Department of Agriculture Development & Farmers' Welfare
Farm Information Bureau

Government of Kerala

MARCH 2024
VOLUME - 11
ISSUE - 09

# KERALA KARSHAKAN

English journal

The First English farm journal from the house of Kerala Karshakan

## GROWING INDOOR PLANTS BEAUTY AND HEALTHY

# INSIDE KERALA KARSHAKAN

English journal

**MARCH 2024** Volume - 11 Issue - 09

Mail: editorejournalkkfib@gmail.com Log on to http://www.fibkerala.gov.in
Phone: 0471-2314358

**The First English farm journal from the house of Kerala Karshakan**






## ATTENTION AUTHORS

Articles for Kerala Karshakan e-journal should be certified by head of the institution concerned stating that the article is original and has not been published anywhere. Reference should also be included wherever relevant.

18







Chief Editor
Asa S Kumar

Editor
Haripriya Devi V V

Asst. Editor
Vishnu S P

Design & Layout
Rajesh V


Articles/ Features appearing in this e-journal are either commissioned or assigned neverthless, other articles of farm relevance are also welcome. A maximum of 750 wordage is appreciated. Such items should be addressed to The Editor, Kerala Karshakan e-journal, Farm Information Bureau, Kowdiar PO, Thiruvananthapuram, Pin: 695003
These may also be mailed to editorejournalkkfib@gmail.com in word format. Responses can be also sent to this mail. Authors are requested to provide the following details along with the articles, for quick processing of the remuneration, after the articles are published: Account Number, Name of Bank, Branch (Place), IFSC Code.

# GROWING INDOOR PLANTS BEAUTY AND HEALTHY

[1]Bhanu murthy K.C
[2]Sapna Panwar
[3]Shanthesh K
[4]Gireesh
[5]Lava Kumar D
[1, 3,4& 5.] Ph.D Scholars,
[2] Scientist,
FLS, ICAR-IARI, New Delhi

*Chamaedoreaseifrizii*

Most of us know instinctively that being close to greenery makes us feel more at ease with our surroundings. We experience less stress when there are plants around us. Plants help reduce stress and create a feeling of well-being.

There is general agreement amongst scientists that plants improve the indoor environment and are useful in fighting the modern phenomenon of Sick Building Syndrome (SBS). No specific cause of SBS has been identified but poor air quality, excessive background noise and inadequate control of light and humidity are all thought to be important factors.

Plants that decontaminate

*Hedera helix*



*Anthuriumandraeanum*

*Chrysanthemum indicum*

volatile pollutants from air show APTI (Air Pollution Tolerant Index). These plants provide natural way of removing toxic agents from the air, helping neutralize the effects of sick building syndrome.There exist several such plants which exhibit this factor and can be suitably advised for residences, schools, colleges and hospitals. Because plants have large surface area and exchange gases & water with their surroundings, that can help tackle some of the issues.

**Benefits of growing indoor plants include:**

1.Reducing carbon dioxide levels
2.Increasing humidity
3.Reducing levels of pollutants such as benzene and nitrogen dioxide etc.
4.Reducing airborne dust levels
5.Keeping air temperatures down
6.Lower background noise

Common Indoor Pollutants:

**a) Trichloroethylene:** Found in printing inks, paints, lacquers, varnishes, adhesives, and paint

*Sansevierialaurentii*

*Aloe barbadensis mill*

*Homalomenawallisii*

removers. Symptoms associated with short-term exposure include excitement, dizziness, headache, nausea, and vomiting followed by drowsiness and coma.

**b)Formaldehyde:** Found in paper bags, waxed papers, facial tissues, paper towels, plywood panelling and synthetic fabrics. Symptoms associated with short-term exposure include irritation to nose, mouth, throat and in severe cases, swelling of the larynx and lungs.

**c) Benzene:** Used to make plastics, resins, lubricants, detergents, drugs and found in tobacco smoke, glue and furniture wax. Symptoms

associated with short-term exposure include irritation to eyes, drowsiness, dizziness, headache, increased heart rate, confusion and in some cases can result in unconsciousness.

**d)Xylene:** Found in rubber, leather, tobacco smoke and vehicle exhaust. Symptoms

*Dieffenbachia sp.*

*Philodendron bipinnatifidum*

*Ficuselastica*

*Dracaena marginata*

*Spathiphyllum sp.*

associated with short-term exposure include irritation to mouth and throat, dizziness, headache, confusion, heart problems, liver &kidney damage and coma.

**e) Ammonia:** Found in window cleaners, floor waxes, smelling salts and fertilizers. Symptoms associated with short-term exposure include eye irritation, coughing, sore throat.

**f)Nitrogen Dioxide:** This harmful gas is formed by

emissions from vehicles and factories during the burning of fuel. It is high in concentration in regions that are congested with vehicles and traffic. The gas is a respirator irritant, causing specific damage to the cardiovascular and respiratory system.

**g) Sulphur Dioxide:** A highly reactive gas that carries a smell which is pungent and irritating, sulphur dioxide is formed by the burning of fuels in industries and factories. Its presence in the air results in the irritation of the lining of lungs, throat, nose and also respiratory diseases such as asthma and other cardiovascular problems.

**h)Suspended Particulate Matter:** Suspended Particulate

*Ficusbenjamina*

*Aglaonemamodestum*

*Chlorophytumcomosum*

*Raphisexalsa*

*Nephrolepis Exaltata*

**Indoor plants that give beauty and improve health by removing air pollutants are**

| S.No. | Common name | Botanical name | Family | Air pollutants removed |
|---|---|---|---|---|
| 1 | Peace lily, Spath, closet plants | *Spathiphyllum sp.* | Araceae | Benzene, Formaldehyde, Trichloroethylene, Ammonia, Xylene and Toluene |
| 2 | Common ivy, English ivy, European ivy, ivy | *Hedera helix* | Araliaceae | Benzene, Formaldehyde, Trichloroethylene, Ammonia, Xylene and Toluene |
| 3 | Mother in laws tongue, snake plant | *Sansevierialaurentii* | | Benzene, Formaldehyde, Trichloroethylene, Xylene and Toluene |
| 4 | Red-edged dracaena, Dracena tree | *Dracaena marginata* | | Asparagaceae Benzene, Formaldehyde, Trichloroethylene, Xylene and Toluene |
| 5 | Bamboo palm | *Chamaedoreaseifrizii* | Arecaceae | Benzene, Formaldehyde, Trichloroethylene, Xylene and Toluene |
| 6 | Money plant, Golden pothos, Hunter's robe, Silver vine, Devils ivy | *Epipremnumaureum* | Araceae | Benzene, Formaldehyde, Trichloroethylene, Xylene and Toluene |
| 7 | Janet Craig | *Dracaena deremensis* | Asparagaceae | Benzene, Formaldehyde and Trichloroethylene |
| 8 | Flamingo lily | *Anthuriumandraeanum* | Araceae | Formaldehyde, Ammonia, Xylene and Toluene |
| 9 | Areca palm, Golden cane palm, Y ellow palm, Butterfly palm | *Dypsislutescens* | Arecaceae | Formaldehyde, Xylene and Toluene |
| 10 | Raphis palm | *Raphisexalsa* | Arecaceae | Formaldehyde, Xylene and Toluene |
| 11 | Spider plant | *Chlorophytu mcomosum* | Asparagaceae | Formaldehyde, Xylene and Toluene |
| 12 | Chinese evergreen | *Aglaonemamodestum* | Araceae | Benzene and Formaldehyde |
| 13 | Ficus, Weeping fig, Benjamin fig, Ficus tree | *Ficusbenjamina* | Moraceae | Benzene and Formaldehyde |
| 14 | Lacy tree philodendron, selloum | *Philodendron bipinnatifidum* | Araceae | Formaldehyde |
| 15 | Rubber plant | *Ficuselastica* | Moraceae | Formaldehyde |
| 16 | Dumb cane | *Dieffenbachia sp.* | Araceae | Xylene and Toluene |
| 17 | King of hearts | *Homalomenawallisii* | Papaveraceae | Xylene and Toluene |
| 18 | Aloe, Aloe vera, Ghritkumari | *Aloe barbadensis mill* | Asphodelaceae | Benzene and Formaldehyde |
| 19 | Daisy, chrysanthemum, Guldawdi | *Chrysanthemum indicum* | Asteraceae | Benzene, Formaldehyde, Trichloroethylene, Ammonia, Toluene |
| 20 | Transvaal daisy, Barbeton daisy, | *Gerbera jamesonii* | Asteraceae | Benzene, Formaldehyde and Trichloroethylene Gerbera |
| 21 | Boston sword fern, Wild Boston fern | *Nephrolepisexaltata* | Nephrolepidaceae | Formaldehyde, Xylene, Toluene and airborne germs, molds, bacterias |

*Dracaena deremensis*

Matter (SPM) refers to the suspended solid and liquid particles in the air that are too small in size. Its short effects include irritation of the eyes and the respiratory tract, with the long term exposure causing asthma and weaker cardiovascular function.

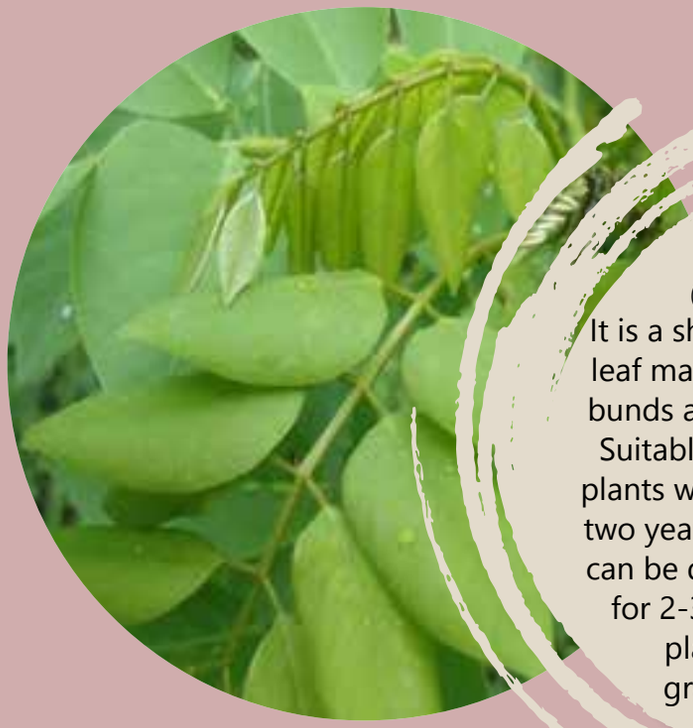
# Green Leaf Manure

## Natures gift to improve soil fertility

Green leaf manuring is the application of green leaves gathered from shrubs and trees growing in waste lands to the fields where crops are to be raised. Green leafy material is gathered from all sources by farmers for manuring purpose. Different kinds of shrubs growing on tank bunds, waste lands,


**[1]M.Ananthi**
**[2]S.Umesh Kanna**
**[3]M.Anitha**

[1]Teaching Assistant, Directorate of Planning and Monitoring, Tamil Nadu Agricultural University, Coimbatore
[2]Professor (Forestry), Directorate of Planning and Monitoring, Tamil Nadu Agricultural University, Coimbatore
[3]Assistant Professor, Selvamm Arts and Science College (Autonomous), Namakkal

### Glyricidia

*(Gliricidiamaculata)*

It is a shrub and useful for green leaf manuring. Can be grown on bunds and also as a border crop. Suitable for alley cropping. The plants will be ready for pruning in two years after planting. Pruning can be done at a height of 2-3 m for 2-3 times every year. Each plant gives 5-10 kg of green leaves annually.

### Cassia

*(Cassia auriculata)*

A shrub with large bright yellow flowers. Propagated by seeds. During flowering tree is topped (stem and branches cut) and loppings used for green leaf manuring. The plant attains a height of 7mt. Drought tolerant.

Karanj

*(Pongamia glabra)*

It is a leguminous moderate sized ever green tree. It can be grown successfully on roadsides, river banks, tank bunds, in coastal forests, along streams and wastelands. Two to three months old seedlings can be planted at 4 to 5 m to establish. Lopping may be taken once or twice a year and a tree gives on an average 100 to 150 kg of green material per lopping.

**White gulmohar**

*(Delonixelata)*

It is tropical ever-green tree which can grow on all types of soils. Possess medicinal value. It is propagated by stem cuttings. Two or three loppings can be taken in an year

**Gulmohar**

*(Peltophorumferrugenum)*

It is of potential use for reforestation, in agro-forestry farming systems and as a source of green manure. As a fast-growing species, young trees raised from seed will, under good conditions, flower from age 4 years.

## Trees / Shrubs

***Calotropis gigantea***
It is present on field bunds and waste lands. Water loving aquatic weed. Abundant along canal bunds. It is propagated through seeds.

***Tephorsia candida***
It is a drought-tolerant, nitrogen-fixing shrub. It is commonly used in agro-forestry systems, especially for soil improvement and erosion control. It is also used as a green manure and in extended fallows, contour hedgerows.

field bunds, garden lands, etc. are used. Forest tree leaves are the main sources for green leaf manure.In addition, loppings from miscellaneous trees are also gathered for use as green leaf manure. Green leaves have the same effect as green manure on the land and the crop.The important plant species useful for green leaf manure are neem, mahua, wild indigo,

### Subabul

*(Leucaena leucocephala)*

It is a leguminous branched shrub. Dual purpose crop i.e. green leaf manure and forage. Can be grown on bunds, borders and waste lands. Needs aggressive lopping to avoid shading effect. Leaves contain 3.5-3.7% N. Fixes 500-600 kg N ha-1 year- Can be incorporated in rice fields well ahead of planting

### Neem

*(Azadirachta indica)*

It is a large ever green avenue tree with profuse branching and plenty of green foliage. They can be grown along field borders, rivers banks, roads, waste lands and also in garden lands and homestead gardens. Trees are established by planting seedlings at a spacing of 5-6 m. One or two lopping in a year can be taken and each lopping weigh about 150 to 200 kg of green matter.

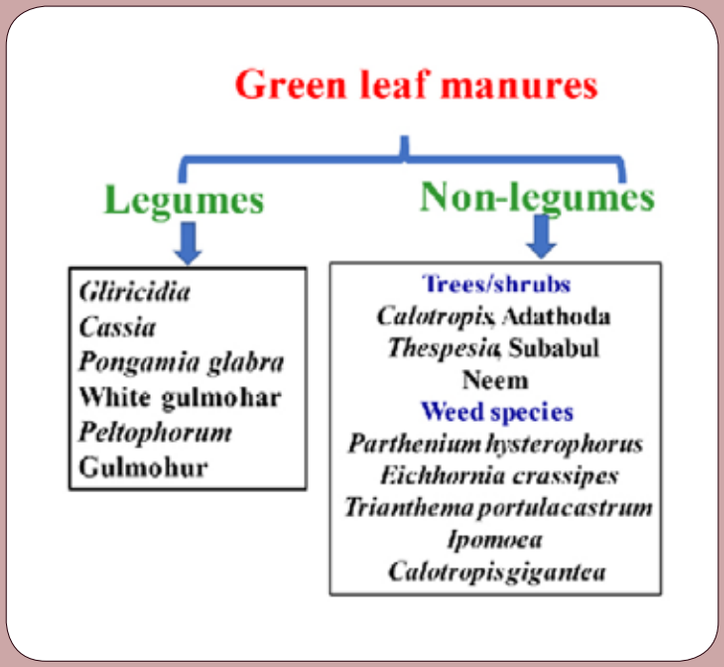
Glyricidia, Karanji (Pongamia glabra) calotropis, avise(Sesbania grandiflora), subabul and other shrubs.

## Why Green Leaf Manures

Using chemical fertilizers as a nutrient source for plant growth is not at all a good way to treat the soil. This indiscriminate use of various chemical fertilizers is causing a number

**Weed Species**

Morning Glory
*(Ipomoea spp).*
It is a water loving aquatic shrub. Spreads through water. It is quick growing shrub with profuse branching. It produces abundant green leafy material with in short time. Can be multiplied by mature stem cuttings. Two to three lopping can be taken in an year. Each plant will give 5 to 7 kg of green matter per lopping.




of environmental and health hazards along with permanent damage to the most precious natural resource soil. By using chemical goes unrestrained, the soil will no longer be available for crop production after a certain period. So, it is time to shift the agricultural system from chemicals to organic manures to maintain a healthy soil for the upcoming generations.As organic manure, green leaf manure is capable of supplying the required plant nutrients with maintaining very good soil health.

**Classification of Green Leaf Manure**

**Purpose of green leaf manuring**

- Moderate tall growing shrubs or tress for easy lopping
- Ability to produce heavy foliage and biomass

Nutrient content of Green leaf manure

| Plant | Scientific name | Nutrient content (%) on air dry basis | | |
|---|---|---|---|---|
| | | N | $P_2O_5$ | K |
| Gliricidia | *Gliricidiasepium* | 2.76 | 0.28 | 4.60 |
| Pongania | *Pongamia glabra* | 3.31 | 0.44 | 2.39 |
| Neem | *Azadirachta indica* | 2.83 | 0.28 | 0.35 |
| Gulmohur | *Delonix regia* | 2.76 | 0.46 | 0.50 |
| Peltophorum | *Peltophorumferrugenum* | 2.63 | 0.37 | 0.50 |
| Weeds | | | | |
| Parthenium | *Parthenium hysterophorus* | 2.68 | 0.68 | 1.45 |
| Water hyacinth | *Eichhornia crassipes* | 3.01 | 0.90 | 0.15 |
| Trianthema | *Trianthemaportulacastrum* | 2.64 | 0.43 | 1.30 |
| Ipomoea | *Ipomoea* | 2.01 | 0.33 | 0.40 |
| Calotrophis | *Calotropis gigantea* | 2.06 | 0.54 | 0.31 |
| Cassia | *Cassia fistula* | 1.60 | 0.24 | 1.20 |

- Insecticidal properties
- Legume nature
- Resistant to lopping and ability to regrow faster
- Amenable for quick decomposition
- Multipurpose use (fodder, green manure, N fixation, seed, shade)
- Highly resistant to adverse climatic conditions
- Ability to grow in all agro-climatic zones

## Preparation of Green Leaf Manures

Producing green leaf manures is very easy and cheap. Different green manuring trees and plants are grown in live fences or on barren lands. When they are well grown, their leaves are simply cut and brought to the crop fields in bundles. Leaves of green manuring crop like Thespesia are needed to wither for two days before incorporating them into the soil

## Application of Green Leaf Manures

Application of green leaf manures to a soil is dependent on the moisture content of the soil. Enough moisture content is necessary to apply this manure to a soil.

## Advantages

1. Green manuring improves soil structure, increases water holding capacity and decreases soil loss by erosion.
2. Growing of green manure crops in the off season reduces weed proliferation and weed growth.
3. Green manuring helps in reclamation of alkaline soils. Root knot nematodes can be controlled by green manuring.
4. It ensures balanced nutrition for plants and improve soil fertility to a great extent.
5. The trees are perennial and supply leaves 2-3 times in a year for manuring; so, there is no need to replant.
6. They are slow releasing fertilizers and act as plant nutrient source for a long time after their application.
7. Soil structure is improved to a great extent due to the application of GLM.
8. Encourage the development of earthworms by acting as food material to them
9. Stimulate the growth of various beneficial microorganisms in soil and thus improve the soil biodiversity.
10. Green Leaf Manure are very useful in reclaiming salinity affected soils.

**Nandhakumar Natarajan[1*]**
**Dinesh Dhakshanamoorthy[1]**
**Dinesh Jinger[1]**
**Gaurav Singh[1]**
**Malharimart**
**Jagannivas Kaledhonkar[1]**
Scientist, ICAR-IISWC-Research Centre,
Vasad-388 306, Gujarat, India

# *Integrated Scientific Management Strategies for* Lemon Cultivation

**Abstract**

Lemon (*Citrus limon* Burm. f.),) is a widely used fruit with yellow or pale yellow, prolate shape and containing 5-10 seeds. It thrives in tropical and subtropical regions globally, historically originating in Southeast Asia before spreading to Persia and the Middle East by the 12$^{th}$century. Lemon trees, small and thorny, are cultivated both for personal and commercial

use, mainly in subtropical areas due to challenges in more humid climates. Propagated through budding and single-leaf node cuttings, they offer higher yields with proper management, particularly suitable for ravine land cultivation. Lemon trees contribute to soil fertility and ecosystem stabilization, aiding in the restoration of degraded lands and promoting sustainable agriculture.

## Introduction

Citrus fruits, including lemons (*Citrus limon* Burm. f.), hold significant socio-economic and cultural importance because they are highly valued and in high demand.Lemon stands out for its distinct flavour and acidity, making it valuable both as a food product and for industrial use. Rich in phenolics, vitamins, essential oils, and other compounds, lemon offers health benefits, particularly attributed to its vitamin C and flavonoid content, which act as natural antioxidants. Beyond the fruit, various parts of the citrus plant possess anticancer and antimicrobial properties. Byproducts like peels and seeds, often discarded during juice processing, are rich sources of flavonoids, making them valuable for nutraceutical applications. Lemon seeds, in particular, contain flavonoids and limonoids, with anti-cancer properties demonstrated in studies. Lemon seed oil has potential applications in biodiesel production (Goetz, 2014; Mabberley, 2004; Papp et al., 2011; Balogun and Ashafa, 2019).

## Botanical Characteristics and Occurrence of *C. limon*

The lemon tree, scientifically known as Citrus limon (L.) Burm. f., typically reaches a height of 2.5–3 meters and features evergreen lanceolate leaves. Its bisexual flowers are white with a hint of purple along the petal edges, often clustered or found individually in leaf axils. As the fruit ripens, the initially green elongated berry transforms into an oval, pointed yellow berry with juicy pulp segmented similar to an orange. Internally, the berry comprises a thin, wax-covered exocarp enclosing the flavedo, rich in oil vesicles and carotenoid dyes, while the albedo, a spongy white tissue, forms the inner part of the mesocarp. The endocarp, or fruit flesh, is segmented by the spongy white tissue of the mesocarp. Thriving in sunny locations, the lemon tree favours loamy, well-drained, and moist

## Chemical composition of *Citrus limon*per 100 g of edible portion (Waleed, 2019)

| Components | Amounts (g) |
|---|---|
| Moisture | 85 |
| Protein | 1 |
| Fat | 0.9 |
| Fibre | 1.7 |
| Carbohydrates | 11.1 |
| Ash | 0.3 |
| Calcium | 70 |
| Phosphorous | 10 |
| Iron | 2.3 |
| Thiamine | 0.02 (in juice) |
| Riboflavin | 0.01 (in juice) |
| Niacin | 0.01 (in juice) |
| Vitamin C | 39 |
| Carotene | - |
| Energy | 57 K cal |

**Area, Production and Productivity of Lemon in India (Source: Ministry of Agriculture and Farmers Welfare, Govt. of India)**

| (1991-1992 and 1993-1994 to 2022-2023-3rd Advance Estimates) | | | |
|---|---|---|---|
| Year | Area (In'000Hectare) | Production (In'000MT) | Productivity (InMT/Hectare) |
| 1991-1992 | 91.4 | 923.7 | 10.1 |
| 1993-1994 | 91.4 | 923.7 | 10.1 |
| 1994-1995 | 95.9 | 970.1 | 10.1 |
| 1995-1996 | 106.0 | 920.0 | 8.7 |
| 1996-1997 | 123.7 | 1048.4 | 8.5 |
| 1997-1998 | 129.8 | 1101.3 | 8.5 |
| 1998-1999 | 139.5 | 1259.8 | 9.0 |
| 1999-2000 | 169.3 | 1491.5 | 8.8 |
| 2000-2001 | 164.2 | 1377.2 | 8.4 |
| 2001-2002 | 161.3 | 1413.7 | 8.8 |
| 2002-2003 | 146.2 | 1439.6 | 9.8 |
| 2003-2004 | 167.8 | 1493.3 | 8.9 |
| 2004-2005 | 167.8 | 1493.3 | 8.9 |
| 2005-2006 | 167.9 | 1796.0 | 10.7 |
| 2006-2007 | 294.9 | 2310.2 | 7.8 |
| 2007-2008 | 302.8 | 2501.7 | 8.3 |
| 2008-2009 | 316.1 | 2571.5 | 8.1 |
| 2009-2010 | 295.6 | 2629.2 | 8.9 |
| 2010-2011 | 219.0 | 2108.0 | 9.6 |
| 2011-2012 | 234.0 | 2272.1 | 9.7 |
| 2012-2013 | 255.2 | 2523.5 | 9.9 |
| 2013-2014 | 286.4 | 2835.0 | 9.9 |
| 2014-2015 | 268.4 | 2950.4 | 11.0 |
| 2015-2016 | 245.0 | 2438.0 | 10.0 |
| 2016-2017 | 248.0 | 2364.0 | 9.5 |
| 2017-2018 | 286.0 | 3148.0 | 11.0 |
| 2018-2019 | 305.0 | 3482.0 | 11.4 |
| 2019-2020 | 322.0 | 3687.0 | 11.5 |
| 2020-2021 | 327.3 | 3548.4 | 10.8 |
| 2021-2022 | 312.7 | 3776.3 | 12.1 |
| 2022-2023 (3rd dvance Estimates) | 308.3 | 3714.7 | 12.1 |

soils with a wide pH range. Although the precise original natural habitat of the lemon tree remains uncertain, it is believed to be native to either North-Western or North-Eastern India (Goetz, 2014; Mabberley, 2004 and Citrus Page. Available online: http://citruspages.free.fr).

## Land preparation, soil and climate

To ensure optimal growth conditions for citrus cultivation, proper land preparation is essential. This involves thorough ploughing, cross- ploughing, and levelling of the land. In hilly regions, where planting is done on terraces against slopes, high-density planting becomes feasible. Citrus plants, being sub-tropical, are sensitive to prolonged cold periods, with temperatures below 3°C and above 40°C proving injurious to their health. During flowering and fruit set, hot winds and excessive heat can lead to fruit drop and sunburn, as citrus fruits thrive in sunlight. Ideal soil conditions for citrus cultivation include deep, loose, and well-aerated soils with a pH range of 5.5 to 6.2, devoid of any calcium carbonate hardpan layers within the rooting zone up to 150 cm. High water tables and poor drainage systems are unsuitable for citrus cultivation, as they can lead to root drying and nutritional imbalances, respectively. Before the monsoon arrives, pits should be created

**Table 1. Classification of fruit plants on the basis of nutritional status (Kunte and Yawalkar et al. (2005))**

| Class | Carbohydrates and Nitrogen | Effect |
|---|---|---|
| i) | C / NNNN | Class i plants exhibit poor growth and minimal fruiting, characterized by low levels of carbon (C) and excessive nitrogen (N). Trees nearing bearing age that have suffered defoliation due to insects or diseases, or those grown in shaded or overcrowded conditions, often fall into this category. |
| ii) | C / NNN | An abundance of N coexists with an ample supply of C, facilitating vigorous and succulent growth. During this stage, nearly all available carbon is utilized for growth, with no storage occurring. This phase is typical for young trees not yet bearing fruit or for mature trees stimulated into growth through severe pruning or excessive fertilization. |
| iii) | CCC / N | Class iii exhibits satisfactory growth with fruitful outcomes. The balance of C is optimal for both growth and fruit production, with a slight surplus of C. |
| iv) | CCCC / N | In this class, growth is inadequate, and only a small quantity of fruit is yielded. The presence of excessive C alongside minimal N indicates a starved or devitalized state. Many older trees and neglected specimens fall into this nutritional category. |

at three-meter intervals, each measuring 0.5 m x 0.5 m x 0.5 m, and filled with a 1:1 mixture of topsoil and FYM. Planting lemon is recommended between May and August to ensure successful establishment.

Popular varieties with their yield

***1) Punjab Baramasi*** The shoots typically extend to touch the ground. The lemon fruits are round with a tapering base, boasting a vibrant yellow hue. They are seedless and known for their juicy nature. Each tree yields an average of 84 kg of fruit.

***2) Eureka***This variety features semi-vigorous trees with a lemon-yellow skin colour. The juice is highly acidic, offering an excellent flavour profile. Fruit ripening occurs during August.

***3) Punjab Galgal*** These vigorous trees display light green foliage and bear medium-sized, oval-shaped fruits. The juice is notably acidic, containing 8-10 seeds per fruit. Fruits reach maturity between November and December, with trees yielding an average of 80-100 kg per tree.

***4) PAU Baramasi*** Fruit typically matures in the first week of July, with very few seeds present. Each tree yields an average of 84 kg of fruit.

***5) PAU Baramasi***-1Maturation occurs in the last week of November, and the fruit is seedless. Each tree yields an average of 80 kg of fruit.

**Other States Varieties**

***1. Rasraj*** Developed by IIHR, this variety features yellow fruits with 70% juice content and 12 seeds. It boasts an acidity level of 6% and a TSS content of about 8 brix. Rasraj is resistant to bacterial blight and canker

**Table 2. Three types of situations of C:N ratios (Chandler (2012))**

| | |
|---|---|
| Type 1- Low N - Moderate to High C | In conditions where nitrogen (N) availability is limited but there's sufficient opportunity for carbohydrate synthesis and soil moisture, vegetative growth will be sluggish, and fruiting will be minimal or absent due to nitrogen deficiency. These plants typically exhibit a yellow-green appearance, are rich in stored carbohydrates, and show reduced levels of sugars and sucrose (Brix), with very low total nitrogen and nitrates (NO3). Additionally, their stems tend to be excessively woody. |
| Type 2- Moderate to High N - Low C | Conversely, when there is ample soil nitrogen and abundant water availability, but limited opportunity for adequate carbohydrate synthesis, plants tend to exhibit excessive vegetative growth or lush foliage. In some cases, they may even produce an abundance of flowers, which may ultimately drop without setting fruit. |
| Type 3- Moderate N - Moderate to High C | The ideal scenario lies in maintaining a moderate balance, where nitrogen (N) levels are kept at moderate levels influenced by external factors such as sufficient radiant energy, temperature (heat units), and soil moisture. |

disease.

***2. Lisbon Lemon*** Resistant to frost and high wind velocity, Lisbon lemon produces medium-sized fruits with a smooth, lemon-yellow surface.

***3. Lucknow Seedless***These medium-sized fruits sport a yellow hue and are devoid of seeds.

***4. Pant Lemon*** A dwarf variety known for its medium-sized, juicy fruits. Pant Lemon exhibits resistance to scab, canker, and gummosis.

Other varieties include Assam Lemon, Italian Lemon, Eureka Lemon, and Malta Lemon.

## Propagation

***Single leaf node cutting:*** Single leaf node cuttings, taken from branches with healthy, well-developed buds and actively growing leaves, consist of a leaf blade and a 2-2.5 cm stem segment. Branches should be at least 6 months old (semi-hardwood), with pencil thickness and a white-brown strip appearance on the bark. Harvesting is recommended in the early morning or evening. Cuttings should be immediately immersed in water or planted in a prepared bed to reduce aeration, followed by regular watering to maintain soil moisture.

***Stem cutting:*** Cuttings, typically sourced from fully grown stems, are 18-20 cm long with a pencil thickness and a brown strip appearance on the bark. The

**Primary Hardened Seedles Lemon Plant**

upper cut is made 1 cm above the node, while the lower cut is angled near the node. Each cutting should have 3-4 nodes. After preparation, cuttings are immediately immersed in water or planted directly in the nursery bed to prevent aeration. In the nursery, they're planted at a slanting angle with 30cm x 30cm spacing in a mixture of decomposed cow dung, topsoil, and sand. Watering follows immediately after planting.

***Air layering:*** To start air layering, remove a 3 cm strip of bark 15 cm below the tip end, ensuring the complete removal of phloem and cambium to delay healing. Cover the exposed area with moss or mud pudding (1:1:1 mixture of cow dung, soil, and sand). Wrap the branch with a 15-20 cm wide polythene sheet, tying both ends securely. Water regularly to keep the bundles moist. Rooting usually begins 6-10 weeks after layering but it is not commercial.

***Budding:*** Shield or T budding is a common method of vegetative propagation, usually done in spring or September. It involves transferring a bud from the desired variety onto the rootstock to combine their best traits. The bud is carefully selected, excised, and inserted into a T-shaped incision on the rootstock. After about three to four weeks, the bud unites, and the new shoot is trimmed to about 10 cm. Proper rootstock selection is crucial for vigour, productivity, and fruit quality.

***Rootstock:*** Rootstock selection is crucial in orchard management due to varying responses of scion cultivars to growth, fruit quality, and nutrient accumulation. The mineral nutrient content of scion cultivars plays a vital role in achieving optimal fruit quality. Citrus rootstocks significantly influence fruit yield and quality, providing orchardists with eco-friendly means to adjust tree vigour and performance. Rootstocks directly impact water and nutrient uptake from the soil, with their long-term performance studied across diverse climates. Lemon, especially Kagzi Kalan, is a significant citrus fruit globally, cultivated mainly through budding. In India's sub-dry regions, lemon cultivation often relies on its own roots or Jatti Khatti rootstock, susceptible to salt and phytophthora. Dubey and Sharma (2016) conducted studies on Kagzi Kalan lemon on eight rootstocks, observing significant differences in growth,

fruiting density, quality, and leaf nutrients. Rough lemon and RLC-4 exhibited superior growth, while RLC-4 and Attani-2 had higher fruiting density and quality. RLC-4 showed improved juice attributes, and RLC-4 and Troyer citrange had higher ascorbic acid levels. Different rootstocks showed variations in foliar nutrients, with RLC-4, rough lemon, and Attani-2 displaying higher N, and RLC-4 and rough lemon showing higher K. Jatti Khatti accumulated more Mg, while sour orange had higher Cu and Zn uptake. RLC-4, rough lemon, and Karna Khatta absorbed more Fe, with rough lemon having the highest Mn content. Troyer citrange exhibited poor performance, while RLC-4, rough lemon, and Karna Khatta excelled in growth, fruit quality, and nutrient uptake overall.

## The influence of cultural practices on flowering induction and fruit quality

Despite good health and no apparent disease, trees may not bear fruit. The carbon-nitrogen ratio (C:N) in organic matter is critical for plant growth and fruit production. Achieving an optimal balance between carbohydrates and nitrogen is essential for robust growth, flowering and fruitful outcomes. Transitioning trees to Class iii during fruit-bearing stages is vital for optimal fruiting conditions. Various methods can help achieve and sustain this balance(Table 1 &2). Methods include increasing sunlight intensity, boosting available carbon concentrations, ensuring well-drained soils, bahar treatment, root pruning, or reducing soil nitrogen levels through the application of soluble carbohydrates. The C:N ratio varies among plant species, varieties, and plant parts.Citrus, renowned for its nutrient-rich fruits, engages in a dynamic competition among flowers, fruits, and vegetative growth for plant metabolites, particularly carbohydrates, during the growth season. Carbohydrate availability and reserves play animportant role in regulating fruit set and

### Bahar Treatment (Regulation of Flowering)

To regulate fruiting, water is withheld for approximately two months before the usual flowering season. This withholding helps manage fruit production timing. Additionally, to enhance fruit yield during specific periods, plants undergo a resting period where their natural growth cycle is artificially altered. This manipulation allows for better control over the timing and quantity of fruit production.

| Bahar Period | | |
|---|---|---|
| Type of flowering | Time of flowering | Time of harvesting |
| Ambe Bahar | January-February | June-August |
| Mrig Bahar | June-July | November-January |
| Hasth Bahar | September- October | February-April |

Citrus trees naturally exhibit irregular blooming and fruiting throughout the year, prompting the need for controlled cropping methods. To synchronize fruit production with market demands, citrus orchards employ Bahar treatment. This method aims to induce a full crop during specific seasons—January-February (Ambe bahar), June (Mrig bahar), and October (Hastha bahar). For Ambe bahar, initiated in November or December, irrigation is gradually reduced and halted by December, followed by ploughing the land around mid-December. Once wilting symptoms appear (usually 3-4 weeks later), soil within a 120 cm radius of each tree is dug to a depth of 10 cm, and prescribed manure is added before irrigation. Flowering typically occurs approximately a month after the first irrigation. In Maharashtra, roots are exposed for about 10 days as part of this treatment, though this practice is not encouraged due to potential long-term harm.

subsequent fruit drop. Fruit set and growth require ample carbohydrates sourced from current season's photosynthesis or winter reserves. If demands exceed assimilate capacity, fruitlet abscission occurs to align fruit load with carbohydrate availability. Citrus cultural operations like bahar treatment aim to optimize carbohydrate balance, enhancing flower and fruit set and quality

## Pruning and Training

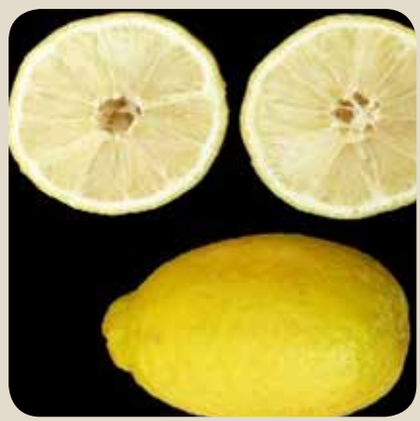
Pruning plays a crucial role in citrus tree management, supporting controlled growth and blooming by shaping canopy structure and enhancing biochemical processes. Its main aim is to maintain tree form and optimize fruit quality and yield annually. Studies highlight the importance of pruning citrus trees to rejuvenate them when vigour, yield, and fruit size decline. This practice helps balance growth, ensuring a suitable leaf-to-fruit ratio, fruit size, and colour. Excessive growth can negatively impact fruit production and flower bud formation. While pruning promotes light exposure and fruit colouration, it can also reduce growth by affecting photosynthesis and carbohydrate reserves. For lemon trees, pruning should start when nursery seedlings begin to sprout from leaf bud cuttings, stem cuttings, or air layering. In the main field, lateral branches are pruned, leaving the main trunk 50-60 cm above ground level. Trimming before fruiting aims to develop sturdy trees with well-spaced limbs above 50-60 cm. Ground-contacting branches during fruit bearing should be pruned close to lateral branches without leaving stubs in winter when bearing is low. Additionally, removing diseased, damaged, crossing, and water sprouting branches is essential (Rathour et al., 2023).

**Seedless Lemon**

| Age of tree (Year) | FYM (Kg/tree) | Urea (g/tree) | DAP (g/tree) | MOP (g/tree) |
|---|---|---|---|---|
| 1 | 5 | 160 | 35 | 25 |
| 2 | 10 | 320 | 70 | 50 |
| 3 | 15 | 480 | 105 | 75 |
| 4 | 20 | 640 | 140 | 100 |
| 5 | 25 | 800 | 170 | 120 |
| 6 | 30 | 960 | 205 | 150 |
| 7 | 35 | 1120 | 240 | 175 |
| 8 | 40 | 1280 | 275 | 200 |
| 9 | 45 | 1445 | 310 | 225 |
| More than 10 years | 50 | 1600 | 345 | 250 |

*Note: Apply the full amount of FYM and phosphatic fertilizer in January. Apply the entire potash and half of the nitrogenous fertilizers 15 days before flowering, and the remaining half of the nitrogenous fertilizer after fruit set. For improving yield and fruit quality, a foliar spray of a nutrient mixture containing 400 g CuSO4, 200 g FeSO4, 200 g borax, 1.04 kg lime, and 100 litters of water on new emerging growth flushes is beneficial.Recommendations may vary depending on the location and management practices.*

**Punjab Baramasi PAU Baramasi – 1**



EurekaPunjab Galgal

*Note:The image depicting a seedless lemon, credited to an anonymous person, was sourced from social media, while the remaining images were obtained from H.S. Rattanpal et al., 2017, a book focusing on citrus cultivation*

Ghosh et al. (2017) investigated the impact of pruning intensity and nutrient management on lemon tree yield and quality in northern West Bengal, aiming to standardize their effects on fruit quality and nutrient availability in soil and leaves. The study found that different pruning intensities interacted with nutrient management, with T25 (pruning 75 cm from the terminal portion + vermicompost (20 g plant–1) + azotobacter (18 g plant–1) + vesicular arbuscular mycorrhiza (150 gplant–1) resulting in the highest ascorbic acid content. This variation in ascorbic acid content suggests the role of optimal nutrient supply and growth hormone stimulation in promoting essential physiological processes like cell division and fruit development. Continuous use of chemical fertilizers has degraded soil health, prompting the combined application of organic, inorganic, and biofertilizers to mitigate these effects. Microorganisms such as Azotobacter, vermicompost, and vesicular arbuscular mycorrhiza play key roles in facilitating nutrient uptake, particularly for immobile elements like phosphorus and mobile elements like potassium and nitrogen. Leaf nutrient availability varied significantly across treatments, increasing post-fertilization until the pre-harvesting phase and declining post-harvest, indicating substantial nutrient uptake during vegetative and reproductive stages. Overall, the combined action of beneficial microorganisms enhances leaf nutrient availability by fixing atmospheric nitrogen and converting it into accessible forms for plants.

## Use of growth regulators

Based on large-scale pilot trials at the Fruit Research Station, Anantharajupet, a regimen of three 2,4-D sprays at 10 ppm was proposed to enhance fruit set, reduce fruit drop, and boost yields by 35-50% in sweet orange. These sprays are recommended during flowering, 15 days post fruit set, and two months pre-harvest. Additionally, employing the same spray one month before harvest extends fruit retention by three weeks beyond the usual harvest period.

## Orchard management

Perform weeding monthly and consider mulching with paddy straw to control weeds and maintain soil moisture. Grow short-duration fruit crops like papaya and pineapple, along with seasonal vegetables like cowpea and French bean, within lemon orchard rows for extra income during the pre-bearing

stage. Santiago et al. (2023) reported that citrus growers are increasingly adopting sustainable soil management techniques such as fabric mulch ground covers to enhance weed and pest control while conserving soil moisture. This study aimed to investigate the effects of fabric mulch ground covers on the rhizosphere health of lemon trees. The experiment involved four-year-old Meyer lemon trees grafted onto sour orange rootstocks. Two treatments were administered: trees with fabric mulch ground covers and trees without. Analysis of rhizosphere DNA revealed that trees treated with fabric mulch ground covers exhibited significantly greater bacterial diversity compared to those without covers. The presence of fabric mulch ground covers correlated with elevated soil Zn and Mn levels, soil temperatures, and pH, potentially contributing to the enhanced diversity of rhizosphere bacterial communities compared to trees grown without fabric mulch ground covers.

## Harvesting and yield

Spring (Feb-March) and autumn (Sep-Oct) are the two main flowering seasons of "Citrus lemon" each year, with sporadic blossoming occurring year-round. Harvest fruits when they reach maximum size and develop a desirable green to light yellow colour, which typically occurs from June to July and December to January. Fruit production depends on soil, climate, and management practices, with proper techniques potentially yielding 2-3 times more fruit than traditional methods. A 3-year-old plant can yield around 40–50 fruits.

## Post-harvest management

When stored at room temperature, lemon an remain saleable for weeks, but moisture loss affects texture and freshness. Shrink wrapping individual fruits at 30-32°C and 80-85% RH extends shelf life without compromising quality, preserving freshness and colour for up to a month, reducing waste. Packaging must be durable, cost-effective, printable, and eco-friendly, enduring compression, impact, and vibration. It should also appeal to consumers. Preferred materials range from traditional wooden options to paper, cardboard, flexible films, and polystyrene, offering versatility and protection. Combined materials like CFB and plastic balance durability and versatility, crucial for preserving lemon quality throughout the supply chain (Rathour et al., 2023).

## Citrus adaptability to ravine terrain

In the face of growing global population and mounting pressure on agricultural land from industrial and infrastructure projects, reclaiming wasteland has become crucial for sustainable food production and environmental preservation. Ravine rehabilitation using lemon tree emerges as the optimal approach to transform degraded land into a valuable economic asset. Lemon, in particular, stands out as a significant contributor to litter fall and nutrient enrichment, making it a preferred choice for ravine or gully lands. This selection not only improves soil fertility but also enhances vegetative barriers, promoting a stable ecosystem.

## Reference


1) Balogun, F., & Ashafa, A. (2019). A Review of Plants Used in South African Traditional Medicine for the Management and Treatment of Hypertension. Planta Medica, 85(04), 312–334. https://doi.org/10.1055/a-0801-8771

2) Chandler, E. K. (2012). Nitrogen carbon ratios for fruiting plants. www.TexasPlantandSoilLab.com.1-2.

3) Dubey, A., & Sharma, R. (2016). Effect of rootstocks on tree growth, yield, quality and leaf mineral composition of lemon (Citrus limon (L.) Burm.). Scientia Horticulturae, 200, 131–136. https://doi.org/10.1016/j.scienta.2016.01.013

4) Ghosh, A., Dey, K., Bhowmick, N., Ghosh, S. K., Bandyopadhyay, S., Medda, P. S., & Ghosh, A. (2017). Lemon Cv. Assam Lemon (Citrus limon Burm.) Quality and Soil-Leaf Nutrient Availability Affected by Different Pruning Intensities and Nutrient Management. Current Science, 112(10), 2051.

Finger blast: *P. oryzae*

# Millets Under Siege

## Navigating Crop Diseases for Sustainable Cultivation

**Bhukya Srinivas[1*]**

[1*]M.Sc. (Agri.),
Department of
Plant Pathology,
NMCA, NAU, Navsari,
Gujarat, India, 396 450

Neck blast:P. oryzae

Leaf blast: *Pyricularia oryzae*

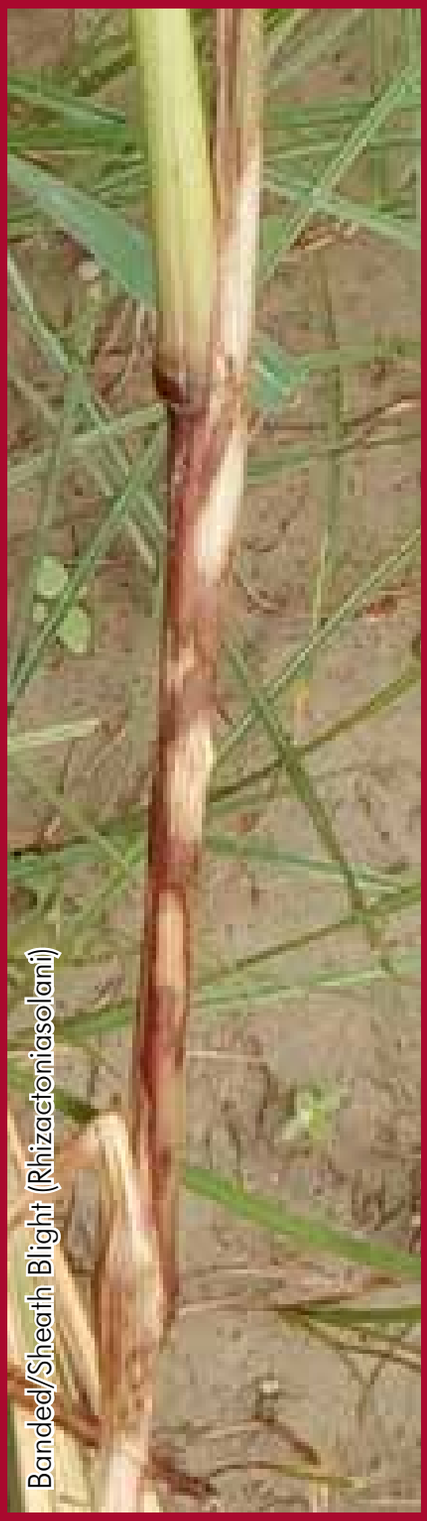
**Abstract**

Millet crops play a crucial role in global food security and livelihoods, particularly in regions with challenging growing conditions. However, these crops face numerous disease challenges that threaten their productivity and sustainability.Various pathogens,

Foot rot: *Sclerotium rolfsii*

including fungi, bacteria and viruses, cause diseases in millets, leading to symptoms such as leaf spots, blights, rots and wilting. Among the most prevalent diseases are blast disease, foot rot and banded/sheath blight, each caused by specific pathogens such as *Pyricularia oryzae, Sclerotium rolfsii and Rhizoctonia solani,* respectively. Continued research efforts are needed to develop new disease-resistant millet varieties, improve disease diagnostics and identify sustainable disease management strategies.

Foxtail millet





Barnyard millet

Disease is on the rise in AP, CG, JH, MP, & UK; reported even from farmers' fields

**Important diseases in Finger millet**

Finger millet, also known as *Eleusine coracana*, is a resilient cereal crop cherished for its nutritional value and adaptability to diverse environments.


Kodo millet

However, like all crops, finger millet is susceptible to various diseases that can significantly impact yields and quality. In this article, we delve into some of the most important diseases affecting finger millet cultivation, their symptoms, impacts and management strategies.

**Blast Disease**

***(Pyricularia oryzae)***

Blast disease, caused by the fungus *Pyricularia oryzae*, is one of the most destructive diseases affecting finger millet. It manifests as small, water-soaked lesions on leaves, which later enlarge and turn brown. In severe cases, the lesions can merge, leading to extensive damage to foliage and panicles. Blast disease not only reduces yield but also affects grain quality.Finger millet cultivation faces numerous challenges, with diseases being a primary concern. Effective disease management strategies, including the use of resistant varieties, cultural practices and judicious application of fungicides, are essential for safeguarding yields and ensuring the sustainability of finger millet production. Continued research and extension efforts are critical for developing innovative solutions to combat these diseases and support the livelihoods of finger millet farmers worldwide.

Proso millet



Ragi

**Foot rot: Sclerotium rolfsii**

Foot rot, caused by the soil-borne fungus Sclerotium rolfsii, is a significant threat to finger millet cultivation and is capable of causing devastating losses in yield and quality.Survives in the soil as sclerotia, which are small, hard structures capable of persisting for several years. Under favorable conditions, the fungus produces mycelium that infects the roots of finger millet plants, leading to the characteristic symptoms of foot rot. Typically manifest as water-

soaked lesions near the soil line, which progress rapidly, causing the rotting and decay of affected tissues. As the disease advances, plants may exhibit wilting, stunting and ultimately, death. Additionally, white mycelial growth may be observed on infected tissues, particularly under moist conditions.

**Banded/Sheath Blight *(Rhizactoniasolani)***

Banded/Sheath Blight, caused by the fungus *Rhizoctonia solani*, is a prevalent and destructive disease affecting various millet species, including finger millet, pearl millet, and foxtail milletetc.Soil-borne fungal pathogen, is the primary causal agent of banded or sheath blight in millets. It thrives in warm and humid conditions, making it particularly problematic in regions with tropical or subtropical climates. The fungus infects millet plants at various growth stages, causing characteristic symptoms that can lead to significant yield losses. Typically manifest as elongated lesions or bands on the leaves, sheaths and stems of affected plants. These lesions are initially water-soaked and may appear brown or dark-colored as the disease progresses. In severe cases, the lesions coalesce, leading to extensive blighting of foliage and lodging of plants. Additionally, banded or sheath blight can predispose plants to secondary infections and reduce grain quality.profound economic consequences for millet growers, resulting in yield reductions, lower grain quality, and increased production costs associated with disease management.

Little millet


**Banded/Sheath Blight *(Rhizactoniasolani)***

Disease is on the rise in AP, CG, JH, MP, & UK; reported even from farmers' fields

**Control measures**

- Avoid excessive use of fertilizers
- Adopt higher seed rate
- Crop rotation with legumes
- Grow resistant varieties

**Chemical control:**

- Application of fungicides,Edifenphos (0.1%), Carbendazim (0.2%) and Mancozeb (0.2%)
- Use of biocontrol agents: *Pseudomonas, Bacillus, Trichoderma*

**Conclusion:**

Effective disease management is essential for ensuring the resilience and productivity of millet cultivation systems worldwide. By implementing integrated approaches and leveraging the latest advancements in research and technology, farmers can minimize the impact of diseases on millet crops and contribute to food security, livelihood sustainability and agricultural resilience in millet-growing regions.

Rollinia is a genus of plants in the family Annonaceae. While it is widely recognized as a distinct genus in *Annona*. Among the 65 species within the genus Rollinia. *Annona mucosa*, a flowering plant, originates from tropical South America. Rollinia

| | | |
|---|---|---|
| Kingdom | : | Plantae |
| Clade | : | Tracheophytes |
| Clade | : | Angiosperms |
| Clade | : | Magnoliids |
| Order | : | Magnoliales |
| Family | : | Annonaceae |
| Genus | : | Annona |
| Species | : | A. mucosa |

# Rollinia

## The Hidden Star of Annonaceae

**Pavan P. R.**[1]
**Arun Kumar Kamble**[2]
**Tarakeshwari K. R.**[3]
[1,3]Ph.D. scholar, KRCCH,
University of Horticultural Sceinces, Bagalkot
[2]Assistant Professor, University of
Horticultural Sceinces, Bagalkot

is believed to have originated in the northern regions of Brazil, particularly along the Amazon River banks. Additionally, it is naturally distributed in Guiana, southern Mexico, Peru, and northern Argentina (Lim, 2011). It is deliberately grown for its edible fruits, which are widely recognized as biriba (Brazilian name), lemon meringue pie fruit or wild sugar-apple and it is cultivated across various tropical and subtropical regions of the world. Biriba has gained popularity because of its delicate taste, high pulp content and fruit size suitable for one person.

**Composition of edible flesh of briba 100g (Love and Paull, 2011)**

| Proximate | % | Minerals | mg | Vitamins | mg |
|---|---|---|---|---|---|
| Water | 77.2 | Calcium | 24 | Ascorbic acid | 33 |
| Energy (kcal) | 80 | Iron | 1.2 | Niacin | 0.5 |
| Protein | 2.8 | Phosphorus | 26 | | |
| Lipid | 0.2 | | | | |
| Carbohydrate | 19.1 | | | | |
| Fibre | 1.3 | | | | |
| Ash | 0.7 | | | | |

The fruit is typically eaten fresh, although in the Amazon region, some people prefer to blend it into a juice, with or without milk. The fruit consists of 52% pulp, 42% peel and 6% seeds. Its pulp is creamy, mildly acidic to sweet, with total soluble solids ranging from 10 to 20% (Sousa, 1998). It is considered rich in vitamin C. Both the fruit and seeds contain acetogenins and alkaloids that may have anti-tumor properties and can inhibit platelet aggregation (Liaw *et al.,* 2003). The wood, which is dense and heavy, is utilized for crafting boats, masks and boxes.

## Description

Biriba is a fast-growing tree can reach heights ranging from 13 to 50 feet (4-15 meters). It features brown, hairy twigs and alternate, deciduous leaves that are oblong-elliptic or ovate-oblong in shape, with pointed tips and rounded bases, measuring between 10-25 cm long. The leaves are thin but somewhat leathery and hairy on the underside.

The flowers, which appear individually or in groups of 1 to 3 in the leaf axils, are hermaphroditic, with a width ranging from 2-3.5 cm. They

have a triangular shape, with 3 hairy sepals, 3 large outer petals that are fleshy and can have upturned or horizontal wings and 3 smaller inner petals.

The fruit varies in shape from conical to heart-shaped or oblate and can grow up to 15 cm in diameter. Its yellow rind consists of hexagonal, conical segments, each ending in a wart-like projection and is nearly 3 mm thick, tough, leathery, and does not split open when ripe. The pulp is white, translucent, mucilaginous, juicy, and ranges from slightly acidic to sweet in taste. It contains a slender, opaque-white core and numerous dark-brown seeds that are elliptic or obovate and measure 1.6 - 2 cm in length (Janick et al., 2008).

## Cultivation

Trees are propagated through either vegetative means or by using seeds. It is recommended to sow seeds immediately after harvesting. The juvenile period from seed is about 3 years. Germination typically occurs within approximately 30 days, with a success rate of around 80%. Grafting is the most widely used vegetative propagation method. Alternatively, rooted plantlets can be generated *in vitro* (Figueiredo *et al.*, 2000).

The biriba tree prefers deep soil with rich organic content and good drainage, although it can tolerate poor, acidic and heavy-textured soils. The tree typically thrives in hot and humid climates. Climate is characterized by a brief dry season with relatively low rainfall, with an annual average rainfall of approximately 2700 mm and the average annual temperature has been around 26°C.

Commercially grown fruit is harvested as it begins to soften and change color to yellow. It's essential to handle the fruit with care since touching it can lead to significant darkening of both the fruit protuberances and its skin that easily bruise and darken upon handling, resulting in an unattractive look. Due to this susceptibility to damage and a short shelf life of under a week, its commercial cultivation has been constrained. Nevertheless, it is gaining popularity for cultivation in home gardens within tropical regions.

After the fruit skin becomes completely black, the color and texture of the pulp change to a clear, mucilaginous consistency, hence the botanical name, R. mucosa. At this point, the fruit remains edible for just 1 or 2 days before fermentation starts.

The ripe fruit pulp is consumed fresh, used in desserts, blended into refreshing beverages, incorporated into ice creams, and fermented to produce wine.

## References


Figueiredo, S.F.L., Alarello, N. and Viana, Y.R. (2000). Minor propagation of *Rollinia mucosa* (jacq.) Baill. *In Vitro* Cellular and Deuelopment Biology, 37, 471-475.

Janick, Jules, and Robert E. Paull 2008. The encyclopaedia of fruits and nuts. CABI Wallingford, Oxon, UK. p. 68–70.

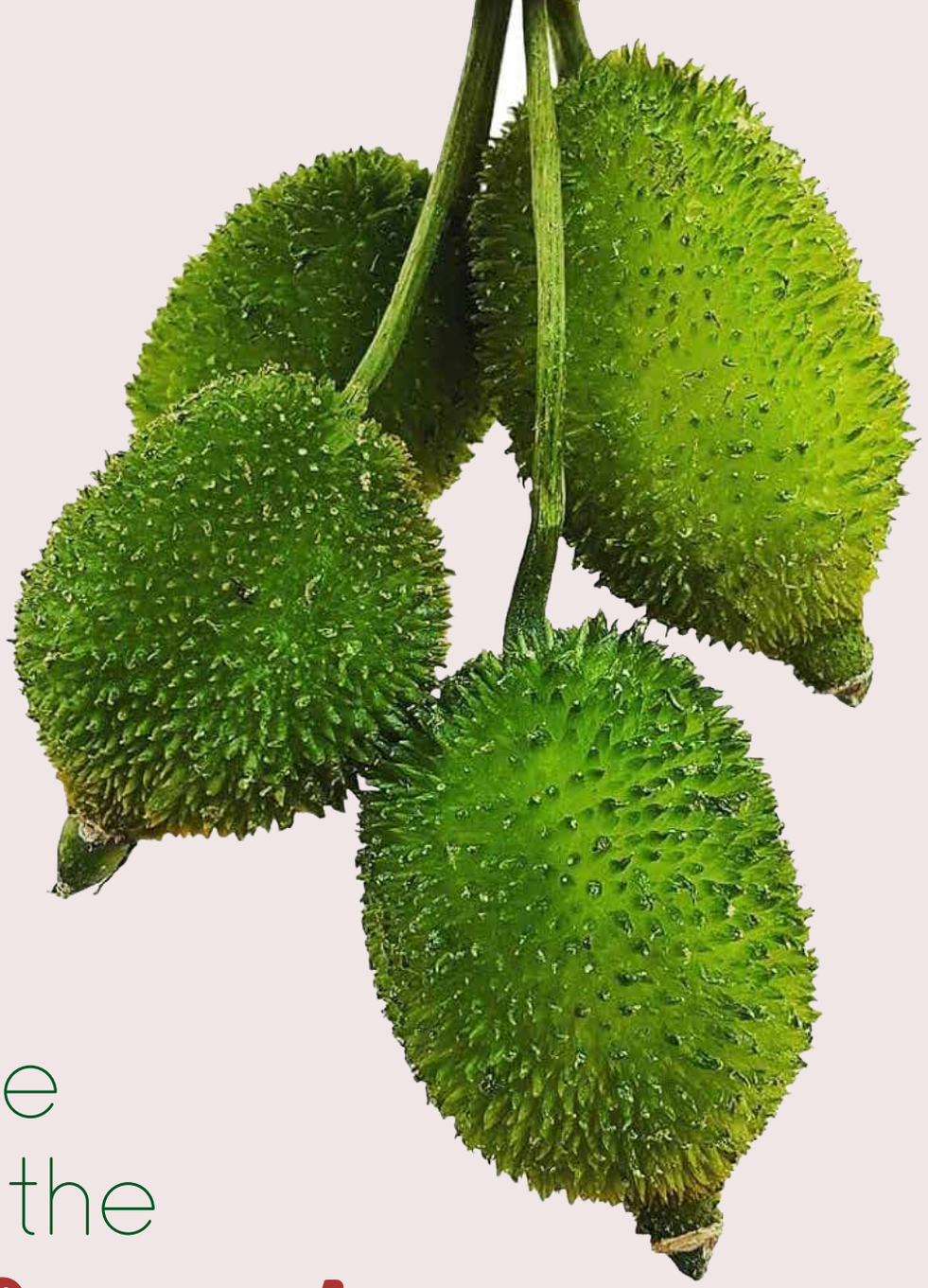
Liaw, c.c., Chang, F.R., Wu, M.J. and Wu, Y.c. (2003). A novel constituent from *Rollinia mucosa*, rollicosin, and a new approach to develop Annonaceaus acetogenius as potencial anti-tumor agents. *Journal of Natural Products* 66, 279-281.

Lim, T.K., 2011. *Rollinia mucosa*. In Edible Medicinal and Non-Medicinal Plants: Volume 1, Fruits (pp. 221-226). Dordrecht: Springer Netherlands.

Love, K. and Paull, R.E., 2011. Rollinia.

Sousa, R. (1998) Biribazeiro fruits in a diversified collection of Amazon indegineous species genetic resources. Proceedings *Inter. American Society for Tropical Horticulture* 42, 140-142.

**Satyapriya Singh***
**A.V.V. Koundinya**
**Deepa Samant**
**Gobinda Chandra Acharya**
Central Horticultural Experiment Station
(ICAR-IIHR), Bhubaneswar,
Odisha 751019, India



**Abstract**

The spine gourd *(Momordica dioica Roxb.)*, a unique and nutritionally rich vegetable indigenous to the Indian subcontinent, is facing a severe threat from diverse insect pests. Despite

# Battling pests Safe guarding the **Spine Gourd** A Tale of Culinary Treasure Under Insect Siege

its distinctive appearance and culinary versatility, the vegetable is vulnerable to relentless attacks by pests such as fruit flies, beetles, caterpillars, aphids, and mites, compromising both quality and yield. The pests inflict damage through feeding activities that lead to structural harm, premature ripening, defoliation, and deformities in the spine gourd. Farmers and cultivators

are challenged to develop effective and environmentally sustainable pest management strategies to preserve the vegetable and protect their livelihoods. Argo-ecosystem analysis and integrated pest management are proposed as essential tools for understanding and mitigating the intricate relationship between the spine gourd and its insect adversaries. These practices, coupled with good agricultural practices, offer a holistic approach to ensure the survival of this remarkable vegetable while maintaining a diverse and resilient agricultural ecosystem.

## Background

The spine gourd, scientifically known as *Momordica dioicaRoxb.*, is a unique and lesser-known vegetable that belongs to the Cucurbitaceae family. Also recognized by various regional names such as Kantola, Kakrol, Kankada, and Teasel gourd. This intriguing plant is native to the Indian subcontinent but has gradually found its way into culinary traditions across Asia. It is characterized by its distinctive appearance; the spine gourd is named for the spiky protrusions that cover its vibrant green skin. Despite its formidable exterior, the spine gourd has earned a place on the dining tables of many cultures due to its unique flavor and nutritional benefits. Culinarily versatile, the spine gourd is employed in a variety of dishes, showcasing its ability to complement both vegetarian and non-vegetarian cuisines. Beyond its culinary applications, the spine gourd carries a wealth of health benefits. Rich in essential nutrients such as vitamins A and C, potassium, and dietary fibre, this vegetable contributes to a well-rounded and nourishing diet (Hadi et al., 2022). Furthermore, it is believed to possess medicinal properties in traditional herbal medicine, with claims of potential benefits for digestion and blood sugar regulation.

The spine gourd, a resilient and unique vegetable, faces a formidable challenge in the form of relentless attacks by insect pests (Mondal et al., 2020). These pests, ranging from sucking to chewing viz., aphids to caterpillars, are attracted to the succulent leaves and tender shoots of the spine gourd, where they wreak havoc by feeding on essential nutrients and disrupting the plant's growth cycle. The impact of insect infestations extends beyond mere cosmetic damage, as these tiny invaders compromise the vegetable's nutritional content and overall health. Farmers and cultivators, dependent on the spine gourd as a valuable crop, are faced with the challenge of devising effective strategies to combat these pests, balancing the need for pest control with environmentally sustainable practices. As we delve into the

Fig 1. Spine gourd vegetable

Fig 2. Pumpkin beetle damage

intricate relationship between the spine gourd and its insect adversaries, it becomes clear that addressing this challenge is crucial not only for the survival of this remarkable vegetable but also for sustaining the livelihoods of those who cultivate it.

## Damage symptoms of major insect pests

### *1. Cucurbit fruit fly Batrocera cucurbitae*

- **Oviposition Scars:** Female fruit flies lay eggs under the skin of the spine gourd fruit and appear as small puncture wounds on the fruit's surface.
- **Maggot Infestation:** After hatching from the eggs, fruit fly larvae (maggots) burrow into the flesh of the spine gourd. Their feeding activity inside the fruit can lead to the development of tunnels or galleries, causing structural damage.
- **Premature Ripening:** Infested spine gourds may exhibit premature ripening, leading to a decrease in the overall quality and market value of the produce.
- **Secondary Infections:** The entry wounds created by fruit fly oviposition provide entry points for bacteria and fungi, leading to secondary infections. This can result in rotting and decay of the affected fruit.
- **Fruit Deformation:** Severe infestations can cause deformities in the shape and size of the spine gourd as the feeding activity of the larvae disrupts normal fruit development.

### *2. Red pumpkin bettle: Aulacophora foveicollis (Lucas)*

- **Leaf Feeding:** Adult beetles primarily feed on the foliage of spine gourd. They create irregular holes in leaves, resulting in a characteristic shot-hole appearance. Severe feeding can lead to defoliation, reducing the plant's photosynthetic capacity.

Fig 3. Larvae, adult and damage symptoms of Diaphaniainsect



- **Fruit Damage:** Larvae feed on the fruit, result in deformed and damaged fruits, affecting both quality and market value.
- **Stunted Growth:** Continuous feeding by red pumpkin beetles can lead to stunted growth of the plants. The reduction in leaf area and overall plant vigour can impact the plant's ability to produce healthy fruits

***3.Epilachna beetle/ Hadda bettle***
***Epilachna vigintioctopunctata (Fabricius)***

- **Leaf Feeding:** Epilachna beetles feed on the leaves and consume the leaf tissue, leaving behind characteristic round holes. The extent of damage depends on the population density of the beetles and the stage of plant growth.
- **Defoliation:** If the population is high, they can cause defoliation by extensively feeding on the leaves. Severe defoliation can weaken the plant, affect its ability to photosynthesize, and ultimately reduce yield.
- **Yellowing of Leaves:** Continuous feeding may lead to the yellowing of affected leaves.
- **Impact on Fruit Development:** Heavy infestations can indirectly impact fruit development. The reduction in photosynthetic activity due to leaf damage can affect the overall health and quality of spine gourd fruits.
- **Egg Clusters:** Epilachna beetles lay clusters of yellowish eggs on the undersides of leaves. The presence of these egg clusters can be an early indicator of a potential beetle infestation.

***4. Pumpkin caterpillar: Diaphania indica (Saunders)***

- **Leaf Consumption:** Caterpillars feed voraciously on spine gourd leaves, consuming leaf tissue. The extent of damage depends on its population density, and the size of the larvae.
- **Irregular Holes:** Caterpillars typically create irregular holes in the leaves as they chew through the foliage. These holes can vary in size and shape, contributing to a shredded appearance of the leaves.
- **Defoliation:** If caterpillar populations are high, they can lead to significant defoliation. Severe defoliation weakens the plant, reduces its ability to photosynthesize, and may negatively impact overall plant health.
- **Faecal Droppings (Frass):** Presence of caterpillar faecal droppings, also known as frass, on leaves and surrounding areas. Frass may indicate the location of caterpillar feeding and can serve as a clue for pest identification.
- **Stunted Growth:** Prolonged and severe caterpillar feeding can stunt the growth of spine gourd plants.
- **Fruit Damage:** While caterpillars primarily feed on leaves, it can also feed on fruits. Larvae may bore into the fruit, causing damage and affecting the quality of the harvest.

***5. Aphids: Aphis gossypii***

- **Stunted Growth:** Aphids feed on the sap of plants, which can lead to stunted growth in spine gourd. The removal of vital nutrients from the plant's vascular system affects its overall development.
- **Curling or Distortion of Leaves:** Feeding can cause the leaves to curl, distort, or become puckered. This distortion is a result of the aphids withdrawing plant juices.
- **Honeydew Deposits:** Aphids excrete a sugary substance called honeydew as they feed. The presence of honeydew on spine gourd leaves and surrounding

surfaces can attract ants and serve as a medium for the growth of sooty mould, leading to further issues.

- **Yellowing of Leaves:** Aphid feeding can cause a yellowing of spine gourd leaves, a condition known as chlorosis.
- **Wilting:** In severe infestations, aphids can cause wilting of spine gourd plants.

***6. Whiteflies: Bemisia tabacii***

- **Yellowing of Leaves:** It feeds on the sap of plants, and their feeding can cause yellowing of spine gourd leaves.
- **Transmission of Plant Viruses:** Whiteflies are known vectors of certain plant viruses. If infected whiteflies feed on spine gourd plants, they may transmit viruses, leading to additional symptoms such as mosaic patterns, mottling, and deformities in leaves and fruits.
- Honeydew Production
- Leaf Curling or Distortion
- Reduced Photosynthesis
- Stunted Growth

***7.Leaf miner: Lyriomyza trifolii***

- **Leaf Mining Tunnels:** The primary and most characteristic symptom of leaf miner infestation is the presence of serpentine or winding tunnels within the leaves. These tunnels are created by the larvae as they feed on the internal tissues of the leaves.
- Visible Trails on Leaves
- Leaf Discoloration
- Reduced Photosynthetic Capacity
- **Premature Leaf Drop:** Severe infestations of leaf miners can lead to premature leaf drop.
- Secondary Infections

***8. Red spider mites: Tetranychus sp.***

- **Leaf Discoloration:** Red spider mites feed on plant sap by piercing leaf cells and extracting their contents. This feeding activity can cause stippling on the upper surface of spine gourd leaves, resulting in a characteristic yellow or bronzed discoloration.
- **Fine Webbing:** Mites produce fine silk-like webbing on the undersides of leaves and between plant parts. This webbing serves as a protective shelter for the mites and can be a noticeable sign of their presence.
- **Deformed Growth:** Prolonged infestations of red spider mites can cause distorted growth in spine gourd plants. Young leaves may exhibit abnormal shapes, and overall plant development may be hindered.
- **Fruit Damage:** While red spider mites primarily feed on leaves, heavy infestations can extend to spine gourd fruits. The feeding activity may result in small, deformed, or discoloured fruits.

***9. Thrips: Thrips palmi***

- **Silvering or Bronzing of Leaves:** Thrips feed on the plant sap by puncturing the cells and extracting the contents. This feeding activity can lead to a silvering or bronzing of spine gourd leaves, especially on the upper surface.
- Stippling or Tiny Dots
- **Scarring on Fruits:** In severe infestations, thrips can also feed on spine gourd fruits, causing scarring and blemishes. This damage may affect the quality and marketability of the harvested produce.
- **Excretion of Honeydew**

Sustainable pest management strategy (Satyagopal et al., 2014) Agro-ecosystem analysis (AESA) is an approach, which can be gainfully employed by extension functionaries and farmers to analyze the field situations with regards to pests, defenders, soil conditions, plant health and

the influence of climatic factors and their relationship for growing a healthy crop.

The basic components of AESA are:

- Plant health at different stages
- Built-in compensation abilities of plants
- Pest and defender population dynamics
- Soil conditions
- Climatic factors
- Farmers past experience

## IPM approaches

It implies strategic use of available technologies to mitigate pest issues considering ecological concerns and economic benefits.

- Eliminate debris, crop residues, weeds, and other alternate hosts to reduce pest habitats
- Conduct deep summer ploughing to disrupt the life cycle of pests in the soil
- Regularly rake the soil beneath the crop to expose and eliminate eggs, grubs, and pupae
- Employ hand collection and destruction of infested leaves and fruits
- Practice proper crop rotation and avoid consecutive cultivation of cucurbit crops
- During fruiting time and post-harvest, lightly rake the soil to expose pupae (fruit fly)
- Use cue-lure traps to attract B. cucurbitae males
- Implement poison baiting against fruit flies using a mixture of jaggery/ripen banana, malathion, and plastic containers
- Employ fish meal traps to control fruit fly infestations
- Cover fruits with polythene/ paper bags to minimize fruit fly infestation
- Conserve natural predators viz. Spiders, lace wings and lady bird beetles
- Conserve parasitoids such as hymenopteran insects
- Apply well-decomposed FYM or compost treated with Trichoderma sp. and Pseudomonas sp. for seed/ nursery treatment
- Judicious use of chemical pesticides (CIBRC, 2023)

## Conclusion

In conclusion, the spine gourd, a unique and nutritionally rich vegetable, faces a significant threat from various insect pests that jeopardize both its quality and yield. The intricate relationship between the spine gourd and its adversaries, ranging from fruit flies to caterpillars, underscores the urgent need for effective pest management strategies. The impact of these pests extends beyond cosmetic damage, affecting the vegetable's nutritional content and overall health. Implementing sustainable practices, such as agro-ecosystem analysis and integrated pest management, is crucial to safeguarding the spine gourd and sustaining the livelihoods of farmers who cultivate this remarkable crop.

## References


Hadi, N., Tiwari, P., Singh, R.B., Rupee, K., Rupee, S., Hanoman, C. and Singh, J., 2022. Beneficial effects of gourds in health and diseases. *Functional Foods and Nutraceuticals in Metabolic and Non-Communicable Diseases*, pp.61-77.

Mondal, B., Mondal, C.K., Mondal, P., Mondal, B., Mondal, C.K. and Mondal, P., 2020. Insect pests and non-insect pests of cucurbits. *Stresses of cucurbits: current status and management,* pp.47-113.

Satyagopal, K., Sushil, S.N. and Jeyakumar, P., 2014. AESA based IPM–cucurbitaceous vegetable crops (cucumber, bottle gourd, bitter gourd, sponge gourd, snake gourd, ash gourd, pumpkin, squash). *AESA BASED IPM Package,* (21).

CIB & RC, 2023. Department of Agriculture & Farmers Welfare, Directorate of Plant Protection, Quarantine & Storage Central Insecticide Board & Registration Committe) N.H.-IV, Faridabad-121 001 (Haryana), https://ppqs.gov.in/divisions/central-insecticides-board-registration-committee.

**Navaneetha C**
College of Agriculture,
Vellayani, Thiruvananthapuram

# Mulberry as a fodder

Production of green fodder on cultivated land is not very common in India, because of its low economic return. Furthermore, the lack of sufficient arable land with irrigation facilities also restricts fodder production. Such a situation is more acute in the hilly areas of the country. The huge cattle population in areas depends only on the leaves of certain tree species. Trees have the advantage that they can be planted on hills, on wasteland and at the edges of ponds,

canals, etc. Trees can also be grown on boundaries where regular crops cannot be grown. They have the potential to produce as much green fodder per unit area as agricultural fodder crops. Trees do not need to be watered since they can extract water through their deep and extensive root system. The abilities of trees to extract water from deep underground layers and to withstand drought are outstanding advantages over agricultural fodder crops. Trees also do not need such heavy inputs in the form of fertilizers, pesticides, fungicides and labour, as are needed for growing agricultural crops. Of all the tree species used as fodder, mulberry *(Morus sp.)* occupies a significant place as it grows anywhere, either in the form of a tree or shrub. Mulberry is believed to have originated in the foothills of the Himalayas and has been exploited for rearing silkworm in China since at least 3500 BC. Sericulture then spread to India and to other countries. Although mulberry is the only food for the silkworm, its casual use as animal feed has also been known for a long time. The nutritional quality of locally produced mulberry leaves is equivalent to that of grain-based concentrates. Thus, they are an ideal supplement in most forage diets.

## Distribution of mulberry

Mulberry is distributed through out the world as it has enough plasticity to survive under disruptive environmental conditions. At least 30 countries are now producing raw silk with mulberry and silkworms. In some of these countries, the use of mulberry leaf as fodder has also been adopted. Mulberry can be grown successfully in all conditions, even in tropical, subtropical and temperate climates. It can survive with rainfall ranging from 400-4500 mm per annum. Although the optimum temperature for growth is between 18 and 30°C, mulberry can survive even when the temperature goes beyond 48°C or below 0°C. It can therefore be considered a universal plant, which can grow anywhere under varied climatic conditions. Although this does not guarantee successful silkworm rearing, the plant's wide adaptability can be exploited in plantations, fully or partly, for animal feed.

## Nutritive value

Mulberry fodder is considered to be of good quality. Mulberry Leaves are highly palatable and digestible (70-90 %) to herbivorous animals and can also be fed to monogastrics. Leaf yield varies with nutrient supply and irrigation. In general, under irrigation with the recommended dose of fertilizer, mulberry yields nearly 35-45 tonnes of fresh leaf/ha/year. On a dry matter basis, leaves contain an average of 20-23 percent CP, 8-10 percent, total sugar, and 12-18 percent minerals. The leaves contain nearly 70 percent moisture. The cell wall constituents are neutral

detergent fibre 45.6 percent, cell contents 54.4 percent, acid detergent fibre 35.0 percent, hemicellulose 10-40 percent, lignin 10 percent, cellulose 21.8 percent and silica 2.7 percent (Lohan, 1980). The contents of minerals are as follows: magnesium, 0.52-1.25 percent; chlorine, 0.02-0.29 percent; sulphur, 0.18-0.76 percent; potassium 0.93-3.19 percent and sodium 0.13-0.23 percent (Majumdar et al., 1967). Tannin accounts for 0.85 percent in leaf DM. The chemical composition of the leaves varies from season to season. In hilly areas where the plants are not pruned repeatedly the protein content gradually decreases from February onwards, and minimum values are found in December when leaf fall starts. Like nitrogen, phosphorus also shows the same trend, its maximum content being in February.

Mulberry leaf stalks and leftovers, after silkworm feeding, are generally fed to cattle. Their composition on a DM basis is 11.5 percent CP, 34.0 percent CF, 76.5 percent total carbohydrate, 9.3 percent total ash, 1.6 percent Ca and 0.2 percent P. The calculated values were 70.8 percent for digestible CP, 48.4 percent for total digestible nutrients and 35.6 percent for starch equivalent on a dry basis. The balance of N, Ca and P were positive and animals also gained weight (Rao et al.,1971).

## Mulberry as animal feed

The important role of green leaves in supplementing animal feed is unquestionable. In the developing countries, cereal straws and grasses are fed to animals, but they cannot support full performance because of their poor nutritive value. In most places where concentrates are also provided, the diet is not balanced. Mulberry leaf supplementation can improve the efficiency of the whole diet. In addition, because of increasing pressure from the human population and to higher incomes earned from cereal and cash crops rather than from forage crops, more agricultural land cannot be set aside for fodder production. Another consequent advantage of mulberry is that it can be grown either as a tree or a shrub and harvested several times a year. In countries such as India, where mulberry is primarily grown for sericulture, excess leaves and leftovers are fed to cattle, sheep and goats. In hilly areas, where mulberry trees are abundant, their leaves are fed to animals. Of the different species available, Morus alba and other species that are suitable for silkworm rearing are cultivated in the plains and on hilly ground. Morus serrata, Morus laevigata and Morus australis are grown in the hills. Because of their deep root system, the leaves remain green for most of the year, except in winter when the leaves fall. As a result of the above advantages, mulberry can be considered as a perennial source of feed for most of the year.

## Mulberry as cattle feed

The leaves are nutritious and palatable, and are stated to improve milk yield when fed to dairy animals. The feeding value of mulberry leaves is rated high by the livestock owners. Feeding experiments have shown that up to 6kg of leaves per day can be fed to milch cows without adversely affecting the health of animals or the yield and butter content of milk. The mulberry leaf stalks remnants, left after feeding silkworms, can also be used for feeding cattle without any adverse effect on their health and performance. The potential gas production is higher for the young leaves which eventually reduces as the crop matures. The high rate of gas production for mulberry indicates high intake potential of this forage. Mulberry leaves have the potential to be used as a supplementary feed for increasing livestock productivity in crop residue-based livestock systems. Being rich in nitrogen, sulphur and minerals their supplementation could increase the efficiency of utilisation of crop residues by increasing the efficiency of microbial protein synthesis in the rumen leading to higher microbial protein supply to the intestine.

## Propagation and cultivation

Mulberry trees be propagated by seed and by cuttings, grafting and air-

layering. In India, mulberry seeds are sown in nurseries. Provided they have been scarified, the seeds germinate within 9-14 days and the seedlings are pricked out when 10-15 cm tall. Vegetative propagation is generally done with cuttings of 3-4 buds and 30-60 cm length with brownish green bark and cut at a 45 degree angle at both ends. The cuttings are buried for 15-20 cm of their length, including 2 buds. After two months, the rooted cuttings are ready to be planted out in the field. Mulberry trees are planted in a way that eases leaf harvest and pruning. Density of plantation is thus very variable and depends upon the intensity of pruning that can be allowed. 30,000 plants/ha will be adequate for low pruning operations, 7,000-12,000 plants/ha for medium pruning, and 2,250-6,000 plants/ha for high pruning intensity. In India, cuttings planted in paired rows have the following spacing: 1.8 m between pairs, 0.6 m within a pair and 0.5 within the row. After plantation, the field requires occasional weeding. Grafting mulberry trees was reported to yield higher amount of leaves, therefore resulting in silkworm cocoons of higher grade. After establishment the trees should be pruned from time to time to allow the growth of new shoots. *Morus alba* begins to bear in the first or second year of cultivation. Organic fertilisers (Manure) can be applied pre-planting and biannually.

## Feeding Mulberry to Small Ruminants

In many studies Mulberry, has been shown as an ideal forage to replace commercial concentrates. A normal standard for feeding small ruminants is to feed a 4% of the body weight of the animal on a dry matter basis. Mature animals should be fed 2.5% body weight on a dry matter basis.

## Forage Management

Mulberry can be harvested 3-4 months after planting, this is followed by a cutting interval of 6-8 weeks. When harvesting, it is important that the branches be cut in an upward direction, this will prevent any stripping of the bark that will cause fungal infections. Mulberry could give a dry matter yield between 2-47 tonnes/year/hectare provided there are favourable growing conditions. Mulberry foliage can also be harvested for silage. Silage was obtained by chopping foliage to 2-3 cm long, wilting it under sunshine, adding 5% rice bran and 5 % molasses, and then putting the mixture in plastic bags stored at room temperature during 56 days. The resulting silage had a high protein and ash content and had the best quality low pH, low N-NH3 ratio) with molasses addition. White mulberry foliage was ensiled with Guinea grass (Megathyrsus maximus), the optimal proportion being 70:30 mulberry/Guinea grass for fermentation process.

## Conclusion

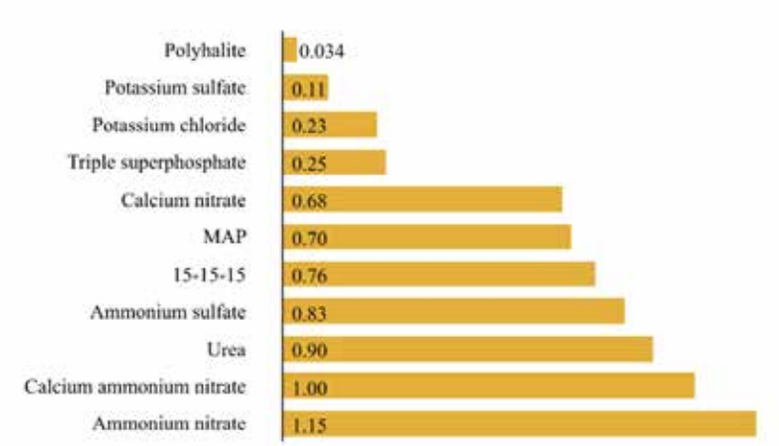
Production of green fodder on cultivated land is constrained by difficulties in setting aside sufficient cultivable area for fodder production, lack of irrigation facilities and other inputs; and low economic returns compared to cash crops. Mulberry trees that can be grown under varied climatic condition, including fallow and wastelands not fit for agriculture can be used, totally or partly, for producing nutritious green fodder. The urgent need for a high quality feed for ruminants in the tropics, in particular for small ruminants, and the excellent characteristics of mulberry, are the justifications for the great enthusiasm for its intensive cultivation and use as a supplement for cattle, and as the main feed for goats. Moreover, feeding mulberry as part of the daily ration of cows, improves the quality and quantity of milk and help in reducing calving intervals.

## References

Lohan, O.P. 1980. Cell wall constituents and in vitro DM digestibility of some fodder trees in Himachal Pradesh. Forage Res., 6: 21-27. Majumdar, B.N., Momin, S.A. & Kehar, N.D. 1967a. Studies on tree leaves as cattle fodder. 1. Chemical composition as affected by the stage of growth. Indian J. Vet. Sci., 37(b): 217-223. Rao, S., Amrith Kumar, A., and Sampath, S.R. 1971. Studies on mulberry (Morus alba) leaf stalk palatability, chemical composition and nutritive value. Indian J. Vet. Sci., 48: 853-857.

# Polyhalite
## A boon for Indian Organic Farming

Polyhalite, a new mineral fertilizer consisting of sulphur (S-48%), potassium (K-14%), magnesium (Mg-6%) and calcium (Ca-17%) offers an opportunity for pre-planting soil amendment and provides prolonged availability of these nutrients during the whole season. Polyhalite can fully replace all other Ca and Mg liquid fertilizers. It can also provide 33% of the K dose, as well as N-free Mg, thus reducing K-Mg competition and avoiding surplus N nutrition. Polyhalite has a low environmental impact as its production processes involve only mining, grinding, screening and packaging. Polyhalite, as




*Carbon footprint measurement of products used as fertilizers in agriculture. Source: ICL.*

**Dr. Akino A.[1]**
**Dr. Venkatakrishnan L.[2]**
**[1]Assistant Professor (Horticulture), SRM College of Agricultural Sciences.**
**[2]Assistant Professor (Soil Science and Agricultural Chemistry), RVS Agricultural College.**

*Polyhalite fertilizer is available in granular form. Photos: ICL.*

*Polyhalite extraction from 1,200 m below ground at Boulby Mine, Yorkshire, UK. Photo: ICL, UK.*

Polysulphate, has been authorized for organic agriculture and is available in many countries.

Polyhalite is widely formed as a constituent of marine evaporates, associated with halite (NaCl) and anhydrite (CaSO4) (Barbier et al., 2017).

Polyhalite deposits exist in several places in the world, being initially found in Austria and described by Stromeyer (1818), and later found in other areas of Europe. The main deposits of the mineral were recorded decades later in Texas and New Mexico, USA (Schaller and Henderson, 1932), then in Russia (Kurnakov et al., 1937), and finally in Zechstein Basin in Yorkshire, UK (Stewart, 1949)

**Natural mineral for direct use in agriculture**

As it is a mineral practically free of contaminants and with nutrients present in the form of soluble salts, polyhalite is simply extracted, crushed, and sieved, with no chemical processes in its production. Due to this simplified production, polyhalite fertilizer has a low carbon footprint, which is an increasingly important factor for food producers and processors globally.

Studies were conducted on sorghum, soybean, maize, cotton, alfalfa, tomato, tea, turmeric, mandarin, strawberry, durian and pomegranate etc.

*Polyhalite fertilizer is available in powdered form. Photos: ICL.*

# The triumphant journey of a vernacular farm magazine

## KERALA KARSHAKAN

The premiere farm magazine in Malayalam entered year of publishing **64th**


**Subscribe - Rs 200/- Annual**
**Rs 2000/- Lifetime**

**For details : editorkkfib@gmail.com**

**MO/DD Send to Principal Information Officer,**
**Farm Information Bureau,**
**Kawdiar PO,**
**Thiruvananthapuram, Kerala**
**Phone - 0471- 2314358 / 2318186**
**Mail: editorejournalkkfib@gmail.com**
**Log on to http://www.fibkerala.gov.in**

Published by **Asa S Kumar** Principal Information Officer Farm Information Bureau Owned by Department of Agriculture, Government of Kerala and Published at Farm Information Bureau, Kowdiar P.O, Thiruvananthapuram-3. Editor(i/c): **Haripriya Devi V V** Mail: editorejournalkkfib@gmail.com Log on to http://www.fibkerala.gov.in Phone: 0471-2314358