

film as mulch is equally beneficial. Suckers start growing with the emergence of inflorescence while slips grow with developing fruits. Only one or two suckers are retained on the plant for ratooning while additional suckers and all slips are removed. This is essential as the growth of these may weaken plant and hinder fruit development. Desuckering can be delayed as much as possible since fruit weight was found to increase with increasing number of suckers per plant. Increased number of slips delayed fruit maturity; therefore they are removed as soon as they attain the size required for planting. Where early harvest is required slips are removed as and when they sprout. Removal of crown is not recommended as it mars appeal of fruit, increases chances of disease infection and also makes handling difficult. However, partial pinching of crown by removing the inner whorls of leaflets along with the growing tips one and a half month after fruit set leads to increased fruit size.

Pests

Mealy Bug (*Pseudococcus brevipes* / *Pseudococcus bromeliae*) : The rapid spread of this malady in the pineapple field is largely due to the feeding habit of bugs. Symptoms first appear on roots which cease to grow, eventually leading to collapse of tissues. The most predominant symptom is wilting of leaves, commencing from leaf tips. Reddish-yellow colour develops in the wilting areas. Finally the plants rot and develop decaying suckers. Fruits developed are undersized. Ants of several species act as carriers of mealy bugs.

Application of chlorpyrifos (Hilban) 2.5ml/l or Imidacloprid (Tatamida) 0.3ml/l at 100 days after planting controls mealy bugs. This insecticide should not be applied at the time of flowering and fruiting because of its systemic nature.

Care should be taken that the spray shall reach the base and also the sides of the plant. Destroy grasses and other monocot weeds, which serve as alternate hosts for the pest. For the control of mealy bugs, control of ants is necessary. Hence apply carbaryl to control ants in its colonies in the farm.

Scale insects (*Diaspus bromeliae*) : Scale-like bodies appear on the plant, especially on leaves. Other symptoms are similar to that of



Fig. 13. Mealybug



Fig. 14. Heart Rot



Fig. 15. Neck Cracking



Fig. 16. PMWA Virus Disease



Fig. 17. Leaf Spot Disease



Fig. 18. Fruit Rot



Fig. 19. Variations

mealy bugs. The spraying of chemicals for the control of mealy bugs, mentioned above, will be sufficient for the control of scale insects.

Diseases

Black-rot or Soft-rot : A delay of some days between harvest and utilization of the ripe fruits leads to the development of black-rot or soft-rot. The fungus makes its entry through wounds caused during picking and packing. Infection starts at the stalk-end of the fruit, resulting in small, circular, water-soaked spots that are very soft. Gradually, fruit rots and emits foul smell. Dipping of fruits for 5 minutes in Thiabendazole (100 ppm) or Benomyl (3000 ppm) minimise rotting. Avoiding injury to the fruit during harvest and transit reduces disease occurrence.

Heart-rot (*Phytophthora parasitica*) : Root rot / heart rot / fruit rot caused by *Phytophthora* sp. is common in poor drainage conditions. The disease causes complete rotting of the central portion of the stem. The top leaves turn brown and basal portion of leaves shows sign of rotting with foul odour. Finally the whole plant rots. Poor physical condition of the soil and inadequate drainage are responsible for spread of the disease. Providing drainage is most essential. The water table should be at least 60 cm below the soil surface. Badly affected plants should be destroyed and the remaining plants should be drenched with 0.2% zineb / mancozeb / ziram.

Leaf and Fruit-rot (*Cyrtosomella paradoxa*) : Base or butt rot of planting material occurs when they are not dried and packed with little aeration. Fungus also destroys older plants by entering through wounds caused in the collar region while weeding or other operations. In severe conditions, the entire plant may turn dark and rot within two or three days. The disease can be controlled by dipping planting materials in 0.3% Dithane Z-78 or by spraying on leaves. Copper fungicide should not be used in pineapple as they cause leaf scorching. The diseased plants must be destroyed and suckers for propagation should never be collected from the infested area.

Sun burn : This results when plant leans or falls over to one side, thus exposing one side of the fruit to direct sunlight. The cells of the exposed surface get damaged. Later shell surface assumes a brownish to black colour and cracks may appear between fruitlets. Affected fruits soon rot and become infested with pests. They must be cut as soon as noticed and safely disposed of where they will not contaminate other fruits. Under favourable climate where leaf growth is luxuriant, leaves can be tied around the fruits to protect them from sun-scald. The other method is to cover sun-exposed portion of the fruit with dry straw or grass or with any other locally available materials. During summer months it is necessary to protect the fruits from scorching sun by putting dried grasses, coconut or arecanut leaves to prevent sunburn

Harvesting

Pineapple is a perennial fruit crop and the returns continue, usually, for a period of 3 years. Under natural conditions, pineapple comes to harvest during May- August. With the application of Ethephon and fertilizers the first yield is obtained within 10-12 months. Pineapple plants flower 7-8 months after planting and attain harvesting stage in a year, depending on the variety, time of planting, the type and size of plant material used and the prevailing temperature during fruit development. Observing the colour change is the most common method of determining the maturity of fruits. For long distance transportation, fully mature fruits in green itself just before colour change are harvested. With a slight colour change at the base of

developing fruit, it could be harvested for canning purpose. But for table purpose, the fruit could be retained till it develops satisfactory uniform golden yellow colour. Harvesting is done with a sharp knife, severing the fruit-stalk with a clean cut retaining 5-7cm of stalk with the fruit in such a way that the fruit is not damaged. Fruits are stacked in piles or on to the vehicles with the crown facing down. Fruits for fresh fruit market are often marketed with crowns.

Yield

The yield of pineapple fruit varies with the variety, agroclimate, agrotechniques and planting density. The fruit yield with a plant density of 20000-25000 plants/ha is about 25-35 t with the yield decreasing progressively from first year to third year which is the normal economic life span of Mauritius pineapple.

Ratoon Crop

The plant crop after harvest can be retained as ratoon crop for two more years. After the harvest of the plant crop, chopping the side leaves of the mother plant should be done for easy cultural operations. The suckers retained should be limited to one or two per mother plant. Excess suckers and slips if any should be removed. Earthing up should be done. Other management practices are same as for the plant crop.

Uses

Pineapple can be stored up to 20 days at 10-13°C. Pineapple is used as fresh fruit, for canning and juice purposes. The surplus fruits can be processed into various products for using throughout the year. Squash, Jam, Jelly, Pickles, Halva, Candy, etc. can be prepared even at home. Pineapple juice contains lot of calcium, potassium, fibre, vitamin C, B1 and B6. Pineapple contains an enzyme bromelain which enhances digestion, repairs body tissues and imparts freshness. It is effective against rheumatism and heart diseases.



Fig. 20. Juice



Fig. 23. Halva



Picture 22. Pickle



Fig. 21. Pineapple Pieces



Fig. 24. Candy

Challenges

Agriculture in Kerala, especially the pineapple sector is undergoing great crisis mainly because of the lethargy to agriculture, scarcity and high cost of labour, market uncertainty, high cost of fertilisers and other inputs, ABC grading in pineapple and large variation in the prices of various grades. Pineapple Cultivation has become an agribusiness now, especially on leased lands on a very large scale. Pineapple cultivation costs about Rs. 4.3 lakhs/ha during the first year and more than Rs. 2.5 lakhs during the second and third years. It works out to Rs. 12-13 per sucker. Therefore, pineapple cultivation will be profitable only when the market price is more than Rs. 16-20. The prices at certain times increased up to Rs. 50 and came down drastically during other times causing farmers impossible to market their produce.

PINEAPPLE

(*Ananas comosus*, Bromeliaceae)

Dr. P. P. JOY, Associate Professor & Head



Technical Support
Justin T. Jose, Anjana R.



KERALA AGRICULTURAL UNIVERSITY
PINEAPPLE RESEARCH STATION
VAZHAKULAM-686 670, MUVATTUPUZHA, ERNAKULAM DISTRICT
PHONE: 0485 2260832, FAX: 0485 2260832
Email: prsvkm@kau.in, Website: www.kau.edu/prsvkm

Pineapple (*Ananas comosus*, Bromeliaceae)

Pineapple (*Ananas comosus*, Bromeliaceae) is a herbaceous perennial, 90 to 100 cm in height with spreading leaves which gives the plant a rosette appearance. The plant bears a single fruit terminally on a peduncle protruding out from the centre of the rosette. The Pineapple variety 'Mauritius' is also known as 'European Pine', 'Malacca Queen', 'Red Ceylon' and 'Red Malacca' in international trade. It is important in India, Malaya and Ceylon. Mauritius is exclusively grown for **table purpose**. The fruit is medium, 1.36-2.25 kg, yellow externally; has a thin core and very sweet golden yellow flesh and juice. Vazhakulam pineapple is considered the best in quality, sweetness aroma and flavour. It is grown in the districts of Ernakulam, Kottayam, Pathanamthitta and the low elevation areas of Idukki district in Kerala. In Kerala, pineapple is cultivated in an area of 12500 ha with a production of 102400 t and a low productivity of 8.2 t/ha, consistently stable over the last few years.

Varieties

In international trade, pineapple cultivars are grouped in four main classes: 'Smooth Cayenne', 'Red Spanish', 'Queen', and 'Abacaxi', despite much variation in the types within each class. **Smooth Cayenne** (Kew) is extensively cultivated in Hawaii, Philippines, Australia, South Africa, Puerto Rico, Kenya, Mexico, Cuba and Formosa. The ovoid medium-sized fruit (1.5 to 2.5 kg) of 'Smooth Cayenne' is held on a short and strong peduncle. It ripens progressively, turning yellow from the base to the top, which is reflected in a strong internal maturity gradient too. The flesh is firm, close-textured, juicy and with a pale-yellow to yellow colour at maturity. **Mauritius** or **Vazhakulam pineapple** locally known as 'Kannara' belongs to Queen Cultivar (Mauritius) suited for table purpose. The average fruit weight is 1300-1600g. The fruit is having a pleasant aroma, have a slightly conical shape, fruit 'eyes' deeply placed, fruit flesh is crisp and golden yellow in colour, juice is sweet with 14-16° brix and its acidity is 0.50 - 0.70%. **Amrutha** is a hybrid between Kew and Ripley queen. It has spiny leaves and 13-15 months duration. Fruit



Fig. 1.
Kew



Fig. 2.
Mauritius



Fig. 3.
Amrutha



Fig. 4.
MD-2

is cylindrical, tapering slightly from near base, weighing 1.5-2.0kg. Crown is small weighing 80-100g; ratio of fruit weight to plant weight is medium. Fruit is green when unripe and uniformly yellow when ripe; fissure and eye corking absent, spirals are left oriented. Fruit is firm with mild external aroma, skin 6 mm thick, flesh firm, non-fibrous, crisp and pale yellow in colour with rich aroma. Taste is good with high total soluble salts and low acidity.

MD-2 or Dinar pineapple is the standard for the international market because of its colour, flavour, shape, lifespan and ripeness. It has excellent fruit qualities like high brix value (17 for ripe fruit), low acidity (0.4-0.45%), medium fruit size (1.5 to 2.0 kg), cylindrical shape with square shoulder, small core size, resistant to internal browning, very long shelf life (about 30 days) etc.

Soil & Climate

Pineapple is grown on various types of soils including very poor soils. The flavour and quality of fruit grown on light soils is considered to be superior. However, the sandy and loamy soils rich in humus and the laterite soils on the hill slopes in South India are suitable for its cultivation. The plant is particularly sensitive to soil being waterlogged. Therefore, care should be taken to ensure proper drainage. It prefers soils with a pH range of 5.0-6.0. Pineapple grows in warm and humid climate. The optimum temperature is from 15° to 32°C for normal growth. High temperature over 35°C is unfavourable for the development of fruits, especially if the relative humidity is low. Exposure of the fruits to strong sunshine leads to sun scalding. It can be grown up to an elevation of 1,100 m above the sea level, if these places are free from frost, have a relatively high atmospheric humidity and an annual rainfall of 760-1,000 mm. Main season of planting is April-May and August-September, but it can be planted in all months except during heavy rains of June-July. The best time for planting is August. For getting maximum price and better keeping quality, the best planting time is April-May.

Planting Material

Pineapple is very easy to propagate vegetatively. Suckers arising in the lower axils of the leaves on the main stem form roots and can be used for propagation. Even the crown of leaves above the fruit and parts of the stem itself can be used. Another method of propagation is by slips, which are the propagules arising from the base the fruit. Suckers and slips should be preferred over the crown for planting as they come to bearing earlier and produce larger fruits.



Fig. 5.
Suckers



Fig. 6.
Slips



Fig. 7.
Crown



Fig. 8.
Tissue Culture Plant

Suckers are selected from disease and pest free healthy plants. Suckers are to be graded into those having less than 500g, 500-750 g and more than 750g in weight to avoid competition between plants of different sizes. Suckers weighing 400-500g are considered ideal for planting. The graded suckers are planted in different blocks or plots, to get uniformity in growth and flowering. Bigger suckers give early yield. Prior to planting curing of suckers for 8-10 days in shade is necessary as fresh suckers planted in moist soil begin to decay. Before planting some of the lower leaves are removed from the sucker to facilitate the formation and entry of roots into the soil. A solution of Hilban (2.5ml/l) and Indofil (2.5g/l) can be used for dipping of suckers.

Planting

After preliminary land preparations, planting is done in small pits of 10-15 cm depth at a spacing of 45 cm between rows and 30 cm between plants in the rows.

The planting method varies depending upon the topography of land, rainfall and drainage. There are five planting methods in practice, viz. raised bed or ridge (in paddy lands, poorly drained soils or high rainfall areas), flatbed (in soils with assured drainage), furrow (in areas with good drainage or poor rainfall), trench (in rainfed areas with water scarcity) and contour planting (in hilly areas or sloppy lands).

Pure cropping: Suckers are planted at 90 cm width in rows / strips, leaving the interspaces undisturbed. However, ploughing can be adopted in level land. Planting is done in paired rows of 45 cm distance between rows and 30 cm within the row. Suckers may be planted in triangular method in the paired rows. Interspace between the paired rows is kept at 150 cm. Contour planting may be adopted in sloppy areas. **Intercropping in coconut garden:** Land preparation, spacing and planting are the same as described above. There can be three-paired rows in between two rows of coconut.



Fig. 9. Pure crop



Fig. 10.
Inter crop in Rubber Plantation



Fig. 11.
Inter crop in Coconut Plantation



Fig. 12.
In Reclaimed Paddy Fields

Intercropping in rubber plantations: System of planting is in paired rows at 45 x 30 cm. There will be only one paired row of pineapple in between two rows of rubber. **Wetlands / lowlands:** Pineapple is highly sensitive to water stagnation and high moisture regimes. Hence it is important to provide good drainage, if grown in wetlands. In paddy lands, pineapple is planted in paired rows at 45 x 30 cm spacing on ridges taken at 60-90 cm height, depending on the water table and drainage requirement. The ridges are separated by drainage channels having 60 cm width. The width of the ridges varies from 120-150 cm. Wherever water stagnation and poor drainage are expected, a wider and deeper channel is given in between ridges.

Manuring

Pineapple plants require heavy manuring. Application of 20 to 30 t/ha of cow dung / FYM / compost at the time of planting is essential for good yield. It is recommended to give fertilizers at the rate of 8:4:8 g N:P₂O₅:K₂O per plant per year. Nitrogen and potash should be

applied in 6 split doses at bimonthly intervals, except during heavy rains. The first dose of fertiliser is given 2 months after planting. Entire phosphorus can be given at the time of planting. Application of fertilizer in rainfed areas has to be done when moisture is available.

Irrigation

Pineapple needs light and frequent irrigation due to its shallow root system. Irrigation is given only during dry months from January till the onset of monsoon. It requires five or six irrigations during dry months at an interval of about 20 days. Mulching the crop with dry leaves at 6 t/ha will help to conserve moisture.

Weed control

Weeding is important from the economic point of view. Hand weeding especially in closely spaced crop is cumbersome and uneconomic. Therefore chemical control of weed is advisable. Application of Diuron at 3 kg/ha or combination of Diuron (1.5 kg/ha) + Bromacil (2.0 kg /ha) as pre-emergence spray is recommended. It should be repeated with half of the dose, 5 months after the first application. Irrigation followed by the herbicide spray helps in carrying herbicides to the root zone of the weeds. Weeds in interspaces can be controlled by spraying glyphosate 0.8 kg/ha. While spraying in interspaces, care should be taken that the herbicide shall not fall on pineapple plant.

Flower induction

Since pineapples flower erratically, induction of flowering is a common practice. This is done chemically by use of growth regulators which induces flowering and subsequent fruiting. In Kerala, for inducing uniform flowering, 25 ppm ethephon is applied on physiologically mature plants having 39-42 leaves (7-8 months after planting). The solution for application in 1000 plants is prepared by adding 1.25 ml of ethephon (3.2 ml of 39% ethrel or 12.5 ml of 10% ethrel), 1 kg urea and 20 g calcium carbonate to 50 litres of water. Pour 50 ml of the prepared solution to the heart of the plant during dry weather conditions (when there is no rain within 36 hours of application). If it rains within 36 hours ethephon application is repeated. Flowering starts by 30 days and completes within 40 days of growth regulator application. Fruits will be ready for harvest by 130-135 days after the application of growth regulator. Harvest over different months could be obtained by carefully phasing the planting and growth regulator application.

Interculture

Due to its shallow root system and weak stem pineapple plants are prone to lodging. Lodging of plants during fruit development results in lopsided growth and uneven development of fruits. Hence earthing up is an important operation in pineapple cultivation, as it helps in promoting good anchorage. It involves pushing soil to the base of the plant from the periphery or into the trench from the ridge, where trench planting is common. Mulching is one of the cultural practices aimed at weed control and soil moisture conservation. It is essential when pineapple is grown as a rainfed crop and is feasible where flatbed planting is followed. In South India, mulch of leaves or straw is spread on soil between the plants. Use of black polythene