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## PRESENT STATUS OF NUTRITIVE CEREAL: AMARANTHUS GRAIN IN AGRICULTURAL SCENARIO

G. Kasirao<sup>1</sup>, P. Himavarsha<sup>1</sup>, Arpita Sharma<sup>1\*</sup>, Shiv Singh Tomar<sup>1</sup> and Nimmy M.S<sup>2</sup>

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### ABSTRACT

Cereals are the primary carbohydrate source for majority of the global population, with minor cereals, a category of neglected crops, playing a significant role as a substitute for rice or wheat. But the major cereals alone can not meet the demand of the growing population as these crops are high in calories and are deficient in protein and other important elements. Hence, a better replacement for them are the minor cereals. A large number of traditional crops are known, but have received little attention in the last century. Amaranth is such an underutilized pseudo cereal that is of particular interest because of its balanced amino acid and micro-nutrient profiles. Additionally, the C<sub>4</sub> photosynthetic pathway and ability to withstand environmental stress make the crop a suitable choice for future agricultural systems.



**KEYWORDS:** Millets, Amaranth, Pseudo cereal

### INTRODUCTION

Minor cereals are a range of underutilized crops having excellent nutritional properties. Such crops as foxtail millet, sorghum, oats and barley have made significant contributions to agriculture. They can act as an alternative to rice or wheat, the main carbohydrate source as of today. They are considered as resistant to different abiotic stresses and with the development of irrigation facilities these crops are now being grown in many regions (Biswas *et al.*, 2021). Also, there is a rapidly growing global market for diverse and healthy foods, and most of these minor cereals are recognized as healthy foods. They are an excellent source of carbohydrates, protein and B-group vitamins, including folate and minerals, such as iron, magnesium, copper, phosphorus, and zinc (Sanyal *et al.*, 2021). Small millets have better water use efficiency, nutrient use efficiency, lower global warming potential (GWP), better resistance to biotic and abiotic stress and are more nutrient-rich than major cereals (Muthamilarasan *et al.*, 2021).

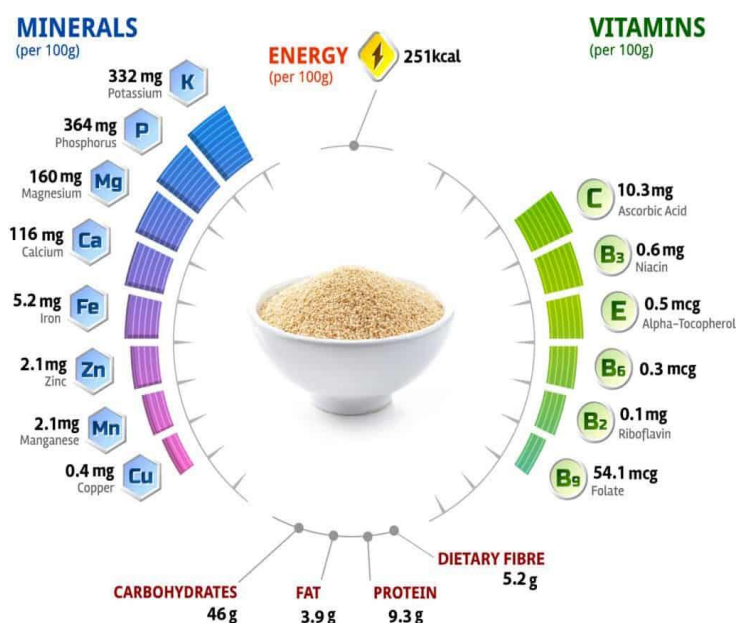
### AMARANTH AS A PSEUDOCEREAL

*Amaranthus* sp., a pseudo-cereal, is one such crop that is nutritionally superior to many common types of grain and meets majority of the requirements of current diets. The use of amaranth species in food

formulations will broaden the range of food products available on the market. Extensive scientific research has been conducted on the high nutritional quality and possible functioning of amaranth-based food products (Bodroza *et al.*,2022).

## NUTRITIONAL VALUE OF AMARANTHUS GRAIN

*Amaranthus* is a highly nutritious plant; both the grain amaranth and the leaves are used for human and animal food. The nutritional value and chemical composition of the species vary slightly. Amaranth leaves have been demonstrated to be great sources of protein, with the highest accumulation occurring during the flowering phase. Amaranthus is known for its nutritional value from early civilization and it is also referred to as “Ram dan” in India.



Source: [Health benefits of Rajgira \(Ramdana\) or Amaranth and How to Eat It \(happybharat.com\)](https://www.happybharat.com)

## HEALTH – BENEFIT ASPECTS OF AMARANTHUS SP.

When compared to true cereals, amaranth grain is a highly nutritious pseudocereal with a higher protein content (Sousa *et al.*, 2012). It is a reasonably well-balanced diet with medicinally beneficial functional characteristics. The health benefits include lower plasma cholesterol levels, immune system stimulation, anticancer activity, lower blood glucose levels, and improved hypertension and anemia conditions. It has also been found to have anti-allergic and antioxidant properties.

## STATUS OF AMARANTHUS CULTIVATION IN INDIA

The Grain of God, The Royal Grain and there are numerous names for amaranth. But its name derives from the Greek word Amaranthos meaning, "that which does not wither". Amaranthus comes in a variety of forms, including green vegetables and grains. In India, a type of amaranth grain is called Rajagra or Ramdana (Maurya *et al.*, 2018). It takes less than a month to harvest and are simple to grow. It can be started at any time of year, but it cannot withstand frost. Even though amaranth is frequently grown in the summer, the optimal time to do it is during a light winter. A lot of water is necessary for amaranth. Plants need damp soil to grow well (Huerta *et al.*, 2009). Farmers typically like to water the plants twice a day with sprinklers. Amaranth on an acre can produce 4-6 tonnes of leaves. This is determined by the seed's quality, the plant's health, and the soil's nutrition.

## PROS AND CONS OF AMARANTHUS CULTIVATION

Benefits	Limitations
Faster return on investment	Limited market
Quick start to harvest	Poor shelf life
Can be grown throughout the year	-

## CONCLUSION

Minor cereals, such as foxtail millet, sorghum, oats, barley, and amaranth, offer excellent nutritional properties and are emerging as alternatives to traditional carbohydrate sources like rice and wheat. These crops have shown resilience to abiotic stresses and are being cultivated in various regions with the development of irrigation facilities. Minor cereals are recognized as healthy foods due to their high content of carbohydrates, proteins, B-group vitamins, and minerals. Among these cereals, amaranth stands out as a pseudocereal with exceptional nutritional value. Extensive scientific research has highlighted its high protein content and potential health benefits, including cholesterol reduction, immune system stimulation, anticancer activity, and improved blood glucose levels. In India, amaranth is known as Rajagra or Ramdana and can be grown throughout the year with a relatively quick harvesting period. While amaranth cultivation offers advantages such as faster returns on investment and year-round cultivation, there are limitations such as limited market opportunities and a shorter shelf life. Nonetheless, the cultivation of amaranth holds promises for meeting dietary needs and promoting sustainable agriculture.

## REFERENCES

Bodroža-Solarov, M., Šimurina, O., Kojić, J.S., Krulj, J., Filipović, J., Cvetković, B.R., & Ilić, N. (2022). Utilization of Amaranthus spp. grains in food. *Food and Feed Research*.

Caselato-Sousa, V. M., & Amaya-Farfán, J. (2012). State of knowledge on amaranth grain: a comprehensive review. *Journal of food science*, 77(4), R93–R104.

[Health benefits of Rajgira \(Ramdana\) or Amaranth and How to Eat It \(\*happybharat.com\*\)](#)

Huerta-Ocampo, J. A., Briones-Cerecero, E. P., Mendoza-Hernandez, G., De Leon-Rodriguez, A., & Barba de la Rosa, A. P. (2009). Proteomic analysis of amaranth (*Amaranthus hypochondriacus* L.) leaves under drought stress. *International journal of plant sciences*, 170(8), 990-998.

Maurya, N. K., & Arya, P. (2018). Amaranthus grain nutritional benefits: A review. *Journal of Pharmacognosy and Phytochemistry*, 7(2), 2258-2262.

Muthamilarasan, M., & Prasad, M. (2021). Small millets for enduring food security amidst pandemics. *Trends in Plant Science*, 26(1), 33-40.

Sanyal, R., Jawed, D., Kumar, N., & Kumar, S. (2021). Small Millets (Nutri cereals): Food for the Future.

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## TECHNIQUES FOR GROWING THE UNDERUTILIZED NONI CROP AND ITS HEALTH BENEFITS

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### ABSTRACT

Noni, botanically known as *Morinda citrifolia* L, a miracle plant with more than 150 nutraceuticals were found growing naturally in all types of lands right from sea coast to interior and are now being cultivated as crop by the farmers of India. While the crop's cultivation and medical importance are becoming more well-known, it's necessary to comprehend the different difficulties, constraints, and biotic stresses that the plant faces. The research and development work done in India and abroad led to an effort to review the material that is now out there and provide it here. Noni has been traditionally used in various folk medicine systems for treating a wide range of health conditions.



**KEYWORDS:** *Morinda citrifolia* L., Health benefits, Cultivation practices and Pest management

### INTRODUCTION

*Morinda citrifolia*, L. popularly known as Indian Noni or Indian mulberry is an ever-green small tree bearing flowers and fruits throughout the year. It's a member of the Rubiaceae family. Tropical areas of the world are where it is grown. According to Morton (1999), this tree's fruits have historically been used in South East Asian and Pacific Island pharmacopoeias. It is the fullness of nature condensed into one fruit. It has more than 150 nutraceuticals, numerous vitamins, minerals, and micro and macro nutrients that support the body in a variety of ways from the cellular level to the organ level, making it the largest pharmaceutical unit in the universe. In Polynesia, noni is one of the most significant traditional folk medicines that has been utilised for more than 2000 years.

### BIO-SYSTEMICS:

**Botanical name:** *Morinda citrifolia*

**Family:** Rubiaceae

**Common name:** Starvation fruit

**Origin:** South East Asia



**DISTRIBUTION OF NONI:**

Although it adapts well to coastal environments, the species is typically found from sea level to 400 m above MSL (Lu berck and Hannes, 2001). Evergreen noni trees are frequently observed beside lava flows. There are currently 80 species of the genus Morinda, most of which are found in tropical nations. Africa, Australia, Fiji, India, Thailand, and Vietnam are all affected. It is commonly produced in India's Andaman and Nicobar Islands under natural circumstances. Due of its wide range of environmental adaptation, it is common along fences and road sides throughout the coastal region. It can be found along the coasts of Kerala, Karnataka, Tamil Nadu, and many other places in India's main land.

Survey of Morinda in south India indicated that 12 different species or varieties of Morinda are distributed throughout Tamil Nadu and Kerala.

S. No.	State	Species
1.	Tamil Nadu	<i>M. tinctoria</i> L.
2.	Kerala	<i>M. citrifolia</i> L.

*M. citrifolia* L. is not known to exist in the Tamil Nadu study area, although it is widely dispersed throughout most of Kerala, particularly in the coastal region, as well as in the Mangalore district of Karnataka. A recently discovered species of Morinda with big, leathery leaves has been found in Orissa (Singh *et al.*, 2007).

**Table 1: NUTRITIONAL VALUE OF NONI (PER 100G EDIBLE PORTION)**

S. No.	Constituents	Content	S. No.	Constituents	Content
1.	Protein	0.9 g	7.	Calcium	30 mg
2.	Fat	0.2 g	8.	Iron	0.4 mg
3.	Vitamin C	33 mg	9.	Magnesium	24 mg
4.	Vitamin A	15 µg	10.	Phosphorus	20 mg
5.	Vitamin E	0.5 µg	11.	Sodium	4 mg
6.	Vitamin K	0.2 µg	12.	Zinc	0.2 mg

## HEALTH BENEFITS

Noni has been traditionally used in various cultures for its potential health benefits. While scientific research on noni is ongoing, here are some of the potential health benefits associated with consuming noni (Moorthy *et. al.*, 1970).

- **Antioxidant properties:** Antioxidants found in noni, including anthraquinones, flavonoids, and vitamin C, can assist the body in scavenging dangerous free radicals. Antioxidants may maintain a healthy immune system and improve general well-being.
- **Anti-inflammatory effects:** Anti-inflammatory qualities have been discovered in noni, which may aid in lowering inflammatory levels in the body. The anti-inflammatory properties of noni may contribute to its potential health advantages because chronic inflammation is linked to a number of medical disorders.
- **Immune system support:** Noni is thought to provide immunity-enhancing qualities that support immune system strength and general immune health. This might be as a result of its antioxidant concentration and potential immune response regulation.
- **Digestive health:** Traditional uses of noni include supporting digestive health and easing tummy aches. According to Peter et al. (2007), it might support regular bowel movements and maintain a healthy digestive tract.

### ➤ Varieties:

1. **Hawaiian Noni:** This cultivar, which is frequently produced in Hawaii, is renowned for its big fruits. Hawaiian noni grows well in tropical areas and is frequently utilised for commercial production.
2. **Tahitian Noni:** Tahiti and other Pacific Islands have a significant farming presence for this cultivar. Tahitian noni is preferred for making noni juice because of its great fruit output.



3. **Indian Noni:** This cultivar, which is grown in India, is renowned for its capacity to cope with many environmental conditions. Indian noni plants can withstand a wide range of temperatures and, in contrast to Hawaiian and Tahitian types, yield smaller fruits.
4. **Australian Noni:** Australia's northern areas, in particular, are where this cultivar is cultivated. Australian noni plants were created to resist the unique climatic conditions of that nation.



## Climate and Soil

A tropical plant called noni grows well in hot, humid environments. It thrives in tropical and subtropical climates all over the world. Here are some essential elements that contribute to a climate that is ideal for noni farming (Hawaii *et al.*, 2006).

- ✚ **Temperature:** Noni favours temperatures between normal and hot. It thrives in environments that are between 75°F (24°C) to 95°F (35°C) in temperature. Since noni is susceptible to cold, it cannot withstand frost or prolonged low temperatures.
- ✚ **Sunlight:** Sunlight is essential for noni's growth and fruit production. It needs at least 6 to 8 hours of direct sunlight each day in order to grow.
- ✚ **Rainfall:** A tropical plant called noni prefers frequent rains. It needs a steady supply of water all year round. For noni farming, rainfall should fall between 40 inches (1,000 mm) and 70 inches (1,800 mm) annually.
- ✚ **Soil:** Although noni may grow in a variety of soil types, it likes fertile, well-draining soils. For noni cultivation, sandy or loamy soils with a high organic matter concentration are best. The pH of the soil should be between 5.5 and 6.5.
- ✚ **Humidity:** Noni thrives in high humidity environments. Relative humidity levels around 70% to 80% are ideal for its growth.



## **Selection of Planting Materials**

It is possible to grow noni from seeds, stem cuttings, or tissue culture. For good plant growth and fruit production, it's essential to choose healthy and disease-free planting materials.

## **Propagation of Noni**

It is possible to grow noni from seeds, cuttings, or tissue culture. Due to the plant's high cross-pollination rate, there is a great deal of variety among plants grown from seedlings. Seeds from recently ripened fruits should be collected and put in nursery beds in order to raise seedlings. Even after cutting, viability after storage loss in 6–8 months can be employed for multiplication. In commercial gardens, tissue culture saplings are typically planted.

## **NURSERY AND CULTURAL PRACTICES**

### **Seed collections and storage**

Noni fruits mature on the plant itself and are climacteric. For seed collection, only ripe, soft noni fruits should be used. By rubbing the fruit pieces together and scrubbing them vigorously with water, the seeds must be extracted from the fibrous fruit flesh. 200g of clean seeds can be obtained from a kilogramme of fruit. Noni seeds are oblong-triangular, reddish-brown, and have a noticeable air chamber. Due to their air chamber and their robust, water-repellent, fibrous seed coat, they are buoyant and hydrophobic. The seed coat is layered with parchment that resembles cellophane and is extremely robust and substantial in thickness. Between 70 and 90 percent of seeds germinate. If maintained in refrigerator and sealed bottles, the seeds' viability can be extended for a year.

### **Seeds treatment:**

Mechanically scarified seeds treated for 24 hours with 800 ppm GA will exhibit a germination rate of 80-85% in 20- 30 days. The best cot mattresses will have a 1:2:1 ratio of soil, sand and FYM. Seedlings that are 30 days old and 10 cm or less in height can be transferred to poly bags with a 1:1:1 mixture of sand, soil, and FYM.

### **Vegetative propagation:**

With a dip in IBA 400 ppm for 15 to 30 seconds, semi-hard stem cuttings (5-7 cm dia, 12 to 18 cm long, and 2-3 nodes) demonstrate strong roots and shooting in 3 to 4 weeks. For field transfer, seedlings and cuttings that are 90–120 days old (20–25 cm in height) works best. May through July are the ideal months for planting (Antony *et al.*, 2006).

**Site Selection:**

Tropical and subtropical climates are ideal for noni. It needs soil that is well-drained and has a pH between 6.0 and 7.5. Pick a location with plenty of sunlight because noni plants need full sun exposure for the best growth.

**Planting and Spacing:**

Noni plants should be spaced 10-15 feet apart. There are 290 plants per acre with a 12-foot spacing. Plant crowding results from shorter distances between plants, which may also make some pest and disease issues worse.

**Irrigation:**

When conditions are dry and plants are younger than 2-3 years old, irrigate once or more a week, applying up to 10 gallons per plant; for older plants, irrigate less frequently. Overwatering can speed up damage from root-knot nematodes, cause root rot, and leach fertilizer nutrients outside the root zone. Noni thrives with moderate irrigation and can survive prolonged drought once established and mature.

**Fertilization:**

Noni depends on the soil and rainfall for the quantity and frequency of fertilizer applications. Without fertilizer, noni trees growing in woodlands typically look healthy. While more mature or flowering or fruiting plants are encouraged to produce many large fruits by applying high-phosphorus fertilizers such as 10-20-20 or 10-45-10, younger, nonfruiting noni plants are encouraged to produce lush vegetative growth with balanced fertilizers (such as 14-14-14 or 16-16-16). Fertilizer formulations with controlled release are given to young seedlings and transplants, whereas formulations with rapidly available granules are given to older, mature plants. At the "drip line" of the plant, or the region where water drips from the edge of the leaf canopy, fertilizer should be applied away from the trunk.

Spraying foliar fertilizer works well on noni plants of all ages. Sprays of foliar fertilizers high in phosphorus (such as 10-45-10) and substances (such as seaweed emulsions) containing nitrogen and minor elements have been shown to increase the production of noni flowers and fruits.

Instead of fertilizing noni seldom with bigger volumes of fertilizer, it should be fertilized regularly with smaller amounts. Balanced fertilizer (14-14-14) can be applied to young plants up to a year old in high-rainfall locations at a rate of 12 pound per month, and to more mature plants at a rate of up to 1 pound per month.

Crushed coral, dolomite, K-mag, 7-7-7, composted chicken dung, and macadamia nut husks are among the efficient organic fertilizers for noni growing. A yearly lime application, around 1 pound per plant, will help some areas.

### **Pruning and Training:**

Pruning helps noni plants create a balanced canopy structure and enhance airflow. Additionally, pruning can promote simpler harvesting and assist regulate plant size. Depending on the intended shape and management techniques, noni plants can be trained to have a single stem or several stems.

### **Harvesting and yield:**

After being planted, noni plants can start producing fruit in around 9 months. Even though they are typically small and few at this early stage, fruits can still be plucked. Some farmers elect to prune back the branches in place of harvesting during the first and second years. As a result of this trimming, the plant becomes bushier, has more lateral and vertical branches, and yields more fruit overall. Although there are seasonal tendencies in fruit production that may be impacted or altered by the weather and fertilizer treatments, noni fruits can be gathered all year long.

Depending on nutrition and plant spacing, mature, robust plants should yield 250–500 pounds per plant year. However, with appropriate crop management, yields at some areas can approach 500 pounds per plant year. Fruits can be picked just before they start to fully mature and turn a whitish-yellow color on the tree.

### **Post-Harvest Handling:**

Due to their high-water content and quick degeneration after harvest, noni fruits have a limited shelf life. The shelf life can be increased with prompt cooling and suitable storage conditions, such as cold temperatures and high humidity. Another method for extending the shelf life of the fruits is to process them into juices, purees, or other products with value-added.

It is important to keep in mind that noni agricultural production methods can change based on regional factors, climatic factors, and particular farming systems. Therefore, speaking with local agricultural extension agencies, noni specialists, or knowledgeable farmers in your area might offer insightful advice that is targeted to your particular locale.

### **Plant diseases**

#### **1. Black flag of noni**

India experiences a severe leaf and fruit blight. *Phytophthora botryose* is the pathogen responsible for the illness. Among the signs are a chocolate- or black-colored fruit rot, stem or branch dieback, and

black leaf and stem blight. Extended damp weather is favorable for the sickness. The use of trimming, weeding, and field cleaning are examples of control measures.

## 2. Sooty mold

A nonparasitic fungus called sooty mould is a black, surface growth that feeds on the sugary exudates secreted by soft-bodied insects like scales and aphids. Leaves can be easily cleaned of sooty mould by hand. Sooty mould can be eliminated with a spray of soapy water.

## 3. Noni root-knot disease

Root-knot nematodes of the *Meloidogyne* species are responsible for the illness known as noni root-knot. Plant stunting, yellowing, and diminished vigour are the symptoms that are visible above ground. Roots that have been harmed may be galled, swelled, fractured, or rotting. By using nematode-free transplants and organic soil additions like composts containing chicken dung, this illness can be reduced.

## 4. Stem rot

In stem rot, plant tissues at the base deteriorate, causing stunted growth. Wilt, which includes leaf flagging, yellowing, and dropping, is the first sign of plant disease. Stem rot can be prevented or at least less severely affected by using pathogen-free plants, choosing suitable locations, and reducing plant stress.

## Insect pests:

Pest attacks on cultivated noni can result in serious harm. Aphids (*Aphis gossypii*), ants, scales (the green scale), mites (eriophyid mites), whiteflies (fringe guava whitefly), and slugs are pests that have been observed attacking noni crops. Monocultures of noni favour pest outbreaks. Therefore, combining nonhost plant species in intercropping can reduce the overall intensity and frequency of pest infestations.

## CONCLUSION

More than 50 nations around the world have access to noni. Millions of customers have experienced its health benefits. All portions of the noni fruit are used to make various goods, including noni juice, capsules, soap, and cosmetics. The growing of noni in North Bihar offers the local population a fantastic opportunity to create a living and receive health advantages.

## REFERENCES

- Antony Selvaraj, L. Manju Kamath and J. Subramani. (2006). Micro propagation of *Morinda citrifolia* L. International Journal of Noni Research 1 (2) :4-9.
- Hawaii Plant Conservation Center. (1992). Noni. National Tropical Botanical Garden, Kauai. 2 pp.
- Lubeck, W., & Hannes, H. (2001). Noni: el valioso tesoro curativo de los Mares del Sur. Edaf.
- Moorthy NK, Reddy GS (1970). Preliminary phytochemical and pharmacological study of *Morinda citrifolia*. Antiseptic. 3:167-171.



Morton JF. (1999). The ocean-going Noni, or Indian Mullerry (*Morinda citrifolia*, Rubiaceae) and some of its 'colorful' relatives. *Economic Botany*. 46:241-56.

Peter, K. V (2007). Indian Noni: A unique fruit crop with high medicinal value. Underutilized exploited horticultural crop. KV Peter (ed), pp 301-312, NIPA, New Dekhi.

Singh DRR, Sudha VB, Pandey V, Jayakumar RC, Srivastava, Damodaran T. (2007). Influence of noni (*Morinda citifolia* L.) herbal extracts on growth and production of chillies, *Capsicum annum* var. Arka Lohit – Souvenir and Abstracts - - Noni Search, 39.

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## THEILERIOSIS A TICK-BORNE DISEASES IN LIVESTOCK: THE BASIC UNDERSTANDING

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### ABSTRACT

Vector-borne parasites are the predominant reason for mortality and morbidity in livestock globally. The major tickborne diseases in livestock include Theileriosis, babesiosis, and anaplasmosis. These diseases are a major threat to dairy animals and are responsible for significant economic loss to the dairy industry. In ruminants, theileriosis is more prevalent. It is caused by two organisms, *T. annulate* and *T. parva* but in India, *T. annulate* is more common.

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### INTRODUCTION

*Theileria* is a unicellular and eukaryotic protozoan parasite. It comes under the phylum Apicomplexa similar to Plasmodium. Apicomplexa phylum have some unique features such as apical organs for the entry of parasite into host cells. It is caused by two organisms, *T. annulate* and *T. parva* but in India, *T. annulate* is more common. *T. annulate* is transmitted by different species of hyalomma (tick). The complex life cycle of *Theileria* starts at high temperature in summer, tick feeds on animal blood. Theileriosis is also called a lymphoproliferative disease because *Theileria* converts WBCs into cancer-like cells by transforming them. Transformation of the WBCs is a unique characteristic of *T.annulate*. These infected cells produce several cytokines such as TNF-alpha, responsible for inducing various symptoms of theileriosis. In comparison to indigenous, the cross bred animals are more susceptible to theileriosis. There are various acute and chronic cases of theileriosis in dairy animals. Common clinical symptoms are fever, conjunctivitis, lymph node enlargement, anemia, respiratory abnormalities, weight loss, decreased milk production, abortion, diarrhea, weakness, nasal discharge, anorexia and sudden death of animals etc. Carrier animals are major reason behind prevalence of this disease because even after recovery from acute infection, animal become carrier for the disease. This article gives us a basic idea about prevention, treatment, diagnosis and life cycle of *Theileria* parasite.

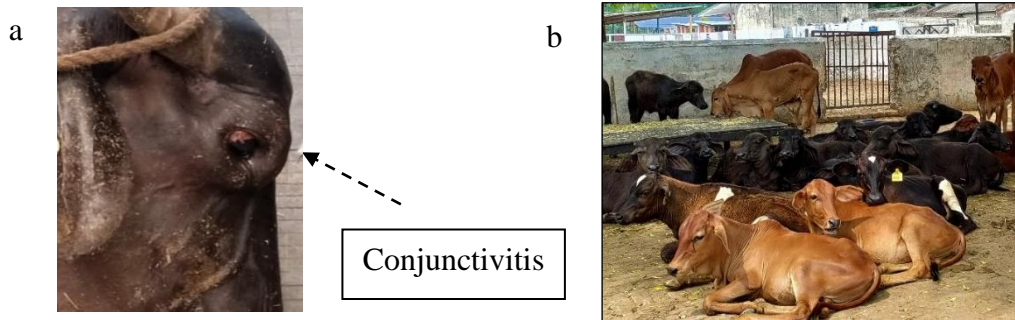


Figure: a) Conjunctivitis, the symptom of theileriosis and b) Group of animals in herd

### LIFE CYCLE

- The Life cycle of *Theileria* parasite complete in carrier/vector and host.
- There are two phases, sexual and asexual. Sexual phase takes place in tick and asexual phase in host cell.
- In host cell, *Theileria* parasite infect two type of cells, WBCs and RBCs.
- In WBCs, there are development of two stages of parasite, schizonts and merozoites but in RBCs there is development of Piroplasm stage.
- Sporozoite stage from tick saliva is infectious for host and piroplasm stage in host RBCs is infectious for tick.

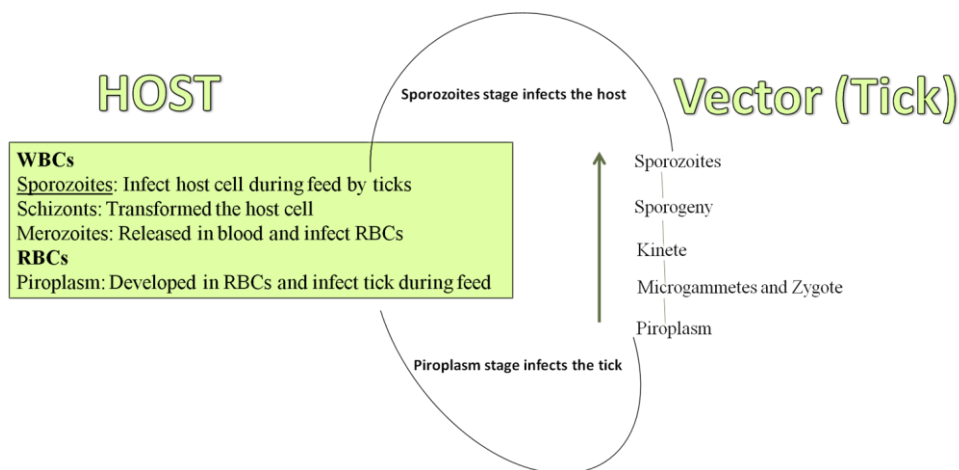


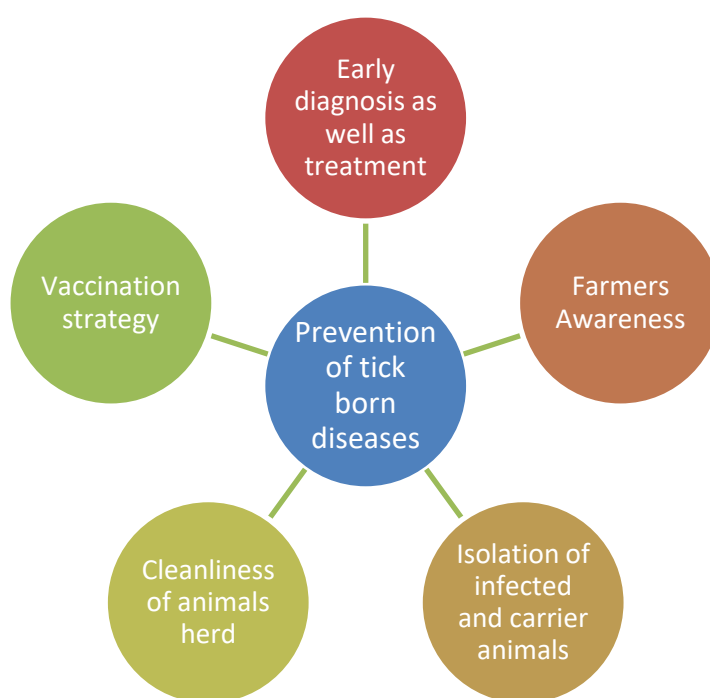
Figure: Outline for life cycle of *T. annulata*

### PREVENTION OF TICK-BORNE DISEASE

Some points to control the tick-borne disease given as:

- Cleanliness of animals as well as animal's herds.

- Vaccination strategy is also important to prevent tick borne diseases. Live Attenuated vaccines are available for tick borne diseases.
- It is challenging to control tick born disease because of carrier animals. Carrier animals play important role to complete the cycle of parasite in host and tick body. So, isolation of carrier animals can control the disease.
- It is important to get the farmers aware about clinical symptoms, prevention and treatment of tick-borne diseases. Because experience person can diagnose disease even from clinical symptoms. So, awareness is essential for further confirmation steps.



**Figure: Possible prevention and control measures for tick-borne disease.**

## DIFFERENT DIAGNOSTIC METHODS

The most common used diagnosis methods are given as:

- The simplest tests for diagnosis of theileriosis are observation of clinical symptoms such as Fever, conjunctiva, lymph node enlargement, anemia, respiratory abnormalities, weight loss, weakness and sudden death of animals etc.
- Due to intracellular nature of parasite, it can also easily diagnose under microscopy by Geimsa staining of blood smear. This is simplest tests for diagnosis in which detection of macroschizonts and piroplasm by just blood smears stained with Geimsa.



- Molecular based methods of diagnosis are the polymerase chain reaction, reverse line blotting assay (RLB) and Loop mediated isothermal amplification (LAMP) assays. These methods detect DNA of parasite in the host blood. This is antigen-based method of diagnosis.
- Serological based methods such as enzyme linked immunosorbent assays (ELISA) and lateral flow immunoassay (LFIA) in which detection antigen/antibodies in the blood of infected animals. These can be both antigen and antibody based.

## CONCLUSION

Theileriosis is responsible for significant economic loss to the dairy industry. Both Animals are more prone to this kind of diseases because of dirtiness of animal herd. Carrier animals are major reason behind prevalence of this disease because even after recovery from acute infection, animal become carrier for the disease. Morbidity and Mortality rate is very high because undiagnosed and untreated animals die within weeks, so diagnosis is very much important for effective early treatment.

## REFERENCES

- Abdo, J. et al. (2010) 'Development and laboratory evaluation of a lateral flow device (LFD) for the serodiagnosis of *Theileria annulata* infection', *Parasitology Research*, 107(5), pp. 1241–1248. doi: 10.1007/s00436-010-1994-8.
- Bilgic, H. B., Karagenc, T., Bakırcı, S., Shiels, B., Tait, A., Kinnaird, J., Eren, H., & Weir, W. (2016). Identification and Analysis of Immunodominant Antigens for ELISA-Based Detection of *Theileria annulata*. *PloS one*, 11(6), e0156645. <https://doi.org/10.1371/journal.pone.0156645>
- Khaton, S. et al. (2015) 'Detection of tropical bovine theileriosis by polymerase chain reaction in cattle', *Journal of Parasitic Diseases*, 39(1), pp. 53–56. doi: 10.1007/s12639-013-0270-0.
- Krishnamoorthy, P., Akshatha, L. G., Jacob, S. S., Suresh, K. P., & Roy, P. (2021). Theileriosis prevalence status in cattle and buffaloes in India established by systematic review and meta-analysis.
- Kumar, A., Gaur, G. K., Gandham, R. K., Panigrahi, M., Ghosh, S., Saravanan, B. C., Bhushan, B., Tiwari, A. K., Sulabh, S., Priya, B., V N, M. A., Gupta, J. P., Wani, S. A., Sahu, A. R., & Sahoo, A. P. (2017). Global gene expression profile of peripheral blood mononuclear cells challenged with *Theileria annulata* in crossbred and indigenous cattle. *Infection, genetics and evolution: journal of molecular epidemiology and evolutionary genetics in infectious diseases*, 47, 9–18. <https://doi.org/10.1016/j.meegid.2016.11.009>
- Ochanda, H., Young, A. S., Mutugi, J. J., Mumo, J., & Omwoyo, P. L. (1988). The effect of temperature on the rate of transmission of *Theileria parva parva* infection to cattle by its tick vector,

Rhipicephalus appendiculatus. *Parasitology*, 97 (Pt2), 239–245.

<https://doi.org/10.1017/s0031182000058443>

Rajendran, C. and Ray, D. D. (2014) ‘Diagnosis of tropical bovine theileriosis by ELISA with recombinant merozoite surface protein of *Theileria annulata* (Tams1)’, *Journal of Parasitic Diseases*, 38(1), pp. 41–45. doi: 10.1007/s12639-012-0183-3.

Ram, P. K., Singh, S. K. and Sudan, V. (2021) ‘The phenotypic and haemato-biochemical appraisal of tropical theileriosis in newborn calves’, *Tropical Animal Health and Production*, 53(5). doi: 10.1007/s11250-021-02889-8.

Selim, A. M., Das, M., Senapati, S. K., Jena, G. R., Mishra, C., Mohanty, B., Panda, S. K., & Patra, R. C. (2020). Molecular epidemiology, risk factors and hematological evaluation of asymptomatic *Theileria annulata* infected cattle in Odisha, India. *Iranian journal of veterinary research*, 21(4), 250–256.

Yin, H., Liu, Z., Guan, G., Liu, A., Ma, M., Ren, Q., & Luo, J. (2008). Detection and differentiation of *Theileria luwenshuni* and *T. uilenbergi* infection in small ruminants by PCR. *Transboundary and emerging diseases*, 55(5-6), 233–237. <https://doi.org/10.1111/j.1865-1682.2008.01031.x>

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## NUTRITION GARDEN: AN EFFICIENT TECHNIQUE TO MINIMIZE MALNUTRITION

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### ABSTRACT

*In this vast world, about 75% of the folks face a lack of essential micronutrients like Zn, Cu, I, and Fe, causing malnutrition and health woes. It's a massive global problem, stemming from insufficient intake of dietary supplements like proteins, vitamins, and minerals. Fruits and veggies are crucial sources of nutrients and phytochemicals vital for our body's growth, development, and immunity against various diseases. As the population grows, available land shrinks daily. But there's a bright solution emerging—the nutrition garden. It's gaining immense popularity as people cultivate fruits and veggies right at their doorstep or backyards. This garden ensures sufficient, safe, and proper nutrients, helping combat malnutrition-related issues and diseases. Embracing this natural connection paves the way to a healthier, thriving future for all.*



### INTRODUCTION

Nutri-garden is an effective effort to ensure availability of chemical free vegetables and fruits rich in nutrients at affordable prices. With a focus on fruits and vegetables, it is the best source of nutrition and meets the diverse dietary needs of the entire family. This is an effective way to eliminate malnutrition. Several fruit crops are important source of phytochemicals having health benefit (Lal et al., 2017; Lal et al., 2018; Diwan et al., 2018). In a nutrition garden, fruits and vegetables are cultivated for food and a source of income. This is a more advanced type of kitchen gardening. Nutritional gardens are especially beneficial for women and can help small and marginal farmers by providing a variety of nutritious food, as well as providing a host of other benefits, such as selling fruits and vegetables grown in nutritional gardens for additional income. The main objective of developing the concept of nutri-garden is to motivate rural women to grow food crops in the vacant land available on their doorstep or back side of the home. Not every rural household with a food garden is heavily dependent on the market to meet family nutritional requirements and in case of surplus production, the produce may also be kept for sale. In case of space constraints, nutrition gardens can be set up in the city in the form of terrace gardening, vertical gardening and container gardening.

## **PURPOSE OF NUTRITION GARDEN**

One of the main objectives of the nutrition garden is to grow fresh and pesticide free vegetables and fruits on the farm for their family uses. The nutrition garden provides the daily needs of the family members and also provides a beautiful, pollution free and comfortable environment to the family. Malnutrition is a serious problem in rural areas especially in women and children. Women need high quality nutrients in their diet as they work whole day which requires more energy every day. Plant secondary metabolites, vitamins, mineral and fiber are found in large quantities in vegetables and fruits, which are essential for health (Teodoro, 2019; Subramaniam et al., 2019). The emphasis is on how the nutrition garden can meet local needs. Production of local vegetables and fruits will not only ensure safe food supply but will also help in creating new employment opportunities. Micronutrients are abundant in seasonal vegetables and fruits. In summer, tomatoes, chillies, okra, bitter gourd, bottle gourd, cucumber, brinjal, colocasia, amaranth and brinjal can be grown. Vegetables like tomato, cauliflower, cabbage and pumpkin can be grown in the rainy season. Establishing nutrition gardens is a potent and cost-effective solution to mitigate the current malnutrition crisis.

## **ESTABLISHMENT OF NUTRITION GARDEN**

Generally, nutrition gardens can be established in the vicinity of the farm where there is sufficient space and availability of water. The nutrition garden should be made close to the home so that it can be protected from animals. The area for nutrition garden should be selected keeping in view the fertility potential of the land, availability of water etc. Generally the area selected may be of 400 to 500 square meters. For a 5 member family, about 200 square meters of rectangular land is best suited for the production of vegetables and fruits throughout the year. The layout of the nutrition garden, crop selection and sowing should be done according to the time availability, climate and seasonal changes.

## **LAY OUT OF NUTRITION GARDEN**

- Choose a location for the nutrition garden where the plants get at least 6 hours of direct sunlight.
- After selecting the place for the nutrition garden, the land should be plowed or turned over at least 2-3 times.
- Sufficient vermicompost (1 kg per square meter) or farmyard manure (3-4 kg per square meter) should be applied in the soil.
- Mixing Trichomash with vermicompost or cow dung manure is also beneficial.
- A fence should be made around the nutrition garden, on which seasonal vine vegetables can be planted.



- The space selected for the nutrition garden should be divided into smaller size plots as per the requirement, each of which should be built not to exceed 2 feet in width.
- There should be a gap of at least 2 feet between the plots so that threshing and harvesting can be done easily.
- Plants of low height should be planted in the south direction and tall plants in the north direction. This will prevent taller plants from shading smaller plants.
- Fruit trees and shrubs should be planted in the north direction.
- A total of 5-6 vegetables, 2-3 green leafy vegetables and 2-3 tuber vegetables should be planted at any time of the year.
- Tuber plants like radish, beetroot, carrot should be sown on a mound-like border made of soil between two plots.

## **POINTS TO BE CONSIDERED FOR NUTRITIONAL GARDEN**

- The land selected for the nutrition garden should have high fertility soil.
- The colours on the food plate are indicative of the various vitamins and pigments so a well-managed farm should have a "rainbow" concept.
- Perennial trees should be planted on one side of the garden so that the rest of the garden gets enough sunlight.
- Once the area for perennial crops is determined, the area of the field garden can be divided into 6 to 8 equal plots for growing annual vegetable crops.
- Shade-growing plants can be planted in beds with perennials. You can grow two to three annual crops on the same plot of land.
- Scientific practices like crop rotation, inter cropping and mixed cropping should be followed for effective use of layout.
- Passages should be provided in the middle and all four sides of the nutrition garden so that fresh vegetables can be collected without any damage.
- Vermicompost and organic manure should be used in the beds.
- The nutrition garden should be near the kitchen, so that the runoff water from the kitchen can be used.
- For optimum utilization of kitchen waste, a compost pit should be made at the corner of the poultry garden.

- A water tank should be made in one corner of the nutrition garden, so that the excess water flowing from the kitchen can be stored and used for irrigation of crops. This water tank should remain covered.
- No chemical fertilizer should be used in the nutrition garden. If necessary, bio pesticide can be used to make the crops free from pests and diseases.

## **BENEFITS OF NUTRITION GARDEN**

- In the Nurture Garden, fruits and vegetables are grown organically, so are more nutritious and contain no chemicals.
- It helps in saving money by avoiding buying fruits and vegetables from the market.
- A steady supply of a variety of nutrient-rich vegetables and fruits can be maintained depending on the needs and preferences of the family.
- It also provides aesthetic view of the road.
- Nutritional gardens can be a useful solution to concerns such as malnutrition, excessive use of chemical fertilizers, growing populations and unpredictable weather. This is a better measure for food security and dietary diversity.

## **CONCLUSION**

Nutritional gardens have been a foundation of traditional agricultural practices, but their importance has diminished over time. A variety of fruits and vegetables in our daily diet improves a person's ability to fight disease and boosts immunity. Various phytochemicals found in fresh fruits and vegetables are antioxidant, anti-allergic, anti-carcinogenic, anti-inflammatory and anti-viral effect. Poultry gardens are very important to eradicate malnutrition in rural areas. Nutrition garden is one of the most efficient ways to increase the nutrition level of women with minimum effort.

## **REFERENCES**

- Diwan, G., Sinha, K., Lal, N. and Rangare, N.R. 2018. Tradition and medicinal value of Indian gooseberry: A review. *Journal of Pharmacognosy and Phytochemistry*. **7**(1): 2326-2333.
- Lal, N., Pandey, S.K., Nath, V., Agrawal, V., Gontia, A.S. and Sharma, H.L. 2018. Total phenol and flavonoids in by-product of Indian litchi: Difference among genotypes. *Journal of Pharmacognosy and Phytochemistry*. **7** (3): 2891 – 2894
- Lal, N., Sahu, N., Shiurkar, G., Jayswal, D.K. and Chack, S. 2017. Banana: Awesome fruit crop for society (Review). *The Pharma Innovation Journal*. **6**(7): 223-228
- Subramaniam, S., Selvaduray, K.R. and Radhakrishnan, A.K. 2019. Bioactive Compounds: Natural Defence Against Cancer? *Biomolecules*. **9**: 758.



Teodoro, A.J. 2019. Bioactive Compounds of Food: Their Role in the Prevention and Treatment of Diseases. *Oxidative Medicine and Cellular Longevity*. 3765986: 1–4.

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## AVOIDING BURIAL OF CROP RESIDUES FOR SUSTAINABLE AGRICULTURE

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### ABSTRACT

Modern input-intensive farming has led to increased crop residues, often burned by farmers with adverse environmental effects. Crop residue management improves soil health, water movement, and nutrient incorporation, enhancing productivity and yield. India's agricultural sector generates substantial crop residues, often burnt after harvest, causing nutrient losses and degrading soil properties. This leads to environmental issues like greenhouse gas emissions and air pollution. Using machinery-based residue management practices, such as zero till drills and happy seeders, can mitigate negative impacts, promote microbial activity, and improve soil and environmental health.



### INTRODUCTION

Modern input-intensive farming techniques resulted in linear growth in crop residual production. These agricultural wastes are frequently burned often by farmers, which has adverse impacts on the environment. (Blanco-Canqui & Lal, R.2009). A well-known and widely accepted method for managing different soil physical, chemical, and biological functions is crop residue management. Crop residues have an impact on soil water movement, runoff, and infiltration as well as the number of nutrients that are incorporated into the soil for crop production. Conservation-based management of crop residue by maintaining soil organic matter levels, agriculture can increase soil productivity and crop yield. Increased OM at the soil surface and improved nitrogen cycling and retention are two important benefits of surface-residue management. Increased microbial activity and biomass at the soil's surface serve as a storage area for nutrients essential for crop production and improve long-term stability to allow for more absorption. Changes also exist in the soil's chemical and physical properties in addition to the altered nutrient distribution throughout the soil profile. A practical strategy to decrease agriculture's environmental impact is only through higher crop residues management and decreased soil carbon sequestration. The agricultural sector in India generates a large volume of crop residues (Pandit *et al.*, 2020). The distribution and availability of the residues are highly spatiotemporal due to the diversity in the cropping practices and agroclimatic conditions across the country. According to Hiloidharriet *et al.* (2014), the gross crop residue in India was 686.2 Mt, out of which 234.5 Mt (34.2 %) surplus residues were available for use. Annual

output of 110 Mt of wheat, 122 Mt of rice, 71 Mt of maize, 26 Mt of millets, 141 Mt of sugarcane, 8 Mt of fibre crops (jute, cotton), and 28 Mt of pulses results in 500-550 Mt of agricultural residue, both on and off the farm. Surplus residues are burnt after the harvesting by the farmers in the fields. The surplus residue is expressed as ‘total residue – used for cattle animal, looking as fuel, organic fertilizer’.

**Table:1. Crop-wise gross and surplus residue potential in India**

Crop group	Gross residue (Mt)	Surplus residue (Mt)
Cereal	367.7	90.1
Oilseed	48.8	13.7
Pulse	17.9	4.83
Sugarcane	110.6	55.7
Horticulture (Banana, Coconut, Arecanut)	61.4	22.5
Others (Cotton and jute)	79.8	47.3
<b>Total (Mt)</b>	<b>686.2</b>	<b>234.5</b>

(Source: Hiloidhari et al. 2014)

❖ **Production of crop residues:**

Crop residues generate per year by Punjab (51 Mt), Maharashtra (60 Mt), and Uttar Pradesh (60 Mt) produce the most crop residues (46 Mt). Cereals provide the most residues (352 Mt) among various crops, followed by fibres (66 Mt), oilseeds (29 Mt), pulses (13 Mt), and sugarcane (12 Mt). 70% of the agricultural wastes seem to be from cereal crops (rice, wheat, maize, and millets), with rice contributing for 34% of the total. The top and leaves of sugarcane produce 12 Mt of agricultural residues in India or 2% of all crop residues. (NPMCR.2014).

❖ **Losses during the burning of crop residue:**

**Nutrient loss:**

In addition to organic carbon, it is predicted that burning one tonne of rice straw results in losses of 5.5 kg of nitrogen, 2.3 kg of phosphorus, 25 kg of potassium, and 1.2 kg of sulphur. Crop residues from various crops often contain N is made up of 80% nitrogen, 25% phosphorus, 50% sulphur, and 20% potassium (K). The amount of N, P, K, and S lost as a result of completely burning the rice straw were 100, 20.1, 19.8, and 80.2%, respectively. Thus, there would be losses from the burning wheat straw of



100, 22.2, 21.8, and 75.0%. The loss of each nutrient was less due to partial burning of the agricultural residues as compared to complete burning.

**Table:2 Loss of nutrients due to burning of Crop residue.**

Crop Residues	N Loss	P Loss	K Loss	Total
	Mt/year			
Rice	0.236	0.009	0.2	0.45
Wheat	0.079	0.004	0.061	0.14
Sugarcane	0.079	0.001	0.033	0.84
<b>Total</b>	<b>0.394</b>	<b>0.014</b>	<b>0.295</b>	<b>1.43</b>

[Source: Jain *et al.* (2014)]

❖ **Impact on soil properties:**

**Physical properties:**

Burning agricultural waste reduces the soil's organic matter content, which affects the physical health of the soil. Maintaining crop residues is crucial for protecting soil aggregates from the impact of incoming raindrops. Poor organic matter content causes the breakdown of soil aggregates and the destruction of soil structure. The physical protection against wind and water is provided by agricultural residue remaining on the soil's surface. Burning crop wastes exposes the soil, making it vulnerable to wind and water erosion. The direct exposure of bare soil to sun radiation causes an increase in soil temperature, which is unfavourable for plants and other soil organisms. In addition, the soil is losing moisture, which increases the risk of crop failure in regions with a lack of water.

**Chemical properties:**

Burning of crop residues leads to loss of organic matter from the soil which can potentially deteriorate soil productivity and soil health due to decrease organic matter content. The amount of N and C in the top 0–15 cm of the soil profile decreases as a result of the decreasing organic matter content, which also causes the pH of the soil to rise towards alkalinity. Reduced cation exchange capacity, an essential indicator of soil fertility, is a result of decreased levels of organic matter. Agricultural residue is a significant and economical source of organic carbon and nutritional components. however, when they are burned off, they are lost.

It is estimated that when one tonne of paddy straw is burnt, it accounts for the loss of approximate 5.5 kg nitrogen, 2.3 kg phosphorus, 25 kg potash, 1.2 kg sulphur, all secondary nutrients, 50 to 70 percent of

various essential micronutrients, as well as organic carbon (Anonymous 2014). But, if the crop residue is retained or applied to the soil, it enriches the soil with organic matter and nutrients, especially organic nitrogen and carbon.

### Biological properties:

Burning crop residue may destroy pests and diseases associated with the stubble and straw of earlier crops while also increasing mineralization, which results in an increase in nutrients available for the plants (Thakur et al. 2019). However, the heat produced by burning crop residues raises the soil's temperature and kills beneficial soil organisms. 1 cm of soil is heated by burning paddy straw, increasing the soil's temperature to 33.8 to 42.2°C. This kills the fungal and bacterial populations critical for fertile soil. Burning wheat straw may destroy 50% of the bacterial population up to 2.5 cm soil depth (Hesammi *et al.* 2014).

### IMPACT ON ENVIRONMENT

Burning crop residues cause several environmental issues. Burning crop residue primarily has adverse impacts on the environment, including the emission of greenhouse gases (GHGs) that contribute to global warming, increased levels of particulate matter (PM) and smog that create health risks, decreased in the biodiversity of agricultural lands, and decrease soil fertility (Lohan. S. K. 2018).

Burning crop residue increases the number of air pollutants such as CO<sub>2</sub>, CO, NH<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, non-methane hydrocarbon (NMHC), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and particulate matter (PM) by a large amount. (Mittal, S. K.2009). As a result, the residue burning in India's northwest contributes to around 20% of the country's total emissions from burning agricultural waste, including organic and inorganic.



## IMPACT ON MICROORGANISMS

There is a greater diversity of microorganisms, especially those which live in the soil (Maron *et al.* 2011). an increase in density in the soil's uppermost layers. As a result, the degradation of soil organic matter, including crop residues, maintains soil structures while decreasing crop residue, which substantially impacts the biogeochemical cycling of nutrients. Via the mineralization-immobilization of soil organic matter, soil microbes are essential in mediating changes in the soil TOC (Breulmann *et al.* 2014). A significant proportion of components, such as carbon, nitrogen, and sulphur, vaporise during burning and are subsequently lost from plant residues as a result of volatilization (Raison 1979).

## BENEFITS OF CROP RESIDUE MANAGEMENT

- **On the soil:**

Conserving soil organic matter (SOM) levels through crop residue management can increase soil productivity and crop production. Enhanced nitrogen cycling and retention and higher OM at the soil surface are two important benefits of surface-residue management. Increased microbial activity and biomass at the soil's surface provide a reservoir for nutrients essential for crop production and improve soil structural stability to allow for more penetration. One of these responsibilities is protecting the soil from wind and water erosion. The risk of soil erosion increases when crop waste is removed because it exposes the soil surface to erosive forces. Although most people are focused on water erosion, wind erosion may be just as harmful. This is particularly true in areas that face rolling hills and strong winds frequent, both of which contribute to soil erosion.

- **On the environment:**

Retaining crop residues has various ecological and environmental advantages for the soil, water, and plant system, including improved soil structural quality. Crop residue management, with its potential to reduce the need for fossil fuels and the carbon dioxide emissions that result from improper in-situ incorporation of residue, improves the environmental quality, that would've been negatively affected by the field crop residue burning practice.

- **On microorganism:**

Soil microbial communities play an important role in the soil ecosystem process and the biogeochemical cycle of fundamental elements, such as nitrogen and carbon. Agricultural residue returning can increase the amount of organic matter in soil and provide suitable habitat for the growth and proliferation of microorganisms. fatty acid analysis was used to evaluate the community structure of cultivable bacteria and fungi, and two substrate utilisation assays were used to define the overall soil microbial community structure. When compared to black polyethylene mulch, hairy vetch cover

cropping did not substantially increase crop yield, but had a significant effect on the structure of the microbial community. When compared to inorganic fertilizer, crop productivity under the black polyethene mulch was significantly increased by the highest levels of compost and manure, but there was no visible impact on the structure of the soil microbial community.

❖ **PRACTICES OF CROP RESIDUE MANAGEMENT BY MACHINERY:**

**Machinery used to retain crop residue on the soil surface:**

i. **Zero till drill:** it is the tractor-drawn sowing machine with the invented ‘T’ type. Furrow openers are fitted.

**Advantages:** Capable of direct sowing the crop without tillage Simple design, operation and maintenance.

**Limitations:** Unsuitable due to clogging of furrow openers in open crop residue.



ii. **Happy seeder:** it is a PTO-driven machine with attached flails/blades for cutting stubble at the front and a hoe sowing system.

**Advantages:** capable and doing buried and exposed ruins direct sowing in the field.

**Limitation:** ineffective in cutting damp residue.



iii. **Mulcher:** it is a tractor PTO-driven machine, which chops crop residue into small pieces.

**Advantages:** Incorporation of crop residues cut by mulcher into the soil by simple machines like disc harrow.

**Limitations:** Additional field handling and timing for sowing



iv. **Rotary disc drill:** it is a tractor-driven machine. It is fitted with a soil razor disc at the front and a sowing system at the rear.

**Advantages:** Effective on dry and moist residues able to cut

- Capable of sowing even after the residues have been mixed in the soil.

**Limitation:** Commercial and non-availability.





## ❖ SUITABLE MACHINERY FOR INCORPORATION OF CROP RESIDUE INTO THE SOIL:

i. **Rotavator:** This tractor is the main PTO-driven tillage equipment fitted with L or C-type blades.

**Advantages:** Suitable for soil application of compacted residues or loose residues (4-5 tonnes per hectare)

**Limitations:** Additional field for sowing operational requirement from long-term use subsurface hardening



ii. **Super seeder:** It is an active type sowing machine with 'LJF' type blades at the front and a seed sowing system at the rear.

**Advantages:** Direct sowing of the crop in case of compacted and loose residues.

**Limitations:** High fuel consumption and high horsepower and wear of blades.



iii. **Mouldboard Plough:** It is the main implement for the primary ploughing of the soil.

**Advantages:** Capable of burying the residues more deeply in the soil.

- Useful in burying the weed seeds present in the upper surface to a depth.

**Disadvantages:** excess of energy and time need for additional field operations for seedbed preparation and sowing.



## CONCLUSION

The agricultural sector generates a large volume of crop residues along with there will be more burning of crop residues which will be directly impacting on soil nutrients, soil properties, environment, as well as microbial activity. Burning of crop residue leads to the loss of valuable nutrients contained in it. Soil health deteriorates and harmful air pollutants are released so there is a great challenge to agriculturists to manage crop residues effectively and efficiently for enhancing the sequestration of carbon and



maintaining the sustainability of production. As a result, for the welfare of society, agricultural production, and environmental safety, effective management and optimum utilisation of crop residue are now required. And practising the management of crop residue by the machinery to enhance the soil fertility status by improving/ maintaining soil chemical and nutritional properties.

## REFERENCES

- Blanco-Canqui, H & Lal, R. (2009). Crop residue removal impacts soil productivity and environmental quality. *Critical reviews in plant science*, 28(3), 139-163.
- Breulmann, M., Masyutenko, N. P., Kogut, B. M., Schroll, R., Dörfler, U., Buscot, F & Schulz, E. (2014). Short-term bioavailability of carbon in soil organic matter fractions of different particle sizes and densities in grassland ecosystems. *Science of the total environment*, 497, 29-37.
- Chen, J., Gong, Y., Wang, S., Guan, B., Balkovic, J & Kraxner, F. (2019). To burn or retain crop residues on croplands? An integrated analysis of crop residue management in China. *Science of The Total Environment*, 662, 141-150.
- Devi, S., Gupta, C., Jat, S. L & Parmar, M. S. (2017). Crop residue recycling for economic and environmental sustainability: The case of India. *Open Agriculture*, 2(1), 486-494.
- Hesammi, E., Talebi, A. B., & Hesammi, A. (2014). A review of the burning of crop residue on the soil properties. *WALIA J*, 30, 192-194.
- Jain, N., Bhatia, A. & Pathak, H. (2014). Emission of air pollutants from crop residue burning in India. *Aerosol and Air Quality Research*, 14(1), 422-430.
- Lohan, S. K., Jat, H. S., Yadav, A. K., Sidhu, H. S., Jat, M. L., Choudhary, M & Sharma, P. C. (2018). Burning issues of paddy residue management in north-west states of India. *Renewable and Sustainable Energy Reviews*, 81, 693-706.
- Maron, P. A., Mougél, C., & Ranjard, L. (2011). Soil microbial diversity: methodological strategy, spatial overview and functional interest. *Comptes rendus biologies*, 334(5-6), 403-411.
- Mittal, S. K., Singh, N., Agarwal, R., Awasthi, A & Gupta, P. K. (2009). Ambient air quality during wheat and rice crop stubble burning episodes in Patiala. *Atmospheric Environment*, 43(2), 238-244.
- Pandit L, Sethi D., Pattanayak S.K. and Nayak Y. (2020) Bioconversion of lignocellulosic organic wastes into nutrient rich vermicompost by Eudriluseugeniae. *Bioresource Technology Reports* 12, 100580.
- Raison, R. J. (1979). Modification of the soil environment by vegetation fires, with particular reference to nitrogen transformations: a review. *Plant and soil*, 51, 73-108.



Thakur, J. K., Mandal, A., Manna, M. C., Jayaraman, S & Patra, A. K. (2021). Impact of residue burning on soil biological properties. *Conservation Agriculture: A Sustainable Approach for Soil Health and Food Security: Conservation Agriculture for Sustainable Agriculture*, 379-389.

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## MUCOSA-ASSOCIATED LYMPHOID TISSUE IN BIRDS: AN INTEGRAL COMPONENT OF AVIAN IMMUNE DEFENSE

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### ABSTRACT

*The mucosa-associated lymphoid tissue (MALT) in birds plays a crucial role in maintaining their overall health and survival by serving as a frontline defense against pathogens that attempt to break the body's various mucosal surfaces. This article explores the structure, function and significance of MALT in avian species along with the unique adaptations that make birds resilient to a wide range of infectious agents. By understanding MALT's mechanisms of action in birds, it may prove very beneficial to enhance the avian health.*

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**KEY WORDS:** Mucosa, Lymphoid, Birds, Gut, Tissue

### INTRODUCTION

Mucosa-associated lymphoid tissue (MALT) is a specialized part of the immune system that exists along the mucosal surfaces of various organs such as the respiratory, gastrointestinal and urogenital tracts. In birds, MALT holds prime importance because of the airborne nature of many pathogens and their susceptibility to causing countless infections. Thus, this article aims to provide a comprehensive analysis of MALT in birds, explaining its structural components, functional aspects and significance in avian health.

### STRUCTURE OF MALT IN BIRDS

MALT in birds comprises several lymphoid structures that serve as the immune response in primary sites. The most prominent components of avian MALT are the bursa of Fabricius, gut-associated lymphoid tissue (GALT), and bronchus-associated lymphoid tissue (BALT). The bursa of Fabricius, located near the cloaca, plays a crucial role in B-cell development and maturation. GALT encompasses various lymphoid nodules, Peyer's patches, and ceecal tonsils along the intestinal tract, while BALT exists in the respiratory system to fight with airborne pathogens. Other type of MALT's distribution in different mucosal organs also ensures comprehensive protection against a wide range of pathogens.

## TYPES OF MALT IN BIRDS

The mucosa-associated lymphoid tissue (MALT) constitutes as an essential part of the avian immune system serving as the first line of defense against pathogens that enter the body through mucosal surfaces. In birds, MALT is distributed in various regions of the respiratory, gastrointestinal, and urogenital tracts. Different types of MALT present in birds have different structures, organization and immune functions.

### 1. Gut-Associated Lymphoid Tissue (GALT):

GALT is the most extensively studied type of MALT in birds. It includes the various structures such as the tonsils, ceecal and colonic patches and the bursa of Fabricius. The bursa of Fabricius, is a unique avian organ which plays a critical role in B cell development and antibody production. Additionally, the ceecal and colonic patches contribute to the regulation of gut micro flora and immune responses.

### 2. Bronchus-Associated Lymphoid Tissue (BALT):

BALT is a crucial component of the avian respiratory defense system. It is primarily located in the bronchial walls and facilitates immune responses against airborne pathogens. BALT plays a key role in generating local and systemic immune responses to respiratory infections, including viral and bacterial agents.

### 3. Conjunctiva-Associated Lymphoid Tissue (CALT):

CALT is found in the conjunctival mucosa of the avian eye. It serves as a defense barrier against ocular pathogens and its organization allows for efficient immune surveillance of the eye and its surrounding tissues.

### 4. Cloacal-Associated Lymphoid Tissue (Cloacal MALT):

The cloacal MALT is present in the avian urogenital tract mainly in the cloaca region. Its role in immune defense against urogenital infections is crucial for maintaining reproductive health and overall well-being in birds.

### 5. Nasal-Associated Lymphoid Tissue (NALT):

NALT is located in the nasal cavity of birds and participates in the protection against inhaled pathogens. It shares functional similarities with mammalian nasal-associated lymphoid tissue and contributes to respiratory immune responses.

### 6. Other MALT-Related Structures:

This section covers additional avian MALT-related structures and their roles in the immune system. It includes the Harderian gland, specialized ceecal tissues and other lesser known MALT structures.

## **FUNCTIONS OF MALT IN BIRDS**

The main function of MALT in birds is to detect and neutralize pathogens that attempt to break the mucosal barriers. MALT achieves this through a combination of innate and adaptive immune responses. The innate immune response involves the presence of specialized immune cells like macrophages, dendritic cells and natural killer cells. These cells serve as the first line of defense which rapidly identify and eliminate invading pathogens. The adaptive immune response is primarily mediated by B and T lymphocyte which provides long-lasting immunity upon exposure to specific antigens.

## **MALT ADAPTATIONS IN BIRDS**

Avian MALT exhibits several unique adaptations that contribute to its effectiveness in fighting with the infections. One remarkable adaptation is the diversification of avian immunoglobulins. Birds possess five classes of immunoglobulins - IgM, IgY, IgA, IgD, and IgE. Out of these, IgY being the predominant antibody isotype in circulation. IgY serves as a functional analog of mammalian IgG and plays a crucial role in passive immunity transfer from mother to offspring through egg yolk.

Additionally, birds lack a true lymph node structure but have organized lymphoid aggregates known as lymphoid nodules, dispersed along the mucosal surfaces. This arrangement ensures rapid and effective immune responses to pathogens encountered at various entry points.

## **SIGNIFICANCE OF MALT IN AVIAN HEALTH**

The significance of MALT in bird is of great importance as it directly impacts their survival and reproductive success. Pathogen exposure is unavoidable especially in the wild birds and MALT's ability to recognize and neutralize these threats reduces the risk of infections which could be harmful to individual bird or entire population. Furthermore MALT's role in the development of oral tolerance prevents harmful immune reactions also and thereby maintaining gut health and nutrient absorption.

## **CHALLENGES AND FUTURE PERSPECTIVES**

Despite its importance, avian MALT can face challenges that compromise immune defenses. Environmental factors, stress, and changes in habitat can impact MALT function and consequently, the overall health of birds. Understanding these factors and their influence on MALT is crucial for conservation efforts and disease management especially in wild bird populations.

## **CONCLUSION**

The mucosa-associated lymphoid tissue (MALT) in birds is an essential component of their immune defense system. Its unique adaptations and strategic distribution along mucosal surfaces equip the birds with the ability to fight with the diverse range of pathogens effectively. The study of MALT in birds



provides valuable insights into avian health, disease prevention and conservation strategies that can benefit both captive and wild avian populations.

## REFERENCES

- Casteleyn, C., Doom, M., Lambrechts, E., Van den Broeck, W., Simoens, P., & Cornillie, P. (2010). Locations of gut-associated lymphoid tissue in the 3-month-old chicken: a review. *Avian pathology: journal of the W.V.P.A.*, 39(3), 143–150.
- Cesta, M. F. (2006). Normal structure, function, and histology of mucosa-associated lymphoid tissue. *Toxicologic pathology*, 34(5), 599–608.
- Nochi, T., Jansen, C. A., Toyomizu, M., & Van Eden, W. (2018). The Well-Developed Mucosal Immune Systems of Birds and Mammals Allow for Similar Approaches of Mucosal Vaccination in Both Types of Animals. *Frontiers in nutrition*, 5, 60.
- Reese, S., Dalamani, G., & Kaspers, B. (2006). The avian lung-associated immune system: a review. *Veterinary research*, 37(3), 311–324.
- Van Ginkel, F. W., Gulley, S. L., Lammers, A., Hoerr, F. J., Gurjar, R., & Toro, H. (2012). Conjunctiva-associated lymphoid tissue in avian mucosal immunity. *Developmental and comparative immunology*, 36(2), 289–297.

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## SUSTAINABLE FERTILIZATION PRACTICES FOR DATE PALM CULTIVATION

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### ABSTRACT

*This article offers a comprehensive overview of effective fertilization practices for date palms, including understanding nutrient requirements, soil analysis, fertilizer selection, optimal application timing, proper techniques, and monitoring tree response. By following these guidelines, growers can promote healthy growth, maximize fruit yield, and contribute to a thriving date palm industry with sustainable cultivation and abundant harvests of quality dates.*

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### INTRODUCTION

Date palms (*Phoenix dactylifera*) are majestic trees that have been cultivated for centuries for their delectable fruits, cultural significance, and aesthetic appeal. Whether you are a commercial grower or a homeowner with date palms in your landscape, proper fertilizer application is essential to promote healthy growth, enhance fruit production, and ensure the overall vigor of these remarkable trees. Fertilizers provides date palms with the necessary nutrients they require for their metabolic processes, including photosynthesis, root development, and fruit formation. Fertilizers replenish the soil with essential elements that may be lacking naturally or have been depleted over time due to previous crop growth or other factors.

However, achieving the optimal fertilizer application for date palms requires careful consideration of various factors, including the specific nutrient requirements of the trees, soil conditions, and appropriate application techniques. By understanding the nutrient needs of date palms and implementing proper fertilizer application techniques, growers can ensure their trees receive an adequate and balanced supply of essential elements. This will foster healthy growth, improve the tree's ability to withstand environmental stresses, and optimize the yield and quality of the delicious dates they produce.

This comprehensive exploration emphasizes the significance of grasping nutrient requirements, conducting soil analysis, choosing suitable fertilizers, determining the best timing for application, employing appropriate techniques for application, and closely monitoring the tree's response. These steps

are vital in developing a comprehensive fertilizer management plan for date palms, promoting their long-term health and productivity. Whether you are starting a new date palm plantation or looking to improve existing trees, this resource provides the knowledge and practical insights needed to apply fertilizer techniques effectively. Following these guidelines will promote the vitality and success of your date palm trees, leading to a thriving and productive landscape or commercial operation.

## **UNDERSTANDING NUTRIENT REQUIREMENTS**

To ensure the best growth and development of date palms, it is crucial to know their nutrient needs, including macronutrients like nitrogen, phosphorus, and potassium, which are essential for vegetative growth, root development, and fruit quality. Secondary nutrients (calcium, magnesium, and sulfur) and micronutrients (iron, manganese, zinc, copper, and boron) also play vital roles in various metabolic processes. Maintaining a balanced nutrient profile is essential to facilitate optimal uptake and utilization by date palms, and a soil analysis assists in tailoring fertilizer recommendations based on specific site requirements.

## **SOIL ANALYSIS**

Before implementing a fertilization program, conducting a soil analysis is advisable. This process helps assess existing nutrient levels and pH, enabling customized fertilizer recommendations. Collect soil samples from different locations within the root zone and send them to a reputable laboratory for analysis.

## **FERTILIZER SELECTION**

Based on soil analysis results, select fertilizers that address specific nutrient deficiencies along with farmyard manure (compost), respectively. Date palms typically benefit from a balanced fertilizer with an N-P-K ratio of 12-12-17 or similar. Slow-release fertilizers are recommended to provide nutrients steadily over an extended period. Ensure chosen fertilizers also include necessary micronutrients.

## **FERTILIZATION TIMING**

Timing plays a crucial role in fertilizer application for date palms. Apply the first round of fertilizer in late winter or early spring, just before new growth begins. This promotes vigorous vegetative growth and sets the foundation for fruit development. The second application should occur in late spring or early summer to support optimal fruit maturation.



**Fig 01: Fertilizers and Organic Manure Selection**

## **EFFECTIVE FERTILIZER APPLICATION TECHNIQUES**

### **Broadcast Application**

Begin by scattering farmyard manure and fertilizer evenly across the entire root zone area beneath the tree canopy, avoiding direct contact with the trunk or fronds. Using a handheld spreader or mechanical spreader can help achieve an even distribution of the fertilizer. Pay close attention to the recommended application rates provided by the fertilizer manufacturer to avoid over or under-fertilization. After applying the farmyard manure and fertilizer, thoroughly water the area to facilitate nutrient uptake into the soil and root system. Ensuring uniform distribution of the fertilizer is crucial to prevent uneven nutrient availability and potential damage to the tree.

### **Banding Application**

Begin by creating shallow trenches or furrows around the tree's drip line, ensuring they are at least 2 to 3 feet away from the trunk. The depth of these trenches should be around 6 to 8 inches. Directly apply the farmyard manure and fertilizer into the trenches, adhering to the recommended application rates. Once applied, backfill the trenches with soil, fully covering the fertilizer. This approach allows for a more focused and efficient delivery of nutrients to the tree's roots, promoting better nutrient uptake. After fertilization, thoroughly water the area to aid in dissolving and distributing the nutrients within the soil.





**Fig 02: Applying Organic Manure (Left), and NPK Fertilizers (Right) to the date palms**



**Fig 03: Stones picking from the basin (Left), backfilling the trenches with soil (Right)**

Both methods can be effective, but the choice of technique may depend on factors such as the size of the tree, soil conditions, and available equipment. It is essential to follow the fertilizer manufacturer's instructions regarding application rates and timing. In addition to the application techniques, it is crucial to consider irrigation practices after fertilizer application. Adequate watering helps dissolve and distribute the nutrients within the soil, making them accessible to the roots. Regular monitoring of the tree's response to fertilization, including visual observations and periodic soil testing, can guide adjustments to the fertilizer application technique or nutrient ratios if necessary.

By employing appropriate fertilizer application techniques, date palm growers can ensure a consistent and efficient supply of nutrients to their trees, promoting healthy growth and maximizing fruit production.



## IRRIGATION PRACTICES

Proper irrigation is essential to facilitate nutrient absorption and prevent fertilizer burn. After fertilizer application, irrigate the area thoroughly to help dissolve and distribute the nutrients throughout the root zone. Maintain a regular watering schedule to keep the soil moisture levels consistent but avoid overwatering, as it can lead to root rot and nutrient leaching.



**Fig 04: Irrigating the Date Palms with Drip pipes (Left), normal hose pipes (Right)**

## MONITORING AND ADJUSTMENTS

Regular monitoring of the tree's health and growth is crucial to identify any nutrient deficiencies or excesses. Visual symptoms such as yellowing fronds or stunted growth may indicate specific nutrient imbalances. Adjust the fertilization program accordingly, either by increasing the frequency or adjusting the nutrient ratios based on observed deficiencies.

## CONCLUSION

Proper fertilization application is crucial for the health and productivity of date palms. Understanding nutrient requirements, conducting soil analysis, selecting suitable fertilizers, and employing appropriate application techniques are key factors in optimizing growth and fruit production. By following these guidelines, date palm growers can ensure their trees receive the essential nutrients they need, leading to healthy, vibrant trees and abundant, high-quality fruit.

## REFERENCES

Ait-El-Mokhtar, M., Baslam, M., Ben-Laouane, R., Anli, M., Boutasknit, A., Mitsui, T., Wahbi, S., & Meddich, A. (2020). Alleviation of detrimental effects of salt stress on date palm (Phoenix

dactylifera L.) by the application of arbuscular mycorrhizal fungi and/or compost. *Frontiers in Sustainable Food Systems*, 4, 131.

Al-Bahrany, A. M., & Al-Khayri, J. M. (2012). Optimizing in vitro cryopreservation of date palm (*Phoenix dactylifera* L.). *Biotechnology Journal*, 11(2), 59– 66.

Ezz, T. M., Kassem, H. A., & Marzouk, H. A. (2010). Response of date palm trees to different nitrogen and potassium application rates. In *IV International Date Palm Conference* (pp. 761–768). *ISHS Acta Horticulturae*.

Marzouk, H. A., & Kassem, H. A. (2011). Improving fruit quality, nutritional value and yield of Zaghloul dates by the application of organic and/or mineral fertilizers. *Scientia Horticulturae*, 127(3), 249– 254.

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## NANO FERTILIZERS: TRANSFORMING INDIAN AGRICULTURE FOR A SUSTAINABLE FUTURE

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### ABSTRACT

*Nano fertilizers have emerged as a transformative technology in agriculture, offering a solution to India's challenges of soil fertility decline and water scarcity. These nanoparticles deliver nutrients directly to plant cells, enhancing nutrient efficiency and minimizing environmental impact. Nano fertilizers provide numerous advantages, including improved nutrient uptake, increased crop yields, water conservation, eco-friendliness, and tailored formulations for specific crops. However, barriers like cost and awareness hinder widespread adoption. To promote sustainable agriculture, the Indian government supports nano fertilizers through research grants and collaborations. Further development and accessibility of nano fertilizers to small-scale farmers are essential for fostering a sustainable agricultural ecosystem.*



### INTRODUCTION

Nanotechnology has made enormous advancements in the last few years, and its uses now go well beyond those of electronics and medicine. One such groundbreaking application is in agriculture - introducing nano fertilizers. Nano fertilizers appear as a viable approach for improving how we cultivate crops as India's agricultural industry faces mounting difficulties, including declining soil fertility and water scarcity. We shall examine the wonder of nano fertilizers, their potential advantages, and how they are transforming Indian agriculture in this article.

### THE RISE OF NANO FERTILIZERS

Conventional fertilizers have long been the backbone of Indian agriculture, ensuring higher crop yields and increased food production. They do, however, have a number of limitations. The overuse of chemical fertilizers has resulted in soil degradation, pollution of the ecosystem, and nutrient imbalances. On the other hand, nano fertilizers present a ground-breaking strategy that confronts these difficulties head-on.

Nano fertilizers are nanoparticles created specifically to deliver micronutrients, nitrogen, phosphorous, and potassium to plants. These tiny particles, which are hundreds of times smaller than a human hair, enable plants to receive nutrients precisely at the cellular level. This method of regulated

release not only improves crops' ability to absorb nutrients but also reduces waste and harm to the environment.

## ADVANTAGES OF NANO FERTILIZERS

1. *Improved Nutrient Efficiency:* Nano fertilizers release nutrients gradually, guaranteeing a consistent supply to the plants for a long time. Because of the increased nutrient uptake, less fertilization is required.
2. *Enhanced Crop Yield:* Better nutrient uptake by plants is made possible by the controlled nutrient delivery, which results in healthier and more productive crops. Farmers can increase yields without using more fertilizer.
3. *Water Conservation:* Nutrient leaching is considerably decreased with nano fertilizers, reducing groundwater contamination. This helps conserve vital water resources, especially in areas where there is a shortage of water.
4. *Environmentally Friendly:* Nano fertilizers have shown the potential to reduce greenhouse gas emissions and prevent soil and water pollution, contributing to a more sustainable agricultural ecosystem.
5. *Customized Nutrient Formulations:* By customizing these fertilizers to meet the needs of a certain crop, it is possible to provide plants the well-balanced nutrient profile they need for optimum growth.

## CHALLENGES AND ADOPTION

As with any emerging technology, the adoption of nano fertilizers in India is not without challenges:

1. *Cost:* Due to the complicated production procedures needed, nano fertilizers can now be more expensive than conventional fertilizers. The top objective is to make them inexpensive and cost-effective for small-scale farmers.
2. *Research and Awareness:* Widespread usage requires intensive research and development to improve application methods and formulations. A successful deployment also depends on teaching farmers about the advantages and proper application of nano fertilizers.

## GOVERNMENT INITIATIVES

The Indian government has made substantial efforts to encourage the use of nano fertilizers as a result of its recognition of their potential. Public-private collaborations, research grants, and other initiatives aimed at promoting the further development and accessibility of nano fertilizers across the nation.

## CONCLUSION

Nano fertilizers represent a new era in Indian agriculture, promising to revolutionize the way we nourish our crops and protect our environment. They are an effective tool for sustainable farming because of their ability to increase agricultural output, preserve water, and reduce environmental effects. The future



of agriculture appears more promising than ever as India adopts this cutting-edge technology, ushering in a new era of food security and ecological balance. Nano fertilizers have the potential to significantly influence how the country's agricultural environment is shaped in the years to come with continuing study, assistance, and collaboration.

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