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Moringa Leaf Production Technique Using Takedapot

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Foreword

Appropriate technology is developed so that human work becomes easier while also increasing economic value. For that reason, appropriate technology should apply methods that are resource-efficient, easy to maintain, and non-polluting, producing minimal waste and avoiding environmental contamination.

Appropriate technology can bridge traditional technology and advanced technology. When it is used optimally, it can improve community welfare by increasing income and adding value to products. It can also simplify work and shorten the time required to complete it.

The agricultural sector makes wide use of appropriate technology to make the work of farmers and agribusiness practitioners easier. This technology is also considered more effective and efficient, and it can improve the quality of the harvest or products produced.

In implementing the Tri Dharma of Higher Education, especially community service, the preparation of appropriate technology booklets is very necessary. The Institute for Research and Community Service, University of Mataram, will continue to contribute to disseminating research results through seminars, workshops, extension activities, community service, practical guidebooks, appropriate technology publications, and other activities so that rural communities can strengthen their capacity and potential and use natural resources for welfare.

We warmly welcome the publication of this booklet. Its publication shows that the Institute for Research and Community Service, University of Mataram, has actively participated in transforming knowledge, science, and practical experience for user communities. To the authors, we extend our appreciation and thanks for their persistence and hard work in realizing this booklet. We hope it will be used as widely and as beneficially as possible by students, lecturers, the general public, and developers who need it.

Author's Preface

This appropriate technology booklet, entitled Moringa Leaf Production Technique Using **TAKEDAPOT**, was prepared as a practical guide for providing a sustainable source of healthy food, at least for the family. It also serves as a means of conserving moringa plant resources and as a landscape or home-garden element.

Takedapot is viewed as a solution for people who have limited land but wish to grow plants that provide benefits for daily life. When cultivated in sufficient numbers and maintained properly, surplus harvests can be sold. This becomes a business opportunity that can provide additional household income.

Hopefully, this appropriate technology will also inspire and guide moringa observers and developers in the utilization of moringa plants and the intensification of home yards in areas with limiting factors, especially land and water. In Sustainable Food House programs (RPL) or Sustainable Food House Area programs (KRPL), **TAKEDAPOT** can be relied upon as a component for program optimization.

As the saying goes, there is no ivory without cracks; this work is a human work and certainly has shortcomings. Suggestions and criticism are highly expected. With gratitude to Allah SWT for the completion of this publication, the author hopes this work will become a good deed in the sight of God Almighty and be useful for those who are interested in and committed to developing moringa in Indonesia.

Author

Moringa plant grown in a pot as a TAKEDAPOT example.

Preparing Seedlings

Good seedlings are a key guarantee of success in cultivating moringa plants in pots (**TAKEDAPOT**). The following steps describe seed-based moringa seedling production for **TAKEDAPOT**.

Preparing Nursery and Seedling Media

The seedling media that should be prepared consist of sowing media and transplanting media in polybags. The sowing medium should be a mixture of topsoil, river sand, and rice husk. The transplanting medium should be a mixture of topsoil and compost or other agricultural organic waste at an appropriate ratio.

Good media mixtures for moringa seedlings include soil and cocopeat, soil and bamboo leaf litter, or soil mixed with compost from other agricultural wastes. The soil used for the transplanting medium should be loose, fine-textured soil prepared by mixing topsoil, sand, and compost or manure.

Sowing the Seeds

Ready-to-sow seeds can be placed directly into polybags (direct nursery method) or first sown in a germination tray or box (indirect nursery method). Seeds are buried 1-2 cm deep in the medium and then covered with the same medium.

Maintaining the Germination Tray

Seedbed maintenance is carried out until seedlings are ready to be pricked out. Seedlings are ready for transplanting when they have an upright, healthy young stem and 1-2 newly opened leaves. Maintenance of seedlings or sprouts mainly involves keeping the sowing medium moist through watering. Water should be poured slowly along the edge of the tray.

Preparing the Transplanting Medium

To provide sufficient nutrients, topsoil should be mixed with compost or manure. To ensure good drainage, the medium should include rice husk or bamboo leaf litter. The recommended ratio for soil-cocopeat-manure or soil-bamboo leaf litter-manure is 1:1:1 by volume.

The nursery container is a black polybag with a diameter of 16 cm and a height of 20 cm, suitable for seedlings up to two months old, or a polybag with a diameter of 25 cm and a height of 30 cm for three-month-old seedlings. The polybag is filled with seedling medium and then lightly compacted so that the medium is firm.

The transplanting hole is made in the center of the polybag, about 3-5 cm deep. Most importantly, when the seedling is planted, the root-stem collar should be at least 2 cm below the surface of the medium. The polybags are arranged neatly in a nursery bed in an area not exposed to intense direct sunlight, preferably under natural shade with 70-80 percent light penetration.

Transplanting Seedlings

Seedlings are transplanted after they have 1-2 leaves, an upright stem about 5-7 cm tall, and a healthy appearance. This stage is usually reached 8-10 days after sowing. The hook stage, when the hypocotyl or seedling stem forms a hook, and the stage when the young root-shoot axis forms a straight line, are both good stages for transplanting.

Maintaining Seedlings

Seedlings produced from seed generally do not require shade. Initial shade is only intended to protect newly transplanted seedlings from excessive sunlight. If nursery humidity can be kept from fluctuating sharply, shade is not necessary.

Shade intensity should begin to be reduced when seedlings are two weeks after transplanting. At this age, more light is required to produce stronger moringa seedlings. Light intensity should be about 80-85 percent, then about 80-90 percent after one month. In the second month, seedlings can be left open without shade. Reducing shade prepares seedlings to withstand full sunlight and strengthens them.

Moringa seedlings are ready for planting when they are healthy, have a single stem, have started to lignify so they can stand firmly, and have 6-8 healthy leaves. This condition is reached when seedlings are 2-3 months after transplanting.

Weeding is carried out when weeds, such as grasses, interfere with seedling growth. Fertilization is first applied when seedlings are at least 14-16 days after transplanting. Use compound NPK fertilizer 15:15:15 or 16:16:16 at a dose of 5 g per polybag.

Prevention of pests and diseases is important. To suppress pest and disease incidence, the nursery should not be too humid or waterlogged. Drainage around the nursery and in the polybag medium must be good and should not be blocked.

Preparing Planting Pots

Pot Preparation

Type of Pot

A pot or planting container with adequate drainage is a basic requirement for **TAKEDAPOT**. Most commercial pots have drainage holes, but these are often not sufficient for good drainage. Additional drainage holes should therefore be made when necessary.

Many types of pots can be used, including wooden pots, plastic pots, concrete pots, iron drums, and planter bags. Each type has its own advantages and disadvantages.

Pot Size

Large pots are the best choice for **TAKEDAPOT**. As long as moringa plants have adequate root space, moringa grown in pots can produce satisfactory results like plants grown in the field. Pot volume directly determines the size or number of plants that can be grown in it. For example, growing only one moringa plant for a short maintenance period requires a smaller pot than a longer-term planting plan. Likewise, if two, three, or more plants are planned in one pot, a larger pot is needed for the higher population.

Pot height is important because it determines root depth. **TAKEDAPOT** uses a perennial plant with a deep root system; therefore, it also requires a deep pot. Shallow pots should be avoided.

For leaf production as a healthy food source, a wider pot diameter is needed so that 2-3 moringa plants can be planted in one pot.

Pot shape is not very critical unless **TAKEDAPOT** is also planned as a yard decoration or garden component. However, cylindrical pots that do not narrow too much toward the bottom are preferred because they provide sufficient root space. Avoid pots with a very wide upper rim and a narrowed middle section.

Number of Plants Per Pot

Regulating the number of plants in a pot is very important because it is related to an adequate harvest. It is essentially the regulation of planting distance, or more precisely, plant layout within the pot. The larger the pot, the more plants can be grown up to a certain optimum number. Conversely, if many plants are to be grown, a larger pot is needed. However, large pots require more growing medium and will make **TAKEDAPOT** quite heavy.

Drainage Holes

Pots for TAKEDAPOT must have sufficiently large bottom holes so that excess water can drain away. Drainage holes should not be too large or too small.

A good pot for TAKEDAPOT has the following criteria:

- It supports root development up to the desired plant age or growth size.
- It has drainage holes to remove excess water.
- It is not too heavy, so it is easy to move.
- It does not decay or break easily.
- Its walls allow water and air movement so that medium temperature remains stable.

Planting Medium Preparation

Types of Media

The planting medium is a key factor in **TAKEDAPOT** success because the amount of medium in the pot is limited by pot volume. A proper medium composition ensures that moringa roots can develop well and support plant growth.

TAKEDAPOT media are available in two basic forms: soil-based and organic-based. Soil-based media, or media using soil as the main component, tend to produce poorer plant growth. Organic-based media, using compost, husk, peat, coconut fiber, or other organic materials mixed with inorganic components such as soil, tend to produce better and more vigorous growth.

Mixed Media

The planting medium functions as the place for root growth and as support for the upright plant. **TAKEDAPOT** media must store water and supply nutrients needed by the plant, but must also drain excess water quickly.

Mixed media are strongly recommended for **TAKEDAPOT**. A single soil-based medium is not recommended. Garden soil is heavy and easily becomes compacted, reducing air space, so it is not suitable for **TAKEDAPOT**. Compost-based mixed media provide the components needed by moringa plants to grow and develop well.

Recommended media include a mixture of soil, compost, and rice husk charcoal at a 1:1:1 volume ratio, or soil, goat manure, and rice husk at a 1:1:1 volume ratio. In addition to producing more leaves, these mixed media produce greener leaves that are not stiff or overly thick.

Planting

The following sequence describes how to prepare planting holes and plant seedlings in **TAKEDAPOT**:

- Determine the planting points in the pot by considering the desired spacing or plant population per pot.
- Make planting holes with a minimum size of 25 x 25 x 25 cm if the seedlings are one month old, or 30 x 30 x 30 cm if the seedlings are two months old.
- Apply phosphate fertilizer such as SP36 at the bottom of the planting hole at a dose of 10-15 g. Phosphorus is needed by moringa to form strong roots and root systems during early growth, enabling the plant to grow better and faster.
- Tear the polybag carefully, remove the seedling, and place it in the center of the planting hole at the appropriate depth.
- Return the soil or medium mixture around the hole, covering all seedling roots up to the root collar or lower stem.
- Compact the soil around the seedling so that it stands upright and does not lean to one side, which could later result in poor growth direction.
- Repeat steps 1 to 6 for the second, third, or fourth plant, depending on the planned population per pot.
- Final compaction of the soil or medium around the plants is needed so that the plants stand upright and firmly. Because TAKEDAPOT uses a very loose mixed medium, pressing the medium is necessary. Compaction also fills any empty spaces along the side or wall of the pot, preventing large cavities when watering is carried out.
- Immediately water the pot with sufficient water, not more than 5 liters, so the medium becomes moist and saturated and the plants do not wilt after planting.

Figure 1: Stages of Planting Moringa in the TAKEDAPOT System

Figure 2: TAKEDAPOT Plant Layouts with Different Populations and Plant Growth 45 Days after Transplanting

Maintenance and Harvesting

Watering

The main objective of **TAKEDAPOT** is to produce leaves, whether for fresh consumption as vegetables, herbal products, processed foods, or other industrial materials. For leaf production, regular watering is required. Although moringa is drought tolerant, leaf production is relatively disturbed during a long dry season when water supply is limited.

During a long dry season with limited irrigation, **TAKEDAPOT** may lose its leaves, but the plants will not die. When routine watering resumes or rain returns, the plants will grow vigorously again. If rainfall is the main water source, moringa plants in pots should be pruned at the beginning of the rainy season and supplied with organic fertilizer such as manure or compost to ensure healthy branch and leaf regrowth.

Moringa plants in containers dry out more quickly than plants in the field. Therefore, **TAKEDAPOT** should be watered regularly. Watering is needed every three days during the first 3-4 weeks; after that, watering can be done once every 5-7 days.

Growing Medium Management and Fertilization

Replacing the **TAKEDAPOT** planting medium is not absolutely necessary. Even if the medium is never fully replaced, regular and sufficient supply of organic and inorganic nutrients enables **TAKEDAPOT** to continue growing well and to produce leaves over a long production cycle.

Medium replacement can be carried out in two ways. The first is replacing the medium together with changing to a larger pot, commonly known as repotting. The second is replacing the medium without changing the pot, which requires reducing part of the root mass to create new space for fresh medium. The second method is best carried out by scraping the top 10-15 cm of medium and replacing it with new medium.

To produce large quantities of leaves, moringa in **TAKEDAPOT** must be fertilized. Adding compost or manure is necessary both as a nutrient source and as a medium conditioner.

Fertilizer is added to **TAKEDAPOT** media gradually and continuously. The first fertilization is done when the planting medium is prepared, using about 5-6 kg compost or manure per square meter, equivalent to about 50-60 tons per hectare. Subsequent applications of manure or compost are applied once a year at 0.5-1 kg for each plant grown in the **TAKEDAPOT** system, preferably at the beginning of the rainy season.

The follow-up fertilization in the second or third year can be combined with the second method of medium replacement by scraping the upper medium layer and replacing it with a mixture of soil and manure or compost.

If manure or compost is difficult to obtain at the start of planting, initial fertilization can use 3 g urea per pot, 1 g SP36 per pot, and 1 g KCl per pot. Three months later, apply a follow-up fertilizer consisting of 2 g urea per pot per plant, 1 g SP36 per pot per plant, 1 g KCl per pot per plant, and 500 g manure or compost per pot. Repeat this every three months until **TAKEDAPOT** is 1-1.5 years old. After **TAKEDAPOT** reaches two years old, the follow-up fertilizer dose is recommended to be doubled.

Pruning

For plants whose harvestable organs are located at the shoots of branches, such as moringa, pruning can increase the number of secondary branches formed. More secondary branches positively influence the number of leaves that can be harvested.

There are two types of pruning in **TAKEDAPOT**. The first is pruning for leaf harvest, and the second is removing unwanted twigs or branches.

When moringa plants in pots are pruned, they regrow vigorously and produce more branches with fresh green leaves. The first pruning may be done only to stimulate early shoot formation. In this case, the pruned leaves may not be used for fresh consumption but can be processed into leaf powder or moringa leaf tea.

The first pruning can be carried out when plants are 50-60 days after planting. At this age, moringa plants usually have only one main stem, so the pruning material consists of one apical shoot with 5-6 leaves.

The pruning height in **TAKEDAPOT** does not greatly affect leaf yield. The recommended pruning height on the main stem is 25 cm above the medium surface. This height supports good growth and leaf biomass, makes care and harvesting easier, and allows the pruned stem to be potentially used for vegetative propagation.

Good and regular pruning or harvesting in **TAKEDAPOT** can also improve root growth. This is important because **TAKEDAPOT** is a production system where the growing space is limited by pot size. Limited root growth may also restrict shoot growth, which is the main harvested component.

Root pruning helps keep moringa plants relatively small compared with plants grown in the field. Root pruning is carried out together with pot replacement or by cutting a small part of the roots during partial medium replacement.

In the second or third production cycle, prune again at 50-75 cm above the medium surface to maintain plant height and make harvesting easier. If **TAKEDAPOT** is expected to form 2-3 main branches, harvesting or pruning in this production cycle is done on about two-thirds of the branch, leaving a branch length of about 10-20 cm. This is important for leaf production. If moringa is left to grow naturally, it tends to produce a tall main stem and leaves only around the apical and sub-apical parts, resulting in low harvestable leaf biomass.

Technical pruning guidelines for sustainable **TAKEDAPOT** production are as follows:

- **First Pruning:** carried out when the moringa plant reaches about 60 cm in height, or 1.5-2 months after transplanting, by cutting the main stem at 25-30 cm above the planting medium.
- **Second Pruning:** carried out on primary branches at 10-20 cm from the base of the branch. The pruned material is also the second harvest product of TAKEDAPOT.
- **Third Pruning:** harvest pruning on secondary branches that grow from the tips of the cut primary branches. The pruning length is the same as in the second pruning.
- **Fourth Pruning:** maintenance pruning. This is often done when leaves are harvested by cutting all branches above a certain height, precisely slightly below the position of the first pruning. This pruning maintains TAKEDAPOT plant height. It can also serve as complete pruning of tertiary branches at the third harvest, allowing new branches to grow afterward.

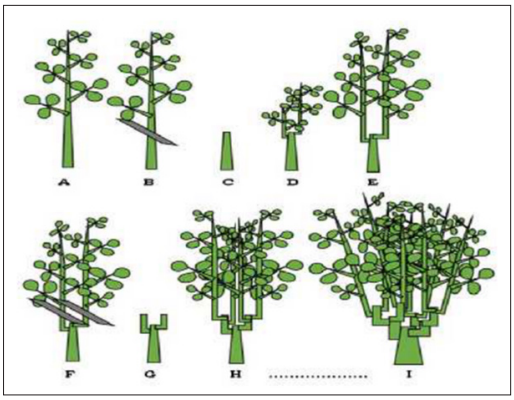

Figure 3: Harvest Pruning in the TAKEDAPOT System

Pest and Disease Control

Moringa trees can be considered resistant to pests and diseases. Even when attacked, the effects are usually not fatal. However, pest and disease attacks may become serious as moringa is cultivated more intensively.

Several pests that commonly attack moringa in areas where the plant grows widely include mites, termites, aphids, and caterpillars. Diseases found on moringa include root rot caused by root rot fungi such as Diplodia sp.

Because moringa leaves are harvested for consumption or processing, pest and disease control should use organic or biological insecticides whenever possible. Chemical insecticides can leave active ingredient residues that may endanger consumer health.

To control or suppress pest attacks, proper and routine harvesting is recommended. Regular harvesting reduces the continuous presence of dense leaves and helps maintain humidity at a safer level, limiting the development of insect pests and diseases. Good and regular harvesting is therefore recommended over the use of hazardous chemical insecticides.

If chemical use cannot be avoided, use biological insecticides based on leaves or seeds of insecticidal plants. Neem seeds, at 500 g crushed seeds in 10 liters of water and mixed with 3 percent soapy water, can be used to control several pests.

In addition to root rot, common diseases are fungal diseases with dark spots on leaves or spots covering the entire leaf, causing yellowing and leaf death. These diseases can be controlled using fungicides with active ingredients such as mancozeb or maneb.

Harvest Time

The harvested product of **TAKEDAPOT** is moringa leaves. Leaves can be harvested for the first time about 3-4 months after transplanting one-month-old seedlings. At that time, moringa plants in the **TAKEDAPOT** system have stems about 1.5-2.0 m tall from the ground surface on which the pot is placed.

If **TAKEDAPOT** grows well, harvesting can be done routinely every 30-60 days. Harvesting should be done in the morning when the leaves are free from dew, or in the afternoon.

Harvesting Method

When leaves are harvested from moringa, harvesting is usually carried out together with pruning. In the **TAKEDAPOT** system, harvesting can be done in two ways: picking leaves without cutting stems or shoots, or harvesting leaves by cutting the stem or shoot 20-50 cm from the tip of the apical shoot or branch. The first pruning or harvest stimulates lateral branch growth, which increases leaf yield in subsequent harvests.

If the first harvest is conducted by pruning the apical shoot, it should be done when the tree is 1.0-1.5 m tall, about 4-5 months from seed sowing or 2-3 months after seedling transplanting. At this stage, the moringa plant has only the main stem system. Pruning can be done at 25-50 cm above the soil surface.

This harvest encourages new shoot growth, which can be harvested again 30-60 days after the first harvest. Subsequent harvests cut 30-50 cm of branches from the shoot tip, or leave 10-15 cm of branch from the branch base.

The best harvest time is morning or afternoon. If harvesting is done in the morning, leaves should be free from dew to prevent decay during transport.

Initial Postharvest Handling

The harvest product of **TAKEDAPOT** is fresh moringa leaves, which generally can be consumed within two days after harvest and often within only one day. Leaves are easily damaged and wilt quickly, so they should be stored at low temperature and high humidity to avoid excessive wilting.

If processing or use must be delayed, do not leave harvested moringa leaves in piles. If piled for too long, the leaves will be damaged by heat generated within the pile. The leaves should be spread out in one or two thin layers.

A simple, inexpensive, and fairly effective way to maintain the freshness of harvested moringa leaves is to place them in plastic bags and store them in a room at about 10-15 degrees Celsius.

If drying is necessary, it should be done quickly. Good drying uses flowing warm air without direct exposure to sunlight. This allows moringa leaves to dry gradually while avoiding vitamin degradation caused by ultraviolet rays from the sun [1-5].

Three simple drying techniques that can be applied by farmers or community members are:

- Drying on racks placed in a simple building.
- Drying by spreading harvested leaves on mats on the floor of a building.
- Drying by hanging harvested moringa leaves on stretched ropes.

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