



2. Pusa Delicious: An improved variety with excellent fruit quality, sweet taste, and attractive deep orange flesh. Fruits are medium to large sized, weighing 1.5-2.5 kg. The variety shows good performance in the region's climate and has relatively better disease resistance.



3. Pusa Majesty: This is a gynodioecious hybrid suitable for commercial cultivation. It produces uniform fruits with good keeping quality, making it ideal for distant markets. The variety is moderately tolerant to papaya ring spot virus.



4. Pusa Nanha: A dwarf variety ideal for high-density planting. Plants are short, allowing for closer spacing and higher yields per unit area. Fruits are small to medium sized, sweet, and of good quality.



5. CO-7: Developed for higher yields, this variety performs well in eastern UP. It produces fruits weighing 1.5-2 kg with good flesh quality and sweetness. The variety shows reasonable tolerance to major diseases.

6. Red Lady: A popular hybrid variety with excellent fruit quality, deep red flesh, and high sugar content. Plants bear fruits weighing 1.5-2 kg. Though slightly more expensive in terms of seed cost, the variety offers superior returns due to its market appeal and productivity.



7. Taiwan varieties: Several selections from Taiwan including Taiwan Red and Taiwan Pink perform well in eastern UP. These varieties produce fruits with excellent taste, attractive appearance, and good market demand.



Land Preparation and Planting

Field Preparation

Proper land preparation is fundamental to successful papaya cultivation. The field should be plowed 2-3 times to achieve a fine tilth, breaking all clods and removing weeds, stons, and crop residues. During the last plowing, well-decomposed farmyard manure at 20-25 tonnes per hectare should be incorporated into the soil.

INTRODUCTION

Papaya (*Carica papaya* L.) is one of the most important and commercially valuable fruit crops grown in tropical and subtropical regions of India. Eastern Uttar Pradesh, with its unique agro-climatic conditions, offers excellent potential for successful papaya cultivation. The region's warm climate, adequate rainfall, and fertile alluvial soils make it particularly suitable for this fast-growing, high-yielding fruit crop.

Papaya is highly valued for its nutritional and medicinal properties. The fruit is rich in vitamins A and C, minerals, and digestive enzymes, particularly papain, which has significant industrial applications. With a short gestation period of 8-10 months from planting to first harvest and continuous fruiting for 2-3 years, papaya provides quick returns to farmers and serves as an excellent source of income in eastern UP.

The crop thrives in the warm, humid conditions prevalent in districts like Gorakhpur, Deoria, Kushinagar, Maharajganj, Azamgarh, Mau, Ballia, Ghazipur, and Varanasi. However, successful cultivation requires understanding of specific regional requirements including variety selection, soil management, irrigation scheduling, pest and disease control, and post-harvest handling suited to local conditions.



Climate and Soil Requirements

Climatic Conditions

Eastern Uttar Pradesh experiences a humid subtropical climate that is generally favorable for papaya cultivation. The region receives an average annual rainfall of 1000-1200 mm, with most precipitation occurring during the monsoon months from June to September. Temperature ranges are suitable, with summer temperatures reaching 35-42°C and winter temperatures dropping to 5-10°C.

Papaya grows best in warm conditions with temperatures between 25-35°C. The crop is sensitive to frost and cold winds, which can cause severe damage to plants. In eastern UP, protection from cold winds during December-January is essential, particularly for young plants. Excessive humidity combined with heavy rainfall can promote fungal diseases, requiring careful disease management during the monsoon season.

The crop requires abundant sunshine for optimal growth and fruit quality. Eastern UP's sunny climate during most of the year supports good photosynthesis and sugar accumulation in fruits. However, strong winds can damage plants and cause fruit drop, so windbreaks using tall growing crops or trees are recommended in exposed areas.

Soil Requirements

Papaya can be grown on a wide range of soils, but performs best in well-drained, deep, fertile sandy loam to loam soils. The alluvial soils prevalent in eastern UP are generally suitable for papaya cultivation. The soil should be rich in organic matter and have good water holding capacity while ensuring proper drainage.

The optimal soil pH range is 6.0-7.0. Papaya is highly sensitive to waterlogging, which can cause root rot and plant death within 24-48 hours. Therefore, fields with poor drainage or heavy clay soils should be avoided, or provisions for proper drainage must be made through raised bed cultivation.

Recommended Varieties for Eastern UP

Selecting appropriate varieties is crucial for successful papaya cultivation in eastern UP. Both dioecious and gynodioecious types can be grown, though gynodioecious varieties are preferred for commercial cultivation as they produce only female and hermaphrodite plants, ensuring better fruit set and uniformity.

Popular Varieties

1. Pusa Dwarf: This variety is well-suited to eastern UP conditions. Plants are medium-sized, bearing fruits weighing 1-2 kg. The flesh is sweet, orange-red colored, and of good quality. It shows moderate resistance to papaya ring spot virus and is suitable for both table and processing purposes.

एग्रीकल्चर फ़ोरम फॉर टेक्निकल एजुकेशन ऑफ़ फार्मिंग सोसायटी

कोटा, राजस्थान



Cultivation of Papaya under Eastern Uttar Pradesh Conditions

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Planting Layout and Spacing

Papaya can be planted in square or rectangular systems depending on land availability and variety characteristics. For medium to tall growing varieties, a spacing of 1.8 x 1.8 meters (approximately 3000 plants per hectare) is recommended. For dwarf varieties like Pusa Nanna, closer spacing of 1.5 x 1.5 meters can be adopted, accommodating about 4400 plants per hectare.

Spacings of 60 x 60 cm should be dug at the predetermined spacing 15-20 days before planting. These pits should be filled with a mixture of topsoil, 15-20 kg well-decomposed farmyard manure, 500 grams single superphosphate, and 250 grams muriate of potash per pit. Infest 50 grams of a nematocide like carbofuran can help prevent nematode damage in affected soils.

Planting Time

In eastern UP Pradesh, papaya can be planted during two main seasons. The monsoon planting from June to July takes advantage of natural rainfall and ensures good establishment. However, winter planting may expose young plants to excessive moisture and disease pressure during the rainy season.

The preferred planting time for most farmers in eastern UP is February to March, which allows plants to establish before the monsoon arrives. Plants grow vigorously during the warm summer months and are better able to withstand monsoon conditions. Additionally, this timing often results in fruiting during the winter months when market prices are typically higher.

Transplanting

Seedlings should be transplanted when they are 8-10 weeks old and have 4-6 true leaves. Transplanting is best done during cool hours of the day, preferably in the evening. The seedlings should be planted at the same depth as they were in the nursery, ensuring the root collar is not buried too deep.

Since papaya exhibits sex variation and sex cannot be determined at the seedling stage, 2:3 seedlings (male to female) are typically planted per pit. Once flowering begins and sex is identified, thinning is done to retain one best hermaphrodite plant per pit. For dioecious varieties, one male plant should be maintained for every 10-15 female plants to ensure adequate pollination.

Immediately after transplanting, light irrigation should be provided to settle the soil around roots and ensure good plant-soil contact. Mulching around young plants with dry grass, sugarcane trash, or paddy straw helps conserve moisture and suppress weeds.

Nutritional Management

Papaya is a heavy feeder and responds well to adequate nutrition. Proper fertilizer application based on soil test results and plant growth stages is essential for achieving high yields and quality fruits in eastern UP conditions.

Fertilizer Requirements

For mature bearing plants, the recommended dose is 200-250 grams nitrogen, 150-200 grams phosphorus, and 200-250 grams potassium per plant per year. This translates to approximately 400-500 kg nitrogen, 300-400 kg phosphorus pentoxide, and 400-500 kg potassium oxide per hectare annually for a population of 2000-2500 plants.

Fertilizers should be applied in split doses rather than as a single application. In the first year, nitrogen and potassium should be applied in 8-10 split doses at monthly intervals, while phosphorus can be given in 2-3 splits. For bearing plants in subsequent years, monthly applications ensure continuous nutrient availability for growth and fruit development.

The fertilizer should be applied in a circular band 15-20 cm away from the plant stem at young stages, gradually increasing the application radius as the plants grow. After fertilizer application, light irrigation should be provided to facilitate nutrient uptake.

Irrigation Management

Papaya requires regular and adequate moisture throughout its growth period, though specific requirements vary with growth stages, season, and soil type. In eastern UP, strategic irrigation management is crucial given the distinct wet and dry seasons. Water Requirements

Papaya needs frequent, light irrigations rather than heavy, infrequent watering. The crop is extremely sensitive to both water stress and waterlogging. During the hot summer months of April to June, irrigation at 4-5 day intervals is necessary, while during the monsoon season from July to September, irrigation may not be needed if rainfall is adequate.

During the winter months of November to February, irrigation at 7-10 day intervals is generally sufficient. However, actual irrigation frequency should be adjusted based on soil type, plant age, and prevailing weather conditions.

Irrigation Methods

Traditional flood irrigation is commonly practiced in eastern UP but is inefficient and can lead to waterlogging problems. Furrow or ring basin irrigation is preferable, where water is applied in furrows or circular basins around plants rather than flooding the entire field.

Drip irrigation is the most efficient method for papaya cultivation, reducing water consumption by 40-50 percent compared to flood irrigation while improving fruit yield and quality. In drip irrigation, water is applied directly to the root zone, maintaining optimal soil moisture without waterlogging. This method also allows for fertigation, enabling efficient nutrient delivery through the irrigation system.

For small-scale farmers in eastern UP, a semi-drip system using simple gravity-fed drip lines can be an affordable alternative to expensive automatic drip irrigation systems. During the monsoon season, excess water should be drained away through proper drainage channels to prevent root rot.

Intercropping and Mulching

Intercropping

During the first year when papaya plants are small, the inter-row space can be utilized for growing short-duration intercrops to generate additional income and improve land use efficiency. Suitable intercrops for eastern UP conditions include vegetables like bottle gourd, bitter melon, cucumber, and ridge gourd during summer, and leafy vegetables, radish, and coriander during winter.

Leguminous crops like cowpea, mung bean, and black gram can be grown as intercrops, providing additional benefits through nitrogen fixation. Turmeric and ginger are also suitable intercrops in the region, though they should be planted at adequate distance to avoid competition with papaya plants.

Intercropping should be discontinued once papaya plants attain full size and begin heavy fruiting, typically after 10-12 months from planting. Care should be taken that intercrops do not compete heavily with papaya for nutrients and water, and do not serve as alternate hosts for pests and diseases.

Mulching

Mulching is highly beneficial in papaya cultivation, helping conserve soil moisture, suppress weeds, moderate soil temperature, and add organic matter to the soil. In eastern UP, organic mulches like dry grass, paddy straw, sugarcane trash, or coconut coir can be used effectively.

A mulch layer of 8-10 cm thickness should be maintained around plants in a circle of 60-90 cm radius. Mulching is particularly important during the hot summer months to reduce water stress and during winter to protect roots from cold. The mulch should be kept slightly away from the plant stem to prevent collar rot.

Plastic mulch can also be used, particularly black polyethylene sheets, which effectively suppress weeds and conserve moisture. However, plastic mulch is more expensive and requires proper disposal after use.

Pest and Disease Management

Papaya cultivation in eastern UP faces various pest and disease challenges, particularly during the humid monsoon season. Integrated pest management approaches combining cultural, biological, and chemical methods are essential for sustainable crop protection.

Major Pests

1.Papaya Fruit Fly: This is the most serious pest in eastern UP, with females laying eggs in developing fruits. Larvae feed on pulp, making fruits unmarketable. Management involves installing fruit fly traps with methyl eugenol at 25-30 traps per hectare, bagging of fruits, use of protective netting or cloth bags, and spraying of malathion or dimethoate if infestation is severe.

2.Papaya Mealybug: These sap-sucking insects appear in clusters on stems, leaves, and fruits, secreting honeydew that promotes sooty mold growth. Control measures include removal and destruction of affected plant parts, encouraging natural enemies like lady beetles, and spraying neem oil or chemical insecticides like thiamethoxam or acetamiprid if infestation is heavy.

3.Red Spider Mites: These tiny pests cause yellowing and bronzing of leaves, particularly during dry periods. They can be controlled through regular water spraying on leaf undersides, application of sulfur dust, or spraying of acaricides like propargite or spirodisifen in severe cases.

4.Aphids: These sap feeders can transmit papaya ring spot virus. Management involves regular monitoring, encouraging natural enemies, and spraying neem-based products or systemic insecticides if populations exceed threshold levels.

Major Diseases

1.Papaya Ring Spot Virus (PRSV): This is the most devastating disease in eastern UP, causing severe yield losses. Symptoms include mosaic patterns on leaves, ring spots on fruits, and stunted growth. Since no chemical cure exists, management focuses on prevention through use of resistant varieties, removal and destruction of infected plants, control of aphid vectors through regular insecticide sprays, and maintaining isolation from old papaya orchards and cucurbit crops.

2.Damping Off: This fungal disease affects seedlings in nurseries, causing them to wilt and die. Prevention involves using disease-free soil or sterilized potting mix, treating seeds with fungicides like thiram or carbendazim, avoiding overwatering and overcrowding in nurseries, and drenching soil with fungicides if disease appears.

3.Stem Rot and Foot Rot: These diseases cause rotting at the stem base, leading to plant wilting and death. They are prevalent during monsoons in poorly drained soils. Management includes ensuring good drainage, avoiding waterlogging, removing and destroying affected plants, and drenching soil around plants with copper oxychloride or metalaxyl-based fungicides.

4.Anthrax: This disease causes dark, sunken spots on fruits, particularly during summer. Control involves maintaining field sanitation, removing affected fruits, ensuring good air circulation, and spraying fungicides like mancozeb or carbendazim on fruit set and during fruit development.

5.Powdery Mildew:

White powdery growth appears on leaves during dry periods with high humidity. Management includes spraying sulfur dust or wettable sulfur, or systemic fungicides like hexaconazole or myclobutanil.

Harvesting and Post-Harvest Management

Harvesting

Papaya fruits mature 5-7 months after fruit set, depending on variety and season. In eastern UP, fruits set during winter mature in 5-6 months, while those set during summer take 7-8 months. Proper determination of maturity is crucial for fruit quality and market acceptance.

Fruits are ready for harvest when they show a color break from dark green to pale green with slight yellowing at the blossom end. For local markets, fruits can be harvested when 25-30 percent yellow, while for distant markets, harvesting at earlier maturity stages with just a trace of yellow is preferable to allow for ripening during transit.

Harvesting should be done during the cooler hours of the day using a sharp knife or pruning shears, leaving a short stalk attached to the fruit. Care must be taken to avoid injury to fruits during harvest as damaged fruits deteriorate rapidly. Latex flow from the stem should be avoided from falling on fruits as it causes skin blemishes.

Post-Harvest Handling

Immediately after harvest, fruits should be washed in clean water to remove field heat and any adhering latex. Treatment with fungicides like carbendazim or hot water treatment at 48-49°C for 20 minutes helps control post-harvest diseases and extends shelf life.

Storage and Transportation

Papaya is a climacteric fruit that ripens rapidly at room temperature. At ambient temperatures in eastern UP during summer, harvested fruits ripen in 3-5 days. For extending shelf life, fruits can be stored at 10-12°C with 85-90 percent relative humidity for 2-3 weeks. Storage below 10°C can cause chilling injury, resulting in uneven ripening and poor flavor. For local markets within eastern UP, fruits harvested at proper maturity can be transported without refrigeration. For distant markets, refrigerated transport maintains fruit quality and extends market period.

Yield and Returns

Under good management in eastern UP conditions, papaya yields 40-60 kg per plant in the first year and 60-80 kg per plant in the second year. With a plant population of 2500 plants per hectare, this translates to 100-150 tonnes in the first year and 150-200 tonnes in the second year. At prevailing market prices of 15-25 rupees per kg depending on season and quality, gross returns range from 1.5-3.75 lakh rupees in the first year and 2.25-5.00 lakh rupees in the second year. After deducting cultivation costs, net profit ranges from 0.75-1.75 lakh rupees in the first year and 1.55-4.00 lakh rupees in the second year.

Returns are significantly higher with improved varieties like Red Lady, better management practices, and favorable market conditions. Contract farming arrangements with processing units can provide assured markets and stable prices.

CONCLUSION

Papaya cultivation offers excellent opportunities for farmers in eastern UP Pradesh given the region's favorable agro-climatic conditions. With proper variety selection, diligent pest and disease management, and effective pest and disease control, papaya can provide attractive returns with relatively short gestation period compared to other fruit crops.

Success in papaya cultivation requires attention to critical factors including site selection with good drainage, use of quality planting material of suitable varieties, balanced nutrition and irrigation management, proactive pest and disease management particularly for papaya ring spot virus and fruit flies, timely harvesting and proper post-harvest handling, and efficient marketing strategies.

The crop's ability to fit into small land holdings, generate quick returns, provide year-round income, and create employment opportunities makes it particularly suitable for small and marginal farmers in eastern UP. Government support through subsidies for planting material, drip irrigation, and post-harvest infrastructure can further promote papaya cultivation in the region.

As consumer awareness about papaya's nutritional and health benefits increases and processing industry expands, the demand for quality papaya is expected to grow, offering sustainable livelihood opportunities for farmers in eastern UP Pradesh.