tenuifolia A. Chev. = B. angustifolia
Brehmia spinosa (Lam.) Harv. ex DC. = Strychnos spinosa
Brehmia spinosa ssp. lokua (A. Rich.) E.A. Bruce = Strychnos spinosa
Butyrospermum paradoxum subsp. parkii (G. Don) Hepper = B. parkii
BUTYROSPERMUM PARKII (G.DON) KOTSCHY

C

CADABA FARINOSA FORSK.
CADABA GLANDULOSA FORSK.
Cadaba mombassana Gilg et Benedict = C. farinosa
Cailliea dichrostachys Guill. et Perrott. = Dichrostachys cinerea
CALOTROPIS PROCERA (AIT.) AIT. F.
Capparis aphylla Hayne ex Roth = C. decidua
CAPPARIS CORYMBOSA LAM.
CAPPARIS DECIDUA (FORSK.) EDGEW.
Capparis persicifolia A. Rich. = C. tomentosa
Capparis puberula DC. = C. tomentosa
Capparis sepiaria L. = C. corymbosa
CAPPARIS TOMENTOSA LAM.
Cassia kotschyana Oliv. = C. sieberiana
CASSIA SIAMEA LAM.
CASSIA SIEBERIANA DC.
CASUARINA EQUISETIFOLIA J.R. ET G. FORST.
Casuarina litorea L. = C. equisetifolia
Celastrus coriaceus Guill. et Perrott. = Maytenus senegalensis
Celastrus senegalensis Lam. = Maytenus senegalensis
CELTIS INTEGRIFOLIA LAM.
Combretum abbreviatum Engl. et Diels = C. paniculatum

COMBRETUM ACULEATUM VENT.
Combretum altum Perr. = C. micranthum
Combretum elliotii Engl. et Diels = C. nigricans
Combretum etessei Aubrév. = C. glutinosum
Combretum floribundum Engl. et Diels = C. micranthum
COMBRETUM GLUTINOSUM PERROTT. EX DC.
Combretum lecananthum Engl. et Diels = C. nigricans
Combretum leonense Engl. et Diels = C. glutinosum
COMBRETUM MICRANTHUM G. DON
COMBRETUM NIGRICANS LEPR. EX GUILL. ET PERROTT.
COMBRETUM PANICULATUM VENT.
Combretum parviflorum Reichb. = C. micranthum
Combretum passargei Engl. et Diels = C. glutinosum
Combretum pincianum Hook = C. paniculatum
Combretum raimbaultii Heck = C. micranthum
Combretum ramosissimum Engl. et Diels = C. paniculatum
COMMIPHORA AFRICANA (A. RICH) ENGL.
Commiphora calcicola Engl. = C. africana
Commiphora pilosa Engl. = C. africana
Conocarpus leiocarpus DC. = Anogeissus leiocarpus
CRATEVA ADANSONII DC.
Crateva religiosa Forst = C. adansonii

D

DALBERGIA MELANOXYLON GUILL. ET PERROTT.
Dichrostachys arborea N.E. Br. = D. cinerea
DICHROSTACHYS CINEREA (L.) WIGHT ET ARN.
Dichrostachys glomerata (Forsk.) Hutch
et Dalz. = D. cinerea
Dichrostachys nutans (Pers.) Benth. = D. cinerea
Dichrostachys platycarpa Welw. ex Oliv. = D. cinerea
DIOSPYROS MESPILIFORMIS HOCHST. EX A. DC.
Diospyros senegalensis Perrott. et A. DC.= D. mespiliformis

E

ENTADA AFRICANA GUILL. ET PERROTT.
Entada sudanica Schweinf. = E. africana
Entada ubanguiensis De Wild. = E. africana
Entadopsis sudanica (Schweinf.) Gilbert
et Boutique = E. africana
ERYTHRINA SENEGALENSIS DC.
EUCALYPTUS CAMALDULENSIS DEHNHARDT
Eucalyptus rostrata Schlecht. = E. camaldulensis
EUPHORBIA BALSAMIFERA AIT.
Euphorbia rogeri N.E. Br. = E. balsamifera
Euphorbia sepium N.E. Br. = E. balsamifera

F

Faidherbia albida (Del.) A. Chev. = A. albida
FERETIA APODANTHERA DEL.
Feretia canthioides Hiern = F. apodanthera
Ficus bibracteata Warb. = F. platyphylla

Ficus bongoensis Warb. = F. iteophylla
FICUS CAPENSIS THUNB.
Ficus dekdekena (Miq.) A. Rich. = F. iteophylla
FICUS GNAPHALOCARPA (MIQ.) STEUD. EX A. RICH.
FICUS INGENS (MIQ.) MIQ.
FICUS ITEOPHYLLA MIQ.
Ficus lutea Vahl. = F. ingens
Ficus katagumica Hutch. = F. ingens
Ficus kawuri Hutch. = F. ingens
FICUS PLATYPHYLLA DEL.
Ficus pseudovogelii A. Chev. = F. vogelii
Ficus sassandensis A. Chev. = F. iteophylla
Ficus senegalensis Miq. = F. vogelii
Ficus spragueana Mildbr. et Burret = F. iteophylla
Ficus sur Forsk. = F. capensis
Ficus sycomorus L. = F. gnaphalocarpa
FICUS THONINGII BLUME
Ficus umbrosa Warb. = F. platyphylla
Ficus trachyphylla Fenzl = F. gnaphalocarpa
FICUS VOGELII (MIQ.) MIQ.
Fluggea microcarpa Bl. = Securinega virosa
Fluggea virosa (Roxb. ex Willd.) Baill. = Securinega virosa

G

GARDENIA AQUALLA (SCHWEINF.) STAPF ET HUTCH.
GARDENIA ERUBESCENS STAPF ET HUTCH.
Gardenia jovis-tonantis Hiern = G. ternifolia
Gardenia medicinalis Vahl ex Schum. = G. ternifolia
GARDENIA SOKOTENSIS HUTCH.
GARDENIA TERNIFOLIA K. SCHUM. ET THONN.
Gardenia thunbergia Hiern = G. ternifolia
Gardenia triacantha var. parvilimbis
F.N. Williams = G. erubescens
Grewia betulifolia Juss. = G. tenax
GREWIA BICOLOR JUSS.
Grewia corylifolia Guill. et Perrott. = G. villosa
GREWIA FLAVESCENS JUSS.
Grewia grisea N.E. Br. = G. bicolor
Grewia guazumifolia A. Chev. = G. flavescens
Grewia kwebensis N.E. Br. = G. bicolor
Grewia miniata Mast. ex Hiern = G. bicolor
GREWIA MOLLIS JUSS.
Grewia mossambicensis Burret = G. bicolor
Grewia pilosa Lam. = G. flavescens
Grewia populifolia Vahl = G. tenax
Grewia salvifolia Heyne ex Roth = G. bicolor
GREWIA TENAX (FORSK.) FIORI
Grewia venusta Fres. = G. mollis
GREWIA VILLOSA WILLD.
GUIERA SENEGALENSIS J.F. GMEL.
Gymnosporia crenulata Engl. = Maytenus senegalensis
Gymnosporia dinturi Loes = Maytenus senegalensis
Gymnosporia senegalensis (Lam.) Loes = Maytenus senegalensis

H

Heudelotia africana A. Rich. = Commiphora africana
HYPHAENE THEBAICA (L.) MART.

K

KHAYA SENEGALENSIS (DESR.) A. JUSS.

L

LANNEA ACIDA A. RICH.
Lannea djalonica A. Chev. = L. microcarpa
LANNEA MICROCARPA ENGL. ET K. KRAUSE
LEPTADENIA PYROTECHNICA (FORSK.) DECNE.
Leptadenia spartium Wight = L. pyrotechnica
Leucaena glauca (Moench) Benth. = L. leucocephala
Leucaena latisiliqua (L.) W.T. G'Illis = L. leucocephala
LEUCAENA LEUCOCEPHALA (LAM.) DE WIT.
Leucaena salvadorensis Standley = L. leucocephala
Lophostylis pallida Klotzsch = Securidaca longepedunculata

M

MAERUA ANGOLENSIS DC.
MAERUA CRASSIFOLIA FORSK.
Maerua de-wailly Aubrév. et Pellegr. = M. crassifolia
Maerua rigida R. Br. = M. crassifolia
Maerua senegalensis R. Br. = M. crassifolia
MANGIFERA INDICA L.
MAYTENUS SENEGALENSIS (LAM.) EXELL.
Melia azadirachta L. = Azadirachta indica
Melia indica (A. Juss.) Brandis = Azadirachta indica
Mimosa arabica Lam. = Acacia nilotica
Mimosa asperata L. = M. pigra
Mimosa biglobosa Jacq. = Parkia biglobosa
Mimosa cinerea L. = Dichrostachys cinerea
Mimosa glomerata Forsk. = Dichrostachys cinerea
Mimosa juliflora Swartz. = Prosopis juliflora
Mimosa lebbeck L. = Albizia lebbeck
Mimosa leucocephala Lam. = Leucaena leucocephala
Mimosa mellifera Vahl = Acacia mellifera
Mimosa nilotica L. = Acacia nilotica
Mimosa nutans Pers. = Dichrostachys cinerea
Mimosa pennata L. = Acacia pennata
MIMOSA PIGRA L.
Mimosa scorpioides L. = Acacia nilotica
Mimosa senegal L. = Acacia senegal
Mitragyna africana (Willd.) Korth = M. inermis
MITRAGYNA INERMIS (WILLD.) O. KTZE.
MORINGA OLEIFERA LAM.
Moringa pterygosperma Gaertn. = M. oleifera

N

Nauclea africana Willd. = Mitragyna inermis
Nerium obesum Forsk. = Adenium obesum

O

Odina acida (A. Rich.) Oliv. = Lannea acida

P

PARKIA BIGLOBOSA (JACQ.) BENTH.
PARKINSONIA ACULEATA L.
PHOENIX DACTYLIFERA L.
Phyllanthus virosus Roxb. ex Willd. = Securinega virosa
PILIOSTIGMA RETICULATUM (DC.) HOCHST.
PILIOSTIGMA THONINGII (SCHUM.) MILNE-REDH.
Piliostigma rufescens (Lam.) Benth. = Bauhinia rufescens
Podoria senegalensis (Pers.) Lam. ex Poir. = Boscia senegalensis
Poupartia birrea (A. Rich.) Aubr. = Sclerocarya birrea
PROSOPIS AFRICANA (GUILL., PERROTT. ET RICH.) TAUB.
Prosopis dubia Guill. et Perrott. = Acacia sieberiana
PROSOPIS JULIFLORA (SW.) DC.
Prosopis lanceolata Benth. = P. africana
Prosopis oblonga Benth. = P. africana
Pterocarpus abbyssinicus Hochst. = P. lucens
Pterocarpus angolensis DC. = P. erinaceus
Pterocarpus echinatus DC. = P. erinaceus
PTEROCARPUS ERINACEUS POIR.
PTEROCARPUS LUCENS LEPR. EX GUILL. ET PERROTT.
Pterocarpus simplicifolius Bak. = P. lucens

S

SALVADORA PERSICA L.
SCLEROCARYA BIRREA (A. RICH.) HOCHST.
SECURIDACA LONGEPEDUNCULATA FRESEN
Securidaca spinosa Sim. = S. longepedunculata
SECURINEGA VIROSA (ROXB. EX WILLD.) BAILL.
Securinega microcarpa (Blume) Pax et Hoffm. = S. virosa
Sodada decidua Forsk. = Capparis decidua
Spondidas birrea A. Rich. = Sclerocarya birrea
Sterculia cinerea A. Rich. = S. setigera
STERCULIA SETIGERA DEL.
Sterculia tomentosa Guill. et Perrott. = S. setigera
Stereospermum dentatum A. Rich. = S. kunthianum
STEREOSPERMUM KUNTHIANUM CHAM.
Strychnos buettneri Gilg. = S. spinosa
Strychnos djalonis A. Chev. = S. spinosa
Strychnos courtti Chev. = S. spinosa
Strychnos emarginata Bak. = S. spinosa
Strychnos dulcis Chev. = S. spinosa
Strychnos gracillima Gilg. = S. spinosa
Strychnos laxa Solered. = S. spinosa
Strychnos lokua A. Rich. = S. spinosa

STRYCHNOS SPINOSA LAM.
Strychnos spinosa var. pubescens Bak. = S. spinosa
Strychnos volkensi Gilg. = S. spinosa
Swietenia senegalensis Desr. = Khaya senegalensis

T

TAMARINDUS INDICA L.
TAMARIX SENEGALENSIS DC.
Terminalia adamauensis Engl. = T. macroptera
TERMINALIA AVICENNIOIDES GUILL. ET PERROTT.
Terminalia chevalieri Diels = T. macroptera
Terminalia dawei Rolfe = T. macroptera
Terminalia dictyoneora Diels = T. avicennioides
Terminalia elliotii Engl. et Diels = T. macroptera
Terminalia lecardii Engl. et Diels = T. avicennioides
TERMINALIA MACROPTERA GUILL. ET PERROTT.
Terminalia suberosa Chev. = T. macroptera

U

Uncaria inermis Willd. = Mitragyna inermis
Urostigma dekdekena Miq. = Ficus iteophylla
Urostigma ingens Miq. = Ficus ingens
Urostigma vogelii Miq. = Ficus vogelii

V

Vinticena flavescens (Juss.) Burret = Grewia flavescens
Vitellaria paradoxa Gaertn. = Butyrospermum parkii
Vitex cienkowskii Kotschy et Peyr. = V. doniana
Vitex cuneata Schum. et Thonn. = V. doniana
VITEX DIVERSIFOLIA BAK.
VITEX DONIANA SWEET
Vitex paludosa Vatke = V. doniana
Vitex simplicifolia Oliv. = V. diversifolia
Vitex umbrosa G. Don ex Sabine = V. doniana
Vitex vogelii Baker = V. diversifolia

X

XIMENIA AMERICANA L.
Ximenia aegyptiaca L. = Balanites aegyptiaca

Z

Ziziphus amphibia A. Chev. = Z. spina-christi
Ziziphus jujuba (L.) Lam. = Z. mauritiana
ZIZIPHUS MAURITIANA LAM.
Ziziphus mitis A. Rich. = Z. mucronata
ZIZIPHUS MUCRONATA WILLD.
Ziziphus orthacantha DC. = Z. mauritiana
ZIZIPHUS SPINA-CHRISTI (L.) DESF.

FAMILIES AND GENERA IN ALPHABETICAL ORDER

Family	Genus
Anacardiaceae	Anacardium, Lannea, Mangifera, Sclerocarya
Annonaceae	Annona
Apocynaceae	Adenium
Asclepiadaceae	Calotropis, Leptadenia
Balanitaceae	Balanites
Bignoniaceae	Stereospermum
Bombacaceae	Adansonia, Bombax
Burseraceae	Commiphora
Caesalpiniaceae	Bauhinia, Cassia, Parkinsonia, Piliostigma, Tamarindus
Capparidaceae	Boscia, Cadaba, Capparis, Crateva, Maerua
Casuarinaceae	Casuarina
Celastraceae	Maytenus
Combretaceae	Anogeissus, Combretum, Guiera, Terminalia
Ebenaceae	Diospyros
Euphorbiaceae	Euphorbia, Securinega
Fabaceae	Dalbergia, Erythrina, Leucaena, Pterocarpus
Loganiaceae	Strychnos
Meliaceae	Azadirachta, Khaya
Mimosaceae	Acacia, Albizia, Dichrostachys, Entada, Mimosa, Parkia, Prosopis
Moraceae	Ficus
Moringaceae	Moringa
Myrtaceae	Eucalyptus
Olacaceae	Ximenia
Palmae	Borassus, Hyphaene, Phoenix
Polygalaceae	Securidaca
Rhamnaceae	Ziziphus
Rubiaceae	Feretia, Gardenia, Mitragyna
Salvadoraceae	Salvadora
Sapotaceae	Butyrospermum
Sterculiaceae	Sterculia
Tamaricaceae	Tamarix
Tiliaceae	Grewia
Ulmaceae	Celtis
Verbenaceae	Vitex

APPENDIX III

VERNACULAR NAMES

BAMBARA

Botanical name	Bambara
Acacia albida	balanzan, balasa
Acacia macrostachya	bonzoni, génidé, korote, sofara-goueni
Acacia nilotica var. adansonii	bagana-iri, barana, boina, daibe
Acacia pennata	toufi-tuku, tufi
Acacia senegal	dibe, dankari, dunkari
Acacia seyal	sadee, zayee
Acacia sieberiana	baki-de
Acacia tortilis	baki-fin, zadie
Adansonia digitata	sira
Annona senegalensis	dan-ha, dyangara
Anogeissus leiocarpus	n'galama, n'garamr
Balanites aegyptiaca	ségéné, seguene, zegene
Bauhinia rufescens	guesembe, sifile, sifle
Bombax costatum	bumbu, bumi, ndéra, togodo
Borassus aethiopum	sebe
Boscia senegalensis	bele, bere
Butyrospermum parkii	si
Calotropis procera	fogofoko
Capparis corymbosa	tufi
Cassia sieberiana	baga-sinedian, sinia
Combretum aculeatum	uolokonti
Combretum glutinosum	tyangara
Combretum micranthum	baraule, blèn, kofina, n'golobe, singolobe
Combretum nigricans	jilini ble
Combretum paniculatum	dirinimblé
Commiphora africana	badi, barakande, dalasi,darabé
Crateva adansonii	mongo kulu, sunamin
Dichrostachys cinerea	giliki, ntirigi
Diospyros mespiliformis	sunzun, susu
Entada africana	sama-nere, soso
Ficus gnaphalocarpa	gaul, turu
Ficus platyphylla	gaba
Gardenia ternifolia	buru ke
Guiera senegalensis	gundie, kundje, muyee
Hyphaene thebaica	kolo kotole
Khaya senegalensis	dyala

BAMBARA

Botanical name	Bambara
Lannea acida	peku-ni
Lannea microcarpa	m'peku, peku-ba
Maerua crassifolia	berediu
Mitragyna inermis	dion-dyum, diu
Parkia biglobosa	nere
Piliostigma reticulatum	nyama
Piliostigma thonningii	nyama-ba
Prosopis africana	gele, gouele
Pterocarpus erinaceus	goni, gwani, n'gueni
Pterocarpus lucens	bala, dabakala, gala, guiri
Sclerocarya birrea	gna, kuna, kunan
Securidaca longepedunculata	dioro, doro, doto, yuro
Sterculia setigera	kakoro, kongosira
Tamarindus indica	domi, n'tomi
Terminalia avicennioides	wolo
Terminalia macroptera	wolo, wolo-ba, wolo-muso
Vitex doniana	koro ni fiin, koro, koroba
Ximenia americana	donga, nôgbe, ntônge, sene, tonga
Ziziphus mauritiana	domo, ntomono, surgo ntomono, tomboro, tomonou
Ziziphus mucronata	suruku ndomo

BAMBARA

Bambara	Botanical name
badi	Commiphora africana
baga sinedian	Cassia sieberiana
bagana-iri	Acacia nilotica var. adansonii
baki-de	Acacia sieberiana
baki-fin	Acacia tortilis
bala	Pterocarpus lucens
balanzan	Acacia albida
balasa	Acacia albida
barakande	Commiphora africana
barana	Acacia nilotica var. adansonii
baraule	Combretum micranthum
bele	Boscia senegalensis
bere	Boscia senegalensis
berediu	Maerua crassifolia
blèn	Combretum micranthum
boina	Acacia nilotica var. adansonii
bonzoni	Acacia macrostachya
bumbu	Bombax costatum
bumi	Bombax costatum
buru ke	Gardenia ternifolia
dabakala	Pterocarpus lucens
daibe	Acacia nilotica var. adansonii
dalasi	Commiphora africana
dan-ha	Annona senegalensis
darasé	Commiphora africana
dibe	Acacia senegal
dion-dyum	Mitragyna inermis
dioro	Securidaca longepedunculata
dirinimblé	Combretum paniculatum
diu	Mitragyna inermis
domo	Ziziphus mauritiana
domi	Tamarindus indica
donga	Ximenia americana
donkori	Acacia senegal
doro	Securidaca longepedunculata
doto	Securidaca longepedunculata
dunkari	Acacia senegal
dyala	Khaya senegalensis
dyangara	Annona senegalensis
fogofoko	Calotropis procera
gaba	Ficus platyphylla
gala	Pterocarpus lucens
gaul	Ficus gnaphalocarpa
gele	Prosopis africana
génidé	Acacia macrostachya
giliki	Dichrostachys cinerea
gna	Sclerocarya birrea
goni	Pterocarpus erinaceus

BAMBARA

Bambara	Botanical name
gouele	Prosopis africana
guesembe	Bauhinia rufescens
guiri	Pterocarpus lucens
gundie	Guiera senegalensis
gwani	Pterocarpus erinaceus
jilini ble	Combretum nigricans
kakoro	Sterculia setigera
kofina	Combretum micranthum
kolo kotole	Hyphaene thebaica
kongosira	Sterculia setigera
koro	Vitex doniana
koroba	Vitex doniana
koro ni fiin	Vitex doniana
korote	Acacia macrostachya
kuna	Sclerocarya birrea
kunan	Sclerocarya birrea
kundje	Guiera senegalensis
mongo kulu	Crateva adansonii
muyee	Guiera senegalensis
m'peku	Lannea microcarpa
ndéra	Bombax costatum
nere	Parkia biglobosa
n'galama	Anogeissus leiocarpus
n'garamr	Anogeissus leiocarpus
n'golobe	Combretum micranthum
n'gueni	Pterocarpus erinaceus
nôgbe	Ximenia americana
ntirigi	Dichrostachys cinerea
n'tomi	Tamarindus indica
ntomono	Ziziphus mauritiana
ntônge	Ximenia americana
nyama	Piliostigma reticulatum
nyama-ba	Piliostigma thoningii
peku-ba	Lannea microcarpa
peku-ni	Lannea acida
sadee	Acacia seyal
sama-nere	Entada africana
sebe	Borassus aethiopum
ségéné	Balanites aegyptiaca
seguene	Balanites aegyptiaca
sene	Ximenia americana
si	Butyrospermum parkii
sifile	Bauhinia rufescens
sifle	Bauhinia rufescens
singolobe	Combretum micranthum

Bambara	Botanical name
sinia	Cassia sieberiana
sira	Adansonia digitata
sofara-goueni	Acacia macrostachya
soso	Entada africana
sunzun	Diospyros mespiliformis
suramin	Crateva adansonii
surgo ntomono	Ziziphus mauritiana
suruku ndomo	Ziziphus mucronata
susu	Diospyros mespiliformis
togodo	Bombax costatum
tomboro	Ziziphus mauritiana
tomonou	Ziziphus mauritiana
tonga	Ximenia americana
toro	Ziziphus mauritiana
toufi-tuku	Acacia pennata
tufi	Acacia pennata, Capparis corymbosa
turu	Ficus gnaphalocarpa
tyangara	Combretum glutinosum
uolokonti	Combretum aculeatum
wolo	Terminalia avicennioides, Terminalia macroptera
wolo-ba	Terminalia macroptera
wolo-muso	Terminalia macroptera
yuro	Securidaca longepedunculata
zadie	Acacia tortilis
zayee	Acacia seyal
zegene	Balanites aegyptiaca

DJERMA

Botanical name	Djerma
Acacia albida	gao
Acacia laeta	danngha
Acacia macrostachya	goumbi
Acacia nilotica var. adansonii	bani
Acacia nilotica var. tomentosa	bani
Acacia senegal	danja, danngha, deligna
Acacia seyal	saykire
Acacia sieberiana	mane
Acacia tortilis	bissau, bissogna, bissohou
Adansonia digitata	konian
Annona senegalensis	moupa
Anogeissus leiocarpus	gonga
Balanites aegyptiaca	garbei
Borassus aethiopum	sabouze
Boscia senegalensis	djlo, orba
Butyrospermum parkii	boulanga
Cassia sieberiana	samturi
Combretum aculeatum	bouboure
Combretum glutinosum	delinia, kokorbe
Combretum micranthum	koubou
Combretum nigricans	deligina
Euphorbia balsamifera	berre
Grewia tenax	sali
Guiera senegalensis	sabara
Hyphaene thebaica	kangau
Khaya senegalensis	farei
Maerua crassifolia	hassu, hassuhi
Parkia biglobosa	dosso
Parkinsonia aculeata	sassa bani
Piliostigma reticulatum	kosseye
Pterocarpus erinaceus	tolo
Tamarindus indica	bossaie, bosse, bossogna
Terminalia avicennioides	farkahanga
Vitex doniana	bo-i

DJERMA

Djerma	Botanical name
bani	Acacia nilotica var. adansonii, Acacia nilotica var. tomentosa
berre	Euphorbia balsamifera
bissau	Acacia tortilis
bissogna	Acacia tortilis
bissohou	Acacia tortilis
bossaie	Tamarindus indica
bosse	Tamarindus indica
bossogna	Tamarindus indica
bouboure	Combretum aculeatum
boulanga	Butyrospermum parkii
bo-i	Vitex doniana
danja	Acacia senegal
danngha	Acacia senegal, Acacia laeta
deligina	Combretum nigricans
deligna	Acacia senegal
delinia	Combretum glutinosum
djlo	Boscia senegalensis
dosso	Parkia biglobosa
farei	Khaya senegalensis
farkahanga	Terminalia avicennioides
gao	Acacia albida
garbei	Balanites aegyptiaca
gonga	Anogeissus leiocarpus
goumbi	Acacia macrostachya
hassu	Maerua crassifolia
hassuhi	Maerua crassifolia
kangau	Hyphaene thebaica
kokorbe	Combretum glutinosum
konian	Adansonia digitata
kosseye	Piliostigma reticulatum
koubou	Combretum micranthum
mane	Acacia sieberiana
moupa	Annona senegalensis
orba	Boscia senegalensis
sabouze	Borassus aethiopum
sabara	Guiera senegalensis
sali	Grewia tenax
samturi	Cassia sieberiana
sassa bani	Parkinsonia aculeata
saykire	Acacia seyal
tolo	Pterocarpus erinaceus

FRENCH

Botanical name	French
Acacia albida	cad, kad(e)
Acacia nilotica var. adansonii	nèb-nèb
Acacia nilotica var. tomentosa	gommier rouge, gonakié
Acacia senegal	gommier (blanc), vérek
Acacia seyal	mimosa épineux
Adansonia digitata	baobab, pain de singe
Adenum obesum	baobab des chacals
Albizia lebbeck	acacia langue de femme, bois noir
Anacardium occidentale	pomme d'acajou, pommier cajou
Annona senegalensis	annone, pomme cannelle du Sénégal
Anogeissus leiocarpus	bouleau d'Afrique
Azadirachta indica	lilas des Indes, margose, nim
Balanites aegyptiaca	dattier du désert, myrobalan d'Egypte, dattier sauvage
Bombax costatum	kapokier (à fleurs) rouge(s)
Borassus aethiopum	rônier
Butyrospermum parkii	karité, arbre à beurre
Calotropis procera	arbre à soie du sénégal, pomme de Sodome
Capparis tomentosa	câprier d'Afrique
Cassia siamea	sindian
Casuarina equisetifolia	filao
Celtis integrifolia	mboul, micocoulier africain
Combretum micranthum	kinkéliba
Commiphora africana	bdellium d'Afrique, myrrhe africaine
Dalbergia melanoxylon	ébénier du Sénégal
Dichrostachys cinerea	mimosa clochette
Diospyros mespiliformis	ébénier de l'Ouest Africain, faux ébénier
Erythrina senegalensis	arbre corail
Ficus thonningii	arbre à palabres
Guiera senegalensis	nger, n'guère
Hyphaene thebaica	doum, palmier doum, palmier fourchu
Khaya senegalensis	caïlcedrat, acajou du Sénégal
Lannea microcarpa	raisinier
Moringa oleifera	ben ailé, nevedie, pois quenique
Parkia biglobosa	arbre à farine, arbre à fauve, nété, caroubier africain, mimosa pourpre, néré

FRENCH

Botanical name	French
Parkinsonia aculeata	genêt épineux
Phoenix dactylifera	dattier
Pterocarpus erinaceus	kino de Gambie, palisandre du Sénégal, santal du Sénégal,véne
Sclerocarya birrea	prunier
Securidaca longepedunculata	arbre à serpent
Sterculia setigera	arbre à gomme, gommier mbep, mbep, platane du Sénégal
Tamarindus indica	tamarinier
Tamarix senegalensis	tamarix du Sénégal
Terminalia macroptera	badamier du Sénégal
Vitex doniana	prunier noir
Ximenia americana	prunier de mer, citronnier de mer
Ziziphus mauritiana	jujubier
Ziziphus mucronata	jujubier de la hyène

French	Botanical name
acacia langue de femme	Albizia lebbeck
acajou du Sénégal	Khaya senegalensis
annone	Annona senegalensis
arbre à beurre	Butyrospermum parkii
arbre corail	Erythrina senegalensis
arbre à farine	Parkia biglobosa
arbre à fauve	Parkia biglobosa
arbre à gomme	Sterculia setigera
arbre à palabres	Ficus thonningii
arbre à serpent	Securidaca longepedunculata
arbre à soie du Sénégal	Calotropis procera
badamier du Sénégal	Terminalia macroptera
baobab	Adansonia digitata
baobab des chacals	Adenium obesum
bdellium d'Afrique	Commiphora africana
ben ailé	Moringa oleifera
bois noir	Albizia lebbeck
bouleau d'Afrique	Anogeissus leiocarpus
cad	Acacia albida
caîlcedrat	Khaya senegalensis
câprier d'Afrique	Capparis tomentosa
caroubier africain	Parkia biglobosa
citronnier de mer	Ximenia americana
dattier	Phoenix dactylifera
dattier du désert	Balanites aegyptiaca
dattier sauvage	Balanites aegyptiaca
doum	Hyphaene thebaica
ébénier de l'Ouest Africain	Diospyros mespiliformis
ébénier du Sénégal	Dalbergia melanoxylon
faux ébénier	Diospyros mespiliformis
filao	Casuarina equisetifolia
genêt épineux	Parkinsonia aculeata
gommier (blanc)	Acacia senegal
gommier mbep	Sterculia setigera
gommier rouge	Acacia nilotica var. tomentosa
gonakié	Acacia nilotica var. tomentosa
jujubier	Ziziphus mauritiana
jujubier de la hyène	Ziziphus mucronata
kad(e)	Acacia albida
kapokier (à fleurs) rouge(s)	Bombax costatum
karité	Butyrospermum parkii
kino de Gambie	Pterocarpus erinaceus
kinkéliba	Combretum micranthum

French	Botanical name
lilas des Indes	Azadirachta indica
manguier	Mangifera indica
margose	Azadirachta indica
mbep	Sterculia setigera
mboul	Celtis integrifolia
micocoulier africain	Celtis integrifolia
mimosa clochette	Dichrostachys cinerea
mimosa épineux	Acacia seyal
mimosa pourpre	Parkia biglobosa
myrrhe africaine	Commiphora africana
myrobalan d'Egypte	Balanites aegyptiaca
neb-neb	Acacia nilotica var. adansonii
néré	Parkia biglobosa
nété	Parkia biglobosa
nevedie	Moringa oleifera
nger	Guiera senegalensis
n'guère	Guiera senegalensis
nim	Azadirachta indica
palisandre du Sénégal	Pterocarpus erinaceus
pain de singe	Adansonia digitata
palmier dattier	Phoenix dactylifera
palmier doum	Hyphaene thebaica
palmier fourchu	Hyphaene thebaica
platane du Sénégal	Sterculia setigera
pois quenique	Moringa oleifera
pomme cannelle du Sénégal	Annona senegalensis
pomme d'acajou	Anacardium occidentale
pomme de Sodome	Calotropis procera
pommier cajou	Anacardium occidentale
prunier	Sclerocarya birrea
prunier de mer	Ximenia americana
prunier noir	Vitex doniana
raisinier	Lannea microcarpa
rônier	Borassus aethiopum
santal du Sénégal	Pterocarpus erinaceus
sindian	Cassia sieberiana
tamarinier	Tamarindus indica
tamarix du Sénégal	Tamarix senegalensis
véne	Pterocarpus erinaceus
vérek	Acacia senegal

GOURMANCHE

Botanical_name	Gourmanche
Acacia albida	bu lantuabu, gabongu, kanbundisiagu, linkougouable
Acacia ataxacantha	tubongu
Acacia dudgeoni	konchinga
Acacia gourmaensis	gowugobri, li guanguabli, li konguabli, okipangongou
Acacia macrostachya	balkongu, ku calipangbangu, ku tialipangbangu, okipangongou
Acacia nilotica var. adansonii	bu kadatibu, kada, kom boanga, konbonkarga, peguenega
Acacia pennata	tugu
Acacia polyacantha	bunka
Acacia senegal	i konsindi, li konguabli
Acacia seyal	komoandi, komondi, li komuanli, u kompienu
Acacia sieberiana	li komuanli
Adansonia digitata	bu tobu, bu tuobu
Albizia chevalieri	gmanjaduri, k kadunga
Annona senegalensis	bu bualansambu, gorisaatibu, luboualansanhu
Anogeissus leiocarpus	bu siebou
Azadirachta indica	dan madatchi, nim
Balanites aegyptiaca	bangbabu, bu kpankpagubu, pakpoanpagabu, panpaabu
Bauhinia rufescens	k baabutika, timamarga
Bombax costatum	bu fobu, bu fuobu, fuombu
Borassus aethiopum	bu kpakpalbu, ku kpankpagibu
Boscia senegalensis	kankarigu, ogpanbugu, tjutjiri
Butyrospermum parkii	bu sambu
Calotropis procera	ku pulumpugu
Capparis corymbosa	kankargu, karinyanga, konnukuli, tangongu
Capparis tomentosa	k kalinyanga
Cassia sieberiana	i sandiani, k siesiega, nambiri, samdiani, sandiantigu
Celtis integrifolia	bu bannabu, bu sansambu
Combretum aculeatum	kaatjeguarbu, k huanyualolgu
Combretum glutinosum	faliyiendi, fapebri, li fapebli, li fapelu
Combretum micranthum	baalantigu, eniani, e tiani, i tiani, u diabalu
Combretum nigricans	okoua monnou
Commiphora africana	k sidmudiga, li natontyanli, seliymigri ,sirmurga
Dalbergia melanoxylon	siebou
Dichrostachys cinerea	li diaguoli, li jaguoli
Diospyros mespiliformis	bu gaabu

GOURMANCHE

Botanical name	Gourmanche
Entada africana	bu lokuabu, olokouagou
Feretia apodanthera	tipepiar
Ficus gnaphalocarpa	bu kankabub
Ficus ingens	li kankanmuanli
Ficus iteophylla	kankanpeliga, luonkao
Ficus platyphylla	kankanpwaari
Ficus thonningii	ku kamkanpuogu, ku kankannigu, panpanbu
Gardenia ternifolia	djabuli, li diabugili, lidaiboulguili
Grewia bicolor	juombu
Grewia mollis	keiouamoni, ku yuangu
Guiera senegalensis	mi puglima, pompewaru, pomporidi, u pompuaru
Hyphaene thebaica	papargu
Khaya senegalensis	bokebu, bu kogbu, bu kokebu
Lannea acida	bu gmantyabu
Lannea microcarpa	bu makiabu, bu tyabu
Maerua crassifolia	dyelgu
Maytenus senegalensis	male, mali
Mimosa pigra	jankongou
Mitragyna inermis	bu yelimbu, maniga
Moringa oleifera	aljan-tiga, makkakomboanga
Parkia biglobosa	bu dubu, budugu
Phoenix dactylifera	bu dabintibu
Piliostigma reticulatum	li nabanli, nabandi, nabali
Piliostigma thoningii	li nabanjali, nabaana, nabali
Pterocarpus erinaceus	bu natombu
Pterocarpus lucens	boutounbou, bu tonbu
Sclerocarya birrea	bu namagbu, namabu
Securidaca longepedunculata	opolou, polhani, u populu
Securinega virosa	i tyilimi
Sterculia setigera	bu fobou, bu nafuobu, poliponbu, tjembiri
Stereospermum kunthianum	k maniga, k nalilinga
Tamarindus indica	bu pugubu
Terminalia avicennioides	gwadi, gwarli, lesakoula, li sakuali, li sidiguali
Vitex doniana	bu anbu, bu hambu, haandi
Ximenia americana	bu midatibu, migliga, milimbu
Ziziphus mauritiana	batenluongu, bu sakonhiouabu, i nakpayuani, nanjanlwane
Ziziphus mucronata	bousakkon, hiouabou, namunkongu

GOURMANCHE

Gourmanche	Botanical name
aljan-tiga	Moringa oleifera
baalantigu	Combretum micranthum
balkongu	Acacia macrostachya
bangbabu	Balanites aegyptiaca
batenluongu	Ziziphus mauritiana
bokebu	Khaya senegalensis
bousakkon	Ziziphus mucronata
boutounbou	Pterocarpus lucens
bu anbu	Vitex doniana
bu bannabu	Celtis integrifolia
bu bualansambu	Annona senegalensis
bu dabintibu	Phoenix dactylifera
bu dubu (budugu)	Parkia biglobosa
bu fubou (bou foubou)	Sterculia setigera
bu fobu	Bombax costatum
bu fuobu	Bombax costatum
bu gaabu	Diospyros mespiliformis
bu gmantyabu	Lannea acida
bu hambu	Vitex doniana
bu kadatibu	Acacia nilotica var. adansonii
bu kankabub	Ficus gnaphalocarpa
bu kogbu	Khaya senegalensis
bu kokebu	Khaya senegalensis
bu kpakpalbu	Borassus aethiopum
bu kpankpagubu	Balanites aegyptiaca
bu lantuabu	Acacia albida
bu lokuabu	Entada africana
bu makiabu	Lannea microcarpa
bu midatibu	Ximenia americana
bu nafuobu	Sterculia setigera
bu namagbu	Sclerocarya birrea
bu natombu	Pterocarpus erinaceus
bunka	Acacia polyacantha
bu pugubu	Tamarindus indica
bu sakonhiouabu	Ziziphus mauritiana
bu sambu	Butyrospermum parkii
bu sansambu	Celtis integrifolia
bu siebou	Anogeissus leiocarpus
bu tobu	Adansonia digitata
bu tonbu	Pterocarpus lucens
bu tuobu	Adansonia digitata
bu tyabu	Lannea microcarpa
bu yelimbu	Mitragyna inermis
dan madatchi	Azadirachta indica
djabuli	Gardenia ternifolia
dyelgu	Maerua crassifolia

Gourmanche	Botanical name
ehianiz	Combretum micranthum
e tiani	Combretum micranthum
faliyiendi	Combretum glutinosum
fapebri	Combretum glutinosum
fuombu	Bombax costatum
gabongu	Acacia albida
gmanjaduri	Albizia chevalieri
gorisaatibu	Annona senegalensis
gowugobri	Acacia gourmaensis
gwadi	Terminalia avicennioides
gwarli	Terminalia avicennioides
haandi	Vitex doniana
hiouabou	Ziziphus mucronata
i konsindi	Acacia senegal
i nakpayuani	Ziziphus mauritiana
i sandiani	Cassia sieberiana
i tiani	Combretum micranthum
i tyilimi	Securinega virosa
jankongou	Mimosa pigra
juombu	Grewia bicolor
kaatjeguarbu	Combretum aculeatum
kada	Acacia nilotica var. adansonii
kanbundisiagu	Acacia albida
kankarigu	Boscia senegalensis
kankanpeliga	Ficus iteophylla
kankanpwaari	Ficus platyphylla
kankargu	Capparis corymbosa
karinyanga	Capparis corymbosa
k baabutiga	Bauhinia rufescens
keiouamoni	Grewia mollis
k huanyualolgu	Combretum aculeatum
k kadunga	Albizia chevalieri
k kalinyanga	Capparis tomentosa
k maniga	Stereospermum kunthianum
k nalilinga	Stereospermum kunthianum
kom boanga	Acacia nilotica var. adansonii
komoandi	Acacia seyal
komondi	Acacia seyal
konbonkarga	Acacia nilotica var. adansonii
konchinga	Acacia dudgeoni
konnukuli	Capparis corymbosa
k sidmudiga	Commiphora africana
k siesiega	Cassia sieberiana
ku calipanbangu	Acaica macrostachya
ku kamkanpuogu	Ficus thonningii

GOURMANCHE

Gourmanche	Botanical name
ku kankannigu	Ficus thonningii
ku kpankpagibu	Borassus aethiopum
ku tialipangbangu	Acacia macrostachya
ku yuangu	Grewia mollis
lesakoula	Terminalia avicennioides
lidaiboulguili	Gardenia ternifolia
li diabugili	Gardenia ternifolia
li diaguoli	Dichrostachys cinerea
li fapebli	Combretum glutinosum
li fapelu	Combretum glutinosum
li guanguabli	Acacia gourmaensis
li jaguoli	Dichrostachys cinerea
li kankanmuanli	Ficus ingens
li komuanli	Acacia sieberiana, Acacia seyal
li konguabli	Acacia gourmaensis, Acacia senegal
li nabanjali	Piliostigma thonningii
li natontyanli	Commiphora africana
linkougouable	Acacia albida
li sakuali	Terminalia avicennioides
li sidiguali	Terminalia avicennioides
li suanlagli	Prosopis africana
luboualansanhu	Annona senegalensis
luonkao	Ficus iteophylla
makkakomboanga	Moringa oleifera
male	Maytenus senegalensis
mali	Maytenus senegalensis
maniga	Mitragyna inermis
migliga	Ximenia americana
milimbu	Ximenia americana
mi puglima	Guiera senegalensis
nabaana	Piliostigma thonningii
nabali	Piliostigma reticulatum, P. thonningii
nabandi	Piliostigma reticulatum
namabu	Sclerocarya birrea
nambiri	Cassia sieberiana
namunkongu	Ziziphus mucronata
nanjanlwane	Ziziphus mauritiana
nim	Azadirachta indica
ogpanbugu	Boscia senegalensis
okipangongou	Acacia macrostachya, A gourmaensis
okuoa monnou	Combretum nigricans
olokouagou	Entada africana
opolou	Securidaca longepedunculata
poliponbu	Sterculia setigera
pompewaru	Guiera senegalensis

GOURMANCHE

Gourmanche	Botanical name
pomporidi	Guiera senegalensis
samdiani	Cassia sieberiana
sandiantigu	Cassia sieberiana
seliymigri	Commiphora africana
siebou	Dalbergia melanoxylon
sirmurga	Commiphora africana
tangongu	Capparis corymbosa
timamarga	Bauhinia rufescens
tipepiar	Feretia apodanthera
tjembiri	Sterculia setigera
tjutjiri	Boscia senegalensis
tubongu	Acacia ataxacantha
tugu	Acacia pennata
u diabalu	Combretum micranthum
u kompienu	Acacia seyal
u pompuaru	Guiera senegalensis
u populu	Securidaca longepedunculata

HAUSSA

Botanical name	Haussa
Acacia albida	gao
Acacia ataxacantha	sark'ak'ya, gumi
Acacia ehrenbergiana	tamat
Acacia laeta	akkora, akoria, akuara, dakwara
Acacia nilotica	bagarua, bagaruwa
Acacia polyacantha	kartji, karki
Acacia senegal	d'akwara, dakworo
Acacia seyal	erehi, fara-'k'aya
Acacia sieberiana	fara bagaruwa
Acacia tortilis	kandili, tamatchi
Adansonia digitata	kuka
Albizia chevalieri	kasari
Anogeissus leiocarpus	maréké
Azadirachta indica	dogo'n yaro
Balanites aegyptiaca	adua, aduwa, adoua
Bauhinia rufescens	dirga, jirga, shishi
Bombax costatum	kuria, gurjia
Borassus aethiopum	kâba ginia, jijinia
Boscia angustifolia	agahini, ballakani
Boscia salicifolia	zuré
Boscia senegalensis	hansa, anza
Butyrospermum parkii	kaday, kadé
Cadaba farinosa	bagey, bagahi
Calotropis procera	tumfafia
Capparis corymbosa	bagaye
Capparis tomentosa	jany baybay, hojéri
Cassia sieberiana	malga, thidiaye
Celtis integrifolia	dukki, zuwuo, zu
Combretum aculeatum	bubukia, fara-sheza, kulokulo
Combretum glutinosum	katakara, taramnya
Combretum micranthum	géza, giéza
Combretum nigricans	tsiriry, kiriri, tchilili, dagéra
Commiphora africana	dâshi, iskitchi, daski, biskiti, korore
Crateva adansonii	gud'é, gudai, ingidide, ingodidi, kalu, ungududu,
Dichrostachys cinerea	d'und'u
Diospyros mespiliformis	kanyia
Entada africana	tawatsa
Euphorbia balsamifera	aguwa
Ficus gnaphalocarpa	baure, bawri, bore, bouri, dubalé, tiédya
Ficus iteophylla	bingi
Ficus platyphylla	gamjy

HAUSSA

Botanical name	Haussa
Gardenia erubescens	gaudé
Grewia bicolor	dargaza, derza
Grewia flavescens	kamanmua
Grewia tenax	kamanmua
Grewia villosa	gwaragumi, gursummy, gurumeuchy
Guiera senegalensis	shabara
Hyphaene thebaica	gôriba (big, kâaba (small)
Khaya senegalensis	mad'âtchi
Lannea microcarpa	malga
Leptadenia pyrotechnica	kalumbo
Maerua crassifolia	jiga, ziga
Mimosa pigra	gardaji
Mitragyna inermis	amazo, giayia, diéya, kabé
Moringa oleifera	zôgala gandi, bagaruwa'n maka
Phoenix dactylifera	wa dabino
Piliostigma reticulatum	kalgo
Prosopis africana	kiryia
Pterocarpus erinaceus	madobihia
Salvadora persica	talaekia, babul
Sclerocarya birrea	dânia
Securidaca longepedunculata	warnagunguna, sanya
Securinega virosa	fulasko
Sterculia setigera	kukuki
Stereospermum kunthianum	sansami
Strychnos spinosa	kokhyo
Tamarindus indica	tsamia
Terminalia avicennioides	bawshi
Ximenia americana	tsâdâ, mararuwu
Ziziphus mauritiana	magaria
Ziziphus mucronata	magaria'n kura
Ziziphus spina-cristi	kurna

HAUSSA

Haussa	Botanical name
adoua, adua	Balanites aegyptiaca
aduwa	Balanites aegyptiaca
agahini	Boscia angustifolia
aguwa	Euphorbia balsamifera
akkora	Acacia laeta
akoria	Acacia laeta
akuara	Acacia laeta
amazo	Mitragyna inermis
anza	Boscia senegalensis
babul	Salvadora persica
bagai	Butyrospermum parkii
bagarua	Acacia nilotica var. adansonii
bagaruwa'n maka	Moringa oleifera
bagarwa	Acacia nilotica var. adansonii
bagaye	Capparis corymbosa
bagahi, bagey	Cadaba farinosa
bakengunbi	Acacia ataxacantha
ballakanis	Boscia angustifolia
bauchi	Terminalia avicennioides
baure, bauri, bawri	Ficus gnaphalocarpa
bawshi	Terminalia avicennioides
bingi	Ficus iteophylla
biskiti	Commiphora africana
bore	Ficus gnaphalocarpa
bubukia	Combretum aculeatum
cami	Pterocarpus lucens
dagéra	Combretum nigricans
dakwara	Acacia laeta
d'akwara	Acacia senegal
dakworo	Acacia senegal
dalza	Grewia bicolor
dâia	Sclerocarya birrea
dargaza	Grewia bicolor
dâshi	Commiphora africana
daski	Commiphora africana
darza	Grewia bicolor
dielou	Boscia senegalensis
diéya	Mitragyna inermis
dirga	Bauhinia rufescens
dogo'n yaro	Azadirachta indica
dorowo	Parkia biglobosa
dubalé	Ficus gnaphalocarpa
dukki	Celtis integrifolia
d'und'u	Dichrostachys cinerea
erehi	Acacia seyal
fara bagaruwa	Acacia sieberiana
fara-gheza	Combretum aculeatum
fara-'k'aya	Acacia seyal
finta	Pterocarpus lucens
forak-aya	Acacia seyal
fulasko	Securinega virosa

HAUSSA

Haussa	Botanical name
gao	Acacia albida
gamjy	Ficus platyphylla
gardaji	Mimosa pigra
gaudé	Gardenia erubescens
géza	Combretum micranthum
giayia	Mitragyna inermis
giéza	Combretum micranthum
gigunia	Borassus aethiopum
gôriba	Hyphaene thebaica (big)
gud'é	Crateva adansonii
gudai	Crateva adansonii
gumi	Acacia ataxacantha
gurja	Bombax costatum
gursummy	Grewia villosa
gurumeuchy	Grewia villosa
gwaragumi	Grewia villosa
hansa	Boscia senegalensis
hanza	Maerua angolensis
hassakaabe	Combretum aculeatum
haujari	Capparis tomentosa
hojéeri	Capparis tomentosa
ingidide	Crateva adansonii
ingodidi	Crateva adansonii
iskitchi	Commiphora africana
Jany baybay	Capparis tomentosa
jiga	Maerua crassifolia
jijinia	Borassus aethiopum
jirga	Bauhinia rufescens
kâaba	Hyphaene thebaica (small)
kâba ginia	Borassus aethiopum
kabé	Mitragyna inermis
kaday	Butyrospermum parkii
kadé	Butyrospermum parkii
kalgo	Piliostigma reticulatum
kalu	Crateva adansonii
kalumbo	Leptadenia pyrotechnica
kamanmua	Grewia flavescens, G. tenax
kandili	Acacia tortilis
kanyia	Diospyros mespiliformis
karki	Acacia polyacantha
karji	Acacia polyacantha
kasari	Albizia chevalieri
katakara	Combretum glutinosum
kiriri	Combretum nigricans
kiryia	Prosopis africana
kokhyo	Strychnos spinosa
korore	Commiphora africana
kuka	Adansonia digitata
kukuki	Sterculia setigera
kulokulo	Combretum aculeatum
kuria	Bombax costatum

HAUSSA

Haussa	Botanical name
kurna	Ziziphus spina-christi
mad'âtchi	Khaya senegalensis
madobihia	Pterocarpus erinaceus
magaria	Ziziphus mauritiana
magaria'n kura	Ziziphus mucronata
malga	Cassia sieberiana, Lannea microcarpa
maréké	Anogeissus leiocarpus
marawuwu	Ximenia americana
sabara	Guiera senegalensis
sansami	Stereospermum kunthianum
sanya	Securidaca longepedunculata
sark'ak'ya	Acacia ataxacantha
shabara	Guiera senegalensis
shishi	Bauhinia rufescens
syia bara	Guiera senegalensis
talaekia	Salvadora persica
tamat	Acacia ehrenbergiana
tamatchi	Acacia tortilis
taramnya	Combretum glutinosum
tawatsa	Entada africana
tchilili	Combretum nigricans
thidiaye	Cassia sieberiana
tiédya	Ficus gnaphalocarpa
tsamia	Tamarindus indica
tsâdâ	Ximenia americana
tsiriry	Combretum nigricans
tumfafia	Calotropis procera
ungududu	Crateva adansonii
wa dabino	Phoenix dactylifera
warnagunguna	Securidaca longepedunculata
ziga	Maerua crassifolia
zôgala gandi	Moringa oleifera
zu	Celtis integrifolia
zuré	Boscia salicifolia
zuwuo	Celtis integrifolia

Botanical name	More
Acacia albida	zaaga, zaanga
Acacia dudgeoni	galpelgha
Acacia gourmaensis	gonpangialga, gonpoliali, goponyaendegha, gonsablega
Acacia macrostachya	giembaogo, guembaogo, kardega, zamenega, zamenga
Acacia nilotica var. adansonii	pegenenga, peghnaga, piaralga, pieghlanga
Acacia nilotica var. tomentosa	peguenega
Acacia pennata	kagenga, kaogo, kaongo
Acacia polyacantha	guaga
Acacia senegal	gomiga, goniminiga, gonmihougou, kunkwina
Acacia seyal	gomiga, gominga, goporgho, gumiiga, gompelaga, gomminga
Acacia sieberiana	golponsgo, gonponasogo
Adansonia digitata	toayga, toega, twega
Albizia chevalieri	donsendouaga, dosendoagha
Annona senegalensis	bakikudiga, barkudi, barkudugo, barkoudouga
Anogeissus leiocarpus	piega, sieegha, siiga
Azadirachta indica	neem
Balanites aegyptiaca	kieghaligha, kielega, kyegelga, kyegliga, tiegaliga, tjaralra
Bauhinia rufescens	bagande, bangande, pipoega, tipoiga, tipwegha
Bombax costatum	vaka, voaka
Borassus aethiopum	koanga, kwanga
Boscia angustifolia	kisinkinde
Boscia senegalensis	lamboiga, lamwetgha, lanwetga, nabediga, nabegida nabegiola, nabre
Butyrospermum parkii	taanga, taga
Cadaba farinosa	silogho, zilogo
Calotropis procera	pantrepouga, poutrepouga, puturpunga
Capparis corymbosa	kalnyaka, kalyatga, kuango, lamboaga, lamboetga, lambwethga, silkere
Cassia sieberiana	batepsado, kombissaka, kombrisaka, nyaamdé
Celtis integrifolia	bargande, tintigeliga
Combretum aculeatum	kodentabaga, koditambiga, kouguinga, kulkutka, schibri, sogodagha
Combretum glutinosum	dandegha, koagenga, kongounka, kuiglenga, kuiklenga, kuikinga
Combretum micranthum	kanga, kalnyaka, kwigenga, landaga, namyiri sughdo, ramdega, randiga

MORE

Botanical name	More
Combretum nigricans	karemtouaga
Combretum paniculatum	kudgunlungu
Commiphora africana	jamnutuga, kodintiabaga, sabnoadga, sabociga, wabembangha
Entada africana	benga, sianlogo, sinnego, sinnogo, seogho
Feretia apodanthera	borouhi, filinga, fininga
Ficus capensis	wolseegha
Ficus gnaphalocarpa	kamsango, kankanga
Ficus platyphylla	kankanga, kempsaogo, kosueri, niamlorogo
Ficus thonningii	kuoga, kusga
Gardenia erubescens	garzungo
Gardenia ternifolia	bambre-zounga, sabudug-ghaga, soudouga, sougoudagara, susuba
Grewia bicolor	jualaga, tonlaga, yolsa beirka
Grewia mollis	moudrimouka, mounimouka, suomkogo
Guiera senegalensis	ouiliwiga, wilenawiga, wilimwiiga, wilinwiiga
Khaya senegalensis	kuka
Lannea acida	komsabgha, pekuni, sabgha, sabtulga, sambiga, uamsabgha, yamsabgha
Lannea microcarpa	sabgha, sabtoulouga, siibiga
Maerua crassifolia	kessiga kiesgha, kinsga, zilogo
Mitragyna inermis	gilgha, gwinga, hiliga, jilega, nijilega, yliga
Moringa oleifera	alsan-tiiga, argentinga, arzantiga
Parkia biglobosa	doaaga, ghoaga, roaga, rouaga
Phoenix dactylifera	teenga
Piliostigma reticulatum	bagande, baghanga, baghen dagha, baghna, barani, barendaoga
Piliostigma thonningii	bagandre, baghen nyaga, barnaga
Prosopis africana	duanduangha, kyeega, niuri-segue, segue
Pterocarpus erinaceus	noega, noeka,
Pterocarpus lucens	boutounbou, pempelaga, pemperga
Sclerocarya birrea	bunamagabu, noabega, noabegha, nobega
Securidaca longepedunculata	opoulou, pelaga, pelegha, pelgha
Securinega virosa	sughed-dagha
Sterculia setigera	boufobou, burumuku, koutroumouka, ponpongo, posemporgo, punpunga
Stereospermum kunthianum	buambako, nikilenga, vulga
Strychnos spinosa	katempuanga, katerpwinga

MORE

Botanical_name	More
Tamarindus indica	puaga, pusga, pusiga, pusuga
Terminalia avicennioides	kodre, kondre, kotumpogonde, kutruagale, lesakoualu
Terminalia macroptera	kodpoko, kontpoko
Vitex doniana	aadgha, aadra, ada, andega, kadgha
Ximenia americana	leanga, leega, lega
Ziziphus mauritiana	magunuga, mugulga, mugulanga, muegunga, mugunuga, mug-niga
Ziziphus mucronata	kimo mugulga, muegunga, muguninga

More	Botanical name
aadgha	Vitex doniana
ada	Vitex doniana
alsan-tiiga	Moringa oleifera
andega	Vitex doniana
argentinga	Moringa oleifera
arzantiga	Moringa oleifera
baghen dagha	Piliostigma reticulatum
baghen nyaga	Piliostigma thonningii
bagande	Bauhinia rufescens,
bagande	Piliostigma reticulatum
bagandre	Piliostigma thonningii,
baghanga	Piliostigma reticulatum
baghen dagha	Piliostigma reticulatum
baghen nyaga	Piliostigma thoningii
baghna	Piliostigma reticulatum
bakikudiga	Annona senegalensis
balepsado	Cassia sieberiana
bambre zounga	Gardenia ternifolia
bangande	Bauhinia rufescens
barani	Piliostigma reticulatum
barendaoga	Piliostigma reticulatum
bargande	Celtis integrifolia
barkoudouga	Annona senegalensis
barkudga	Annona senegalensis
barkudi	Annona senegalensis
barkudugo	Annona senegalensis
barnaga	Piliostigma thonningii
benga	Entada africana
boufobou	Sterculia setigera
borouhi	Feretia apodanthera
boutounbou	Pterocarpus lucens
buambako	Stereospermum kunthianum
bunamagabu	Sclerocarya birrea
burumuku	Sterculia setigera
dandegha	Combretum glutinosum
dauwo suuri	Dalbergia melanoxylon
doaaga	Parkia biglobosa
donsendouaga	Albizia chevalieri
dosendoagha	Albizia chevalieri
duanduangha	Prosopis africana
filinga	Feretia apodanthera
fininga	Feretia apodanthera
gaaka	Diospyros mespiliformis
galpelgha	Acacia dudgeoni
ganka	Diospyros mespiliformis
gaoka-ganaka	Diospyros mespiliformis

More	Botanical name
garzungo	Gardenia erubescens
ghoaga	Parkia biglobosa
giembaogo	Acacia macrostachya
gilgha	Mitragyna inermis
golponsgo	Acacia sieberiana
gomiga	Acacia senegal, A. seyal
gomminga	Acacia seyal
gompelaga	Acacia seyal
goniminiga	Acacia senegal
gonmihougou	Acacia senegal
gonpangialga	Acacia gourmaensis
gonpoliali	Acacia gourmaensis
gonponasogo	Acacia sieberiana
gonsablega	Acacia gourmaensis
goponyaendegha	Acacia gourmaensis
goporgho	Acacia seyal
guaga	Acacia polyacantha var. campylacantha
guembaogo	Acacia macrostachya
gumiiga	Acacia seyal
gwinga	Mitragyna inermis
hiliga	Mitragyna inermis
jamnutuga	Commiphora africana
jilega	Mitragyna inermis
jualaga	Grewia bicolor
kadgha	Vitex doniana
kagenga	Acacia pennata
kalegain	Crateva adansonii
kalnyaka	Capparis corymbosa, C. micranthum
kalyatga	Capparis corymbosa
kambabga	Lannea acida
kamsango	Ficus gnaphalocarpa
kanga	Combretum micranthum
kankanga	Ficus gnaphalocarpa, F. platyphylla
kaogo	Acacia pennata
kaongo	Acacia pennata
kardega	Acacia macrostachya
karemtouga	Combretum nigricans
katempuanga	Strychnos spinosa
katerpwinga	Strychnos spinosa
kempsaogo	Ficus platyphylla
kessiga	Maerua crassifolia
kieghaligha	Balanites aegyptiaca
kielega	Balanites aegyptiaca
kiesgha	Maerua crassifolia
kimo mugulga	Ziziphus mucronata
kinsga	Maerua crassifolia
kirdiandaga	Dalbergia melanoxylon

More	Botanical name
kisinkinde	Boscia angustifolia
kissikiinde	Dalbergia melanoxylon
koagenga	Combretum glutinosum
koanga	Borassus aethiopum
kodentabaga	Combretum aculeatum
kodintiabaga	Commiphora africana
koditambiga	Combretum aculeatum
kodpoko	Terminalia macroptera
kodre	Terminalia avicennioides
kombissaka	Cassia sieberiana
kombrisaka	Cassia sieberiana
komsabgha	Lannea acida
kondre	Terminalia avicennioides
kongounka	Combretum glutinosum
kontpoko	Terminalia macroptera
kosueri	Ficus platyphylla
kotumpogande	Terminalia avicennioides
kouguinga	Combretum aculeatum
koutroumouka	Sterculia setigera
kuango	Capparis corymbosa
kudgunlungu	Combretum paniculatum
kuiglenga	Combretum glutinosum
kuikinga	Combretum glutinosum
kuiklenga	Combretum glutinosum
kuka	Khaya senegalensis
kulkutka	Combretum aculeatum
kunkwina	Acacia senegal
kuoga	Ficus thonningii
kusga	Ficus thonningii
kutruagale	Terminalia avicennioides
kwanga	Borassus aethiopum
kwigenga	Combretum micranthum
kyeega	Prosopis africana
kyegelga	Balanites aegyptiaca
kyegliga	Balanites aegyptiaca
lamboaga	Capparis corymbosa
lamboetga	Capparis corymbosa
lamboiga	Boscia senegalensis
lambwethga	Capparis corymbosa
lamwetgha	Boscia senegalensis
landaga	Combretum micranthum
lanwetga	Boscia senegalensis
leanga (lengha)	Ximenia americana
lega	Ximenia americana
lesakoualu	Terminalia avicennioides
muegunga	Ziziphus mucronata
mug-niga	Ziziphus mauritiana
mugulanga	Ziziphus mauritiana
mugulga	Ziziphus mauritiana

More	Botanical name
muguninga	Ziziphus mauritiana
mugunuga	Ziziphus mauritiana
nabediga	Boscia senegalensis
nabegida	Boscia senegalensis
nabegiola	Boscia senegalensis
nabre	Boscia senegalensis
namyiri-sughdo	Combretum micranthum
neem	Azadirachta indica
niamlorogo	Ficus platyphylla
nikilenga	Stereospermum kunthianum
nijilega	Mitragyna inermis
niuri-segue	Prosopis africana
noabega	Sclerocarya birrea
noabegha	Sclerocarya birrea
nobega	Sclerocarya birrea
noega	Pterocarpus erinaceus
noeka	Pterocarpus erinaceus
nyaamdé	Cassia sieberiana
opoulou	Securidaca longepedunculata
pantrepouga	Calotropis procera
pegenenga	Acacia nilotica var. adansonii
peghnaga	Acacia nilotica var. adansonii
peguenega	Acacia nilotica var. tomentosa
pekuni	Lannea acida
pelaga	Securidaca longepedunculata
pelegha	Securidaca longepedunculata
pelgha	Securidaca longepedunculata
pempelega	Pterocarpus lucens
pemperga	Pterocarpus lucens
piaralga	Acacia nilotica var. adansonii
piega	Anogeissus leiocarpus
pieghlanga	Acacia nilotica var. adansonii
pipoega	Bauhinia rufescens
ponpongo	Sterculia setigera
posemporgo	Sterculia setigera
poutrepouga	Calotropis procera
puaga	Tamarindus indica
punpunga	Sterculia setigera
pusga	Tamarindus indica
pusiga	Tamarindus indica
pusuga	Tamarindus indica
puturpunga	Calotropis procera
quiliwiga	Guiera senegalensis
ramdega	Combretum micranthum
randiga	Combretum micranthum
roaga	Parkia biglobosa

More	Botanical name
rouaga	Parkia biglobosa
sabgha	Lannea acida, L. microcarpa
sabnoadga	Commiphora africana
sabobiga	Commiphora africana
sabudug-ghaga	Gardenia ternifolia
sabtoulouga	Lannea microcarpa
sabtulga	Lannea acida
sambiga	Lannea acida
sanoabga	Commiphora africana
schibri	Combretum aculeatum
segue	Prosopis africana
seogho	Entada africana
sianlogo	Entada africana
sieegha	Anogeissus leiocarpus
siibiga	Lannea microcarpa
siiga	Anogeissus leiocarpus
silkere	Capparis corymbosa
silogho	Cadaba farinosa
sinnego	Entada africana
sinnogo	Entada africana
sogodagha	Combretum aculeatum
soudouga	Gardenia ternifolia
sougoudagara	Gardenia ternifolia
sousoutiga	Dichrostachys cinerea
sugehd-dagha	Securinega virosa
sunsutiga	Dichrostachys cinerea
suomkogo	Grewia mollis
susuba	Gardenia ternifolia
susutri	Dichrostachys cinerea
taanga	Butyrospermum parkii
taga	Butyrospermum parkii
teenga	Phoenix dactylifera
tiegaliga	Balanites aegyptiaca
tipoiga	Bauhinia rufescens
tipwegha	Bauhinia rufescens
tjaralra	Balanites aegyptiaca
toayga	Adansonia digitata
toega	Adansonia digitata
tohiga	Crateva adansonii
tonlaga	Grewia bicolor
twega	Adansonia digitata
uamsabgha	Lannea acida
vaka	Bombax costatum
voaka	Bombax costatum
vulga	Stereospermum kunthianum
wabembangha	Commiphora africana

More	Botanical name
wilenwiiga	Guiera senegalensis
wilimwiiga	Guiera senegalensis
wolseegha	Ficus capensis
yaeka	Diospyros mespiliformis
yamsabgha	Lannea acida
yliga	Mitragyna inermis
yolsa beirka	Grewia bicolor
zaaga	Acacia albida
zaanga	Acacia albida
zamenega	Acacia macrostachya
zamenga	Acacia macrostachya
zilogo	Maerua crassifolia,
"	Cadaba farinosa

PEULH

Botanical name	Peulh
Acacia albida	tchaiki, tiaski, tieski, tieaki, tjaiki
Acacia ataxacantha	goututi, gubidaney, korobi, morare, ngoradie
Acacia dudgeoni	patouki, wayadugesehi, yanorgo
Acacia ehrenbergiana	bakanchili, djilouki,
Acacia gourmaensis	gonponyalehi
Acacia laeta	dibbchi, patouki
Acacia macrostachya	kedi, onare, patarhami, thane, tchidi, tschildi
Acacia macrothyrsa	paturlahi
Acacia nilotica var. adansonii	gabdi, gaoudi, gawari, gawdi
Acacia nilotica var. tomentosa	gaddé, gonaki, n'angnanaki
Acacia pennata	goumi
Acacia senegal	delbi, dibehi, dioshi, patouki, patouni, patterlahi
Acacia seyal	bidehi, boulbi, bouldi, boulhi, komanahi
Acacia sieberiana	allouki, dandane, djelouki, giedaneji, sogue
Acacia tortilis	chilluki, djeloki, djilouki, tamaki, tamakich, tili
Adansonia digitata	bobbe, boki, olohi
Adenium obesum	darbogél, ndarbogél, darbouki
Albizia chevalieri	dgariahi, gondogahi, jarichi, nzariehi
Albizia lebbeck	nemaari
Annona senegalensis	barkoutahe, dokumi, doukouhi
Anogeissus leiocarpus	godoli, kodjoli, kolioli, kolioni
Azadirachta indica	leeki-kaaki, miliahi, nim, tirotiya
Balanites aegyptiaca	adwahi, goleteki, mourotouki, mutchétéki, tane, tanni
Bauhinia rufescens	namaare, namadi, namali, nemali
Bombax costatum	bantinehi, bantinei, bouboli, boogadje, boumboni, boumboovi, djoi, jourouhi, koulohi, koupouhi, n'bogahi
Borassus aethiopum	akot, bahardhehi, dubbi, dubé
Boscia angustifolia	amzagi, danarehi, karbaseji, ngangahi
Boscia salicifolia	tientirgaye, tirehi
Boscia senegalensis	bulduhi, djigilli, gegilli, ghidiili, guidjili, guiguile, nghighile, nguiguile

PEULH

Botanical name	Peulh
Butyrospermum parkii	karedie, karehi, kolo
Cadaba farinosa	bagahi, balami, segseni, sinsini, tiegseni
Cadaba glandulosa	hasu, wadagohi
Calotropis procera	badadi, bamambi, bamanbe, bamandi, bambami, bandambi, bawani
Capparis corymbosa	bal(i)morahi, guljawi, gulunjaabi, n'gumi balevi
Capparis decidua	n'gumi danevi, ngulunjaabi
Capparis tomentosa	dalevi, goumi
Cassia sieberiana	bosé, gama fadahi, goma fadabi joudendi, kohobi, kombeygilahi malgahi, padwuadub, sisangahi
Celtis integrifolia	gaki, n'gaki
Combretum aculeatum	boulapal, bularal, laonadi, laongi, laougni, launi, oualo, yahon niandi
Combretum glutinosum	buski, dooki, doukoui, laongi, ookai, talli
Combretum micranthum	dooki, gugumi, goungoumi, gungumi, laongi, laonlapal, talli
Combretum nigricans	buiti, dokigori, dooki, duyki
Commiphora africana	badadi, badaki, badi, jambeoe, watanta
Crateva adansonii	dantakoulagué, landam-bani, leggel-nai, naiko
Dalbergia melanoxylon	dalaban, dialambani, gelhelahi jalhelahi, ngelgelalu
Dichrostachys cinerea	bourri, m'buuri, patroulahi
Diospyros mespiliformis	gagahi, ganadje, ganaje, kukui, nelbi, poupouhi
Entada africana	batchari, fadowanduki, faroanduki, fedawandaoui, mbuda, tufel lelehi, uhel ruruhi
Erythrina senegalensis	mbototay
Euphorbia balsamifera	badacavadie, badakarei, badulahi, barnaahi, laide kosse, magara, yaro
Feretia apodanthera	boraouhi, burudehi, tchombie, tiamelgore, tobé, tobida
Ficus gnaphalocarpa	durmi, ibbi, jibi, obbi, yibe
Ficus iteophylla	sekehi
Ficus platyphylla	dinde, dundehi
Ficus thonningii	biskehi, biskevi

PEULH

Botanical name	Peulh
Gardenia ternifolia	diengoli, tiamelegore
Grewia bicolor	keli, kelli, kieli, leloko, tielle
Grewia flavescens	djibohi
Grewia mollis	djiboli, kelli
Grewia tenax	jingehi, kaltohi, yengohi, kelli-niéwa, kéné
Grewia villosa	goursohi, goursoi, nyadohi
Guiera senegalensis	gelohi, ieloki, ieloko, jelouki, lekolo, n'dieloki, n'geloki, yeloki
Hyphaene thebaica	djelehi, gelohi, gielehi, jeleje, mbalihi
Khaya senegalensis	cail, dalehi, kahi, kail
Lannea acida	bagi, bembey, farouh, farouhi, kibihe, peguhi, peguuje, siibihi, tindi, tuko
Lannea microcarpa	falfahi, farouh, farouhi, peguhi, peguuje, tukoneudu
Leptadenia pyrotechnica	suwalehul, tiaptovi allah
Maerua angolensis	yelafitahi, buguhi
Maerua crassifolia	dégér, hassou, sogui, tirehi, cheincherni, jigahi
Maytenus senegalensis	giyalgoti, yengotehi, yarelesdi
Mitragyna inermis	kadioli, kauli, koli, kooli, ngoboli
Moringa oleifera	guilgandeni, latjiri, leggelmeleke, legi-lakili
Parkia biglobosa	narehi, narghi, n'duturi, neré, nerehi
Parkinsonia aculeata	gaudi-misila
Phoenix dactylifera	barkehi, bukki, dibinobi, tamborohi
Piliostigma reticulatum	barkei, barkelehi, barki, barkileho, maerkehi
Piliostigma thonningii	barkehi, barkevi, balkilehe
Prosopis africana	kohi, rimajogaahi
Prosopis juliflora	gaudi maaka
Pterocarpus erinaceus	banaahi, bani, banovhi, banuhi, bary
Pterocarpus lucens	tami, tani, tchagi, tiagni, tiami, tieni
Salvadora persica	hirchi, hiroyi, gudi, katiatki, khirohi, bawudi

PEULH

Botanical_name	Peulh
Sclerocarya birrea	beri, edi, eri, hedehi, hedi, kede
Securidaca longepedunculata	alali
Securinega virosa	sugurlaagahi, kamal
Sterculia setigera	boberi, boboli, bobori, boholi, koletatiigi, nefine
Stereospermum kunthianum	golombi, ngolobi, wabahe
Strychnos spinosa	datokulewi, marbatahi, norbotahi, uormatabe, noybata
Tamarindus indica	dabé, dianhmi, diami (djibo), djatabe (dori), ngatabbi, n'jabi, n'jami, yammere
Tamarix senegalensis	bélvélki
Terminalia avicennioides	boodi, pulémi
Terminalia macroptera	bodévi
Vitex doniana	goumedji, kalbehi, ngummehi
Ximenia americana	tabburli, téné, tiaboule, tiabourli, tiaboute
Ziziphus mauritiana	djabe, djabi, jabi, n'giabi
Ziziphus mucronata	dabiforu, gulijabi, gulunjaabi, ngulunjaabi
Ziziphus spina-christi	ngulunjaabi, kurnahi

Peulh	Botanical name
adwahi	Balanites aegyptiaca
akot	Borassus aethiopum
alali	Securidaca longepedunculata
allouki	Acacia sieberiana
amzagi	Boscia angustifolia
badacavadie	Euphorbia balsamifera
badadi	Commiphora africana,
"	Calotropis procera
badakarei	Euphorbia balsamifera
badaki	Commiphora africana
badi	Commiphora africana
badulahi	Euphorbia balsamifera
bagahi	Cadaba farinosa
bagardhehi	Borassus aethiopum
bagi	Lannea acida
bakanchili	Acacia ehrenbergiana
balami	Cadaba farinosa
bal(i)morahi	Capparis corymbosa
balkilehe	Piliostigma thonningii
bamambi	Calotropis procera
bamanbe	Calotropis procera
bamandi	Calotropis procera
bambami	Calotropis procera
banaahi	Pterocarpus erinaceus
bandambi	Calotropis procera
bani	Pterocarpus erinaceus
banovhi	Pterocarpus erinaceus
banuhi	Pterocarpus erinaceus
bantinehi	Bombax costatum
bantinei	Bombax costatum
banuhi	Pterocarpus erinaceus
barkehi	Phoenix dactylifera,
"	Piliostigma thonningii
barkei	Piliostigma reticulatum
barkelehi	Piliostigma reticulatum
barkevi	Piliostigma thonningii
barki	Piliostigma reticulatum
barkileho	Piliostigma reticulatum
barkoutahe	Annona senegalensis
barnaahi	Euphorbia balsamifera
bary	Pterocarpus erinaceus
bassiandi	Calotropis procera
batchari	Entada africana
bawani	Calotropis procera
bawudi	Salvadora persica
bembey	Lannea acida
beri	Sclerocarya birrea
bewelki	Tamarix senegalensis
bidehi	Acacia seyal
biskehi	Ficus thonningii

Peulh	Botanical name
biskevi	Ficus thonningii
boberi	Sterculia setigera
bobbe	Adansonia digitata
boboli	Sterculia setigera
bobori	Sterculia setigera
bodévi	Terminalia macroptera
boholi	Sterculia setigera
boki	Adansonia digitata
boodi	Terminalia avicennioides
boogadje	Bombax costatum
boraouhi	Feretia apodanthera
bosé	Cassia sieberiana
bouboli	Bombax costatum
boulapal	Combretum aculeatum
boulbi	Acacia seyal
bouldi	Acacia seyal
boulhi	Acacia seyal
boumboni	Bombax costatum
boumboovi	Bombax costatum
bourri	Dichrostachys cinerea
bowani	Calotropis procera
buguhi	Maerua angolensis
buiti	Combretum nigricans
bukki	Phoenix dactylifera
bularal	Combretum aculeatum
bulduhi	Boscia senegalensis
burudehi	Feretia apodanthera
buski	Combretum glutinosum
cail	Khaya senegalensis
cheincherni	Maerua crassifolia
chilluki	Acacia tortilis
dabé	Tamarindus indica
dabiforu	Ziziphus mucronata
dalaban	Dalbergia melanoxylon
dalehi	Khaya senegalensis
dalevi	Capparis tomentosa
danarehi	Boscia angustifolia
dantakoulagué	Crateva adansonii
darbogél	Adenium obesum
darbouki	Adenium obesum
datokulewi	Strychnos spinosa
dégéri	Maerua crassifolia
delbi	Acacia senegal
dgariahi	Albizia chevalieri
diami (Djibo)	Tamarindus indica
dianhmi	Tamarindus indica
dibbehi	Acacia laeta
dibehi	Acacia senegal
dibinobi	Phoenix dactylifera

PEULH

Peulh	Botanical name
dibshi	Acacia senegal
dibinobi	Phoenix dactylifera
diengoli	Gardenia ternifolia
dinde	Ficus platyphylla
dioshi	Acacia senegal
djabe	Ziziphus mauritiana
djabi	Ziziphus mauritiana
djatabe (Dori)	Tamarindus indica
djelehi	Hyphaene thebaica
djeloki	Acacia tortilis
djelouki	Acacia sieberiana
djibohi	Grewia flavescens
djiboli	Grewia mollis
djigilli	Boscia senegalensis
djilouki	Acacia ehrenbergiana,
djilouki	Acacia tortilis
djoi	Bombax costatum
dokigori	Combretum nigricans
dokumi	Annona senegalensis
dooki	Combretum glutinosum,
dooki	Combretum micranthum
dooki	Combretum nigricans
doukouhi	Annona senegalensis
doukoui	Combretum glutinosum
dubbi	Borassus aethiopum
dubé	Borassus aethiopum
dundehi	Ficus platyphylla
duyki	Combretum nigricans
durmi	Ficus gnaphalocarpa
edi	Sclerocarya birrea
eri	Sclerocarya birrea
fadowanduki	Entada africana
falfahi	Lannea microcarpa
farouh	Lannea acida, L. microcarpa
farouhi	Lannea acida, L. microcarpa
faroanduki	Entada africana
fedawandaoui	Entada africana
gabdi	Acacia nilotica var. adansonii
gaddé	Acacia nilotica var. tomentosa
gagahi	Diospyros mespiliformis
gaki	Celtis integrifolia
galbihi	Vitex doniana
gama fadahi	Cassia sieberiana
ganadje	Diospyros mespiliformis
ganaje	Diospyros mespiliformis
gaoudi	Acacia nilotica var. adansonii
gaudi maaka	Prosopis juliflora
gaudi misila	Parkinsonia aculeata

PEULH

Peulh	Botanical name
gawari	Acacia nilotica var. adansonii
gawdi	Acacia nilotica var. adansonii
gegilli	Boscia senegalensis
gelhelahi	Dalbergia melanoxylon
gelohi	Guiera senegalensis,
"	Hyphaene thebaica
ghidjili	Boscia senegalensis
giedaneji	Acacia sieberiana
gielehi	Hyphaene thebaica
giyalgoti	Maytenus senegalensis
godoli	Anogeissus leiocarpus
goleteki	Balanites aegyptiaca
golombi	Stereospermum kunthianum
goma fadabi	Cassia sieberiana
gonaki	Acacia nilotica var. tomentosa
gondogahi	Albizia chevalieri
gongonyalehi	Acacia gourmaensis
gougoumi	Combretum micranthum
goumedji	Vitex doniana
goumi	Acacia pennata
goumi	Capparis tomentosa
goungoumi	Combretum micranthum
goursohi	Grewia villosa
goursoi	Grewia villosa
goututi	Acacia ataxacantha
gubidaney	Acacia ataxacantha
gudi	Salvadora persica
guidjili	Boscia senegalensis
guiguile	Boscia senegalensis
guilgandeni	Moringa oleifera
gulijabi	Ziziphus mucronata
guljawi	Capparis corymbosa
gulunjaabi	Capparis corymbosa,
gulunjaabi	Ziziphus mucronata
gungumi	Combretum micranthum
hasu	Cadaba glandulosa
hassou	Boscia angustifolia,
hassou	Maerua crassifolia
hedehi	Sclerocarya birrea
hedi	Sclerocarya birrea
hischi	Salvadora persica
hiroyi	Salvadora persica
ibbi	Ficus gnaphalocarpa
ieloki	Guiera senegalensis
ieloko	Guiera senegalensis
jabi	Ziziphus mauritiana
jalhelahi	Dalbergia melanoxylon
jambeoe	Commiphora africana

Peulh	Botanical name
jarichi	Albizia chevalieri
jeleje	Hyphaene thebaica
jelouki	Guiera senegalensis
jibi	Ficus gnaphalocarpa
jigahi	Maerua crassifolia
jingehi	Grewia tenax
joudendi	Cassia sieberiana
jourouhi	Bombax costatum
kadioli	Mitragyna inermis
kahi	Khaya senegalensis
kail	Khaya senegalensis
kalbehi	Vitex doniana
kaltohi	Grewia tenax
kamal	Securinega virosa
karbaseji	Boscia angustifolia
karedie	Butyrospermum parkii
karehi	Butyrospermum parkii
katiatki	Salvadora persica
kauli	Mitragyna inermis
kede	Sclerocarya birrea
kedi	Acacia macrostachya
keli	Grewia bicolor
kelli-niéwa	Grewia mollis, G. bicolor,
kelli-niéwa	G. tenax
kénéi	Grewia mollis
khirohy	Salvadora persica
kibihe	Lannea acida
kieli	Grewia bicolor
kodjoli	Anogeissus leiocarpus
kohi	Prosopis africana
kohobi	Cassia sieberiana
koletatiigi	Sterculia setigera
koli	Mitragyna inermis
kolioli	Anogeissus leiocarpus
kolioni	Anogeissus leiocarpus
kolo	Butyrospermum parkii
komanahi	Acacia seyal
kombeygilahi	Cassia sieberiana
kooli	Mitragyna inermis
korobi	Acacia ataxacantha
koulohi	Bombax costatum
koupouhi	Bombax costatum
kukui	Diospyros mespiliformis
kurnahi	Ziziphus spina-christi
laide kosse	Euphorbia balsamifera
landam bani	Crateva adansonii
laonadi	Combretum aculeatum
laongi	Combretum aculeatum,
laongi	Combretum glutinosum

Peulh	Botanical name
laonlapal	Combretum micranthum
laougni	Combretum aculeatum,
laougni	Combretum glutinosum
laouni	Combretum aculeatum
latjiri	Moringa oleifera
launi	Combretum aculeatum
leeki-kaaki	Azadirachta indica
leggelmeleke	Moringa oleifera
leggel-nai	Crateva adansonii
legi-lakili	Moringa oleifera
lekolo n'dieloki	Guiera senegalensis
leloko	Grewia bicolor
maerkehi	Piliostigma reticulatum
magara	Euphorbia balsamifera
malgahi	Cassia sieberiana
marbatahi	Strychnos spinosa
mbalihi	Hyphaene thebaica
mbototay	Erythrina senegalensis
mbuda	Entada africana
m'buuri	Dichrostachys cinerea
miliahi	Azadirachta indica
morare	Acacia ataxacantha
mourotouki	Balanites aegyptiaca
mutchétéki	Balanites aegyptiaca
naiko	Crateva adansonii
namaare	Bauhinia rufescens
namadi	Bauhinia rufescens
namali	Bauhinia rufescens
n'angnanaki	Acacia nilotica var. tomentosa
narehi	Parkia biglobosa
narghi	Parkia biglobosa
n'bogahi	Bombax costatum
ndarbogél	Adenium obesum
n'duturi	Parkia biglobosa
nefine	Sterculia setigera
negelgelalu	Dalbergia melanoxylon
nelbi	Diospyros mespiliformis
nemaari	Albizia lebbeck
nemali	Bauhinia rufescens
neré	Parkia biglobosa
nerehi	Parkia biglobosa
nété	Parkia biglobosa
ngangahi	Boscia angustifolia
n'ganki	Celtis integrifolia
ngatabbi	Tamarindus indica
nghighile	Boscia senegalensis
n'geloki	Guiera senegalensis
n'giabi	Ziziphus mauritiana
ngoboli	Mitragyna inermis

PEULH

Peulh	Botanical name
ngolobi	Stereospermum kunthianum
ngoradie	Acacia ataxacantha
ngulunjaabi	Ziziphus spina-christi, Z. mucronata, Capparis corymbosa
n'gumi (balevi)	Capparis corymbosa
n'gumi danevi	Capparis decidua
ngummehi	Vitex doniana
nguiguile	Boscia senegalensis
nim	Azadirachta indica
n'jab(b)i	Tamarindus indica
n'jami	Tamarindus indica
norbotahi	Strychnos spinosa
noybata	Strychnos spinosa
nyadohi	Grewia villosa
nyebal	Albizia chevalieri
nzari ehi	Albizia chevalieri
obbi	Ficus gnaphalocarpa
olohi	Adansonia digitata
onare	Acacia macrostachya
ookai	Combretum glutinosum
ooki	Combretum glutinosum
oualo	Combretum aculeatum
padwuadub	Cassia sieberiana
patarhami	Acacia macrostachya
patouki	Acacia dudgeoni, A. laeta,
patouki	A. senegal
patouni	Acacia senegal
patroulahi	Dichrostachys cinerea
patterlahi	Acacia senegal
paturlahi	Acacia macrothyrsa
peguhi	Lannea acida, L. microcarpa
peguuje	Lannea acida, L. microcarpa
poupouhi	Diospyros mespiliformis
pulémi	Terminalia avicennioides
rimajogaahi	Prosopis africana
segseni	Cadaba farinosa
sekehi	Ficus iteophylla
sinsini	Cadaba farinosa
siibihi	Lannea acida
sisangahi	Cassia sieberiana
sogue	Acacia sieberiana
sogui	Maerua crassifolia
sugurlaagahi	Securinega virosa
suwalehul	Leptadenia pyrotechnica
tabburli	Ximenia americana
talli	Combretum glutinosum, C. micranthum

Peulh	Botanical name
tamaki	Acacia tortilis
tamakich	Acacia tortilis
tamborohi	Phoenix dactylifera
tami	Pterocarpus lucens
tane	Balanites aegyptiaca
tani	Pterocarpus lucens
tanni	Balanites aegyptiaca
tchagi	Pterocarpus lucens
tchaiki	Acacia albida
tchidi	Acacia macrostachya
tchombie	Feretia apodanthera
téné	Ximenia americana
thane	Acacia macrostachya
tiaboule	Ximenia americana
tiabourli	Ximenia americana
tiaboute	Ximenia americana
tiagni	Pterocarpus lucens
tiamelegore	Gardenia ternifolia
tiamelgore	Feretia apodanthera
tiami	Pterocarpus lucens
tiaptovi allah	Leptadenia pyrotechnica
tiaski	Acacia albida
tieaki	Acacia albida
tiegseni	Cadaba farinosa
tielle	Grewia bicolor
tieni	Pterocarpus lucens
tientirgaye	Boscia salicifolia
tieski	Acacia albida
tili	Acacia tortilis
tindi	Lannea acida
tirehi	Boscia salicifolia, Maerua crassifolia
tirotiya	Azadirachta indica
tjaiki	Acacia albida
tobé	Feretia apodanthera
tobida	Feretia apodanthera
tschildi	Acacia macrostachya
tufel lelehi	Entada africana
tuko	Lannea acida
tukoneudu	Lannea microcarpa
uhel ruruhi	Entada africana
uormatabe	Strychnos spinosa
wabahe	Stereospermum kunthianum
wadagohi	Cadaba glandulosa
watanta	Commiphora africana
wayadugesehi	Acacia dudgeoni
yammere	Tamarindus indica
yahon niandi	Combretum aculeatum

Peulh	Botanical name
yanorgo	Acacia dudgeoni
yarelesdi	Mayteunus senegalensis
yaro	Euphorbia balsamifera
yelafitahi	Maerua angolensis
yeloki	Guiera senegalensis
yengohi	Grewia tenax
yengotehi	Maytenus senegalensis
yibe	Ficus gnaphalocarpa

SERER

Botanical name	Serer
Acacia albida	hak, sas
Acacia ataxacantha	ingol
Acacia macrostachya	sim
Acacia nilotica var. adansonii	nenef, nefnef
Acacia polyacantha	ngobop
Acacia senegal	dogoragayob
Acacia seyal	ndomb, ndob
Acacia sieberiana	sul
Acaica tortilis	sên
Adansonia digitata	ba(k)
Anacardium occidentale	daf-durubab
Anogeissus leiocarpus	godal
Balanites aegyptiaca	model
Bauhinia rufescens	ndindi
Bombax costatum	nondel
Borassus aethiopum	dof, ndof
Boscia angustifolia	daaba, ndeyis
Boscia senegalensis	banaa
Cadaba farinosa	gavargi
Calotropis procera	bodafot
Capparis tomentosa	bufa
Cassia sieberiana	sélé
Celtis integrifolia	ingan
Combretum aculeatum	nelafum, sambe
Combretum glutinosum	yay
Combretum micranthum	day, séded, lakak, nkag
Combretum nigricans	bes
Combretum paniculatum	bindil
Commiphora africana	bop bop, saagh,
Crateva adansonii	ingorel, ngorol
Dalbergia melanoxylon	ndelemban
Dichrostachys cinerea	kurkur
Diospyros mespiliformis	nen
Entada africana	batar
Erythrina senegalensis	dédé
Euphorbia balsamifera	ndamol
Feretia apodanthera	teker
Ficus capensis	bahut
Ficus gnaphalocarpa	dunt
Ficus iteophylla	bélén
Ficus thonningii	dubalé
Ficus vogelii	badat
Gardenia ternifolia	mpos
Grewia bicolor	ngal
Grewia flavescens	ngelboli

SERER

Botanical name	Serer
Grewia tenax	ngel
Guiera senegalensis	hud
Khaya senegalensis	garim
Lannea acida	dugun
Mangifera indica	imaaguru
Maytenus senegalensis	ndukut
Mimosa pigra	bursa
Mitragyna inermis	ngaul
Moringa oleifera	mbum
Parkia biglobosa	séu
Phoenix dactylifera	sumareg
Piliostigma reticulatum	ngayo
Piliostigma thonningii	ngayo-goor
Prosopis africana	som
Pterocarpus erinaceus	ban, bau
Sclerocarya birrea	ari(k)
Securidaca longepedunculata	ndêdo
Securinega virosa	baram baram
Sterculia setigera	bep, bob
Strychnos spinosa	ngoba
Tamarindus indica	sob
Tamarix senegalensis	bardu
Terminalia avicennioides	bulem, mbulem
Terminalia macroptera	mbalak
Vitex doniana	diob
Ximenia americana	sap
Ziziphus mauritiana	ngit
Ziziphus mucronata	ngik-mon

SERER

Serer	Botanical name
ari(k)	Sclerocarya birrea
badafot	Calotropis procera
badat	Ficus vogelii
bahut	Ficus capensis
ba(k)	Adansonia digitata
ban	Pterocarpus erinaceus
banaa	Boscia senegalensis
baram baram	Securinega virosa
bardu	Tamarix senegalensis
batar	Entada africana
bau	Pterocarpus erinaceus
bélén	Ficus iteophylla
bep	Sterculia setigera
bes	Combretum nigricans
bindil	Combretum paniculatum
bob	Sterculia setigera
bodafot	Calotropis procera
bop bop	Commiphora africana
bufa	Capparis tomentosa
bulem	Terminalia avicennioides
bursa	Mimosa pigra
daaba	Boscia angustifolia
daf-durubab	Anacardium occidentale
day	Combretum micranthum
dédé	Erythrina senegalensis
diob	Vitex doniana
dof	Borassus aethiopum
dog	Annona senegalensis
dogoragayob	Acacia senegal
dubalé	Ficus thonningii
dugun	Lannea acida
dunt	Ficus gnaphalocarpa
garim	Khaya senegalensis
gavargi	Cadaba farinosa
godal	Anogeissus leiocarpus
hak	Acacia albida
hud	Guiera senegalensis
imaaguru	Mangifera indica
ingan	Celtis integrifolia
ingol	Acacia ataxacantha
ingorel	Crateva adansonii
kurkur	Dichrostachys cinerea
lakak	Combretum micranthum
lol	Balanites aegyptiaca

Serer	Botanical name
mbalak	Terminalia macroptera
mbulem	Terminalia avicennioides
mbum	Moringa oleifera
model	Balanites aegyptiaca
mpos	Gardenia ternifolia
ndamol	Euphorbia balsamifera
ndêdo	Securidaca longepedunculata
ndelemban	Dalbergia melanoxylon
ndeyis	Boscia angustifolia
ndindi	Bauhinia rufescens
ndob	Acacia seyal
ndof	Borassus aethiopum
ndomb	Acacia seyal
ndukut	Maytenus senegalensis
nefnef	Acacia nilôtica var. adansonii
nelafum	Combretum aculeatum
nen	Diospyros mespiliformis
nenef	Acacia nilotica var. adansonii
ngaul	Mitragyna inermis
ngayo	Piliostigma reticulatum
ngayo-goor	Piliostigma thonningii
ngal	Grewia bicolor, G. tenax
ngelboli	Grewia flavescens
ngik-mon	Ziziphus mucronata
ngit	Ziziphus mauritiana
ngoba	Strychnos spinosa
ngorol	Crateva adansonii
nkak	Combretum micranthum
nondel	Bombax costatum
saagh	Commiphora africana
sambe	Combretum aculeatum
sap	Ximenia americana
sas	Acacia albida
séded	Combretum micranthum
sélé	Cassia sieberiana
sên	Acacia tortilis
séu	Parkia biglobosa
sim	Acacia macrostachya
sob	Tamarindus indica
som	Prosopis africana
sul	Acacia sieberiana
sumareg	Phoenix dactylifera
teker	Feretia apodanthera
yay	Combretum glutinosum

TAMACHEK

Botanical name	Tamachek
Acacia albida	assana, atheus, athous, attehes, habates, hatess
Acacia ataxacantha	taghalzibayt
Acacia ehrenbergiana	emi, tamat
Acacia laeta	haya, haza, taezeyt, tazoet, tsaihit
Acacia macrostachya	taralsebeyt, tagolsubet
Acacia nilotica	tahadjard, tahagar, tahaggard, tihidjart
Acacia nilotica var. adansonii	tuggoeur
Acacia nilotica var. tomentosa	taydjart
Acacia senegal	eouar-ouar, erwarwar
Acacia seyal	oraf, orof-torah, tamat, turreuft
Acacia tortilis	afadar, afadjadj, tafagak
Adansonia digitata	dokudust, tadghut, taedrumpt, takoudous
Anogeissus leiocarpus	akarkara, akoukou, ikahan
Azadirachta indica	nim
Balanites aegyptiaca	aboragh, tabarak, taborak
Bauhinia rufescens	addaeny, tadayni, tedehini, tedeine
Borassus aethiopum	zigine
Boscia angustifolia	tirehi, tirza
Boscia salicifolia	kitsaegoess
Boscia senegalensis	sihir, tadahant, tadeut, tadomet
Butyrospermum parkii	bulanga
Cadaba farinosa	abego, abogou, alagahu
Cadaba glandulosa	tahahist, teis, teyst
Calotropis procera	tezera, tirza, torscha, toucha, tourje
Capparis decidua	ajaêlayam, ajangham, aûjngun
Celtis integrifolia	sia
Combretum aculeatum	agersegil, akak, akamjavo, buka-buki
Combretum glutinosum	akalafa
Combretum micranthum	dagaera, ewan, geza, kadedjo
Combretum nigricans	dagara
Commiphora africana	adaras, adras
Crateva adansonii	agedudu, lele
Dalbergia melanoxylon	dieldianadju, kalgalam
Dichrostachys cinerea	agarjuba, agarof
Diospyros mespiliformis	kania, nelbi, pupuy, takoi
Entada africana	batala
Euphorbia balsamifera	taharalt, takhalt

TAMACHEK

Botanical name	Tamachek
Feretia apodanthera	efaranfar
Ficus gnaphalocarpa	baouri, ori
Ficus iteophylla	atafi
Grewia bicolor	dargaza, didie, djedje, looafer, luwafoer
Grewia tenax	gyrsemum, tarakat, tarhak, terkoet
Guiera senegalensis	assubara, inaraf-malan, sobara, touhila
Hyphaene thebaica	akof, ikkokan, tako kait, taggeyt
Khaya senegalensis	kahi
Lannea microcarpa	ayardahi
Leptadenia pyrotechnica	anah, eneg, hanaeg,
Maerua crassifolia	adiar, agar, e'ag'ar, eggar, tagart, tahidjiart
Mitragyna inermis	aboezgoed, tadgalalt
Moringa oleifera	leggel-makka, zogael gandi
Parkia biglobosa	ndutuuri
Piliostigma reticulatum	hadugu, kadagi, tafararat
Phoenix dactylifera	talidisk, tazoeldok
Pterocarpus lucens	alebonis, alibunes
Salvadora persica	abesigain, abesqui, abisga, nehek, ntichek, ntikoek, taizak, techak, tihoa, tihoq
Sclerocarya birrea	tauila'h, touhila
Stereospermum kunthianum	alammar, tabba
Tamarindus indica	basoro, bassasu, bochocho, somiya, tchimia
Terminalia avicennioides	tabenet
Ziziphus mauritiana	ajzen
Ziziphus mucronata	bischon, finta
Ziziphus spina-christi	abakat, kurna, tabakat, waeruu

Tamachek	Botanical name
abakat	Ziziphus spina-christi
abego	Cadaba farinosa
abogou	Cadaba farinosa
abesigain	Salvadora persica
abesqui	Salvadora persica
abisga	Salvadora persica
aboezgoed	Mitragyna inermis
aboragh	Balanites aegyptiaca
adaras	Commiphora africana
addaeny	Bauhinia rufescens
adiar	Maerua crassifolia
adras	Commiphora africana
afadar	Acacia tortilis
afadjadj	Acacia tortilis
agar	Maerua crassifolia
agarjuba	Dichrostachys cinerea
agarof	Dichrostachys cinerea
agersegil	Combretum aculeatum
ajaêlayam	Capparis decidua
ajangham	Capparis decidua
ajzen	Ziziphus mauritiana
akalafa	Combretum glutinosum
akamjavo	Combretum aculeatum
akarkara	Anogeissus leiocarpus
akak	Combretum aculeatum
akof	Hyphaene thebaica
akoukou	Anogeissus leiocarpus
alagahu	Cadaba farinosa
alammar	Stereospermum kunthianum
alebonis	Pterocarpus lucens
alibunes	Pterocarpus lucens
anah	Leptadenia pyrotechnica
agedudu	Crateva adansonii
assana	Acacia albida
assubara	Guiera senegalensis
atafi	Ficus iteophylla
atheus	Acacia albida
athous	Acacia albida
attehes	Acacia albida
aûjungun	Capparis decidua
ayardahi	Lannea microcarpa
baouri	Ficus gnaphalocarpa
basoro	Tamarindus indica
bassasu	Tamarindus indica
batala	Entada africana
bischon	Ziziphus mucronata
bochocho	Tamarindus indica
buka-buki	Combretum aculeatum
bulanga	Butyrospermum parkii

TAMACHEK

Tamachek	Botanical name
dagaera	Combretum micranthum
dagara	Combretum nigricans
dargaza	Grewia bicolor
didie	Grewia bicolor
dieldianadju	Dalbergia melanoxylon
djedje	Grewia bicolor
dokudust	Adansonia digitata
e'ag'ar	Maerua crassifolia
efaranfar	Feretia apodanthera
eggar	Maerua crassifolia
emi	Acacia ehrenbergiana
eneg	Leptadenia pyrotechnica
eouar-ouar	Acacia senegal
ewan	Combretum micranthum
erwarwar	Acacia senegal
finta	Ziziphus mucronata
geza	Combretum micranthum
gyrsemum	Grewia tenax
habates	Acacia albida
hadugu	Piliostigma reticulatum
hanaeg	Leptadenia pyrotechnica
hatess	Acacia albida
haya	Acacia laeta
haza	Acacia laeta
ikahan	Anogeissus leiocarpus
ikkokan	Hyphaene thebaica
inaraf-malan	Guiera senegalensis
kadagi	Piliostigma reticulatum
kadedjo	Combretum micranthum
kahi	Khaya senegalensis
kalgalam	Dalbergia melanoxylon
kania	Diospyros mespiliformis
kitsaegoess	Boscia salicifolia
kurna	Ziziphus spina-christi
leggel-makka	Moringa oleifera
lele	Crateva adansonii
looafer	Grewia bicolor
luwafoer	Grewia bicolor
ndutuuri	Parkia biglobosa
nehek	Salvadora persica
nelbi	Diospyros mespiliformis
nim	Azadirachta indica
ntichek	Salvadora persica

Tamachek	Botanical name
ntikoek	Salvadora persica
oraf	Acacia seyal
ori	Ficus gnaphalocarpa
orof-torah	Acacia seyal
pupuy	Diospyros mespiliformis
sia	Celtis integrifolia
sihir	Boscia senegalensis
sobara	Guiera senegalensis
somiya	Tamarindus indica
tabakat	Ziziphus spina-christi
tabarak	Balanites aegyptiaca
tabba	Stereospermum kunthianum
tabetenet	Terminalia avicennioides
taborak	Balanites aegyptiaca
tadahant	Boscia senegalensis
tadayni	Bauhinia refescens
tadeut	Boscia senegalensis
tadgalalt	Mitragyna inermis
tadghut	Adansonia digitata
tadomet	Boscia senegalensis
taedrumpt	Adansonia digitata
taezak	Salvadora persica
taezeyt	Acacia laeta
tafagak	Acacia tortilis
tafararat	Piliostigma reticulatum
tagart	Maerua crassifolia
taggeyt	Hyphaene thebaica
talidisk	Phoenix dactylifera
taghalzibayt	Acacia ataxacantha
tagolsubet	Acacia macrostachya
tahadjard	Acacia nilotica
tahagar	Acacia nilotica
tahaggard	Acacia nilotica
tahahist	Cadaba glandulosa
taharalt	Euphorbia balsamifera
tahidjiart	Maerua crassifolia
taizak	Salvadora persica
takhalt	Euphorbia balsamifera
tako kait	Hyphaene thebaica
takoi	Diospyros mespiliformis
takoudous	Adansonia digitata
tamat	Acacia seyal
tamat	Acacia ehrenbergiana
taralsebeyt	Acacia macrostachya
tarakat	Grewia tenax
tarhak	Grewia tenax
tauila'h	Sclerocarya birrea
taydjart	Acacia nilotica var. tomentosa

Tamachek	Botanical name
tazoeldok	Phoenix dactylifera
tazoet	Acacia laeta
tchimia	Tamarindus indica
techak	Salvadora persica
tedehini	Bauhinia rufescens
tedeine	Bauhinia rufescens
teis	Cadaba glandulosa
terkoet	Grewia tenax
teyst	Cadaba glandulosa
tezera	Calotropis procera
tihidjart	Acacia nilotica
tihoa	Salvadora persica
tirehi	Boscia angustifolia
tirza	Calotropis procera
torscha	Calotropis procera
touhila	Sclerocarya birrea
touhila	Guiera senegalensis
tourje	Calotropis procera
tsaihit	Acacia laeta
tuggoeur	Acacia nilotica var. adansonii
turreuft	Acacia seyal
waeruu	Ziziphus spina-christi
zigine	Borassus aethiopum
zogael gandi	Moringa oleifera

WOLOF

Botanical name	Wolof
Acacia albida	kad
Acacia ataxacantha	ded, ngarap
Acacia macrostachya	sama
Acacia nilotica var. adansonii	neb neb
Acacia nilotica var. tomentosa	gonaké
Acacia polyacantha	narab
Acacia senegal	verek
Acacia seyal	fonah, surur, mpena
Acacia sieberiana	sandandur, kada
Acacia tortilis	seing
Adansonia digitata	ghouis, gui, lalo
Adenium obesum	lissugar
Anacardium occidentale	darkasu
Annona senegalensis	digor, dugor, jorgut
Anogeissus leiocarpus	mara, ngegan, wej
Azadirachta indica	dimi buki, dimi tubab, neem
Balanites aegyptiaca	sump
Bauhinia rufescens	rada, rand
Bombax costatum	dundu, garab-laobe
Borassus aethiopum	ris, ron, sebe, sibi
Boscia angustifolia	nos
Boscia senegalensis	banâ,ndaadam, n'kiandam, diendoum
Cadaba farinosa	debarka, ndebarga
Calotropis procera	faftan
Capparis decidua	gumel
Capparis tomentosa	karen
Cassia sieberiana	seden, senjen, siniang
Celtis integrifolia	mbul
Combretum aculeatum	sawat, suat
Combretum glutinosum	rat
Combretum micranthum	keseu, kinkeliba, seheou
Combretum nigricans	karemtouaga, tab
Combretum paniculatum	kindindolo, tundal
Commiphora africana	moot, ngoot, ngotut, niotu, sagh
Crateva adansonii	horel, kred kred, kulel, tambe
Dalbergia melanoxylon	dalaban
Dichrostachys cinerea	seb, sinke
Diospyros mespiliformis	alom, kalum
Entada africana	batar
Euphorbia balsamifera	salan
Erythrina senegalensis	huniul
Feretia apodanthera	nalafum, santiar
Ficus gnaphalocarpa	bot, gang, santan

WOLOF

Botanical name	Wolof
Ficus ingens	dob
Ficus iteophylla	lodo
Ficus platyphylla	hel, mbap
Ficus thonningii	dibalé
Ficus vogelii	dob
Gardenia erubescens, G. spp	bossi
Gardenia ternifolia	pos
Grewia bicolor	horom radj, kel
Grewia tenax	kel
Guiera senegalensis	nger
Hyphaene thebaica	ela, gélé, kielo
Khaya senegalensis	kail
Lannea acida	son
Maerua angolensis	toji
Maerua crassifolia	dibarka
Mangifera indica	mâgo
Maytenus senegalensis	gédek
Mimosa pigra	busaina
Mitragyna inermis	hos, khoss, rhos
Moringa oleifera	benaile, nebedayo
Parkia biglobosa	houlle, nette, ul
Phoenix dactylifera	tandarma, tamaro
Piliostigma reticulatum	ngisgis
Piliostigma thonningii	gigis, ngisgis-bugar
Prosopis africana	her
Pterocarpus erinaceus	ven, yirk, yor
Pterocarpus lucens	bei-bei, saagari, wem
Salvadora persica	googoo
Sclerocarya birrea	ber, birr
Securidaca longepedunculata	fouf
Securinega virosa	kên
Sterculia setigera	bep, mbep
Stereospermum kunthianum	bolnak
Strychnos spinosa	ramboet, tobé
Tamarindus indica	bêgal, dakkar
Tamarix senegalensis	bundu
Terminalia avicennioides	robrob
Terminalia macroptera	wolo
Vitex doniana	jei, leg
Ximenia americana	golon
Ziziphus mauritiana	dem, dim, sedem
Ziziphus mucronata	dembuki

Wolof	Botanical name
alom	Diospyros mespiliformis
banâ	Boscia senegalensis
batar	Entada africana
bêgal	Tamarindus indica
bei-bei	Pterocarpus lucens
ber	Sclerocarya birrea
benaile	Moringa oleifera
bep	Sterculia setigera
birr	Sclerocarya birrea
bolnak	Stereospermum kunthianum
bossi	Gardenia erubescens, G. spp.
bot	Ficus gnaphalocarpa
bundu	Tamarix senegalensis
busaina	Mimosa pigra
dakkar	Tamarindus indica
dalaban	Dalbergia melanoxylon
darkasu	Anacardium occidentale
debarka	Cadaba farinosa
ded	Acacia ataxacantha
dem	Ziziphus mauritiana
dembuki	Ziziphus mucronata
dibalé	Ficus thonningii
dibarka	Maerua crassifolia
diendoum	Boscia senegalensis
digor	Annona senegalensis
dim	Ziziphus mauritiana
dimi buki	Azadirachta indica
dimi tubab	Azadirachta indica
dob	Ficus vogelii
dugor	Annona senegalensis
dundul	Bombax costatum
ela	Hyphaene thebaica
faftan	Calotropis procera
fonah	Acacia seyal
fouf	Securidaca longepedunculata
gang	Ficus gnaphalocarpa
garab-laobe	Bombax costatum
gédek	Maytenus senegalensis
gélé	Hyphaene thebaica
ghouis	Adansonia digitata
gigis	Piliostigma thonningii
golon	Ximenia americana
gonaké	Acacia nilotica var. tomentosa
googoo	Salvadora persica
gui	Adansonia digitata
gumel	Capparis decidua

Wolof	Botanical name
hel	Ficus platyphylla
her	Prosopis africana
horel	Crateva adansonii
horom radj	Grewia bicolor
hos	Mitragyna inermis
houlle	Parkia biglobosa
hunine	Erythrina senegalensis
jei	Vitex doniana
jorgut	Annona senegalensis
kad	Acacia albida
kada	Acacia sieberiana
kail	Khaya senegalensis
kalum	Diospyros mespiliformis
karemtouaga	Combretum nigricans
karen	Capparis tomentosa
kel	Grewia bicolor, G. tenax
kên	Securinega virosa
keseu	Combretum micranthum
kohss	Mitragyna inermis
kielo	Hyphaene thebaica
kinkeliba	Combretum micranthum
kred kred	Crateva adansonii
lalo	Adansonia digitata
leg	Vitex doniana
lissugar	Adenium obesum
lodo	Ficus iteophylla
mâgo	Mangifera indica
mbap	Ficus platyphylla
mara	Anogeissus leiocarpus
mbep	Sterculia setigera
mbul	Celtis integrifolia
moot	Commiphora africana
mpena	Acacia seyal
nalafum	Feretia apodanthera
narab	Acacia polyacantha
ndaadam	Boscia senegalensis
ndébarga	Cadaba farinosa
nebedayo	Moringa oleifera
neb neb	Acacia nilotica var. adansonii
nette	Parkia biglobosa
ngarap	Acacia ataxacantha
ngegan	Anogeissus leiocarpus
nger	Guiera senegalensis
ngisgis	Piliostigma reticulatum, Piliostigma thonningii
ngarap	Acacia ataxacantha

Wolof	Botanical name
ngisgis-bugar	Piliostigma thonningii
ngoot	Commiphora africana
ngotut	Commiphora africana
neem	Azadirachta indica
niotut	Commiphora africana
n'kiandam	Boscia senegalensis
nos	Boscia angustifolia
pos	Gardenia ternifolia
rada	Bauhinia rufescens
ramboet	Strychnos spinosa
rand	Bauhinia rufescens
rat	Combretum glutinosum
rhos	Mitragyna inermis
ris	Borassus aethiopum
ron	Borassus aethiopum
saagari	Pterocarpus lucens
sagh	Commiphora africana
salan	Euphorbia balsamifera
sama	Acacia macrostachya
sandandur	Acacia sieberiana
sangari	Pterocarpus lucens
santiar	Feretia apodanthera
santon	Ficus gnaphalocarpa
sawat	Combretum aculeatum
seb	Dichrostachys cinerea
sebe	Borassus aethiopum
sedem	Ziziphus mauritiana,
seden	Cassia sieberiana
seheou	Combretum micranthum
seing	Acacia tortilis
senjen	Cassia sieberiana
sibi	Borassus aethiopum
siniang	Cassia sieberiana
sinke	Dichrostachys cinerea
son	Lannea acida
suat	Combretum aculeatum
sump	Balanites aegyptiaca
surur	Acacia seyal
tab	Combretum nigricans
tamaro	Phoenix dactylifera
tambe	Crateva adansonii
tandarma	Phoenix dactylifera
tobé	Strychnos spinosa
toji	Maerua angolensis
tundal	Combretum paniculatum
ul	Parkia biglobosa

Wolof	Botanical name
ven	Pterocarpus erinaceus
verek	Acacia senegal
wej	Anogeissus leiocarpus
wem	Pterocarpus erinaceus
wolo	Terminalia macroptera
yirk	Pterocarpus erinaceus
yor	Pterocarpus erinaceus

LIST OF BOTANICAL TERMS

English	German	French
acicular, needle-shaped	nadelförmig	aiguille
aculeate	bestachelt	aiguillonné
acuminate	zugespitzt	acuminé
acute	spitz	aigu
alternate	wechselständig	alterne
anther	Staubbeutel	anthère
apex, top	Blattspitze	pointe
apiculate	fein zugespitzt	apiculé
applanate	abgeflacht	aplati
arrow-shaped	pfeilförmig	sagitté
ascending	aufsteigend	ascendent
awl-shaped	pfriemförmig	subulé
axillary	achselständig	axillaire
bark	Rinde, Borke	écorce
bell-shaped	glockig	campanulé
bent, curved	gebogen, gekrümmt	arqué
berry	Beere	baie
biennial	zweijährig	bisannuel
bilobed	zweilappig	bilobé
bipinnate	doppelt gefiedert	bipenné
bisexual	zweigeschlechtig	bisexuel
blunt	stumpf	obtus
bole, stem, trunk	Stamm, Schaft	fût
bract	Hochblatt,	bractée
branch	Ast	branche
bristle	Borste	soie
bristle-shaped, setaceous	borstig	séteux
bud	Knospe	bouton, bourgeon
bullate	aufgetrieben, blasig	bullé, boursouflé
butt	unteres Ende	bas
caducous	abfallend	tombant
calyx	Kelch	calice
capsule	Kapsel	capsule
carpel	Fruchtblatt, Karpell	carpelle
carve, incise	aufschneiden, ein-schneiden, einkerben	entailler
caustic	ätzend, brennend	caustique
chamber (of ovary)	Fach	loge
ciliate	gewimpert	cilié
claw	Nagel, Kralle	onglet
climbing	rankend	sarmenteux, grimpant
club-shaped	keulenförmig	claviforme
clustered	büschelig	fasciculaire
coarse	grob	grossier
compound	zusammengesetzt	composé
compressed	zusammengedrängt	comprimé

English	German	French
concave	vertieft	concave
conduplicate	zusammengefaltet	condupliqué
connate	verwachsen	conné
connective	Mittelband	connectif
constricted	eingeschnürt	resserré
convex	gewölbt	convexe
convolute	übergerollt	convoluté
cordate	herzförmig	cordiforme
coriaceous	lederig	coriace
corky	korkig	subéreux, liégeux
corolla	Blumenkrone	corolle
corymb	Doldentraube	corymbe
cotyledon	Keimblatt	cotylédon
creeping	kriechend	rampant
crenate	gekerbt	crénelé
crisped	gekraust	crépu, ondulé
cross-section	Querschnitt	section transversale
cross-wise	kreuzständig	décussé
crown	Krone	couronne
cuneiform	keilförmig	cunéiforme
cupule	Fruchtbecher	cupule
cupola-shaped	becherförmig	cyathiforme
curved	gebogen	courbé
cushion	Blattpolster,	coussinet foliaire
cuspidate	feinspitzig	cuspidé
cutting	Steckling	bouture
cyme	Trugdolde, Krone	cime, cyme
deciduous, caducous	laubabwerfend	caduc
decumbent	liegend	décombant
decurrent	herablaufend	décurrent
deflexed	niedergebogen	décliné
dehiscent	aufspringend	déhiscent
dentate	gezähnt	denté
dichotomy	Gabelung	dichotome
digitate	gefingert	digité
dioecious	zweihäusig	dioïque
distichous	zweizeilig	distique
dotted, punctate	punktiert	ponctué
double	gefüllt	double
drooping	übergebogen, nickend	penché
drupe	Steinfrucht	drupe
dull	matt	mat, opaque
elliptic	oval, elliptisch	elliptique
elongated	verlängert	élongé
emarginate	ausgerandet	émarginé
enclosed/covered	bedeckt	couvert
entire	ganzrandig	entier
epigynous	unterständig	épigyne
epiphyte	Epiphyt	épiphyte
equitant	umfassend	équitant

English	German	French
evergreen	immergrün	toujours vert
exuding	ausscheidend	exudante
falcate	sichelförmig	falciforme
fascicle	Büschel	faisceau, touffe
fastigiate	fastigiat	fastigié
ferruginous	rostfarbig	rubigineux
filament	Faden	filet
filiform	fadenförmig	filiforme
fingered, digitate	gefingert	digité
fissured	gespalten, rissig	fissuré
flaked	schuppig	écaillé
flush	sprießen	poindré
flower	Blüte	fleur
folded	gefaltet	plissé
foliage	Laub	feuillage
foliole	Blättchen	foliole
form, shape	Habitus, Gestalt	forme
fragrant	duftend	odorant
fringed	gefranst	fimbrié
fruit	Frucht	fruit
fruit pulp	Fruchtfleisch	pulpe, chair
furrowed	gefurcht	silloné
geniculate	geknickt	genouillé
genus	Gattung	genre
glabrous	kahl, unbehaart	glabre
gland	Drüse	glande
glandulary-hairy	drüsenhaarig	glanduleux-pubescent
glaucus	bläulichgrün	glauque
globose	kugelig	globeux
globose head	kugeliges Köpfchen	globule
gracious	zierlich	gracieux
grain	(Samen) Getreide	graine
grooved	rinnenförmig	cannelé
gynophore	Gynophor	gynophore
hair	Haar	poil
hairy	behaart	pileux, pubescent
hastate	spießförmig	hasté
head	Köpfchen	capitule
herbaceous	krautartig, krautig	herbacé
hermaphrodite	zwittrig	hermaphrodite
hilum	Nabel	hile
hirtuse	rauhhaarig	hérissé
hispid	steifhaarig	hispide
hook, hooked	Haken, hakenförmig	crochet, en crochet
husk	Schote	silique
hypanthium	Blütenboden	receptacle, hypanthium
hypogynous	oberständig	hypogyne
imbricate	dachziegelig	imbriqué
imparipinnate	unpaarig gefiedert	imparipipenné

English	German	French
incised	eingekerbt	entaillé
indehiscent	nicht öffnend (Schließfrucht)	indéhiscent
inflated	aufgeblasen	renflé
inflorescence	Blütenstand	inflorescence
involucre	Hüllkelch	involucre
jointed	gegliedert	articulé
keeled	gekielt	caréné
kernel, stone	Kern	noyau
kidney-shaped	nierenförmig	en forme de rein
lanceolate	lanzenförmig lanzettlich	lancéolé
latex	Latex, Milchsaft	latex
leaf	Blatt	feuille
leaflet	Blättchen, Fiederblättchen	foliole,
leaf margin	Blattrand	bordure de feuille
leaf scar	Blattnarbe	cicatrice foliaire
leathery	lederartig	coriace
lenticel	Lentizelle	lenticelle
lobed	gelappt	lobé
long shoot	Langtrieb	rameau longue
macerate	aufquellen	maceré
mealy	mehlig	farineux
membrane	Häutchen	membrane
membranous	pergamentartig	membraneux
monoecious	einhäusig	monoïque
mucilage	(Pflanzen)Schleim	mucilage
mucronate	stachelspitz	mucroné
needle-shaped, acicular	nadelförmig	acéreux
nodding	überhängend	incliné
notched, retuse	retus, eingedrückt	rétusé
nut	Nuß	noix
obcordate	obcordat, verkehrt herzförmig	obcordé
oblanceolate	oblanzettlich	oblancéolé
oblate	oblat	aplati
oblique	schief	oblique
oblong	länglich	oblong
obovate	obovat, verkehrt eiförmig	obovale
obtuse	stumpf	obtus
obvolute	halbumfassend	obvoluté
opposite	gegenständig	opposé
orbicular	kreis-, ringförmig	orbiculaire
orifice	Öffnung	orifice

English	German	French
ovary	Fruchtknoten	ovaire
ovate	eiförmig	ovoide
palmate	handförmig, handteilig	palmé
panicle	Rispe	panicule
pappus	Haarkelch	aigrette
paripinnate	paarig gefiedert	paripenné
pectinate	kammförmig	pectiné
pedate	fußförmig	pédatiforme
pedicel	Blüten- oder Fruchtstiel	pédicelle
peduncle	Blütenstiel	pedoncule
pedunculate	gestielt (Blüte)	pédonculé
peltate	schildförmig	pelté
pendulous	hängend	pendant
perfoliate	durchwachsen	perfolié
perianth	Blütenhülle, Perigon	périanthe
persistent	ausdauernd	persistent
petal	Blütenblatt, Blumen- oder Kronblatt	pétale
petiole	Blattstiel	pétiole, pédicelle
petioled	gestielt (Blatt)	pétiolé
phyllotaxis	Blattstellung	phyllotaxie
pilose	haarig, rauh	velu
pinnate	gefiedert	pinné
pinnately partite	fiederteilig	pennatipartite
pinnatisect	fiederschnittig	pinnatiséqué
pinnule	Fieder	pinnule
pistil	Stempel	pistil
pith	Mark	moelle
plaited	geflochten	tressé
pod	Hülse	gousse
poisonous	giftig	vénéneux
pollen	Blütenstaub	pollen
powdered	bepudert, bestaubt	pulvérulent
prickle	Stachel	aiguillon
prickly	stachelig	aiguillonné
procumbent	niederliegend	tracant
prostrate	niedergestreckt	couché
pruinose	bereift	pruineux
pubescent	fein-, weichhàarig	pubescent, duveteux
pulpy	(dick) fleischig	charnu
pungent	stechend	piquant
raceme	Traube	grappe, racème
racemose	traubig	en grappe
rachis	Spindel, Rhachis	rachis
radiate	strahlig	radiaire
receptacle	Fruchtboden	réceptacle
reflexed	zurückgebogen	réfléchi
resinous	harzig	résineux

English	German	French
reticulate	netznervig	réticulé
retuse	eingedrückt	rétus
revolute	zurückgerollt	revoluté
rhizome	Wurzelstock	rhizome
rhombic	rautenförmig	rhombique
rigid	starr, steif	rigide
rolled inwards	eingerollt	enroulé
rod	Rute	verge
root	Wurzel	racine
(root) sucker	(Wurzel)schößling	rejet, surgeon
rough	rauh, scharf	acerbe, rude
runner	Ausläufer	stolon, drageon
rusty	rostig	rouilleux
samara	Flügelfrucht	samara
sapwood	Splint	aubier
sarmentose	kriechend, kletternd	sarmenteux
sawed, serrate	gesägt	serré
scale, scaly	Schuppe, schuppig	écaille, écailleuse
scar	Narbe	stigmate
schizocarp	Spaltfrucht	schizocarpe
scion	Pfropfreis	greffe
seed	Samen	semence, graine
semi-double	halbgefüllt	demi-double
sepals	Kelchblätter	sépales
serrulate	feingesägt	serrulé
sessile	sitzend, ungestielt	sessile
shining	glänzend	brillant, luisant
shoot	Trieb	pousse
short branch	Kurztrieb	rameau court
shrub	Strauch	arbuste, arbrisseau
silky	seidenhaarig	soyeux
sinuate	gebuchtet	sinué
slash, blaze	Anhieb	tranche
smooth	glatt	lisse
solitary	einzelstehend	solitaire
spadix	Blütenkolben	régime
spate	Blütenscheide	spathe
spatulate	spatelförmig	spatulé
species	Art	espèce
spike, ear	Ähre	épi
spindle, rachis	Spindel	fuseau
spine	Dorn	épine
spiral	schraubig	spiralé
spread	ausbreiten	envahir
spur	Sporn	éperon
stalk	Stengel, Stiel	pétiole, pédoncule, queue
stamen	Staubblatt	étamine
stellate	sternhaarig	étoilé
stem, bole, trunk	(Baum)-Stamm	tige
stem-clasping	stengelumfassend	amplexicaule
sticky	klebrig	poisseux, bisquex glutineux, visqueux

English	German	French
stigmatic	narbenartig	stigmatique
stipitate	gestielt	stipité
stipule	Nebenblatt	stipule
strap-shaped	bandförmig	loriculé
striated	gestreift	strié
strigose	striegelhaarig	à poils rudes
stump	Steckling, gestutzter	barbatelle
style	Griffel	style
subspecies (ssp.)	Unterart	sous-espèce
swollen	verdichtet, verdickt	épaissé, bombé
syncarp	Sammelfrucht	syncarpe
tapering	verschmälert	attenué
terminal	endständig	terminal
terminal bud	Endknospe	bourgeon terminal
ternary	dreizählig	terné
thorn	Dorn	épine
thornless	ohne Stacheln(Dornen)	inerme
tomentose	filzig	tomenteux
toothed, dentate	-zähnig, gezähnt	denté
translucent	durchscheinend	pellucide
trichoma	Haare	trichome
trifoliate	dreiblättrig	trifolié
trioecious	triözisch	trioïque
truncate	abgestutzt, gestutzt	tronqué
trunk	Stamm	tronc
tube	Röhre	tube
tubercled	höckerig	tuberculeux
tufted	dicht, buschig	touffu
twig	Zweig(ende)	ramille, brindille
twining	windend	volubile
twisted	gedreht	tortueux
two-edged	zweischneidig	à deux faces
umbel	Dolde	ombelle
undulate	gewellt, gekraust	ondulé
unisexual	eingeschlechtig	unisexuel
valved	Fruchtklappen	-valve
variety (var.)	Varietät	variété
varnished	gelackt, glasiert	vernissé
veined	geädert	veiné
velvety	samthaarig	vélouté
viscid (viscous)	schmierig, klebrig	visqueux
warty	warzig	verruqueux
wedge-shaped	keilförmig	en forme de coin
weeping	hängend	pendant
whorled	quirlig	verticillé
winged	geflügelt	ailé
woody	holzig, verholzt	ligneux
woolly	wollig	laineux

APPENDIX V

SITE REQUIREMENTS

These may be variable, depending on mutual feedbacks. The most common or typical requirements have been recorded (for the Sahel environment only) as follows:

I Annual rainfall
1 less than 300 mm
2 300 - 600 mm
3 more than 600 mm

II Geomorphology
1 depressions, river banks, etc.
2 plains, dunes
3 hills, slopes
0 not specific

III Soils
1 sands
2 loam, clay, alluvial
3 rocks, gravel, hard pans
0 not specific

IV Soil/water regime
1 depends on accessible ground water
2 tolerates seasonal inundation
3 requires moist, but well-drained soils
4 not specific

	I	II	III	IV
Acacia albida	2	1, 2	1, 2	1
Acacia ataxacantha	3	1	2, 3	1
Acacia dudgeoni	3	2	2	3
Acacia ehrenbergiana	1	2, 3	1, 2	0
Acacia gourmaensis	3	2	2, 3	3
Acacia macrostachya	2	0	0	0
Acacia macrothyrsa	3	2	3	0
Acacia mellifera	2	2, 1	2	2
Acacia nilotica var. adansonii	2	2	1, 2	3
Acacia nilotica var. tomentosa	2	1	2	1, 2
Acacia pennata	3	1	2	1
Acacia polyacantha	3	1	2	1
Acacia tortilis	1	2	3, 1	0
Acacia senegal	2	2	1	0
Acacia seyal	2	1, 2	2, 0	2
Acacia sieberiana	3	1	2, 1	2
Adansonia digitata	2	2	2	0
Adenium obesum	2	2	0	0
Albizia chevalieri	3	1	2	1
Albizia lebbeck	3	0	0	1
Anacardium occidentale	3	2, 1	1, 2	1
Anogeissus leiocarpus	2	1	2	2
Annona senegalensis	3	0	3	0
Azadirachta indica	2	2	0	0
Balanites aegyptiaca	1	2, 1	0	0, 3
Bauhinia rufescens	2	2, 1	1	3
Bombax costatum	3	2	0	0
Borassus aethiopum	3	2, 1	2	1

	I	II	III	IV
Boscia angustifolia	2	3	3, 2	0
Boscia salicifolia	2	3	3, 1	0
Boscia senegalensis	2	2	0	0
Butyrospermum parkii	3	2	2	0
Cadaba farinosa	2	1	1	3
Cadaba glandulosa	2	2	1, 2	0
Calotropis procera	1	0	1	0
Capparis corymbosa	3	2	2	0
Capparis decidua	1	1	1, 2	0
Capparis tomentosa	3	1	2, 3	0
Cassia siamea	3	2	2	3
Cassia sieberiana	3	2	0	3
Casuarina equisetifolia	2	2	1, 0	1
Celtis integrifolia	3	1	2	1
Combretum aculeatum	2	2	0	2
Combretum glutinosum	2	0	1	0
Combretum micranthum	2	1, 3	0	0
Combretum nigricans	3	3	3	3
Combretum paniculatum	3	1	2	2
Commiphora africana	2	2	0	0
Crateva adansonii	3	1	2, 1	2, 3
Dalbergia melanoxylon	2	1	2	3
Dichrostachys cinerea	2	0	0	0
Diospyros mespiliformis	2	1	2	3
Entada africana	3	2	2	1
Erythrina senegalensis	3	1	0	3
Eucalyptus camaldulensis	3	2	0	0
Euphorbia balsamifera	1	2	1, 2	0
Feretia apodanthera	2	1	2	2
Ficus capensis	3	3	0	0
Ficus gnaphalocarpa	2	1, 0	1	1
Ficus ingens	1	3	3	0
Ficus iteophylla	3	1	2	1
Ficus platyphylla	3	1, 2	2	3
Ficus thonningii	3	3, 2	0	3
Ficus vogelii	3	1	2	3
Gardenia aqualla	3	1	2	3
Gardenia erubescens	3	2	2	3
Gardenia sokotensis	3	3	3	0
Gardenia ternifolia	3	1	0	2, 3
Grewia bicolor	2	0, 3	3	3
Grewia flavescens	2	3	0	0
Grewia mollis	2	2	0	0

	I	II	III	IV
Grewia tenax	1	2, 3	3, 0	0
Grewia villosa	2	1	0	2
Guiera senegalensis	2	2	1	2
Hyphaene thebaica	1	2, 3	1, 2	1
Khaya senegalensis	3	2	2	3
Lannea acida	3	0	2	3
Lannea microcarpa	3	0	2	3
Leptadenia pyrotech.	1	2	1	0
Leucaena leucocephala	3	2	0	3
Maerua angolensis	3	2	2	0
Maerua crassifolia	2	2	1, 2	0
Mangifera indica	2	2	2	3
Maytenus senegalensis	3	2, 1	0	3
Mimosa pigra	3	1	2	2
Mitragyna inermis	2			
Moringa oleifera	2	2	2	3
Parkia biglobosa	3	2	0	3
Parkinsonia aculeata	2	2	0	0
Phoenix dactylifera	1	1	1	1
Piliostigma reticula.	2	2, 1	0	2
Piliostigma thonnin.	3	2, 1	2	3
Prosopis africana	3	2	0	3
Prosopis juliflora	2	0	0	0
Pterocarpus erinaceus	3	1	2, 3	3
Pterocarpus lucens	2	3, 2	3	0
Salvadora persica	1	2, 1	2, 1	1
Sclerocarya birrea	2	2, 1	0	0
Securidaca longe-pedunculata	3	1	2	3
Securinega virosa	2	1	2	1
Sterculia setigera	2	1, 3	0	0
Stereospermum kunth.	2	0	3, 2	0
Strychnos spinosa	3	3	0	0
Tamarindus indica	2	1, 0	0	1
Tamarix senegalensis	1	1	1, 2	1
Terminalia avicen-nioides	3	2	2, 1	0
Terminalia macroptera	3	1	2	3, 2
Vitex doniana	3	2	0	3
Ximenia americana	3	1	2	3
Ziziphus mauritiana	1	0	0	2
Ziziphus mucronata	2	0	0	2
Ziziphus spina-christi	1	1, 2	2	2

SEED WEIGHTS

	Approximate number of seeds per kg*	weight of 1,000 seeds (mg)
Acacia albida	11,500 - 19,000	87 - 53
Acacia ataxacantha	11,000	90
Acacia dudgeoni	8,000	125
Acacia gourmaensis	11,000 - 18,000	90 - 55
Acascia laeta	10,000 - 12,000	100 - 83
Acacia macrostachya	13,000	77
Acacia macrothyrsa	8,900	112
Acacia nilotica var. adansonii	5,000 - 6,000	200 - 166
Acacia nilotica var. tomentosa	7,500	133
Acacia pennata	9,000	111
Acacia polyacantha	11,000	90
Acacia senegal	12,000 - 18,000	83 - 55
Acacia seyal	20,000 - 22,000	50 - 45
Acacia sieberiana	4,500	222
Acacia tortilis	15,000 - 20,000	66 - 50
Adansonia digitata	2,000 - 3,000	500 - 333
Albizia chevalieri	13,000	77
Albizia lebbeck	7,700 - 10,000	130 - 100
Anacardium occidentale	150 - 200	6,700 - 5,000
Annona senegalensis	25,000	40
Anogeissus leiocarpus	140,000 - 150,000	7 - 6
Azadirachta indica	1,800 - 4,000	555 - 250
Balanites aegyptiaca	500 - 1,500	2,000 - 670
Bauhinia rufescens	9,000 - 10,000	111 - 100
Bombax costatum	17,000 - 27,000	59 - 37
Boscia senegalensis	2,500 - 3,500	400 - 300
Butyrospermum parkii	150 - 300	5,000 - 3,300
Capparis corymbosa	5,000	200
Cassia occidentalis	45,000	22
Cassia siamea	35,000 - 40,000	28 - 25
Cassia sieberiana	7,000 - 16,500	143 - 61
Casuarina equisetifolia	650,000	2
Celtis integrifolia	4,000 - 10,000	250 - 100
Combretum aculeatum	17,000	59
Combretum glutinosum	20,000	50
Combretum micranthum	13,500-30,000	74 - 33

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*) Figures are valid for air-dry (15 % moisture content) seeds, cleaned from fruit pulp, wings, etc. In literature figures may vary considerably. Control measurements were therefore made with fresh seeds and those that had been stored for at least half a year.

Approximate number of seeds per kg	weight of 1,000 seeds (mg)
Commiphora africana 8,000	125
Crateva adansonii 7,000 - 7,500	140 - 130
Dalbergia melanoxylon 16,000	63
Dichrostachys cinerea 39,000	26
Diospyros mespili. 2,400 - 3,200	417 - 313
Entada africana 4,000	250
Eucalyptus camal. 200,000 - 1 Mill.	5 - 1
Feretia apodanthera 93,000	11
Gardenia ternifolia 88,000	10
Grewia bicolor 15,000	66
Grewia mollis 15,000	66
Grewia tenax 21,000	48
Grewia villosa 16,000	63
Hyphaene thebaica 20 - 50	50,000 - 20,000
Khaya senegalensis 4,500 - 7,000	111 - 143
Lannea acida 8,000	130
Lannea microcarpa 5,000	200
Leucaena leucocephala 22,000	45
Mimosa pigra 42,600	23
Mitragyna inermis 750	1,333
Moringa oleifera 4,000	250
Parkia biglobosa 5,000	200
Parkinsonia aculeata 12,000	83
Piliostigma reti. 11,000 - 14,500	91 - 69
Piliostigma thonningii 8,500	118
Prosopis africana 7,500 - 8,000	153 - 125
Prosopis juliflora 8,000 - 15,000	114 - 67
Pterocarpus erinaceus 3,500	286
Pterocarpus lucens 5,000	200
Sclerocarya birrea 400	2,500
Securidaca longepedunculata 6,000	167
Sterculia setigera 2,500 - 3,500	400 - 286
Tamarindus indica 2,000 - 2,500	500 - 400
Terminalia avicennioides 3,000	333
Terminalia macroptera 4,000	250
Vitex doniana 1,300	769
Ximenia americana 1,400	714
Ziziphus mauritiana 3,600 - 7,000	278 - 143

SEEDS and FRUITS

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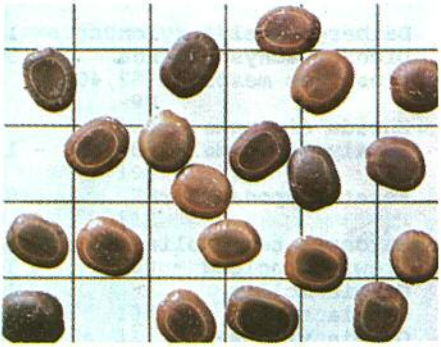
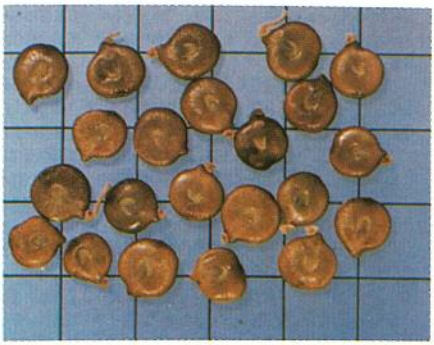
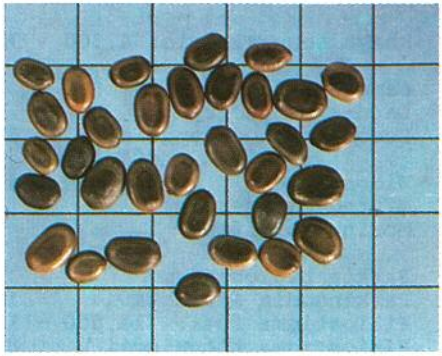


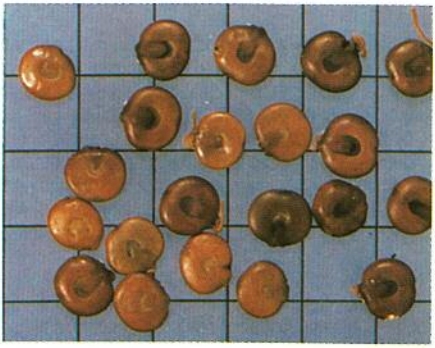
Acacia nilotica var. adansonii



Acacia gourmaensis

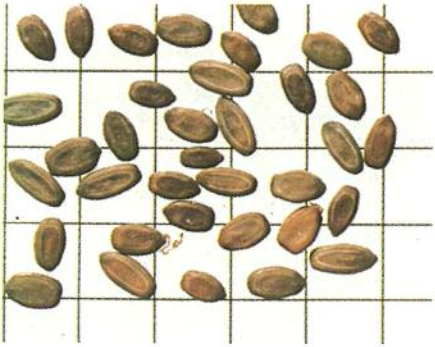


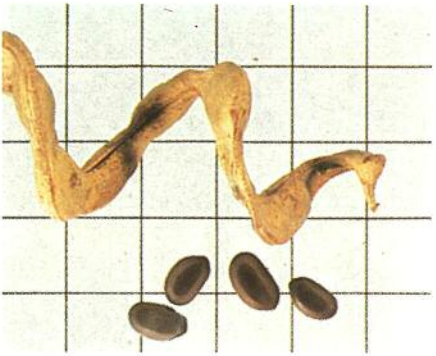
Acacia nilotica var. tomentosa

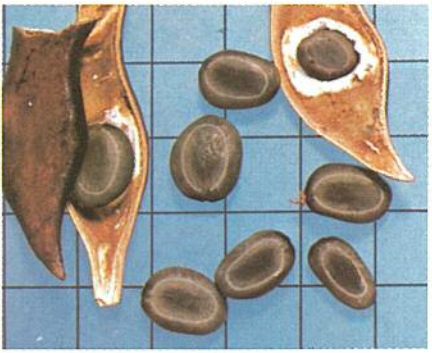


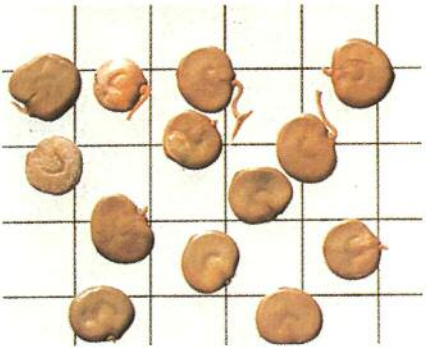
Acacia macrostachya

Acacia pennata



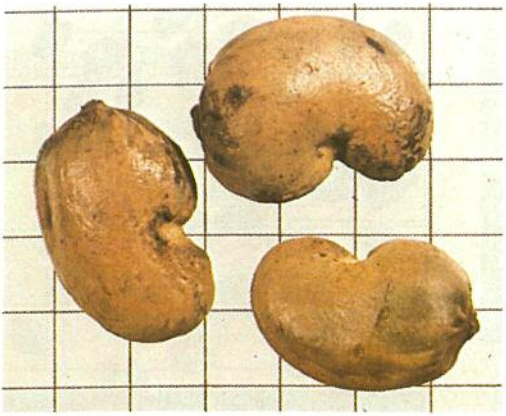


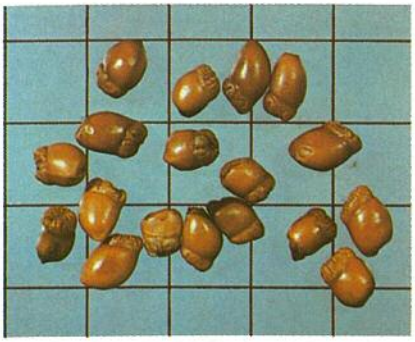


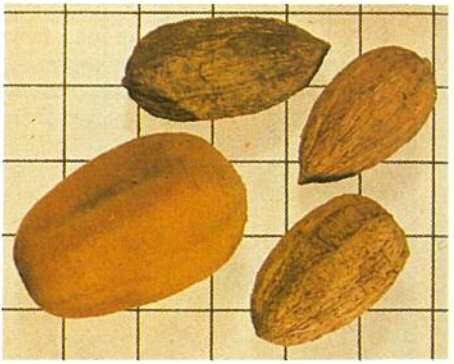


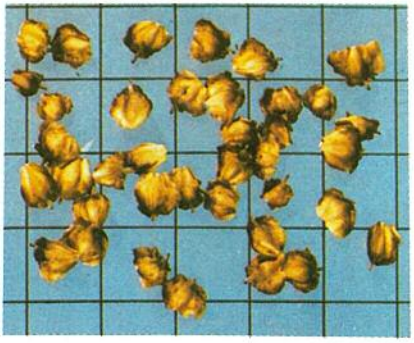
Acacia polyacantha
Acacia raddiana
Acacia senegal

Acacia seyal
Acacia sieberiana
Adansonia digitata

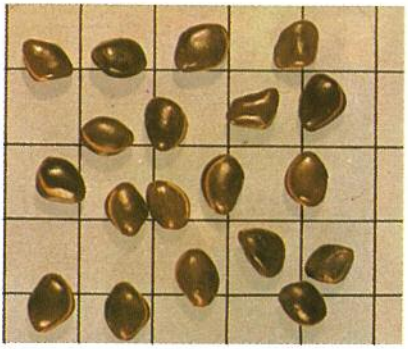






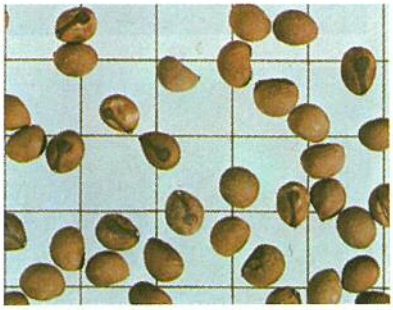


Anacardium occidentale
Annona senegalensis
Anogeissus leiocarpus

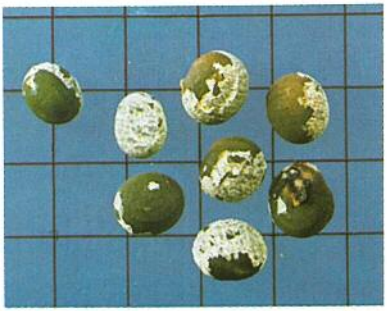


Azadirachta indica
Balanites aegyptiaca
Bauhinia rufescens

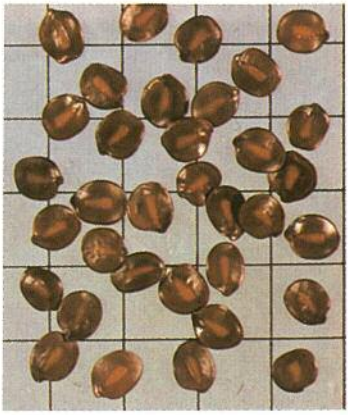
Borassus aethiopum

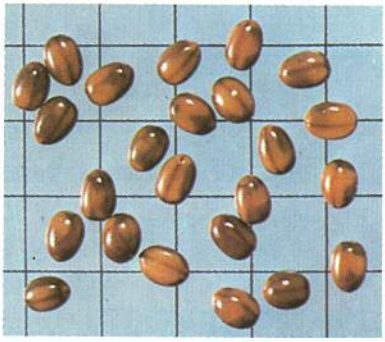


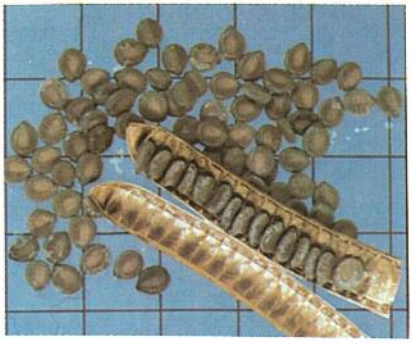
Bombax costatum



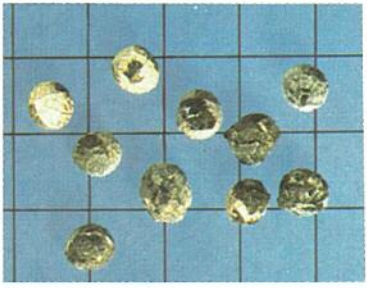
Boscia senegalensis



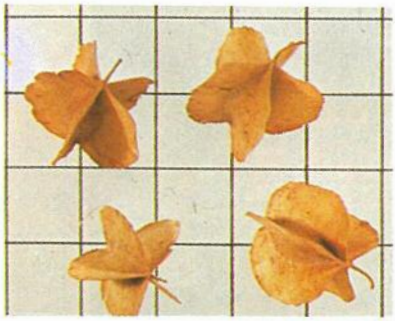


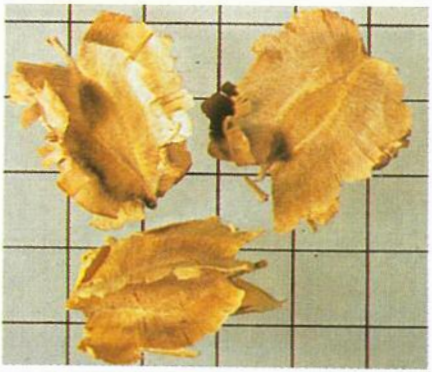


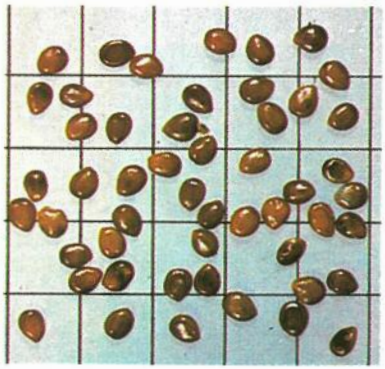
Butyrospermum parkii
Capparis corymbosa
Cassia occidentalis



Cassia siamea
Cassia sieberiana
Celtis integrifolia

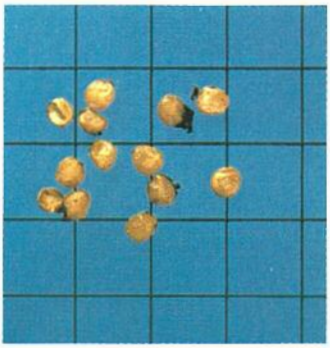


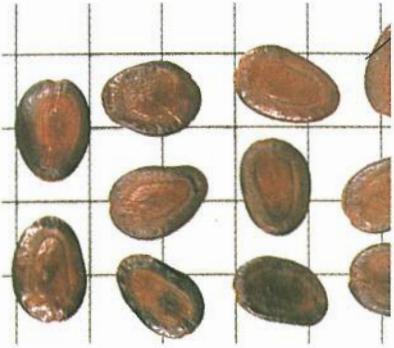


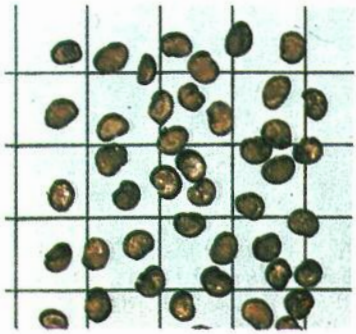


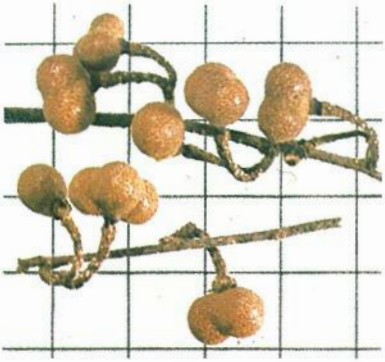
Combretum aculeatum
Combretum glutinosum
Combretum micranthum

Commiphora africana
Dalbergia melanoxylon (F)
Dichrostachys cinerea



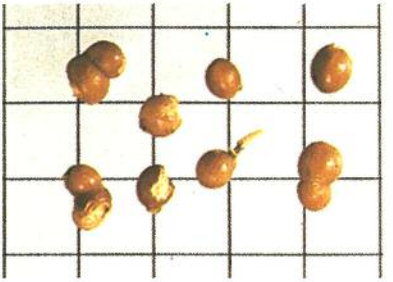


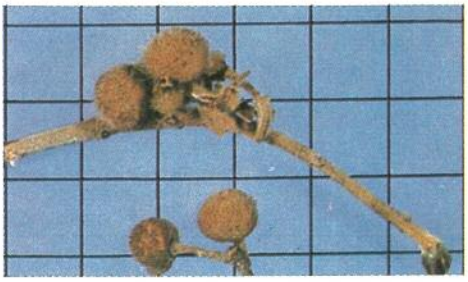




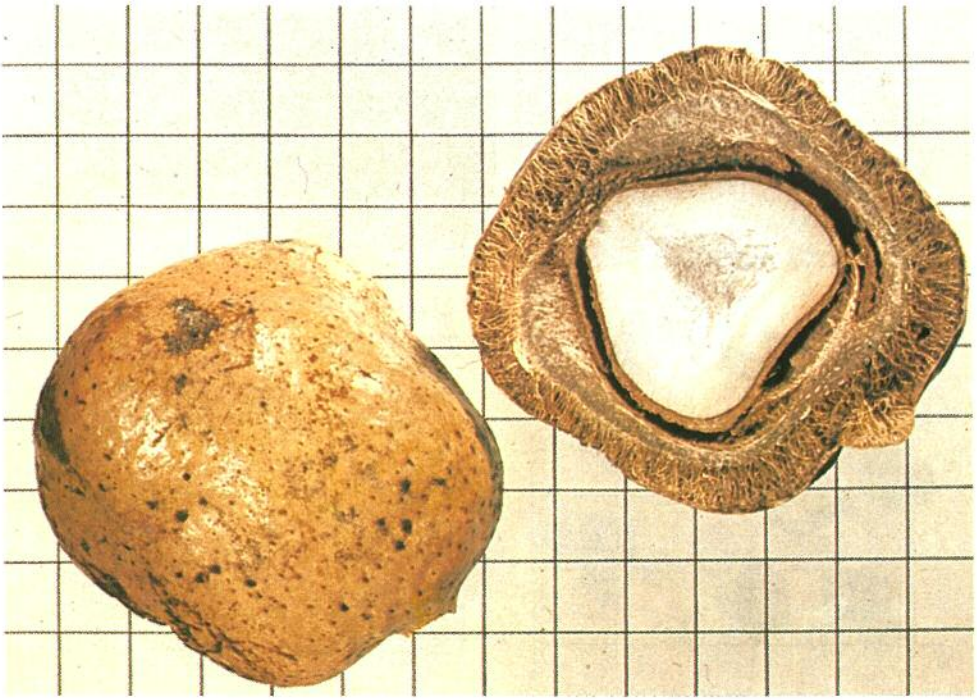
Diospyros mespiliformis
Entada africana
Feretia apodanthera

Ficus gnaphalocarpa
Gardenia ternifolia
Grewia mollis (F)

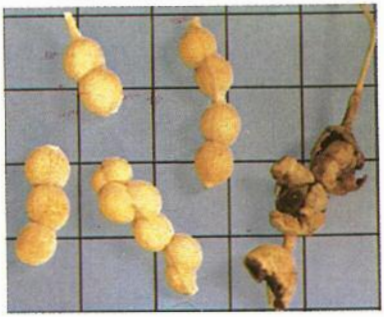


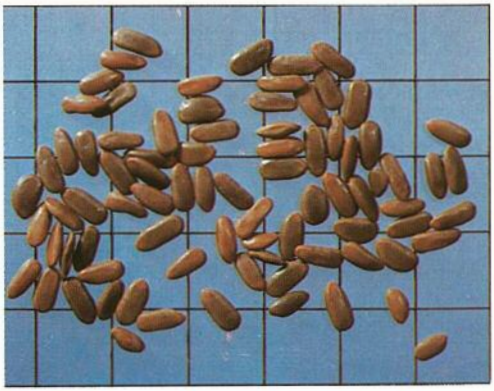


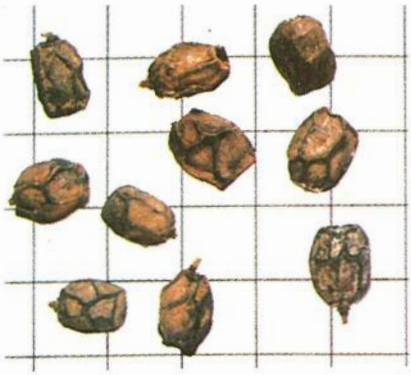
Grewia tenax



Hyphaene thebaica

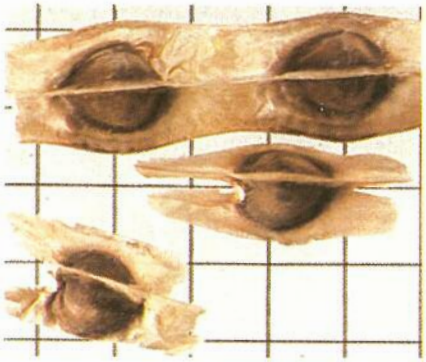


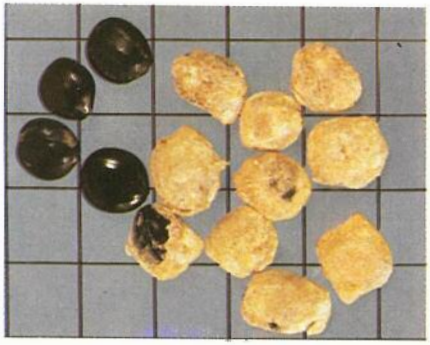


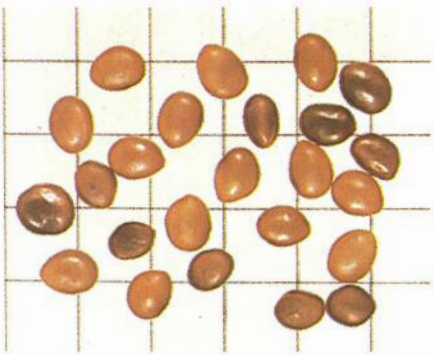


Khaya senegalensis
Lannea acida
Lannea microcarpa

Maerua crassifolia (F)
Mimosa pigra
Mitragyna inermis (F)

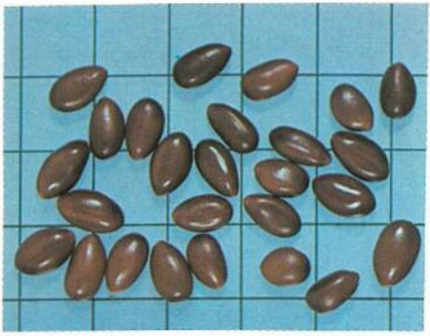


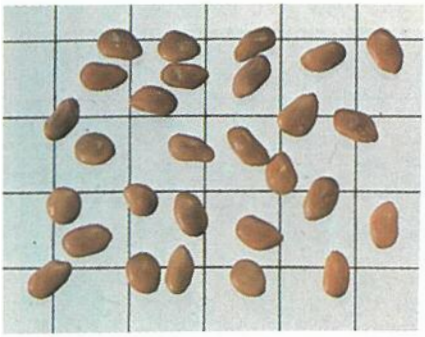


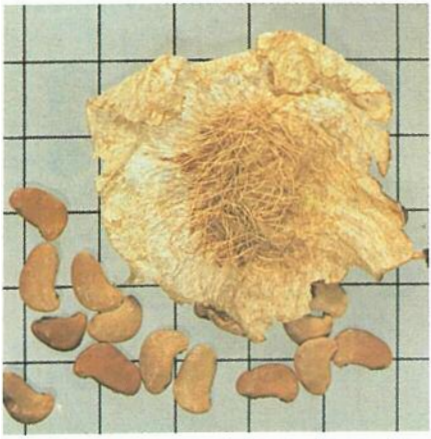


Moringa oleifera
Parkia biglobosa
Parkinsonia aculeata

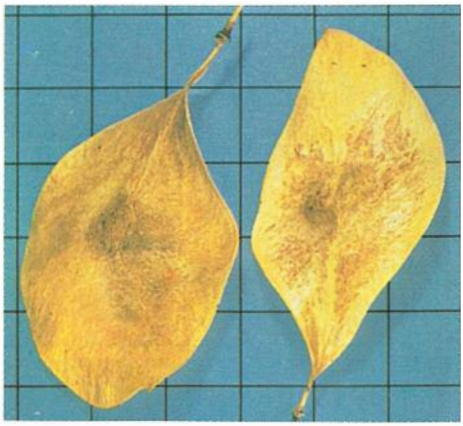
Phoenix dactylifera
Piliostigma reticulatum
Piliostigma thonningii

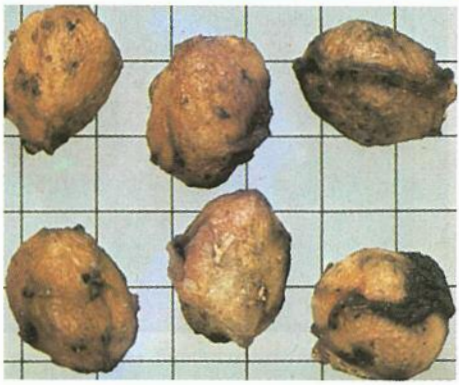


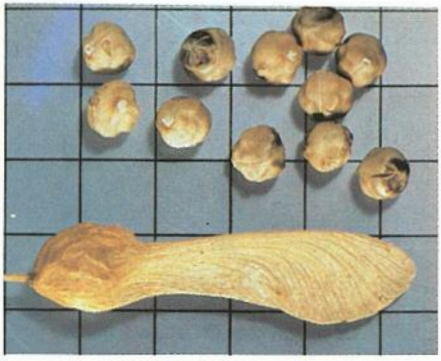




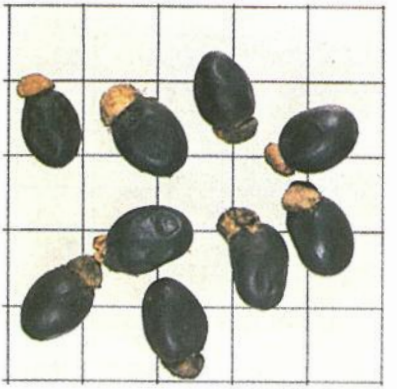
Prosopis africana
Prosopis juliflora
Pterocarpus erinaceus

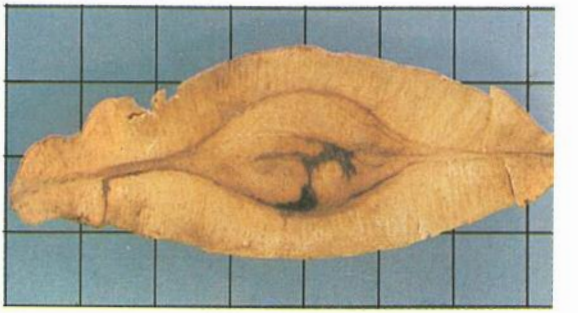


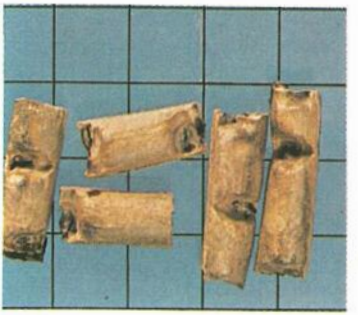


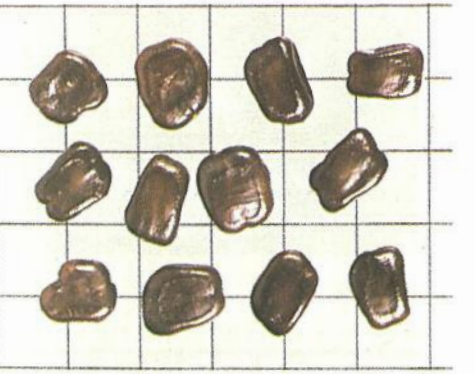


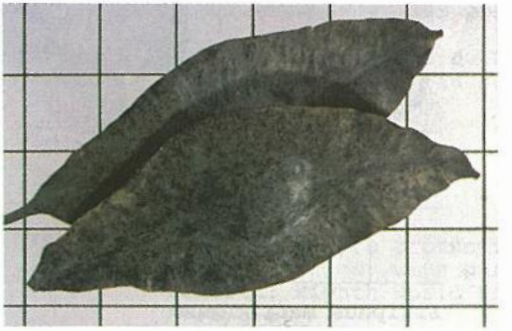
Pterocarpus lucens (F)
Sclerocarya birrea
Securidaca longepedunculata

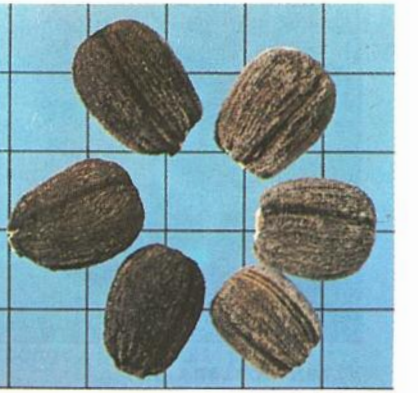






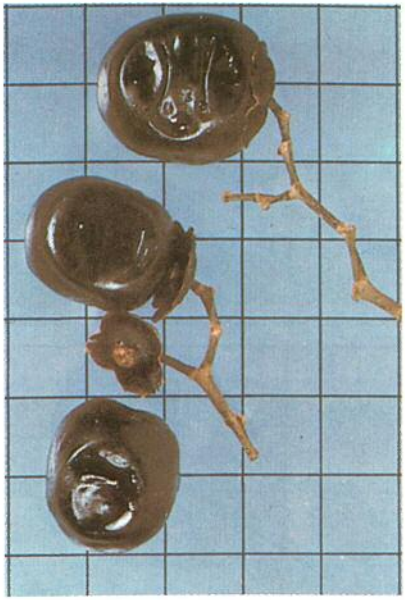


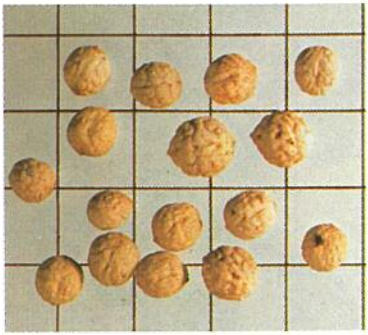


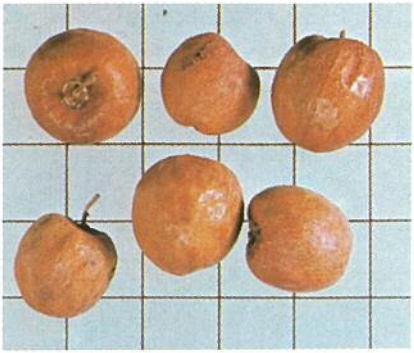


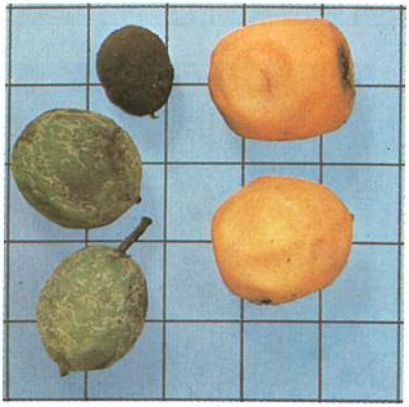
Sterculia setigera
Stereospermum kunthianum
Terminalia avicennioides

Terminalia macroptera
Tamarindus indica
Vitex doniana

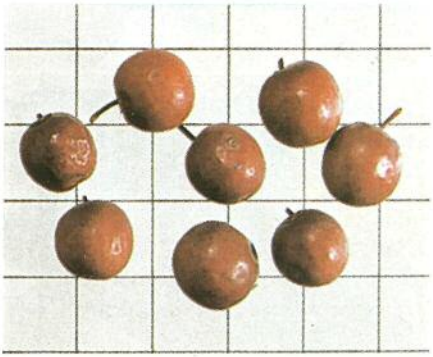








Vitex doniana (F)
Ximenia americana (F)



Ziziphus mauritiana
Ziziphus mauritiana (F)
Ziziphus mucronata (F)

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