

The background of the entire page is a close-up photograph of moringa leaves. The leaves are bright green, oval-shaped, and arranged in clusters on thin, light-colored stems. The lighting is soft, creating a natural and fresh appearance.

COLLECTION
PRO-AGRO

Production and processing of

moringa

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General

information

With its scientific name of *Moringa oleifera* Lam (“Glilandjah” in Fulfulde in the northeast of Cameroon, and “Horseradish tree” in its English-speaking area), the moringa is a tree in the *Moringaceae* family that can grow up to 10 m tall.

Sometimes called “the tree of life” or “the tree of paradise” due to its exceptional environmental, medicinal and dietary benefits, the moringa is a multi-purpose tree whose leaves, flowers, fruits, bark and roots can all be directly consumed. Its nutritional qualities are becoming increasingly recognised and could represent an effective solution in combating malnutrition.

The importance of the moringa can also be increased in the form of products with higher added value, such as moringa oil, which generates greater profit due to its high price.



Growing moringa is quite simple. It is resistant to drought and suited to almost all tropical regions. It is frequently found in gardens in sub-Saharan Africa. It is a fast-growing tree whose leaves can be harvested in the first months of growth.

1

THE MORINGA PLANT

Growing to a height of almost 10 m, the moringa has grey or pale tan bark that is smooth or slightly coarse. Its trunk reaches a diameter of 20 to 40 cm.

Its fruit takes the form of elongated three-sided pods that are 10 to 50 cm in length, which turn brown when ripe and each contain between 12 and 35 round seeds with a semi-permeable brown shell. The shell has three white "wings" that extend from the bottom to the top.



The moringa tree, leaves, fruits and seeds

The flowers are white or cream and sometimes have red marks. They usually grow in abundance and give off a pleasant fragrance.



Moringa flowers

2

GROWING YOUNG PLANTS IN A NURSERY

Although growing young moringa plants in a nursery enables them to reach a good size before being transplanted, it is not highly recommended as it is the most expensive method and involves the greatest risk, since the young plants do not always survive being transplanted because of their fragile roots.

The production of young plants in a nursery should therefore only occur when it is impossible to plant them directly

2.1 Setting up a nursery

Arrange for the following materials and equipment:

- Posts and palm leaves for the construction of a protective canopy.
 - Perforated 25 cm x 17 cm plastic (polyethylene) bags or wicker baskets to grow the plants in.
- Use the posts to create a canopy approximately 2.5 m from the ground. Cover it with the palm leaves, allowing about 50% of light to pass through.



- Fill the bags or baskets with a mixture of three-quarters black earth and one-quarter coarse sand.



- Place the bags in rows of about 10 m long and 1 m apart.

2.2 Growing young plants in a nursery from seeds

Moringa seeds do not have a dormant period and can therefore be planted as soon as they are mature.

- Remove the seeds from the pods; once removed, avoid storing them for extended periods.



- To help them germinate, soak the seeds in water for 48 hours to soften the shell.



- Next sow two or three seeds per bag at a depth of 2 cm. Germination will take place in 5-12 days after sowing. Replace the seed if it has not sprouted after a maximum of 15 days.



Young moringa shoot

1 or 2 days after germination

Young plants of about 2 weeks

- Thin the plants approximately 14 days after they emerge to keep the strongest ones. Then pat them down.
 - In the dry season, water every other day, early in the morning or after sunset.
 - In the rainy season, water as required.



👆 Maintaining young plants in a nursery

2.3 Growing young plants in a nursery from cuttings

Growing plants from cuttings is faster than growing from seeds, but cuttings are more sensitive to a lack of water and strong winds as they do not have a deep root system.

- Take cuttings of about 2 to 3 cm in diameter and 1 to 1.5 m in length from the branches of trees at least 1 year old, consisting of hard wood without green or soft tissues and that is no longer producing fruit (this will encourage the development of new shoots and the resumption of fruiting).
- Before planting the cuttings in the nursery, leave them in the shade for at least 3 days.
- Then plant them in 40 cm x 40 cm pots or plastic bags filled in advance with a mixture of three-quarters black earth and one-quarter coarse sand. Pat down firmly around the base of the cutting.
- Water thoroughly without drowning the cutting. Ideally the water should not touch the stem of the young tree.



👆 *Moringa cuttings growing in a nursery*

3

MORINGA CULTIVATION

Optimum growing conditions for moringa are:

- Well drained, silty or sandy soil (preferably neutral or only slightly acidic soil), to help moringa plants take root. Avoid boggy soil, former rubbish tips and industrial waste sites.
- Excellent light. A clear site is required for better sunlight penetration.
- Total annual rainfall of between 250 and 3,000 mm per year.
- Altitude preferably below 500 m. Growth rate will be slower above 1,300 m altitude.

3.1 Planting density and cultivation systems

The planting density for moringa depends on the objective and cultivation system.

Intensive monoculture for leaf production

Intensive monoculture is the best choice for the intensive production of leaves. The space between the plants must be 20 cm x 20 cm, 15 cm x 15 cm, or 20 cm x 10 cm (i.e. a density of 250,000 to 500,000 plants per ha).

Set out paths at regular intervals (e.g. every 4 m) to provide access for maintenance and harvesting. These intensive systems are suitable for industrial production, although they require greater care and more resources for hoeing, fertilisation and disease prevention due to their high density.



**Intensive
monoculture
for intensive
leaf production**



Semi-intensive monoculture for leaf production

Small-scale farmers who want to obtain good results with less labour should plan to use a semi-intensive production system. The space between plants should be between 50 cm and 1 m.



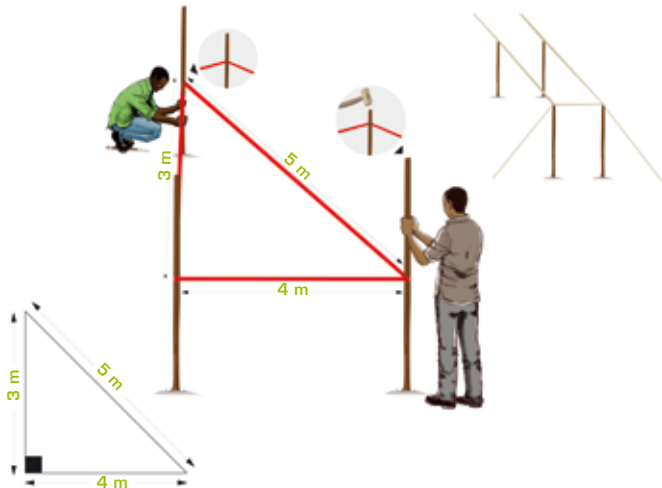
Monoculture for seed production

The distance between the plants is much greater in a monoculture, i.e. at least 3 m x 3 m, or 2.5 m x 2.5 m. For a plot with 3 m x 3 m spacing, create an outline with marker posts, beginning with a right angle in a corner of the area. The right angle is that of an A-shaped right-angle triangle. Side A should be 5 m, side B should be 4 m and side C 3 m long, B is 4 metres and A is 5 metres. Place marker posts every 3 m on side B and side C. Side B and C will act as the base lines on which the rest of the staking out will be carried out.

Semi-intensive monoculture



Low density monoculture for seed production



Agroforestry

Moringa trees can be planted in rows together with other crops. The distance between rows of moringa should be between 2-4 m. The planting lines must be oriented from east to west to provide optimal sunlight for the crops.

When applying agroforestry techniques, avoid planting the moringa with the following:

- Intercrops requiring high nitrogen levels, such as maize and cassava.
- Crops likely to require chemical treatments.
- Tall crops likely to compete with the moringa plants for sunlight, such as millet or sorghum.

Use low-growing shade-tolerant plants where the crop residues can enrich the soil with minerals (particularly with nitrogen): pulses such as groundnut plants, soya or cowpea. Cabbage and beans may also be used.



↑ Agroforestry: growing moringa in rows, combined with soya

Finally, the moringa can also be planted around a plantation, thus acting as a form of fencing, shade and windbreak for the plantation crops. To form a hedge or border, the trees should be planted in a row about 1 m apart.

3.2 Preparation of the land

Clear the area by cutting down trees, removing any stumps and roots, and then clean the field thoroughly.

- For high-density plantations, plough the plot manually or with a machine.
- For low-density plantations, move directly to staking out and digging cube-shaped holes. Staking out consists of outlining the future location of each plant using stakes or posts in order to maintain a consistent planting density, ensure the optimum use of ground space and provide easy access for maintenance.

3.3 Planting methods

There are three planting methods: direct sowing, direct planting of cuttings, and transplantation of plants from a nursery.

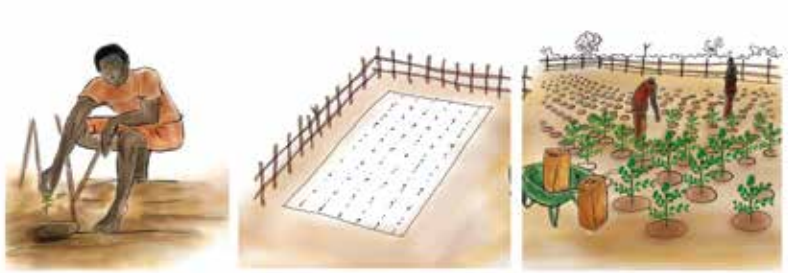
It is recommended that seeds are directly planted in the field, rather than transplanting young plants produced in a nursery which are fragile and do not always survive the replanting process.

Direct sowing

- Before the start of the rainy season, dig holes measuring 40 cm x 30 cm x 30 cm and enrich them with 2 to 3 kg of manure per hole, depending on the fertility of the soil.
- Soak the seeds for 48 hours before sowing.



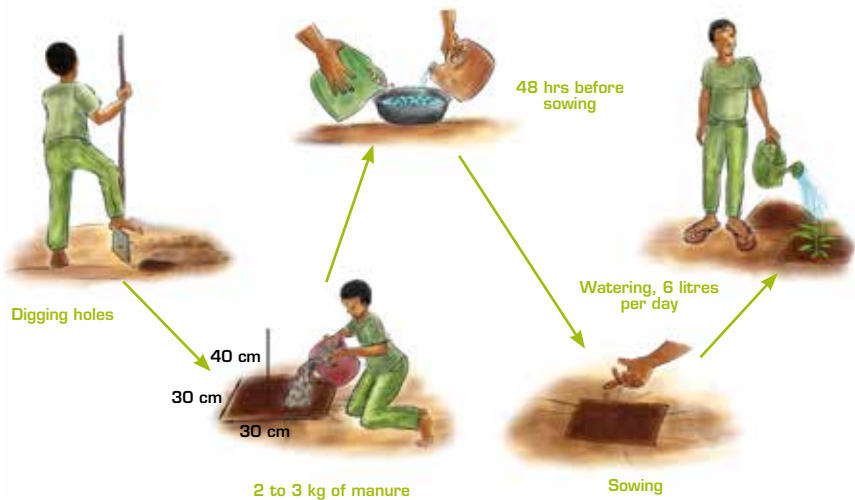
- Sow two to three seeds per hole, at a maximum depth of 2 cm.
- Water each hole with about 6 litres of water per day.



- When the plants have reached a height of 25 cm (1 month after sowing), replace them as required or thin them out, leaving only one plant per hole.

Direct planting of cuttings

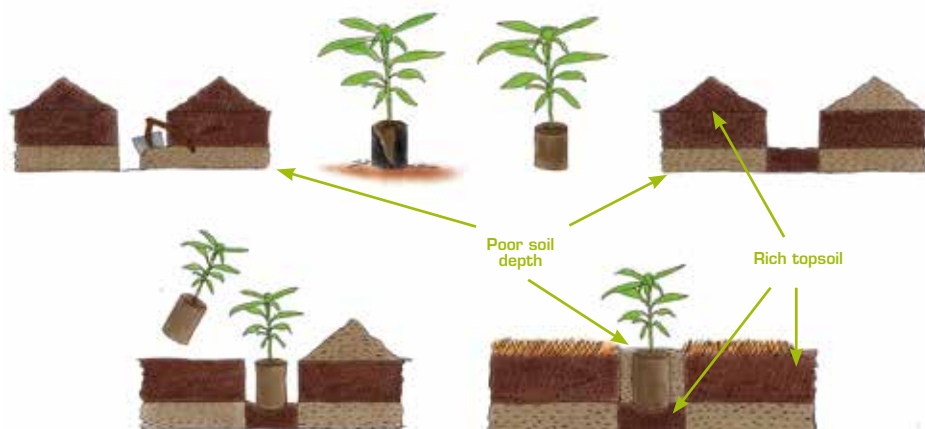
- Follow the same procedure for taking and collecting cuttings as shown in part 2.3 above.
- Leave the cuttings in the shade for at least 3 days.
- Then plant them in holes measuring 40 cm x 30 cm x 30 cm. At least one third of the cutting must be under the surface (35 cm for a 1 m cutting).
- Fill the holes with a mixture of earth, sand and organic manure.
- Water generously, without drowning the cutting. Ideally, the water should not touch the stem of the young tree.



⬆ **Direct planting**

Transplanting young plants grown in a nursery

- Transplantation takes place 4 to 6 weeks after introduction into the nursery, by which time the young plants will have reached a height of about 30 cm.
- Do not water the plants for 2 days before planting, so that the soil does not break up and tear the bags.
- Move the plants early in the morning or in the evening into holes measuring 40 cm x 30 cm x 30 cm.



↑ Replanting mature moringa plants grown in a nursery

4

MAINTAINING A FIELD OF MORINGA

4.1 Hoeing

For the best results, plots of moringa must be weeded and hoed on a regular basis, making sure that the roots are not damaged. Hoeing must be carried out early enough for the weeds not to have time to form seeds.

- During the first few months of growth, hoeing must be carried out frequently. This allows the sunlight to reach the ground and restricts the competition for nitrogen between weeds and the young plants.
- For adult plants, hoeing is recommended four times a year.



Farmers are strongly advised not to bury residue if the plot is on sloping ground to limit the loss of fertility through erosion

Once the weeds have been pulled up, it is a good idea to leave them on the ground like straw. This reduces evaporation and minimises irrigation requirements, while at the same time limiting weed growth.

It is not necessary to bury the weeds in the ground; leave them in contact with the topsoil to decompose. This ensures optimal distribution of minerals for the plants in the long-term.

4.2 Pruning and mulching

When pruning, plant waste should be left on the ground between the rows to restrict the growth of weeds and reduce evaporation. This practice is called mulching.

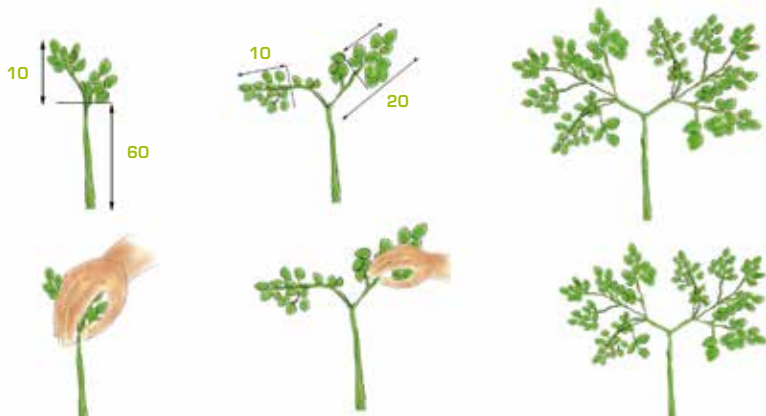
Formation pruning

This is important for leaf production.

If left to grow naturally, the moringa tree has a tendency to produce long vertical branches that only produce fruit at their extremities, leading to a poor yield. It is therefore essential to encourage lateral bisections that give the moringa the shape of a bush.

Step 1 : when the plant reaches a height of about 60 cm, cut the main stem 10 cm from the top.

Step 2 : secondary branches will appear one week later. When they are about 20 cm long, cut them 10 cm from their ends.



Step 3 : tertiary branches appear and the tree takes on the shape of a bush with leaves accessible for harvesting.

Maintenance pruning

Maintenance pruning is often carried out when the leaves are harvested, by cutting all the branches above a certain height (see 6.1 Harvesting leaves and postharvest operations).

If the leaves are not harvested during the dry season, the trees lose their bushy shape and must therefore be pruned again before the rainy season.

In all cases, it is important to cut just above a knot to prevent the end sections from rotting.



↑ *Shaping the bisections after pruning*

↑ *Moringa shaped like a bush*

Formation pruning is not necessary for seed production. Pruning is only required for general maintenance of the trees or to control their height: cut the end bud when the tree reaches about 1 m to create bisections.

4.3 Fertilisation

For the moringa to produce large quantities of leaves, the soil must be fertilised. Adding compost (plant waste left to ferment in heaps) and manure (animal waste mixed with plant waste) is required for the development of the moringa. A mixture of rapid decomposition waste (excrement, green and soft plants) and slow decomposition waste (straw, dry plants and twigs) provides optimum fertilisation.

When must the soil be fertilised?

- Fertilisation first takes place when the ground is being prepared, before sowing (5 to 6 kg of compost or manure per m²). That amounts to about 50-60 t of manure per ha.

- Next, it is important to introduce manure and/or compost at least once a year (about 500 g per tree), ideally at the start of the rainy season, before the trees commence significant production.
- If there are two rainy seasons, two additions of manure/compost are recommended.



The effect of this form of fertilisation will depend on the pedology of the soil and the age of the plantation.



4.4 Irrigation

If sowed in the rainy season, the moringa can germinate and develop without irrigation. The roots begin to form 20 days after sowing, allowing the young plants to tolerate dry periods. However, for optimum growth, it is recommended that irrigation takes place for 3 months after sowing.

For permanent leaf production, it is necessary to irrigate during dry periods. Water requirements depend on climate zones:

- In forest zones: leaf production is possible without irrigation all year round, with a fall in production during dry periods.
- In savannah zones: planting can be carried out without irrigation, although leaf harvests will be interrupted during the dry season.
- In the Sahelian zone: plantations must be irrigated almost all year round (every day in the dry season, and two or three times a week in the humid or rainy season).

If water is scarce, it is possible to continue cultivation throughout the year, irrigating only when water is available. In the dry season, the trees will lose their leaves, but they will not die. When the rain returns, prune the trees severely and add organic fertiliser (manure, compost) to ensure a healthy resumption of branch and leaf growth.

Any irrigation system can be used: hose pipes, watering cans, sprinklers/sprayers, or drip irrigation. To reduce evaporation, irrigate early in the morning, during the evening, or at night. If water is scarce, mulching or a very light hoeing of weeds will reduce evaporation.

5

COMBATING PESTS AND DISEASES

5.1 Pests

Moringa is generally not very susceptible to pests and disease, although it is sometimes attacked by caterpillars or locusts, especially in dry areas, or termites in some countries. Insects bite and eat parts of the plant, resulting in the destruction of leaves, buds, flowers, shoots, fruit or seeds, and interruption of sap flow.

It is generally recommended to cut the trees back completely to avoid leaving any green parts. Regrowth will then be very strong.

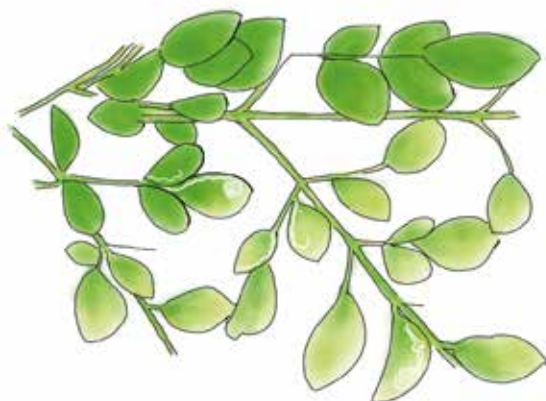
Biological treatment is also possible using leaf-based insecticides (350 g per litre of water), neem seed insecticides (500 g of seeds crushed in 10 litres of water) mixed with 3% soapy water, or other biological methods. Spraying must be concentrated on the centre and tip of the shoots to reach young caterpillars.

With regular harvests, it is preferable to avoid chemical treatments. However, if this proves necessary, opt for contact fungicides and insecticides. A mild, less toxic insecticide such as Decis can be used. Delay the harvest by 2 weeks during the rainy season or by 1 month during the dry season. Protect the moringa plantation from animals.

Chemical treatment should only be considered when other solutions are ineffective.

5.2 Diseases

Fungi cause dark stains to appear on leaves or cover them completely, which may cause the leaves to turn yellow and die. These symptoms are often difficult to detect and when they are noticed, it is often too late and defoliation is usually inevitable. It is therefore necessary to inspect the leaves and shoots of young plants regularly to detect fungal attacks, and to memorise the periods during which the damage appears in order to intervene at an earlier stage during the following season.



⬆ **Fungal attack on moringa leaves**

Effective and inexpensive fungicide products are based on mancozeb or maneb.

For organic cultivation, it is necessary to maintain a high level of cleanliness around the trees by eliminating weeds that act as hosts for pathogens. Neem leaf or seed extracts can be sprayed to control fungal attacks. However, these organic methods are not as fast or long-lasting as chemical products. The extract should therefore be applied as early as possible and on several occasions. This product is not toxic to humans and can be manufactured locally. Neem leaf extract is not as effective as the seed extract, but it may also be used.

6

HARVESTING MORINGA AND POSTHARVEST OPERATIONS

6.1 Harvesting leaves and postharvest operations

Leaf harvesting

Moringa leaves can be harvested 3-4 months after sowing. Good harvests take place every 30 to 45 days.

- Carry out the harvest in the coolest parts of the day; early morning or late evening. Make sure the leaves are not wet with dew, particularly in the morning, in order to avoid mould growth during transport.
- Cut all branches with leaves 50 cm from the ground.



- Take them off site. The branches must be well ventilated during transport: for short distances, baskets or perforated plastic containers can be used. Do not place anything on top of the leaves.
- Remove the leaves from the branches away from the site.



- Use the remaining green branches as animal fodder. They make a good protein supplement.



A density of 250,000 to 500,000 plants per ha with a yield of 16 g of leaves per tree, and with nine cuts per year over a 4 year period, results in about 144-288 t of fresh leaves, which is 24-49 t of dry matter.

Drying the leaves

The leaves must be dried quickly and away from sunlight and dust to avoid mould growth and degradation of the vitamins by ultraviolet light (UV).



Two main drying methods can be used:

- A drying shelter can be constructed from simple materials. An empty hut can also be used. There must be mats on the floor or on racks, where the leaves will be spread out in thin layers to help them dry properly.
- The leaves can be dried on a string, as is the case with tobacco drying.



Drying moringa leaves

6.2 Harvesting moringa seeds

The pods and the seeds are the second product to be harvested. One adult moringa tree produces around 200 to 250 pods, which equals 1 kg of pods.

The pods can be harvested green or dry.

- Green pods can be harvested 7 months after planting.
- Dry pods can be harvested about 6 weeks later. They are ready to be harvested when they become brown and dry, and open up easily.



- The seeds are extracted, placed in bags and stored in a dry place.



As the moringa branches are fragile, it is not recommended to climb the tree to collect the pods.

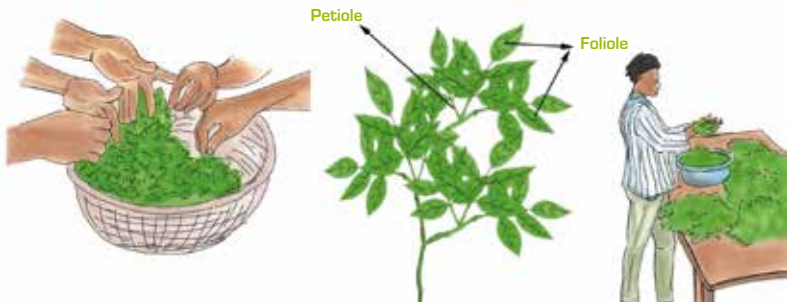
7

PROCESSING THE MORINGA

7.1 Dried leaf powder

Rich in vitamins, minerals and protein, moringa leaves processed into powder improve the diet of children and nursing mothers, and can be used as a treatment for diabetes and digestive and respiratory problems. To obtain moringa leaf powder:

- Wash and dry the leaves away from the sun on the day of the harvest.
- Two days later, separate the folioles from the petioles, then dry the folioles for 3-4 days. Collect and clean the dried leaves.



- Grind them in a mortar or a grain mill. The result is a fine green powder.



- Sift the powder, place in hermetically sealed boxes or plastic bags, and store them in the shade in a container to avoid contamination.

Poor drying results in a brown powder that is not fit for consumption



↑ *Moringa leaf powder*

From 100 kg of fresh whole leaves including the petioles, it is possible to obtain approximately 6.5 kg of dried leaf powder (ground in mortars).

7.2 Moringa flower powder

Moringa flower powder is produced in the same way as the leaf powder, after drying the flowers in a drier away from sunlight. It is used as medication or as a nutritional supplement.



↑ *Moringa flowers*

7.3 Powder from stems and petioles

Separated from their folioles, the stems and petioles are dried in the sun for about 15 days, then ground in a mill to obtain the powder. This is stored in bags and can be used as a food product for animals and humans.

7.4 Powder from the roots, trunk, bark and bark skin

- Cut the trunk and the roots into pieces.
- Wash them in water, strip the bark/skin, and then cut them into smaller pieces.
- Group the pieces into four batches of the same type (roots, trunk, root skin, tree bark).
- Dry them separately in four baskets for about 10 days. Then grind them separately in a mill to obtain four different powders that can be used to treat certain medical problems, including swelling of the legs (water retention), dental pain and scabies.

7.5 Moringa seed powder

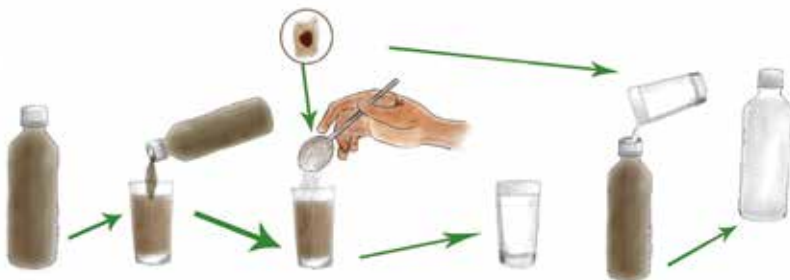
Leave the pods to dry on the tree and collect them when they have dried. Then remove the seeds from the pods and grind them into a fine powder using a mortar and pestle.

Moringa seed powder is used to treat and purify water. The quantity of crushed seeds needed to treat water will depend on the amount of suspended matters it contains:

For 1 litre of water: add 50 g of moringa seeds or moringa seed powder. Leave for 30 minutes, stirring occasionally, then filter.

For 20 litres of water (the contents of a large pail): first prepare a solution of two teaspoons of moringa seed powder in 250 ml of clear or boiled water, mix thoroughly, and then filter. Add this preparation to 20 litres of water, stir for 10 to 15 minutes, then leave it to settle. When stirring, the moringa seed powder bonds together (or coagulates) the fine particles and bacteria to form larger particles that then sink to and settle on the bottom of the pail. After 1 hour the water will be clear.

This process removes 90-99% of the bacteria attached to the solid particles. However, some harmful micro-organisms may still be present in the water, especially if it is extremely polluted. To obtain drinking water, more powerful purification is recommended by boiling it and passing it through a filter containing sand.



↑ *Using moringa seeds and seed powder to purify water in a rural environment*

7.6 Moringa leaf tea

Preparation of tea bags:

- Dry the moringa leaves and stems.
- Crush the leaves gently in a mortar.
- Mix the powder obtained with the stems that have previously been cut into small pieces. Pack the mixture into tea bags.

Consume after infusion in hot water. Moringa tea is often used as a cold remedy.



Preparing an infusion of leaves:

- For 1 litre of water, use 5 g of dried moringa leaves.
- Bring the water to the boil. Add the leaves and allow them to infuse for 30 minutes, then filter.
- The infused leaves can be reused to season a soup or side dish.

7.7 Moringa seed oil

- Crush the moringa seeds and boil them in water.
- Remove the foam that rises to the surface with a perforated skimming ladle.
- Recover the floating oil with a ladle.

The oil can also be extracted by using a manually operated hydraulic press or with a solvent (e.g. hexane).



Moringa seed oil

One litre of oil is obtained from 4 kg of moringa seeds. The oil is used in the manufacturing of cosmetics.



8

MARKETING MORINGA

Moringa plants, seeds, powders (leaves, roots, flowers, etc.), tea, oil or even fruit (pods) can be sold.



Given its medical and nutritional interest, ensure that the quality of products is met to satisfy your customers.

8.1 Selling moringa plants

One plant fetches between €1-3 (650-2,000 FCFA) with a production cost of approximately €0.5 (375 FCFA). It takes about 4-5 months' work in a nursery to produce one marketable moringa plant. The profit per plant sold therefore varies between 275 FCFA and 1,625 FCFA (€0,42 and €2,48).

Production cost for 1,000 plants

Description	Unit cost (FCFA)	Total (FCFA)
Construction of protective canopy	25,000	25,000
Purchase of 1,300 bags for a nursery	40	52,000
Purchase of 20 barrowfuls of black earth	1,600	32,000
Purchase of six barrowfuls of coarse sand	1,400	8,400
Purchase of 0.5 kg of moringa seeds	40,000	20,000
Purchase of four bags of poultry droppings	2,000	8,000
Purchase of tools for a nursery	Flat rate	112,000
Labour	Flat rate	130,000
Grand total expenses		387,400

Anticipated income for 1,000 moringa plants sold

Description	Unit cost (FCFA)	Total (FCFA)
Sale of 1,000 plants	1,000	1,000,000
Gross margin		612,600



8.2 Selling moringa seeds



One kilo of moringa seeds costs between €30-45 (20,000-30,000 FCFA), depending on the country.

Set-up and operating budget for a 1 ha plot (1,000 plants)

Description	Unit cost (FCFA)	Total (FCFA)
Purchase of 1 ha plot	1,000,000	1 000,000
Production of 1,000 moringa plants		387,400
Clearing, cutting down trees and cleaning	200,000	200,000
Digging holes, transport and transplantation	200	200,000
Maintenance costs (equipment and labour)	Flat rate	2,000,000
Packaging and marketing costs	Flat rate	500,000
Grand total expenses		4,287,400

Annual yield: 1,000 moringa trees (1 tree gives at least 500 g of seeds per year)

Description	Unit cost (FCFA)	Total (FCFA)
Sale of 500 kg of seeds	20,000	10,000,000
Gross margin		5,712,600

8.3 Selling moringa leaf powder

One kilo of dried moringa leaf powder is sold for between €10-50 (6,550-32,800 FCFA), depending on the country.



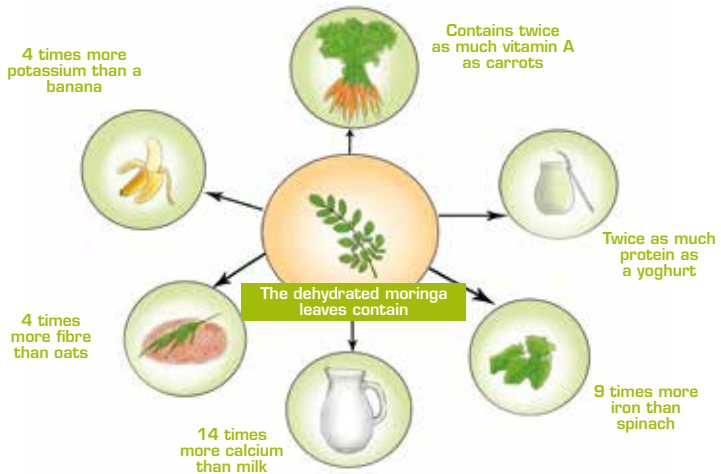
Marketing moringa leaf powder

9

RECIPES

9.1 Recipes for cooking

Moringa leaves have significant nutritional properties.



Fresh moringa leaves can be eaten raw if they are young and tender, and they can be cooked. Given that cooking destroys some of the nutrients (particularly the vitamins), it is important to use preparation techniques that preserve as many of the nutritional elements as possible.

For example:

- by combining moringa leaves with other ingredients (oil, lemon juice, tomatoes)
- by cooking the leaves for a short time only
- by preserving the liquid (water, sauce) in which they have been cooked.



Adding moringa powder to food

Moringa leaf powder can be added to food after cooking, or in the final minutes of cooking, both for baby food and in food for the whole family. It enhances the nutritional value of the food.



Sautéed moringa leaves

Ingredients

- 500 g of moringa leaves
- 1 large onion
- 25 g of refined oil
- 2 large tomatoes
- some salt and seasoning

Preparation and cooking

- Wash the leaves and chop them finely.
- Boil and salt the water. Put the leaves in the water, then switch off the gas.
- Stir several times and when the leaves are soft, drain them, allow them to cool and wring them out.
- Chop the onion and tomatoes into small pieces.
- Fry the onion, then the tomatoes and season well.
- When the tomatoes are cooked, gradually add the balls of moringa leaf and leave to stew for a few minutes.
- Adjust the seasoning to taste.

Moringa pod curry

Fresh moringa pods can also be cooked.



Ingredients

- *fresh moringa pods*
- *2-3 finely chopped onions*
- *1 teaspoon of tamarind extract or 1 chopped tomato*
- *1 sprig of curry leaf*
- *salt and curcumin powder as required*

Seasoning

- *1/2 teaspoon of mustard seeds*
- *2 pods of chilli pepper cut into small pieces/chilli powder*
- *2 tablespoons of oil*

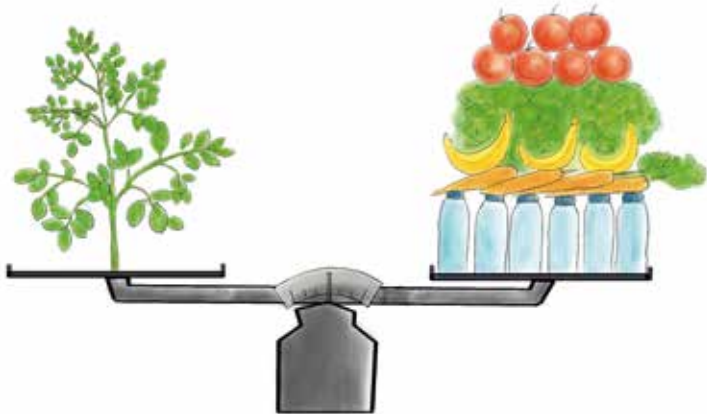
Preparation

- Cut the moringa pods into pieces 2 to 3 cm long.
- Heat the oil in a frying pan and add seasoning.
- When the mustard seeds stop sizzling, add the chopped vegetables (except the tomato) and sauté them in the frying pan.
- Add the salt and curcumin powder.
- Cover the pan and leave to simmer over a low flame.
- Stir occasionally until completely cooked.
- Add the chilli powder and the tamarind extract or chopped tomato. Leave to cook for a little longer. Serve with rice.

9.2 Medicinal recipes

Malnutrition in children

Use the leaf powder: mix a teaspoon of moringa leaf powder into soya or maize gruel and serve once a day.



Rheumatism

Use the seeds: chew and swallow three moringa seeds per day, after removing the shell.

Toothache

Use the root powder: apply a pinch of moringa root powder to the painful tooth or mix a teaspoon of root powder in a glass of water and use as a mouthwash.

Insomnia

Use the leaf powder: mix a teaspoon of moringa leaf powder soup in a glass of warm water and drink each evening until the insomnia has gone.

10

ADDITIONAL INFORMATION

10.1 Bibliography

De Saint Sauveur A., Broin M. (eds), 2010. *Produire et transformer les feuilles de moringa.* Moringa news, CDE, CTA, 36 p.

Lowell J. Fuglie, 2002. *L'arbre de la vie : les multiples attributs du moringa.* Dakar, Sénégal. CTA; New York: Church World Service. 177 p.

SAILD, 2009. *Dossier sur le moringa.* La Voix du Paysan 218, Yaoundé, Cameroon.



10.2 Useful contacts

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PRO-AGRO is a collection of practical, illustrated guides that are jointly published by CTA and EWB Cameroon. They are an ideal source of information for farmers, rural communities and extension workers in tropical and subtropical regions.

This technical manual describes the production of plant material and the cultivation techniques used for *moringa oleifera*. It is aimed at promoting the improved development of a number of by-products from this fast-growing tree to make it a viable source of income.

- **The Technical Centre for Agricultural and Rural Cooperation (CTA)** is a joint international institution of the African, Caribbean and Pacific (ACP) Group of States and the European Union (EU). Its mission is to advance food and nutritional security, increase prosperity and encourage sound natural resource management in ACP countries. It provides access to information and knowledge, facilitates policy dialogue and strengthens the capacity of agricultural and rural development institutions and communities. CTA operates under the framework of the Cotonou Agreement and is funded by the EU.

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