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Moringa Leaf Cultivation: A Profitable Agribusiness in Semi-Arid Regions

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Abstract

***Moringa oleifera* considered as a highly nutritious plant having whole parts of plant to be beneficial majorly leaves that carries rich protein, vitamins and minerals, making it useful in improving health and also its fruits are key of calcium collection, fulfil the calcium enrichment to the body. It is a fast-growing plant, grows in well-drained soils and warm climates condition and also tolerate the conditions of drought. Leaf production can be increased with maintain high-density planting, balanced fertilizer, optimum level of moisture and in such pest management. Having the proper feature of high yield with low input requirement, moringa is an important crop that can be grown for sustainable agriculture and enhances the farmer income.**

Keywords: - Moringa, Moringa leaf, Moringa Leaf Production, Moringa Farming, Moringa cultivation

1. INTRODUCTION

Moringa is a plant that belongs to the Moringaceae family. Its most common species is Moringa oleifera, which is known by different names such as horseradish tree, ben oil tree, miracle tree, tree of life and mother's best friend. In recent years, this plant has gained global most importance as a superfood crop because of its highly rich nutritional value. It sustains essential vitamins (A, B-complex, C), minerals, proteins and antioxidants that make it much beneficial for health and nutrition. Regular consumption contributes to combating malnutrition, anaemia and micronutrient deficiencies. Beyond human nutrition, moringa leaves are extensively used as livestock feed, green manure and raw material in pharmaceutical and nutraceutical industries. Its rapid growth rate and ability to withstand drought conditions make it an ideal crop for sustainable agriculture and climate-resilient farming systems. Moringa is one of the most popular vegetables in the south Indian households. The fruits, leaves and flower's are used in culinary preparation. The plant of moringa used for treatment of rheumatism and as cardiac and circulating stimulants. Ancient Indian texts highlight moringa as a valuable plant because of its extensive uses in agriculture, medicine, beauty and various industries (Rajangam *et al*., 2001). In recent studies, Moringa oleifera oil has been observed as a promising raw material for the production of biodiesel. Initially, there is an acid pre-treatment is carried out to lower the value of oil acid. This process is followed by a trans-esterification process using methanol and an alkaline catalyst at around 60°C, with an alcohol-to-oil ratio of 6:1. The oil is enriched with oleic acid, accounting for more than 70% of its composition, although the remaining portion mainly consists of saturated fatty acids. Due to this composition, the biodiesel produced from moringa oil traversed a high acetane number, that indicates the good fuel quality. Therefore, Moringa oleifera oil can be considered as an efficient and suitable feedstock for biodiesel production (Umer Rashid *et al*., 2008).

2. SOIL REQUIREMENTS

Moringa can be easily adapted to the varied range of soil. However, well-drained sandy loam, red loam or loamy soils are most suitable for optimum growth. pH of the ideal soil ranges from 6.5 to 7.5. The crop is highly sensitive to waterlogging, as excess moisture can lead to root rot and reduced plant vigor. Deep, loose soils enhance root penetration and nutrient uptake, thereby improving leaf biomass production. Seedlings of *Moringa oleifera* is grown in sodic soils there will be significant decrease in plant height, no. of leaves, stem diameter, plant spread and root length occurred at ESP 41.0 (Valia *et al*., 1998).

3. CLIMATE REQUIREMENTS

Moringa raise well in warm tropical and subtropical regions where temperatures generally between 25°C to 35°C. It is having requirement of plenty of sunlight, as direct sun exposure helps the plant produce more energy through photosynthesis and supports better production. Although, the plant can survive in dry conditions, giving water every 7 to 10 days can greatly improve leaf production, especially in intensive farming. However, very cold weather, frost and high humidity levels can harm the plant and reduce its overall growth and yield.

4. VARIETIES

High-yielding improved annual varieties such as PKM-1 and PKM-2, developed by the Tamil Nadu Agricultural University, are broadly adopted for large-scale commercial cultivation. These varieties generally for their early flowering, usually within 5 to 6 months, along with fast growth and high productivity. The plant is especially suitable for intensive leaf production system because it can quickly regrow after pruning, potentially highly efficient for repeated harvesting.

5. SPACING AND SEED RATE

For intensive leaf production, high-density planting is essential. Spacing of 4 × 1 feet or 2 × 2 feet allows optimum plant population. A seed rate of about 10 kg per hectare is used for sowing, seed are sown directly in well-prepared beds with uniform distribution to ensure better plant growth. Higher density leads to increased competition, resulting in tender shoots and higher leaf biomass suitable for frequent harvesting. Closer plant spacing makes it possible to harvest immature, edible shoots at intervals of two to three weeks. In many cases, trees are planted in rows at about one meter or even less apart to form effective living fence posts. (Palada and chang, 2003). The seed of Moringa plant are observed to be pungent and stimulant (Chopra *et al.*, 1958).

6. Fertilizer And Fym Management

Although moringa can grow under low fertility conditions, the application of nutrients significantly boosts leaf production. Basal application of 10-20 kg FYM per pit improves soil structure, microbial activity and moisture retention. Balanced fertilization with nitrogen, phosphorus and potassium improves vegetative growth, root development and overall plant health. Integrated nutrient management (INM) is annual moringa, includes the use of organic manures, biofertilizer and different levels of N, P and K. All these significantly improves plant growth and productivity. The study of moringa responded positively when organic and inorganic nutrients are applied in combination. Higher initial

growth and plant vigour were observed when the application of poultry manure (500g/pit) and neem cake (250g/pit) along with 150:120:100g NPK per tree (Beaulah *et al*., 2001).

In ratoon crops, similarly treatment also promoted early and vigorous growth. Overall, the use of organic manures, compost, vermicompost and biofertilizer in combination help maintain soil fertility and sustainable crop productivity and these results reported by Khader Mohideen and Shanmugavelu (1982).

8. WEED MANAGEMENT

Weed management in moringa is the process of controlling and regulating unwanted plants in a crop field to reduce their competition with crops for nutrients, water, light and space, thereby improving crop growth and yield. Mainly weed management done in moringa by the biological method and chemical method. Trees should be maintained with a weed-free zone around them to ensure healthy growth and proper resource availability. (Fuglie and Sreeja, 2000). Application of herbicide in the crop row to a width of 10-30 cm to avoid any environmental problems is considered to be the beneficial approach (Labrada, 1996). Weed growing within the crop row can be managed separately, simultaneously those present between the rows are eliminated by carrying out intercultural operations.

7. PEST AND DISEASE MANAGEMENT

Major insect pests include leaf-eating caterpillars, aphids and fruit flies, which can reduce leaf quality and yield. Common diseases include root rot and fungal infections, mainly under poorly drained conditions. Adoption of integrated pest management (IPM) strategies-such as biological control agents, neem-based formulations and proper field sanitation-helps in minimizing losses. Maintaining proper drainage and avoiding excess irrigation are crucial preventive measures. In India, the exposed end of the cutting is commonly covered with cow dung protect it from pests, diseases and damage caused by rainwater. (Rajangam, 2001).

8. PRODUCTION POTENTIAL

Under optimum leaf production systems, moringa can produce up to 6s tonnes of dry leaf biomass per hectare per year. Harvesting is usually done at intervals of 30–40 days when plants reach about 50 cm height. Multiple cuttings (7-9 harvests annually) are possible due to the plant's strong regenerative capacity. This makes moringa one of the highest biomass-producing leafy crops.

9. CONCLUSION

Moringa leaf production represents a highly profitable and sustainable agricultural enterprise. Its adaptability to diverse environments, low input requirements and high nutritional value make it a promising crop for addressing global food and nutritional challenges. The use of advanced cultivation techniques such as dense planting methods, proper nutrient management and integrated pest control can significantly improve crop yield and increases farmer

earning. Uplifting the cultivation of moringa can encourage sustainable farming practices, strengthen the livelihoods and help to enhance the global nutritional security.

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