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# KENYA AGROFORESTRY TREE SEED PROJECT REPORT

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*Acacia albida*
*Acacia holosericea*
*Acacia melanoxylon*
*Acacia nilotica*
*Acacia saligna*
*Acacia senegal*
*Acacia tortilis*
*Acrocarpus fraxinifolia*
*Adansonia digitata*
*Ailanthus altissima*
*Azadirachta indica*
*Balanites aegyptica*
*Cassia siamea*
*Casuarina equesitifolia*
*Gleditsia triacanthos*
*Grevillea robusta*
*Leucaena leucocephala*
*Melia azedirach*
*Parkinsonia aculeata*
*Podocarpus gracilior*
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# INTRODUCTION

This report describes the activities and findings of ICRAF's one-year Kenya Agroforestry Tree Seed Project. The Project was established with the principle aim of obtaining modest quantities of tree seed appropriate for use in agroforestry systems designed by ICRAF with collaborating Kenyan institutions. It was intended that the Project provide a vehicle through which to explore the issue of tree seed availability in Kenya, generally, and to investigate methods of overcoming a perceived supply constraint.

More specifically, the Seed Project was designed with the immediate goal of securing access to adequate quantities of seed for use by Mazingira Institute's Agroforestry Plots for Rural Kenya Project. A collaborative relationship had developed between the two organizations through which ICRAF had agreed to provide design recommendations for five agroforestry system demonstration trials for implementation through the Mazingira project. In keeping with Mazingira's focus on establishing self-sustaining community-based agroforestry activity, the emphasis of the Seed Project has been on exploring "appropriate" methods of facilitating access to seed by rural non-government organizations.

The report consists of eight sections. The first presents background information on the purpose and organizational structure of the Seed Project as well as the functional relationships among participant institutions.

Second, the general Kenyan context in which the issue of NGO access to tree seed emerges is described. A brief overview of the existing situation is provided which includes identification of major interested agencies or groups, their roles, and perceptions of the problem.

The third section documents the approach used to identify seed requirements of the Mazingira Project. Section four describes seed sources identified by the Project and provides an inventory of the species procured to date. Section five discusses the issue of storage.

These are followed by a section on seed multiplication activities initiated through the Project. Propogation techniques employed are described, along with an initial evaluation of the Project's experience with certain species to date.

Section seven describes the seed distribution activities initiated through the Project and addresses the issue of appropriate supply networking. The final section offers a brief synthesis of the Project's activities and findings.

## 1.0 BACKGROUND AND INSTITUTIONAL PARTICIPATION

### 1.1 BACKGROUND

The idea for the Kenya Tree Seed Project stemmed from ICRAF's understanding that in order to obtain timely feedback from its diagnostic and design input on Mazingira Institute's Agroforestry Plots project, it must ensure that its recommendations could be readily implemented. Initially, the Mazingira project was to have been responsible for all aspects of design implementation, on a trial basis. It soon became evident, however, that ready access to seed of a sufficient variety of species for ICRAF's purposes was problematic. Upon this realization it was decided that a special effort was required to investigate seed availability and to acquire the desired species on a timely basis.

Further consideration of the problem sparked recognition that Mazingira was not the only non-government organization interested in multipurpose tree-planting facing a seed constraint. The problem had been frequently cited at the Kenya National Seminar on Agroforestry, held a year before (1). And it was apparent that no significant steps had been taken at either government or non-government levels to have a practical effect on alleviating the shortfall.

Thus it was decided to use the opportunity of ICRAF's collaboration with Mazingira Institute and, through it, with a variety of locally-based NGO s to explore the seed supply issue more thoroughly. Further, it was suggested that ICRAF and Mazingira Institute together would be a well-suited pair to develop and assess prospects for a systematic, and self-sustaining approach to funds agroforestry seed supply in Kenya.

By commencement of the one-year project, two additional non-government organizations had become involved. Inputs consisted of staff secondments and material assistance. The Mennonite Central Committee (MCC) provided a volunteer from its organization. CARE-Kenya contributed one staff person and funds for purchase and storage of seed. Following are descriptions of the organizations involved in the Seed Project with respect to their direct interests and functional contributions.

## 1.2 MAZINGIRA INSTITUTE

Mazingira Institute is a private Kenyan consulting group whose focus is on social research aimed at low income populations. Through its Agroforestry Plots for Rural Kenya project it is both a collaborator and a direct beneficiary of the Seed Project. The two projects are intimately linked through the sharing of a single manager/co-ordinator. Furthermore the two initially unsolicited secondees to the Seed Project were absorbed into functions which served the objectives of the Mazingira project as well.

Mazingira's agroforestry plots project is a three year pilot probe into the feasibility of introducing concepts and practices of agroforestry to rural communities through locally managed nurseries and demonstration plots. Institutionally, the focus is on NGO s and primary schools. Geographically, a range of agro-climate zones is represented from high potential uplands through semi-arid lowlands. Research emphasis is on monitoring and evaluation of both the agroforestry species and systems trials and the effectiveness of the community development approach at the project's five sites.

Detailed information on the project's objectives, activities and findings to date is presented in two documents, both available in ICRAF's library (2,3). Information of particular significance to the present report includes the five site locations and the social organizations involved at each, as presented below:

| Site Location | Social Organizations |
|---|---|
| 1. Kaewa. Northern Machakos District Kivaa Sub-Location. A-C Zone V | Kaewa Community Self-Help Project |
| 2. Kibiko. Kajiado District, Northern end Ngong Hills near Ngong Town A-C Zone III-IV | Kibiko Primary School, 4-K Club |
| 3. Nyeri. Nyeri District and Municipality. A-C Zone II. | Salvation Army Church |
| 4. Ol Donyo Nyoike. Kajiado District, adjacent Magadi Town. A-C Zone VI. | Group Ranch |
| 5. Siakago. Embu District, Siakago Town. A-C Zone III-IV | Siakago Primary School and 4-K Club. |

These sites provided the focus of activity for the Seed Project. At each, local agroforestry management committees have been established which provide the vehicle through which direct contact with farmers is made. At these sites also, ICRAF obtained early field experience with its Diagnostic and Design Methodology.

The relationship between ICRAF and Mazingira Institute is scheduled to continue beyond the Seed Project's duration. ICRAF will advise on monitoring and evaluation aspects of the Mazingira project with respect to the agroforestry system designs under trial. It will take no further formal responsibility, however, for any aspect of seed supply.

1.3 CARE-KENYA

CARE-Kenya is a non-governmental organization which provides assistance to community development. Its parent organization, CARE, is an international community development and disaster relief agency who has sponsored community forestry initiatives throughout the world.

Initially, CARE-Kenya became involved in the seed Project as a minor financial donor. Soon after commencement of the Project the organization provided a full-time CARE field officer as a further donation and in order to obtain some Kenyan experience in practical community agroforestry. Later during the Project CARE-Kenya offered additional financial assistance. As it was not feasible for the short-lived Seed Project to fully utilize the aid, the Mazingira project became an additional beneficiary.

Through its experience with the Seed and Mazingira Projects, CARE-Kenya has taken interest in developing a full-scale community agroforestry program of its own in Kenya. In this regard momentum initiated through the Seed Project will continue, including collaboration between CARE-Kenya and Mazingira Institute.

1.4 MENNONITE CENTRAL COMMITTEE (MCC)

MCC is a church group who has operated in Kenya for about 19 years. It became involved in the Seed Project during its early stages by offering a volunteer staff member in return for training opportunities with ICRAF.

MCC's secondee assumed a key role in the Project. He was particularly instrumental in developing contacts with non-foreign seed sources, including motivation of local collections. And he has been primarily responsible for researching and recording information on the various species evaluated and/or procured.

As described more fully in Section VII of this report, MCC plans to build on its experience through the Seed Project by advising

local church groups within its own network on appropriate species selection and propogation techniques. It also intends to expand its fledging seed/information bank, initiated during the course of the Project. It is likely that the Mazingira and CARE-Kenya projects will continue to draw on MCC's mounting resource.

## 2.0 AGROFORESTRY TREE SEED AVAILABILITY: THE KENYAN CONTEXT

Continuing interest in agroforestry and afforestation in Kenya has brought the issue of seed supply to the forefront. Two years ago, at the Kenyan National Seminar on Agroforestry seed supply was identified as an issue in need of urgent attention by policy makers, as it was viewed as a significant constraint to widespread promotion and adoption of a promising technology (4).

It appears now that remedial action is under official consideration and that steps are being taken at that level which should lead to an eventual easing of the shortfall. In the meantimo, though, ready access to seed of species appropriate for agroforestry remains a controversial problem. At the practical level it is being dealt with by affected institutions or programs in a variety of ways.

Open consideration of the seed issue at the National level was sparked this year by a German Agency for Technical Cooperation (GTZ) mission to Kenya. The mission team's aim was to assess the need for donor assistance with the seed problem and to explore the feasibility of various program options. Within this context a number of concerns were raised which appear to feature at the centre of deliberations on the topic. These are discussed below in order to provide a view of the Kenya tree seed supply situation at present and, thus, a basis for evaluating this Project's activities.

### 2.1 INSTITUTIONAL RESPONSIBILITY AND COORDINATION

At the heart of the tree seed supply issue lies the question, what institution should take lead responsibility and what should be the roles of other interested parties? The answer to this question intimately affects other aspects of the issue.

### 2.1.1 Present Responsibilities

Presently in Kenya there are two institutions authorised to play the key roles in the provision of forest tree seed. The Forest Department of the Ministry of Environment and Natural Resources (MENR) and the Forestry Division of the Kenya Agricultural Research Institute (KARI), Ministry of Regional Development, Science and Technology (MRDST) coordinate to effect the collection, selection and treatment, storage, and distribution of seed.

The Forest Department requests KARI to collect seed of specific types and quantities, assists in collection and handles public distribution through its Management Services Division at Headquarters. KARI's Forestry Division is responsible for coordination and management of seed collection and for seed processing at its central facility in Muguga. Thus, the routine quality control function is lodged within this institution.

Within KARI is also situated the Division of Plant Quarantine Services. This body controls the importation of vegetative material and seed which is required to pass through quarantine. It appears that relatively few tree species of potential value in agroforestry are presently on the list of plants subject to quarantine.

Seed collection for the Forest Department's plantation program is undertaken primarily at established seed stands. Seed of other species used by the Forest Department's Rural Afforestation and Extension Scheme (RAES) is collected mainly from natural stands at various identified locations throughout the country. KARI has seven research officers and ten rangers. The research officers supervise various aspects of seed collection and handling. The later constitute the field team in charge of collection. They are assisted in their collection efforts by Forest Department personnel.

Other government ministries which have a direct role or interest in tree seed supply include the Ministry of Agriculture (MOA) and the Ministry of Energy (MOE). Within MOA the National Agricultural

Laboratories (NAL) controls importation of seed which is not subject to quarantine. Also within MOA is the Soil Conservation Extension Unit which, through its forest and fruit tree nursery program, procures and uses a variety of tree seed. The Unit has obtained seed from the Forest Department, other on-going projects in Kenya, local collections by MOA staff and by importation (5). Seed obtained by local collection is not channeled through KARI, but is traded directly among the Units 62 soil conservation nurseries.

The Ministry of Energy makes use of agroforestry tree seed through its Fuelwood Development Program which features six large scale tree nurseries located throughout the country. To date, its means of procuring seed have been similar to those of MOA, above, but with relatively greater emphasis on importation and program-administered collections. Through this program the MOE plans to establish a seed treatment and storage facility within the near future, at a site close to Nairobi.

In addition to training foresters the University of Nairobi's Department of Forestry plays a role in the research aspect of seed supply, including species identification, selection and propogation. It's general concern is with quality improvement and control. To date there have been informal links, only, between the University's research program and KARI's Forestry Division.

At least two commercial ventures operating in Kenya are involved in tree seed supply, BAT, Ltd., and Baobab Farms Ltd. BAT produces seed to supply its own tree nurseries. Baobab Farms producus and sells seed of about eight species which are particularly suitable for the coastal enviroement.

Finally, non-government organizations (NGOs) also play a role. For the most part they represent demand for agroforestry tree seed and have not had a significant role to play in supplying it. There are notable exceptions, however. Furthermore this role is changing.

The National Christian Council of Kenya (NCCK) has operated a seed exchange program primarily for the benefit of its member churches in the northern arid areas of Kenya (6). The East Pokot Agricultural Project located in Baringo District is involved in seed collection, importation, propogation and exchange on a modest scale (7). Indications from KENGO, a coalition of NGO s concerned with renewable energy development, are that its member organizations aim to become increasingly active in supplying seed through local collection. Through the present Project three additional NGO s have become involved in seed supply; Mazingira Institute, CARE-Kenya and the Mennonite Central Committee (MCC).

2.1.2 Future Needs

Virtually all interested parties agree that tree seed demand is not being met and and has no possibility of being so under present conditions. It is further apparent to all that financial constraints alone do not constitute the limiting factor. Rather, the problem centers on the organization of the institutional components so as to achieve maximum efficiency and effectiveness from an expanded seed supply program in its various aspects.

At the policy-making level within the Ministry of Environment and Natural Resources (MENR) a matter of priority is to effect a careful assessment of the situation through formal study(8). Each potential institutional actor should be evaluated for its capability to contribute to particular aspects of the total picture. For example, of interest is the possibility of a research program offering grants to individuals to study the potential of indigenous plants for commercial agroforestry and the best methods of propogation. Related to this is the idea of a plant breeding facility wherein propogation by tissue culture could be readily undertaken. How these functions could be effectively incorporated into an integrated agroforestry plant material and seed supply program, is the question which proper study should address.

An advisor to the Forest Department's RAES Program expresses another idea on institutional development priorities (9). Essentially, the object should be to recognize and strengthen the role the farmer can play directly in tree establishment and seed collection. A national policy on communication should be formulated which would specify the need for increasing institutional capacity in education and "encouragement". The aim of such a program would be to assist the farmer to exploit his own resources, in association with his local community, to meet his own need for trees and seed. Working under the supervision of Forest Department officers, retrained with an orientation towards 'community forestry', communities would collect, store and use their own seed, rather than rely on national distributions.

The obvious difficulty with the comprehensive evaluation and re-organization approach lies in the probable interruption of institutional momentum and associated political constraints to implementation. Furthermore, program development on the scale suggested by the foregoing is costly. For these reasons it appears more likely that the immediate course of action will be to strengthen the existing tree seed supply network and control institutions. Further, there is likely to be increased emphasis on the role NGO s and local communities themselves can play in obtaining seed for their own purposes. It is simply a cheaper way of addressing the problem than any other. The question appears to remain, however; what institution or authority, if any, shall assume responsibility for coordinating the activities of the various government and non-government organizations involved in tree establishment and seed supply?

## 2.2 QUALITY CONTROL

The issue of institutional responsibility and coordination is fundamentally tied to the question of seed quality control. The general concern is that efforts by the institution concerned with and assigned to safeguard certain standards concerning collection, treatment, distribution and propogation of seed may be negated by the unsupervised activities of another, or by individuals.

Within the scientific community there is concern about the risks associated with inadequate attention to quality control in the face of mounting demand for agroforestry tree seed. Adherence to strict control standards for collection, documentation, distribution and propogation is advocated by agroforestry specialists in the interest of maintaining the integrity of a given gene pool. Their specific objective is the greater probability of obtaining optimum performance with respect to desired form or use characteristics not only from the parent stand, but from second and third generation growth as well. In addition to the prevention of genetic material erosion, proper provenence certification is understood by scientists to reduce the risk of uncontrolled spread of pathogenes associated with introductions of exogenous plant material.

Development planners, on the other hand, have a legitimate concern with expediency. They argue that the urgency in meeting a real need for trees at the household and community level (not to mention a presidential directive to increase seedling production manyfold within a very short time period), coupled with significant program limitations on the part of institutionalized forest tree seed processing facilities, leaves no choice but to use uncertified seed. Despite the counter-argument that failure to adhere to standards may lead not only to short-lived projects, but also to long lasting damage, the "seed bottleneck" remains viewed basically, as an obstacle to be circumvented by the most expedient means possible.

A strategy which appears to be gaining momentum is local seed collecting by untrained nursery labourers or rural residents representative of the target beneficiary groups of certain tree projects. Such seed may be intended for use within the vicinity of collection or for distribution elsewhere within the country. For the time being KATI does not appear to discourage such activity, in practice. To the contrary it appears pleased to obtain assistance in meeting the soaring demand for tree seed intended for community forestry users which it, admittedly, is in no way prepared to do alone.

The scientific community of foresters have argued that this means of seed acquisition is not only inadequate, but the worst possible method with respect to genetic selection for certain desirable characteristics. In particular, where height and stature are the objectives this method is likely to result in negative selection. The reason is that local seed gatherers, paid on a per weight basis, will go for the lower, shrubbier trees from which it is easier to collect more within a shorter time period (10).

The argument for or against tall, straight trees notwithstanding, the point is that there are stages in the seed handling process which require careful supervision by trained personnel. What is probably nonarguable is the need for such supervision in making careful choices and enforcing strict standards to uphold the viability of a commercial seed export industry. Since such a prospect is reviewed by many as an important and realistic opportunity for Kenya, it is realistic to expect that for this reason alone, seed quality control will become a matter of increasing concern here.

Until firm policy and technical directives are issued, however, it seems appropriate that all organizations involved in tree seed collection be encouraged to document sources as thoroughly as possible and preferably according to a standardized format. In this way the task of tracing origins, should it be desirable, will be made simpler. Through a coordinated effort it seems probable that most organisations would comply. The question remains, though, who should assume the coordinating role?

Avoidance is the best control of possible problems associated with introducing exotic plants and seeds. The agroforestry phenomena has spotlighted a host of "promising" new species, often obtainable only by importation. Most of these have not yet been evaluated with respect to the need for such material to pass through KARI's Division of Plant Quarantine Services (11).

## 2.3 CENTRALIZATION VS. DECENTRALIZATION

On the assumption that an improved and expanded formal seed handling facility is indeed necessary, an issue being debated is whether it should be solely and centrally located at Muguga or developed on a regional basis as several smaller facilities located throughout the country. The arguments in favour of a central unit include initial cost savings in construction and equipment provision, the likelihood of earlier establishment and a less complex administrative burden. Those favouring a decentralized approach speak of cheaper operating costs, primarily due to transportation savings, and expediency in catering to regional demand. Particularly because of a natural regionalization that exists with respect to species suitability on the basis of varying agro-climatic potential, proponents argue the sense of having seed handling station in each major zone.

KARI's Forestry Division favours the centralized approach. Forest Department and University of Nairobi opinion is probably divided, although it appears that decentralization is favoured. From the point of view of other Ministries involved in tree establishment, as well as NGOs having a number of seed facilities located throughout the country would be preferable in terms of ready access, assuming adequate management.

It appears, in any event, that seed handling will occur, increasingly, on a localized, decentralized basis. The nature of agroforestry as applied to the immediate needs of rural farmers, prescribes a simple, practical and inexpensive approach to making seed available. Minimization of seed processing, storage and transportation will be a necessary objective on economic grounds, assuming a national tree establishment campaign which relys on farmers' interest in helping themselves (12).

## 2.4 COMMERCIALIZATION

The main issue associated with commercial aspects of seed supply concerns the discontent by purchasers of seed from foreign sources with the lengthy procedures, high cost and dubious quality involved. A sense of being at the mercy of unscrupulous international seed dealers is largely responsible for the growing momentum behind the quest for an expanded in-country program and facility (13,14).

Regarding commercialization of seed services within Kenya, there appears to be concensus that such a step is a long way off. Presently, the supplying of tree seed at the national level does not present an economic opportunity. It is the view of many that Kenya has tremedous potential to become a tree seed exporter and that a national seed supply program should be designed with this objective in mind (15,16,17,18). When this stage is reached, it will then be appropriate to consider commercialization of the activity. It is generally agreed that close regulation by the public sector of such an industry would be essential.

## 2.5 TECHNOLOGICAL APPROPRIATENESS

The issue of what level of technology is appropriate for overcoming the seed constraint is related again to the purpose for which agroforestry development is intended. At one level there is strong interest in modernizing technology through the introduction of higher level and more complex tools and procedures. This strategy is prescribed for the research sector to hasten performance and findings (19). It would also be employed to safeguard quality during storage and handling at a national facility. It is recognized, and apparently accepted, that such introductions as tree breeding through tissue culture, temperature and humidity regulated storage, and others would require substantial financial and technical/managerial assistance from outside donors.

At the other end of the spectrum is the desire to reduce or simplify the technology required. Some involved at the local level in assisting farmers directly tend to view agroforestry as

a technological opportunity of appropriately modest sophistication. This view extends to the seed supply question. Emphasis is placed on use of techniques which can be employed directly by the intended beneficiaries. For example, use of local species is encouraged. Controlled seed storage then poses no problem because seed would be picked fresh and used relatively immediately. Selection of non-local species would be based in part on adequate seed viability without special storage. Seed would be propogated in local mini-nurseries using locally available containers and, for the most part, self-motivated labour.

## 2.6 SUMMARY

In summary, the issues which characterize the rapidly evolving dialogue on tree seed supply reflect the various roles involved in promoting agroforestry development and various views about the role of agroforestry in national development. As the record on agroforestry awareness in Kenya indicates, there exists a wide range of interpretation about its nature and potential value in addressing developmental problems. Thus, specific approaches to agroforestry implementation are often best evaluated on the basis of program objectives.

ICRAF's Kenya Tree Seed Project was designed to compliment a particular approach to agroforestry development. As indicated previously, the focus of Mazingira Institute's Agroforestry Plots project is on direct interaction between local level participants/beneficiaries and the project team, consisting of NGO representatives. It is therefore biased towards inexpensive, non-commercial and locally appropriate methods of implementation. The Seed Project has maintained a basic interest, however, in keeping perspective on the larger issues associated with seed supply and demand.

## 3.0 ASSESSMENT OF SEED REQUIREMENTS

The first objective of the Tree Seed Project was to make a realistic determination of the Mazingira project's seed requirements. The assessment process consisted of four major components.

The first step involved collection and synthesis of existing species lists which had been developed for other purposes, but were considered pertinant to the Project's needs. The second was application of ICRAF's Diagnostic and Design (D&D) Methodology at each site to determine the nature of respective farming system problems and associated needs, or desired uses, of trees. Third, an inventory was taken of species existing on farms within the target areas of three sites and their uses documented to create an additional list of candidate species. The fourth component involved evaluation on the basis of the D&D team's design recommendations, existing experience with various species through other projects and literature available in ICRAF's library. The process was an iterative one whereby proposal and evaluation of candidate species was ongoing throughout the Project.

### 3.1 SYNTHESIS OF SPECIES LISTS

The Mazingira project's five sites are located, one each, in five different agro-climatic zones. Thus, the first criterion established for species selection was environmental suitability. Average annual rainfall, altitude and soil type are the most significant measurable determinants of species adaptability.

Due to the multiple factors involved in classifying soil types and extensive soil variation within limited geographic areas, no serious attempt has been made to systematically relate candidate agroforestry species to soil type on a wide geographical basis. The approach taken, thus, was to commission soil sample analyses for each site. These were intended for use by ICRAF's Senior Design Team in screening candidate species on the basis of this factor.

Altitude and rainfall determinants can be more readily classified and as such related to species adaptability. Thus, the first procedure undertaken in the species assessment process was to collect and evaluate lists of candidate species accordingly, with respect to the five target sites.

Three lists were obtained. Two had been developed by respective senior foresters with considerable agroforestry experience in northern and eastern africa (20,21). The third was compiled by ICRAF's senior staff member in charge of overseeing the Seed Project (22) and was based primarily on popular literature. The product of the first environmental evaluation effort was five preliminary lists, one for each site. It was on the basis of these that the seed procurement process was initiated.

## 3.2 DIAGNOSTIC ASSESSMENT

Implementation of ICRAF's Diagnostic and Design Methodology (D&D) at the Mazingira project's five sites featured as a major activity over the year and has been well documented in the Mazingira project's first annual progress report (23). The essence of the diagnostic process was to conduct a three stage inventory and evaluation of local land use and farming system patterns and constraints. On the basis of the diagnoses, agroforestry "remedies" were prescribed for trial demonstration and evaluation. Through this process then, desirable tree use specifications were indicated.

The product of the diagnostic and design exercise is a report by ICRAF's D&D team to the Mazingira project which specifies species which may be appropriate as "components" for each suggested functional intervention (24). For example to address an identified problem of wind damage to crops and infrastructure, a windbreak is prescribed. Various features of a good windbreak are listed, followed by a list of species potentially capable of fulfilling those requirements. For each agroforestry technique

described, however, only very partial lists of candidate species were offered. The task was given to the Seed/Mazingira project staff to expand and qualify the lists as time and access to information permitted.

## 3.3 ON-SITE SPECIES INVENTORY

ICRAF's technical field forester, assigned briefly to the Seed Project, undertook an inventory of species growing on shambas of those farmers interviewed for the diagnostic problem identification survey.

When the forester or assisting Mazingira/Seed Project team members were unsure of a species' identity, the local name was recorded and a specimen taken for identification at the National Herbarium. A list of potential uses of each species was developed through questioning farmers and by reference to literature.

Farmers were also asked to provide personal assessment as to whether or not each species was compatible with crops, with a simple yes/no response. These were cross-checked by the field forester. Relative growth rates of each species were indicated by comparing each with that of one well-known medium growing species. Thus, each species was assigned a qualitative value of fast, medium or slow growing.

A further aspect of the species inventory involved determination of seeding times for each species. In most cases farmers were aware of when, throughout the year, their trees produced seed. This information was cross-checked and supplimented by the field forester.

The product of the on-site species inventory is a matrix for three of the five sites[x] which specifies uses, crop compatibility, growth rate, and seeding times for each species. From these matrices ICRAF's D&D team selected species which have a potential role to play in the design of agroforestry systems for each site, and

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[x] Unfortunately, the field forester was dismissed from ICRAF's services prior to completion of the exercise.

synthesized a summary matrix. This then constituted an additional list of candidate species, pre-selected for environmental suitability and seed availability. Both the site matrices and the summary matrix are presented in Appendix A.

## 3.4 SPECIES EVALUATION

Information sources used for evaluating the potential value of candidate tree species for the respective project sites are listed in the reference section of this report. The team member principally responsible for this aspect was MCC's secondee to ICRAF. In addition to published information sources, substantial reliance was placed from the beginning on discussion with individuals involved in other projects who had developed practical experience with various agroforestry species, particularly exotics.

As the Project progressed and feedback from its seed procurement component became available, increasing emphasis was placed on evaluation of indigenous species. Unfortunately, however, relatively little information of practical value to agroforestry designers has been published. The information which does exist on Kenyan species places primary emphasizes on the timber value of wood (25). Thus, increasing reliance for information was placed on discussion with members of the Mazingira project's agroforestry management committees, other local farmers, and District Forest Officers with knowledge of local species.

As information was obtained it was recorded on index cards and filed alphabetically, by species. As the project progressed into the seed multiplication stage, information pertinant to that aspect was added. In order to make both seed multiplication and distribution more meaningful to the beneficiaries the indexed species information was transposed onto single page descriptions, one for each species.

To date, 25 species information sheets have been prepared, including one for each species so far propogated through the Mazingira project.

They have been made available to the Project's seed recipients and are presently being translated into Kiswahili through the Mazingira project so as to be of more value locally. They are presented in this report as Appendix B.

In addition of these, the Project files contain further lists of potentially suitable local species for the Mazingira sites along with whatever limited information may be available. It is the intent that as experience is gained through efforts of the Project's collaborating institutions, further information will be recorded.

## 4.0 SEED SOURCES AND PROCUREMENT

The Project's search for seed focused on both local and foreign sources. At commencement of the Project the information available on seed sources included that published in the Kenya Agroforestry Seminar Proceedings (26) and a short list of foreign companies culled from ICRAF's files.

Feedback from inquiries about seed availability for species featured on the Project's original working lists was disappointing. In particular, the majority of foreign companies approached by mail either failed to respond or indicated very limited seed choices available with reference to the Project's requests. Locally, it was found that one organization who in the recent past had operated an impressive seed distribution program with respect to species choice for dryland areas, the National Christian Council of Kenya (NCCK), had become partially defunct. Potential government sources (Forest Department, Soil Conservation Extension Unit, and Ministry of Energy Fuelwood Project) were able to supply none of the species sought. So early on, expectations were reduced and attention was turned towards identification of further sources.

An important activity in this regard was the development of personal contacts with other tree establishment project. These

included both government and NGO sponsored nurseries. Often it was found that either seed, in small quantities, or information about seed sources was obtainable through this informal means. The presumption (and reality) was that the present Project may be approached someday for a returned favour.

Relatively late in the Project an additional listing of foreign seed suppliers was obtained from personal files of an ICRAF senior staff member. A number of forestry research institutes were listed, several of which appear promising as sources for trial quantities of some of the more difficult to obtain species. A third source category cultivated by the Project was organized collection of local species at the Mazingira project sites. Ultimately though, because of the lag time involved in identifying sources and procuring seed, availability became a leading criteria in selecting appropriate species for trial demonstration at the Mazingira sites.

## 4.1 FOREIGN SUPPLIERS

Foreign suppliers who have responded to the Project's request for seed or information are listed below. Commercial suppliers are private enterprises whose primary business is seed trade. Non-commercial suppliers, generally, are research organizations who may offer seed for sale, or sometimes for no charge if intended for research purposes. In addition to these lists, a compilation of seed catalogues offered by commercial suppliers in four major seed exporting countries is available as a single document in ICRAF's library*

Normally, seed orders were accompanied by a request for specific provenance information about each species. The listings indicate the extent to which such information was provided. Only one foreign supplier from whom seed has so far been ordered has provided a full response.

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* Michael D. Benge, Selected Tree Seed Sources in Australia, India, Holland and the United States, Technical Series No.1, S&T/FNR Agro-Forestation, Run. 203-E, SA-18, AID, Washington D.C. 20523, U.S.A.

4.1.1 Commercial Suppliers

1. Arava Seeds Suppliers, Haifa,
P.O. Box 45109
ISRAEL

Have received six species; *Ailanthus altissima*, *Casuarina cunninghamia*, *Cassia sturtii*, *Parkinsonia aculeata*, *Melia azedarach*, *Zizyphus spinachristii*. Provenance information: country of origin. Company's revised list (August, 1982) of trees and shrubs available includes wide variety of species suitable for Mediterranean or semi-arid regions. Relatively moderate prices.

2. Carter Seeds
475 Mar Vista Drive
Vista
California 92083, U.S.A.

Have ordered 1 pound of *Alnus nepalensis*, not yet received. Awaiting provenance information.

3. Flamingo Seeds Pty Ltd.,
P.O. Box 1046
East Nowra NSW 2541, AUSTRALIA

No seed procured to date.
Three species about which information requested are available; *Acacia saligna*, *Ailanthus altissima* and *Albizia lebbek*.
However, more expensive than other sources.

4. Herbst Brothers Seedsmen, Inc.,
N. Main Street.
Brewster
N.Y. 10509
U.S.A.

Request for catalogue has produced no response after two months. Kenya's EDI/MOE Fuelwood Project has ordered 59 species from this company.

5. The Inland and Foreign Trading Co., (PTE) Ltd.,
P.O. Box 2098
Maxwell Road Post Office
Singapore, 9040

Indicate availability of 17 shrubs and trees selected for shade, medicinal and perfume purposes. No orders placed.

6. International Tree Seed Bank
   43 Le Puy
   France

   Have received cataloque, but placed no orders.

7. Kumar International
   Ajitmal 206121
   Etawah, UP.,
   India

   Have received two species: *Moringa oleifera* and *Sesbania aculeata*. Company advertised *Adhatoda vasica*, but not available. Provenance information: Country of origin.

8. Lowe Farms, Inc.,
   P.O. Box 131,
   Kahuku, Hawaii 96731
   U.S.A.

   Supplies only *Leucaena leucocephala* (KOA seed).

9. National Seed Company of Malawi
   P.O. Box 30050
   Lilongwe 3
   Malawi

   Only Leucaena available for commercial distribution. Recommended contacting Forestry Research Institute of Malawi.

10. Native Plants,
    360 Wakara Way
    Salt Lake City, Utah 84108
    U.S.A. (Attn: Hugh Bolinger)

    No seed procured to date. Company states that upon receipt of a confirmed request, can make available almost any quantity of virtually any plant in the world, but it may take some time. Relatively expensive.

11. Setropa
    P.O. Box 203
    Bassum, Holland (Attn: J. Koiter)

    Seed procured to date: *Gleditsia triacanthos*, *Prosopis juliflora*, *Sesbania grandiflora*, *Zizyphus jujuba*. Company catalogue offers a wide variety of species suitable for the tropics.

12. Timmers and Leyer,
    P.O. Box 17, Heemstede 2100 AA
    Holland (Attn: John D. Leyer)

    One species ordered and received: *Samanea saman, mer.* Provenence information: country of origin.

13. Tree Seeds International
    3402 Esther Court
    Silver Spring, Maryland 20910
    U.S.A. (Attn: D.C. Crowley)

    No seed procured. Can supply *Leucaena K8, K28*, and K67; also *Sesbania*, *Calliandra*, and "a wide variety of leguminous trees and shrubs". Seed stocked by request however, so needs must be anticipated in advance.

4.1.2 Non-Commercial Suppliers

1. Department of Forestry
   Mineral House,
   41 George Street
   Brisbane,
   Australia

   Indicated availability of *Acacia mangium*, but not yet ordered. Provenence information (provided prior to placing order): source, latitude, longitude, altitude, average rainfall, parent stand (Nat.), parent trees and date of collection (most comprehensive provenance information received to date).

2. Fusa Sudzuki Hills
   Universidad de Chile
   Fac. de Ciencias Agrarias
   Vedeievarias y Forestales
   Depto. Production Agricola
   Area de Frutic. y Vitic
   Casilla 1004 - Santiago
   Chile

   Has delivered 25 grammes of *Prosopis tamarugo*. No provenence information.

3. Dr. Ben Chang
Banco Latinoamericano de Semillas Forestales
CATIE
Turrialba
Costa Rica

Have ordered following species from CATIE regional seed bank: *Mimosa scabrella*, *Enterolobium cyclocarpum* and *Alnus acuminata*. First two sent (though not received). Alnus presently out of stock. Awaiting provenence information.

4. Dr. Ashok Raina
Silviculturalist
Central and Arid Zone Research Institute
Jodhpur, 342003,
India

No seed has as yet been received. However, we have had a positive response to requests for the following species. *Prosopis cineraria*, *Harbrickia binata* and *Colophospermum mopane*.

5. Forest Research Institute,
Salan Junurg Batu
P.O. Box 66
Bogor
Indonesia

Institute does not sell or distribute forest tree seed.

6. Research and Development Authority
Ben-yurian University of the Negev
P.O. Box 1025
Beer-Sheva 84110
Israel

Indicated have send *Prosopis tamarugo* seed, but collected 1971, which they admit to be old. Suggest we write:

7. Confar-Huerfanos 554
6th Floor
Santiago
Chile.

No response to date.

8. Forestry Research Institute of Malawi
P.O. Box 270
Zombe
Malawi

Only forest tree seed available is *Acrocarpus fraxinifolia*. No order placed.

9. Forestry Research Institute of Nigeria
Private Mail Bag 5054
Ibadan
Nigeria

Sent list of 128 species available along with indication of original eco-type. No prices quoted. No orders placed.

10. Silviculturalist
Forest Division, Silviculture Research Station
P.O. Box 95
Lushoto
Tanzania

Indicated availability of all five indigenous species ordered, to be sent as they are harvested: *Albizia lebbeck*, *Albizia schimperana*, *Cassia spectabilis*, *Maesopsis eminii*, *Melia arborea*. Indicated all provenance information requested to be provided. Offer 75 species for sale. Moderate prices.

11. University of Dar-es-Salaam
Faculty of Agriculture, Forestry and Veterinary Science
Sub Post Office
Chuo Kikuu
Morogoro
Tanzania

No *Pithecellobium dulce* seed available, as requested.

12. National Research Council
Office of International Affairs
2101 Constitution Avenue
Washington D.C. 20418
U.S.A.

Ordered and received trial quantities of *Anogeissus leiocarpus*, *Prosopis alba* and *Terminalia comphoratus*. Provenance information: country of origin. Also, original supplier and accession number.

13. Paul K. Soderholm
Horticulturalist
Subtropical Horticulture Research Unit,
13601 Old Cutler Road
Miami, Florida 33158
U.S.A.

*Adhatoda vasica* unavailable this season due to local weather conditions. Suggested two other possible sources (listed below as Nos. 3 and 4).

4.1.3 Further Possible Non-Commercial Sources:

Although responses have not been received, the following are included either because information requests were made only recently, or because the supplier is reputed to be slow to reply.

1. Mr. A.S. Raturi
Seed Testing Laboratory
Forest Research Institute and Colleges
P.O. Box New Forest
Dehra Dun
Uttah Pradesh
India

Ordered *Emblica officinalis*. No response to date.

2. Pratap Nursery
P.O. Premnagar
Dehra Dun (U.P.)
India

Requested catalogue. No response to date.

3. N.Y. Mohan Ram
Department of Botany
University of Delhi
Delhi 110007
India

Possible source for *Adhatoda vasica* seed. No response to date.

4. C.K. Atal
Director
Regional Research Laboratory
Council of Scientific and Industrial Research
Canal Road
Jammu Tawi 150001
India

Possible source of *Adhatoda vasica* seed.

5. Lembaga Penelitian Hutan
Djl. Gunung Batu
P.O. Box 66
Bogor
Indonesia

Requested catalogue. No response to date.

6. Mr. O. Hamel
CNRF
B.P. 2312
Dakar-Hann
Senegal

Requested information on three species. No response to date.

## 4.2 LOCAL SUPPLIERS

Kenya-based seed sources include both government and non-government organizations. Because local sources are of particular relevance to the present Project, listings include all species available at the time of Project requests to the respective suppliers regardless of their value in meeting the Project's specific seed requirements. Species actually obtained are also indicated.

### 4.2.1 Government Sources

1. Kenya Forest Department
Ministry of Environment and Natural Resources
Forest Department Headquarters
Office of the Seedsman
Kenyatta Avenue
Nairobi

In anticipation of June/July nursery planting dates the Project approached the Forest Department in early May about seed availability. The following species were available for purchase:

| | |
|---|---|
| *Acacia tortilis* | *Eucalyptus paniculata* |
| *Cassia siamea* | *Jacaranda mimosifolia* |
| *Cupressus lusitanica* | *Machaerium tipu* |

No seed was ordered.

2. Office of the Silviculturist (Mr. Konuche)
Forest Department
P.O. Box 74
Kikuyu

Mid-way through the Project period the team obtained from the Silviculturist the following list of species which are subject to collection throughout the year. The Project was informed that orders for small quantities of these could be placed directly with the Silviculturist. Orders to meet next year's Mazingira project requirements are presently under consideration.

| | |
|---|---|
| *Afzelia quanzensis* | *Gmelina arborea* |
| *Araucaria cunninghamii* | *Leucaena leucocephala* |
| *Cassia spectabilis* | *Machurium tipu* |
| *Cupressus lusitanica* | *Melia volkensii* |
| *Delonix regia* | *Parkinsonia aculeata* |
| *Eucalyptus maculata* | *Pinus patula* |
| *Eucalyptus microcorys* | *Prosopis juliflora* |
| *Eucalyptus paniculata* | *Tecoma stans* |
| *Eucalyptus robusta* | *Terminalia brownii* |
| *Eucalyptus saligna* | |

3. Kenya Forest Department
District Forest Officer
Nyahururu.

The project team found this forest station to be in the process of collecting several highland species at the time of contact. It made seed of the following species available:

*Acacia melanoxylon*
*Calodendron capense*
*Podocarpus gracilior*

Throughout the Project other Forest Department field officers were approached as well. In general it was found that the rangers in charge were willing to assist with providing seed if available.

4. EDI/Ministry of Energy (MOE) Renewable Energy Program
(Agroforestry/Fuelwood Project - Attn: Amare Getahun)
Harambee Avenue
Nairobi.

The Project team has collaborated with the EDI/MOE fuelwood project throughout the Project period with respect to information sharing about species suitability and seed sources. EDI/MOE initiated implementation of its agroforestry/fuelwood project simultaneously with commencement of the Seed Project. Similarly to the Mazingira project, the EDI/MOE project's directive was to establish agroforestry nurseries within a range of agro-climatic zones throughout Kenya. Although the scale of the nurseries and their specific locations differed, species requirements were similar. Likewise, interest in cultivating local sources, in addition to importation of exotics, was shared.

The two projects sought seed from essentially the same local sources. EDI/MOE did procure some seed from the Forest Department. Regarding importation EDI/MOE was limited in acting until late in the year when its procurement officer was assigned. In the meantime, minor quantities of seed acquired through the Seed Project was provided. Since then, seed of the species listed below have been obtained from EDI/MOE. It is possible that small quantities of additional species may be made available for informal trade upon arrival of a major seed order from a U.S. based commercial supplier. The Project, however, will not become a formal supplier of tree seed until its own planned seed stands are productive. Species obtained: -

*Acacia cyanophylla*
*Acacia decurrens*
*Acacia melanoxylon*

5. Kenya Agricultural Research Institute
Katumani Dry Land Research Station
Machakos

Contact was made with no success in procuring seed. Certain dryland grass species were potentially available later in the year.

4.2.2 Non-Government Sources

Non-Government seed suppliers with whom the Project has made contact include both commercial and private voluntary organizations. The Project has identified only one commercial enterprise involved in producing and selling seed.

1. Baobab Farms, Ltd. (Rene de Haller)
P.O. Box 90202
Mombasa, Kenya.

This company produces seed commercially on land which Baobab Farms manages for Bamburi Cement Ltd. The seed is expensive, but because of limited alternative sources, worth the price. The following species are available, all of which have been obtained by the Project.

*Azadirachta indica* (distributed rather than used due to short viability)
*Casurina equisetifolia*
*Conocarpus lancifolia*
*Leucaena leucocephala*
*Prosopis juliflora*
*Prosopis pallida*

2. BAT, Ltd.,

BAT, Ltd., has seed available for its own use only. It is in search of a wider variety of species for use in its developing fuelwood/agroforestry program through which tobacco-growing farmers are provided with tree seedlings. Through contacts with the Seed Project information and small quantities of seed have been informally exchanged. The following are species which BAT is presently raising in its nurseries:

*Acacia spectabilis*
*Cassia siamea*
*Cassia spectabilis*
*Eucalyptus globulus*
*Eucalyptus maturensis*
*Eucalyptus saligna*
*Grevillia robusta*
*Leucaena leucocephala*
*Prosopis pallida*

BAT is developing seed stands of each, several of which are already productive. It also has immediate plans to raise *Acacia albida* with seed obtained from the Seed Project. To date the Project has procured small quantities of *Grevillia robusta* from BAT. Company employees have supervised its collection from farmers' fields.

3. Mr. Mark Lyles
c/o Mr. Rob Bloemers
Project Manager
A.R.I.D.
P.O. Box 1215
Kitale.

The Salvation Army Church's Turkana Program sponsored the collection of 100 kgs of *Acacia albida* in 1981. The church offered to sell the seed to A.R.I.D. for KShs. 7/= per kg. A.R.I.D. could use only 5 kgs., so contacted ICRAF to see if it could dispose of the remainder. The Seed Project purchased about 50 kgs. The seed has been propogated at the Mazingira project nurseries. It has also been important to the Project for its exchange value. The offer of sizable quantities of *Acacia albida* seed for use by other projects has promoted access to other species of value to the Seed Project.

4. National Christian Council of Kenya (NCCK)
(Attn: Jidraph Kimura)
Church House
Moi Avenue
Nairobi

At commencement of the Seed Project is was envisaged that a primary seed source, especially for dry area species, would be NCCK. Much had been published about the organization's seed networking program including lengthy species lists of seed it had distributed (27).

Project contact with NCCK found that its "seed bank" has become practically defunct following departure of its ex-patriot organizer. But although there was no seed presently "in stock" the collection network was said to be well enough in tact, that orders placed for the species listed below could be met within the year. No orders were placed, however, as most of the species of potential interest were obtainable from other sources.

| | |
|---|---|
| *Acacia senegal* | *Conocarpus latifolia* |
| *Acacia tortilis* | *Leucaena leucocephala* |
| *Algaroba* | *Prosopis juliflora* |
| *Azadirachta indica* | *Tylosema esculentum* |
| *Casuarina equisetifolia* | |

5. UNESCO (Hugh Lamprey)
Integrated Project for Arid Lands (IPAL)
Bruce House - 6th Floor
Standard Street
Nairobi

The director of the IPAL project was approached for information about the stock at IPAL's three drylard nurseries (28, 29). All of the project's nurseries were said to have been disbanded due primarily to poor success of the trees after planting out. One species which had thrived in the Huri Hills under an intermitant watering regime, *Parkinsonia aculeata*, was said to be producing seed. A written request to the caretaker of the trees would probably produce some seed later within the year.

6. Baringo Fuelwood Nursery Project (Murry Roberts)
Marigat

The Seed Project exchanged information and seed with the Baringo project, which was initiated at approximately the same time. The seed so far obtained from Mr. Roberts is *Prosopis chilensis*.

7. East Pokot Agricultural Project (Ed Barrow)
Kositei Catholic Mission
P.O. Marigat
Nakuru

This project was the major local source of seed and of information on propogation and establishment techniques for the Seed Project. A social range rehabilitation project, it has been on-going for about 7 years. A number of the dryland tree species it has established are now producing seed (30, 31).

Below is a list of species which the project was able to collect and distribute in 1981 and 1982. Seed was obtained by the Project of those species indicated by an *.

In addition to those listed, *Moringa oleiphera* was obtained. No charge was made for the seed. However, if larger quantities are sought a small charge may be made to cover collection and cleaning of the material.

*Acacia albida*
*Acacia aneura*
*Acacia eliator*
*Acacia haloserica*
*Acacia tortilis**
*Adansonia digitata (Baobab)*
*Atriplex nummelaria*
*Balanitias aegyptica**
*Bosica spp.*
*Cassia sianea**
*Cassia sturtii*
*Cassuarina equistifolia*
*Conocarpus lanoifolia*
*Delonix elata**
*Eucalyptus camaldulensis*
*Eucalyptus citriodora*
*Leucaena leucocephala*
*Moringa oleiphera*
*Parkinsonia aculeata*
*Prosopis chilensis**
*Prosopis juliflora (P2) Haller*
*P. (Jerusalem) juliflora*
*Tamarindus indica*
*Tamarix spp.*
*Zizyphus mauritiana**

## 4.3 LOCAL COLLECTIONS

A key objective of the Seed Project was to examine prospects for local seed collection and in particular, for engaging rural residents in the effort. The four Mazingira project agroforestry management committees involved in nursery establishment were used as the principle vehicles through which the Seed Project sought to motivate seed collection.

At two of the Mazingira project sites (Siakago and Kibiko) it was found upon initial discussion that seed of certain species had already been collected by management committee members. The assumption was that since nurseries were intended, seed would be needed. Likewise, it was found at the remaining sites that generating interest in seed collection presented little challenge.

The task for the Seed Project, thus, was to systematically identify local species, uses and potential disireability of each, and seeding times. Further, the Project team attempted to establish rules about seed labelling in the interest of recording provenance information and in generating local awareness about the value of doing so. The only other instruction provided by the Project team was that different species must not be mixed. Collected seed was inspected prior to acceptance to insure adherence to this rule.

In addition to collections which were made voluntarily by interested committee members, the Project team organized "sponsored" collections. Based, in part, upon interviews with committee members to determine which local species are particularly highly regarded and why, lists of desired seed were developed. These did not necessarily correspond to the lists developed in parallel with the diagnostic survey, as the latter included only species found on survey respondent's shambas. Rather, lists of sought-after seed included species known or thought to be present in the respective areas, but which are not necessarily common.

Depending upon what was known about the size of the seed and its relative availability in the area, prices per kilogram were fixed to the lists. In addition, an upper limit was set on the amount of clean seed which the Project was willing to purchase.

The best effort to date to effect this procedure has been at Kaewa. There, seven of the nine species specified were collected and purchased by the Project. Only two problems were experienced.

First, the committee made an oversight in failing to limit the amounts collected to those specified on the list. Thus, seed was provided far in excess of requirements. As the Project was willing to purchase only the amounts specified, the management committee was left to determine how the money should be distributed among the various collectors.

The second, and more fundamental problem was not discovered until later. The Project team brought to Kaewa several species of the collected seed for propogation during the second cycle of nursery operations there (seed planting in November, 1982). The committee opposed the use of the seed. It was argued that the seed had been collected with the understanding it was to be used at other sites, not at Kaewa. Committee members appeared angry in their demands for "new" species only.

As the most adamant of the new-species advocates did not arrive at the scene until several beds had already been planted of locally collected seed, the Project team found it possible to convince the committee that those should remain. The team had to agree, however, that seedlings be earmarked for use at the community demonstration plot and not for general distribution.

In exploring the issue further with the committee it was learned that had the two species on the collection list which had not been obtained been proposed for planting, the committee would have welcomed the idea. These two, *Dalbergia melanoxylon* (muviago) and Malinditi (scientific name unknown), had become rare because of their particular value, locally. Thus, it was not necessarily

the "newness" of the species which influenced interest in propogating it, but that it not be commonly available. It is possible, of course, that this view may change as unfamiliar management techniques with familiar species are tried and "proven" at the demonstration plot.

To date the Project has not obtained sufficient breath of experience with local seed collection efforts to make a realistic evaluation of its potential. There is certainly enough promise, however, to warrant continued and expanded effort through the Mazingira project, and others.

Below is a list of species obtained by the Project through local collections at the respective sites. Appendix C contains a list of information items specified for collected seed labeling. Also presented there is the list of collectable species as presented to the committee by the Project team.

| Site | Species |
|---|---|
| Siakago | *Grevillia robusta* |
| | *Melia volkensii* |
| Kibiko | *Calodendron capense* |
| | *Croton megalocarpus* |
| Nyeri | *Aerocarpus frazinifolia* |
| Kaewa | *Acacia brevispica* |
| | *Acacia mellifera* |
| | *Acacia nilotica* |
| | *Acacia senegal* |
| | *Hymenodictyon parvifidium* |
| | *Lannea stuhlmannii* |
| | *Melina volkensii* |

## 4.4 SPECIES INVENTORY

Following is a list of species which had been procured through the Seed Project as of the end of November, 1982. Four additional species have been purchased from foreign suppliers but not yet received.

The list includes the date of seed collection, if known. If not, the date the seed was received by the Project is indicated, as well as the amount received. Each of the suppliers listed is further identified in the proceeding lists of seed sources.

SPECIES INVENTORY - Through November, 1982

| Species | Date Received (R) or Collected (C) | Amount Received (Kgs) | Supplier |
|---|---|---|---|
| *Acacia albida* | Dec.'80 (C) | 1 | Ed Barrow |
| *Acacia albida* | Jan.'82 (R) | | Salvation Army/Turkana |
| *Acacia brevispica* | Aug.'82 (C) | 3 | Kaewa Committee |
| *Acacia cyanophylla* | Oct.'82 (R) | .100 | EDI/MOE |
| *Acacia decurrens* | Oct.'82 (R) | .100 | EDI/MOE |
| *Acacia melanoxylon* | Oct.'82 (R) | .100 | EDI/MOE |
| *Acacia melanoxylon* | Oct.'82 (C) | .600 | DFO Nyahururu |
| *Acacia mellifera* | Aug.'82 (C) | .025 | Kaewa Committee |
| *Acacia nilotica* | Aug.'82 (C) | 1.0 | Kaewa Committee |
| *Acacia senegal* | Aug.'82 (C) | .025 | Kaewa Committee |
| *Acacia tortilis* | Dec.'80 (C) | 3.0 | Ed Barrow |
| *Acrocarpus fraxinifolia* | Aug.'82 (C) | .250 | Nyeri Committee |
| *Ailanthus altissima* | Oct.'82 (R) | 1.0 | Arava |
| *Anacardiacha indica* | Apr.'82 (C+R) | 2.0 | Baobab Farms |
| *Balanites aegyptica* | May '82 (R) | .800 | Ed Barrow |
| *Calliandra calothyrsus* | Dec.'81 (R) | | NAS/USAID |
| *Cassia siamea* | July '82 (C) | .100 | Project Team/Siakago |
| *Cassia siamea* | Aug.'81 (C) | .450 | Ed Barrow |
| *Cassia sturtii* | Oct.'82 (R) | 1.0 | Arava Seeds |
| *Casuarina cunninghamiana* | Oct.'82 (R) | 1.0 | Arava Seeds |
| *Casuarina equisetifolia* | May '82 (R) | .110 | Baobab Farms |
| *Croton megalocarpus* | March '82 (R) | 2.0 | Kibiko Committee |

SPECIES INVENTORY Contd.

| Species | Date Received (R) or Collected (C) | Amount Received (Kg) | Supplier |
|---|---|---|---|
| *Delanix elata* | May '82 (R) | .750 | Ed Barrow |
| *Gleditsia triacanthas* | March '82 (R) | 1.0 | SETROPA |
| *Grevillea robusta* | Sept. '82 (C) | .750 | BAT, ENA Nursery |
| *P[illegible]modiotaon parvia-[illegible]um* | Aug.'82 (C) | .010 | Kaewa Committee |
| *Lannea stuhlmannii* | Aug.'82 (C) | 1.0 | Kaewa Committee |
| *Leucaena leucocephala* K8 | May.'82 (R) | .200 | Baobab Farms |
| *Leucaena leucocephala* K8 | Aug.'81 (C) | 1.525 | Ed Barrow |
| *Leucaena leucocephala* K28 | Aug.'81 (C) | .435 | Ed Barrow |
| *Leucaena leucocephala* K87 | Dec.'81 (R) | | NAS/USAID |
| *Markhamia platycalyx* | July '82 (C) | .150 | Siakago Committee |
| *Melia azaderach* | Oct.'82 (R) | 1.0 | Arava Seed |
| *Melii volkensii* | Oct.'82 (C) | | Siakago Committee |
| *Moringa oleiphera* | May '82 (R) | .150 | Ed Barrow |
| *Moringa oleiphera* | Aug.'82 (R) | 1.0 | Kumar Int. |
| *Parkinsonia aculeata* | Oct.'82 (R) | 2.0 | Arava |
| *Podocarpus gracilior* | July '82 (C) | .800 | DFO Nyahururu |
| *Prosopis alba* | Oct.'82 (R) | .025 | N.R.C. |
| *Prosopis chilensis* | May '82 (R) | .420 | Murry Roberts |
| *Prosopis chilensis* | March '82 (C) | .500 | Ed Barrow |
| *Prosopis juliflora* (pods) | Feb. '82 (C) | 15 | Baobab Farms |
| *Prosopis juliflora* (seed) | March '82 (R) | 1 | Setropa |
| *Prosopis nigra* (pods) | | 1.365 | IFONA |
| *Prosopis pallida* (pods) | Feb. '82 (C) | 5 | Baobab Farms |
| *Prosopis tamarugo* | Oct. '82 (R) | .025 | Chile |
| *Sesbania grandiflora* | March '82 (R) | 1 | Setropa |
| *Sesbania bispinosa* | Dec. '82 (R) | 2.0 | Kumar Int. |
| *Tamarindis indica* | Dec. '80 (C) | .820 | Ed Barrow |
| *Tylosema esculentum* | Apr. '82 (R) | .100 | Botswana Friends United Mission |
| *Zizyfus jujuba* | March '82 (R) | 1 | Setropa |
| *Zizyfus mauritiana* | Dec. '80 (C) | 1.8 | Ed Barrow |
| *Zizyfus spina-christi* | Oct. '82 (R) | 1 | Arava Seed |

## 5.0 STORAGE

What constitutes appropriate seed storage is primarily a function of the seeds' natural period of viability, length of time anticipated between ripening and planting of the seed and the level of storage technology available. In addition to these variables, virtually all seed benefits from dry and relatively cool conditions. As most seed is prone to insect attack it is also useful to apply a general treatment of insecticide to any seed subject to storage.

### 5.1 STORAGE OF PROJECT SEED

The majority of seed obtained through the Project was treated with a powdered compound of BHC available locally as a dressing for maize seed. It was then placed in air-tight tins which were kept in ICRAF's Nairobi offices. Although efforts were made to determine the general seed viability period for each species obtained along with respective collection dates, it was not feasible to store seed differentially as a function of these findings. Before using seed whose viability was questionable viability tests were performed by an ICRAF trainee.

To date, seed has not been stored at the Mazingira project sites. Rather, centrally stored seed has been transported from Nairobi to the sites on planting days. This applies also to most of the seed collected locally.

### 5.2 LOCAL STRATEGIES

The most appropriate method of addressing the storage question is to eliminate the need for controlled storage altogether by planting seed immediately after harvesting. Insofar as propogation of locally available species is desirable and a nursery available the strategy is feasible. From Project experience it appears that farmers know the seeding times of locally desirable species and can readily organize seed collection. What is needed is the impetus to do so at the proper time.

Elegantly simple and potentially efficient as this strategy is, however, it does not account for opportunities associated with

exchanging seed geographically. Translocation of seed implies the need for storage. The approach taken by the Project to devising locally appropriate storage strategies is two fold.

First, information on viability and pest problems of locally available and/or locally desirable species has been sought and recorded. And second, inexpensive, but effective storage facilities are being developed at the Mazingira project sites.

The information aspect is intended to provide a basis for consideration of storage requirements on a species by species basis. Seeds with a very short viability period, for example, should be subject to limited periods of storage only. In addition to information, demonstration of locally appropriate techniques for testing seed viability is currently in process.

## 5.3 INFORMATION AND DEMONSTRATION

The Project's information search on seed viability has focused on the seeds which have so far been multiplied at the Mazingira project sites nurseries. Findings have been included in the species information sheets (Appendix B). They are presented in summary form as Appendix D-2.

Demonstration of locally appropriate viability testing techniques is scheduled for January, 1983. It is intended that the following method will be tested and evaluated at four sites (32).

1. Punch holes in the bottom of a flat wide tin, using a nail.
2. Fill the tin with wet coarse sand and press the top flat.
3. Cover the sand with water and allow to drain for one day
4. Put seeds on the top of the sand and press flat, but do not bury completely. The seed should be visible.
5. Cover with polythene and put in shade.
6. If using very small seed, put a piece of absorbant paper over the top of the seed and keep moist, rather than watering directly.

## 5.4 FACILITIES

Storage sheds are in various stages of completion at the Mazingira project sites. Approximately 10 x 12 feet in size, they are intended as stores for nursery equipment and record keeping materials as well as for seed storage, when appropriate. It is likely that for one site, at least, the store's location and material composition will render it unsuitable for seed storage. Ambient temperatures at the Northern Machakos site (Kaewa) are probably too high for storing seed under a mabati roof without shade protection.

It is likely at this site, and perhaps at others, that alternative facilities will be developed. These are intended to consist of a hole dug in a bank where flooding will not occur. At Kaewa the lower side of the community dam provides a potentially ideal location, immediately adjacent to the nursery and storage shed. The objective will be to keep the seed at least 10° cooler than normal air temperatures (33). In the meantime, any locally collected seed which is not brought to Nairobi will be stored in a grass-roofed house.

# 6.0 MULTIPLICATION

Seed multiplication begins with propogation of existing seed stock. Propogation efforts, conducted jointly by the Seed Project team and the local agroforestry management committees at the Mazingira project sites, account for significant staff activity over the Project period. Emphasis has been upon obtaining direct experience with seed propogation under the various conditions presented by the Mazingira project sites, and upon demonstrating the necessary techniques to the committees. A key objective has been to document all aspects of the experience in order to enhance the potential for easy replication and refinement of the techniques.

## 6.1 NURSERIES

Propogation of seed obtained through the Seed Project has been supervised by the Project team, together with the local agroforestry

management committees at four of the five Mazingira project sites. Plans for developing a nursery to serve the fifth (Ol-Donyo Nyoike-arid) site are in progress. Requirements of the Mazingira project to produce a detailed record of nursery - related activity for monitoring and evaluation dictate that all aspects of seed multiplication be carefully documented. As the Seed Project team has been largely responsible for seed multiplication activities on the Mazingira project to date, the present report provides the forum for documentation.

To date, Mazingira project Trip Report notes on nursery activities have been synthesized into step-by-step accounts for the two sites where planting out of the first seedlings produced has taken place (Siakago and Kaewa). Accompanying these reviews are preliminary evaluations of the Project Team's experience with the species so far multiplied at the two sites. It is intended that similar evaluations will be prepared by the Mazingira project team for the other two nursery sites (Kibiko and Nyeri) following planting out in April, 1983.

In addition, summaries of seed treatment methods and seedling performance to date (end November, 1982) at each of the four nurseries have been prepared. The material is presented in Appendix E.

With regard to the latter, inconsistances in presentation are due to the nature of record-keeping activities at the Mazingira project sites. In particular, it was not possible to obtain adequate summaries of seedling performance and species availability during distribution at Siakago because of failure of the Project team and local management committee to count empty pots following seedling distribution. Furthermore at Siakago, the nursery record-keeping book was misplaced by the committee for a period and activities and observations undertaken then were not properly recorded.

Height measurements were to have been recorded once each week. But upon review of the Kaewa record book on October 30, as seedlings were being distributed, figures recorded after Oct. 19th appeared unreliable and so are not documented.

In general, the Project team has found that while the keeping of nursery records by local project participants is understood in principle, consistency and accuracy of the recordings are dubious. Awareness of the problems so far encountered shall, hopefully, result in better performance during the next cycle. Nevertheless, expectations for scientifically reliable measurements are unrealistic. The figures presented in the summary tables are intended to provide only relative approximations of species performance.

## 6.2 DEMONSTRATION TRIALS

Seed multiplication does not, of course, end with seedling production and distribution. The other aspect undertaken by the Project has been planting of seedlings in trial demonstration plots at the Mazingira project sites. The nature of the demonstration trials is elaborated in the Mazingira project progress report (34). To date initial plantings have been made at two sites.

At Siakago, approximately 615 seedlings have been planted out as components of a school shamba and an additional 389 trees have been planted in various configurations throughout the compound. At Kaewa an agroforestry demonstration shamba is being developed on a community church compound, where 232 trees were planted during the short rains of 1982. In addition, three demonstration farmers have been identified at Kaewa who have received advice from the Project team on the planting of 150 trees each on their respective shambas.

Each of these trials, in addition to those to be developed at the remaining Mazingira project sites during the long rains of 1983, will be monitored by Mazingira staff with advice and assistance from ICRAF senior staff. ICRAF will also assist in the design and monitoring of special seed stands to be established in close proximity to each nursery. Initial plantings are scheduled for the April 1983 rains. A specified objective of the monitoring effort is to assess prospects for early seed production among trees of the

various species already planted, and to cultivate "best bets" for seed production. Any seed produced will become the property of the local management committees, or the demonstration farmers themselves, and may be used directly, or sold.

In addition to the potential for seed for multiplication through the monitored demonstrations, any other seedling recipient may in time elect to harvest and sell seed as well. To date approximately 150 farmers at Kaewa and another 120 at Siakago have received seedlings raised from Seed Project seed. Records have been kept of the names of each recipient, and the species received. The location of each farmer's shamba is known by the management committees. It is anticipated that through networking performed by them, farmers will become informed about any seed marketing or distribution program developed through committee activities, and thereby become involved.

## 7.0 DISTRIBUTION

At the outset of the Project ICRAF disclaimed interest in undertaking any aspect of the seed distribution function itself. Rather, the objective was to identify local and potentially self-sustaining distribution channels and to assist in cultivating these. More specifically, it was suggested that possibilities for seed "marketing" by NGO s or farmers themselves be exploited.

### 7.1 MCC SEED BANK

The Project has identified and nurtured a promising seed distribution networking mechanism which would operate primarily in the interest of NGO's with moderate levels of demand for seed, particularly indigenous varieties. The Mennonite Central Committee (MCC), a collaborator on the Seed Project, has taken active interest in collaborating with NCCK to revive and expand the seed distribution function which NCCK alone used to assume. The differences between the past and future programs as envisaged by MCC, however, are notable.

NCCK's activities have focused on Kenya's northern dry regions. MCC would intend to operate nationwide and possibly on an East Agrica regional basis, including high potential areas as well. In addition MCC's fledgling collection, storage and distribution program places important emphasis on providing pertinant information with each packet of seed distributed.

A single page informs the recipient about known local names, species' native range, potential uses, seed viability, seed treatment and propogation techniques, any cultural anectodes which may be known and the sources, from which the information was derived. To date such species information sheets have been developed and distributed for only those species with which MCC has some direct experience. The collection of these so far developed by MCC's secondee to the Seed Project is presented as Appendix B.

The primary seed source for MCC's distribution network is intended to be local collections. They will be initiated through a variety of on-going or prospective tree establishment projects. In addition to source contacts which MCC has made already through the Seed Project, and those which NCCK has fostered as well, MCC and other church sponsored development projects will receive priority attention in the organization's efforts to cultivate additional collection agents.

At present MCC stores its seed stock in air-tight tins at its residential headquarters in Nairobi. A masonry store located beneath spreading shade trees provides a relatively cool environment throughout the year. This facility is viewed as sufficient for the time being.

MCC is committed to facilitating the type of documentation procedures initiated through the Seed Project. In particular, it will attempt to assess and record local perceptions about the particular value of each species under consideration for collection, and how it performs on the shamba. It will also encourage the labeling of collected seed with respect to provenance information. In addition to providing summary information sheets with each species, it will request feedback from seed recipients on their experience with propogation and planting.

Thus, in effect MCC will become not only a seed bank, but also an information bank. As the store of information develops, increasingly it will reflect a variety of users' practical experience with the species stocked.

To date, MCC's seed sources have been essentially the Kenya-based suppliers identified through the Seed Project. In addition, MCC has procured several species from NCCK, although it has obtained no seed from Baobab Farms or the EDI/MOE fuelwood project. Most seed requestes received by the Seed Project are referred to MCC. In addition, the organization's secondee to the Seed Project has taken a number of field trips over the Project period. The resulting contacts have contributed to the developing exchange network. Following is a list of organizations and the locations of the representative in contact with MCC who are on record as being recipients of its seed bank.

ACROSS; Juba, Sudan
ACROSS; Yeri, Sudan
ACROSS; Mundri, Sudan
Action Aid; Nairobi, Kenya
BAT; Meru, Kenya
AIC; West Pokot, Kenya
CARE-Kenya; Nairobi
Christian Rural Services; Gulu, Uganda
EDI/MOE; Nairobi, Kenya
Episcopal Church; Mundri, Sudan
East Pokot Agricultural Project; Kenya
Habitat for Humanity; Jinja, Uganda
Interchurch Response; Luhg Refugee Camp, Somalia
MCC Church of Uganda; Gulu, Uganda
MCC; Somalia
MCC; Kitgur, Uganda
MCC; Migore, South Nyanza, Kenya
MCC; Thaib, Sudan
Methodist Mission; Meru, Kenya
Muka Mukuu; Ol Donyo Sabuk, Kenya
New York Zoological Society; Juba, Sudan

NORAD; Lokitaung, Kenya
Swedish Free Mission
VSO; Marsabit, Kenya
VSO; Meru, Kenya
VSO; Nyanza, Kenya
UNHCR; Rwanda Refugee Camps
USAID; Singida, Tanzania
USAID; Somalia

## 7.2 COASTAL AGROFORESTRY WORKSHOP FOR NGO S

In June, 1982 an agroforestry and tree-planting workshop for NGO's was sponsored jointly by the EDI/MOE Shelwood project and a Kenyan coalition of NGO's concerned with renewable energy development; KENGO. ICRAF was requested to provide information on tree species suitable for coastal agroforestry systems, seed sources and propogation techniques.

The Seed Project used the opportunity to undertake its only formal distribution of tree seed throughout the Project period. In addition to meeting an obvious need at the workshop the Project's purpose in participating as requested was to test the feasibility of developing a two-way information flow through an NGO oriented distribution network. In particular, the forum was used as an opportunity to formally elicit information feedback from seed recipients.

Ten seed and information packets were distributed to workshop attendees identified as having sincere interest in developing a tree nursery at their project locations within Coastal Province. Each packet contained a variety of seed along with propogation instructions and descriptions of use characteristics. It also contained a questionnaire form which the recipient was requested to fill out and return to the Project once the information became available.

The product of the exercise is a list of 10 individuals representing non-government organizations interested or active in small scale tree nursery establishment at the Coast and the species of seed

received by each. To date, three questionnaires have been returned to MCC which provide the following information:

- location of nursery
- germination percentages for each species planted
- number of transplantable seedlings resulting
- timing and location of transplanting
- additional seed needs in terms of species, or tree use specifications
- problems to date
- additional information requests

## 7.3 MARKETING PROSPECTS

Experience from the Seed Project indicates that tree seed distribution among NGO s is more appropriately perceived as a service function than as a marketing opportunity. A growing number of NGO s profess or demonstrate interest in tree planting and are becoming increasingly cognizant of the need to plant "appropriate" species. Although motivation may derive from various rationales, thinking on implementation strategy is similar.

In general, NGO s involved in tree establishment want to prevent such projects from becoming a source of local dependency on outside funds. Instead, NGO leaders are searching for opportunities to assist locally initiated efforts through the provision of technical information, and seed. Other inputs, including labour, are expected to be provided by project beneficiaries.

Organizations taking this community development approach are not interested in generating commercial marketing opportunities, *per se*. However, in the interest of providing a fair return to labour, project sponsors may become "markets" themselves by offering to purchase locally collected seed.

One idea which may be gaining popularity among NGOs concerned with this issue is that project sponsors specify use restrictions for funds obtained through sponsored seed collections. In particular,

local groups interested in nursery establishment would have to "reinvest" funds received through seed collections in the nursery itself. In effect, then, the "selling" of seed would pay for other nursery components such as polybags or fencing.

The project sponsor could then offer the seed to a seed bank, as "credit", perhaps for entitlement to seed of other desired species. Or it could act as a sort of seed bank itself by sharing or trading among its various nursery development groups.

The value of locally collected seed compensated on a fair return to labour basis is undoubtedly greater than the price, particularly when considered in relation to the cost of alternative sources. For the time being, however, it is unlikely to be worth enough more to attract commercial interest, except in special cases and where particularly valued species are involved.

Once significant quantities of seed become available from seed stands which are just now being planned through project initiatives such as EDI/MOE's and Mazingira Institute's it may then be time to re-assess prospects for marketing. The existence of readily identifiable sources of quality seed for species which may by then have "proven" themselves as useful agroforestry system components may precipitate commercialization of distribution. This, in fact, is the circumstance which Baobab Farm Ltd., now enjoys, it being a commercially oriented pioneer in the area of fast-growing, multipurpose species testing. In the case of the Mazingira project's development model, the local management committees would be the obvious commercial agents at the production level. Time is required, however, before an assessment can be made of the committees' ability to handle such a role responsibly.

## 8.0 SUMMARY AND CONCLUSIONS

The seed constraint to widespread multipurpose tree planting by rural farmers and communities was the general focus of a one-year pilot probe undertaken by ICRAF jointly with three other NGO's: Mazingira Institute, Mennonite Central Committee (MCC) and CARE-Kenya. The purpose of the Seed Project was to assess the nature of the frequently sited seed availability problem in Kenya and to explore appropriate methods of overcoming it. The specific key objective of the Project, was to assist Mazingira Institute's Agroforestry Plots for Rural Kenya project to obtain seed of appropriate species for its five small scale, community level agroforestry nurseries. In this regard, the project may be viewed as successful.

### 8.1 SUMMARY

An initial Project task was to assess the seed requirements of Mazingira's agroforestry plots' project. The process developed as a joint undertaking between ICRAF's Diagnostic and Design (D&D) Team, consisting of an interdisciplinary group of senior scientists, and the Seed Project's field staff representing the institutions indicated above. An iterative process was undertaken whereby the D&D team identified the nature of farming system problems in each area as well as potentially mitigating agroforestry solutions. The Seed Project staff then examined lists of multipurpose trees and attempted to assess the potential suitability of various promising species for the respective sites. Seed for those of interest was then sought through various channels. Once indications were developed of seed availability, the Diagnostic and Design team refined its agroforestry system design recommendations accordingly, although not very specifically. Choices and refinements among general options provided were left for the Mazingira and Seed Project staff to decide upon.

Seed for desirable species was sought from both indigenous and foreign sources. The long lead times involved in obtaining seed from foreign suppliers, plus the unavailability of many of the most potentially interesting species from the inventory of suppliers obtainable by the Seed Project, pushed the focus towards in-country suppliers.

Within Kenya the Forest Department headquarters, as the country's official tree seed supplier, was able to supply virtually none of the species desired by the Project on an immediate basis. The Project's evolving orientation towards indigenous species, however, produced a number of subsequent probes within the Department. The Chief Silviculturalist alleged that by specifying desired seed types from a lengthy Department list of species, a year in advance, the seed would be collected and made available. Ostensibly, this service is provided to NGOs as well as to District Forest Officers for whom it is primarily intended.

Although the duration of the Seed Project did not allow for testing the reality of this prospect, the Project did meet with some success in obtaining seed from District Forest Officers directly. In general, there appears to be a keen willingness at the District level to assist NGOs in acquiring seed and making community-level tree planting projects feasible. This willingness is not always translatable into action, however, due to considerable staff and transportation limitations.

The most lucrative seed source exploited by the Project was on-going non-governmental nursery and tree-planting related projects. There appears to be a general willingness among these to share seed and ideas alike. And with respect to ideas about obtaining appropriate tree seed, certain on-going government sponsored projects were helpful as well. In particular, the Ministry of Energy's Renewable Energy Resource project, through its agroforestry centres', and the Ministry of Agriculture's Soil Conservation Unit tree nursery program became useful resources for the Seed Project.

An approach advocated by each of these programs, and which the Seed Project was charged with itself, was local seed collection by interested members of project beneficiary groups. Seed of several Project-team specified species was obtained by this means. Indeed, the Project found it to be relatively simple to organize local collections through the Mazingira Institute project infrastructure. General concern with seed quality control prompted the team to insist upon proper labeling of collected seed (to the extent possible by the local collection agents). However, it was not feasible within the context of the Project to inspect and evaluate the individual trees from which seed was collected. Neither

is this done by the Ministry of Energy or the Ministry of Agriculture projects cited above.

Most of the seed obtained by the Project was evaluated with respect to storage requirements, although species-specific information on viability and storage aspects proved to be relatively scanty. During the course of the Project seed was stored in air-tight tins at ICRAF. Locally appropriate methods of storage as well as viability testing were discussed with the agroforestry management committees at the Mazingira project sites. Although the ideas appeared well received, they remain to be implemented until the next collection season. In general, the Project advocated local seed storage only in those instances where it was infeasible to plant collected seed immediately due to incongruities in the nursery - planting-out cycle. The "fresh seed is best" doctrine was prescribed.

The majority of seed obtained by the Project was distributed to the Mazingira project sites. However, minor quantities were made available to other NGOs, who requested it. It was the large number of seed requests obtained by the Project, indicating significant unmet demand by locally - operating NGOs which prompted Mennonite Central Central Committees' (MCC) team member on the Project to initiate an informal seed bank under the auspices of MCC. MCC's network developed considerably over the course of the Project to include not only certain NGOs operating in Kenya, but a number in Somalia, Sudan, Tanzania and Uganda as well.

MCC's seed bank idea, as it grew out of the Seed Project, is predicated on the need to share information about the species being distributed as well as the seed itself. The species information sheets presented in the present document are prototypical of the type of information MCC plans to distribute with each packet of seed, once its program is fully operational. Seed recipients will be encouraged to share their on-site tree raising experience with MCC as it develops. Thus, the species briefs will be updated accordingly.

Propagation of seed obtained by the Project was supervised by the team at the four Mazingira project site nurseries. Some direct sowing was attempted at the fifth site, but rather unsuccessfully. The present report details the techniques employed at the nurseries.

The approach was based, in general, upon readings in popular literature pertaining to non-labour intensive, small-scale community-oriented tree nurseries. The ideas so obtained were accompanied by a hefty dose of trial and error mentality as neither the Seed Project nor the Mazingira project were well endowed with nursery related expertise. Thus, the purpose in carefully recording the steps involved was both to meet the monitoring requirements of the Mazingira project and to invite critique by experienced nursery practioners.

Seed multiplication shall be the outgrowth of successful trial plantings at the Mazingira project sites. If/as seed from these trees does become available it will be the responsibility of the respective local management committees to decide its fate. MCC, however, intends to remain in contact with these sites and will thereby become a potential buyer of the seed. Furthermore, the Mazingira project staff have now been sensitized to the seed issue and will remain alert as to the most viable means of both acquiring seed for future planting seasons and disposing of locally obtained seed in the best interest of the respective committees.

## 8.2 CONCLUSIONS

The following conclusions can be drawn from the Seed Project experience.

- There is a large and growing number of actors involved in seed procurement and supply in Kenya. This phenomena is largely a function of rapidly increasing interest and pressure to plant and raise trees. Governmental directives to this effect, however, have not been accompanied by corresponding formal institutional development in the area of seed acquisition, handling and distribution.

- Among the various actors taking a role in seed acquisition, including both government and non-government organisations, there appears to be little coordination except on an informal or project by project basis. This situation has potentially serious consequences for controlling seed quality and thus the

future integrity of the afforestation/agroforestry phenomena which Kenya is currently experiencing.

- The local level non-government organizations represented by regional or national level groups involved in promoting tree-planting projects often have a sincere committment to tree planting in its various aspects and can be rezdily motivated to engage in seed collection, both on their own behalf or for sale to project sponsors who may distribute the seed elsewhere. The ease and relative cheapness with which such collection programs can be organized speaks to the probability of increasing reliance on this method of seed acquisition, assuming the absence of enforced regulations to the contrary.

- Within this burgeoning network of non-traditional forestry related activity there is substantial interest among project planners in broadening their rpertoire of species choice and thus in sharing seed and information across project target areas throughout the country. At commencement of the Project no organization was committed to facilitating this process through systematic means.

- MCC, therefore, appears to be responding to a genuinely felt need in its undertaking of a seed bank program aimed at coordinating the distribution of both seed and pertinant use information among non-government organizations and where interested, government sponsored projects, throughout the country and East Africa.

- The long-term credibility, and therefore success, of MCC's fledgling seed and information bank program shall be largely dependent upon the type of recognition and advice it receives from professional agroforestry related specialists as well as pertinant governement bodies. It shall be largely up to MCC to seek out critical professional advice and positive support from the relevant groups and individuals. Seed quality control will inevitably constitute an issue of major importance in this regard.

Finally, any project faced with obtaining seed prior to nursery start-up would do well to make a systematic assessment of seed requirements, identify sources and place orders accordingly, well in advance. Lond lead times are required for obtaining seed from both foreign and indigenous sources. Particularly for operational scale agroforestry system projects where interaction among specific component species is of the essence, a two-year pre-implementation period may not be excessive if one wants to avoid the disappointment and setback of a seed constraint on implementing the desired options.

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# APPENDIX A

## LOCAL SPECIES IDENTIFICATION MATRICES

KAEMA

NYERI

SIAKAGO

KIBIKO

KAEWA

APPENDIX A-1

| Scientific Name | Local Name | Firewood | Charcoal | Poles | Posts | Sav timber | Animal Feed | Human food | Honey | Mulch/green Manure | Living fences | Medicine | | | | Compatability w/crops (+/-) | Rate of growth (S,M,F) | Seeding Time | Mogadi | Kaewa | Katlama | Sinkapo | Kibiko | Nyeri |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kigelia aethiopicum | (Sausage tree) Kiatina | X | | | | | | | | | | X | X | | | - | S | Year round Not known | | X | | | | |
| Albizia harveyi | Kiundya | X | X | | X | X | X | | X | X | | | | | | + | S | Aug-Sept. | | X | | | | |
| Lannea stuhlmanii | Kyuasi | X | X | X | X | | | | | | | | X | | | + | S | Sept. | | X | | | | |
| Boscia angustifolia | Kiui | X | X | X | | | X | | | | | | | | | + | S | Sept. | | X | | | | |
| Cordia sinensis | Kithea | X | X | | X | | X | X | | | | | | | | + | S | Aug-Sept | | X | | | | |
| Croton macrotachyus | Muthuru | X | X | X | | X | | | | | | | | | | + | M | Aug. | | X | | | | |
| Cassia singuensis | Mukengeka | X | X | | | | X | | | | | | | | | + | S | July-Aug. | | X | | | | |
| Combretum zeyheri | Mutithi | X | X | X | | | | | X | | | | X | | | + | S | Aug. | | X | | | | |
| Vitex spp | Kimuu | X | X | X | | | | X | | | | | X | | | + | S | Aug-Sept. | | X | | | | |
| Maerua pubencens | Kiuku | X | X | | | | Goats only X | | | | | | X | | | + | F | Aug. | | X | | | | |
| Bougainvillea spectabilis | Kilaa | X | X | X | X | | X | | | | X | | | | | - | M | Aug-Sept. | | X | | | | |
| Combretum exalatum | Mkokola | X | X | | | | X | | | | | | | | | + | S | Sept. | | X | | | | |

X = Reported use
(X) = Potential use

KAEWA

APPENDIX A-1

| Scientific Name | Local Name | Firewood | Charcoal | Poles | Posts | Saw timber | Animal Feed | Human food | Honey | Mulch/green Manure | Living fences | Medicine | | | | Compatability w/crops(+/-) | Rate of growth (S,M,F) | Seeding Time | Magadi | Kaewa | Kathama | Siakago | Kibiko | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Combretum spp. | Kingata | X | X | X | X | | | | X | | X | | X | | | + | M | Aug. | | X | | | | |
| Rhus africana | Ithia | X | X | X | | | | | | | | | | | | + | S | Sept. | | X | | | | |
| Commiphora africana | Ikuu | X | X | | | | X | | | | | X | | | | + | S | Aug. | | X | | | | |
| Acacia brevispica | Mukusyi | X | X | | X | | X | | | | X | | | | | + | M | July-Aug. | | X | | | | |

X = Reported use
(X) = Potential use

NYERI

APPENDIX A-2

| Scientific Name | Local Name | Firewood | Charcoal | Poles | Posts | Saw timber | Animal Feed | Human food | Honey | Mulch/green Manure | Living fence | Medicine | | | | Compatability w/crops (+/-) | Rate of growth (S,M,F) | Seeding Time | Magadi | Kawa | Kathama | Siakago | Kibiko | Nyeri |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cupressus lusitanica | Mthida | X | X | X | | X | | | | | X | | | | | - | M | Aug-Sept | | | | | | X |
| Acacia mearnsii | Muthanduku | X | X | | | | X | | | | | | | | | - | F | Aug-Sept | | | | | | X |
| Jackaranda mimosifolia | Muchakaranda | X | X | | | | | | | X | X | | | | | + | F | Dec | | | | | | X |
| Bridelia micrantha | Mukoiga | X | X | | | | X | | | | X | | | | | + | S | Not Known | | | | | | X |
| Croton macrotachyus | Mutundu | X | X | X | X | X | | | | X | X | | | | | + | M | June-July | | | | | | X |
| Cordia abyssinica | Muringa | X | X | X | X | X | | | X | X | | | | | | + | S | Aug-Sept | | | | | | X |
| | Mkandania | | | | | | | X | | | | | | | | + | F | Not known | | | | | | X |
| | Loquat | | | | | | | X | | | | | | | | + | F | Not known | | | | | | X |
| Annona squamosa | Custard Apple | | | | | | | X | | | | | | | | + | F | May-Sept. | | | | | | X |
| Albizia gummifera | Mkurwe | X | X | X | X | X | X | | X | X | | | | | | + | M | Dec. | | | | | | X |
| Commiphora zimmernmanii | Mukungugu | | | X | X | | X | | | | X | | | | | + | S | March | | | | | | X |

X = Reported use
(X) = Potential use

NYERI

APPENDIX A-2

| Scientific Name | Local Name | Firewood | Charcoal | Poles | Posts | Saw timber | Animal Feed | Human food | Honey | Mulch/green Manure | Living fence | Medicine | | | | Compatability w/crops(+/-) | Rate of growth (S,M,F) | Seeding Time | Magadi | Karwa | Katham | Siakago | Kibiko | Nyeri |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Croton megalocarpus | Mukinduri | X | X | X | X | X | | | | X | | | | | | + | M | June-July | | | | | | X |
| Aberia caffra | Kei-Apple | X | X | | | | | | | | X | | | | | - | M | Sept-Oct. | | | | | | X |
| Eucalyptus saligna | Mubao | X | X | X | X | X | | | | | | | | | | - | F | Aug-Sept. | | | | | | X |
| Cupressus lusitanica | Mthida | X | X | X | | X | | | | | X | | | | | - | M | Aug-Sept. | | | | | | X |
| Acacia mearnsii | Muthaduku | X | X | | | | X | | | | | | | | | - | F | Aug-Sept | | | | | | X |
| Jackaranda mimosifolia | Muchakaranda | X | X | | | | | | | X | X | | | | | + | F | Dec. | | | | | | X |
| Bridelia micrantha | Mukoigo | X | X | | | | X | | | | X | | | | | + | S | Not Known | | | | | | X |
| Croton macrotachyus | Mutundu | X | X | X | X | X | | | | X | X | | | | | + | M | June-July | | | | | | X |
| Cordia abyssinia | Muringa | X | X | X | X | X | | | X | X | | | | | | + | S | Aug-Sept | | | | | | X |
| Croton megalocarpus | Mukinduri | X | X | X | X | X | | | | X | | | | | | + | M | June-July | | | | | | X |
| Aberia caffra | Kei-Apple | X | X | | | | | | | | X | | | | | - | M | Sept-Oct. | | | | | | X |
| Eucalyptus saligna | Mubao | X | X | X | X | X | | | | | | | | | | - | F | Aug-Sept | | | | | | X |

X = Reported use
(X) = Potential use

NYERI

APPENDIX A-2

| Scientific Name | Local Name | Firewood | Charcoal | Poles | Posts | Saw timber | Animal feed | Human food | Honey | Mulch/green Manure | Living fences | Medicine | | | | Compatability w/crops(+/-) | Rate of growth (S,M,F) | Seeding Time | Magadi | Karwa | Kathama | Siakago | Kibiko | Nyeri |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Citrus sinensis | Machungua | X | X | | | | | X | | | | | | | | + | M | Mar-Apr. | | | | | | X |
| Rapanea rhododendroides | Mugaita | X | X | | | | | | | | | X | | | | + | M | Dec. | | | | | | X |
| Elaeodendron buchananii | Munderendu | X | X | | | | | | | | | | | | | + | S | Dec. | | | | | | X |

X = Reported use
(X) = Potential use

SIAKAGO

APPENDIX A-3

| Scientific Name | Local Name | Firewood | Charcoal | Poles | Posts | Saw timber | Animal Feed | Human food | Honey | Mulch/green Manure | Living fence | Medicine | | | | Compatibility w/crops(+/-) | Rate of growth (S,M,F) | Seeding Time | Magadi | Kaewa | Kathama | Siakago | Kibirio | Nyar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Combretum zeyheri | Marava | X | X | X | X | | | | (X) | X | | | | | | + | S | Aug-Sept | | | | X | | |
| Faurea speciosa | Muunjate | X | X | X | X | | | | X | | | | | | | + | S | March | | | | X | | |
| Grevillea robusta | Mkista | X | X | X | X | X | | | | X | | | | | | + | M | Jan-Feb | | | | X | | |
| Melia volkensii | Mukau | X | X | X | X | X | X | | X | X | | | | | | + | F | Sept. | | | | X | | |
| Jackaranda mimosifolia | Muchakaranda | X | X | X | | X | | | | X | | | | | | + | F | Dec. | | | | X | | |
| Eucalyptus melliodora | Mbao | X | X | X | X | X | | | | | | | | | | - | F | Dec | | | | X | | |
| Poliostigma thonningii | Mukura | X | X | X | | | X | X | | | X | (X) | | | | + | S | Aug-Sept | | | | X | | |
| Mengisfera indica | Mayembe | X | X | X | X | X | | X | | | | X | | | | + | M | Jan-Feb July | | | | X | | |
| Acacia tortilis | Musemeri or Muga | X | X | X | X | | X | | | | X | | | | | + | S | July/ August | | | | X | | |
| Bridelia micrantha | Mukwego | X | X | X | X | | | | X | | | | | | | + | S | Sept. | | | | X | | |
| Annon chrysophylla | Mumu | X | X | X | X | | | X | | | | | | | | + | S | Sept. | | | | X | | |
| Dichrostachys cinerea | Mvingo | X | X | | X | | X | | | | X | | | | | + | S | July-Aug | | | | X | | |

X = Reported use
(X) = Potential use

SIAKAGO

APPENDIX A-3

| Scientific Name | Local Name | Firewood | Charcoal | Poles | Posts | Saw timber | Animal Feed | Human food | Honey | Mulch/green Manure | Living fences | Medicine | | | | Compatability w/crops(+/-) | Rate of growth (S,M,F) | Seeding Time | Magadi | Kaeva | Kathama | Siakago | Kibiko | Nyeri |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Persea americana | Avocade | X | X | X | | | | X | | | X | | | | | + | F | Not known | | | | X | | |
| Caesia siamea | - | X | X | X | X | | | | | | X | | | | | - | M | July-Aug. | | | | X | | |
| Strychnos spinosa | Mwage | X | X | X | X | X | | X | | | | | | | | + | S | Aug-Sept. | | | | X | | |
| Cassia singuensis | Mukengeka | X | X | X | X | | X | | | | | | | | | + | S | Not known | | | | X | | |
| Combretum species | Mugereki | X | X | | X | | | | X | | | | | | | + | S | Sept. | | | | X | | |
| Lannea schweinfurthi | Muraci | X | X | X | X | | X | | X | | | | | | | + | S | Sept. | | | | X | | |
| Combretum molle | Murama | X | X | X | X | | | | | X | | | | | | + | S | April | | | | X | | |
| Vitex doniana | Mvuru | X | X | X | | | | X | X | X | | | | | | + | S | July-Aug. | | | | X | | |
| Anzanza garkhana | Mtoc Mtoo | X | X | X | | | | X | X | | | | | | | + | S | Aug. | | | | X | | |
| Acacia seyal | Musewa | X | X | X | X | | X | | | | | | | | | + | S | Aug-Sept. | | | | X | | |
| Croton macrotachyus | Mutundu | X | X | X | X | X | | | | X | | X | | | | + | F | August | | | | X | | |
| Croton megalocarpus | Mkinduri | X | X | X | X | X | | | | X | | | | | | + | F | March | | | | X | | |

X = Reported use
(X) = Potential use

| SIAKAGO<br>Scientific Name | APPENDIX A-3<br>Local Name | Firewood | Charcoal | Poles | Posts | Saw timber | Animal Feed | Human food | Honey | Mulch/Green Manure | Living fence | Medicine | | | | Compatability w/crops(+/-) | Rate of growth (S,M,F) | Seeding Time | Magadi | Kaewa | Kathama | Siakago | Kibiko | Nyeri |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Makhamia hildebrandtii | Muu | X | X | X | X | X | | | X | | | | | | | + | S | August | | | | X | | |
| Pappea capensis | Mura | X | X | | X | | | | | | | | | | | + | S | Aug-Sept | | | | X | | |
| Catha edulis | Muraa | X | X | X | X | | | X | | | | X | | | | + | S | Sept. | | | | X | | |
| Albizia zimmernianii | Mukorwe | X | X | X | X | X | X | | X | X | | | | | | + | S | Sept. | | | | X | | |

X = Reported use
(X) = Potential use

KIBIKO

APPENDIX A-4

| Scientific Name | Local Name | Firewood | Charcoal | Poles | Posts | Saw timber | Animal Feed | Human food | Honey | Mulch/green Manure | Living fences | Medicine | | | | Compatibility w/crops(+/-) | Rate of growth (S,M,F) | Seeding Time | Magati | Kieva | Kathama | Slakago | Kibiko | Nyeri |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Acacia tortilis | Mugaa | X | X | | X | | X | | | | | | | | | + | S | | | | | | X | |
| | Miririshwa | X | X | | X | | X | | | | | | | | | + | S | | | | | | X | |
| | Mrembu | X | X | X | X | | | | | | | | | | | + | S | | | | | | X | |

X = Reported use

(X) = Potential use

KIBIRO

APPENDIX A-4

| Scientific Name | Local Name | Firewood | Charcoal | Poles | Posts | Saw timber | Animal Feed | Human food | Honey | Mulch/green Manure | Living fences | Medicine | | | | Compatability w/crops(+/-) | Rate of growth (S,M,F) | Seeding Time | Kagadi | Kaeva | Kathama | Sinkago | Kibiko | Nyeri |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Miu (Loquat) | | | | | | | X | | X | | | | | | + | F | | | | | | X | |
| Warburgia ugandensis | Muthiga/ Osokonoi | X | X | | | | | | | | | X | | | | + | S | | | | | | X | |
| | Mutanga/ Osoket | X | X | | | | | | | | | X | | | | + | S | | | | | | X | |
| Eucalyptus saligna | Mringamu | X | X | X | X | X | | | | | X | | | | | - | F | | | | | | X | |
| Croton megalocarpus | Mkinduri | X | X | X | X | X | | | | X | X | | | | | + | M | June-July | | | | | X | |
| Croton macrotachyus | Mutundu | X | X | X | X | X | | | | X | X | | | | | + | M | June-July | | | | | X | |
| | Mutuma | X | X | X | | | | | | | | | | | | + | S | | | | | | X | |
| Grevillea robusta | Mkima | X | X | X | X | X | | | | X | | | | | | + | M | Dec. | | | | | X | |
| Cupressus lusitanica benthamii | Mithithida | X | | X | X | X | | | | | X | | | | | - | M | | | | | | X | |
| Acacia mearnsii | Mthanduku | X | X | X | X | | | | | | | | | | | - | F | | | | | | X | |
| Rapanea rhododendroides | Mugaita | X | X | | | | | | | | | | X | | | + | M | | | | | | X | |
| | Mutongu | X | | | | | X | | | | | | X | | | + | S | | | | | | X | |

X = Reported use
(X) = Potential use

## APPENDIX B

### SPECIES INFORMATION SHEETS*

*Acacia albida*
*Acacia holosericea*
*Acacia melanoxylon*
*Acacia nilotica*
*Acacia saligna*
*Acacia senegal*
*Acacia tortilis*
*Acrocarpus fraxinifolia*
*Adansonia digitata*
*Ailanthus altissima*
*Azadirachta indica*
*Balanites aegyptica*
*Cassia siamea*
*Casuarina equisetifolia*
*Gleditsia triacanthos*
*Grevillea robusta*
*Leucaena leucocephala*
*Melia azedirach*
*Parkinsonia aculeata*
*Prosopis chilensis*
*Podocarpus gracilor*
*Prosopis juliflora*
*Samanea saman*
*Tamarindus indica*
*Zizyphus jujiba*

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*Prepared by Wayne Teel, Mennonite Central Committee.

MAZINGIRA INSTITUTE

MENNONITE CENTRAL COMMITTEE

Scientific Name: *Acacia albida*

Local Name: Apple-ring Acacia; Olerui (Masai);Mukuababu (Tavata)

Native Range: A common tree of the Sahelian sorghum belt in Africa. It extends from Senegal through Upper Volta, Nigeria, Chad, Sudan and Kenya. In Kenya it is primarily a riverine species in the semi-arid midlands of the Rift Valley. It can be easily found in the Kerio Valley.

Uses: The *A. albida's* most well known characteristic is its tendency to lose its leaves during the rainy season. Leaf fall from this nitrogen fixer makes a fine green manure and is widely used for this purpose in West Africa. A spacing of about 50 trees per hectare for a 30 year old stand provides substantial fertilizer. It is deep rooted and does not compete with crops for moisture. When the end of the rains come *A. albida* puts out new leaves which help reduce surface evaporation. It also provides a good source of fodder for goats in the later dry season when seed pods fall. It has only marginal use as a fuelwood.

Environmental requirements: *Acacia albida* needs an average annual rainfall of greater than 500 mm or root access to a high water table. It will grow up to 1 200 meters or more. Soils can be of variable consistency though loamy, sandy, clay types are best.

Planting technique: This species can be direct seeded or grown in pots in a nursery. The seed should be scarified by nicking or soaking. Nicking produces rapid germination in up to 90% of undamaged seeds. Plant them about 2 cm. deep in moist soil. In the nursery it usually is ready for transplanting within 4 months.

Seed storage: *Acacia albida* seed stores well if kept free from insects in a dry place.

Problems: *Acacia albida* grows somewhat slowly and does need extra water until roots find deep soil moisture, usually about 2 years. If a constant moisture supply is available without waterlogging the tree grows much quicker. The leaves are palatable to goats and other livestock so care must be taken to prevent animal access.

Information sources:

23.9.1982

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MAZINGIRA INSTITUTE

MENNONITE CENTRAL COMMITTEE

Scientific Name: *Acacia holosericea*

Local Name: None

Native range: This Acacia comes from the semi-arid belt of Northern Australia. Normally it is a lowland species which springs up quickly in denuded or disturbed sandy sites. In Africa it has proven successful on overgrazed land in Senegal. It grows at a rate favourably comparable with other Acacias.

Uses: *Acacia holosericea* has been used in Australia to restore areas after mining. It is nitrogen fixing, and its large phyllode (adapted leaf stem) makes a good fodder. Plants produce large quantities of seeds which were used by Aboriginal peoples as a food source. Seeds were roasted, then eaten. *A. holosericea* makes a good firewood crop, windbreak and border planting species.

Environmental requirements: Rainfall in its native area is monsoonal with between 400 - 800 mm. annually. It likes sandy, moderately well-drained soils. Normally coastal or lowland adapted, it will grow to 1 500 meters if temperatures are high enough.

Planting technique: The seed must be either boiled and soaked, or nicked prior to planting. The seed is small which makes nicking a difficult procedure. However, nicking yields quicker and more uniform germination. Sow about 1 cm. deep in soil more sandy and coarse than for most species. They grow slowly at first, requiring, perhaps four months in the nursery depending on location and climate.

Seed storage: Seeds store well if kept cool and dry. Unlike most *Cassias* pods do not fall before releasing seeds so they must be collected on the tree.

Problems: Unknown

Information source: Tim Willing
P.o. Box 432
Broome, Australia 6725

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Acacia melanoxylon*

Local Name: None in Kenya. Australian Blackwood

Native range: The Australian blackwood is a native of the moist highlands of sub-tropical parts of Eastern Australia. In East Africa it exists around Kampala and the highland forests of Tanzania and Kenya. Extensive planting has been done around plantations in the Central Highlands, including Nyeri and Nyahururu.

Uses: *Acacia melanoxylon* grows with good form in fairly dense plantings but spreads out when in isolation. The wood is durable and strong, yielding good fence posts, plywood and veneer. It is often used as an ornamental providing shade, shelter and windbreaks. It also has some use for soil stabilization in steep, slide-prone areas.

Environmental requirements: This species is one good for highland tropical areas, relatively cool ($5^{o}$ - $22^{o}$C) and between 1 500 and 2 500 meters. It prefers light to medium soils, deep, neutral to slightly acid and well-drained.

Planting technique: It grows well from seed. Soak the seed in water 24 hours prior to sowing. An initial hot water soak, allowed then to cool, works best. Nicking the seed coat gives poor germination. Germination varies between one and four weeks. It grows slowly, requiring 5 or more months in the nursery.

Seed storage: Cool, dry and airtight, the seed lasts for several years.

Problems: In Kenya it is often subject to a root fungus which kills the tree. It does not mix well with crops.

Information sources:

1. Webb, O.B., Wood, F.J. and Smith, J. A Guide to Species Selection for Tropical And Sub-tropical Plantations. Trop.For. Pap. No. 15, CFI, Oxford, 1980.

2. Cyrus Ndegwa, Forester, Energy Development International, Ministry of Energy, Kenya, July, 1982.

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Acacia nilotica*

Local Names: Musene (Kam) Tuwer (Som) Ol-erbat(Mas) Mgunga (Swa).

Native range: Musene is a widespread tree of semi-arid and sub-humid climate in Africa and Asia. In Kenya there are two varieties, leiocarpa near the coast, and sublata found elsewhere in dry savannas. *A. nilotica* normally grows to 10 meters in height but may reach 20 meters on good sites.

Uses: A. Nilotica's hard heavy wood makes good fuel with high energy value. The wood is very tough, termite resistant and water repellant. It makes good tools and can be used for carving. Leaves and pods are good, high protein fodder. Tannin for the leather industry often comes from Musene bark. A gum similar to that of *Acacia nilotica* can be obtained as well. It is thorny and makes a good living fence.

Environmental requirements: Very heat resistant, Musene can also withstand cool temperatures, but not frost. It grows to 1 500 meters in Kenya. It grows best in areas seasonally flooded or having more than 500 mm annual average rainfall. For soil it prefers alluvial types, but also does well on black cotton or heavy clays.

Planting technique: Normally *Acacia nilotica* is direct sown, but results are often poor due to weed competition and grazing. Fresh seed can be sown without treatment, but stored seed should be soaked or nicked. Sow 2 seeds per pot 2 cm deep. Prick-out within 2 weeks of germination. Transplanting can be in about 4 months.

Seed storage: As with other Acacia, beetle attack is the main problem. Seed should be sorted and dried before storing in cool, dry, airtight containers.

Problems: It grows fast in moist conditions, but can be very slow in others. Wood boress sometimes attack the tree.

Information sources: 1. NAS, Firewood Crops, 1980

2. Dale and Greenway, Kenya Trees and Shrubs, 1961

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Acacia saligna* (or A. cyanophylla)

Common Name: Blue-leafed wattle

Native range: Western Australia provides the original home for this widespreading bushy tree. It has since been spread throughout the arid and semi-arid tropics including North Africa, Ethiopia and South Africa. In Kenya it has only recently been introduced.

Uses: As fuel the blue-leafed wattle is not exciting. However, it can provide an understorey crop for widely spaced fuelwood and timber species. Its major use has traditionally been for low-level windbreaks and sand fixation. Leaves and pods are edible by goats and sheep, mainly when other fodder is short. It can withstand heavy grazing and large scale lopping of branches.

Environmental requirements: *A. saligna* grows best in warm, dry climates, free of frost, yet having a cool season. Normally a lowland species, it may go to 1 200 meters near the equatorial belt. It requires only 250 mm rainfall, though the range of 350 - 600 mm is best. It tolerates a wide range of soils including heavy clays, light sands, saline and alkaline types. Even acid soils do not hinder the plant.

Planting technique: Seeds readily germinate and the plant is easily raised in the nursery. Often seed beds are used to select the best young seedlings for pots. If sown direct into the pot, use 2 seeds in each and remove the least healthy. Pretreat the seed by nicking, soaking with boiling water allowed to cool. It competes with weeds very well.

Seed storage: Good. Keep in cool, dry airtight containers.

Problems: Possibly weedy in some zones. Generally termite resistant, its main problems comes from grazing animals.

Information sources:

1. NAS, Firewood Crops, 1980.

2. Peter von Carlowitz, ICRAF (on planting technique), November, 1982.

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Acacia senegal*

Local Name: Gum-Arabic, Adad (Som.) Idado (Boran) Ol-munishui (Masai)

Native range: This is a widespread Sahelian species regarded as very useful through most of its range. It is most famous in Sudan where it has long been used as a source of foreign exchange through the production of Gum Arabic. In Kenya it is found almost everywhere in the dry zones, extending from Magadi to Turkana to the Somalia border.

Uses: Its hard, heavy wood makes one of the finest arid country fuelwoods. Normally a small tree, it will grow to 12 meters in good, protected conditions. In Sudan, plantations of *A. senegal* are specifically for the production of Gum Arabic. Wood can be used for poles and agricultural implements. Foliage and pods make fodder for camels, goats and sheep. Seeds are commonly dried and consumed as a vegetable. It also fits well in dryland agroforestry where Adad can be grown with millet, grasses and many other crops without problems. Idado also helps reduce erosion and improve soil conditions.

Environmental requirements: *Acacia senegal* is a very hearty plant, growing in hot regions with as little as 200 mm rainfall, and 11 months dry season. The best annual rainfall average is between 300 and 450 mm. In Kenya Ol-munishui can be found near the coast and at 1 700 mm in the Rift Valley. For soil it prefers sandy types or non-waterlogging clay.

Planting technique: Although it rarely establishes itself from seed, that is quite easily done in a nursery. Sow pre-soaked or nicked seed between 1 and 2 cm deep, 2 seeds per pot. Prick-out extra seedlings within 2 weeks of germination. Transplanting can be done at 4 months. The tree needs weeding for the first year or two.

Seed storage: Generally good though very susceptible to beetle attack. Keep cool, dry and airtight.

Problems: Generally slow growing, seedlings susceptible to insect attack in severe drought.

Information sources: NAS, Firewood Crops, 1980

2. Dale and Greenway, Kenya Trees & Shrubs, 1961

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Acacia tortilis*

Local Name: Umbrella thorn, Mgunga (Swahili), Kura (Somali), Ol- gorete (Masai).

Native range: An African native spread throughout the arid and semi-arid region of the continent. There are 4 sub-species of which 2 are found in Kenya, *raddiana* and *spirocarpa*. The former is coastal near Lamu while the latter is widespread.

Uses: *Acacia tortilis* has a wide variety of uses not the least of which is its ability to make excellent charcoal. As a firewood it is favoured by Somalis and Boran peoples. Also it is an excellent fodder tree for camels, goats, sheep and giraffe. The seed pods, dropped late in the dry season, are greedily devoured by goats. It can also make a living fence and is a sand stabilizer.

Environmental requirements: Grows well in hot, arid and semi-arid regions with between 100 - 1 000 mm. rainfall, depending on variety. Normally a lowland tree, it does grow up to 1 500 meters in Kenya. It favours alkaline soils and tolerates shallow soil.

Planting technique: *Tortilis* has a very hard seed coat which makes scarifying difficult. Dipping in hot water and soaking overnight helps. So too does scratching the seed coat with a file. Plant about 1.5 cm. deep in moist sandy soil. *A. tortilis* transplants well. Keep in the nursery between 3 and 5 months, or until about 30 cm. high. If planted out at the beginning of the rains it will need no further watering. Initial weeding helps.

Problems: The wide spreading root system makes it a poor species for planting next to crops. Since it is especially palatable to goats it is advisable to protect the seedling. Also, as with many Acacias, it tends to spread out rather than up for its first few years. Trimming branches and staking up the longest runner will encourage upward growth. An unconfirmed report from a Kaewa, Kenya, farmer says that pregnant goats may abort if they diet solely on *A. tortilis* seeds.

Seed storage: Seed will last indefinitely if kept free of beetles.

Information source: 1. NAS, Firewood Crops, 1980
2. Dale and Greenway, Kenya Trees and Shrubs, 1961
3. Herdsmen, Kaewa.

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Acrocarpus fraxinifolia*

Local Name: None

Native range: *Acrocarpus* grows into a full straight climax tree in the forests of Southwest Asia. It can reach 60 meters in height in a closed canopy and up to 50 meters when planted in open settings. This tree is quite common in the Kenya Highlands, where it was imported as a coffee shade tree over 50 years ago.

Uses: Not only is *Acrocarpus* tall, it also presents a spectacular display of red flowers and new red leaf growth. It is popular for ornamental border planting. Its timber is of good quality, useful as furniture or general construction. As a deciduous legume, the voluminous leaf fall can be used as mulch/green manure. However, because of shade and root competition, it should not be grown close to annual food crops.

Environmental requirements: Drought is one climatic factor *Acrocarpus* cannot tolerate. It prefers deep soils in medium to high rainfall areas. In Kenya it grows well above 1400 meters in areas with 1000 mm of rainfall annually. It does not tolerate frost or dry heat.

Planting technique: The seed of this species is similar to Acacia seed but the coat is not as hard. Scarification by nicking, or soaking 24 hours in hot, then cooled, water work equally well. Germination should be nearly 50%. It is a fast grower once transplanted but takes 4 to 6 months in the nursery. The time is dependent on local weather and temperature patterns.

Seed storage: The seed seems to store well but more research is needed. Keep it in cool, dry storage.

Problems: *Acrocarpus* is rarely affected by disease though die-off has been noted in African plantations. Leaf fall can be rather messy and thick.

Information sources: 1. Tropical Legumes, 19

2. Cyrus Ndegwa, Forester,
Energy Development International,
Ministry of Energy, Kenya.

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Adansonia digitata*

Common Name: Baobab

Native range: The Baobab, or the upside-down tree, is a widespread indigenous tree in dry savanah country of Africa. Its water swollen trunk enables it to survive long dry seasons. Its numerous, and often unusual uses have prompted people to take seeds and plant them in India and as far away as Florida in the U.S.A.

Uses: Baobab has numerous and wide ranging uses. One tree in the Caprivi Strip of Namibia has, inside the hallow trunk, a flush toilet. Most uses are more practical. In famine times in West Africa roots are cooked and eaten. Young leaves can make fine vegetables. The fruit pith can be made into a refreshing drink. The wood is light and fibrous, not useful for timber or firewood. It does make good paper pulp, wide canoes, floats, trays and platters. Bark fibre is used for making rope, baskets, snares, fibre cloth, musical instrument strings and even waterproof hats. Striping the bark does not kill the tree. Hallowed out trunks are used for water storage, some large trees holding up to 2,000 litres.

Environmental requirements: Baobab grows naturally in areas with between 200-800 mm annual rainfall although planted trees do extend to 1400 mm areas. In Kenya it occurs naturally from the coast to 1000 meters. It prefers heavier soils of medium depth. Calcarious soils are tolerated but Interitic, red soils, are less likely to have baobabs growing.

Planting technique: The seed is very hard and takes a long time to germinate if left untreated. Nicked seed coats hasten germination. Plant about 2 cm deep in sandy-clay nursery soil. It may take 6 months in the nursery before ready for transplanting.

Seed storage: Keeps well if kept cool and dry.

Problems: Germination is difficult and growth slow. It may take 25 years to get the first fruits. Leaves for vegetables can be obtained in limited quantities after 2 years.

Information sources: "The Baobab-Africa's Upside-Down Tree"
Kew Bulletin Vol.37 No.2 1982.
G.E. Wilkins

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Ailanthus altissima*

Local Name: None. Sometimes called 'Tree of Heaven'.

Native Range: *Ailanthus altissima* can be found as a street tree in Northern China, its native home, or Washington D.C. It has become a popular urban tree all over the western world as well as China. It normally grows to 10 meters in height at a fairly rapid rate. In sub-tropical areas it has only been tried in Iran. How it will do in the tropical highlands remains to be seen.

Uses: *Ailanthus* grows almost anywhere;garbage heaps, open sections of sidewalks, eroded slopes and polluted soil. It grows fast and coppices well, with a hard heavy wood suitable for charcoal and woodfuel. The wood does make fairly good timber but has not been used extensively for this purpose. As an erosion control tree on rocky slopes it has great potential. Since it competes with weeds well, it can be used on sites plagued with weed problems.

Environmental requirements: As a native of dry temporate climates, *Ailanthus* is adapted to grow in areas with 350 - 600 mm rainfall and 8 months dry season. However, in tropical settings with no cold season, it may require more rainfall. It may grow in areas in excess of 2000 meters altitude and has no soil restrictions, growing in nearly anything.

Planting technique: No seed treatment is needed. Break off the seed wings and sow just under the soil surface. Germination is generally good but somewhat slow. Care must be taken as the seed leaves resemble some East African weeds, so may be weeded. The length of time needed in the nursery is not yet known.

Seed storage: If kept cool, dry and sealed, the seed stays viable for 2 years.

Problems: Since *Ailanthus* grows almost anywhere, seeds prolifically and produces root suckers, it should not be grown near crops. Control can be maintained by thinning out female trees and propagating from male tree root suckers once a stand is established.

Information sources:

1. NAS;Firewood Crops, 1980
2. Mazingira Demonstration Plots Project Nursery experience.

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Azadirachta indica*

Local Name: Neem

Native range: Neem is native to the dry forest areas of Southeast Asia and Indonesia. It has proven very useful in semi-arid tropical areas around the globe, especially India and Africa. In Kenya it has become a naturally spreading tree along the coast. Successful planting has occured in Garba Tula, Wajir, Garissa, Mandera, Ramu and near Lake Baringo.

Uses: The uses of the Neem are multiple. There is even a Neem Society devoted to the collection, distribution and research of Neem information. After its first year Neem grows rapidly, giving high yields of fuelwood. Timber is very durable, tough, and resistant and quite good looking. Neem makes excellent poles and heavy construction wood. A useful energy source comes from seed oil, usable as lamp fuel. The seed cake leftover is high in nitrogen calcium and potassium, making an excellent fertilizer. Leaves and twigs make a good mulch, which may also be nematode repellent. The leaves, twigs and seeds are known to be insect repellent, though the seed pulp attracts flies. It grows well on wastelands, often helping land reclamation The tree also provides a windbreak and shade. Since cattle, camels and goats dislike it, Neem has establishment advantages over other trees.

Environmental requirements: The only soils Neem dislikes are seasonally waterlogged areas or deep, dry sands with a deep water-table. It tolerates high temperate and even a light frost. It grows up to 1 500 meters and at the coast where salt water penetrates the water table. It can stand very long dry seasons and as little as 150 mm per annum, though it grows best with 500 mm or more.

Planting technique: Easily established from fresh seed, Neem starts slowly and needs 4 to 6 months in a nursery. Sow depulped seed 1 cm deep.

Seed storage: The seed loses viability very quickly and should be planted within two weeks of harvesting for maximum germination. Some seed remains viable for 2 months. In Kenya fresh seed is available from late February to April.

Problems: Young seedlings need light shade for the first year and do not compete well with grasses. They are also fire sensitive. Provenance testing is needed.

Information source: NAS, Firewood Crops, 1980.

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Balanites aegyptica*

Local Name: Kilului (Kamba), Desert date

Native range: In Kenya the desert date is found in most sub-humid to arid zones such as in Machakos district along the Athi River and near Olorgasalie in the Rift Valley. It is a widespread and much appreciated tree all across Africa. In parts of the Kerio Valley it is regarded as one of the most important trees.

Uses: As the name, desert date, implies the fruit of *B. aegyptica* is edible. It produces even in very dry years, the reason for its high value. An emulsion of this same fruit put in slow moving streams, irrigation canals or lakes, kills the snail which carries bilharzia and the water flea which carries Guinea worm. In high concentration it can kill fish. Leaves are an especial favourite of camels and goats, some tribes even use it in cut and carry systems. The wood is heavy, with a smooth open grain, carving and turning well, of good colour and durable. It also provides good charcoal and firewood.

Environmental requirements: *Balanites* grows well to 2 000 meters in areas having an annual average rainfall of 350 - 1 000 mm. It is drought tolerant and can withstand some waterlogging. Normally it prefers sandy soils but can be found on thin black cotton soils with sand or more porous soils beneath.

Planting technique: The seed should be soaked to remove fruit. Soaking in lukewarm water overnight before planting speeds germination. Sow the seed vertically with the end previously attached to the stem down. The top should be just beneath the surface. Put two seeds in each pot to insure germination. Pricking-out extra germinators is an easy task if done when the first green appears. It takes 18 - 24 weeks before it is ready to transplant. Direct seeding is an option.

Seed storage: Cool, dry storage will keep the seed viable for at least 6 months. More study is required however.

Problems: Relished by goats, this tree must be protected until in excess of 1½ meters high. It tends to be a slow grower.

Information sources: 1. Dale and Greenway, Kenya Trees and Shrubs, 1961.

2. Ed. Barrow; East Pokot Agricultural Project, on-site interview, May, 1982.

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Cassia siamea*

Local Name: Yellow cassia

Native Range: This *Cassia* is one of two commonly found in Kenya, the other being *C. spectabilis*. It is indigenous to SE Asia, India and Sri Lanka and is now found throughout the tropics and sub-tropics in suitable locations. In Kenya it can be found in Nairobi, Mombasa and other cities and towns planted as a street side ornamental.

Uses: *C. siamea* wood is hard and heavy with an attractive heartwood. The fuel it supplies is excellent though a bit smoky. Because it coppices well and grows quickly it is used as a firewood crop, producing good volumes of wood. Cassia provides a dense cover, good for shades and windbreaks. It grows well on denuded hills or overgrazed sites.

Environmental Requirements: Normally a lowland species, it does fairly well in Nairobi at 1 700 meters. It thrives in hot climates with seasonal rainfall of about 1 000 mm, though will survive in areas with 500-700 mm. if there is access to soil moisture. Cassia likes deep, well-drained, fairly rich soils. Good drainage is the most important factor.

Planting Technique: Fresh seed is the best. Old seed should be nicked. If the seed was picked that month no treatment is needed. Germination is between 30 and 40 percent with fresh seed and as low as 20 percent with old nicked seed. Sow about 1 cm deep, 3 seed per pot or use a seed bed. A woodlot transplanting scheme will require weeding for the first year or so.

Seed Storage: Stores well if cool and dry. One should probably not store over two years. It is best to use fresh seed.

Problems: Pods are poisonous to pigs.

Information Sources: 1. NAS, Firewood crops, 1980

2. Edmund Barrow, East Pokot Agricultural Project, On-site interview, May, 1982.

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MENONNITE CENTRAL COMMITTEE

Scientific Name: *Casuarina equisetifolia*

Local Name: Mvinje (Swahili)

Native range: Mvinje is a widespread tree around the tropical Indian Ocean Coast. Stands of this species are found in N.E. Australia, some Pacific Islands, Malaysia and Sri Lanka. Mvinje may be indigenous to the Kenya Coast region as well, though some people think it was transported by traders in the not too distant past. Mvinje is a straight tree which commonly grows to 20 meters.

Uses: *Casuarina* species in general, and *C. equisetifolia* in particular have a variety of uses. Mvinje is used as timber, poles, fuelwood, charcoal, mulch and soil reclaimation at the Kenya Coast alone. The timber is dark, strong and heavy. It is salt tolerant and helps control erosion on coastal sands. A row of *C. equisetifolia* makes an excellent windbreak. A dye and tannin are found in the bark. Good pulp can be obtained from the wood. The firewood has been called the 'best-in-the-world' by some. Charcoal, too, is of fine quality.

Environmental requirements: *Casuarina equisetifolia* tolerates a wide variety of tropical climates, the only real limiting factor being frost. It will survive with as little as 200 mm rainfall or 500 mm annually, 700 - 2000 mm being best. It grows poorly above 1500 meters. Mvinje is very salt tolerant. It nodulates readily, making its own nitrogen supply. Heavy clay soils retard growth, though it can stand partial water-logging.

Planting technique: The small seeds should be treated to repel ants and innoculated with crushed root nodules from established trees. These should be sown in a seed bed, then pricked-out into pots. Transplanting should occur at the onset of the rainy season some 4 months after germination.

Seed storage: Not well known at this time, but some sources indicate upto one year in cool, dry, airtight conditions.

Problems: Ants and other insects may harm young seedlings. *C. equisetifolia* should not be planted near crops or in fire swept zones. It does not coppice well.

Information sources:


1. NAS: Firewood Crops, 1980
2. Dale and Greenway, Kenya Trees and Shrubs, 1961
3. Rene de Haller, Baobab Farms Ltd, Mombasa, Kenya.

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Gleditsia triacanthos*

Common Name: Honey locust

Native Range: Honey locust is a temperate area species native to North America. Its natural range extends from sub-tropical Louisiana to cold central Minnesota. It has been tried in many other areas but has only recently been introduced to Kenya. Whether honey locust will do well in the highlands is a question we shall have to wait to answer.

Uses: *G. triacanthos* gets its common name from the sweet, edible pod it produces. The honey locust pod contains up to 30 percent sugar. Cattle greedily eat the pods. Some dairy farmers in the U.S. keep the tree especially for fodder production. It can be ground up as flour for human food or eaten by people straight from the tree. The timber produced is durable in the ground and can be made into heavy furniture. The crown is open, letting light pass through allowing for grass or crop growth underneath. Firewood could also be obtained. Hedges, windbreaks and other shelter uses are also common in the U.S.

Environmental Requirements: *Gleditsia* withstands drought and grows in areas with 500 mm. rainfall. However, these areas have a cold or cool winter with low potential evaporation compared to tropical sites. It is probably most suited to cooler highland locations with more than 800 mm. rainfall. We do not yet know if honey locust requires a frost to flower. It does have a deep, widespread root system which allows it to survive long dry spells. It prefers deep loamy soils but is found on a wide variety.

Planting Technique: Once a stand gets going the best way to propogate is from root cutting of favoured trees. It does grow from seed as well. Scratch the seed coat, which is shiny but not hard, until the lighter coloured flesh is exposed at one point. Sow about 2 cm. deep, 2 or 3 seeds per pot. Germination takes about 2 weeks. It should be ready to transplant in 4-5 months.

Seed Storage: Easily stored, lasts for well over 3 years if kept cool, dry and insect free.

Problems: Uncertainty about use in tropical areas. Grows at only a medium pace, but does reach a good size, up to 80 feet.

Information Source: Smith, Tree Crops, A permanent Agriculture, 1950.

27.10.1982

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Grevillea robusta*

Local Name: Silk oak; Mkima (Kikuyu)

Native and Present Range: This tree is another of the many Australian imports into Africa. It is native to subtropical regions of Queensland and New South Wales. It can now be found in appropriate zones throughout East Africa.

Uses: Grevillea was originally introduced as a coffee and tea shade tree as it does not interfere with crop growth. It grows moderately fast producing good fuel wood. The timber resembles oak and has a good grain, working well, making good cabinets, furniture and even heavy use timber. It flowers prolifically making it a good ornamental and honey tree.

Environmental requirements: A sub-tropical tree, *Grevillea* grows well in midlands and highlands up to 2 500 meters. Drought tolerant, it can grow even in semi-arid zones with as low as 400 mm as long as there are two rainy seasons. It needs deep soils, free from waterlogging. It grows in sandy and medium fertility loamy soils and acid soils.

Planting techniques: A prolific seeder, one can either plant fresh seed or wildlings found under old stands. Plant about 1-5 mm. deep in the nursery. Transplant when just over ½ meter tall. No seed treatment required.

Seed storage: Usually not viable after 3 months unless dried and stored in a refrigerat[illegible] It is best to use fresh seed.

Problems: Can become weedy if not controlled. Limbs are brittle and large branches can break off in high winds.

Information sources:

23.9.1982

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Leucaena leucocephala*

Local Names: None in Kenya. Ipil-ipil (Philipines)

Native Range: Originally this tree comes from the Pacific coast belt of Southern Mexico and Central America. This region has a sub-humid tropical climate. Nowadays it has an extremely broad range, being of great economic importance in the Philipines and Malawi. A center for research on Leucaena is located in Hawaii and the best rhizobium comes from there. In Kenya Leucaena is found wild along the coast south of Mombasa and is grown in a number of different locations.

Uses: Leucaena has a number of different uses and a number of different varieties often designated by K-numbers. Some, like K8, K28 and K67 are used for timber and firewood. These are taller, produce less seed and are less branched. The Peru Cunningham varieties are bushier and provide fodder, green manure and small fuelwood. It is deep rooted so does not compete with crops for soil moisture. Also it fixes nitrogen. Leucaena coppices vigorously.

Environmental requirements: *L. leucocephala* grows best in hot, humid locations with over 1 000 mm annual rainfall. However this species, depending on variety and soil conditions, can grow in places receiving 500 mm or more. Usually it does poorly above 1 400 meters. It prefers neutral to alkaline soils, deep, well drained, and, in dry areas, with a high water table.

Planting Techniques: Soaking the seed 24 hours helps if large quantities are to be planted. Nicking the seed coat works best, percentage wise, for small amounts. Plant about 2 cm. deep in pots or by direct seeding. The plant being edible by cattle, goats and sheep, should be protected until of sufficient height. Three months in the nursery is usually sufficient, unless temperatures are low.

Seed storage: The seed stores well over long periods if kept dry and insect free.

Problems: Leucaena seeds prolifically, spreads rapidly and is difficult to kill once the roots are established. In suitable locations it can become a dense weedy thicket.

Information sources: NAS, Firewood Crops
Rene de Haller Baobab Farms Ltd., Mombasa, Kenya

23.9.1982

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MENNONITE CENTRAL COMMITTEE

Scientific Name: *Melia azedirach* (or azedirachta)

Local Name: Geed-hindi

Native range: A native of dry areas of India and Burma, this species has been spread to many tropical areas around the world. It can now be found in abundance in Somalia and in lesser amounts in Kenya. In Kenya it can be seen in Northern Machakos and Kitui districts. The tree resembles the neem tree *(Azadirachta indica)* but should not be confused with it. The long spreading branches and 18 meter height make this an attractive tree.

Uses: *Melia azedirach* makes a good multiple purpose trees for dry land agricultural sites. The poles it provides are strong and durable. Leaves make a good mulch. It provides shade and a fine shelterbelt. Bark, roots, leaves and fruits have medicinal properties. Twigs can be used as toothbrushes. Geed-hindi wood makes good fuelwood and charcoal as well.

Environmental requirements: Normal rainfall in this species native area is between 450 - 750 mm. In Somalia, however, it has been successfully grown in areas having less than 250 mm a year. It tolerates some salinity and grows well on dry rocky sites with shallow soils. It requires no watertable as some species do.

Planting technique: When the fruit of this prolific seeder falls it must be depulped and dried. Seed is then removed from the woody shell by pounding or cracking. The small seeds should be planted just under the surface. Keep the pot surface wet until germination. Use two or three seeds per pot, sown close together and prick-out soon after germination. Keep the pots well weeded. Transplanting can begin when 8 - 10 cm high. In larger pots wait until the seedling is the same height as the pot. If planted during the rains it will need no further watering.

Seed storage: Dried, depulped fruits can be kept from 6 months to a year in cool, dry storage. Remove the woody coat just prior to sowing.

Problems: Can be weedy in moister areas.

Information sources: 1. Dr. S.H.S. Kasmi,
National Herbarium
National Range Agency,
Mogadishu, Somalia.

MAZINGIRA INSTITUTE

MENNONITE CENTRAL COMMITTEE

Scientific Name: *Parkinsonia aculeata*

Local Names: Jerusalem Thorn

Native Range: This tree is an exotic originally imported from the Americas where it grows over a wide range. In Kenya it is grown in many semi-arid and arid zones notably toward the North-East. It is commonly seen in desert towns like Wajir and Garissa. It grows into a crooked tree up to 10 meters in height.

Uses: *Parkinsonia* is a multiple use speciewith hard, heavy and brittle wood. It makes good firewood and charcoal. Because it has unusual foliage, bright flowers and thorns, it is used as a decorative living fence and hedge. People use it on dry, sandy sites for soil stabilization and erosion control. Seed pods and leaves are used as fodder in cut and carry systems. The tree regrows quickly after pruning.

Environmental Requirements: Jerusalem Thorns are very drought tolerant, growing in areas with 300 - 1 000 mm. annual rainfall and up to 9 months dry season. They can withstand high temperatures and light frosts. Usually it grows below 1 400 meters on light, gravelly, sandy soils. It is salt tolerant but does not do well when waterlogged.

Planting Technique: Soaking for 3 to 4 days in water or nicking the seed coat produces quick germination. Plant the seeds about 2 cm. deep in moist soil, 2 seeds per pot. It will be ready to transplant in 6 to 10 weeks.

Seed Storage: Seeds store well in cool, dry, closed containers.

Problems: Reproduces rapidly and can become a weed. Young plants are susceptible to termite attack.

Information Sources: NAS, Firewood Crops, 1980

27.10.1982

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**MAZINGIRA INSTITUTE**

MENNONITE CENTRAL COMMITTEE

Scientific Name: *Prosopis chilensis*

Local Name: None in Kenya; Algarroba in Chile

Native Range: Indigenous to South America, it has been planted widely in East Africa.

Uses: *Prosopis chilensis* has a dense, hard wood useful for firewood and charcoal. It does not produce a good bole or long straight branches but can still be used for short, durable posts. The wood is coarse grained but works and polishes well. Heartwood of old trees becomes a purplish dark brown. The pods are excellent feed with high sugar content. Foliage makes good fodder in arid areas.

Environmental requirements: Algarroba is a drought tolerant tree good for arid and semi-arid zones with 200-400 mm. rainfall or higher. Not very frost tolerant, it can grow in a temperature range of 0 to 40°C. Normally found below 1 500 meters, it does grow to 2 900 meters in Peru. Soil requirements are not known.

Planting techniques: *P. chilensis* does best if grown in a nursery for 3 months prior to planting out. Nicking the seed coat produces the most rapid germination. Soaking also works. Plant between 1 and 1½ cm. deep in standard nursery soil. Transplanting should take place at the beginning of the rains.

Seed storage: Seeds should be removed from the pods, a hard sticky process, and stored in a cool, dry container, free from insects.

Problems: Very few. This *Prosopis* species tends not to be as weedy as some other types. Only in areas devoid of grass cover will it tend to dominate.

Information source NAS, Firewood Crops, 1980

23.9.1982

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MAZINGIRA INSTITUTE

MENNONITE CENTRAL COMMITTEE

Scientific Name: *Podocarpus gracilior*

Local Name: Podo, East African Yellow Wood, Musengera (kikuyu), Muvengea (Kamba), Piripirindi (Samburu).

Native Range: A Kenyan coniferous species native to drier tropical highland forests. It can be found on Mt. Kenya, the Aberdares, near Nyahururu, Ukambani Hills, Marakwet, Mt. Elgon, and Northern Mau.

Uses: Podo, a term used for both *milanjianus* and *gracilior* species, are 'high-class' softwoods regarded as superior to cypress and pines. The wood can be used for joinery, furniture, frames, cabinet work, linings, boxes, etc. It finishes smoothly, with even grains and light yellow-brown colour. Podo wood can also be used for general purpose plywood. It is a well-formed tree suitable for yard planting as well.

Environmental Requirements: Grows between 4 000 and 9 000 feet in tropical highlands, usually in drier forest areas. It needs about 700 mm or more rainfall and reasonably well drained good-quality soils.

Planting Technique: The seed is hard shelled. Usually germination is good without treatment though soaking 24 hours helps. Plant 3 cm. deep in good forest soil, well-drained. It may take a month or more for germination. It can stay in the nursery from 6 months to a year. Plant out when about 1 foot tall.

Seed Storage: Store dry and cool. Podo has a viability of about 2 years.

Problems: Usually a slow grower. No research or provenence data are available. Wood splits if nailed with grain. Stains patchily. Demand for wood exceeds the trees reproductive capacity and it is in danger of extinction.

Information Sources:

1. Dale and Greenway, Kenya Trees and Shrubs, 1961

2. District Forest Officer, Nyahururu, July, 1982

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MAZINGIRA INSTITUTE

MENNONITE CENTRAL COMMITTEE

Scientific Name: *Prosopis juliflora*

Common Name: Mesquite, Algarroba (U.S.A)

Native range: This tree is one of many American *Prosopis* species which have been a focus of international attention. *Prosopis juliflora* is a native of Central and Northern South America. In Africa it has been successfully established in many dry zones, including the coastal hinterland, N.E. and Turkana district in Kenya. Fast growing, this mesquite sometimes reaches 10 meters in height.

Uses: First and foremost this species is a firewood crop. The wood is hard, heavy and burns slowly with great heat and little smoke. Charcoal produced also has excellent properties. Other uses include bee forage for honey, durable wood, fodder for livestock and even human food from pods. Foliage is not palatable except in periods of fodder shortage, so this tree needs less protection from goats and other grazing animals. Thorny natural varieties of P. juliflora have potential as a living fence. Trees coppice well.

Environmental requirements: Algarroba thrives in dry areas. Trees grow well in Dubai, Arabian Pennisula, where rainfall is often less than 150 mm a year. Annual rainfall in its natural areas ranges from 150 - 750 mm. It grows up to 1500 meters if the region is frost free. Soils can vary greatly as long as they allow the roots to grow deeply. Sandy and even rocky sites are fine.

Planting techniques: Seeds germinate quickly if the hard seed coat is nicked. Large quntities can be treated by pouring boiling water on them and leaving to soak 24 hours. Sow the seed 1 cm deep, 2 per pot. Prick-out within 2 weeks of germination. Ten to twelve weeks is enough time in the nursery. Direct sowing is possible in the moister end of its geographical range. Natural propagation is usually through root suckers.

Seed storage: In a cool and dry place this seed keeps well for long periods.

Problems: Potentially weedy. Should not be used in well-watered sites in an uncontrolled manner.

Information source: NAS, Firewood Crops, 1980

MAZINGIRA INSTITUTE

MENNONITE CENTRAL COMMITTEE

Scientific Name: [illegible]

Local Name: Raintree

Native and Present Range: Indigenous to Venezuela and Trinidad, Raintree has been widely planted in many tropical areas including Hawaii and other Polynesian islands. In Kenya some trees have been planted at Marsabit and near the coast in small numbers.

Uses: [illegible] can grow into a huge shade tree in appropirate environs. Its pods are edible and a favourite food of cattle and goats after falling. Grass grows well under the tree as leaves close during rains letting most drops reach the ground. The wood, called monkeypod, is highly prized for beauty and workability. It is hard, heavy, dark, fine grained and cures easily. Waste timber also provides good fuelwood

Environmental requirements: A tropical species growing between 0 and 1 500 meters in frost free sub-humid climate. It grows naturally in areas with 600 mm rainfall or more, and is drought tolerant. It can grow in poor soils.

Planting technique: Raintree can be direct seeded in protected sites or propogated from seed in a nursery. Scarification can be difficult though a file works well. The seed coat is very hard. Plant about 3 cm. deep in well cultivated soil. The tree is sensitive to too much or too little watering in the nursery. Make sure pots stay moist but are not ever soaked. It usually germinates quickly if scarified and is ready for transplanting in [illegible] months.

Seed storage: Has low viability if kept dry and cool, free from beetles.

Problems: Almost none. This tree is best for pasture land. Do not put in crop land.

Information source: 1. NAS, Underutilized Tropical Legumes.

2. Dr. John Raintree, ICRAF, April, 1982.

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MENNONITE CENTRAL COMMITTEE

Scientific Name: [illegible]

Local Name: Maisi (Swa) Ol-Musambara (Masai)

Native range: Tamarind is an indigenous African tree whose range is very broad. It occurs mostly in sub-humid savannah climates from South Africa to Sudan. India also has numerous Tamarind trees which are more exploited for commercial products than in Africa. In Kenya Tamarind is common in the Kerio Valley and on the lower slopes of Mt.Kenya's eastern side around 1000 - 1500 meters. Some Tamarinds grow to 20 meters in height though most reach only 10 meters.

Uses: Tamarind wood weighs about [illegible] per cubic foot. It is hard, difficult to work but polishes well and can be used for furniture, pestles, mortars and carts. The fruit is a pod which has edible pulp, makes a cool drink, valuable for treating fevers and as a laxitive. Other products of value can be extracted from pods and seeds as well. In addition Tamarind provides good shade, green manure and charcoal.

Environmental requirements: Normally a dry savannah tree growing in areas up to 1500 meters with 500 - 1200 mm of rainfall annually. It tolerates a dry season of 8 months.

Planting technique: Tamarind has a large seed which quickly germinates when the hard seed coat is nicked. Plant 1 seed about 2 cm deep. Normally undamaged seed gives up to 90% germination. Empty pots can be resown after two weeks if nothing comes up. Twelve weeks should be sufficient in a nursery. Direct sowing is possible in moist areas with protection.

Seed storage: Stores well if kept cool and dry.

Problems: This species is generally regarded as a slow grower.

Information sources: 1. Dale and Greenway, Kenya Trees and Shrubs, 1961

2. Ed Barrow: East Pokot Agricultural Project, July, 1982.

MAZINGIRA INSTITUTE

MENNONITE CENTRAL COMMITTEE

Scientific Name: *Zizyphus jujuba*

Local Name: Jujuba, Chinese Date.

Native Name: The natural range of the fruit tree is China. It has been cultivated there for thousands of years. The range of jujuba has spread to North America, notably Oregon. Some rare specimens have been grown in Southern England, but this climate is a bit harsh.

Uses: Primarily a fruit tree, [illegible] produces a mahogany brown oblong fruit about the size of small plums. These are high in vitamins. Normally jujuba is eaten fresh or semi-dried. Most [illegible] species are thorny and make good hedgerows, living fences or shelter belt lines.

Environmental requirements: [illegible] species in general are drought tolerant. [illegible] can withstand both drought and waterlogging. It tolerates a wide range of soils but deep sandy loams are best for fruit. It likes a hot, dry climate but can withstand frost. Because of its success in certain parts of China and the U.S. it should do well in tropical highlands.

Planting technique: Crack open the hard outer shell using light taps with a hammer. Carefully remove the 1 or 2 seeds inside. These can be planted 1½ cm. deep in pots. Use two or three seeds per pot, depending on quantity available. Germination usually takes two weeks in warm settings. Transplanting can occur in 4 to 6 months.

Seed storage: Cool, dry storage. Length of viability is not known, but it is assumed to be lengthy as long as the hard outer shell remains intact.

Problems: Flowering and growth rate in the tropical highlands is not known. In its natural range frost could stimulate flowering.

Information source: "[illegible] minor fruit", 1972
Simmons,

## APPENDIX C-1

Specified Information Requirements for Seed Labels for Locally Collected Species

Date Collected

District

Location

Sub-Location

Size of Tree (DBH Approximation)

Name of Shamba-owner (if applicable)

# APPENDIX C-2

Kaewa Area Tree Seed Offered to Purchase by Project Team

(An * indicates maximum of 1 kilo desired)

1. *Acacia brevispica* - Mukuswi; Mukuswi (wait-a-bit thorn)*

   (fodder, living fence, posts).

   1 kg = 50/-

2. *Acacia mellifera* - Muthia, Kithia

   (honey, living fence, coppicing)

   1 kg = 50/-

3. *Acacia senegal* - Mongolli*

   (living fence, gum arabic)

   1 kg = 50/-

4. *Acacia nilotica* - Musene*

   (living fence especially for flooded/black cotton sites)

   1 kg = 50/-

5. *Dulbergia melanoxylon* Muvingo (East African blackwood)

   (carving wood, excellent turning)

   1 kg = 200/-

6. - Mulinditi

   (Soft wood, termite and wood borer resistant)

   Small Seeds. Perhaps a small tin or bag full (100gms)

   For this tree we need a specimen of flower leaf and

   discription of shape and size.

7. *Melia volkensii* - Mukau

(honey, mulch, timber)

1 kg = 5/- (not more than 5 kilos)

8. *Lannea stuhlmannii* - Mwethi, Kinasi, Chinasi*

(fibre from roots, possible mulch, brown dye)

1 kg = 50/-

9. *Albizia harveyii* - Mukanana

(building, fuelwood, fodder, ant-resistant)

1 kg = 50/-.

APPENDIX - D

MMARY OF VIABILITY CHARACTERISTICS AND STORAGE REQUIREMENTS OF SEED PROPOGATED AT MAZINGIRA PROJECT NURSERIES THROUGH OCTOBER, 1982

1. *Acacia albida*
   Storage - Cool dry sealed place
   Viability - indefinate

2. *Acacia holosericea*
   Storage - Cool and dry place
   Viability - indefinate

3. *Acacia nilotica*
   Storage - Sort out beetle attacked seed and store in cool, dry, tight containers after drying.
   Viability - indefinate

4. *Acacia saligna*
   Storage - Cool, dry, airtight containers
   Viability - indefinate

5. *Acacia senegal*
   Storage - Cool, dry, airtight containers
   Viability - indefinate

6. *Acacia tortilis*
   Storage - Cool dry place
   Viability - indefinate

7. *Acrocarpus fraxinifolia*
   Storage - Cool dry place
   Viability - Research needed

8. *Adansonia digitata* (Baobab)
   Storage - Cool dry sealed place
   Viability - Good, but needs research

9. *Ailanthas altissima*
   Storage - Cool dry sealed place
   Viability - 2 years

10. *Azadirachta indica* (neem)
    Storage - Maximum of 2 months storage period
    Viability - Poor. Seed should be planted within two weeks after harvesting.

11. *Balanites aegyptica*
    Storage - Cool dry place
    Viability - 6 months

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12. *Cassia siamea*
Storage - Cool dry place
Viability - 2 years

13. *Casuarina equisetifolia*
Storage - Cool, dry, airtight containers
Viability - One year, but variable

14. *Gleditsia triacanthos*
Storage - Cool, dry, insect free place
Viability - indefinate

15. *Grevillea robusta*
Storage - Dry and store in refrigerator
Viability - 3 months

16. *Leucaena leucocephala*
Storage - Dry, insect, free place
Viability - indefinate

17. *Melia azedirach*
Storage - Cool dry place
Viability - 6 months

18. *Parkinsonia aculeata*
Storage - Cool dry airtight container
Viability - indefinate

19. *Prosopis chilensis*
Storage - Cool, dry, insect free container
Viability - indefinate

20. *Podocarpus gracilor*
Storage - Cool dry place
Viability - 2 years

21. *Prosopis juliflora*
Storage - Cool dry place
Viability - indefinate

22. *Samanea saman*
Storage - Cool, dry, beetle free place
Viability - indefinate

23. *Tamarindus indica*
Storage - Cool dry place
Viability - indefinate

23. *Zizyphus jujuba*
Storage - Cool dry place
Viability - indefinate

# APPENDIX E

## NURSERY TECHNIQUES EMPLOYED AT MAZINGIRA INSTITUTE PROJECT SITES*

Following are summaries of the various tasks involved in developing and operating the nurseries at Siakago and Kaewa, respectively. The discussion includes techniques employed at each stage, the nature of local participation, types of problems experienced and where appropriate, recommendations for improvement. The form in which the information is presented, that is repetition of each procedural step for the respective sites, is purposeful with respect to monitoring for the Mazingira project.

### APPENDIX E - 1

### SIAKAGO

Nearly every method used in nursery establishment was taught by demonstration. Unfortunately, the composition of the group taught varied from day to day, or throughout some days. The most consistant group of attendees was teachers, of whom the same 2 or 3 showed for most of the work days. Since August, when planting took place, was not an 'in-session' period teacher and student turnout varied substantially. Only 6 boys, all from standard 6, came to the demonstration planting on July 30th. Most of the students who participated were 4-K club members. This was especially true for nursery bed preparation, pot filling and pre-watering.

Nursery siting. The major factor taken into consideration in siting the nursery at Siakago was proximity to the water supply. A slightly sloping site was chosen, approximately 10 meters from the water hole. A recently dug well from which water for the nursery will now be collected was located at about the same distance from the nursery as the original water hole. The nursery site was readily agreed upon by the Committee and Team, jointly. It is on school property.

Fence construction. A 10 by 12 meter rectangle was measured by the project Team and a simple design for the enclosure prescribed. The Committee was charged with the responsibility of purchasing 25 posts locally, with Team provided funds. The posts were treated with used engine oil to prevent termite damage, a measure which, to date has proven effective. The Team purchased barbed wire and chicken wire in Nairobi and delivered these to the site. The Committee was charged by the Team to hire a fundi (local construction expert) and his assistant

* Drafted by Wayne Teel, Mennonite Central Committee.

to erect the poles and fasten the wire. The Committee supervised the one-day job.

Soil Collection and Mixing. The soil mixture prescribed by the Team was 2 parts top soil (obtained from beneath local deciduous trees), 2 parts nursery soil (dug from the nursery beds), 1 part sand and 1 part well-rotted manure. This is equivalent to a 4:1:1 ratio. Top soil was collected by students from a wooded hillside, on school property. They scraped the surface vegetation with their hands, scooped the soil and carried it to the nursery in buckets or tins. The sand was brought by students in tins from a collection site near the nursery. The manure was carried similarly from the students' shambas. The soil was mixed within the nursery enclosure by team members or by teachers under team supervision.

Unfortunately, not enough lead time was available to provide for a recommended two to three month maturing period for the collected top soil. Such a measure is intended to result in the decay of weeds and other organic material in the soil. Also, it appeared that not all of the manure provided was thoroughly rotted. This situation could have resulted in the presence of pesty nematodes in the nursery soil. In fact, no such problems were apparent. It is possible, however, that the application of insecticide to deal with white ant problems also prevented the emergence of soil-harboured pests.

Bed-digging. Boys from standards 6 and 7 dug the beds using jembes and pangas. The 1 by 3 meter beds were marked off by a Team member. Measurement tended to be of inconsistant quality as both the Team and students were learning. The task is basically simple, but does require supervision and care for a uniform job.

Pot-filling. Up to 40 students at a time worked on pot filling. This task is simple, the primary difficulty being getting the soil sufficiently compacted. Part of the compaction problem was due to

overuse of topsoil which contains too high a proportion of unrooted vegetative material. Stacking the pots to make sure they are nearly vertical also proved to be a task needing close supervision.

Pots must be pre-watered before seed sowing can begin. Two methods were demonstrated. The first involved poking holes in the botton of a tin and pouring water into it from another tin. The first pre-watering was done this way. Watering buckets proved easier to use for all watering tasks. Pre-watering was not done as often or as early as it should have been. The purpose should be better explained for next time.

Seed treatment. The need for pre-treatment of seed depends upon the species. Some, including fresh Cassia and Grevillea, require no treatment. *Melia volkensii* requires a special technique, which is known to one of the teachers and is relatively complicated. All other seed used at Siakago was treated by nicking the seed coat in some fashion. This was done in a number of different ways including scratching on a rock (old Cassia), using a file to make a groove deep enough to see light flesh (Samanea) and clipping with scissors and/or fingernail clippers (*Leucaena*, *Prosopis* and *Acacia albida*). Prosopis proved the most difficult for students as the seed is small and it is easy to nick off too much. Overall, this task was done with few problems.

Seed Planting. Obtaining proper seed depth and keeping track of which pots are already planted proved to be the most difficult aspects of the seed planting task. The technique used for measuring seed depth was to mark sticks with the proper hole depth. These were prepared by the nursery advisor or a Committee member. Students then made 1,2 or 3 holes in the pots' soil, as demonstrated. Holes were poked in all the pots before planting. After this the treated seed was dropped in each hole and covered with soil. This prevented confusion between what was seeded and what was not.

The only significant planting error was to make the holes too close to the side of the pots. Students caught on very well to the task in general and teachers were able to both work and supervise without difficulty. Most of the labour for these jobs came from standard 5,6 and 7 boys who live near the school. On August 5th about 20 students and 3 teachers worked. On August 19th 4 teachers and 9 students, including Daniel Nyaga (Committee member) worked. Most of the standard 5,6 and 7 boys (no girls) were present both times.

Watering. Patrick Muriithi (Committee member) and other teachers supervised and taught watering methods after they were taught by the team. Problems of supervision arose in August when school was not in session. The outside pots tended to dry up more quickly, partly as a fault of poor nursery bed design and partly due to poor labour supervision. This problem (and the weeding problem as well) ended in September when Mr. Muriithi and Mr. D. Nyaga began more careful supervision and organized work teams of 4K students (on advise from the Team).

Weeding. This is a simple task, although performance suffered from lack of supervision and organization in August, when school was not is session. Generally, it is handled by the students.

Shade Construction. After receiving basic direction from the Team the Committee performed this duty very well. Four, I meter upright posts were placed in respective corners of the 11 beds. Three meter sisal poles were placed on top lengthwise along the beds. Sisal slats were then layed across to provide shade. It took a while to get a sufficient number of cross slats for the 11 beds. Otherwise there were few problems and the Committee understood the need very well.

Pricking out. Closely supervised by the Team and Committee members, this job went quickly and well. A stick was used to loosen dirt from around the main taproot. The seedling was gently lifted by the cotyledons and planted in an adjacent empty pot. Care was taken to remove the whole root and place it in the new pot without bending the root. Survival rate of pricked out seedlings cannot be determined this season.

Measuring Growth. Five pots in each bed were marked with numbered tongue depressor sticks. These 5 were to be measured weekly. Three teachers (including the 4K Club advisors) and some students were taught how to do this. In addition the number of empty pots per bed was counted. This was to be done weekly.

Some problems arose as to where to keep the record book. It had to be retrieved from a teacher and some students needed to be re-taught. Afterwards the procedure went well. Again, part of the problem was the August vacation period. Final assessment of this aspect requires further attention.

Insecticide application. Upon discovery that white ants were attacking the *Prosopis chilensis* seedlings, an 18% solution of dieldrin was purchased in Embu and applied by Mr. Murithi as per the Team's directions. 66 m of dieldrin was diluted in a 15 litre watering can and applied to each bed. Mr. Murithi, only, did this. The ant problem did not resurface.

KAEWA

As at Siakago, demonstration was the main teaching technique employed at Kaewa. The group taught varied in size, but about 20 people consistantly came to every working day. At times the labour force was disrupted by local community meetings. Usually, about 30 people showed up. Kaewa has many dedicated hard-working people, a good number of whom participated at work days.

Nursery Sitting. As at Siakago, the major factor considered in selecting a nursery site was proximity to water. At Kaewa the only significant non-seasonal water supply is at the communal dam site, which is surrounded by private property. The Committee took the lead in choosing the "appropriate" location, sitting the nursery below the dam itself and about 50 meters from the gate to the reservoir. Apparently, a portion of it lies on private land belonging to a non-committee member. The landowner has informed the Committee that if the nursery were expanded to take in any more of his land, he would demand compensation.

Fence Construction. A 12 by 15 meter rectangle was measured by the project Team. Although slightly larger than the Siakago nursery, the design is essentially the same. The Team had the Siakago Committee purchase the 22 poles in Siakago. They were treated at Kaewa with engine oil. All other fencing material except nails were purchased by the team. Labour for construction was provided by Committee and Team members who worked together for one and one half days to complete the job.

Soil Collection and Mixing. Kaewa soil is very sandy so no sand was added to the mixture. The ratio used for the majority of the mixture was four parts local soil, one part top soil from Nyeri and one part rooted manure. The local soil, in this case, was dug from the seed beds. Later on the mixture was changed to include three parts local soil, dug from beneath a broad leaf tree nearby the nursery, 1 part Nyeri soil and 1 part manure. The seed beds which received the second mixture were planted with *Acacia albida* (beds 1+2) and *Prosopis juliflora*.

Bed Digging. The beds were dug at a rate just ahead of the pot filling operation. Usually three or four men dug in shifts using picks, jembes and pangas. The beds were measured at first by a team member, (1m x 3m and 30 cm deep). Then Peter Mweu of the Committee took charge of measuring; making sure the depth was correct, lines were straight and the bottoms even. The beds turned out very well.

Pot filling. The task of filling the pots with soil was undertaken on five different days with an average of about 30 local people turning up to work each day. Work was supervised, and assisted, by various of the Team members. A work day was normally about 4 to 4 1/2 hours per day. Committee members tended to work for longer periods. On one of the pot-filling work days the Provincial Commissioner had been scheduled to appear and about 60 persons turned out at the nursery. The PC never arrived.

The Kaewa soil mixtures compacted easily, as the local soil contains relatively little organic matter. The workers found the filling task to be simple.

Committee member Peter Mweu supervised stacking the pots into the beds. The job was well done so that little straightening was required later during seed sowing operations.

Pre-Watering. Dry conditions at KAEWA made this task especially important and it was performed reasonably well. The committee was provided with two 20 litre jerry cans which were used for hauling the water from the reservoir to the nursery. The water was transfered to Team-provided watering cans for application to the beds. The job was performed each day for one week prior to sowing as well.

Seed Treatment. The seed treatment most commonly applied was to nick the seed coat in some fashion. *Samanea saman* and *Adansonia digitata* were nicked with a file. All others requiring nicking were done with fingernail clippers. Although time-consuming, the job posed no problems. *Acacia haloserica* was treated by pouring boiling water over the seeds and allowing them to soak for 12 hours in Nairobi.

*Balanites aegyptica* received no treatment.

Seed Planting. Marked sticks were used to measure proper depth, this depending primarily upon seed size. The sticks were prepared by a Team or Committee member. Holes were difficult to make in soil not watered immediately prior, a problem easily remedied. Where two holes per pot were needed they were often made too close to the edges. It was thought that this may prove to be a problem during transplanting although it did not seem to. Seed treatment and seed planting were accomplished in two days, five days apart, in mid-August. On the first day approximately 30 people worked over a four hour period. Later, about 20 people provided labour.

Watering. The need for routine daily watering required that local personnel be hired for this task. The main problem which arose was that of over-watering. This problem was discovered by ICRAF's senior forester on his visit to the site in mid October. He noticed that a fine, smooth clay film had developed on the surface of some pots. Parkinsonia and Samanea were the main species to suffer. The advise given was to withhold the water the following day and, thereafter, reduce the amount per bed to 1/2 watering can, from the full can which had been previously applied. This prescription did seem to eliminate the problem.

The only other problem with watering concerned breakage of the watering cans. Apparently several days lapsed with little or no watering while both cans were under repair. A back-up system is advisable to eliminate repetition of such an occurance.

Weeding. Routine weeding was performed by hired labour, so that weeds were never a problem at Kaewa.

Shade. Although the shade constructed at the KAEWA nursery was effective, the design used was not very appropriate. Instead of erecting a low sisal pole shade for each bed, as at Siakago, a high sisal general shade, covered with Hessian cloth, was used. The five foot

height of the shade did eliminate the need to remove it when working underneath. But the design did not allow for adjustment of light intensity. The cloth was relatively expensive, compared to sisal poles, and has disintegrated considerably from intensive sun and the recent rains. Substitution of the cloth with sisal poles may be advisable for next season as the present system probably will not withstand another.

Pricking Out. This was accomplished by local labour under the direct supervision of Team members and a few "trained" Committee members (the method used is described in the corresponsing section for Siakago). The only problem related to pricking-out concerned timing. Parkinsonia was done too late, for example. *Acacia haloscerica* was not done at all because the germination period was too spread out to effectively judge the best time. This issue needs consideration on a species by species basis.

Seedling Measurement. This task was the responsibility of hired labour. It was done fairly consistantly as per the system devised by the Team, but the actual measurements appear unreliable. One real problem in measuring is that counting of empty pots is not feasible beyond about the fifth week from germination as the canopy tends to close by then. Also, the labourer's ability to count accurately is questionable. The system of pot-marking used was as for Siakago. There was difficulty in finding the sticks in some of the beds due to canopy closure.

Insecticide Application. Problems with white ants, or termites, surfaced as soon as the pots were pre-watered. In two separate doses, the equivalent of 66 ml 18% dieldrin solution diluted with 15 litres of water was applied on and around each bed. Also, 1 bucket of 10 litres water with 50 ml dieldrin was poured down a nearby mound. After these applications on the 13th and 18th of August by the nursery advisor, no ant problems recurred.

APPENDIX E-3

EVALUATION OF EXPERIENCE WITH SPECIES PROPOGATED AT KAEWA AND SIAKAGO NURSERIES: JULY-OCTOBER, 1982*

*Acacia albida* (Kaewa and Siakago). Because this species is widely known and highly respected in West Africa, and also indigenous to Kenya, a considerable amount was planted at both sites. This may have been a mistake. *Acacia albida* requires a high water table for optimum growth. Particularly at Kaewa, the water table situation is not known. Before planting more a study of its survival in the first year is essential. At Siakago it should do well in valley bottoms or on lower valley sides. Even there, no more than 1 bed per season should be grown until first year survival data are developed.

In the nursery *albida* has proved to be a very quick starter. Three months in the nursery is all that it requires. Planting two seeds per pot in Kaewa proved to be excessive. Over 60% of the pots produced two seedlings. It may be better to plant 1 seed per pot, 2cm deep and then, after 2 weeks, if no germination resow seeds in those empty pots. This will space growth starting times, but will result in less competition in the pot and no decision making as to which seedling to thin-out.

*Acacia haloserica* (Kaewa). A slow starting Australian import, it seems to take off once the phyllodes begin to show. Since it is small seeded, the hot water scarification method was used. Spaced out germination resulted along with variable heights after two months. It would be optimal for this species to be in the nursery upto 14 weeks, rather than 9, as it was. Growth picked up in the last few weeks indicating that longer than 14 weeks would be excessive. More direction on pricking-out timing is needed as well. It would be done continously as germination occurs. This season none was done as it was too late by the time germination was completed.

*Adansonia digitata* (Kaewa). The seed treatment for baobab does work, i.e. nicking the seed coat. But it takes considerable time and produces limited results. It is not advisable to expand planting of this species now. If a better technique for enhancing germination is found then more could be planted.

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* Drafted by Wayne Teel, Mennonite Central Committee

*Balanites aegyptica* (Kaewa). The only blemish on the reputation of this tree concerns growth rate. Literature indicates that it grows slowly, though the nursery records indicate rapid seedling growth. The seed planted at Kaewa was from Ed Barrow, probably picked in February of 1982. Normally he estimates 50% germination. Our seed, being 6 months old at planting time, had probably lost some viability. This is to be expected with oily seed. Germination in this case was about 30.5%. Pre-soaking in cool water for 24 hours prior to planting, which was not done, may increase germination.

*Balanites* is not the favourite tree of the Kamba's, but this may be due to a greater variety of vegetation than in areas where the tree is more appreciated. Certainly its survival and performance warrants another attempt on a larger scale, next year.

*Cassia siamea* (Kaewa and Siakago). *Cassia* was disappointing. Germination was poor, especially with scarified, older seed, and growth for the first 2 months very poor. Undoubtably the most correctable problem was use of old seed. The fresh seed, collected by Nyamwanga (ICRAF) and Edward Alitsi (Mazingira) in Siakago, performed much better. The tree probably needs about 4 months in the nursery rathan than the 10 weeks it was given. To improve performance and size the following changes are recommended. Collect fresh seed as it comes available near the first week in July. As soon as the seed is collected it should be planted, 3 seeds per pot, at 1 cm or less deep. Three seeds per pot should eliminate empty ones. Pricking-out should be done two weeks after germination.

*Cassia* makes a good shade tree and windbreak for Siakago, but it may require more water than Kaewa can provide for optimum growth. One bed at Siakago for the next short rains is enough.

*Grevillea robusta* (Siakago). The very slow and erratic pace of germination came as a surprise. Apparently untreated seed takes time to germinate. For Grevillea fresh seed is a requirement. August appears to be the best time for collection and it should be planted right away. An experiment with pre-soaking, drying and then planting the seed may improve germination. The other option, especially for Siakago and Nyeri, is to have students collect widlings, plant them themselves in school

milk containers, and bring them to the nursery. One or two beds in both locations could be used for this purpose.

*Leucaena leucocephala* (Kaewa and Siakago). Growth was very fast in both locations, almost startlingly so. It requires only 10 weeks in the nursery. It appears to be very popular at both Siakago and Kaewa.

Problems do exist. *Leucaena's* palatability to nearly every green-chewing mammal makes it difficult to protect until strong enough to grow in the open. Its major usefulness will come once good, strong, reasonably impenetrable living fences have been established around cropped land. For this reason cutting back on the amount grown is advisable. Local interest in *Leucaena* will diminish if more than half of this year's seedlings are lost to grazing animals.

*Melia volkensii* (Siakago). Mukau has great potential if the germination method used by Dionysio Nyaga works. After 1½ months, however, none had germinated. If it does than we have an indigenous tree for growing in Kaewa, Siakago and elsewhere. The forest department would like the information as well. Since it has known local economic uses a considerable number could be grown.

*Parkinsonia aculeata* (Kaewa and Siakago). Nicking the seed coat on the side or at one end stimulates speedy germination. Pricking out proved the major difficulty. This tree must be pricked out prior to the second week after germination. If delayed after the seedling is about ½ inch high too much of the quick growing root system is damaged.

*Parkinsonia* requires relatively little water. At Kaewa it was over watered so that a good number were lost due to damping off. Small doses, 8 liters per bed of 500 seedlings daily works better than large doses every other day. It grows rapidly in the nursery, requiring only about 10 weeks. Care must be taken in transplating to avoid planting too deep, covering the origianl 'knuckle'.

*Prosopis chilensis* (Kaewa and Siakago). That *Prosopis chilensis* will survive in Kaewa and Siakago (as well as Magadi) is not an issue. The bigger question involves its usefulness and lack of prominent thorns.

Experience at Baringo (Murry Roberts) shows that this particular *Prosopis* is susceptible to rabbit or dik-dik attack. At Kaewa there was some trouble with damping-off in the nursery as well. This was not the case at Siakago. The reason is unclear. Once 5 cm in height it seems to take off, growing very well. Twelve weeks from sowing to planting out is sufficient. The procedure for sowing; 2 nicked seeds per pot, 1 cm deep, works well. Watering should be in small dose daily, as for *Parkinsonia* and *Prosopis juliflora*.

*Prosopis juliflora* (Kaewa). This species has the advantage over *Prosopis chilensis* of stronger thorns, denser immediate growth, and limited palatability to grazing animals. Its disadvantages include potential weediness and susceptibility to termites. Nursery practice is identical to that for *Prosopis chilensis* (Kaewa and Siakago). Care must be taken when transplanting to prevent soil covering the stem above the root collar. This seems to increase termite problems. Also, the soil around the tree should be well packed. Weediness can be a problem to watch for in the future, though it probably is not serious in marginal areas, short of woody biomass. Plant some in Kaewa and also Magadi as a potentially valuable living fence, fodder and firewood tree.

*Samanea saman* (Kaewa and Siakago). At Kaewa growth rates in the dam site have been very slow. Raintree was also damaged in the nursery for reasons which are vague, but may have something to do with watering problems. Kaewa probably is the wrong place to emphasize this tree. Siakago is more likely. Raintree could become a valuable tree there. Waiting a year to assess growth rates, survival and community interest is advisable. Change the planting technique to nicked seeds per pot, 2 cm deep.

*Tamarindus indica* (Kaewa). Germination in the few pots attempted was surprisingly good. Next time plant only 1 nicked seed per pot, 3 cm deep and plant any empty pots two weeks later. This will eliminate the need to prick-out. Tamarind may need 12 to 15 weeks in the nursery. As it has potential as a shade, fruit and mulch tree, it would be good to try a bed in Siakago for the long rains. Sow at the beginning of December, but not later than the first week of January. Before growing this tree again in Kaewa, wait until some survival results are obtained.

*Terminalia brownii* (Kaewa). The major failure, but well worth trying again. Seed *must* be fresh. Have the pots ready. On planting day or the day before, select good Muuku trees and sweep all fallen seed away. Shake tree lightly. Any seed which falls should be ready. Check each seed for insect holes or damage. Use only good, healthy looking seed. Strip-off the seed wings and shiny seed cover. Perhaps nicking near the center of one edge will help as well. Sow seed so it is just covered with soil. Maybe, with a little luck, a tree will sprout. What happens after this can not be stated as experience with this tree is limited.

SEED TREATMENT AND PERFORMANCE SUMMARY - KAWA*

| SPECIES | PLANTING TREATMENT | | | | | PRICKING - OUT | | PERFORMANCE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Date (1982) | No. Pots | No. Seeds Per Pots | Soil Depth | Seed Pre Treatment | Date | Result | Date | Observation (pots empty) | Date | Avg. Height cms |
| Acacia albida | Aug.13 | 983 | 2 | 2cm | Nicked seed coat with nail clippers | Aug.13 | All pots had seedlings 60% had 2ss. | Spt.14<br>Oct.30 | Germination distribution 99.9% of pots had seedlings. 947 pots distributed | Oct.19 | 22.4 |
| Acacia holosserica | Aug.18 | 312 | 2 | 1cm | Poured boiling water over and allowed to soak 20 hrs floating seeds removed. | unrecorded | | Oct.30 | 36[illegible] germination 225 pots distributed | Oct.19 | 5.4 |
| Adansonia digitata | Aug.13 | 38 | 2 | 2cm | scarified with triangular file(very difficult | none | | Oct.19<br>Oct.30 | 55% germination<br>4 pots distributed | Oct.19 | 13.9 |
| Balanites aegyptica | Aug.13 | 108 | 2 | stem-end down, tip at soil surface | none | Aug.13 | | Oct.30 | 30% germination<br>56 pots distributed | Oct.19 | 29.7 |

Germination percentages are approximations, calculated at the time of seedling distribution with consideration to the number of seeds planted per pot, the number of empty pots, the number of pots with multiple seedlings and estimates of the seedlings which had died.

SEED TREATMENT AND PERFORMANCE SUMMARY - KAWA - Cont'd



| SPECIES | PLANTING TREATMENT | | | | | PRICKING - OUT | | PERFORMANCE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Date (1982) | No. Pots | No. Seeds Per Pots | Soil Depth | Seed Pre Treatment | Date | Result | Date | Observation (pots empty) | Date | Avg. Height cm |
| Cassia siamea | Aug.13 | 562 | 2 | 1cm | scarified with nail clippers | none | | Oct.30 | 14% germination 133 pots distributed | Oct.19 | 3.4 |
| Leucaena leucocephala | Aug.13 | 1558 | 2 | 2cm | nicked seed coat with nail clip- | Aug.13 | no empty pots remaining | Oct.30 | 70-80% germination 1477 pots distributed (many died from over-watering) | Oct.19 | 17.0 |
| Parkinsonia aculeata | Aug.18 | 486 | 2 | 2cm | nicked seed coat with nail clippers | Sept.10 | no empty pots remaining | Oct.30 | 60% germination 392 pots distributed (many died from over watering and pricking out) | Oct.19 | 17.6 |
| Prosopis chilensis | Aug.13 | 411 | 2 | 1cm | nicked seed coat with nail clippers | Aug.31 | few empty pots remaining | Oct.30 | 45% germination 304 pots distributed (many died from over watering) | Oct.19 | 17.1 |

SEED TREATMENT AND PERFORMANCE SUMMARY - KASWA - Con'td



| SPECIES | PLANTING TREATMENT | | | | | PRICKING-OUT | | PERFORMANCE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Date (1982) | No. Pots | No. Seeds Per Pot | Soil Depth | Seed Pre Treatment | Date | Result | Date | Observation (pots empty) | Date | Avg. Height cms |
| Prosopis juliflora | Aug.13 | 443 | 2 | 1cm | nicked seed coat with nail clippers | Aug.31 | few empty pots remaining | Oct.30 | 30% germination 304 pots distributed (many died from over watering | Oct.19 | 16.4 |
| Samanea saman | Aug.13 | 148 | 2 | 3cm | scarified with file | none | | Oct.30 | 30% germination 37 pots distributed (at least ½ of seedlings died from unc-cause) | Oct.19 | 9.2 |
| Tamarindus indica | Aug.18 | 78 | 2 | 3cm | nicked seed coat with nail clippers | none | | Oct.30 | 90% germination 78 pots distributed | Oct.19 | 13.1 |
| Terminalia brownii | Aug.18 | 400 | 1 | 1cm | seed wings stripped | none | | | no germination (seed unviable) | - | - |

SEED TREATMENT AND PERFORMANCE SUMMARY - KIBIKO

APP. E4-2

| SPECIES | PLANTING TREATMENT | | | | | PRICKING - OUT | | PERFORMANCE | |
|---|---|---|---|---|---|---|---|---|---|
| | DATE (1982) | NO. POTS. | NO. SEEDS PER POT | SOIL DEPTH | SEED PRE-TREATMENT | DATE | RESULTS | DATE | OBSERVATION |
| Acacia melanoxylon | Sept. 2 | 500 | 2 | 1 cm | Nicked seed coat | | | Nov. 30 | 20% pots had seedlings |
| Acrocarpus fraxinifolia | Sept. 2 | 450 | 2 | 1.5 cm | Nicked seed coat | | | Nov. 30 | 25%<br>120 pots had seedlings |
| Croton megalocarpus | Sept. 2 | 350 | 1 | 2.5 cm | None | | | Nov. 2<br>Nov. 30 | 40% pots had seedlings<br>57% pots had seedlings |
| Gleditsia triacanthos | Sept. 2 | 400 | 2 | 2 cm | Nicked or filed seed coat | Oct. 15<br>Oct. 19<br>Dec. 1 | | Oct. 15<br>Nov. 2<br>Nov. 30 | 80% pots had seedlings<br>85% pots had seedlings |
| Zizyphus jujuba | Sept. 2 | 350 | 2 | 1.5 cm | Removed hard seed shell | Dec. 1 | About 10 pricked into empty pots | Nov. 30 | 77% pots had seedlings |
| Ailanthus altissima | Oct. 19 | 450 replanted | 2 | 0.5 cm | Removed seed wings | | | | |
| | Nov. 30 | 420 | 2 | 0.5 cm | Removed seed wings | | | Nov. 30 | About 30 germinated seedlings remaining after insect damage |

SEED TREATMENT AND PERFORMANCE SUMMARY - KIBIKO Cont'd

| SPECIES | PLANTING TREATMENT | | | | | PRICKING - OUT | | PERFORMANCE | |
|---|---|---|---|---|---|---|---|---|---|
| | DATE (1982) | NO. POTS. | NO. SEEDS PER POT | SOIL DEPTH | SEED PRE-TREATMENT | DATE | RESULTS | DATE | OBSERVATION |
| Acacia decurrens | Nov. 30 | 500 | 2 | 1 cm | Poured hot water over seed, soaked 12 hours. | | | | |
| Casuarina | Nov. 30 | - | - | - | Sown on surface of seed bed 2000 seed (?) | | | | |
| Blue gum (Eucalyptus saligna | Nov. 30 | 60 | - | - | Wind blows seed | | | Nov. 30 | Seed blew on pots from neighbouring trees |

SEED TREATMENT AND PERFORMANCE SUMMARY - NYERI

APP. E4-3

| SPECIES | PLANTING TREATMENT | | | | | PRICKING - OUT | | PERFORMANCE | |
|---|---|---|---|---|---|---|---|---|---|
| | DATE (1982) | NO. POTS. | NO. SEEDS PER POT | SOIL DEPTH | SEED PRE-TREATMENT | DATE | RESULTS | DATE | OBSERVATION |
| Podocarpus gracilior | 26/8 | 289 | 1 | 3 cm | Soaked hot water 3 hours | - | - | 23/11 | No empty pots |
| Acacia melanoxylon | 26/8 | 1020 | 2 | 1 cm | poured hot water over seed and allowed to cool, soak 15 hours | | | 8/11 | 80% pots had seedlings |
| Acacia melanoxylon | 21-22/9 | 221 | 2 | 1 cm | Nicked seed coat with clippers | Oct. 22 Nov. 8 | | 8/11 | 50% pots had seedlings |
| Gleditsia triacanthos | 21-22/9 | 520 | 2 | 2 cm | Nicked seed coat | Oct. 13 | | 8/11 | 95% pots had seedlings |
| Grevillea robusta | 21-22/9 | 535 | | 1/2 cm | None | Nov. 8 | | 8/11 | 45% pots had seedlings |
| Zizyphus jujuba | 21-22/9 | 408 | 2 | 1 cm | Cracked open seed shell removed seed | Oct. 22 | | 8/11 | 20% pots had seedlings |
| Acrocarpus fraxinifolia | 22/9 | | 2 | 1 cm | Nicked seed coat | Oct. 22 | | 8/11 | 75% of pots had seedlings |
| Ailanthus altissima | 23/11 | 410 | 2 | 1/2 cm | Removed seed wings | | | | |

SEED TREATMENT AND PERFORMANCE SUMMARY - SIAKAGO

APP. E4-4

| SPECIES | PLANTING TREATMENT | | | | | PRICKING - OUT | | PERFORMANCE | |
|---|---|---|---|---|---|---|---|---|---|
| | DATE (1982) | NO. POTS. | NO. SEEDS PER POT | SOIL DEPTH | SEED PRE-TREATMENT | DATE | RESULTS | DATE | OBSERVATION |
| Acacia albida | July 30<br>Aug. 5<br>Aug. 19 | 41<br>159<br>700<br>900 | 2<br>2<br>1 | 2 cm | Nicked or were scratched seed coat | Aug. 19<br>Sept. 2 | | | 90% germination 1st 200 pots 12% of all pots empty |
| Cassia siamea | July 30<br>Aug. 5<br>Aug. 19 | 47<br>293<br>408<br>748 | 2<br>2<br>2 | 1 cm<br>1 cm<br>1 cm | Fresh seed, no scarification fresh seed, no old scarified by scratching (bed2) | Aug. 19 | | | |
| Grevillia robusta | Aug. 5 | 400 | 3 | 1/2 cm | None (seed collected from Siakago July) | Sept. 2<br>Sept. 8<br>Sept. 17<br>Nov. 15 | | | No germination<br>21 pots germinated<br>70 " germinated<br>300 pots " |
| Leucaena lucocephala K28<br>K28<br>K 8 | July 30<br>Aug 5<br>Aug 19 | 45<br>476<br>365<br>886(t1) | 2<br>2<br>2 | 2 cm<br>2 cm<br>2 cm | Nicked seed coat with nail clippers or scissors | Aug. 19<br>Sept. 2 | All K28 pots had seedlings 30 had 2 ea. All K8 pots had seedlings | Sept. 2 | 3% of K28 pots empty |
| Prosopis chilensis | July 30<br>Aug 5<br>Aug 19 | 20<br>407<br>450<br>877(t1) | 3<br>2<br>2 | 1 cm<br>1 cm<br>1.5 cm | Nicked seed coat | Aug. 19<br>Sept. 2 | First 427 pots had seedlings Second 450 pots had seedlings | Sept. 2 | 6% of 1st 427 empty |

SEED TREATMENT AND PERFORMANCE SUMMARY - SIAKAGO Cont'd

| SPECIES | PLANTING TREATMENT | | | | | PRICKING - OUT | | PERFORMANCE | |
|---|---|---|---|---|---|---|---|---|---|
| | DATE (1982) | NO. POTS. | NO. SEEDS PER POT | SOIL DEPTH | SEED PRE-TREATMENT | DATE | RESULTS | DATE | OBSERVATION |
| Samanea saman | July 30<br>Aug. 5 | 38<br>495<br>533(tl) | 3<br>2 | 3 cm<br>3 cm | Scarified with scissors or file | Aug 19 | 224 empty pots remaining | Sept. 2 | 41% of all pots empty |