

PAPAYA PRODUCTION TECHNOLOGY

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Papaya (*Carica papaya* L.) is widely grown in the tropical and subtropical regions in about 57 countries across the world. India, Brazil, Indonesia, Dominican Republic, Nigeria and Mexico are the leading countries in papaya production. India contributing 43.7 per cent to total world production, is the largest producer with 5.63 million tonnes (2013-14). It is widely grown in the states of Andhra Pradesh, Gujarat, Maharashtra, Karnataka, Madhya Pradesh, West Bengal, Chhattisgarh, Telangana, Tamil Nadu, Assam, Kerala and has emerged as a very remunerative commercial crop because of its early yields, high productivity, good nutritive value and availability throughout the year. It is grown for both fresh fruits and for papain extraction. Ripe fruits are very rich in carotenoids, precursors of Vitamin A (666IU).

Soil and Climatic Requirements

Regions having summer temperature between 38 to 48⁰C and where winter temperature does not fall below 5⁰C are ideal for its growth.

Varieties

1. **Coorg Honey Dew:** It is a gynodioecious, semi dwarf selection from Honey Dew used for both table purpose and papain extraction. Fruits are big, weighing 1.75 to 2 kg, dark green in colour with the slight ridging skin surface, elongated and oval from hermaphrodite trees and ovoid from female trees, with 13.5⁰ Brix TSS, yellow pulp, large cavity and poor keeping quality.
2. **Pusa Giant:** It is a dioecious selection developed by sib mating the variety Ranchi. Plants are highly vigorous, bearing first fruit at one meter height and can stand the storm and windy conditions well. Fruits weight 2 to 3 kg with yellow, moderately firm

- 5 cm thick pulp having 7 to 8.5°Brix TSS and 18 x 10 cm cavity. It yields about 40 kg/plant.
3. **Pusa Nanha:** It is a dioecious dwarf mutant having 106 cm height, bearing fruit at 30 cm height suited for high density planting (6.400 plants per hectare) and pot cultivation and tolerant to water logging. Fruits are medium sized, round to ovate in shape with thin, yellow pulphaving/plant.
 4. **Arka Surya:** It is an advanced generation hybrid from the cross Sunrise Solo x Pink Pulp Sweet. The fruits are medium sized, weighing about 600-800g with good keeping quality. The pulp is deep pink and firm with 13-14°Brix TSS. Fruit yield is 60 - 70 kg/plant for 28 months cropping period.
 5. **Arka Prabhath:** It is an advanced generation hybrid from the cross (Surya x Tainung-1) x Local Dwarf). The fruits are big sized, weighing 900-1200 g, firm and deep pink in colour with TSS of 13-14°Brix and good keeping quality. The average yield is 90 - 100 kg /plant.
 6. **CO 8:** This is a red pulp dioecious variety developed by initial selective hybridization of CO.2 (yellow pulped) with red anthered male followed by intermating and repeated selection in segregating population for red pulp colour. Fruits are suitable for dessert purpose, pulping, processing (RTS, jam, tutti-fruity) and papain industry (Papain activity 138TU/mg). The fruits are big, oblong, weighing an average of 1.5-2.0 kg/fruit with a TSS of 13.5% with a prominent apex. The tree can be economically maintained for 20-22 months under a favourable condition with a yield potential of 230 t/ha when planted at a spacing of 1.8 x 1.8m.

Propagation

Papaya is generally propagated by seeds obtained through controlled pollination. The seeds lose viability very fast if stored with high moisture content or if sun dried. The seeds show orthodox storage behaviour. Seeds dried to a moisture content of (6 to 8%) and packed in moisture impervious container like poly lined aluminium pouch with airtight sealing can be stored at ambient conditions for short term storage (18 months) and at 15°C for medium term storage (2-3 years). Treating the seeds with 100 ppm GA for 8 hours enhances germination. Seeds are sown in perforated polythene bags measuring 20 X 15 cm

size with 150 gauge thickness, filled with equal proportions of farmyard manure, red soil and sand. Arka microbial consortium @ 1 to 2 per cent (1 to 2 kg for 100 kg potting mixture) may be added for healthy seedling production. Two seeds are generally sown in each bag. The best time for raising the seedling is between June to October. In eastern parts of the country, seeds are usually sown from March to May so that the seedlings are ready for transplanting before the onset of the monsoon. In North India, where frost is common, seeds are sown between February and April. Seeds germinate in about 2 to 3 weeks time, depending on the temperature. In the case of dioecious varieties, about 100 g of seeds and in the case of gynodioecious varieties, 30 to 40 g of seeds are required per acre. Generally, 45 to 60 days old seedlings are preferred for planting.

Spacing and Planting

In the main field, pits of 45 cm³ are dug at the spacing of 1.8m X 1.8m, which should be filled with red earth and FYM. Arka Krishi All Rounder Talk formulation @ 2-3 kg/one ton of FYM or 2-3 litres of liquid formulation/one ton of FYM may be enriched. This enriched FYM may be applied @ 5 kg/plant at the time of planting and repeated at six months interval @ 2 kg/plant for growth promotion and yield enhancement. Instead of pits, trenches can also be dug. In the case of dioecious varieties, three plants are planted per pit so that early flowering males are removed to maintain one male plant for every ten female plants.

Nutrition and Integrated Nutrient Management

For papaya, fertilizers should be applied once every two months. Although fertilizer application in a particular region depends on the soil and leaf analysis, generally 90 g of Urea, 250 g of Superphosphate and 140 g of Murate of Potash per plant are recommended for each application. **The** total requirement is 250 g N + 250 g P₂O₅ + 500 g K₂O per plant/year. Application of 7-10 kg farmyard manure/plant every six months is recommended in addition to fertilizers.

Irrigation

Irrigation should be given at weekly interval during summer and once in 8-10 days during the winter season. The orchard should have a good drainage system as the crop is susceptible to waterlogging. Ring and drip irrigation are the preferred methods of irrigation.

Drip irrigation with 80% replenishment of evaporation losses is recommended. During the summer months, the plants should be given 20-25 L of water and can be gradually reduced to 10-15 L of water/plant in winter.

Integrated Pest and Disease Management

Stem rot or foot rot (*Phytophthora spp.*, *Phythium aphanidrmatum*, *Rhizoctonia solani*) : Water-soaked patches on the stem at ground level, which enlarge and girdle the base of the stem develop. The affected tissues turn brown than black and rot. The terminal leaves turn yellow, wilt and drop. Fruits, if formed, also shrivel and drop off. The entire plant topples and dies because of the disintegration of parenchymatous tissue. For its management, Seed dressing with Captaf (Captan) or Chlorothalonil (Kavach) should be done before sowing the seeds. The soil at the orchard should be well drained. Before planting, application of Neem cake + *Trichoderma harzianum* should be provided. Healthy nursery plants should be planted and crop rotation with non host crop should be followed. Soil drenching with tridemorph (Calixin 0.1%) or metalaxyl + mancozeb (Ridomil MZ 0.2%) or chlorothalonil (Kavach 0.2%) at bimonthly interval provide effective control of the standing crop.

Damping off (*Pythium*, *Phytophthora*, *Rhizoctonia* and *Fusarium* spp.)

Pre emergence damping off : Characterized as the toppling of the growing tip before it comes out of the soil.

Post emergence damping off: Seedlings show pale withering and bending symptoms near the ground level with the severe girdling of the stem tissue. In the case of *Phytophthora* and *Fusarium*, root rot is also observed. Such affected seedlings suddenly topple down.

Seeds for raising nursery should be obtained from healthy fruits. Water stagnation and low lying areas should be avoided for the nursery. Seeds should be treated with oxycarboxin (Vitavax), carbendazim SD, captaf (Captan), Tthiram @ 2 g/Kg seeds. Soil amendments with solarization, application of neem cake + *Trichoderma harzianum*, Dazomet, Formaldehyde should be practised. Drenching of Nursery with chlorothalonil (Kavach 0.2%) or oxycarboxin (Vitavax 0.1%) or carbendazim (Bavistin 0.1%) should be done.

Anthracnose (*Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc.): Disease can attack fruits petioles, leaves, floral parts, etc. Water soaked spots first appear as superficial brown discolouration of the skin and then develop into circular, slightly sunken areas 1-3 cm

diameter. Gradually the lesions coalesce, and sparse mycelial growth often appears on the margins. Under humid conditions, encrustations of salmon pink spores often arranged in a concentric pattern develop on the surface of older spots. Fruits later turn dirty brown and rot. Infection at early stages results in mummification and deformation of fruits, whereas at the mature stage, soft rot develops. Sometimes Chocolate unsunken brown lesions appear on the ripening fruits. The petioles of the lower leaf dry and are shed. To control it, Infected leaves should be removed and destroyed. Spraying of mancozeb (Dithane M 45 0.2%) or chlorothalonil (Kavach 0.2%) or carbendazim (Bavistin 0.1%) at 15 days interval provides effective control. Dipping fruits in water at 46 to 49°C for 20 minutes shortly after harvest provides control of disease under storage.

Powdery mildew (*Oidium caricae*(Noack.): Small circular powdery patches develop on both the sides of leaves and on stem of young seedlings. These patches gradually extend, coalesce and cover the entire leaf surface. Badly infected leaves curl, dry, hang down and ultimately fall off. Young seedlings may die under severe disease attack. Sometimes in severe cases, the pathogen attack fruits also. The disease is effectively controlled through the spraying of wettable sulphur (Sulfex 0.3%) when the atmospheric temperature is below 30°C. Application of systemic fungicides, namely tridemifon (Bayleton 0.1%) or carbendazim (Bavistin 0.1%) or thiophanate methyl (Topsin M or Roko 0.1%) at monthly interval is much more effective.

Ringspot virus (PSRV): Papaya ringspot disease is also known as papaya mosaic, papaya distortion mosaic, mild mosaic, papaya ringspot, papaya leaf reduction, thin leaf and distortion as all the above symptoms are caused due to Papaya ringspot virus. The typical mosaic caused by potexvirus so far not found in India.

PRSV-P strain naturally infects papaya and cucurbits. Plants of all ages are susceptible, and symptoms are generally more severe during cooler weather. The disease derives its name from the characteristic dark green sunken rings that develop on the fruit of affected plants. These rings often persist as dark orange to brown markings as the fruit matures. Dark green, water-soaked streaks develop on petioles and stems. Mottle and mosaic patterns of varying severity develop on leaves that often have a ruffled appearance. One or more leaf lobes may become stunted, and the fruit set is markedly reduced or absent. Fruit from affected plants have poor flavour, a leathery appearance and are predisposed to fungal fruit rots. Growing

of border crops *viz.*, two rows of Sesbania or castor 15 days before planting of papaya, rouging and removal of early infected plants as when noticed helps to control the disease incidence. Several cultural practices have proven useful in slowing epidemics and reducing crop damage. Establishing plantations with seedling plants free of PRSV-P is essential, and new planting should be situated as far as possible away from affected plantations. Plantations can be surrounded by non-host crops or interplant with other tree crops. Growing tolerant or resistant varieties is the best option. Genetically engineered resistance against PRSV has been achieved in Hawaii using Kapoho, Sunup and Rainbow cultivars. However, in India so far PRSV resistant cultivar, However, in India so far PRSV resistant cultivar is not available at present. Efforts are underway to develop PRSV resistant/tolerant types by crossing the commercially grown papaya varieties with wild species of *Vasconcellea*.

Insect Pests

The important pests are Red spider mite and root-knot nematodes. The mite infestation becomes severe during summer, and spraying dicofol @ 2.5 ml /L water on the ventral side of the leaf can control it. Applying 25 g Carbofuran/plant in the main field can control nematodes.

Harvesting and Yield

Harvesting generally starts 9 to 10 months after sowing. Mature fruits are harvested when they show streaks of yellow colouration. Since papaya trees are not very tall, handpicking is employed. Yield in papaya varies from about 25 kg/plant in some varieties like Solo to 75 - 100 kg/plant in varieties like Coorg Honey Dew, CO varieties and Arka Prabath. It also varies from region to region and with cultivation practices. The economic yield in papaya is for a period of three years.

Conclusion

General neglect and non-adoption of scientific cultivation practices are the major constraints for poor return from papaya cultivation in the region. It includes a proper planting system, excessive intercropping of exhaustive nutrient crops like turmeric, ginger, no use of soil and water conservation measures, nutrient application and plant protection measures.

There is no separate package of papaya cultivation practices in the northern region particularly, but only general recommendations have been made in combination with other fruit crops. There is also a general lack of awareness among the growers about the production technologies, and this is perhaps one of the important factors responsible for the low productivity of papaya in the region.

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