

## *Moringa oleifera*: A BOON TO AGRICULTURE

**Mukunda Raj Joshi and Sukriti Pandit\***

Institute of Agriculture and Animal Science, Tribhuvan University

\* Corresponding autor email: [sukriti85pandit@gmail.com](mailto:sukriti85pandit@gmail.com)

Mukunda Raj Joshi : <https://orcid.org/0009-0000-1937-4596>

Sukriti Pandit : <https://orcid.org/0009-0009-3005-6535>

### ABSTRACT

Moringa (*Moringa oleifera* Lam.), also known as the horseradish tree, drumstick, or sajna, is a multipurpose tree that is found around the world in tropical and subtropical climate zones. Having various medicinal and nutrition properties, it is also known as miracle tree. This review study was done for easy access and dissemination of scientifically proven and culturally practiced uses of moringa tree to the agricultural group of Nepal. Different information and data used in this paper were taken from the multiple journals found in online platform. The leaves of the moringa tree are particularly beneficial since they are rich in protein, calcium, iron, and vitamin C, while the bark aids in the absorption of heavy metals. The moringa plant's leaf extracts have a number of beneficial effects, including anticancer, antibacterial, and antifungal characteristics. Making fermented plant juice from leaves and seeds can be used as organic fertilizer in agriculture. Application of moringa leaf extract throughout the booting, milking and heading stages significantly reduces wheat aphid populations. To control pests in stored grain, extracts from different moringa tree parts are employed. Moringa oleifera seed methanolic extract can be used to control *Callosobruchus maculatus* and *Sitophilus oryzae* on their respective grains. Application of the growth hormone present in moringa leaf extract is said to boost crop output by 45%. Due to its good green manure and fencing capacity, moringa plays crucial function in agroforestry system. Therefore, moringa is a multipurpose tree because of its benefits to agriculture, environment and human health.

**Keywords:** Alkaloid, antifungal, biopesticide, multivitamin.

### INTRODUCTION

*Moringa oleifera* Lam. is a multipurpose tree belonging to family Moringaceae native to sub-Indian continent. Moringa is also known as Horseradish tree, Mulangay, Mlonge, Benzolive, Drumstick tree, Sajna, Kelor, Saijihan and Marango (Razis *et al.*, 2014). This crop is extensively grown across a vast geographical area encompassing Pakistan, India, and Nepal, as well as Afghanistan, Bangladesh, Sri Lanka, Southeast Asia, West Asia, the Arabian Peninsula, East and West Africa, the West Indies, and southern Florida, as well as in Central and South America, ranging from Mexico to Peru, including Brazil and Paraguay. Production of moringa typically takes place between sea level and elevations of up to 1200 m in the tropics as well as sub-tropics. Although temperatures as high as 48°C are tolerated, the ideal temperature range is 25–35°C (Ebert & Palada, 2017). Moringa tree is perennial and fast-growing and known as 'miracle tree' due its wide medicinal as well as nutritional properties (Daba, 2016). It is a drought tolerant plant with capacity to grow in diverse soil except waterlogged condition in which its roots get rotten. As slightly alkaline clay and sandy loam soils have good drainage, they are considered best media for this species (Nouman *et al.*, 2014). Moringa is a perennial tree which can reach up to a height of 7-12 m and diameter of 20-40 cm (Foidl *et al.*, 2001).

Each part of moringa (roots, stem, leaves, flowers) has one or more different properties and uses. In some countries, moringa is eaten as vegetable also known to cool your body in hot and dry days. The leaves are very nutrient-dense, including more protein than milk and

eggs, more calcium than milk, more iron than spinach, more vitamin C than oranges, and more vitamin A than carrots (Awad *et al.*, 2014). The trunk bark is useful in the adsorption of heavy metals, as well as for the manufacturing of ropes and carpets (Orestes *et al.*, 2013). Researches have shown that leaf extracts of moringa plant have several properties such as antihypertensive, antifungal, and antitumor activities. Moringa seeds can be used as renewable fuels like biodiesel because of their excellent calorific value and economic production technology (Granella *et al.*, 2021). Strong coagulative and anti-microbial qualities are said to exist in its seed. The seeds are used to make oil, curry powders, and wastewater purification. Ben Oil, a non-drying oil produced by seeds that is utilized in lubricating watches and other delicate gear, is 38-40% of what is produced. The oil never goes rancid and is transparent, pleasant, and odorless. The seed oil has a good taste, is quite palatable, and resembles olive oil in terms of its physio-chemical qualities. It has been used as salad dressing and may be used as an alternative to pricey olive oil. Additionally, the oil is valuable in the production of cosmetics and fragrances (Seifu & Teketay, 2020). Moringa roots are believed to have antibiotic properties and are used in the treatment of conditions such as asthma, gastritis as well as used by females in developing countries as an alternative to contraceptives. Its roots have been reported to show antispasmodic properties (Dubey *et al.*, 2013).

Albeit being a miracle tree and having well growing environment, its various uses are unknown, less focused and unpracticed in Nepal. In such condition, this paper would help for documentation and easy access of various utilization method of moringa tree to the different farmer groups, students, scientific community and government body of Nepal. Scientifically proven and culturally practiced uses of miracle tree, moringa, throughout the world, are gathered and discussed in this paper.

## METHODOLOGY

Secondary sources of data collection was employed for the study. Desk study was done for virgorus reviews of the information collected. Journals findings were thoroughly studied for ensuring high quality literature review. Google scholar was major site for research data.

## RESULTS AND DISCUSSION

Moringa, the miracle tree, is diverse in terms of its uses and importance. It is applied in different fields to solve related problems. In medical field, it is used for treatment of diseases such as gastritis by inducing gastric serotonin level (Posmontier, 2011). In environmental field, it is used in treatment of water as its seeds possess a natural coagulant that can significantly decrease the turbidity of untreated water. However, using the seed as a coagulant in water treatment typically involves creating an aqueous extract on a daily basis to maintain its clarifying abilities (Garcia-Fayos *et al.*, 2015). Likewise, moringa is widely used in the field of agriculture as an alternative to various chemicals. Due to green revolution, the chemicals have destructed soil as well as human health. Some of the ways in which moringa is used in agriculture are:

### **Organic fertilizer (Foliar fertilizer application)**

Foliar fertilization offers quicker nutrient uptake and enables faster remediation of recognized deficits than would be possible with soil application (Fageria *et al.*, 2009). Numerous studies have demonstrated that spraying chelated fertilizer on leaves can increase fertilizer efficiency while reducing the total quantity of fertilizer used (Niu *et al.*, 2021).

Field trial conducted by Arshad, (2014) concluded that foliar applications of 2% moringa and brassica water extracts at intervals of 15 days can increase canola output by 10%, and they can do it inexpensively and efficiently, especially in light of the growing costs of inorganic fertilizers. According to a study by Yasmeen *et al.* (2012), the use of moringa leaf extract as a foliar spray to late-sown wheat at tillering, jointing, booting, and heading lengthened the seasonal leaf area duration (Seasonal LAD), slowed down grain filling, and postponed maturity, yielding 10% more than the control. A single foliar treatment at heading in the field was also found to improve yield by 6.8%.

The study by Zaki & Rady (2015) showed that the exogenous application of moringa leaf extract (MLE), which could shield the plants from harm by salt stress, could reduce the inhibitory effects of salt stress on the development and production of common bean plants. When cultivated under moderate soil salinity (EC = 6.23–6.28), soaking bean seeds + foliar spraying with MLE (1 extract paste: 30 waters by volume) were the most successful combination treatment for enhancing salt tolerance in bean plants.

### **Livestock feed**

Many trees as well as shrubs are being used as livestock feed or supplement by farmers all across the world. The nutrient present in moringa makes its utilization as feed an appropriate choice. Based on the fertilizer used, season and ecological zone, high dry matter (DM), between 4.2 and 8.3 t/ha is produced by moringa tree. Iron, potassium, calcium, and multivitamins are abundant in moringa leaves, and these nutrients are crucial for animal weight gain and milk production (Nouman *et al.*, 2014).

Compared to other woody plants, moringa possesses much higher levels of the amino acids: lysine, leucine, histidine, glutamic acid, valine, isoleucine, alanine, phenylalanine, and arginine. On a dry matter basis, moringa leaf has 24,700 mg kg<sup>-1</sup> calcium, 4,400 mg kg<sup>-1</sup> phosphorus, 318.81 mg kg<sup>-1</sup> iron, 190 mg kg<sup>-1</sup> magnesium, and 22.05 mg kg<sup>-1</sup> zinc. When compared to other tree leaves, moringa leaves have relatively high abundances of several minerals (Su & Chen, 2020). And the importance of these elements (Calcium, Magnesium, Phosphorous, Iron, Zinc) are well known to farmers (Price, 2007).

Moringa is a well-known source of polyphenols, lipophilic antioxidants, including tocopherols and carotenoids, making it a suitable feed for animals that could promote health (Cohen-Zinder *et al.*, 2017). They concluded, when utilized as a dietary alternative to maize silage, moringa silage may improve the health and output of nursing dairy cows.

### **Plant protection**

#### ***Biopesticide***

Biopesticides are organic compounds used to control pests that are generated from plants, animals, microbes, and specific minerals. Currently on the market, *Bacillus thuringiensis*, also known as Bt, is the source of about 90% of the microbial biopesticides (Damalas & Koutroubas, 2018). Biopesticides should replace existing chemical pesticides as chemicals deteriorate the ecosystem.

The field experiment results conducted by Ali *et al.* (2015) in wheat aphid showed that the aphid infestation in wheat was reduced significantly by use of moringa leaf extract in all three stages (booting, milk, and heading). According to the test done by El-Masry *et al.* (2017), the compound found in moringa Rhamnosyloxy-benzyl isothiocyanate had

each toxic effect against each of the adult female of mites and on mealybug. The egg-laying capability of the stored cowpea weevil (*Callosobruchus maculatus*) and rice weevil (*Sitophilus oryzae*) was considerably reduced by higher concentrations of 300 and 400 mg of MOSME (*Moringa oleifera* Seed Methanol Extract) and MOLME (*Moringa oleifera* Leaves Methanol Extract) compared to their control groups. When compared to MOLME, MOSBME (*Moringa oleifera* Stem Bark Methanol Extract), and their control groups, the foraging rate of *Callosobruchus maculatus* and *Sitophilus oryzae* on their respective grains was significantly decreased with an increase in MOSME concentration. In order to control *Callosobruchus maculatus* and *Sitophilus oryzae* on their respective grains, El-Masry *et al.* (2017) advised the use of MOSME.

### **Crop disease management**

Moringa is used for management of different diseases in various crops. Many researches have proved its importance for crop disease management. Moringa has antifungal as well as bactericidal effect on many pathogens. Dania and Thomas (2019) assessed the efficiency of Moringa extracts for preserving sweet potatoes against rot-causing fungal pathogens in vitro and in vivo. The in vivo testing showed that moringa extracts reduced the severity of rot in inoculated tubers by 41.4-52.0% at 75% w/v extract concentration. The researchers concluded that Moringa extracts have promising potential for reducing postharvest rot in sweet potatoes caused by fungal pathogens. Significant levels of phenolics, alkaloids, and tannins were present in the leaves, according to quantitative phytochemical analysis (Adekanmi *et al.*, 2020).

Moringa plant components extract, including roots, leaves, and pod coatings, were tested in vitro for their fungicidal effects against seven phytopathogenic fungi, including *Fusarium oxysporum*, *Fusarium solani*, *Alternaria solani*, *Alternaria alternata*, *Rhizoctonia solani*, *Sclerotium rolfsii* and *Macrophomina phaseolina*. Extracts from the roots, leaves, and pod coatings of moringa all samples drastically reduced in terms of radial development, spore germination, and dry mycelia yield pathogens (El-Mohamedy & Abdalla, 2014).

The presence of flavonoids, alkaloids, tannins and saponins in moringa plants helps us in understanding its efficacy against pathogenic bacteria. Moringa has potential as antimicrobial agent with its applications in pharmaceutical industry for controlling the pathogenic bacteria used in this work (Abalaka *et al.*, 2012).

### **Plant growth hormone**

Using moringa leaf extract as a growth hormone can boost crop growth and harvests, according to the study done by Mvumi *et al.* (2013). Common bean and maize plant height and root growth were both possible benefits of the extract. The extract's zeatin, a hormone related to cytokinin, was what caused the increased growth and yields. This study recommended the application of moringa extract every 2 weeks to maturity from two weeks from germination on maize and bean. Research conducted by Iqbal *et al.* (2020) on sunflower suggested that application of water extract of moringa leaf has more growth enhancing potential as compared to water extract of moringa roots.

The growth hormones found in abundance in moringa leaf extract (MLE) include zeatin, which has been shown to improve crop output by up to 45%. The growth, yield components, and yield of a variety of crops are all increased by the micronutrients that are present in moringa leaf juice in sufficient amounts and in the right proportions. The growth

and yield of cowpea were also increased by use of moringa; increase in dry matter, height and yield was seen with usage of high frequency of moringa (Maishanu *et al.*, 2017).

Fresh moringa leaf juice can be used to make powerful growth hormones that increase output by 25–30% for almost any group of plants, including melons, bell peppers, tomatoes, soy, onions, sorghum, tea, and coffee (Kutawa *et al.*, 2016).

### **Green manure**

The main purpose of a green manure (GM) is to improve the soil and provide nutrients for succeeding crops. The handling and transportation expenditures that other organic inputs frequently have are not incurred by green manures produced on site. In comparison to sources of inorganic nitrogen, the delayed release of nitrogen from degrading GM residues may be more in sync with plant absorption, boosting crop output and N-uptake efficiency while lowering N leaching losses (Cherr *et al.*, 2006).

Fast-growing moringa plants offer a significant opportunity for use as a green manure crop, particularly in plantation crops like date palm, olive, and others. The dry, shaded leaves can be used as organic manure, while the green leaves are good for mulching (Mridha, 2015).

### **Agroforestry**

The main goal of agroforestry is to create a more sustainable system of land use that can increase farm output and the well-being of rural communities (Leakey, 2017). Moringa has been used in agroforestry since ages but without knowing its benefits. Since its deep root structure prevents resource rivalry with understory crops and its canopy may filter light, the moringa tree is best suited for traditional agroforestry systems in home gardens. As a result, it provides the ideal shade for many different crops, including coffee, wild banana, aerial yam, and others (Tenaye *et al.*, 2009).

Agroforestry with moringa benefits local communities and small-holder farmers financially while fostering resilient landscapes. Agroforestry systems that included other crops in addition to cultivating moringa were more profitable than monocropping systems (Devkota *et al.*, 2020). The research conducted by Ndaginna & Ozobia (2017) depicted positive result on moringa plant as alley crop and recommended it.

### **Wind breaks and live fence**

Barriers called windbreaks are used to divert and lessen wind. They typically consist of trees and shrubs, but they can also be fences, grasses, annual or perennial crops, or other things. The climatic conditions or microclimate in the protected zone are altered by the decrease in wind speed behind a windbreak (Brandle & Finch, 1991). The bushier *Moringa stenopetala* can be planted as a wind break (Price, 2007).

Moringa trees are frequently used to make live supports for fencing around gardens across Africa (Bancesi *et al.*, 2019). Having a soft wood, other material or wire can be attached to tree if it is to be used as a fencing material (Price, 2007).

## **CONCLUSION**

The moringa tree is truly a miraculous tree. It can be used as alternative to food nutrition as well as treatment of many diseases. In agriculture sector, it provides wide range of benefits for increasing yield and productivity of different crops. The harmful effects of chemical to the environment and human health (ecological balance) can be mitigated to some extent by



use of moringa. Strategies and plans must be developed for the utilization of full benefits of moringa tree. In developing country like Nepal, moringa has to be promoted more as it is economical and should be used exclusively rather than depending on the rich countries.

Moringa is our opportunity to fight against the havoc caused by green revolution. Biogas, biodiesel plants should be constructed which not only save environment as well provide employment to people. Youths interested in agriculture need to be provided better understanding of moringa tree and its importance. Moringa should be encouraged in multiple sectors. This gift of nature must be utilized and commercialized.

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