PACKAGE AND PRACTICES OF DIFFERENT CROPS FOR TAMILNADU STATE

RICE[1]

Tamil: Nellu; arisi **Botanical Name:** ***Oryza sativa***

Rice can be grown in both tropical and sub-tropical zones. The crop requires a high temperature, high humidity and optimum moisture during its growth. The average temperature ranges between 21–35° C. More uniform and warm conditions enable more than one crop to be taken per year. There are both photo-sensitive and photo-insensitive rice varieties, the latter having a shorter maturation period.

Cropping system

Crop rotation is an agronomic practice followed by farmers to make use of nutrients present in the soil in the best possible way. In various districts of Tamil Nadu such as south Arcot, north Arcot and Chengalpattu, banana, sugarcane and betel are cultivated as alternative crops for paddy. Cultivating Sesbania as an intermediate crop between two paddy crops gives good results. The following sequence can be maintained.

Seasons	**Samba (July–Jan.)**	**Navarai (Dec.–Mar.)**	**Sornavari (April–Aug.)**
Crops	Paddy	Black gram	Sesame
	Paddy	Ground nut	Paddy
	Paddy	Cotton	--
	Paddy	Vegetables	Green manure crops (for seeds)

The crops are planned in such a manner that the nutrients used by the first crop should be replaced by the following crop. The nutrient requirement of the second crop should be different. This will help greatly to maintain the nutrient balance in the soil.

SOIL

Top soil should be ideally 18–23 cm deep. While cultivating paddy, it is always good to study the type, nature and the nutrient content of the soil before adding nutrients. This can be done by having soil samples tested in a soil-testing laboratory. Manure can be applied based on the nitrogen, potassium and phosphorus content of the soil. In paddy cultivation, the yield will be high when the pH of the soil is between 5 and 6.5. The yield will be poor if the pH of the soil is below 5 or above 9. Alluvial soil, sandy clay and clayey soils are suitable for paddy cultivation

VARIETIES

In Tamil Nadu the following varieties are being cultivated:

Varieties resistant to drought: Kattu Samba, Sornavari, Puzhudikar, Puzhudisamba, Mattakkar, Vadansamba, Kullakkar, Gil Gil Samba, GEB – 24, Kuzhiyadichan

Varieties resistant to water logging: Neelansamba, Kudiraival Samba, Kaliyan Samba, Samba Mosanam, Perungar, Koomvazhai, Kudaivazhai

Varieties resistant to both drought and water logging: Kappakkar, Vaigunda, Pichavari, Kurangusamba

Varieties suitable for saline soils: Karuppu nel, Samba, Kuzhiyadichan

Varieties resistant to pest and disease attack: Kappa Samba, Vadan Samba, Kudirai Vali, Kaliyan Samba, Kurangu Samba, Kichali Samba, Muttakkar, Kullakkar, Sigappu Kuruvikkar, Thooyamalle, Sembalai, Kallimadyan, Pitchavari, Sadakar

Variety resistant to brown plant hopper and ear head bug: Neelansamba

Variety resistant to brown plant hopper and rice caseworm: Sigappu Kuruvikkar

Variety resistant to weeds: Vaigund

SEED

Selection of Seeds: Seed selection plays an important role in paddy cultivation. The seeds selected for cultivation should be of uniform size, age and free of contaminants. They should also have good germination capacity.

Separation of quality seed: To separate good seed from bad, soak them in water: the unviable seeds will float on the surface of water. These seeds can be easily removed and the seeds that sink can be used for cultivation. By this method, damaged seeds are easily removed.

Seed rate: The seed rate varies according to the variety to be cultivated. The seed rate required for one hectare of land under irrigated condition is given below:

Short duration variety : 60–70 kg

Medium duration variety : 40–60 kg

Long duration variety : 30–60 kg

Dry and rain fed sowing : 85–100 kg

Treatment: Seed treatment helps to improve germination potential, vigour, and resistance to pests and disease. The different methods of rice seed treatment are:

Soaking the seeds in water: Tie the seeds in a small gunny bag or cloth bag and soak it in water for 12 hours. Later, remove the bag from the water and cover it with a moist gunny bag. The following day, soak the seeds in water for eight hours again. Later, remove the seeds from the water and sow them in the nursery. This method helps to improve the germination capacity of the seeds.

Using cow dung solution: Treating paddy seeds in a cow dung solution enhances their germination. Take ½ kg of fresh cow dung and two litres of cow urine and dilute them with five litres of water. Soak 10–15

kg seeds first in water for 10–12 hours and then in the cow dung solution for 5–6 hours. Dry the seeds in the shade before sowing them in the nursery.

Using goat dung solution: Treating 30-day old seeds for one day in a goat dung solution increases their germination.

Using cow's urine solution: Dilute 500 ml of cow's urine in 2.5 litres of water. Tie the seeds in small bags and soak them in the urine solution for half an hour. Dry the seeds in the shade before sowing them.

Using sweet flag extract: Dissolve 1.25 kg of sweet flag rhizome powder in six litres of water. Tie the seeds in small bags and soak them in the extract for half an hour. Dry the seeds in the shade before sowing. (This is the quantity required for treating seeds to be sown in one hectare.)

Using Salvadora persica: Spread the leaves of Salvadora persica at the bottom of a closelyknit bamboo basket, then fill it with seed and pour about 10 to 12 litres of water over the basket. Cover the basket with the Salvadora leaves and place a weight over it. Leave the seeds undisturbed for 24 hours. The seeds are then ready to be used for sowing in the nursery. This procedure helps in early and vigorous germination. Treatment of rice seed with amrut pani/panchagavya/cow pat pit manure/jeevamrut is also effective. The efficiency needs to be evaluated.

Using biofertilisers: Biofertilisers like azospirillum/azotobacter/pseudomonas (@ 1.25 kg/ha) are first mixed in one litre of cooled rice gruel. Spread the sprouted seeds on a clean floor, add the biofertiliser slurry and mix well. The mixing of seed and biofertiliser slurry can be done in a pot as well. Dry the seeds in the shade for 30 minutes before sowing. Drying the seeds for half an hour in the bright sun before sowing improves germination and seedling vigour.

MANAGING SOIL FERTILITY

From the day of sowing till harvest, the plants take in several nutrients from the soil. It is therefore essential to replace the used nutrients back in the soil for the next season crop and to retain soil fertility. The nutrients required by the plants can be supplied from organic sources such as farmyard manure, green manure, green leaf manure, vermicompost and biofertilisers. These manures help prevent soil erosion and also improve the infiltration capacity of the soil.

Farmyard manure: Wastes of cattle, goat and pig are generally used as farmyard manure. All the nutrients required by the plants are present in small quantities in this manure. They remain in the soil for longer periods and produce good results.

Required quantity

Cow dung – 12–15 tonnes/ha
Goat dung – 12.5 tonnes/ha
Poultry waste – 5 tonnes/ha
Pig dung – 2.5 tonnes/ha

Method of use: Any one of the above mentioned manures should be applied as a basal manure during the final ploughing. The farmyard manure should be allowed to decay before it is used. The manure should be applied and ploughed into the soil the same day. When farmyard manure is allowed to remain in the field

without incorporation into the soil for longer periods, there are chances that more than 50% of the nutrients will get wasted due to soil erosion and high temperature.

BIOFERTILIZERS

Some of the microbes that are commonly used in paddy cultivation for the purpose include azotobacter, azospirillum and phosphobacteria. They not only reduce the cultivation cost of using chemical fertilizers but also increase the yield and improve the fertility of the soil.

Plant growth regulators

Panchagavya: This is a growth regulator produced from a combination of five products obtained from the cow fermented along with a few other bioproducts. For coarse varieties, one spray of 3% panchagavya should be given during tillering and bootling stage. For fine varieties, one spray of 3% panchagavya should be given during the bootling stage.

Amirthakaraisal: About 1,250 litres of amirthakaraisal should be mixed with irrigation water for a one-hectare crop. When it is used as a spray, 25 litres are required. This improves the soil fertility and gives good yield.

Green manure

Plants belonging to the family Leguminosae are commonly used for the purpose. These plants absorb atmospheric nitrogen with the help of certain microorganisms found in their root nodules and convert it into a form which can be used by the plants. These plants should therefore be cultivated before the main crop.

Method of application: Green manure plants such as sunhemp, daincha, Indian indigo should be planted before the paddy season. They should be ploughed into the soil 45–50 days after sowing. The plants should be allowed to decay in the water for ten days and then ploughed.

Commonly used green manure plants: Sunhemp (Crotalaria juncea), daincha (Sesbania cannabina), Sesbania (Sesbania speciosa), Wild indigo (Tephrosia purpurea), Indian indigo (Indigofera tinctoria), Tephrosia noctiflora.

Green leaf manure

It is a common practice among farmers to plough in the green leafy twigs of certain plants into their fields. The leaves used for this purpose are termed as green leaf manure.

Uses of green leaf manures: The leaves of these plants are used both as green leaf manure and in the preparation of certain biopesticides. They help to increase the nitrogen content of the soil and minimize expenses towards pest management.

Commonly used green leaf manure plants: Azadirachta indica, Pongamia pinnata, Morinda pubescens are some of the commonly used green leaf manure plants. The siris tree (Albizia lebbeck), the gigantic swallow wort (Calotropis gigantea), spotted gliricidia (Gliricidia sepium), Tanner’s cassia (Cassia auriculata) and white gulmohar (Delonix elata) are other green leaf manure plants.

Oil seed cake

The pith left behind after oil extraction is commonly called oil seed cake and it is a good source of organic nitrogen. There are different kinds of oil seed cakes available such as groundnut cake, neem seed cake and castor seed cake. Generally, neem and groundnut cakes are used for paddy. They supply the paddy crop with the nitrogen that is essential during its initial growth. The quantity needed is given below:

Cake	**Basal manure**	**Top dressing**
Neem seed cake	150 kg/hectare	60 kg/hectare
Groundnut cake	100 kg/hectare	25 kg/hectare

PROBLEM INSECTS

Paddy crops are attacked by a variety of insedcts and diseases. A significant portion (10–51%) of our country's rice production is lost due to pest and disease attack. They decrease the yield to a great extent.

Insects that affect paddy cultivation can be classified into three major categories. They are

Insects at different crop stages:

STAGE	P OSSIBLE AGENT
Seedling	Rice whorl maggot; thrips, defoliators; stem borers; green leaf hoppers, plant hoppers
Tillering	Thrips; defoliators, stem borers; green leaf hoppers; plant hoppers
Minor pests (vegetative phase): aphids, caseworm, black bugs, grasshoppers, mealy bugs	
Stem elongation	Defoliators; stem borers; green leaf hoppers; plant hoppers
Panicle initiation to Bootling	Stem borers; green leaf hoppers; plant hoppers
Heading	Plant hoppers
Flowering	Plant hoppers; thrips
Minor pests (reproductive phase): Green horned caterpillars, skippers	
Mature grain stage	Plant hoppers; rice bugs
Minor pests (reproductive phase): Panicle mites	

<u>Leaf eating caterpillars</u>

1) **Leaf folder (*Cnaphalocrocis medinalis*)**

Symptoms of attack: The leaves of the affected plant will be found rolled in the field. Eggs and larvae can be seen inside the folded leaf blades. In a severely infested field, the whole crop gives a sickly appearance with white patches.

Management:

- Spray 3–5% Andrographis paniculata kashayam.
- Spray garlic, ginger, chili extract.

• Spray 5% neem kernel extract.
• Spread leaves of Sphaeranthus indicus all over the field. The peculiar smell of this plant has the ability to repel leaf folders.
• Release ducks in the field to feed on the pests.
• Install 4–5 branches or twigs of fishtail palm or wild Saccharum in the field to attract predatory birds. • Apply two cartloads of well decomposed farmyard manure before transplanting.

2) Rice case worm (*Nymphula depunctalis*)

Symptoms: The caterpillar cuts the leaves into smaller pieces. The damaged leaves hang as longitudinal rolls at the tip. Some of these can also be found floating on the surface of nearby water bodies. The larvae will be found inside the cut leaf rolls.

Management:

• Larvae found in the field can be controlled using the rope method.
• Spread chopped pieces of Colacasia and Citrus grandis in the field. They act as repellents.
• Drain water from the field for 3–4 days or apply raw cow dung to the standing water. This prevents the respiration of the larvae which is normally through rectal gills.
• Burn old worn out bicycle tyres during evening hours (light traps).

3) Gall midge (*Orseolia oryzae*)

Symptoms: The terminal portion of the crop turns into a tubular gall. When the infestation is severe, the growth gets affected. Onion-leaf like tubular galls are found in the terminal portion
Management:
• Spread fresh leaves of Cleistanthus collinus (@ 10 kg leaves/100 m2 area) in the field at the initial stage of infestation.

4) Short-horned grasshopper (*Hieroglyphus banian*)

Symptoms: The insects damage leaves and also nibble the tender florets and grains. As a result, ear-heads turn white even before they emerge.
Management:
• Spread Calotropis leaves beside the bunds of the field to prevent the entry of grasshoppers.
• Sesbania aegyptiaca can be grown as a hedge around the field.
• Brush the affected crop with branches of Boswellia serrata and place its twigs in the field at a distance of 6–8 m. This should be done in the evening after irrigation.
• A solution of cow dung or goat dung can be used. Take about 30–50 kg of the dung and put this in a gunny bag. The gunny bag is balanced on a pole. Below the gunny bag a drum is kept filled with 100–200 litres of water. The tip of the gunny bag should be kept in such a way that it touches the surface of the water. The gunny bag is shaken twice a day for 15 days. After 15 days the water in the drum will be brown and a foul smell will emerge. This should be diluted with twice the amount of water and sprayed. It acts as a repellant for grasshoppers.

Sap feeders

1) **Brown plant hopper (*Nilaparvata lugens*)**

Symptoms: The crops have a burnt appearance. The affected crop dries up in patches. While walking across the field, one can see hoppers flying about.

Management

• Use of high levels of nitrogenous fertilizers favours the increase of the BPH population. Hence such fertilizers should be used judiciously.
• Water stagnation should be avoided.
• Light traps can be used to monitor and attract BPH adults. The trapped insects can be killed
• Field and bunds should be cleaned of weeds thoroughly as these function as an alternate host for the insects. • BPH can be controlled by practising the traditional 'neekal podum murai'. • The crops should be planted with proper spacing • Leaf extract of Lasiosiphon eriocephalus (nachinaar) is effective in controlling BPH. One kg of the leaves is boiled in ten litres of water, filtered, diluted with water in the ratio of 1 : 10 and sprayed, once during the nursery stage and again after transplantation. • Leaves of Calotropis gigantea can be spread in the interspaces and worked into the field

2) **Mealy bug (Heterococcus rehi)**
   Symptoms: Stunted crops can be found in various portions of the field. When the infestation is severe, panicle formation is affected.
   Management • Neem seed kernel extract can be sprayed.
   • Burn the straw of Paspalum scrobiculatum and Echinochloa frumentacea near the affected field. Insects get drawn and die. They can also be picked physically and killed.

3) **Black bug (Scotinophara coarctata)**

   Symptoms Blast lesions occur on the leaf and leaf sheath. The nymphs and adults feed on the chlorophyll content present in the central portion of the leaves. Hence the leaves break and then hang. The pest will persist in the tillers, leaves and terminal axils.
   Management
   • Apply neem cake as top dressing to control the entry of beetles.

Stem borers

1) **Yellow stem borer (Scirpophaga incertulas)**

Symptoms: A hole made by the larva can be found on the under surface of the stem. White chaffy ears can be seen at irregular intervals all over the field. When the crop is infested at an early stage, growth and tillering is affected.

Management:

• The land should be ploughed immediately after harvest to destroy eggs and pupae.
• Apply neem cake (42–50 kg) as basal manure.
• Neem cake bags can be placed in the irrigation channel.
• Trichogramma cards can be used. The egg cards of the parasitoids, Trichogramma japanicam, Trichogramma presiliensis, Telenomus pelefecience are available commercially.
• These parasitoids are capable of destroying the egg masses of stem borers.
• Male adult moths can be attracted and trapped using pheromone traps. Seven to eight pheromone traps should be used per hectare. By this method the population of the insect pest can be controlled.
• The adult moths can also be attracted using light traps and then destroyed.
• The seedlings should be planted with proper spacing.
• Put branches of Erythrina indica in the field (3–4 m apart).
• Spray turmeric rhizome extract.
• Spread leaves and stems of Datura in the field and allow them to decompose. They act as repellents.

General management of pests

• Place branches of Calotropis in the irrigation channel. The alkaloid present in the latex acts as an insect repellent.
• Boil leaves of Vitex negundo in water (about 30–40 kg of leaves in 10 litres of water) until it condenses to just one litre. To this, add 10 gm of asafoetida and five litres of cow's urine. Mix well, filter and spray. Leaves of Vitex negundo can be broadcast in the field on observing the first symptoms of insect infestation, especially to control pests infecting root and stem in paddy.
• Broadcast leaves or seeds of custard apple (Annona squamosa). The smell of the leaves repel the insects. Leaves are used raw whereas seeds are processed and used as a powder.
• Cut the leaves of Nerium oleander, Datura stramonium, Annona squamosa, Gloriosa superba and fruits of Strychnos nux-vomica into small pieces and put them in a mud pot containing five litres of water. Cover the mouth of the pot with a lid and bury the pot inside a manure heap for a week. Later, heat the contents, allow it to cool, filter and spray. Two to three litres is needed for one hectare, sprayed at intervals of 10 days each.
• Beating an empty tin or drum or tying the carcass of a crow or a piece of black or red cloth to a end of a long pole at the time of maturity scares away birds and prevents them from destroying the grain.
• Take equal quantities of neem leaves and Cissus quadrangularis leaves, grind them together and soak in cow's urine for one week and then filter. Dilute the filtrate with water at 1 : 9 ratio and spray twice at intervals of 15 days.

DISEASES

Rice brown leaf spot *(Helminthosporium oryzae*)

Symptoms This is a seed-borne fungal disease. The leaves show round to oval or irregular brown spots which may coalesce to cause withering of tissues. A velvety growth may be seen on the glumes. Sometimes browning or greyish browning may be seen at the neck region. The grains show reddish brown discolouration. These spots appear like sesame seeds: hence this condition is also known as sesame leaf spot.

Management

• Seed treatment with 20% mint leaf extract for 24 hours.

• Spread the mature leaves of *Cleistanthus collinus* all over the field (25 quintals/hectare) and allow them to decay. Irrigate after three days.

• Dusting of ash checks the spread of this disease

Bacterial leaf blight (*Xanthomonas campestris oryzae*)

Symptoms This is a seed-borne bacterial disease. It is characterized by the appearance of yellow colour, water-soaked lesions on both the edges of the leaves. Later, they coalesce and the entire surface turns straw coloured. The affected leaves roll completely, droop and ultimately the tillers wither away. These symptoms usually appear 4–6 weeks after transplanting. Affected plants produce chaffy grains. Use of high nitrogenous fertilizer rates favours blight epidemics especially where susceptible cultivars are grown.

Management

A slurry is prepared by mixing 20 kg of cow dung with 200 litres of water. The mixture is strained through a gunny bag. The filtrate is further diluted with 50 litres of water and allowed to stand. The water is then decanted, strained and sprayed.

Tungro or leaf yellowing Maize chlorotic dwarf virus

Symptoms This disease is spread through viral particles. Older leaves turn yellowish orange starting from the tips and spreading downwards to eventually cover the entire leaf. Young leaves are mottled with pale green to whitish spots. Root development is poor and grains are usually covered with dark brown blotches. Plants become stunted and bear poor panicles with empty glumes. This disease is transmitted by the green leaf hopper (*Nephotettix virescens*).

General management of diseases: Take cow's urine in a mud pot and allow it to ferment for one week. Spraying this over the crops controls bacterial and fungal diseases. Mix one litre of cow's urine with one litre of buttermilk and eight litres of water. Spraying this extract over the crop also controls bacterial and fungal disease. Mix 300 ml of sweet flag extract with one litre of cow's urine and 8.7 litres of water. Spraying this extract controls the spread of disease.

SORGHUM[2]

Tamil: Colam **Botanical Name: *Sorghum bicolor***

Sorghum (Jowar) is an excellent source of food, feed, fuel and fodder. Sorghum (Jowar) is an excellent source of food, feed, fuel and fodder. Sorghum is a unique cereal grown with minimum purchased inputs and in a variety of conditions around the year. Presently, sorghum is grown in many states from Tamil Nadu to Uttaranchal, for food and dry fodder in the scanty rainfall areas. The food types are grown during both the rainy (kharif, mostly in south-western states, about 3.78m.ha) and the post rainy seasons (rabi, 5.02 m.ha) mostly in Maharashtra and the adjoining areas of Karnataka and Andhra Pradesh.

I. SEASON AND VARIETIES

District/Season	Month	Varieties/Hybrids
1. Tiruchirapalli		
Thaipattam	Jan. – Feb.	TNAU SORGHUM HYBRID CO 5, BSR 1
Chithiraipattam	April – May	BSR 1, TNAU SORGHUM HYBRID CO 5
Adipattam	June – July	K Tall, CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1
Puratasipattam	Sept. – Oct.	K Tall, CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1
2. Kanchipuram/Tiruvallur		
Thaipattam	January – February	CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1, TNAU SORGHUM HYBRID CO 5
Chithiraipattam	April – May	CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1, TNAU SORGHUM HYBRID CO 5
Adipattam	June – July	K Tall, CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1, TNAU SORGHUM HYBRID CO 5,
Puratasipattam	Sept.- Oct.	K Tall, CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1
3. Vellore/Tiruvannamalai		
Thaipattam	January - February	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5, BSR 1
Chithiraipattam	April – May	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5, BSR 1
Adipattam	June – July	K Tall, CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1, TNAU SORGHUM HYBRID CO 5, Paiyur 1
Puratasipattam	September - October	K Tall, CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1, Paiyur 2
4. Cuddalore/ Villupuram		
Thaipattam	January - February	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5, BSR 1
Chithiraipattam	April - May	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5, BSR 1
Adipattam	June - July	K Tall, CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1, TNAU SORGHUM HYBRID CO 5
Puratasipattam	September - October	K Tall, CO(S) 28, TNAU SORGHUM variety CO 30, BSR 1
5. Coimbatore/Tirupur		
Thaipattam	January - February	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5, BSR 1
Chithiraipattam	April - May	CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1, TNAU SORGHUM HYBID CO 5
Adipattam	June - July	CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1
Puratasipattam	Sept. – Oct.	CO (S) 28, TNAU SORGHUM variety CO 30

6. Erode		
Thaipattam	January - February	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5, BSR 1
Chithiraipattam	April - May	CO (S) 28,TNAU SORGHUM variety CO 30, BSR 1, TNAU SORGHUM HYBRID CO 5
Adipattam	June - July	CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1, Paiyur 2
Puratasipattam	Sept.- Oct.	CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1, Paiyur 2
7. Karur/Perambalur/Ariyalur		
Thaipattam	Jan. – Feb.	TNAU SORGHUM HYBRID CO 5, BSR 1
Chithiraipattam	April - May	BSR 1, TNAU SORGHUM HYBRID CO 5
Adipattam	June - July	K Tall, CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1
Puratasipattam	Sept. – Oct.	K Tall, CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1
8. Salem/Namakkal		
Thaipattam	Jan.- Feb.	CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1
Chithiraipattam	April - May	CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1
Adipattam	June - July	CO (S) 28, Paiyur 1, Paiyur 2, BSR 1
Puratasipattam	Sept. – Oct.	CO (S) 28, TNAU SORGHUM variety CO 30, Paiyur 2, BSR 1
9. Dharmapuri/Krishnagiri		
Thaipattam	Jan. – Feb.	CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1
Chithiraipattam	April - May	CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1
Adipattam	June - July	CO (S) 28, TNAU SORGHUM variety CO 30, Paiyur 1, Paiyur 2
Puratasipattam	Sept. – Oct.	CO (S) 28, TNAU SORGHUM variety CO 30, Paiyur 2
10. Pudukottai		
Thaipattam	Jan. – Feb.	BSR 1, TNAU SORGHUM HYBRID CO 5
Chithiraipattam	April - May	BSR 1, TNAU SORGHUM HYBRID CO 5
Adipattam	June - July	CO (S) 28, TNAU SORGHUM variety CO 30, K Tall, BSR 1, TNAU SORGHUM HYBRID CO 5
Puratasipattam	Sept. – Oct.	CO (S) 28, TNAU SORGHUM variety CO 30, K Tall, BSR 1
11. Madurai/Dindigul/Theni		
Thaipattam	Jan. – Feb.	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5, BSR 1
Chithiraipattam	April - May	CO (S) 28, TNAU SORGHUM variety CO 30, BSR 1, TNAU SORGHUM HYBRID CO 5
Adipattam	June - July	CO(S) 28, TNAU SORGHUM variety CO 30, K 11, BSR 1, TNAU SORGHUM HYBRID CO 5, APK 1
Puratasipattam	Sept. – Oct.	CO(S) 28, TNAU SORGHUM variety CO 30, K Tall, K 11, BSR 1, APK 1
12. Ramanathapuram/ Virudhunagar/ Sivaganga		
Thaipattam	January - February	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5
Chithiraipattam	April - May	CO (S) 28,TNAU SORGHUM variety CO 30, BSR 1, TNAU SORGHUM HYBRID CO 5
Adipattam	June - July	BSR 1, TNAU SORGHUM HYBRID CO 5, APK 1
Puratasipattam	Sept. – Oct.	TNAU SORGHUM variety CO 30, K 11, K Tall, BSR 1, APK 1
13. Tirunelveli/ Thoothukudi		
Thaipattam	January - February	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5, BSR 1
Chithiraipattam	April - May	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5, BSR 1
Adipattam	June - July	K Tall, K 11, CO(S) 28, TNAU SORGHUM variety CO 30, BSR 1, APK 1
Puratasipattam	September - October	K Tall, CO (S) 28, TNAU SORGHUM variety CO 30, K 11, BSR 1, APK 1
14. Kanyakumari		
Thaipattam	Jan. – Feb.	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5

Chithiraipattam	April - May	CO (S) 28, TNAU SORGHUM variety CO 30, TNAU SORGHUM HYBRID CO 5

Growth stages of sorghum

1. Seedling stage**:** 1-15ays
2. Vegetative stage (Grand growth**:** 16-40days
3. (30-40) **:** 41-65days
4. Flowering/Reproductive Stage**:** 66-95days
5. Maturity **:** 96-105 days
Ripening

SELECTION OF SEEDS
Good quality seeds are collected from disease and pest-free fields.

Quantity of seed required

Irrigated Transplanted - 7.5 kg/ha; Direct sown - 10 kg/ha
Rainfed Direct sown - 15 kg/ha

Sorghum under irrigated condition is raised both as a direct sown and transplanted crop.

NURSERY PRACTICES

1. NURSERY PREPARATION

For raising seedlings to plant one hectare, select 7.5 cents (300 m2) near a water source where water will not stagnate.

2. APPLICATION OF FYM TO THE NURSERY

- Apply 750 kg of FYM or compost for 7.5 cents nursery and apply another 500 kg of compost or FYM for covering the seeds after sowing.
- Spread the manure evenly on the unploughed soil and incorporate by ploughing or apply just before last ploughing.

3. LAYING THE NURSERY

- Provide three separate units of size 2 m x 1.5 m with 30 cm space in between the plots and all around the unit for irrigation.
- Excavate the soil from the inter-space and all around to a depth of 15 cm to form channels and spread the soil removed on the bed and level.

4. PRE-TREATMENT OF SEEDS

- Treat the seeds with three packets (600 g) / ha of Azospirillum and 3 packets (600g) of phosphobacteria or 6 packets of Azophos (1200g) using rice kanji as binder.

5. SOWING AND COVERING THE SEEDS

- Make shallow rills, not deeper than 1 cm on the bed by passing the fingers vertically over it.
- Broadcast 7.5 kg of treated seeds evenly on the beds.
- Cover by leveling the rills by passing the hand lightly over the soil.

III. MAIN FIELD PREPARATION FOR IRRIGATED CROP

1. PLOUGHING

Plough the field with an iron plough once (or) twice. Sorghum does not require fine tilth since it adversely affects germination and yield in the case of direct sown crop.

To overcome the subsoil hard pan in Alfisols (deep red soils) chiselling the field at 0.5 m intervals to a depth of 40 cm on both the directions of the field followed by disc ploughing once and cultivator ploughing twice help to increase the yield of sorghum and the succeeding blackgram also. This was true with Sorghum followed by Groundnut also.

Application of FYM and 100% of recommended N can also be followed. In soils with sub-soil hard pan, chiselling should be done every year at the start of the cropping sequence to create a favourable physical environment.

2. APPLICATION OF FYM

Spread 12.5 t/ha FYM or composted coir pith along with 10 packets of Azospirillum (2000g/ha) and 10 packets (2000 g/ha) of phosphobacteria or 20 packets of Azophos (4000g/ha) on the unploughed field and incorporate the manure in the soil. Apply well decomposed poultry manure @ 5 t/ha to improve the grain yield as well as physical properties of soils.

3. FORMATION OF RIDGES AND FURROWS

- Form ridges and furrows using a ridger at 6 m long and 45 cm apart
- Form irrigation channels across the furrows

Alternatively, form beds of size 10 m2 and 20 m2 depending on the availability of water.

APPLICATION OF BIOFERTILIZERS

Transplanted crop

Soil application of Azospirillum at 10 packets (2 kg/ha) and 10 packets (2000g/ha) of phosphobacteria or 20 packets of Azophos (4000g/ha) after mixing with 25 kg of FYM + 25 kg of soil may be carried out before sowing/planting.

5. APPLICATION OF MICRONUTRIENT MIXTURE

Transplanted Crop

- Mix 12.5 kg/ha of micronutrient mixture formulated by the Department of Agriculture, Tamil Nadu with enough sand to make a total quantity of 50 kg and apply the mixture over the furrows and on top one third of the ridges.
- If micronutrient mixture is not available, mix 25 kg of zinc sulphate with sand to make a total quantity of 50 kg and apply on the furrows and on the top one third of the ridges.

IV. MANAGEMENT OF MAIN FIELD

Spacing: 45 x 15 cm
Population:15/m^2

1. TRANSPLANTED CROP

- Pull out the seedlings when they are 15 to 18 days old.
- Prepare slurry with 5 packets of Azospirillum (1000g/ha) and 5 packets (1000g/ha) of Phosphobacteria or 10 packets of Azophos (2000 g/ha) in 40 lit. of water and dip the root portion of the seedlings in the solution for 15-30 minutes and transplant.
- Let in water through the furrows
- Plant one seedling per hill
- Plant the seedlings at a depth of 3 to 5 cm.
- Plant the seedlings on the side of the ridge, half the distance from the top of the ridge and the bottom.
- Maintain a spacing of 15 cm between plants in the row which are 45 cm apart (15/m^2).

2. DIRECT SOWN CROP

- In the case of pure crop of sorghum, maintain the seed rate at 10kg/ha.
- In the case of inter crop of sorghum with pulse crop, maintain the seed rate of sorghum at 10 kg/ha and pulse crop at 10 kg/ha.
- In the case of pure crop of sorghum, sow the seeds with a spacing of 15 cm between seeds in the rows which are 45 cm apart.
- Maintain one plant per hill.
- If shootfly attack is there, remove the side shots and retain one healthy shoot.
- Sow the seeds over the lines where fertilizers are placed.
- Sow the seeds at a depth of 2 cm and cover with soil.
- In the case of sorghum intercropped with pulses sow one paired row of sorghum alternated with a single row of pulses. The spacing between the row of sorghum and pulse crop is 30 cm.

Forage cowpea CO 1 can be inter-cropped in sorghum at two rows of fodder cowpea in between paired rows of sorghum.

3. THINNING OF THE SEEDLINGS AND GAP FILLING

Direct sown crop

Thin the seedlings and gap fill with the seedlings thinned out. Maintain a spacing of 15 cm between plants after the first hand weeding on the 23rd day of sowing. Thin the pulse crop to a spacing of 10 cm between plants for all pulse crop except cowpea, for which spacing is maintained at 20 cm between plants.

4. DEFICIENCY SYMPTOMS

Zinc: Deficiency symptoms first appear in the newly formed leaves at 20 to 30 days age. Older leaves have yellow streaks or chlorotic striping between veins.

Iron: Interveinal chlorosis will be observed. If the deficiency continues the entire leaf including the veins may exhibit chlorotic symptoms. Newly formed leaves exhibit chlorotic symptoms. The entire crop may exhibit bleached appearance, dry and may die.

GROUNDNUT[1]

Tamil – nelakadalai, verkadalai **Botanical name:** ***Arachis hypogaea***

Groundnut is a tropical plant that requires a long, warm growing season. Groundnut is usually grown as a mixed crop with pearl millet, maize, sorghum, castor and cotton. In certain districts of Tamil Nadu, cowpea is intercropped with groundnut. Cowpea, being more succulent, attracts sucking pests and thereby reduces the damage to the groundnut crop. In certain places, groundnut is grown in rotation with wheat, jowar, bajra and garden crops such as chickpea, onions, chilies, garlic, ginger and turmeric. Groundnut fixes nitrogen in the soil. Hence the crop that is grown next to it will show a 25% increase in yield.

VARIETIES:

Groundnut breeding in India reached a sort of watershed in the eighties when 30 new varieties were released. Of the new cultivars, 80% were cross derivatives. During the period, stress was laid on resistance breeding. As a result, foliar disease resistance varieties like Girnar 1, ICGS 10 and ICGU 86590 were released. In groundnut, the varieties under cultivation fall under three botanical groups, viz., Spanish, Valencia and Virginia. The popular ones include JL 24, VR 1, VRI 2, VRI3, TMV2, TMV7, CO2 and BSR-1.

Crop duration: The duration of the crop is 90–105 days for bunch types and between 120–130 days for spreading and semi-spreading types.

Seed rate: The seed rate is an important criterion for an optimum plant population in the field and to achieve good yields. It depends on the variety cultivated. Semi-spreading and spreading varieties require 110 kg/ha while bunch varieties require 120 kg/ha.

Treatment: Before sowing, the seeds can be smeared with lime solution. The heat produced by the lime solution enhances germination. Seed treatment with asafoetida solution helps to protect the crop from blight. Asafoetida solution is prepared by mixing 250 gm of asafoetida in two litres of water. This quantity is sufficient for treating twenty kilo of seeds. The seeds should be soaked in this solution for twelve hours before sowing. Inoculation of seed with efficient strains of nitrogen-fixing bacteria is necessary for areas where groundnut is not generally grown. Seed inoculation with three packets (600 gm) of rhizobium per hectare is recommended. Bio-control agents like *Trichoderma viride* @ 4 gm/kg of seed or Pseudomonas fluorescens @10 gm/kg of seed can also be used for seed treatment. In addition, groundnut seed can also be treated with amrut pani/panchagavya/cow pat pit or jeevamrut.

Method of sowing: The seeds are dibbled either manually or mechanically (using a seed drill) to a depth of 7.5–10 cm.

Spacing: The spacing adopted differs according to the variety and from place to place. Bunch types: 20–30 x 10–20 cm Spreading types: 45–60 x 20 cm.

MANAGING SOIL FERTILITY

Groundnut is a deep-rooted plant and hence uses both moisture and nutrients from the deeper layers of the soil. Nitrogen requirement in the rain-fed crop is 10–20 kg/ha and in the irrigated crop, 20–40 kg/ha. Phosphorus requirement for the rain-fed crop is 20 to 40 kg/ha and in the irrigated crop, 40 to 90 kg/ha. Although Indian soils are rich in potassium, the recommended dose is 20 to 40 kg/ha both for the rain-fed and the irrigated crop. The application of gypsum at the rate of 500 kg/ha at pegging stage will enhance pod fixation. In virgin lands, when groundnut is newly introduced, the application of a culture of rhizobium as seed treatment is beneficial for increasing nodulation and nitrogen fixation.

Spraying buttermilk 25 and 35 days after sowing fetches good yields. It serves as a growth promoter. Three litres of buttermilk prepared by diluting ½ litre of curd is sprayed over the crop.

Organic manures:

Farmyard manure (FYM) and compost are the main organic sources of nutrients for groundnut. Organic matter improves soil structure and reduces compaction and crusting of the soil. It is also required as a source of energy for nodulation and nitrogen fixation by microorganisms. A hard soil may affect pod formation. Adding FYM @ 12.5 tonnes/ha or 4–5 tonnes NADEP/BD/vermicompost helps to get rid of such problems. FYM improves the porosity and structure of the soil and supplies the crop with the required micronutrients. It also helps to get rid of harmful microorganisms in the soil. Besides cow dung, FYM also contains stubbles, stalks and other crop residues. These should be applied well in advance, i.e., 15–30 days before sowing and incorporated into the soil with the help of a country plough or a blade harrow. For a rain-fed crop, 6– 7 tonnes and for an irrigated crop, 12–13 tonnes of farmyard manure should be added. An alternative to FYM is to practise green manuring with crops like sunhemp, daincha and other legumes.

Green manuring with sunhemp/sesbania/cowpea can also be attempted.

Besides these, soil enrichment through bio enhancers, viz., cow pat pit/BD 500/amrut pani/jeevamrut/panchagavya is also advised. Two to three foliar sprays of BD 501, panchagavya or soil application of amrut pani through irrigation water will promote vigour and improve productivity.

PROBLEM INSECTS

Root and pod feeders: White grubs (*Lachnosterna consanguinea, L. reynaudi,* and *L. serrata*)

Damage pattern: The grubs attack starts in the crop about one month after the mass emergence of beetles, i.e., after the first pre-monsoon or monsoon rain. The damage usually occurs in patches in the field. Grubs feed on the fine rootlets and nodules. This results in wilting and death.

Management:

- Summer ploughing helps to bring out the larvae and pupae from the soil. Predatory birds can then feed on them.
- Seed treatment should be done with Solanum surattense extract.
- Early sowing helps the plants to escape from grub damage.
- Setting up light traps helps to monitor and collect the adult beetles.
- The adults can be manually picked from the soil and destroyed.
- Treat the kernels with kerosene (one litre per 70–80 kg seeds) before sowing.

Termites (Odontotermes sp.)

Damage pattern: The insects remain underground and feed on the roots. They penetrate and hollow out the tap root and cause wilting. This results in premature death of the plants. They bore into pods, damage the seeds and weaken the shells

Management

• Harvesting the groundnut immediately after it matures and early removal of produce from the field reduces termite attack.

• Twigs of morning glory (*Ipomoea fistulosa*) can be used for the protection of pods from termites.

Sucking pests: Jassids (Empoasca kerri)

Damage pattern: Both the nymphs and adults cause damage by sucking the sap from the central surface of the young leaves. As they suck, they inject toxins into the plant issue. This results in a whitening of the leaves and formation of 'V' shaped chlorotic patches at the tip of each leaflet. As the infestation gets more severe, the crop turns yellow and presents a scorched appearance known as 'hopper burn'.

Management:

• Intercropping groundnut with lablab in a 4 : 1 ratio reduces the number of jassids on groundnut.

• Spray 1% neem leaf solution per hectare

Thrips (Scirtothrips dorsalis, Thrips palmi, Frankliniella schutzei, Caliothrips indicus)

Damage pattern The nymphs and adults lacerate the leaf surface and suck the oozing sap. This results in distortion of the leaflets and formation of white patches on their upper surfaces and necrotic patches on the lower. When the infestation gets severe, the plant remains stunted. Thrips transmit peanut bud necrosis.

Management

• Thrips damage can be avoided by early (first fortnight of June) sowing

• Intercropping with sunflower reduces the thrips population.

Defoliators: Red hairy caterpillar (*Amsacta albistriga, A. moorei*)

Damage pattern: The larvae eat away the leaves leaving behind the midrib, the veins and the petiole. The infested leaves appear as if grazed by cattle. They move in clusters from one field to the other and cause infestation. The yield obtained from the infested crop is considerably reduced.

Management

• Nuclear polyhedrosis virus (NPV) spray is effective in controlling the larvae when they are young.

• Egg parasitoids – Telenomous manolus is effective in destroying the eggs.

• Fungal parasitoids – Aspergillus flavus effectively controls the larvae.

• Lighting a fire near the field during the night-time helps to get rid of red hairy caterpillars as well.

• Adopt summer ploughing.

• In certain places, farmers chase away the caterpillars from the field by blowing a sangu (conch). Farmers start blowing the sangu from the three corners of the field. It is believed that the caterpillars

congregate and try to escape through the fourth corner where they can be collected manually and destroyed.

• In rain-fed groundnut, raise one row of cowpea for every five rows of groundnut. Crops such as pigeon pea, black gram, sunflower, sesame, pearl millet or other pulses intercropped with groundnut. Mix lemon (150 ml) and tamarind juice (150 ml) in 15 litres of water. Apply this solution thrice for effective control.

Groundnut leaf miner (Aproaerema modicella)

Damage pattern The young larvae which hatch out of the eggs bore into the leaflets and feed on the mesophyll tissue of the leaves. As a result, small, brown blotches appear on the leaves. At later stages, the larvae web the leaflets together, remain inside the web and continue to feed on the leaf tissues. When the infestation gets severe, the leaves lose their shape and the plant remains stunted. A severely attacked crop presents a burnt appearance.

Management

• In rain-fed groundnut, early sowing reduces pest incidence.
• Light traps can be set up to monitor and trap the adults.
• Pheromone traps can be set up in the field as well.
• Groundnut can be intercropped with soybean, pearl millet or lablab in 1 : 4 ratios.
• Mulching in dry lands helps to reduce leaf miner incidence.
• Spray neem seed kernel extract (15 kg/ha) or neem oil (15 litres /ha) or neem leaf extract (25 kg/ha).
• The field is first flooded to submerge the crop overnight and drained the following morning. This is a common practice among the farmers of the Tungabhadra area of Karnataka.

DISEASES

Leaf spot or tikka disease (Causal organism: *Cercospora arachidicola, Cercosporadium personatum*)

Tikka is a major disease-affecting groundnut (and all its varieties) in India. It occurs as well in almost all groundnut-growing countries of the world.

Symptoms: It occurs as two distinct types of leaf spot, namely, early leaf spot and late leaf spot. These are caused by two different species of fungi: *Cercospora personatum and Cercospora arachidicola*.

Management: Sanitary precautions such as destroying the diseased plant debris would reduce the intensity of the disease. Intercrop groundnut and green gram (Vigna radiata) in the ratio of 4 : 1. Do seed treatment with asafoetida solution. Tolerant varieties like T-64, C-501, MH-4, TMV-6 and TMV-10 can be grown.

Rust Causal organism: *Puccinia arachidis*

Symptoms Orange-coloured pustules or uredinia appear on the lower surface of the leaves. They rupture to expose masses of urediniospores. The spores are reddish brown in colour. Corresponding to the sori, small, brown necrotic spots appear on the upper surface of the leaves. When the infection gets severe, the lower leaves wither and drop prematurely. The kernels formed in the infected plants are small and

shriveled. The disease may occur on all aerial parts of the plant apart from the flowers and pegs. It occurs when the crop is over six weeks old.

Management

• Diseased plants should be removed and destroyed.

• Heavy growth of weeds may encourage disease development. Hence, they should be kept under control.

• Monocropping of groundnut should be avoided.

Stem rot Causal organism: *Sclerotium rolfsii*

Symptoms The fungus attacks all parts of the plant but stem infection is the most common and serious. The branches that are in close or partial contact with the soil start wilting. The affected plant parts turn brown and small round bodies of about the size of a mustard seed are produced on the surface of the affected tissue. The leaves turn yellow and then brown and later desiccate. As the infection gets severe, a white thread-like fungal growth can be seen near the soil surface or just below the ground level. The entire plant may get killed or the branches of the plants alone may get affected. Infection of the pegs results in poor development of pods.

Management

• Infected plant debris should be collected and burned periodically.

• Crop rotation helps to keep the disease in check.

• Control of leaf spot disease prevents leaf dropping and indirectly controls stem rot by reducing the availability of nutrients to the pathogen

OKRA[1]

Tamil – vendai **Botanical Name: Abelmoschus esculentus**

Okra is a tropical vegetable and requires a long, warm and humid growing period. Okra can be grown in different cropping systems. Good returns can be obtained when okra is grown along with French beans or radish. The following cropping pattern – okra-cowpea-maize, maize-okraradish and okra-okra-radish – reduces bacterial wilt in tomato and brinjal grown as succeeding crops. The total crop duration is between 90 and 120 days.

VARIETIES

Pusa Sawani, developed as an open pollinated variety, prevailed across the country for more than two decades. With the breakdown of its tolerance to yellow vein mosaic virus, around fifteen to twenty varieties have been developed by different organizations and released for cultivation. The popular okra varieties today are Arka Anamika, Pusa Sawani, Pharbhani Kranti, Janardhan, VRO-5, Pusa Mukhmali, Varsha Uphar, VRO-6, Pusa A-4, and Utakal Gaurav, etc. Besides these, local varieties are still being grown, particularly by organic farmers. Some of the popular local varieties of Tamil Nadu are Bangalore local, Kulemagali Vendai and Nattu vendai (JRDP).

SEED

Selection: For seed purposes, harvesting is done 30 days after anthesis – when the pods are fully mature, dry and start cracking. About 300 plants (left for seeds) are sufficient to sow one hectare of crop.

Treatment: For the summer crop, the seeds should be soaked in water for 12 hours before sowing. The seeds can be treated with sweet flag rhizome extract or cow urine solution (diluted with water in 1 : 5 ratio) for 30 minutes before sowing. This gives resistance against a number of bacterial and fungal diseases. Seeds can also be treated with cow dung solution (viz, beejamrut/jeevamrut/amrut pani/panchagavya) for 4–6 hours after soaking in water for eight hours. The seeds can then be dried in shade and sown.

Seed rate: A seed rate of about 18–22 kg/ha for the spring/summer crop and 10–12 kg/ha for the rainy season crop will be optimum. A higher seed rate is used for the spring crop since it has to augment the loss in germination due to low temperatures. A high seed rate and closer spacing during summer reduces field temperatures and helps in normal fruiting under frequent and light irrigation.

MANAGING SOIL FERTILITY

Continuous application of farmyard manure year after year increases the yield of green fruits. Farmyard manure is applied @ 25 tonnes/ha. Neem cake is applied @ 250 kg/ha and groundnut cake is applied @ 80–100 kg/ha. Two kilograms each of biofertilisers like azospirillum and phosphobacteria are used.

PROBLEM INSECTS: Insects and disease are a major threat to okra cultivation and bring about a considerable loss in yield. A major part of the cultivation cost is incurred for crop protection. A list of major pests and diseases in okra is given below, along with organic control measures:

Shoot and fruit borer (*Earias vittella, E. insulana*)

Symptoms: The larvae bore into tender shoots and move downwards, creating a tunnel inside. The growing points are affected and hence side shoots may arise. The affected shoots wither and droop. The caterpillars also bore into the buds, flowers and fruits and feed on the inner tissues. The damaged flowers fall off and the affected pods are malformed.

Management:

• Sowing in the first week of June is ideal to avoid damage of shoot and fruit borer during the rainy season.

• Summer ploughing should be done to destroy bollworm pupae.

• Spray ginger, garlic, chili or Sida acuta kashayam

Leaf hoppers (*Amrasca biguttula biguttula*)

Symptoms The nymphs and adults suck the sap from the under surface of the leaves and inject toxic saliva into the plant tissues. The affected leaves first turn yellow, then brick red, before they become brittle and fall off. In cases of severe infestation, the fruits are also affected. Climatic factors like cloudy weather play an important role in population build up. Heavy showers wash off the nymphs and adults.

Management

• Install yellow sticky traps @ 30/ha • Spray 5% neem seed kernel extract or ginger, garlic, chili extract or Sida acuta extract.

Fruit borers (*Helicoverpa armigera, Spodoptera litura*)

Damage pattern: The larva feed on the foliage. When the tender leaf buds are infested, symmetrical holes or cuttings are seen when unfolded.

Management:

• Adopt summer ploughing to destroy bollworm pupae.

• Place 15–20 bird perches per hectare. This invites predatory birds

• Mix one kilogram of fenugreek (Trigonella foenum-graecum) flour with two litres of water and keep aside for 24 hours. Then add 40 litres of water to the mixture and spray in onehectare area. This ensures fifty percent control within seven days.

• Prepare an herbal pesticide by boiling 4 kg of aloe (Aloe vera), 500 ml of neem oil and 500 gm of tobacco powder in 20 litres of water. Boil the contents for 3–4 hours until it reduces to one-fourth of the original volume. Allow it to cool, add 50 gm of soapnut (Sapindus emarginatus) seed powder and mix thoroughly. Dilute 100–150 ml of this filtrate in 15 litres of water and spray.

• Install pheromone traps @ 8 per hectare.

Spray 5% neem seed kernel extract or Andrographis kashayam or five leaf extract to kill early stages of the larvae • Use biocontrol agents like Trichogramma @ 50,000 eggs/ha six times at weekly intervals.

DISEASES

Yellow vein mosaic / Vein clearing (Vector: White fly – Bemisia tabaci)

The major symptoms are vein clearing and veinal chlorosis of leaves. The yellow network of veins is conspicuous and the veins and veinlets are thickened. The veins turn yellow throughout the entire leaf blade. In cases of severe infection, the younger leaves are yellow in colour, reduced in size and the plant remains stunted. Leaves continue to show symptoms as they are formed, throughout the growing season. The infection prevents the formation of flowers and fruits. If formed, the fruits are small, malformed, hard and yellowish green in colour. Such fruits do not fetch a good price in the market. The conditionmay affect many plants in the field and may occur at any stage of the plant's growth. Varieties like Parbhani Kranti, Arka Anamika, Arka Abhay, Janardhan and Haritha are reported to be tolerant to yellow vein mosaic. No known variety is reported to be completely resistant to the disease

Management

• Cut a cactus like nawagalli (Euphorbia nivulia) or milk bush (E. tirucalli) into pieces, immerse in water (just enough for the pieces to float), allow to ferment for 15 days, filter and spray.

• Control the vector by spraying 5% neem seed kernel extract or ginger, garlic and chili extract.

• Destroy weeds and other wild hosts wherever possible.

• Remove the affected plants from the field and burn them.

• Avoid summer season planting.

• Plant resistant varieties like Parbhani Kranti, Arka Anamika, VRO-5, VRO-6 and Pusa A-4 (Co-2 is susceptible to YVM).

Cercospora leaf spot (*Cercospora abelmoschi, C.malayensis, C.hibisci, C.hibiscina*)

Several species of Cercospora are reported to cause spots and blight. The pathogen affects the crop often during humid weather conditions and causes defoliation.

Management

• Clean and trim all the bunds.

• Spray 10% cow urine or 5% neem seed kernel extract.

Root knot nematode (Causal organism: *Meloidogyne incognita, M. javanica*)

Symptoms: The plants remain pale and stunted, and pod set is very low. The leaves are yellowish green or yellow in colour. Drooping, sudden wilting together with a scorching of leaves from the margins inward can be observed. Formation of knots or galls in the root system is a characteristic symptom. The maximum number of galls per plant and number of females and egg masses per gram of root occur when the plants are infected at 2-week stage. The main root and the laterals have spherical or elongated galls of various sizes. In advanced stages of infection, the tissues decay and are attacked by other pathogenic and saprophytic organisms. Cultivars like long green smooth, IC-9273 and IC-18960 are reported to be resistant to root knot nematodes

Management

• Crop rotation – There is a wide host range for nematodes. With cereals, there is a definite reduction in the population.

• Intercropping with marigold is helpful in minimising the infestation.

• Add organic amendments like neem cake @ 25 q/ha.

• Fungal species such as *Paecilomyces lilacinus* and *Verticillium* and the bacterium *Bacillus penetrans* can be used as bio-control agents.

TOMATO[1]

Tamil – Thakkali **Botanical name:(*Lycopersicon esculentum)***

The crop requires a warm growing season with abundant sunshine and adequate moisture. In India, the crop can be grown throughout the year. In the northern plains, the crop can be cultivated during autumn and spring as well as summer. In south India, there are three growing seasons: June–July, October–November and January–February. The crop duration ranges between 120–140 days for varieties and for hybrids, it is around 160 days.

VARIETIES

A large number of tomato varieties have been developed in the country. More than 25 open pollinated varieties and 10 hybrids have been released at the national level. Besides several open pollinated varieties and hybrids have been released by the respective tomato growing states and are also cultivated. In a number of states, the local varieties are still popular with farmers and these are better adapted to organic production systems. In Tamil Nadu, the local varieties cultivated include Bangalore local, guli thakkali, periyakulam local, pink thakkali, sirsi nattu thakkali and Nattu thakkali.

SEED

The plant is propagated largely through seed, though vegetative propagation is also possible.

Treatment:

Seeds are soaked for six hours in a fermented mixture of buttermilk (3 days old) and water (1 : 4 ratio) and dried under the shade to remove excess moisture. The practice is applicable only for 6 to 12 month old seeds. Coconut or palmyra toddy can also be used as a substitute for buttermilk. The seeds can also be treated with sweet flag rhizome extract for 30 minutes before sowing. This confers resistance against a number of bacterial and fungal diseases.

The seeds can be mixed with *Trichoderma viride* and *Pseudomonas fluorescens* (@ 5 gm/100 gm of seeds). This will help in the control of early blight and other pathogens.

Seed rate: The seed rate for commercial tomato varieties is around 400–500 gm/ha.

MANAGING SOIL FERTILITY

Farmyard manure should be applied at the rate of 25 tonnes/ha several weeks before sowing. Green manure with crops like sunhemp (Crotalaria juncea), cowpea (Vigna catjang), daincha (Sesbania aculeata) and cluster bean (Cyamopsis tetragonoloba) can also be used to substitute for farmyard manure to an extent. Neem cake can be applied @ 150–250 kg/ha. Top dressing can be given with groundnut cake (@ 80–100 kg/ha) after 40 days of sowing. This will help in increasing the yield as well as the size of fruits. The soil can also be enriched by using vermicompost or biodung compost as additional supplements. Plant vigour can be further stimulated through bio enhancers, viz., amrut pani/jeevamrut introduced through irrigation water and foliar spray of BD/BD liquid manures.

PROBLEM INSECTS Insects and diseases are a major threat to tomato cultivation and are responsible for a considerable loss in yields. A major part of the cultivation cost is in fact incurred for crop protection.

Fruit borer (*Helicoverpa armigera*) This is a polyphagous pest infesting most cultivated crops. It is a major pest of tomato as well and is widely distributed throughout India.

Damage pattern: The young larvae feed on the tender leaves. At later stages, they attack the fruits and bore circular holes. Usually the larvae thrust only their heads inside the fruits. They move from one fruit to another, causing damage. Externally, the damage appears in the form of holes. They are found from flowering to harvest stage, especially during July to November.

Management

• Monitor top three leaves for Helicoverpa eggs and hand pick larvae.

• Intercropping tomato with marigold is an effective IPM practice. Planting of the trap crop should be adjusted in such a manner that tomato flowering coincides with the tight bud stage of the marigolds. Marigolds attract both fruit borer and leaf miner adults for egg laying.

• Growing sorghum (8 rows) as a border crop around the field at 30 x 10 cm spacing promotes natural predators like Chrysoperla and Coccinellids.

• Place 15–20 bird perches per hectare. This invites predatory birds.

• Spray 5% neem seed kernel extract, Andrographis kashayam or five leaf extract to kill larvae at their early stages.

• Soil application of the seed extracts of Strychnos nux-vomica @ 1.5 gm/plant at an interval of 20 days, twice, when there is severe borer attack.

Use of biocontrol agents like NPV (@ 250 LE/ha), Bacillus thuringiensis (@ 1 gm/litre of water), Trichogramma chilonis (@ 50,000 eggs/ha, six times at weekly intervals) and Bracon hibitor (larval parasite).

Tobacco caterpillar (*Spodoptera litura*) This caterpillar is a major tomato pest and is widely distributed throughout the world. It is polyphagous in nature.

Damage pattern Freshly hatched larvae feed gregariously, scraping the leaves from the ventral side. They feed voraciously on the leaves at night. They also feed on the fruits by making holes in them.
Management

- Plant castor @ 125 per hectare as a trap crop. Castor attracts the egg laying moths. The egg masses and larvae can be collected and destroyed.
- Pheromone traps can be installed @ 10 per hectare to monitor the pest.
- 5% neem seed kernel extract can be sprayed to kill the young larvae.

Serpentine leaf miner (*Liriomyza trifolii)*

Damage pattern The maggots damage the plant by mining into the leaf. They feed on the inner most subphyla tissues. The diameter of the serpentine mines increases as the larva grows.
Management

- Grow one row of field bean as an intercrop after every eight rows of tomato. Field beans should be sown 10–12 days before transplanting the tomato seedlings.
- Spray 5% neem seed kernel extract or ginger, garlic, chili extract (@1 litre/tank).

White fly (*Bemisia tabaci*)

Damage pattern The adults lay eggs on the under surface of the leaves. Both nymphs and adults suck the sap from the underside of the leaves and flowers. White flies are also responsible for transmitting leaf curl virus.
Management • Cover the nursery bed with a 40 mesh nylon net to prevent entry of the flies.

- Sow pearl millet as a barrier crop around the main field. This should be done 15 days before transplanting the tomato.
- Install 50 yellow sticky traps/ha.
- Spray 5% neem kernel extract when the pest incidence is above ETL.

DISEASES: Fungal diseases: Damping off *(Pythium aphanidermatum)*

Symptoms: There are two different types: Pre-emergence damping off: The young seedlings are killed even before they emerge from the soil. The fungus attacks the germinating seeds and they rot even before the hypocotyls emerge. Since this happens in the subsoil it cannot easily be spotted by the farmers who may have been misled on the quality of the seeds. Post-emergence damping off: This phase is characterized by toppling over of infected seedlings at any time between the period that they emerge from the soil and the stage the stem hardens to resist pathogen attack. Infection affects the stem at the ground level or spreads through the roots. The affected seedlings are pale green with a brown water soaked lesion

at the base of the stem. Later, the lesion girdles the stem and spreads both upwards and downwards. The affected tissues are soft and water-soaked and they usually rot, leading to the collapse of the seedlings. The disease starts in patches and spreads to the entire lot in the nursery in the course of 2–4 days.

Management

• Use certified seeds.

• Partial sterilisation of the soil by surface burning of a thick stack of farm trash; solarisation by covering the nursery bed with alkathene.

• Formation of raised beds with better drainage facilities.

• Application of 400 gm of neem cake per sq. m. of nursery bed 15 days before sowing, and watering at 3–5 days' interval.

• Use of light soil for nursery beds, thin planting, light and frequent irrigation and application of well decomposed manure.

• Seed treatment using leaf extract of Bougainvillea glabra (@ 20ml per litre of water) for six hours.

Early blight (*Alternaria solani*) This is one of the most common diseases of the potato and is also found to attack the tomato. Since the disease appears early in the season, it is known as early blight.

Symptoms: The pathogen produces leaf spots of varying size. The spots are irregular in shape, dark brown in colour with concentric lines in the centre. In severe cases of infection, several spots coalesce to form large patches resulting in leaf blight. In advanced stages, the disease causes defoliation of plants, exposing the fruits to sun, causing sunscald. Under suitable environmental conditions the fungus can cause damping off and collar rot. Occurs at the seedling stage and with older plants

Management

• Crop rotation with a non-solanaceous crop.

• Do not grow tomato in soils where potato was intensively cultivated.

• Remove infected plant parts such as branches, leaves, buds, and burn them.

• Destruction of collateral host is desirable.

• Spray 5% eucalyptus or lantana leaf extract in the evening.

• Diluted cow dung can be applied to the root zone of the affected plants.

• Treatment with Trichoderma viride or Pseudomonas fluorescens @ 5 gm/100 gm of seeds.

Late blight (Phytophthora infestans)

Symptoms The disease appears on the foliage as water soaked light brown lesions. Under favourable climatic conditions (humid and cloudy weather), the lesion spreads to the entire leaf and petiole causing brown dead spots. The entire leaf may be killed in 1–4 days, if the weather is moist. Under dry weather conditions, the spots remain restricted in size and the dead areas appear hard and break away easily from the rest of the lamina. Whitish growth of fungus can be seen on the lower surface on close examination of infected leaves. Severely diseased plants wilt in a few days causing severe loss in crop yield. Dark olive greasy spots are found on the fruits and the tissues remain firm. Blight is followed by soft rot due to invasion by secondary pathogens.

Management: Five kilos of wood ash should be mixed with 50 litres of water and kept aside for two hours. The extract should then be strained and used as a spray to control late blight. Dried powdered ash can also be applied to the crops.

Fusariam wilt (*Fusarium oxysporum f. lycopersici*)

Symptoms Fusarium wilt causes clearing of vein lets, chlorosis of leaves and drooping of petioles. The young leaves die in succession and later the entire plant will wilt and perish in a few days. The symptoms may appear only on a few branches. Dark brown or black discolouration of vascular tissues may be seen in the roots or basal portion of the stem when the disease is in an advanced stage of infection. The plants remain stunted due to the pathogen attacking the roots. Under humid conditions, pinkish fungal growth can be seen on the dead plants.

Management

• Crop rotation with non-solanaceous crops reduces inoculums in the soil.

Seedling root dip in a solution containing ten grams each of turmeric and asafetida dissolved in a litre of water is preferred before transplanting.

• Keep the fruits away from the soil by proper training and pruning.

• Pull out the affected plants and destroy them.

• Use varieties like Mar globe, Kanora, Sioux and Roma which are resistant.

• Spray fifteen days' old panchagavya, diluted with ten parts of water.

Powdery mildew *(Leveillula taurica and Erysiphe polygoni)* This is a minor fungal disease in which a white powdery growth of the fungus is seen on the leaves.

Management • Spray a mixture of milk and water in equal quantities every three to four days at the first sign of mildew symptoms.

Bacterial diseases: Bacterial canker *(Clavibacter michiganense)*

Symptoms The bacterium affects the various plant parts that are above the ground. Wilting of leaves and drooping of petioles is observed. Light brown streaks appear on the stem and the petiole later turns black and cankerous. Small, water soaked lesions are seen on the fruits. These turn dark brown, corky and cankerous later

Management

• Crop rotation – avoid growing solanaceous crops in sequence.

- Hot water treatment of seeds is desirable.
- Spray cow dung extract.

Bacterial wilt *(Pseudomonas solanacearum*)

Symptoms Wilting, stunting, yellowing of foliage and a severe case of infection leads to death of the plant. The lower leaves droop before wilting occurs. The vascular system becomes brown. If a segment of a lower stem is cut, it yields bacterial ooze.

Management

• Crop rotation with cruciferous vegetables, field bean, maize or soybean

• Seedling root dip in asafoetida solution (@ 10g/litre of water)

Viral diseases: Tomato mosaic

Symptoms The leaves show light and dark green mosaic symptoms. There is uneven growth of the light and dark green portions. As a result, the normal green patches tend to appear sunken, giving a rough appearance to the leaves. In certain cases, downward curling of the leaves is also seen. In advanced stages, necrosis of the stem, petioles, leaves and fruit is observed.

Management

• Powder neem cake or mustard oil cake, mix it with water and apply near the root region.
• Spray asafoetida solution (@ 10 gm/litre of water).
• Spray milk on green house tomatoes to reduce TMV infection.

Leaf curl (caused by *Gemini* virus) Vector – *Bemisia tabaci*

Symptoms The virus causes dwarfing, puckering, severe curling and mottling of the leaves. Downward rolling, crinkling, chlorosis of newly formed leaves and excessive branching are observed and the plants become completely sterile. Association of leaf curl with root knot causes more damage. Occurs during summer (February–June) from seedling to harvest stage.

Management of viral diseases

• Crop rotation
• Use of virus free seedlings
• Soil sterilisation
• Removal and destruction of diseased plants
• Spraying 5% NSKE or neem leaf extract to control the white fly vector

CABBAGE[2]

Tamil: Muttaikkos Botanical Name:*Brassica oleracea*

Cabbage can be grown easily under a wide range of environmental conditions but cool moist climate is most suitable.

Varieties

Hills :Quisto
Plains : Golden Acre, Maha Rani

Soil

It is commonly cultivated in cool moist climate. It is grown as a winter crop in plains. It is grown in varied types of soils ranging from sandy loam to clay. It requires a pH ranging from 5.5 to 6.5 for higher production.

Season of sowing

Hills : January - February, July - August, September- October
Plains : August - November
Seed rate: 650 g/ha

Nursery: 100 sq mt nursery area/ha is required. Raised beds of 15 cm height, 1m breadth and convenient length are formed. 2 kg FYM, 200g vermicompost, 40g VAM, 200g each of *Azospirillum* and Phosphobacteria should be applied per sq mt. Sow the seeds at 10 cm spacing between rows in raised seed beds. Transplant 40 -45 days old seedlings at a spacing of 45 cm. Avoid land infected with 'club root disease'.

Seed treatment

- Seed treatment with cow pat pit @ 3 g in 1 litre of water for 24 hours
- Seed treatment with 5% *Trichoderma viride*
- Seedling root dip with 5% *Pseudomonas fluorescens* before transplanting for the management of club root disease

Preparation of field : Bring the soil to a fine tilth. Pits should be taken up at a spacing of 40 cm either way in hills. Ridges and furrows are formed at 45 cm apart in plains.

Spacing

Hills : 40 x 40 cm
Plains : 45 x 30 cm

Irrigation: Provide continuous supply of moisture.

Application of fertilizers

- Green manuring with lupin 60 days before planting
- Sprinkling of horn manure to the soil at the time of land preparation @ 75 g/ha by dissolving it in 40 litres of water
- Application of well decomposed farm yard manure @ 50 t/ha at the time of land preparation
- Application of biodynamic compost @ 5 t/ha at the time of land preparation
- Application of vermicompost @ 5 t/ha at the time of land preparation
- Application of neem cake @ 1250 kg/ha at the time of land preparation
- Application of biofertilizers, *Azospirillum* and Phsophobacteria @ 25 kg each/ha at the time of land preparation
- Spraying cow pat pit @ 5 kg/ha in 100 litres of water on 45th, 60th and 75th day after planting

After cultivation: Deep hoeing should be avoided, as the cabbage roots are surface feeders.

Growth regulators

- Foliar spraying of panchagavya @ 3 per cent at 10 days interval from 1st month after planting
- Spraying 10% vermiwash 5 times at 15 days interval from one month after planting
- Foliar spray of horn silica @ 2.5 g/ha in 50 litres of water on 65th day after planting to increase the yield and quality of cabbage head

Plant Protection
Pests
Cut worms

- Install light trap during summer to attract adult moths
- Install sprinkler irrigation system and irrigate the field in day time to expose the larvae for predation by birds
- Use of pyrethrum bait prepared out of pyrethrum flowers, wheat bran and jaggery (2:1:1)

Aphids

- Spray neem oil 3 %
- Spraying of 10% nettle leaf extract on 45th, 60th and 75th day after planting

Diamond backmoth

- Grow mustard as intercrop at 20:1 ratio to attract diamond back moths for oviposition
- Install pheromone traps @ 12 numbers/ha
- Spray *Bacillus thuringiensis* @ 2 g/lit at primordial stage
- Spray NSKE 5 % after primordial stage
- Release parasite *Diadegma semiclausum* @ 50,000/ha, 60 days after planting
- Foliar spraying of 10% garlic - chilli extract 3 times on 45th, 60th and 75th day after planting

Diseases
Club root

- Select disease free seeds/seedlings
- Seed treatment @ 10 g/ kg of seeds or soil application @2.5 kg/ha or seedling dip in solution of 5g/lit with *Pseudomonas fluorescens*
- Follow crop rotation
- Crucifers should be avoided for three years
- Application of dolomite @ 10 kg/ha should be done to increase the pH of the soil. This creates unfavourable condition for the pathogen

Leaf spot

- Foliar spray of 5 % Manchurian tea filtrate 3 times at one month interval from one month after sowing/planting
- Foliar spray of 3% Dasagavya at 10 days interval from 1st month after planting
- Seeds should be soaked in hot water (50oC) for 30 minutes, dried and then sown.

Leaf Blight

Spraying Agni Hotra ash (200 g Agni Hotra ash soaked in 1 liter cow urine for 15 days and diluted in 10 liters of water before spraying) 3 times at one month interval from one month after sowing/planting.

Black rot

- Dip the seeds in 100 ppm Streptocycline for 30 minutes
- Two sprays with Streptomycin 100 ppm after planting and at head formation

Soil borne diseases

- Application of *Trichoderma viride* @ 5 kg/ha at the time of land preparation
- Application of *Pseudomonas fluorescens* @ 5 kg/ha at the time of land preparation

COTTON[3]

Tamil: Parutti **Botanical Name: Gossypium**

Cotton is one of the most important fiber and cash crop of India and plays a dominant role in the industrial and agricultural economy of the country. In Tamil Nadu, the major portion of the irrigated and rain fed crop is planted in September-October, whereas the sowing of the rain fed crop in the southern districts is extended up to November. Summer sowings in Tamil Nadu are done during February-March. The sowings of cotton in the rice fallows of Andhra Pradesh and Tamil Nadu extent from the second half of December to the middle of January.[4]

Particulars	***Kharif***
Crop	Cotton
Fortnight of sowing/planting	August 1st fortnight
Fortnight of harvesting	January 2nd fortnight
Varieties suitable for organic farming	Suraj

Important features of suitable varieties

Parameters	***MCU 12***	***Suraj***
Duration (days)	160	165
Average yield under organic condition (kg/ha)	2000 kg/ha	1799 kg/ha
Source (s) of availability	-	CICR, Coimbatore
Suitable regions/districts in the state	Coimbatore, Erode, Madurai, Dindigul, Theni, Dharmapuri, Salem, Namakkal, Erode	Coimbatore

Field preparation: Prepare the field to get a fine tilth. Chiselling for soils with hard pan: Chisel the soils having hard pan formation at shallow depths with chisel plough at 0.5 metre interval, first in one direction and then in the direction perpendicular to the previous one, once in three years. Form ridges and furrows 10 m long with 60 cm spacing by using ridge plough or bund former.

Cultural practices

Seed rate (kg/ha)	7.5 kgs of delinted seeds		
Pre-sowing/planting treatment of seed/seedlings	Material	Recommended rate (kg/ha or lit/ha)	Method of application
	Azospirillum	600 g/ha	Seed treatment
	Phosphobacteria	600 g/ha	Seed treatment
	Pseudomonas	10 g/kg of seed	Seed treatment
	Trichoderma	4 g/kg of seed	Seed treatment
Spacing (Row x plant)	60 x 30 cm		
Basal application of organic manures including soil application of bio-fertilizers, bio-control agents etc	*Source*	*Quantity/ha*	
	FYM	7.05 t/ha	
	Vermicompost	4.49 t/ha	
	Azospirillum	2kg/ha	
	Phosphobacteria	2kg/ha	
	Pseudomonas	2.5 kg/ha	
	Trichoderma	2.5 kg/ha	
Top dressing of organic manures	Source	Quantity/ha	Days after sowing/ planting or stage of crop
	Vermicompost	1 t/ha	45 DAS
	Panchagavya	3% spray	30, 60 and 90 DAS
Irrigation practices	Number of irrigations	Most critical stages for irrigation	Depth of irrigation (cm)
	15-18 irrigations depending on the weather and soil type	Germination phase (1-15 days) Vegetative phase (16-44 days) Flowering phase (85-90 days)	
Major weeds	*Acalypha indica*, *Cyanodon dactylon, Cyperus rotundus*, *Digera arvensis,Chloris barbata, Trianthema portulacastrum, Parthenium hysterophorus*		

Weed management	Critical stage of weeding	Recommended practice	for organic condition
	Vegetative and flowering phase	Manual weeding	Stubble mulching
Organic plant protection practices	Name of pest/ disease	Organic material recommended for control	Quantity (kg or litres/ ha)
	Fruit borer: Helicoverpa armigera	Application of Nuclear Polyhedrosis Virus (NPV) in evening hours at 7th and (12th week after sowing • Beauveria bassiana • Release of egg parasitoid, Trichogramma spp., • Egg-larval parasitoid, Chelonus blackburnii and Predator Chrysoperla carnea • ULV spray of NPV, for effective control of Helicoverpa	3×10^{12} POB /ha 1.15% WP 400 g/ha 6.25 cc/ha at 15 days interval 3 times from 45 DAS1,00,000/ha at 6^{th}, 13^{th} and 14^{th} week after sowing. 3×10^{12} POB /ha with 10% cotton seed kernel extract, with sticking agent
	Pink bollworm: *Pectinophora gossypiella*	• Use pheromone trap to monitor the adult moth activity • Three weekly releases of egg parasitoid Trichogramma sp	(@1,00,000/ha per release
	Cotton Stem Weevil: Pempheres ***(***Pempherulus) affinis and ***Shoot weevil:*** Alcidodes affaber	Basal application of neem cake	250 kg/ha
	Tobacco Cutworm: Spodoptera litura	• Use of light trap • Growing castor along border and irrigation bunds	

		• Removal and destruction of egg masses • Removal and destruction of early stage larvae • Hand picking and destruction of grown up caterpillars	

	Sucking pests	• Neem oil • Neem seed kernel extract • Fish oil rosin soap • Notchi leaf extract Catharanthus rosea extract	3% 5% 2.5% 5% 5%
	Foliar diseases - Alternaria leaf spot: Alternaria macrospora	Neem oil Bacillus subtilis	3% 0.04% on 60, 90 and 120 days after sowing
	Wilt : Fusarium oxysporum f. sp. vasinfectum	• Seed treatment with Trichoderma viride formulation • Destroy the infected - plant debris. • Soil application of Trichoderma viride	4g/kg seed 2.5kg/ha
	Root Rot: Rhizoctonia bataticola	• Seed treatment with T. viride • Seed treatment with Bacillus • Soil application • Seed treatment with Pseudomonas • Soil application of Pseudomonas	@ 4 g/kg seed @ 10g/kg seed @ 2.5 kg/ ha at the time of sowing @10g/kg @ 2.5 kg/ha at the time of sowing
Optimum stage of harvesting	Boll bursting stage		

SUGARCANE[2]

Tamil: Karumpu **Botanical Name: *Saccharum officinarum***

Sugarcane is grown chiefly in the main season (December - May) in the entire State. In parts of Tiruchirapalli, Perambalur, Karur, Salem, Namakkal and Coimbatore districts, it is also raised during the special season (June - September). The particulars in respect of each season are given below:

Season, Period of Planting

1. Main season

i) **Early :** Dec - Jan ii) **Mid :** Feb - March iii) **Late:** April - May

2. Special season : June - July

Early season varieties are suitable for special season.

Crop Management

Main Field Preparation for Planting Sugarcane

1. **Preparation of Field**

a) Wetland (Heavy soils): In wetlands, preparatory cultivation by ploughing the land and bringing the soil to fine tilth could not be done.

i. After harvest of the paddy crop, form irrigation and drainage channels of 40 cm depth and 30 cm width at intervals of 6 m across the field and along the field borders.

ii Form ridges and furrows with a spacing of 80 cm between rows with spade.

iii.Stir the furrows with hand hoes and allow the soil to weather for 4 to 5 days.

b) Problem soils with excessive soil moisture:

In problem soils, with excessive moisture where it is difficult to drain water, form raised beds at 30 cm intervals with Length - 5 m, Width - 80 cm, and Height -15 cm.

Garden lands with medium and light soils:

In medium and light soil irrigated by flow or lift irrigation adopt the following:

1. The initial ploughing with two disc plough followed by eight disc plough and using cultivator for deep ploughing followed by one time operation of rotovator to pulverize the soil to get a fine tilth, free of weeds and stubbles.

2. Level the field for proper irrigation.

3. Open ridges and furrows at 80 cm apart with the help of victory plough or tractor drawn ridger. The depth of furrow must be 20 cm.
4. Open irrigation channels at 10 m intervals.

Basal application of organic manures:

Apply FYM at 12.5 t/ha or compost 25 t/ha or filter press mud at 37.5 t/ha before the last ploughing under gardenland conditions. In wetlands this may be applied along the furrows and incorporated well.

BIOFERTILIZER FOR SUGARCANE

1. ***Azospirillum*** is the common biofertilizer recommended for N nutrition which could colonize the roots ofsugarcane and fix atmospheric nitrogen to the tune of about 50 to 75 kg nitrogen per ha per year

(a) Preparation of Setts For Planting:

- Take seed material from short crop (6 to 7 months age) free from pests and diseases incidence.

- Prepare the slurry with 10 packets (2000 g)/ha of Azospirillum inoculum with sufficient water and soak the setts in the slurry for 15 minutes before planting.

(b) Top Dressing for Nitrogen Saving

- Mix 12 packets (2400 g)/ha of Azospirillum inoculant or TNAU Biofert –1 with 25 kg of FYM and 25 kg soil and apply near the clumps on 30th day of planting. Repeat the same on 60th day with another 12 packets (2400 gm). Repeat the above on the other side of the crop row on the 90th day (for lift irrigated belt).

2. ***Gluconacetobacter diazotrophicus*** isolated from sugarcane can able to fix more nitrogen than *Azospirillum*. It colonizes throughout the sugarcane and increases the total N content. In soil, it can also colonize the roots and able to solubilize the phosphate, iron and Zn. It can also enhance the crop growth, yield of sugarcane and sugar content of the juice

   (a) **Sett treatment:** Before planting the sugarcane setts can be treated with ten packets (2 kg) per ha of *Gluconacetobacter diazotrophicus* prepared as slurry with 250 L of water.

   (b) **Soil application:** Twelve packets (2.4 kg) per ha is recommended for soil application each at 30th, 60th and 90th day after planting under irrigated condition.

3. **Phosphobacteria** as P solubiliser are recommended for sugarcane crop. Method of application is same as *Gluconacetobacter diazotrophicus*.

Crop Protection

- **<u>Pests of Sugarcane</u>**

Early shoot borer: *Chilo infuscatellus snellen*
Symptom:

- Dead heart shows in 1-3 months old crop, which can be easily pulled out.
- Caterpillar bores into the central shoot and feeds on the internal tissue cause Dead heart.
- Rotten portion of the straw coloured shoot emits an offensive odour.
- A number of bore holes at the base of the shoot just above the ground level.

Organic Management:

- Use resistant varieties like CO 312, CO 421, CO 661, CO 917 and CO 853
- Early planting during December – January escapes the early shoot borer incidence.
- Sugarcane intercropped with Daincha recorded the lowest early shoot borer incidence.
- Trash mulching along the ridges to a thickness of 10-15 cm 3 days after planting.
- Ensure adequate moisture to bring down the soil temperature and increase humidity (unfavourable condition for the multiplication of early shoot borer).
- Partial earthing up on 45 days after planting reduces the incidence.
- Remove and destroy dead hearts.

- Install pheromone traps @ 10Nos. /ha for surveillance and monitoring, change the septa/lure once in 30 days.
- Apply granulosis virus 1.5 x 13 5 IBS / ha (750 diseased larvae / ha)along with teepol twice on 35 and 50 DAP.
- Release 125 gravid females of *Sturmiopsis inferens* a tachinid parasite per ac.

Sugarcane Wooly Aphid: *Ceratovacuna lanigera*

Symptom:

- Congregation of large number of white coloured nymphs and adults on the under surface of leaf.
- Yellowing and drying of leaves from the tip along the margins.
- Leaves become brittle and dries completely.
- Heavy secretion of honey dew leads to development of sooty mold.
- Deposition of wooly matter on ground / soil distinctly visible.

Organic Management:

- Paired row system of planting.
- Avoid excessive use of nitrogenous fertilizers.
- Use of organic fertilizers.
- Rapping of canes all along the rows.
- Infested tops should not be transported.
- Infested canes should not be used as seed material for planting.
- Encourage natural predators *viz., Diapha aphidivora , Ishchiodon scutellaris, Episyrphus baleatus, Chrysopa sp., Schymnus sp., Cheilomenes sexmaculata, Coccinella septempunctata, Synnonycha grandis, Brumus sp.* and *Dideopsis aegrota*
- Pathogens like *Cladosporium oxysporum, Metarhizium anisopliae, Verticillium lecanii* and *Beauveria bassiana*
- Release *Encarsia flavoscutellum*

Whiteflies: *Aleurolobus barodensis*

Symptom:

- Yellowing of leaves and later it shows pale in colour
- Leaf turns pinkish or purple and later gradually dry.
- Infested leaves look white and black dots.
- In severe cases it look like fiery appearance
- It shows very slow in growth of plant

Organic Management:

- Avoid water stagnation and provide proper drainage facilities
- Detrashing of cane at the 5th and 7 th month
- Avoid the excess application of fertilizers
- Detrashing the puparia bearing leaves and immediately disposing by burning or burying to prevent emergence of adult white flies.
- Ensure adequate irrigation which facilitates the soil moisture and reduces the multiplication.

Mealybug: *Saccharicoccus sacchari*

Symptom:

- Pinkish oval insects beneath leaf sheath on the nodes, with whitish mealy coating.
- Main cane stunned also attack roots.
- Sooty mould develops on the honey dew giving blackish appearance on canes which attack the black ants
- Yellowing of leaves

Organic Management:

- Use resistant varieties like CO 439, CO 443, CO 720, CO 730 and CO 7704
- Drain excess water from the field.
- Detrash the crop on 150 and 210 DAP
- Avoid excess usage of Nitrogen fertilizers

DISEASES:

Red rot: ***Glomerella tucumanensis***

Symptoms:

- The affected canes exhibit leaf colour change, from green to orange and then to yellow in the third or fourth leaf. Then the leaves start drying from bottom to top.
- If the fungal spores enter the leaf sheath through the leaf midrib, then reddish spots can be seen on the back side of the leaf midrib also.
- The external symptoms appear only after16 - 21 days after infection and drying of entire cane takes another 10 days time.
- When the affected cane is split opened, the inner region is reddish in colour with intermittent white tinges across the cane length.
- Sometimes, the pith inside the cane is filled with blackish brown liquid and exhibited alchohol odour.

Organic Management :

- The best way to control red rot is to select setts for planting from healthy plants in a disease- free area.
- The red rot affected field must be rotated with rice for one season and other crops for two seasons.
- Growing of recommended resistant and moderately resistant varieties *viz*., Co 86032, Co 86249, CoSi 95071, CoG 93076, CoC 22, CoSi 6 and CoG 5
- Removal of the affected clumps at an early stage and soil drenching with Carbendazim 50 WP (1 gm in 1 litre of water)
- The cut ends and entire setts should be dipped in a fungicide solution, such as one per cent Bordeaux mixture.
- If the disease is noticed in the field, the leaves and canes should be collected and destroyed by burning.

Ratoon stunting: ***Leifsonia xyli* subsp. *xyli***

Symptoms:

- The affected plants are stunted, the stunting being most severe in stubble and ratoon crops.
- In infected stocks, the presence of pin head like orange coloured dots of bacteria on the internal

soft tissue in the nodal region

- The setts taken from diseased plants germinate poorly and the few shoots that are emerged grow very slowly.

Organic Management strategies:

- Select healthy setts for planting.
- Field should maintain at proper sanitation.
- Ungerminated setts should be removed and fill the gap with new setts which should be treated before planting.
- Treat the setts with hot water at 50°C for about 2 hours this gives 100 per cent control. A temperature higher than this would kill the cane and lower temperature than the specified enables the pathogen to survive.
- Aerated steam therapy eliminates the pathogen from the infected canes. Use of disinfectants to clean seed cutting tools which would reduce the chance of spread of pathogen from the infected to healthy setts.

Smut: *Ustilago scitaminea*

Symptoms:

- Production of whip like structure (25 – 150 cm) from the growing point of the canes.
- Whip covered by translucent silvery membrane enclosing mass of black powdery spores.
- Initial thin canes with elongated internodes later become reduced in length.
- Profuse sprouting of lateral buds with narrow, erect leaves especially in ratoon crop.

Organic Management strategies:

- Growing of resistant and moderately resistant varieties *viz*., Co 86249, CoG 93076, CoC 22, CoSi 6 and CoG 5
- Discourage ratooning of the diseased crops having more than 10 per cent infection.
- *Cajanus cajan* can be grown as a companion crop between rows of sugarcane, and the secondary spread of the disease is substantially reduced.
- Treating the seed setts with Areated Steam Therapy (AST) at 50 ºC for 1 hour or in hot water at 50 ºC for 30 minutes or at 52 ºC for 18 minutes
- Roguing of smut whips with gunny bags/polythene bag and dipped in boiling water for 1 hour, and diseased clums must be uprooted and burn

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