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Review Article

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History, Taxonomy and Propagation of *Moringa oleifera*-A Review

Ramachandraiah Mallenakuppe[1*], Harini Homabalegowda[2], Mahadevappa Demappa Gouri[3], Prasanna S. Basavaraju[4], Umashankar B. Chandrashekharaiah[5]

[1]Veterinary Officer, Department of AH & VS, Govt. of Karnataka, Ramanagar, Karnataka, India
[2]PhD Scholar, Department of Animal Genetics and Breeding, Veterinary College, Hebbal, Bengaluru, Karnataka, India
[3]Assistant Professor, Department of Livestock Production and Management, Veterinary College, Hebbal, Bengaluru, Karnataka, India
[4]Assoicate Professor (I/C), Department of LFC, Veterinary College, Hebbal, Bengaluru, Karnataka, India
[5]Assistant Professor, Department of Animal Nutrition, Veterinary College, Hebbal, Bengaluru, Karnataka, India

***Address for Correspondence:** Dr. Ramachandraiah Mallenakuppe, Veterinary Officer, Department of AH & VS, Govt. Of Karnataka, Ramanagar, Karnataka, India

E-mail: drramachandragowda@gmail.com

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ABSTRACT

India is one of the fastest developing countries in the world. Presently India has the largest livestock population in the world. With the increase in the human population, to meet the present and future demands of this population, certain new strategies are to be adapted to meet the input requirements and also to enhance the production potential of Indigenous as well as crossbred cattle and other class of livestock for production, reproduction and they are by-products. Current work about the compilation of review works presented by various research works depicts the status and factors responsible for under utilization of *Moringa oleifera* (*M. oleifera)*. Especially with respect to the knowledge on taxonomy, distribution, diverse utilizations, nutritional value, socioeconomic importance, morphological and genetic diversity, domestication, propagation and management of *M. oleifera* is concerned. For fulfilling the Knowledge gaps, research and development avenues, we were suggested and discussed for improved valorisation. Since *M. oleifera* contains most of the nutrients which are required for all classes of livestock including poultry and fish, and even in human moringa leaves are used as tea powder, as a leafy vegetable etc. *M. oleifera* is also a good source of minerals and essential amino acids. The use of moringa can be extended in the pig as well as rabbit reproduction also. Therefore, the characteristics of Moringa make it be considered as one of the world's most useful trees. Better nutritional quality and high biomass production, especially in dry period support its significance as livestock fodder.

Key-words: Livestock fodder, *Moringa oleifera*, Nutritional value, Propagation, Taxonomy

INTRODUCTION

Each part of the Moringa tree (fruits, seeds, leaves, flowers, bark and roots) is associated with the presence of at least one, or in most number of benefits. *M. oleifera* is one of the world's mostly used plants. All parts of the species are traditionally used for different purposes, but leaves are generally the most used all over the world. Fodder scarcity and Low quality of available fodder are considered to be the major constraints hampering the productivity of farm animals. The available feed particularly in a dry season when natural pastures are mature is highly fibrous and inadequate with low nutritive value due to low crude protein content [1].

Moringa species are all native to Asia, from where they have been propagated across many parts of the world especially more seen in warm countries, such as Malaysia and other tropical countries. This tree can tolerate temperatures from 19°C to 28°C, and has height from 5 to 10 m and can be cultured throughout the plains. Moringa leaves are being used as a medicine because it is said to contain many phyto-chemicals, hence it is used as preventive and curative purposes [2].

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Many underutilized crops and trees are the main target for the studies by plant scientists, nutritionists, and growers. Of the many plant and tree verities, *Moringa oleifera* is one of these, which has been neglected since several years, but of late the moringa is being investigated for its fast growth, higher nutritional attributes, and utilization as a livestock fodder crop. Moringa can be grown in areas where growing of other crops is difficult. It can also be grown as a crop on marginal lands with high temperatures and low water availability [3-6].

M. oleifera are originated in sub-Himalayan tracts of the Indian sub-continent. This is one of the fast growing, evergreen, deciduous medium sized perennial tree of about 10 m to 12 m height. The bark has whitish-grey colour and is surrounded by thick cork. Young shoots have purplish or greenish-white bark. Flowers are yellowish creamy white and sweet smelling. The matured fruit is a hanging capsule of 20-45 cm size having 15 to 20 dark brown globular seeds of 1 to 1.2 cm diameter [7].

At present country facing the deficit of green, dry and concentrate at the level of 63.5%, 23.5%, and 64% respectively as a result the CP and TDN availability are not meeting the requirement causing deficit of about 26.5% and 23.70% respectively [8]. Further due to ever-increasing population pressure of human beings, arable land is mainly used for food and cash crops, thus there is little chance of having good quality arable land available for fodder production unless milk production becomes remunerative to the farmer as compared to other crops. The unconventional fodder resources such as Azola, moringa, sesbania, cactuses, etc are emergency fodders with high nutritive values [9].

Table 1: Area under fodder crop [8]

Area (mh)	1990	2010	2020
Gross cropped area (excluding fodder crop)	174.1	188.1	196.8
Area under fodder crop	8.26	7.88	7.09
Permanent pastures and grazing land	11.3	10.2	9.49
Land under miscellaneous tree crops	3.8	3.28	3.15

To meet the current level of livestock production and its annual growth in population, the deficit in all components of fodder, dry crop residues, and feed has to be met through increasing productivity, utilizing untapped feed resources, increasing cultivable land area or through imports.

Trees and browse species like *Subabul, Morus*, *Glyricidia* and *Sesbania* have been used as livestock fodder for centuries in India and many other countries. Most trees and shrubs are easily propagated and not require high management inputs (fertilizers and pesticides) or advanced technology.

Mendieta-Araica *et al.* [10]; Richter *et al.* [11]; and Sanchez *et al.* [12] have explored *M. oleifera* cultivation and propagation practices and its utilization as livestock fodder and also in fish diet. The results of their studies showed that moringa species has great potential as livestock fodder.

Natural history, range and growing condition of *M. oleifera*- *M. oleifera* is a widespread multipurpose tree reported to have nutritional, therapeutic and prophylactic properties with several industrial applications. It is well known to the ancient world, but only recently it has been rediscovered due to the tremendous variety of its potential uses. It is a fast growing, a perennial tree which can reach a maximum height of 7 to 12 m up to the crown [13] and found growing naturally at elevations of up to 1000 m above sea level. It can grow well on hillsides, but is more frequently found growing on pasture land or in river basins as a non-cultivated plant.

M. oleifera belongs to the monogeneric family of shrubs and tree Moringaceae, considered to have its origin in Agra and Oudh, in the northwest region of India and south of the Himalayan Mountains. It is now cultivated throughout the Middle East, almost the whole tropical belt and it was introduced in Eastern Africa from India at the beginning of 20th century.

About 33 species have been reported in the family *Moringa*ceae [14]. Among those, thirteen species namely, *M. arborea*, *M. borziana*, *M. concanensis*, *M. drouhardi*, *M. hildebrandtii*, *M. longituba*, *M. oleifera*, *M. ovalifolia*, *M. peregrina*, *M. pygmaea*, *M. rivae*, *M. ruspoliana*, *M. stenopetala* are well known and found worldwide.

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Table 2: Taxonomic position of *M. oleifera*

Kingdom	Plantae
Superkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Capparales
Family	Moringaceae

Table 3: Geographic distribution of documented thirteen *Moringa* species

Species	Geographical location
Slender trees	
M. concanensis	India
M. oleifera	India
M. peregrine	Fiori Red Sea, Arabia, Horn of Africa
Bottle trees	
M. drouhardii	Madagascar
M. hildebrandtii	Madagascar
M. ovalifolia	Namibia and S.W. Angola
M. stenopetala	Kenya and Ethiopia
Tuberous shrubs and herbs of North Eastern Africa	
M. arborea	North Eastern Kenya
M. borziana	Kenya and Somalia
M. longituba	Kenya, Ethiopia, Somalia
M. pygmaea	North Somalia
M. rivae	Kenya and Ethiopia
M. ruspoliana	Kenya, Ethiopia, Somalia

Table 4: Some common names of *M. oleifera* [15]

Language	Common Name	Language	Common Name
Kannada	Nugge	Sanskrit	Shobhanjana
Tamil	Murungai	Telegu	Munaga, Tellamunaga
Urdu	Sahajna	Konkani	Maissang, Moxing
Punjabi	Sainjna	Marathi	Achajhada, Shevgi
Hindi	saijna, shajna	English	Drumstick tree
Malayalam	murinna, sigru	Assamese	Saijna, Sohjna
Gujarati	Midhosaragavo	Chinese	La ken

Production and management of *M. oleifera* is easy due to its fast growth, low demand for soil nutrients and water after being planted especially in later stages, high capacity to resprout after harvesting make it to perform better under marginal conditions with ample nutritional quality [16].

Table 5: Ecological Requirements of *M. oleifera* [3]

Parameter	Requirement/range
Climate	Tropical or sub-tropical
Altitude/Height	0-2000 meters
Temperature	18.7-28.5°C
Rainfall	250 mm - 2000 mm. Irrigation needed for leaf production if rainfall <800 mm
Soil type	Loamy, sandy or sandy-loam
Soil pH	Slightly acidic to slightly alkaline (pH 5 - 9)

Its roots penetrate deep into the soil to search for water and nutrients, which enables Moringa trees to tolerate severe conditions. Relatively low requirements of irrigation–make Moringa superior to some other livestock meals like soybean, cotton seed cake, and range grasses which require intensive irrigation makes it too difficult to cultivate for small livestock farmers [17]. *M. oleifera* can be grown in diverse soils, including hot, humid, dry tropical and subtropical regions except for waterlogged conditions. Slightly

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alkaline clay and sandy loam soils are considered the best media for this species due to their good drainage [18].

Table 6: Undesirable sites for Moringa cultivation [19]

Site	Reason(s)
Industrial waste dumps	Absorption of undesirable or toxic heavy metals e.g. mercury, arsenic, lead, etc.
Refuse dumps	Absorption of undesirable or toxic heavy metals e.g. mercury, arsenic, lead, etc.
Waterlogged sites	Poor drainage causes roots to rot. e.g. rice fields, clay, river beds, etc.
Termite infested soils	Destruction of young and mature trees
Animal grazing fields	Destruction of young and mature trees

Daba's research reported by Japanese has displayed that the rate of absorption of carbon dioxide by the Moringa tree is twenty times higher than that of general vegetation. The capacity of the Moringa tree is inspiring in mitigating the adverse effects of climate change [20].

The morphological parts of *M. oleifera* include stem, branch, leaves, flowers, fruits with the seeds. Fruits are tri-lobed pods contain 12-35 seeds, each tree can produce 15000-25000 seeds/year, the average weight per seed is 0.3g and the kernel to hull ratio is 75:25 [21].

Propagation of Moringa- Moringa can be propagated by direct seed planting, seedling transplanting and mature stem cuttings. Direct seeding is preferable when the germination rate is high. Seeds must be sown at a maximum depth of 2 cm as deeper seeding might reduce the germination rate. There are around 4000 Moringa seeds (with their shell) in a kilo with the germination percentage of 78-94%. Moringa seeds germinate 5 to 12 days after seeding [22].

Seedlings are grown in polythene bags or sacks prefilled with topsoil by sowing seeds at 2 cm depth and watering once in every 2-3 days. After showing they have to be placed in a slightly shaded area and also protect from heavy rains. The young Moringa plants must be nursed for 4 weeks before transplanting for better survival rate when they are about 30 cm high. Remove the polythene bag when transplanting ensuring that the roots of the plant are not damaged. Hardwood cuttings of 40 cm long and 4 to 5 cm in diameter [23], can also be used for propagation by burying one-third of the stem in the soil. Plants produced with cuttings will not have a deep root system will be more sensitive to wind drought and termite attacks.

Seed production- Spacing must be much wider for fruit or seed production. Trees must be at least 2.5 m apart line and peg using a 3 x 3 m triangular pattern for seed producing farms.

Limitations- Apart from its advantage as high biomass yielding and highly nutritious fodder for both human and livestock there are many limitations for intended cultivation and utilization. Not suitable for cultivation in the highly irrigated area. Lack of exact package, practices to cultivated moringa for fodder production, whereas lack of preservation and processing technology under local conditions. Insufficient researches to validate the level of inclusion under local condition. It can never be used as a sole source feed and fodder for livestock because of its high level of Crude Protein, which has to be balanced with energy. Since the moringa leaves are also used as a vegetable for human beings creates demand and eventual cost hike.

CONCLUSIONS

M. oleifera is a multipurpose plant with the potential to reduce the dependence on expensive conventional protein supplements, the relative ease with which Moringa can be propagated through both sexual and asexual means, low demand of soil nutrients and water. Moringa has almost all essential nutrients in adequate amounts for maintenance and production; provide macro and micronutrient to boost the nutritive value of the feed. Due to high nutritive value, Moringa has been used as a feed supplement in most livestock species and poultry. Its supplementation not only increases meat and milk production but also the quality, healthfulness and shelf life of the product.

The future prospects of *M. oleifera* to be explored in terms of the proper sowing densities and harvesting frequencies, information on agronomical practices, planting densities and cutting frequencies for getting maximum biomass with good nutritional quality need to be explored, studies directed towards the detection and commercialization of bioactive compounds to the

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development of remedies for several ailments. Besides this, its fertilizer and irrigation requirements as a fodder crop have not yet been studied, which needs attention for more biomass production. Finally, the policymakers, researchers and extension institutions should formulate programs focusing on generating awareness among local communities and farmers, especially among those, who are engaged in livestock production, to emphasize the planting of Moringa as a "FOOD-FEED" crop for their family and their livestock.

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CONTRIBUTION OF AUTHORS

Research concept- Mahadevappa D. Gouri
Research design- Mahadevappa D. Gouri, Ramachandraiah
Supervision- Umashankar, Mahadevappa D. Gouri
Materials- Ramachandraiah, Mahadevappa D. Gouri
Data collection- Ramachandraiah, Mahadevappa D. Gouri
Data analysis and Interpretation- Ramachandraiah, Mahadevappa D. Gouri, Harini
Literature search- Ramachandraiah, Harini
Writing article- Ramachandraiah, Mahadevappa D. Gouri
Critical review-Mahadevappa D Gouri, Prasanna
Article editing- Ramachandraiah, Mahadevappa D. Gouri
Final approval- Ramachandraiah, Mahadevappa D. Gouri, Umashankar, Prasanna

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