Passion Fruit

1. Introduction :

The passion fruit (*Passiflora edulis*), family Passifloraceae, is a native of Brazil. In India it is found to be growing wild in many parts of Western Ghat such as Nilgiris, Wynad, Kodaikanal, Shevroys, Coorg and Malabar as well as Himachal Pradesh and North Eastern States like Manipur, Nagaland and Mizoram. The fruit is valued for its pronounced flavour and aroma which helps not only in producing a high quality squash but also in flavouring several other products. The juice of passion fruit with an excellent flavour is quite delicious, nutritious and liked for its blending quality. To enhance the flavour of the final produce, passion fruit juice is often mixed with juices of pineapple, mango, ginger etc. The juice is extensively used in confectionery and preparation of cakes, pies and ice cream. It is a rich source of Vitamin A and contains fair amounts of Sodium, Magnesium, Sulphur and Chlorides. Commercial Processing of yellow passion fruit yields 36% juice, 51% rinds and 11% seeds. The physio chemical properties of ripe fruit are given in Table 1.

Table 1 : Physio - Chemical Properties of ripe Passion Fruit (Purple Variety)

Sr.No.	Physio-Chemical Characters	Value
1	Average Fruit Weight (g)	43.18
2	Volume of the Fruit (ml)	48.40
3	Juice (%)	31.31
4	Specific Gravity	0.892
5	TSS(Brix)	14.70
6	Acidity(%)	4.42
7	Ascorbic Acid (mg/100 g)	26.80
8	Carotenoids (ug/100 g)	308.55
9	Fruit length (cm)	4.48
10	Fruit diameter (cm)	4.49

The passion fruit vine is shallow rooted, woody, perennial, climbing by means of tendrils. A single fragrant flower, 5 cm to 7.5 cm wide is borne at each node on the new growth. The fruits are nearly round to oval and has a tough rind which is smooth and waxy. The fruit has an aromatic mass of double walled, membranous sacs filled with orange coloured, pulpy juice and as many as 250 small, hard, dark brown or black seeds.

The leaf of passion fruit is used as a vegetable in the hills of North Eastern India. Boiled extract of fresh tender leaves is prescribed as a remedy for diabetes, hypertension, diarrhoea, dysentry, gastritis, abdominal flatulence and as a liver tonic. The rinds of passion fruit have very low pectin content (2.4 %). The rind residue contains about 5-6 % protein and could be used as a filler in poultry and stock feed. The seeds yield 23 % oil which is similar to sunflower and soybean oil and accordingly has edible as well as industrial uses. There is currently a revival of interest in the pharmaceutical industry, especially in Europe, in the use of glycoside, passiflorine, especially from P.incarnata as a sedative or tranquilizer. Italian chemists extracted passiflorine from the air-dried leaves. Juice of Passion fruit is prescribed as a digestive stimulant and treatment for gastric cancer.

2. International Scenario :

Passion fruit vines are found wild and cultivated to some extent in many parts of the Old World including the highlands of Java, Sumatra, Malaya, Western Samoa, Norfolk Islands, Cook Islands, Solomon Islands, Guam, the Philippines, the Ivory Coast, Zimbabwe and Taiwan. Brazil has long had a well established passion fruit industry with large-scale juice extraction plants. Passion fruit is grown in North Eastern Region of India. Other countries include Australia, New Zealand, Kenya, Uganda, Rwanda etc.

3. National Scenario :

Passion fruit is commercially cultivated in the North Eastern States of Manipur, Mizoram and Nagaland. It is also cultivated in some parts of Nilgiris and Shevroys.

4. Organic Farming :

Organic farming is a crop production method respecting the rules of the nature. It maximises the use of onfarm resources and minimises the use of off-farm resources. It is a farming system that seeks to avoid the use of chemical fertilisers and pesticides. In organic farming, entire system i.e. plant, animal, soil, water and micro-organisms are to be protected. The guidelines for organic farming is enclosed in Annexure I.

5. Organic Production :

5.1 Climate and Soil

Passion fruit prefers tropical to subtropical humid climate and grows well upto 2000 m altitude

with an annual rainfall of 1000 to 2500 mm. The crop requires an optimum temperature of 200 to 30 0C and temperatures below 15 0C restricts vegetative growth and flowering. It grows best in light sandy loam soils with pH of 6.0 -7.0 and good drainage. A soil having sufficient quantity of moisture, rich in organic matter and low in salts is considered very suitable for its cultivation.

5.2 Varieties

Out of several species, Purple passion fruit (*Passiflora edulis Sims*), Yellow Passion fruit (*Passiflora edulis var. flavicarpa*) and 'Kaveri' Hybrid passion fruit (Purple x Yellow) are of commercial importance in India.

5.2.1 Purple Passion Fruit

Vines are productive at higher elevations. Fruits are 4-5 cm in diameter, deep purple when ripe each weighing 35-45 g. The juice content varies from 31-35 per cent. The variety is known for its quality in terms of flavour and nutrient content. Seeds are black in colour. The variety is susceptible to leaf spot, collar rot, attack by thrips and nematodes.

5.2.2 Yellow Passion Fruit

This variety is suitable for lower elevations and is less productive at higher elevations due to its sensitiveness to low temperature. The fruit is bigger in size than purple variety, each weighing about 60 g, round in shape with yellow mottled spots, turns golden yellow when ripe. Juice is more acidic, its recovery being comparatively less than the purple. Seeds are brown, tolerant to leaf spot and wilt, escapes the damage by thrips and tolerant to nematodes.

5.2.3 Kaveri Hybrid Passion Fruit

It is an hybrid between Purple and Yellow passion fruit developed at Central Horticulture Experimental Station, Indian Institute of Horticulture Research, Chettalli, Karnataka. It is a high yielding variety and each fruit weighs 85-110 g. The fruits are purple in colour, fruit quality comparable to that of Purple variety. The variety is reported to have field tolerance to brown leaf spot, collar rot, wilt and nematodes.

5.3 Propagation

Passion fruit is propagated by seeds, cuttings and grafting on resistant root stocks. Seedlings and grafted plants are more vigorous than cuttings.

5.3.1 Seed Propagation

Fruits are collected from superior vines in respect of yield and quality. The pulp after extraction is allowed to ferment for 72 hours and seeds are extracted. The seeds are sown in well prepared seed beds during March-April. The seedlings after attaining 4-6 leaves stage are transplanted in 10 cm x 22 cm polybags filled with a mixture of soil, compost and sand (2:1:1). The seedlings will be ready for transplanting in the main field in about three months.

5.3.2 Vegetative Propagation

Semi-hardwood cuttings of about 30-35 cm size with 3-4 nodes are ideal. The cuttings are to be first placed in sand beds/pots for root initiation and then transferred to polybags for better root development. The rooted cuttings are ready for planting in about three months. However, most farmers raise nurseries from the seeds and vegetative propagation is not popular as it is time consuming.

5.4 Spacing and Planting

The spacing will vary depending upon the type of training system being followed and variety. In case of Kniffin system of training the spacing adopted is 2m x 3m, which will accommodate 1666 plants/ha. In bower system, the recommended spacing is 3m x 3m which accommodates about 1110 plants/ha.

5.5 Preparation of Land

Planting sites experiencing high winds should be avoided as the wind not only damages the vines but makes it more difficult to train the vines to the trellis. Pits of 45 cm x 45 cm x 45 cm are dug at a spacing of 3m x 2m, on hill slopes/plains. The pits are filled with a mixture of three parts of top soil and one part of compost and planting is done preferably on cloudy days during May-June after onset of monsoon. Seasonal vegetables could be grown as intercrops during the first year. Turmeric and ginger could be grown as intercrops by supplementing the nutrition.

5.6 Training and Pruning

Training is quite important in regulating yield and also in supporting the vine during its economic life. Weak and faulty construction of trellis may lead to sagging and loss of vines.

5.6.1 Training

The vines are trained to a single unbranched shoot from the base of the plant up to the trellis height and from this point, two vigorous shoots (primaries) are allowed to grow on the trellis in opposite directions. In due course, the laterals that arise from the primaries are trained hanging downwards from the wire and the tendrils that come in the way are to be removed periodically.

These laterals constitute the potential fruit bearing area of the vines. Trellising is important to obtain maximum potential yield of passion fruit. The most economical training method is the kniffin system in which 2.5 m long posts/pillars are erected 3 m apart and four lines of 9 to 11 gauge wire is allowed to run across. The trellis should run across the slope or in North-South direction, to have maximum and even exposure of vines to sunlight. In case, wooden posts are used, they have to be painted with coaltar at the base to avoid insect attack and quick rotting. Telephone system on raisers is also economical as it allows growing intercrops on terraces and

suppressing the weed growth. The bower system of training is also followed in many areas.

5.6.2 Pruning

Passion fruit bears on current season's growth and hence systematic pruning of vine encourages new growth resulting in regular and higher yield of fruits. After the harvest of the crop, the laterals are cut back to 4-5 buds. Pruning should be done after harvesting of the crop in April and December.

5.7 Manuring

Application of organic manure is very much necessary to have vigorous plants giving regular and optimum yield. It is observed that almost entire plantation of passion fruit in Meghalaya and other parts of North Eastern Region is generally grown by using organic inputs like farm yard manure, vermicompost, bio-plus (prepared from organic waste), etc. Application of oil cake is also followed in some area. During the first year of plantation, 10 kgs of FYM per vine and from second year onwards 15 kg of FYM per vine is recommended. Mixtures of FYM and vermicompost in the ratio 4:1 or 3:1 and oil cake gives very good result, but due to very limited availability of vermicompost most of the farmers are not applying it. The manure should be applied in February-March.

5.8 Pests and Diseases

5.8.1 Pests

The fruit fly (*Daucus sp.)* punctures the immature fruits during development. Fruits become woody, deformed and the pulp content is reduced. Thrips (*Thrips hawaiiensis Morgan*) feeds on buds and developing fruits. Affected fruits are deformed and fruit weight and juice content are reduced. The incidence of this pest is severe in summer crop. Mites (*Tetranychus neocaledonicus Andro*) feed on leaves and tender fruits. It leads to defoliation and formation of undersized fruits.

5.8.2 Diseases

Brown spot disease is caused by *Alternaria macrospora* Simes. The disease appears as concentric brown spots with greenish margin. Girdling of branches and premature defoliation occurs in severe cases. The affected branches should be pruned and burnt. Root Rot is caused by *Phytophthora nicotianae var. parasitica*. The roots are affected and ultimately the plants die. Drenching with 1 % Bordeaux mixture helps in checking the disease. The affected plants should be mounded with soil to encourage new root formation. Wilt or Collar rot, is a devastating disease caused by *Fusarium oxysporum/ F.passiflorae*. The affected plants die immediately within a day or two. There is no control measure except having tolerant/resistant varieties or use of resistant root stocks.

5.8.3 Control Measures

So far ICAR Research Complex for NEH Region, Barapani, Meghalaya & Central Agricultural

University has not recommended/finalised the doses/frequency of available organic pesticides/fungicides. However it is observed that spraying of organic pesticides like neem based pesticides/fungicides can control effectively the various pests and diseases. Neem based pesticide contains Azadirachtin as active ingredient. The biological insecticide, Verticel, manufactured from *Verticillium lecanii*, a naturally occurring entomopathogenic fungus is very effective in controlling thrips, mites, aphids etc. The larvocel, a wettable powder formulation of *Beauveria bassiana* a highly virulent fungus is effective as a versatile broad - spectrum insecticide.

5.9 Harvesting

The vines start yielding fruits after 10 months of planting and bearing reaches optimum by 16-18 months. There are two main periods of fruiting from August to December and March to May. Fruits take 80-85 days to reach maturity. Slightly purple coloured fruits along with a small portion of stem / pedicel should be picked up. The fruits should be marketed quickly to prevent loss in weight and their appearance. The rind becomes wrinkled on drying but the pulp remains in good condition for several days.

5.10 Yield

Average yield of purple variety is 8-10 t/ha and that of the hybrid Kaveri is 16-20 t/ ha. A yield of 7 to 9 kg or 200 to 250 fruits per vine is generally obtained every year.

6. Post Harvest Management :

Passion fruit is generally not consumed as a table fruit due to numerous (about 250) small, hard, dark brown seeds in fruit and its commercial value lies in its processing in preparation of juice, concentrate, squash, icecream, confectionery etc. or in blending its juice with other fruit juices to enhance the flavour. There is very good demand of juice/concentrate in foreign markets.

In the state of Manipur, passion fruit processing unit has been set up at Punanamei Mao, in Senapati district under the joint venture of Good Samaritan Social Service Association, Mao (NGO), Central Small Farmers Agri Business Consortium, New Delhi and NEDFI. Exim Bank and DFPI(GoI) had extended loan and grant respectively for setting up the unit. The plant has a crushing capacity of 2 t/hour. The unit has entered into agreement with farmers to purchase the fruit at a pre-determined price and State Bank of India had extended loan to farmers under tripartite agreement. The farmers of Senapati and adjoining districts of Manipur and border districts of Nagaland state are largely benefited by this unit. Such processing units are required to be set up in different N.E.States.

7. Linkages :

Since passion fruit is an upcoming crop in most of N.E.States/Region and its consumption as a table fruit is limited, there is a need for developing proper linkages with processing industries. The Department of Horticulture under the technology mission had introduced this crop in all the districts of the state and about 25 to 30 ha area has been covered in each district. The Horticulture Department, Government of Meghalaya may ensure proper marketing tie up of all

existing and upcoming plantations with existing state owned, cooperative or private processing units, while promoting passion fruit cultivation.

8. Financial Aspects :

8.1 Economic Life

The economic life of Passion Fruit vine is considered as five years. It is not economical to maintain the vines afterwards, even though the yield can be obtained after five years.

8.2 Unit Cost

The item-wise unit cost is given in **Annexure-II**. As per the technical & financial parameters, the unit cost per hectare works out to Rs.100600/- spread over a period of two years (I-Year : Rs.76000 + II-Year : Rs.24600 = Rs.100600).

8.3 Margin Money

The percentage of margin / down payment to investment cost prescribed is 5, 10 and 15% for small, medium and large farmers respectively. The rest of the investment cost will be provided as bank loan. Margin considered in the present model is 10%.

8.4 Bank Loan

Bank loan of 85 - 95 % shall be available from the financing institution. Bank loan considered in the model is 90%.

8.5 Interest Rate

The rate of interest to be charged to the ultimate borrower would be guided by RBI guidelines issued from time to time. However, the ultimate lending rate has been considered as 12 % for working out the bankability of the model scheme.

8.6 Security

Banks are guided by RBI guidelines issued from time to time in this regard.

8.7 Financial Analysis :

The detailed financial analysis are given in **Annexures II - V**. Based on the detailed financial analysis, the financial indicators are given below :

- NPW : Rs.74876
- BCR : 1.60 : 1
- IRR : > 50%

8.8 Repayment Period

The bank loan along with interest is repaid in five years including one year grace period. The detailed repayment schedule is given in **Annexure VI**.

9. Conclusion :

Keeping in view the above aspects, it can be concluded thatorganic cultivation of passion fruit is a technically feasible, financially viable and bankable activity.