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Passion Fruit Cultivation: A High-Value Crop for the North Eastern Hill Region of India

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Abstract: -

Passion fruit is a perennial, vigorous, woody climbing vine that bears round to oval-shaped fruits. Three main cultivars of passion fruit are commonly grown. It is considered a high-value, export-oriented crop because of its pleasantly aromatic and richly flavoured juice, which is widely used for preparing premium-quality squash and other beverages. Passion fruit is an excellent source of essential nutrients and vitamins, particularly vitamin C and potassium, along with several non-nutritive phytochemicals such as carotenoids and polyphenols. The fruit also contains plant sterols that contribute to lowering blood cholesterol levels. In addition, it provides vitamin B6, which supports blood sugar regulation and strengthens the immune system. Passion fruit is highly valued for its medicinal properties and in the North Eastern Hill Region, its tender shoots and leaves are also consumed as vegetables. Traditionally, the young shoots and leaves are used to manage diarrhoea, dysentery, diabetes, hypertension, gastritis, abdominal flatulence and as a liver tonic. The leaves contain alkaloids known for their hypotensive, sedative and antispasmodic activities.

Keywords*: Passion fruit, Cultivars, Squash, Alkaloids etc.*

Introduction:

Passion fruit (*Passiflora edulis* Sims) is native to southern Brazil and extends through Paraguay. It belongs to the family Passifloraceae and is widely cultivated in tropical and subtropical regions across South America, Asia, Africa and Australia. In India, passion fruit is grown commercially in Himachal Pradesh, several parts of southern India and north-eastern states such as Manipur, Meghalaya, Mizoram, Nagaland and Sikkim. It is a perennial, vigorous, woody climbing vine that bears round to oval fruits. Passion fruit is

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recognized as a high-value, export-oriented crop because of its pleasantly aromatic and richly flavoured juice. The crop is highly productive, economically rewarding, and performs well in hilly regions even with relatively low management.

Composition

Passion fruit juice is highly appreciated for its distinctive flavour, refreshing taste and excellent blending quality. The fruit is a rich source of essential nutrients, particularly vitamin C (18.2 mg per 100 g edible portion), vitamin A (2410 IU per 100 g edible portion) and potassium (278 mg per 100 g edible portion). It also contains important non-nutritive phytochemicals, including carotenoids (9.25 mg/L) and polyphenols (435 mg/L), which contribute to its antioxidant properties. In addition, passion fruit provides plant sterols that help reduce blood cholesterol levels and vitamin B6, which supports blood sugar regulation and enhances immune function. The rind contains a low level of pectin (about 2.4%). Residual rind material contains approximately 5-6% protein and can be utilized as a filler ingredient in poultry and pig feed.

Uses

- The leaf of passion fruit is very popular for its medicinal value and is also used as a vegetable in the hills of north-eastern India.
- A boiled extract prepared from fresh tender shoots and leaves is traditionally used to treat diarrhoea, dysentery, diabetes, hypertension, gastritis, abdominal flatulence and is also regarded as an effective liver tonic.
- The leaves contain alkaloids that exhibit blood pressure-lowering, sedative and antispasmodic properties. The fruit is highly valued for its distinct flavour and pleasant aroma, making it particularly suitable for the preparation of premium-quality squash.
- The fruit juice with an excellent flavor is quite delicious, nutritious and liked for its blending quality.
- The Passion fruit has been used by the Brazilian tribes as a heart tonic and medicine and as a favourite drink called maracuja grande that is frequently used to control asthma, whooping cough, bronchitis and other tough coughs.

Cultivars

1. Purple Passion Fruit

Purple passion fruit performs best at higher elevations, where the vines are highly productive. The fruits are round to slightly oval, measuring about 4-5 cm in diameter and develop a deep purple colour upon ripening. Individual fruits generally weigh 35-45 g, with a juice content of 31-35%. This cultivar is well

known for its superior flavour, pleasant aroma and high nutritional quality. The seeds are black in colour. Owing to its excellent taste and fragrance, it is widely preferred for fresh consumption, juice extraction and dessert preparation.

2. Yellow Passion Fruit

Yellow passion fruit is better suited to lower elevations and is less productive in cooler, high-altitude areas because of its sensitivity to low temperatures. The fruits are larger than those of the purple type, weighing around 60 g each. They are round in shape, initially green with yellow mottling and turn golden yellow when fully ripe. The pulp has a tangy flavour and is more acidic than that of the purple variety. Although juice recovery is relatively lower, the fruit is extensively used for processing into a range of passion fruit-based products.

3. Kaveri Hybrid

Kaveri is a hybrid developed by the Indian Institute of Horticultural Research at the Central Horticulture Experimental Station, Chettalli, Karnataka. It was produced by crossing purple and yellow passion fruit types. This hybrid is highly vigorous and high yielding with fruits weighing approximately 85–110 g. The fruits combine the attractive purple colour and quality characteristics of the purple variety with the larger size of the yellow variety. The pulp is less acidic than that of the yellow type, making it suitable for both fresh consumption and processing.

4. Giant Granadilla

Giant Granadilla is distinguished by its large leaves and striking flowers. The fruits are greenish-yellow, oblong in shape and resemble melons. They are the largest fruits within the Passiflora genus, measuring 15-20 cm in length and weighing around 600 g. The fruits possess a delicate aroma and a thin, smooth rind. Inside, they contain thick pulp and large seeds, making them suitable for fresh consumption and culinary uses.

Current Scenario in India

In India, passion fruit cultivation is concentrated mainly in the northeastern states, including Manipur, Mizoram, Nagaland and Sikkim. It is also grown in Kerala, Tamil Nadu (particularly in the Nilgiri Hills and Kodaikanal), and Karnataka (especially in Coorg). The crop occupies an area of approximately 19.01 thousand hectares, with an annual production of 123.94 thousand tonnes. Among the producing states, Manipur accounts for the highest production, followed by Nagaland.

Soil and Climate

Yellow passion fruit and giant granadilla are tropical in nature, whereas purple passion fruit is better adapted to subtropical conditions. The purple type can tolerate mild winter frost but is susceptible to

severe freezing temperatures. For optimum vegetative growth and flowering, passion fruit requires a temperature range of 20 to 30°C. The crop grows successfully up to an altitude of 2,000 m above sea level and performs well under annual rainfall ranging from 1,000 to 2,500 mm.

Passion fruit vines thrive best in well-drained soils rich in organic matter (around 2%) with a nearly neutral soil reaction (pH 6.0–7.0). Yellow passion fruit can tolerate slightly alkaline soils. Both excessive heat and severe cold adversely affect growth and fruit set. High temperatures often promote vigorous vegetative growth but may significantly reduce flowering and fruit production.

Propagation

Passion fruit can be propagated through seeds, stem cuttings and grafting onto resistant rootstocks. Seed-propagated and grafted plants generally show greater vigour compared to those raised from cuttings.

Seed Propagation

Fully mature fruits are selected from superior vines known for high yield and good fruit quality. After pulp extraction, the seeds are allowed to ferment for about 72 hours to facilitate separation. The cleaned seeds are sown in well-prepared nursery beds during March–April. When the seedlings reach the 4-6 leaf stage, they are transplanted into polybags (10 cm × 22 cm) filled with a mixture of soil, compost and sand in a 2:1:1 ratio. The seedlings become ready for field planting in approximately three months.

Vegetative Propagation

Semi-hardwood cuttings of pencil thickness, 30-35 cm in length and containing 3-4 nodes are commonly used for vegetative propagation. These cuttings are first placed in sand beds or pots to induce rooting and are later transferred to polybags to encourage better root development. The rooted cuttings are generally ready for transplanting within three months.

Spacing and Planting

The recommended spacing for passion fruit depends on the training system and cultivar used. Under the two-arm Kniffin training system, a spacing of 2 m × 3 m is generally followed, accommodating approximately 1,666 plants per hectare. In the bower or pergola system, a wider spacing of 3 m × 3 m is adopted, allowing for about 1,110 plants per hectare.

Land Preparation

Pits measuring 45 cm × 45 cm × 45 cm are prepared in both plains and hill slopes at the recommended spacing. Each pit is filled with a mixture of three parts topsoil and one-part well-decomposed compost or farmyard manure. Planting is usually carried out during May-June after the onset of the monsoon. Intercrops such as ginger and turmeric can be

successfully grown during the early years of orchard establishment.

Training

Passion fruit vines are commonly trained on the two-arm Kniffin system, with trellis rows oriented in a north-south direction to ensure uniform sunlight exposure. Bamboo or iron posts are erected at intervals of 3-4 m and 3-4 wires are stretched between them at 30 cm spacing. When the main vine reaches the top wire, its growing tip is pinched to encourage the development of two primary leaders, which are trained in opposite directions along the wire. These leaders produce laterals that bear fruits, as passion fruit produces flowers and fruits only on the current season's growth.

The crop can also be trained on a pergola (bower) system, where vines are spread over a criss-cross network of wires spaced 1-20 cm apart and supported 1.8-2.0 m above ground level. The vine is allowed to grow as a single shoot until it reaches the wire, after which the tip is pinched to stimulate side shoots.

Pruning

Pruning is an essential operation in passion fruit cultivation. After harvesting, fruiting laterals are pruned back to 4-5 buds to encourage new growth and subsequent flowering. Pruning is generally carried out twice a year, commonly during April and December.

Nutrient Management

Nutrient requirements according to the age of the vine and its stage of development. A general fertilizer recommendation is 150 kg nitrogen (N), 100 kg phosphorus (P_2O_5), and 200 kg potassium (K_2O) per hectare annually. These nutrients should be applied in split doses, preferably after each major harvest, along with adequate organic manure.

Pollination

Passion fruit flowers are protandrous, meaning that pollen is released before the stigma becomes receptive, which encourages cross-pollination. Pollination is mainly carried out by honeybees. In purple passion fruit and giant granadilla, anthesis usually occurs during the early morning, whereas in yellow passion fruit it occurs in the afternoon. The stigma becomes receptive about 1-2 hours after flower opening.

Fruit Maturity

Purple passion fruit and giant granadilla flower almost throughout the year, with peak flowering during March-April and July-August. In yellow passion fruit and the Kaveri hybrid, the major flowering periods are May-June and September-October. Fruits generally reach maturity within 70-80 days after flowering.

Harvesting and Yield

Commercial harvesting begins 1-2 years after planting. A healthy vine can produce approximately 150-180 fruits annually, with an average yield of 4-6 kg of fruits per plant. Under well-managed conditions, orchard productivity may reach 5-6 tonnes per hectare. Purple passion fruit usually bears more fruits than yellow passion fruit and giant granadilla due to better pollen compatibility. Ripe fruits naturally fall to the ground and quickly lose moisture resulting in wrinkling. Fruits can be stored in polyethylene bags at 7-9°C for up to three weeks without significant quality loss. Since passion fruit is a climacteric fruit, fully mature fruits (10-11 weeks old) can be harvested and ripened off the vine.

Diseases and Pests

Major diseases affecting passion fruit include collar rot, root rot, brown spot and woodiness virus. Disease incidence varies among species and cultivars. Collar rot is particularly severe in purple passion fruit and can be effectively reduced by grafting onto yellow passion fruit rootstocks. Common insect pests include fruit flies and mites, which may cause significant damage if not properly managed. Regular orchard monitoring and integrated pest management practices are essential for maintaining healthy vines and ensuring good fruit quality.

Value-Added Products

Passion fruit juice is rich in vitamin C and possesses strong antioxidant properties. When served chilled, the juice has a refreshing taste and is especially popular during hot weather. Owing to its distinctive flavour and aroma, passion fruit is widely used in the preparation of a variety of processed products, including squash, juice concentrate, jam, jelly, ice cream, cordial, syrup, ready-to-serve (RTS) beverages, carbonated drinks, puree, butter, cream, dehydrated slices and powder. Among these products, juice concentrate has particularly high demand in both domestic and international markets, making passion fruit a valuable crop for processing industries.

Conclusion

Passion fruit is an important horticultural crop with considerable nutritional, medicinal and economic value, especially in the North Eastern Hill Region of India. The fruit and its vegetative parts are traditionally used for the management of several ailments, including high blood pressure, diarrhoea, dysentery, diabetes, gastritis, abdominal flatulence and liver disorders. In addition to its health-promoting properties, passion fruit has strong market demand because of its pleasant flavour, processing suitability and export potential. Its adaptability to hilly regions, high profitability, and scope for value addition make passion

fruit cultivation a promising enterprise for enhancing farmers' income and promoting sustainable horticultural development in North East India.

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