

PINEAPPLE

Introduction

Pineapple (*Ananas comosus*) a native of Brazil is an important fruit crop of India and is mainly grown in West Bengal, Assam, Karnataka, Tripura, Bihar, Manipur, Meghalaya and Nagaland North Eastern States account for nearly 45% of total pineapple production in the country. It can be grown as a pure crop on plantation scale or as an intercrop in plantation crops or as an agro-forestry crop along with a variety of trees. In Tripura and in many parts of the Barak valley in Assam, pineapple is cultivated along with jackfruit trees. In Manipur, Nagaland, Mizoram and Meghalaya it is grown on the hill slopes as pure crop or as intercrop in agro-forestry systems.

Climate, Soil and Crop Duration

Natural habitat of pineapple is humid tropical areas and most pineapples are cultivated between 25° north and south of equator The optimum temperature for successful cultivation is 16–32°C. Leaves and roots grow best at 32°C and 25°C respectively. Their growth ceases below 20°C and above 36°C. A high temperature at night is deleterious and a difference of at least 4°C between day and night temperatures is desirable. Pineapple can be grown up to 1,100 m ASL, if the area is frost-free. Although the annual rainfall for its commercial cultivation is 1000–1500 mm, it grows remarkably well under a wide range of rainfall.

Pineapple can grow in wide variety of soils having capacity for good moisture retention, aeration and good drainage. Calcium content should be low and pH should not be more than 6.0. Medium to heavy loams rich in humus with slightly acidic reaction are preferred soils for pineapple cultivation.

The pineapple is a perennial crop with an economic life of 5–7 years, though many farmers in the North-eastern region cultivate it beyond 12–15 years through crop manipulation and traditional agronomic practices. Even 20–25 year old plantations can be seen in many parts of north Tripura and in the Barak valley of Assam.

Varieties Recommended:

Five varieties of pineapple are grown in North-eastern region: Kew, Giant Kew, Queen, Mauritius and Jaldhup and Lakhat.

Propagation, Suitability of Different Planting Materials and Planting:

Pineapple is propagated vegetatively through suckers, slips, crowns and discs. Plants grown from suckers produce fruits in 15– 18 months, plants grown from slips, and discs take 20– 22 months while plants grown from crowns take longest time of 24-26 months after planting. Suckers and slips are cured by stripping off the lower

leaves followed by drying in the sun or in partial shade for about a week before planting. This curing is done to avoid rotting of plants after they are planted.

There is large variation in size and weight of suckers and slips. Researches conducted at various research institutes and SAUs have shown that suckers weighing around 500g and slips weighing 350g are the best planting materials. Variation in size of planting materials can be usefully utilized for staggering the harvest period and making fruits available throughout the year. In this way by combining different sizes of planting materials, their planting time and induction of flowering, commitments of supplying fruit to the canneries or exports can be met easily.

Suckers can be treated by dipping them in a mixture of a cow pat pit/ jeevamrut or panchgavya, as per convenience. Then they are dried for 6–10 hours. When such treated suckers are used for planting, they result in healthy plants with high yields.

To take care of infestation of mealy bugs and heart rot, the planting material should be dipped, first in *Beauveria bassiana* (10g/ lit water) solution and later in *Pseudomonas fluorescens* (10 g/ lit water).

Planting time is usually during monsoon; however, planting pineapple during peak monsoon season leads to heart rot. Therefore, planting is required to be taken up either early in the monsoon or at the end of monsoon depending upon the situation. If irrigation facilities are available then planting can be done at any time of the year and time of planting can be adjusted as per the demand from market.

Land Preparation

An area with 30–40% slope is generally selected for pineapple cultivation. In NER, the most common method of initial clearing of the land for plantations by way of slash-and-burn is strictly prohibited in organic farming. Generally farmers are not using any FYM/ Compost. But it is recommended that to obtain consistently high yields with good quality fruits organic manure mixture should be used as basal dose, while planting the suckers. Manure mixture is to be added to the pits dug for pineapple plantation.

The land is generally prepared by hoeing, but in areas where the slope is not too steep, the land may be levelled by ploughing to facilitate uniform distribution of water and nutrients. Alternate crisscross rows are made using a bamboo across the slope, which helps in soil and water conservation. In most hill areas of the NER, the fields are not ploughed but uniform rows are demarcated either across the slopes or along the slopes where the suckers are planted at uniform spacing (in the case of mono-cultivation) or random spacing if planted along with other perennial crops such as banana, papaya, etc.

Method of planting:

Methods of planting depend upon the system. In mixed cropping situations where pineapple is being taken up as intercrop with other fruit trees, planting is done in two paired rows between two rows of fruit trees. In hills banana can be planted randomly between pineapple plants or pineapple can be planted in two rows between every row of banana. Under mono-cropping mode, flat bed planting and furrow or trench planting are followed. In hilly areas where lands are sloppy contour planting is adopted. Most common method of planning is trench planting. Usually a two-row system is adopted in this method. The field is laid out in trenches alternating with mounds. Mostly, 20 to 30 cm depth trenches are dug and in hilly areas trenches are dug across the slope.

Planting is done either in flat beds where there is no danger of water logging, or in shallow trenches that are filled as the suckers grow and develop. Care should be taken to see that the bud or heart of the sucker does not get buried. A single or double row system of planting is followed. The suckers are planted in about 8–10 cm deep holes with perfect alignment. The plants in the furrows are arranged in such a manner that two plants are opposite to each other thus allowing larger area for for its growth. After planting, soil around the plant is made firm but ensuring that the soil does not enter the heart of the plant.

Spacing and planting density:

In single row system of planting, plants are spaced 30–60 cm apart with a spacing of 75 cm between rows. In the double row system, the spacing is 30 cm between plants, 60 cm between rows and 1–1.5 m between double rows from the centre. For cultivation of pineapple in flat beds, a planting density of 43,000 plants per hectare is considered optimum, keeping a distance of 30 cm between plants, 60 cm between rows and 90 cm between beds. The interspaces are intercropped with seasonal pulses or vegetables of short duration. In the double row system, planting is done with a spacing of 25 cm x 50 cm x 80 cm for a total plant population of 61,538 plants per hectare. A close spacing pattern is suitable for hill areas on terraces to prevent soil erosion. The plantation is allowed to remain on the same site for 4–5 years after which the old plants are removed and new ones are planted.

Intercropping and Rotations

Under organic management, pineapple is an ideal intercrop with various fruit trees. In North-eastern hill states pineapple and banana are grown together for higher profitability. Cassava and yam can also be grown successfully with pineapple. One row of cassava/ yam can be planted after every 4-paired rows of pineapple. Legume intercrops such as groundnut and beans can also be grown during rainy season on the alternating bunds.

Water Management:

Pineapple is grown mostly as rainfed crop in heavy rainfall areas. Optimum rainfall range for pineapple is 1000-1500mm. In scanty rainfall area/season, irrigation at an

interval of 20-25 days may result in a good crop. During summer months, pineapple plants should be irrigated wherever possible. It may require five or six irrigations during the dry months at intervals of 20–25 days. However, no farmer in NER is resorting to irrigation and crop is generally taken as rainfed.

Weed Control and Mulching:

Weeding is generally done twice a year; first, about a month or two after planting, in the month of August or September, and second, in the months of October to November. Periodic weeding keeps the area clean. The uprooted weeds are either used for making organic compost or as mulch to conserve water/moisture during winter/dry months. Growing green manure crops/cover crops/green legume crops and mulching with weed slashings and leaf litter, etc., suppress weed growth.

Nutrient Management:

Intercropping of legumes and using their biomass as mulch and rotations with legume crops is an essential activity in soil fertility management for organic pineapple cultivation. Ensuring recycling of entire harvested biomass through composting is also essential. In NER majority farmers do not provide any manure. Also in crops where plantations are maintained for 2-4 years or more, application of manure is not feasible. But in flat lands and in cases where crop is taken as annual crop manuring can be done by using mixed manure mixture. Foliar feeding through growth promoting sprays and application of liquid manures during rains can be resorted. One or two foliar applications and one or two soil application with liquid manures not only improves productivity but also ensures good quality and optimum fruit size and weight.

Concentrated manure mixture – For 100 kg manure mixture mix 80 kg FYM/compost with 12 kg vermicompost, 2 kg wood ash, 1.0 kg neem cake, 3.5 kg poultry manure and 200 g each of *Azotobacter* + PSB + KMB biofertilizer and 300 g each of *Trichoderma viride* + *Trichoderma harzianum* + *Pseudomonas fluorescens*. Mix all the ingredients with some water and incubate for 48 hrs. This mixture is most effective within 7-8 days of preparation and needs to be incorporated in the soil within a week's time.

Liquid manure for soil application is a mixture of fermented cow urine, *Jivamrit* and or farm made protein hydrolysate in equal quantities. 500 lit of such liquid manure needs to be applied in soil along with irrigation water or during rains. Liquid manure can also be applied close to plants by drawing a shallow furrow near the plants and pouring liquid manure in it.

Foliar feed solution – Feeding plants through leaves are an important strategy in organic farming. *Vermiwash* (5%), *Panchagavya* (3%) and farm made protein hydrolysate (4-5 ml/lit of water) are ideal inputs. Any one or combination of two or all

can be used depending upon the requirement and availability. 2-3 applications of 500 lit each can meet requirements

Improving Market Value of Pineapple Fruits of Kew Variety by Pinching the Crowns:

In pineapple, crown grows at the expense of the fruit. Large sized crowns not only reduce the fruit size, but they add to the cost in transport. Besides this such big crowns are difficult to manage in transit and often get damaged.

Studies at IIHR, Bangalore have shown that partial pinching i.e. removal of inner most whorl of leaves including growing tip 1½ months after fruit set not only reduces the crown size but also increases the fruit size and improved fruit shape of Kew variety of pineapple.

Pest Management

As diversity is the key to pest management in organic farming and all out efforts must be made to maintain diversity by growing diversified plants on borders, hedgerows and as intercrops.

Other important physical and ecological management strategies found effective in keeping the pest load below threshold level include:

- Using plant material that is free of mealy bugs and heart rot
- Crop rotations with leguminous plants
- Application of balanced dose of nutrients in the form of composts and concentrated organic manures and biofertilizers based on soil test report.
- Apply mycorrhiza and plant growth promoting rhizobacteria (PGPR)
- Apply *Trichoderma* and *Pseudomonas fluorescens* as soil application

Keep on monitoring pest and defender ratio. If pest : defender ratio is 2:1 then there is no need to worry, but if this ratio increases above 2:1 then adopt curative control measures as described below in the table for individual pests.

Important Insect pests

1. Mealy Bugs (*Pseudococcus bromeliae*/ *Dysmicoccus brevipes*)

Symptom - Mealy bug is probably the most damaging pest affecting pineapple. The rapid spread of this malady in fields is due to the feeding habits of these insects. Often, before the visual symptoms appear, mealy bugs have already left the infected plant and moved on to nearby healthy one. Nymphs and adults congregate on leaves and suck the sap. The predominant symptom is wilting of leaves, commencing from the leaf tips. Reddish-yellow colour manifests in the wilting areas. Heavy mealybug attack appears as white, waxy masses of mealybugs on stems, fruits and along the veins on the underside of leaves. Growth of the plants remains stunted. Feeding on fruit results in discoloured, bumpy, and scarred fruit, with low market value. Mealy bugs are also the vector of pineapple wilt disease.

Management

Cultural - Planting material must be free from pest and should be procured from pest-free zones. Pruning and destroying affected parts, this is particularly useful at the initial stage of infestation. Remove basal brownish leaves of cured planting material. Destroy grasses and other monocot weeds from nearby fields, which serve as alternate hosts for the pest.

Control measures - Spray neem oil (0.5 to 1%) soap emulsion (5-10 ml neem oil + 5g soap in one litre of water) or apply *Verticillium lecanii* @ 1g per plant in liquid form. Garlic-chilli extract in combination with neem oil (3%) and soap can also help in minimizing the mealy bug problem.

2. Other minor pests

Other pests that appear sporadically in eastern India are the stem borer (*Metmasius ritchiei*) and the scale insect (*Diaspis bromeliae*). Minor pests include the fruit and stem borer (*Tecla echion*), termites, the pineapple bug (*Carpophilus hemipterus*) and the pineapple mite or red mite (*Stigmacus floridanas*).

Management – In case if their infestation is below the economic threshold limit then no management is requirement. Only in some cases these insects become problem. Garlic chilli extract with neem oil, neem oil (3%) or NSKE (95%) or herbal mixture extract can be used for their management. Herbal mixture extract can be prepared by crushing 1 kg neem kernel, 500 gm lime powder, 500 gm datura leaves and 500 gm pods and seeds of oleander (*Nerium oleander*) in 15 litres of water and allowed fermenting for 15 days. On alternate days, the mixture needs to be stirred with a stick. After 15 days, one litre of filtrate is mixed in 15 litres of water and sprayed on the crop. It is enough for 2.5 ha and is a multi-pest repellent.

3. Nematodes (*Meloidogyne incognita*, *Pratylenchus sp.* and *Rotylenchulus sp.*)

Symptoms - Reduction in crop yield, particularly in ratoon crops, are caused by root knot nematodes. Initially, when the nematode population is low, plants do not exhibit any symptoms. But later, with the increase in population, plant growth is restricted and finally chlorosis appears on the leaves.

Management

Cultural - Use nematode free planting material. Plant material infested with nematodes should be destroyed and only healthy plant material should be used for fresh planting. In severely infested field adopt 3-4 years of crop rotation with non-host/ repellent crop.

Control measures - Application of neem cake @ 350-400kg/ha at the time of planting. Drenching the soil with *Trichoderma viride* and *Paecilomyces lilacinus* @ 20g/ liter of water (20 kg/ha).

Important Diseases

4. Butt rot/ Base rot/ Leaf and Fruit rot (*Ceratostomella paradoxa*)

Symptoms - The fungus causes rotting in planting material, fruits, stems and leaves under conditions of high moisture and high humidity. Base or butt rot of planting material occurs when the suckers are not dried properly and are tightly packed, with little aeration. Fungus also destroys older plants by entering through wounds caused in the collar region during weeding or other intercultural operations. In severe conditions the entire plant may turn dark and rot within two or three days. Leaf rot, base rot and fruit rot are predominant throughout the pineapple growing areas of NER.

Management - The diseased plants must be destroyed and suckers for propagation should never be collected from the infested area. Foliar spray of Bordeaux mixture (1%) or copper oxychloride (0.3%) or Drench the soil with *Pseudomonas fluorescens* @ 20g/ litre.

5. Heart rot/Root rot/ Fruit rot (*Phytophthora parasitica* and *P. cinnamoni*)

Symptoms - The disease causes complete rotting of the central portion of the stem. The top leaves turn brown and basal portion of leaves show sign of rotting with foul odour.

Management

Cultural - Good soil drainage and use of healthy planting material helps in minimising the spread of disease. Clear pineapple residues from the soil that are acting as mulch. Rotate with non-susceptible crops such as sugarcane, corn, soybean and peanuts.

Control Measures - Treating suckers with cow dung slurry mixed with *Trichoderma viride* / *Pseudomonas fluorescens* @ 12.5 kg/ha. At the time of planting apply in the holes FYM enriched with *Trichoderma viride* / *Pseudomonas fluorescens* @ 500g/ 10kg FYM. Two weeks after planting, apply *Pseudomonas fluorescens* @ 2% as drench. Repeat its application if disease is still observed. Prophylactic treatment with Bordeaux mixture (1%) or copper oxychloride (0.3%) fungicidal drench may help to check disease incidence

6. Leaf spot/ Yellow spot (*Phytophthora spp.*) and White leaf spot (*Thielaviopsis paradoxa*)

Symptoms - Leaf spots occur frequently in moist, warm, climate of eastern India. Small water-soaked areas develop on leaves, which gradually enlarge. The affected portions become pale yellow or white in colour and gradually dry up.

Management

Cultural - Good soil drainage and use of healthy planting material helps in minimising the spread of the disease.

Control measures - Treating suckers with cow dung slurry mixed with *Trichoderma viride* / *Pseudomonas fluorescens* @ 12.5 kg/100 litres water. Foliar spray of Bordeaux mixture (1%) or copper oxychloride (0.3%) or Drench with *Pseudomonas fluorescens* @ 20g/ litre of water.

7. Pineapple wilt virus

Symptoms - Infected plants become yellowish-red to bright red at the leaf tips, this colouration spreads down the leaf with time. Soon other leaves turn colour and also show signs of wilting. However, the inner heart leaves remain normal. Severely infected plants become stunted and produce small, under grade and immature fruits. The disease is probably introduced with planting material, which may not show obvious disease symptoms. Once established, it is spread by mealybugs, sedentary insects, which are moved from plant to plant by attendant ants.

Management - Use planting material from wilt-free areas. Management of mealy bug (as mentioned above) reduces infestation of virus.

Harvest and Yield:

It takes about 15–20 months for the crop to mature. Usually flowering takes place from February to April and the fruit is ready between July to September. Sometimes off-season flowers appear and they produce fruit during winter, which is of poor quality. The fruit is harvested when it just becomes yellow, the angularities of eyes start reducing and the bracts wither. Average yield is 10–15 tonnes per hectare in NER states. But this can be increased to 25-30 tons/ha with good organic management practices using manure mixtures, foliar feeding and irrigations during dry periods.

Post-Harvest Handling:

Shelf life of pineapple depends upon a number of factors like time of harvest, stage of harvest and method of cutting stem end. It has been observed that harvesting in the morning hours, cutting the stem end smoothly and harvesting at designated maturity stage help in providing better quality fruits.

Pineapple must be harvested in cool hours either in the morning or in the evening. While harvesting, stem end must be cut smoothly and should not be more than 2 cm long.

Stage of Harvest and Transport to Packhouse:

Harvesting of pineapple can be started without any adverse affect on fruit quality at the stage when fruits start colouring at the base. This stage is also termed as turn in colour. Earliest a pineapple fruit can be harvested is when $\frac{1}{8}$ th fruit surface has

become coloured. In world trade different ripening stages have been designated as M₁, M₂ and M₃:

M₁: Fruit colour on turn

M₂: Half coloured fruit

M₃: Fully coloured fruit

Usually fruits are harvested between M₁ and M₂ stages depending upon the distance it is to be shipped. At M₃ stage fruits are sent only by air. Fruits after harvest are kept in shade in plastic crates till these are shifted to pack house. During field storing as well as transport, fruits should not be compressed or bruised and effort should be made to shift them to packhouse immediately.

Sizing and packing the fruits

In foreign countries size grading is done by weight sizers. In our country it can only be done manually. Usually pineapple size grading is done according to following weight groups.

Grading pineapple fruits according to weight:

S.No.	Fruit grade	Weight
1	Super quality size	1750 to 2750g
2	A grade size	1500 to 1750 g
3	B grade size	1100 to 1500 g
4	C grade size	800 to 1100 g
5	D grade size	Less than 800 g
6	Baby size	Approx. 550 g

Maximum demand for fruits is for medium size pineapple in the range of 0.9 to 1.5 Kg. Packing of pineapple fruits is generally done in gunny bags which is not at all suitable for good quality fruits. For export market, pineapples are packed in card board boxes horizontally keeping fruits side by side with tops opposite to one another. Carton size is maintained according to size of the fruit to be transported. Fruits are packed in cartons keeping vertical orientation. The size of cartons will vary according to number and size of fruits to be packed.

Pre-cooling and cold storage

Pineapples are very sensitive to temperature. Before storing in cold store, fruit needs to be pre-cooled by forced air cooling at below mentioned temperature ranges:

Ripe or half ripe – 7-10°C

Mature green – 10-13°C

Humidity should be around 85-90%.

After pre-cooling, the fruits packed in CBF boxes need to be stored in cold store in temperatures mentioned for pre-cooling.