Pineapple

Pineapple (*Ananas comosus*) is an important fruit crop in India. Originated in Brazil, it has spread to other tropical parts of the world. A good source of vitamins A and B, pineapple is fairly rich in vitamins C, calcium, magnesium, potassium and iron. It is also a source of bromelin, a digestive enzyme.

The cultivation of pineapple is confined to high rainfall and humid coastal regions in the peninsular India and hilly areas of north-eastern region of the country. It can also be grown commercially in the interior plains with medium rainfall and supplementary protective irrigations. At present pineapple is grown commercially in Assam, Meghalaya, Tripura, Mizoram, West Bengal, Kerala, Karnataka and Goa, and on a small scale in Gujarat, Maharashtra, Tamil Nadu, Andhra Pradesh, Orissa, Bihar and Uttar Pradesh.

**Climate and Soil:** The pineapple is a crop of humid tropics. The fruit grows well near the sea coast as well as in the interior, so long as the temperatures are not extreme. The optimum temperature for successful cultivation is 22°C–32°C. Leaves and roots grow best at 32°C and 29°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. It can be grown up to 1,100m above mean sea-level, if the area is frost-free. Although optimum annual rainfall for its commercial cultivation is 100–150cm, it grows remarkably well under a wide range of rainfall. In areas where the rainfall is less, supplementary protective irrigations are necessary during dry season.

The plants come up well in any type of soil except on very heavy clay soil. Sandy loam soils are ideal. The soil should be 45–60cm in depth without hard pan or stones. Low-lying areas with high water table should be avoided. The plants prefer a soil pH of 5.0–6.0.

**Varieties**

**Kew:** It is a leading commercial variety valued particularly for canning. Its fruits are big-sized (1.5–2.5kg), oblong and tapering slightly towards the crown. The fruit with broad and shallow eyes becomes yellow when fully ripe. The flesh is light yellow, almost fibreless and very juicy. The leaves often have a short sector of small margin of spines just behind the tip, and irregularly on the base near its attachment to the stem.

**Giant Kew:** Cultivated in certain regions of West Bengal, it is synonymous to Kew except the size of plant and fruit which are larger than Kew as the name signifies.

**Charlotte Rothchild:** It is partially cultivated in Kerala and Goa. The fruit is similar in taste and other characters to that of Kew.

**Queen:** Widely grown in Tripura, and partly in Assam and Meghalaya, its fruits are rich yellow in colour, weighing 0.9–1.3kg each. The flesh is deep golden-yellow, less juicy than Kew, crisp textured with a pleasant aroma and flavour. Eyes are small and deep, requiring a thicker cut when removing the skin. The leaves are brownish-red, shorter and very spiny.
Mauritious: A mid-season variety of the Queen group, it is grown in some parts of Kerala. Medium in size, its fruits are deep yellow and red. Yellow fruits are oblong, fibrous and medium sweet compared with red ones. This is ideal for table purposes.

Jaldhup and Lakhat: These are 2 indigenous types grown in Assam, both being named after the place of their production. Both are under Queen group with fruits smaller than Queen. Lakhat is markedly sour in taste, whereas Jaldhup has its sweetness well-blended with acidity. The fruits of Jaldhup again have a characteristic alcoholic flavour of their own and can be easily distinguished from other fruits of the Queen group on the basis of this character alone.

Propagation

The performance of the plant depends on vigour, growth rate, time taken for bearing, fruit size and quality of planting material. Besides type and size of plant material also results in variation in the performance of plants. If planting material of different types and sizes is used, it results in poor rate of plant establishment, uneven growth of the plants, uneven flowering and harvesting stretched over a long time. Uniform cultural operations cannot be taken up. Ultimately plant-wise operations are to be followed resulting in increased cost of production. In a mixed planting, a few plants flower while others become ready for harvesting, posing problems for getting good uniform ratoon crops also. Therefore, it is always advisable to use uniform-sized material of monotype. Hence, selection of right type and size of planting material is essential for commercial plantings.

In suckers and slips, larger planting material results in more vigorous plants. Of the types and sizes of propagules tried, slips and suckers weighing about 350 and 450g respectively are ideal for higher yield with better produce. In case of non-availability of slips, suckers weighing about 500g are ideal. If sufficient suckers are not available, slips weighing about 350g are best.

Planting

Time of planting is dictated by the season in which the first plant crop is required. Planting time is very important for natural flowering period, which differs from region-to-region. By the time of natural flowering, if the plant does not attain the optimum physiological maturity, either it escapes flowering the next season or if flowering is induced in the same season, the plant, bear very small fruits. Hence, the ideal time of planting is 12–15 months before the peak flowering season under natural conditions, which varies from December to March in different regions. Time of planting also varies from place-to-place depending upon the time of onset of the monsoon and the intensity of its precipitation. In Assam, planting should be done during August–October, while in Kerala and Karnataka, the best time of planting is April–June. Delaying in planting as late as September, delays crop at least by 7–9 months. The peak flowering under these conditions comes during January–March. The ideal time for planting in north West Bengal is October–November and June–July for other parts.

System of planting varies according to land and rainfall. There are 4 planting systems—flat-bed, furrow, contour and trench.
Plant density of pineapple depends on growth of the plant and system of planting. Adoption of low-planting densities has been the major constraint in India, contributing to high cost of production. The plant density of 63,400 plants/ha (22.5cm × 60cm × 75cm) is ideal for subtropical and mild humid conditions, whereas for hot and humid conditions a plant density of 53,300 plants/ha spaced at 25cm from plant-to-plant within a row, 60cm from row-to-row and 90cm from trench-to-trench (25cm × 60cm × 90cm) provides high yield. In rainfed, high fertile and hilly areas in north-eastern states, a plant density of 43,500 plants/ha spaced at 30cm × 60cm × 90cm is recommended. The yield of 70–105 tonnes/ha may be obtained under high-density planting, the increase in yield/unit area being 45–85 tonnes/ha. Adoption of high-density planting does not have much adverse effect on fruit size, quality and canning recovery. Less weed infestation, protection of fruits from sun-burn, increased production of propagules (suckers and slips)/unit area and non-lodging of plants are added advantages of high-density planting.

**Manuring and fertilization**

Pineapple is a shallow feeder with high N and K requirement. Since these nutrients are prone to heavy losses in soils, practices relating to time of application and form of fertilizer determine their efficient use.

Application of 12g N/plant for Kew pineapple is ideal to obtain high yield at Bangalore, Chethalli (Karnataka) and Thrissur (Kerala). A dose of N, P\textsubscript{2}O\textsubscript{5} and K\textsubscript{2}O at 12, 4 and 12g/plant/year respectively is optimum under Jorhat conditions. No response to P application has been observed. However, in the ratoon crop 4g P\textsubscript{2}O\textsubscript{5}/plant increases fruit weight and yield. Plants receiving 12 g K\textsubscript{2}O/plant/crop give higher yield without any adverse effect on fruit quality both under irrigated and rainfed conditions. For medium-fertile soils in West Bengal, N (12–16g), P\textsubscript{2}O\textsubscript{5}, (2–4g) and K\textsubscript{2}O (10–12g)/plant are optimum.

It is thus advisable to apply N and K\textsubscript{2}O each @ 12g/plant. There is no need for P application. However, if the soils are poor in P, 4g P\textsubscript{2}O\textsubscript{5}/plant can be applied. The N should be applied in 6 split doses. The first dose of N can be given 2 months after planting and the last one 12 months after planting. The K should be given in 2 split doses. Entire P and half of K can be given at the time of planting and the remaining K 6 months after planting. Application of fertilizer under rainfed conditions should be done when moisture is available.

**Interculture**

*Earthing up:* This is an essential operation in pineapple cultivation aimed at good anchorage to the plants. It involves pushing the soil into the trench from the ridge where trench planting is a common practice. As its roots are very shallow, the plants are eventually lodged especially under flat-bed planting in heavy rainfall areas. Lodging of plants at the time of fruit development results in lopsided growth, uneven development and ripening of fruits. It is more important in ratoon crop as the base of ratoon plants shifts up, crop after crop. High-density planting minimizes its necessity as the plants prop each other preventing lodging.

*Weed control:* Weeds could be effectively and economically controlled by application of Diuron (3 kg/ha) or a combination of Bromacil + Diuron @ 2kg/ha each as pre-emergent spray and
Repeated with half of the dose, 5 months after first application. The quantity of each herbicide should be mixed in 1,000 litres of water for a hectare of crop.

**Mulching:** It is essential to conserve soil moisture. Though mulching is not a common practice in India, use of dry leaves or straw is in practice in south India. Mulching with black polythene and saw-dust results in better growth of plants than white polythene and paddy-straw.

**Removal of suckers, slips and crowns:** Suckers start growing with the emergence of inflorescence, whereas slips grow with the developing fruits. The fruit weight increases with increasing number of suckers/plant, while the increased number of slips delay fruit maturity. Crown size has no bearing on the fruit weight or quality. Hence desuckering can be delayed as much as possible, while the slips are recommended to be removed as soon as they attain the size required for planting. Removal of crown is not required as it mars the appeal of the fruit and also makes handling difficult. Partial pinching of crown consisting of the removal of the innermost whorl of leaflets along with growing tips 45 days after fruit set is ideal to get fruits of better size and shape.

**Irrigation**

Although pineapple is cultivated mostly under rainfed conditions, supplementary irrigation can help produce good-sized fruits in areas having optimum rainfall. Irrigation can also help establish an off-season planting to maintain its year-round production. In scanty rainfall and during hot weather irrigating pineapple once in 20–25 days is advisable.

**Use of growth regulators**

Application of NAA and NAA-based compounds—Planofix and Celemone @10–20ppm —induces flowering in pineapple. However, variability in induction of flowering from season-to-season and low effectiveness of this plant growth regulator during unfavourable weather are the main factors which have made NAA less dependable. Flowering in pineapple Kew could be induced with the application of Ethephon or ethrel (2-chloroethyl phosphonic acid) (100ppm). The concentration of Ethephon could be reduced to 25ppm by combining it with 2% urea and 0.04% sodium carbonate. The concentration may further be reduced to 10ppm in combination with urea (2%) and sodium carbonate (0.04%). However, the latter treatment is effective only during January–May. The application of 50ml solution/plant containing calcium carbide (20g/litre) or Ethrel (0.25ml/litre) causes flower induction. Flower induction should be done when the plants attain at least 35–40 functional leaves, so that the plants produce fruits of normal size.

Application of NAA (200–300ppm) 2–3 months after fruit set increases 15–20% fruit size. To get the year-round availability of pineapple, it should be planted at regular intervals round the year. Using suckers and slips of different sizes and crowns as planting material and applying flower-inducing chemicals also provide its availability round the year.
Harvesting and Postharvest Management

Pineapple plants flower 10–12 months after planting and fruits become ready 15–18 months after planting. Irregular flowering results in the harvesting spread over a long period. Under natural conditions, pineapple comes to harvest during May–August. Fruits which mature in winter are acidic. There is a scope of altering fruit size and maturation with the use of chemicals or plant growth regulators.

With a slight colour change at the base of developing fruits, it could be harvested for canning purpose. But for table purpose, the fruits could be retained till they develop golden yellow colour. The fruits with the crown, can be kept without damage for 10–15 days after harvesting.

Ratooning in high-density planting reveals that the average fruit weight in the first and second ratoon is 88% and 79% respectively of the plant crop. The plant stand is also reduced resulting in the reduction of fruit yield by 49.3 and 46.2% in first and second ratoon crops respectively. Prolonged ratooning results in the reduction of flowering plants, consumer appeal of the fruit, fruit size and number of fruits suitable for canning, but in the increase of fasciated fruits. It is also not possible to prevent the reduction of fruit yield in ratoon crop by increasing the irrigation or by higher doses of nitrogenous fertilizers.

Fruit Disorders

Ordinarily pineapple fruit bears a single crown but in some cases a fruit bears more than one, even up to 25 crowns. Consequently, the top of the fruits become flat and broad, and become unfit for canning. Such fruits also taste insipid since they are more corky. It is supposed to be heritable character, found mostly in Cayenne group to which Kew belongs.

In fruit and crown fasciation, fruits become totally useless. Sometimes fruits are highly flattened and twisted with innumerable crowns. Fruit and crown fasciation is associated with high vigour of the plants. Such plants take longer time to flower than the normal ones. High fertility of soil and warm weather, where the conditions are highly congenial for vigorous vegetative growth may favour the fasciation. The incidence of fasciation increases with advancing ratoons.

The collar of slips is typified by the presence of a large number of slips arising from the stem close to the base of the fruit or even directly from the fruit itself. The excessive slip growth is at the expense of the fruit, resulting in small, tampered fruits, often with knobs at the base. High nitrogen fertilization and rainfall along with relatively low temperature are congenial for this abnormality.