Workshop 2
How to Produce Moringa Leaves Efficiently?
(anglophone group)

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Introduction

Moringa (*Moringa* spp.) is one of the world's most useful plants. It is a fast-growing tree and is grown throughout the tropics for human food, livestock forage, medicine, dye, and water purification. Moringa is grown traditionally as backyard trees or hedges (Figs 1 and 2) for its leaves which are used domestically.

Fig 1. Moringa as a Backyard tree

Fig2. Moringa as a Hedge

The increased awareness of the multiple uses of moringa leaves for both domestic and industrial purposes is leading to an increased demand for it. This is creating the need to find more efficient ways of producing moringa leaves to meet this demand. Recent trials in Nicaragua by Dr Foidl (2001) have shown that the moringa crop is suitable for more intensive production. In mostly subsistent farms it grows well as an intercrop in association with other crops, producing a significant amount of leaves. This discussion will now focus on how to produce moringa leaves effectively.

Climate and Soil Requirements

Moringa is basically a tropical crop. It grows best between 25 to 35^{o}C, but will survive up to 48^{o}C. The drought-tolerant tree grows well in areas receiving annual rainfall amounts that range from 250 to 1500 mm. Altitudes below 600 m are best for moringa, but this adaptable tree can grow in altitudes up to 1200 m in the tropics. Moringa prefers a well-drained sandy loam or loamy soils. It does not tolerate prolonged flooding or poorly drained clay soils. In fact clay soils must be clearly avoided when selecting plots for moringa cultivation. It will tolerate a soil pH of 5.0–9.0.

Choosing a Variety

Among moringa species, *M. oleifera* and *M. stenopetala* are the most commonly grown. Among these two *M. oleifera* is more widely cultivated. It is however recommend that growers use locally adapted lines. Characteristics of superior types include wide and dark green leaves, long and tender pods, bushy habit, and rapid regeneration after trimming. A promising new variety, PKM1 which was derived from *M. oleifera* is growing in significance for its heavy biomass and tender leaves.

Field Preparation and Planting Methods

Moringa requires a thoroughly prepared land or seedbed. Moringa is planted either by direct seeding especially in High Density Monocropping or transplanting usually in intercropping with other crops. Hard wood stem cuttings can also be used and their length can be anything ranging from one and half feet and upwards. The cuttings may be cured by allowing it to 'dry' under shade for at least three days.

High Density Cropping

In High Density monocropping direct seeding is preferred. This is possible only when there are plenty of seeds available and labour is limited. Dehulled seeds or seeds soaked in water overnight and properly sowed at 2cm dept should germinate in 9-10 days. Without treating the seeds they will still germinate well but in 14 days. Germination percentage is normally within the range of 80-90%. Some high density spacing for growing moringa includes 10x10 cm, 10x15 cm, 10x 20 cm and 20x20cm. Seed rates are

calculated by dividing 10,000 with the spacing being used in meters. For example 10x10cm (0.1m x 0.1m) spacing gives a plant population or seed rate of one million plants per hectare i.e. 10,000/ 0.1m x 0.1m. High density monocropping of moringa gives the highest leaves yields per unit area.

Fig. 3. 5x15cm spacing

Fig 4. 10x10 cm spacing

The newly established field should be allowed enough time to develop strong roots that are capable of absorbing the shocks of in initial cutting before the first harvest is done. This demands that the plants are allowed a minimum of 60 days. Subsequent harvests can be done every 35-40 days intervals

Intercropping

In intercropping, direct seeding can also be done, or transplantation of seedlings to allow for flexibility in field planting (but this requires extra labour and cost in raising seedlings). Space plants 2–5 m apart between rows and plants. Care should be taken in order not to associate moringa with crops that tend to shade it as that will reduce moringa growth. Choose crops that are adapted to alley cropping, such as shade-tolerant leafy vegetables, legumes and herbs. Good examples could be moringa – cowpea, moringa - cabbage associations.

Transplanting of moringa consists of two steps: seedling production and field planting.

Seedling production. Seedlings can be grown in divided trays, individual pots or plastic bags (Figs. 5, 6). Use of divided trays and individual containers is preferred because there is less damage to seedlings when they are transplanted. Moringa is quite sensitive to transplanting shock that slows down the rate of initial growth. A 50-cell tray with cells 3–4 cm wide and deep is suitable. Fill the tray with a potting mix that has good water-holding capacity and good drainage.

Fig 5a Young Seedlings in Polythene Bags

Fig 5b Young Seedlings in Polythene Bags

Use peat moss, commercial potting soil, or a potting mix prepared from soil, compost or rice hulls, and vermiculite or sand. AVRDC uses a mixture of 67% peat moss and 33% coarse vermiculite. Transplant seedlings one month after sowing. Reduce the stress of transplanting by planting the tree with its plastic bag (cutting the plastic in the bottom and sides) or with its lump of earth when possible. Pots or bags may be used to grow larger transplants. Fill the containers (0.5–1.0 kg by volume) with potting mix similar to that used in seedling trays. If potting mix is not available, use 3 parts soil to 1 part sand. Sow two or three seeds per pot or bag. One week after germination, thin to the strongest seedling. These plants are transplanted in the field after they reach 50 cm high (Fig. 7).

Fig.6 Potted Plant of Moringa (*Courtesy AVRDC)*

Fig 7. Rooted Cutting (45 cm long)

The Use of Stem Cuttings

Stem cuttings are used when the availability of seed is limited but labour and adult trees (to take to cuttings from) are plentiful. Compared to trees planted from seed, trees from stem cuttings grow faster but develop a shallow root system that makes them more susceptible to moisture stress and wind damage. Make stem cuttings using branches of a tree that is at least one year old. Use hard wood and avoid using young green stem tissue. Cuttings can be 45–150 cm long with diameters of 4–16 cm. Cuttings can be dried in the shade for three days before planting in the nursery or in the field. Cuttings are then planted directly or planted in plastic pots or bags in the nursery or screenhouse. When planting directly, plant cuttings in light, sandy soil. Plant one third of the length in the soil (i.e., if the cutting is 90 cm long, plant it 30 cm deep). Cuttings planted in a nursery are ready for field planting after 2 – 3 months. Follow the field planting recommendations mentioned for direct seeding and transplanting.

Fertilizer and Irrigating

In high density cropping systems, the need to start with a very fertile soil is crucial. Large amounts of compost, well decomposed manure or mineral fertilizers will still be needed per hectare per year to maintain productivity at an appreciably high level. A systematic evaluation of the fertilizer requirement research is also needed. Sulphur containing foliar fertilizers is recommended especially when it is easily available as it appears to increase protein contents of the leaves harvested. However it must be applied when there are enough leaves on the plant to allow for easy assimilation of nutrients into the plant. By allowing enough time after the application before harvesting will give the plant enough time to utilize nutrients as well as avoid chemical residues that might still remain in the leaves. Grass or plastic mulching is equally possible which facilitates soil moisture conservation.

Fig 8 Compost Application

Fig 9 Grass Mulching

Newly transplanted trees must be irrigated immediately after transplanting to promote early root development. In dry and arid climates, irrigate regularly for the first two months. The well-rooted tree tolerates drought and needs irrigation only when persistent wilting is evident. Irrigate regularly to keep the soil moist but not wet. Intensively cultivated plants will demand more regular watering and fertilization. Mulching with grass can also be done to conserve moisture. (Figs. 8 and 9)

Weed, Diseases and Pests Control

Cultivate the soil thoroughly before planting to suppress early weed growth. Maintain a weed-free planting by regularly cultivating between beds and rows. In high density or intensive production early weed control is critical and after that, weed control does not pose any serious treat to production. Moringa is resistant to most pests and diseases, but outbreaks may occur under high density cultivation conditions. Mite populations can increase during dry and cool weather. These pests create yellowing of leaves (Fig. 10), but plants usually recover during warm weather. Other insect pests include termites, aphids, leafminers, whiteflies, and caterpillars. Using neem seed preparation as foliar spray or commercial preparations containing Azadirachtin easily controls this problem. Chemical control of insect pests should be used only when severe infestations occur. Choose a pesticide that targets the specific pest causing the damage, and avoid pesticides that kill or inhibit the development of beneficial organisms. Choose pesticides that last only a few days. After spraying with pesticide the next leaf harvest should be delayed to avoid pesticide residual effect on leaves harvested.

Fig 10 Courtesy AVRDC

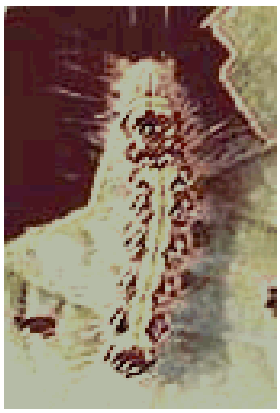

Fig 11 Courtesy AVRDC

The roots of moringa are adapted for water storage and termites find it very convenient in attacking moringa roots in search of water. In soils that are heavily infested with termites their control may not be economical. Such soils should therefore be avoided as much as during site selection. Cattle, sheep, pigs, goats, antelopes, rats and mole rats will eat

moringa seedlings, pods and leaves. Protect moringa seedlings from livestock by installing fence or by planting a hedge around the plot.

Harvesting

Leaves from high density moringa fields can be harvested after plants grow 1.5–2.0 m, which usually takes at least 60 – 90 days in well drained fertile soils. Harvest leaves by cutting leaf stems manually with a sharp knife (Fig.15-18) at 20- 45 cm above ground. Harvesting in this manner will promote the development of new shoots. Subsequent harvesting can be done every 35- 40 days. According to Reyes, 2006 moringa shoots intended for use as fodder can be harvested seventy five (75) days intervals. Under conditions of intercropping plants can be harvested after two to four months of growth. The initial cutting can be done manually at 20cm up to 1.5m height. Moringa plants should be harvested at a height where they are high enough so that they are not shaded by the companion crops if any.

Fig 12a Manual Harvesting with a Sickle (Courtesy C.Olivier 2005 in Senegal)

Fig 12b Manual Harvesting with a Sickle (C .Olivier 2005 in Senegal)

As much as possible avoid heaping freshly harvested moringa leaves together, as they easily start deteriorating under such conditions. Moringa leaves can easily lose moisture after harvesting, therefore, harvest early in the morning and sell the same day, if possible.

Fig 13a Successive Harvests (Courtesy Foidl)

Fig 14b Harvests (courtesy David Makin 2006)

Fig 15 Moringa shoots being carried after harvest leaves tied
(Courtesy C. Olivier 2005 in Senegal)

Fig 16 A bunch of moringa Courtesy AVRDC

Yield Component Analysis and Production Trends

The productivity of Moringa in industrial plantations can be very high but there is a need for continued research to find out whether, in the long term, this kind of productivity is truly sustainable and at what costs Foidl *et. al,.* (2001). Large amounts of compost, well decomposed manure or mineral fertilizers will be needed per hectare per year to maintain such high productivity at the suggested planting density. A systematic evaluation of the fertilizer requirement research is also needed.

Table 1.1 Production parameters of Moringa at first cutting (Foidl, *et. al.* 2001)

Plant density (Plants / ha)	Fresh Matter (Metric tons/ha/ cutting)	Dry Matter (Metric tons/ha)	Protein (kg/ha)	Loss of plants after first cutting
95,000	19.6	3.33	566	n.d
350,000	29.7	5.05	859	n.d.
900,000	52.6	8.94	1,520	n.d.
1,000,000	78.0	13.26	2,254	Approx. 2%
4 million	97.4	16.56	2,815	Approx. 25%
16 million	259.0	44.03	7,485	Approx. 40%

n.d. = not determined

After the initial harvest 9 cuttings per year have been reported in Nicaragua. In the trials with 1 million plant/ha and 9 cuttings/year over 4 years, the average fresh matter production was 580 metric tons of fresh material per ha/year equivalent to about 174 metric tons of fresh leaves (30% of the total biomass harvested). In Senegal, in much dryer conditions, the yield per cutting was as low as 45 metric tons / ha during the dry season while during the rainy season the yield per cutting reached 115 metric tons/ha. With hydroponics irrigation, 6 cuttings a year yielded 115 metric tons of fresh biomass, or 34.5 tons of fresh leaves. The leaves constitutes 30-31% of the entire shoot yields with the remaining being stems and petioles which can go into animal feeding.

The farm produced 100 kg of leaf powder per week, or 5 metric tons a year It required 8kg of fresh leaves (with stems removed) to produce one kg of dried leaves. The kilo of

leaf powder cost 4 € to produce, without taking into account investment costs (building, irrigation system and pump, mechanical mill…). It should be noted that large number of cuttings per year are only possible with a strict regime of adequate fertilization and irrigation.

Conclusion

Moringa leaf productions can viable economic ventures to meet the growing demand for Moringa leaf products. Cultivation systems are varied, from intensive monocropping to intercropping, from direct seeding to cuttings. It is important to make an appropriate choice according to the local context and available means.

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