The tree that purifies water

Cultivating multipurpose Moringaceae in the Sudan

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SUDANESE GIRLS GATHERING WATER a unique way to purify it

Suspensions of seed powder from trees and shrubs of the Moringaceae family can effectively be used to clarify water, even turbid water from the River Nile. But species from this family have a variety of other uses as well. Although they show considerable promise for multipurpose use in the tropical belt, little is known about how to cultivate the various species. This article examines different methods of cultivation appropriate to different species — often with surprising results.

Uses and locations of the most important *Moringa* species

Use	*Moringa oleifera*	*Moringa peregrina*	*Moringa stenopetala*	*Moringa longituba*	*Moringa drouhardii*	*Moringa ovalifolia*
Vegetable	Asia, Africa, America *(leaves, green pods, flowers, roasted seeds)*		S. Ethiopia N. Kenya *(leaves)*			Namibia *(roots)*
Spice	Asia, Africa, *(mainly roots)*		Kenya *(bark)*			
Oil (cooking, cosmetics, miscellaneous)	Asia, Madagascar, Africa, *(seeds)*	Near East			S. Madagascar	*Lab. test,* Angola
Water coagulant	Sudan *(trad., seeds)* Indonesia *(new project)*	*Lab. test*	*Lab. & field tests*	*Lab. & field tests*	*Lab. & field tests*	*Lab. test*
Honey clarifier	Sudan *(trad., seeds)*					
Honey tree	*Recent* Indian *studies*					
Medicinal plant	Asia, Africa, Central America *(all plant organs)*	Near East as far as Sudan *(seeds)*	Kenya *(bark, root, leaves)*	Somalia *(root)*	S. Madagascar *(bark, root)*	Pounded seeds have also "horseradish smell"
Nematocide	Experiments in Philippines *(roots)*					
Fodder	India, Indonesia, *(leaves)*					Namibia *(roots: game; leaves and fruits: giraffes)*
Fences and windsheds	Asia, Africa, Central America		*New suggestion in* Sudan			
Supports for cultivation of climbers	Asia					
Firewood	*Recent* Indian *project;* Togo *(trad.)*					
Ornamental	Central & South America, USA, Africa	Saudi Arabia, Near East	Kenya		S. Madagascar	Namibia

Source: Jahn, 1986

● The family Moringaceae is a single-genus family of shrubs and trees of which only *Moringa oleifera* Lam., commonly called the "horseradish tree", has become widely know as a multipurpose tree. This tree, a native of the sub-Himalayan tracts of Agra and Oudh, Uttar Pradesh, northwestern India, is now cultivated for a variety of purposes in the whole tropical belt (see table).

Our particular interest in *Moringa oleifera* concerned its role as 'clarifier tree' *(shagarat al rauwāq)* in the northern Sudan. After scientific confirmation of the flocculating properties of the seeds, which the village women had so far mainly used to treat the highly turbid water of the Nile (Jahn and Dirar, 1979; Jahn, 1981), systematic search for natural coagulants was also extended to seeds from other *Moringa* species. So far, success has been obtained with *Moringa peregrina* (Forssk.) Fiori (Egypt), *Moringa stenopetala* (Bak. f.) Cuf. (Kenya), *Moringa longituba* Engl. (Somalia), *Moringa drouhardii* Jumelle (Madagascar) and *Moringa ovalifolia* Dinter & Berger (Namibia).

As with *Moringa oleifera* seeds, all investigated seed types contained primary coagulants comparable to the conventional coagulant alum. Applied in doses of 30 to 200 mg/litre in accordance with raw water quality, the *Moringa* seed powder suspensions could clarify different types of tropical surface waters with low, medium and high turbidities to tap-water quality within one to two hours (Jahn, 1984). As efficient elimination of turbidity is accompanied by a 98-99 percent elimination of indicator bacteria, domestic water treatment with *Moringa* seeds became a low-cost technology to be utilized in improving water and health in rural communities of tropical developing countries (Jahn, 1981; Sattaur, 1983; Jahn, 1986).

The main objective for cultivation trials with *Moringa oleifera* and its relatives was therefore to find out which *Moringa* species could provide the essential raw material for water purification in the shortest time and with maximum yield. The trials were aimed, in addition, at finding out whether certain *Moringa* species were more suitable for semi-arid zones and marginal soils and more resistant to plant diseases than the traditional *Moringa oleifera*. In the course of their research, and travels by one of their number, the authors discovered that other Moringaceae species have several similar traditional

uses (see table). This means that the chemotaxonomical relationship detected in connection with the presence of flocculants in the seeds also exists for other chemical constituents in this family, such as for example the seed-oils and an antimicrobial substance in one or several plant organs. Thus most or perhaps all Moringaceae deserve to be considered multipurpose trees or shrubs.

As domestic water purification is traditionally performed by women, it was suggested that both women and men participate in planting *Moringa* trees, with women trying to cultivate one or more trees in their compounds and men establishing communal plantations (Jahn, 1981). For this reason a few young Sudanese female horticulturists were involved in the basic cultivation studies, using methods previously worked out by the Soba foresters, who began cultivation trials in 1980 in the Forestry Research Station at Soba, 20 km south of Khartoum. Supplementary comparative experiments with different *Moringa* species were later also carried out between 1982 and 1984 in the framework of the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) plant protection project (Jahn, 1986).

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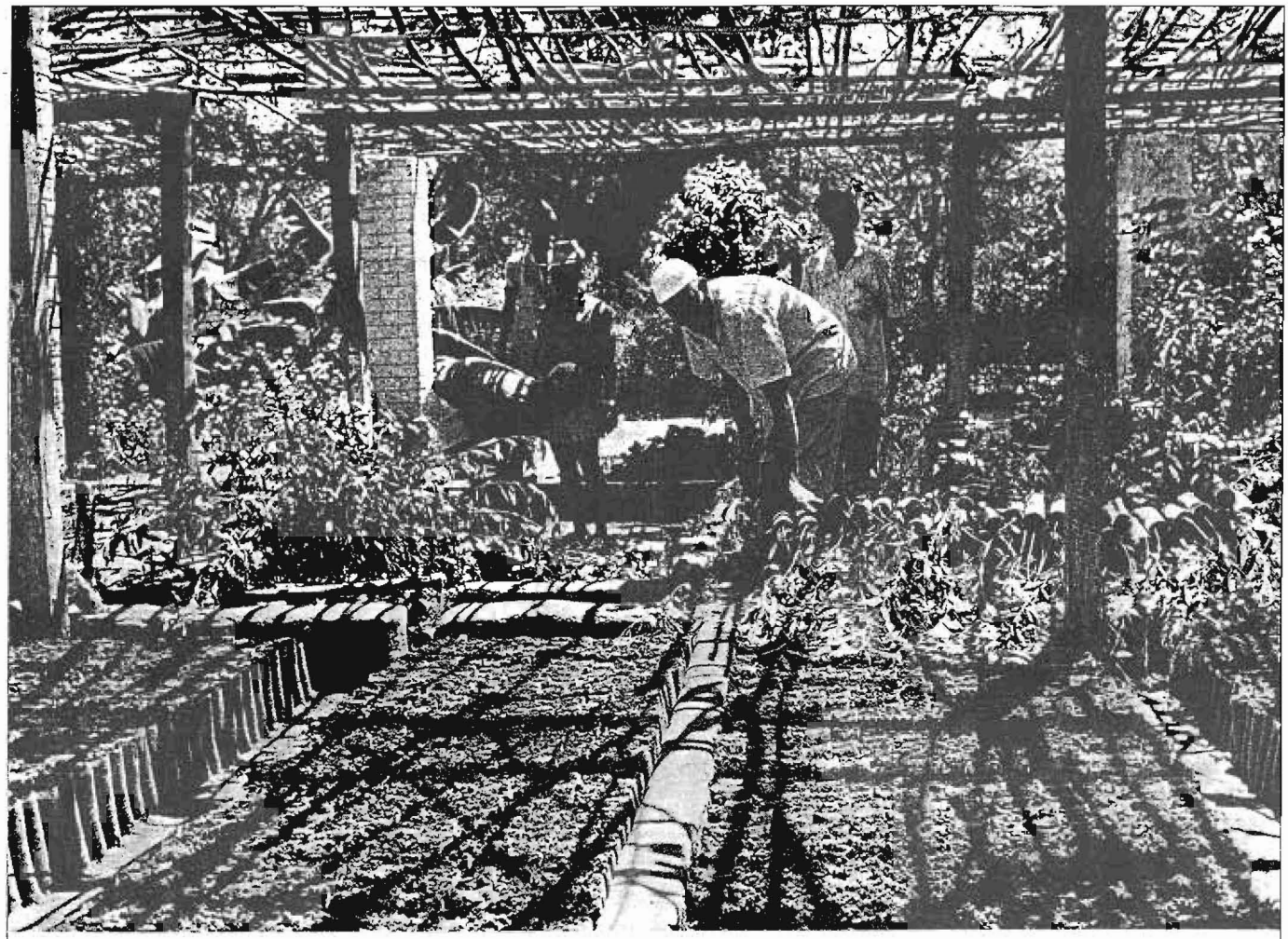
AT LEAST 13 IMPORTANT USES
Moringa oleifera *in the Sudan*

Germination and cultivation

In the Sudan, traditional cultivation of *Moringa oleifera* had involved cultivation only from seeds, whereas vegetative propagation is very common in India, Indonesia and parts of West Africa. Our main work in the northern Sudan was focused on seed propagation: the lack of parent trees meant that only a few trials could be made with vegetative propagation. Sowing was tested during the cool dry season, the hot dry season and the rainy season. Apart from the *Moringa peregrina* seeds, which were supplied from the herbarium in Cairo, the collection dates for the other types of Moringa seeds were known and fresh seeds were used unless otherwise stated.

Pre-treatment of seeds from *Moringa oleifera* and *Moringa stenopetala* was of no advantage at any time of the year. On the contrary, cooling to 8°C caused slight delays in the onset of germination and a minor reduction of germination frequency as compared with untreated seeds sown under the same conditions. Whether this type of cooling is useful for *Moringa drouhardii* seeds is not yet clear on account of the low germination fre-



P. MORIN/WFP/FAO

YOUNG PLANTS IN SUDANESE NURSERY progress in cultivation techniques

quency of the seed material in general, but there was evidence that cooling to 8°C facilitated germination of *Moringa longituba* seeds. Unfortunately, all seedlings from this species grew poorly and succumbed at an early stage of development for unknown reasons. The speed of germination of untreated seeds depended on temperature, humidity and watering.

The optimum light condition for germination of all *Moringa* species was half shade. Exposure to full light did not greatly affect the germination of *Moringa oleifera* and *Moringa stenopetala* seeds that had been sown during the cool dry season. After sowing in the hotter weather in mid-April, however, germination frequencies of *Moringa oleifera* and *Moringa stenopetala* amounted to only 40 and 52 percent in full light as compared with 94 and 92 percent in half shade.

As with germination, growth of the seedlings is much affected by light conditions, particularly during the hot periods of the year. Early removal of tender seedlings to full light, combined with irregular watering, can thus have disastrous consequences. According to our experiments, the average and maximum heights of *Moringa oleifera, Moringa stenopetala* and *Moringa drouhardii* seedlings were 1.7-2.2 times higher in half shade than in full light. Within each species, those seedlings appearing first in a batch usually exhibited fastest development. However, it is remarkable that the seedlings of *Moringa drouhardii,* which had the longest dormancy period, grew faster than those of the two other species. There was evidence, in addition, that growth of seedlings in half shade takes place more slowly in the hot dry season than in the cool dry season. To obtain stable healthy seedlings, the seeds should therefore be sown either during the rainy season or during the dry season.

Moreover, there is evidence that the seedlings should not be transplanted too early. Twelve *Moringa oleifera* and 12 *Moringa stenopetala* seedlings sown at the Soba Forestry Research Station in November 1981 and transplanted after five months showed 100 percent survival when checked at the

Moringa in Latin America

In the south of the Suchitepéquez Department of Guatemala, which I visited recently, *Moringa* trees are commonly utilized for fences and are propagated from both seeds and cuttings. Yet there are strong beliefs that cuttings should be taken only in a week of full moon after the onset of the rainy season. This concern seems to be an inheritance from Maya agricultural practices concerning sowing and planting. The Guatemalan farmers claimed that cuttings taken during other periods of the lunar cycle are dry and fail to develop properly. This still needs scientific confirmation. Some research evidence on lunar-correlated variation of water uptake in seeds already exists. In any case, statements on traditional experiences made by several different informants should be taken seriously in planning future *Moringa* cultivation programmes for these ethnic groups.

In Oaxaca State, Mexico, which I also visited recently, traditional cultivation of *Moringa oleifera* is carried out in the highlands even up to altitudes of 800-1 200 m, provided that the sites are protected by mountains. The highest site with abundantly flowering and fruiting *Moringa* trees we detected was at San Juan Gegoyache in the valley of the Totolepan River in Oaxaca. *Moringa oleifera* was transferred from the lowlands of the Pacific coast toward this region because the tree provided the poor people's white flowers for religious feasts in churches and houses. This successful migration also provides a good indication that *Moringa* trees can be grown in other micro-climates at similar altitudes even if up until now it has been maintained that the tree is only suitable for lowlands under 600 m.

Samia Al Azharia Jahn

end of January 1983. Unfortunately, there was great pressure to initiate the project in two Sudanese villages in 1982, and part of the seedlings were distributed at an age of only two months. The low survival rate of these seedlings was due mainly to the lack of protection against goats and small children as well as to inadequate training in keeping the plants, but it is also very likely that the seedlings were not stable enough to transplant (Jahn, 1986).

Satisfactory growth of the transplanted seedlings depended mainly on suitable spacing and adequate watering; underwatering is just as harmful as leaving the young plants for days in pools of stagnating water. In Soba, the seedlings were transplanted to ploughed plots of land. They were placed in the middle of the ridge according to a procedure adapted there for forestry trees, and irrigation was carried out by half-filling the furrows every 15 days. This corresponds to an irrigation of 800 m^3 per acre per month. Soils, because of their salinity and alkalinity, were only marginal.

In Soba as well as in garden plantations, flowering of seed-grown *Moringa oleifera* trees started after 10 to 11 months. Two months later, ripe, dry seeds were available. *Moringa stenopetala* trees require a longer time. In the Sudan, the first flowers appeared after two and a half years.

The most essential requirements for the cultivation of the "drumstick vegetable" *(Moringa oleifera)* in Asia were recently summarized by South Indian horticulturists (Ramachandran, Peter and Gopalakrishnan, 1980). The traditional cultivation of the "cabbage tree" *(Moringa stenopetala)* in Africa, inside compounds and on terraces, was mentioned for the first time in a 1938 geographical paper concerning Ethiopia (Nowack, 1954). Even today, the leaves are an important vegetable during the dry season, mainly for the Konso, Burji and Gidole tribes in the highlands south of Lake Chamo in Ethiopia (Göttsch *et al.*, 1984), and for the Konso and Burji minorities in the Marsabit District of Kenya (Woche Guyo, Marsabit research assistant of the Kenyan Institute for African Studies, personal communication, 1984).

The authors' experiences in the Sudan with the cultivation of *Moringa oleifera* and *Moringa stenopetala* from seeds can be already taken as guidelines for plantations in similar environments, in particular where longer roots are an advantage for stabilization and access to water. Trees grown from cuttings are known to have much shorter roots.

In the past, *Moringa peregrina* was both an indigenous and a cultivated tree in the Sudan. During the last century, seeds from the pasha's garden at Sennar were traded to Egyptian markets. Thus cultivation seems to be easy with good fresh seeds.

Future trials with *Moringa ovalifolia*, which is said to be easily grown in Namibia and also had a high germination frequency in a

recent experiment in Kenya, seem to be very promising (Jahn, 1986).

Moringa drouhardii, the largest tree among the investigated species, has a trunk like that of a baobab, and tolerates saline soils and annual rainfalls of less than 200 mm in the Androka region of southern Madagascar (Delaveau and Boiteau, 1980). To plant new trees, the people in Ambovombé prefer to dig up the seedlings that germinate under the parent tree during the rainy season. Experiments with further batches of seed have to show whether the germination frequency is always as low as the authors found it to be in the Sudan. However, the development of the seedlings that could be obtained was very satisfactory.

Unfortunately, we have so far completely failed to cultivate *Moringa longituba,* an attractive small shrub with bright red flowers. As far as utilization of the seeds is concerned, however, this species is less suitable than the others owing to its small size.

Although the present studies were specifically devoted to planting trees that can provide valuable natural coagulants for water treatment outside their countries of origin, it seems that it would also be worth while, in general, to carry out more detailed investigations on the potential uses of the other, so far less known, *Moringa* species. The results could then be compared with the many discoveries that have already been made concerning the applications of *Moringa oleifera.* ■

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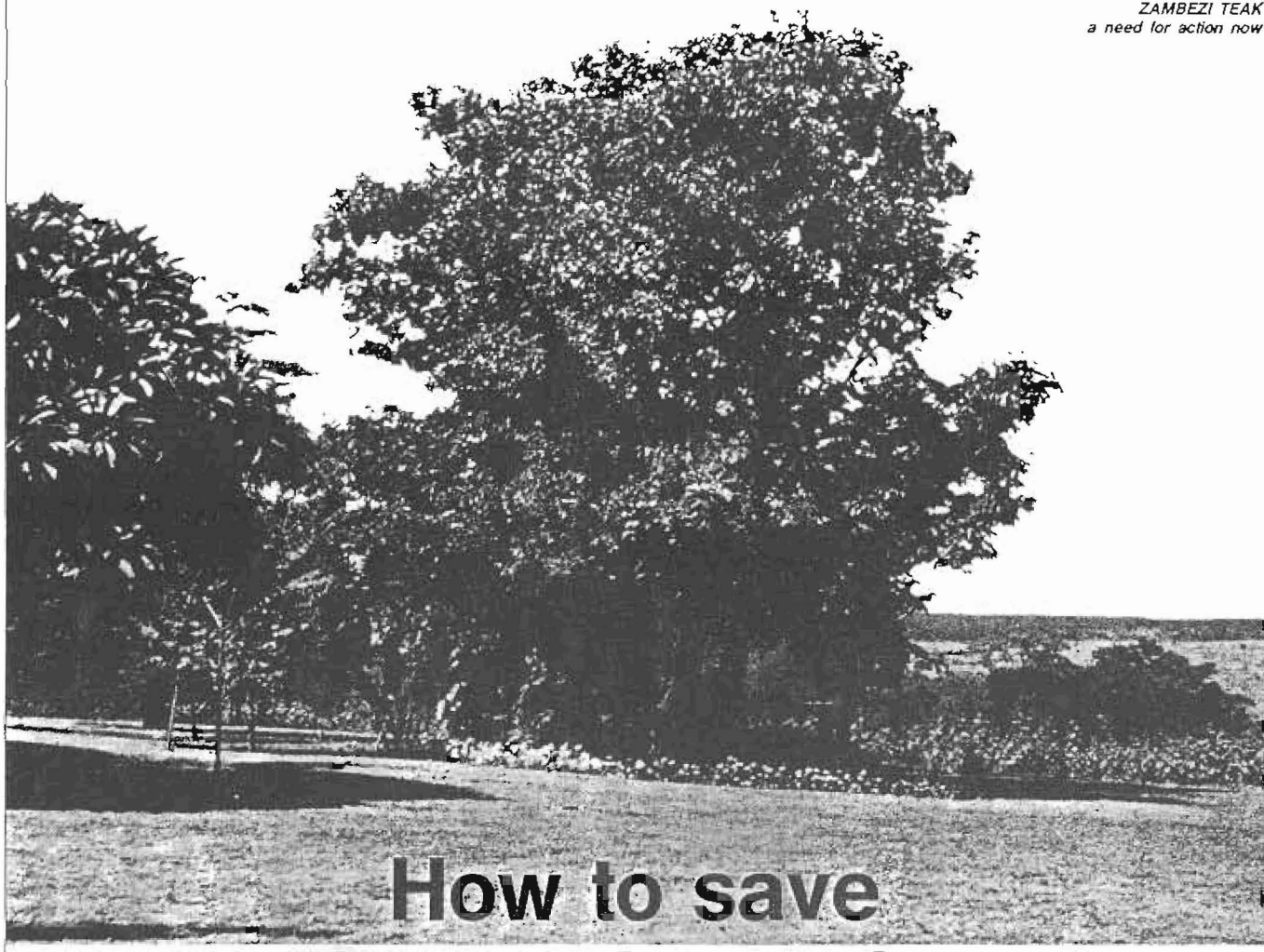

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How to save the Zambezi teak forests

G.D. Piearce

The decline of the Zambezi teak forests has proceeded slowly and steadily during this century. Only now is the international forestry community sensing that an irreplaceable resource could be lost if nothing is done. But what *can* be done? In this article, G.D. Piearce offers a number of solutions, some of them controversial. What is most necessary, he argues, is that action be started now and that funding be found.

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● The indigenous *mukusi* or *Baikiaea* forests and woodlands found in the Kalahari Sands region of tropical Africa are today more aptly and conveniently termed the Zambezi teak forests. These forests have declined greatly in extent and condition during this century, almost entirely as a result of disturbance by man. What remains is still of considerable importance economically, scientifically and sociologically, but the extinction of these forests is imminent if intensive exploitation and devastating fires continue unchecked. Neither natural nor artificial regeneration has been able to keep pace with the rate of destruction over recent decades.

Various local, national and international initiatives have been proposed and are beginning to be implemented in Zambia to deal with the urgent needs for conservation, research and improved methods of