Status and Prospects of Passion Fruit Cultivation in Kerala

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Passion fruit

Passion fruit, a native of tropical America (Brazil), belonging to the family Passifloraceae is a high value and export oriented crop. Passion fruit stands out not only for its exotic and unique flavor and aroma but also for its amazing nutritional and medicinal properties. The name "passion fruit" is not derived from any aphrodisiac quality of the fruit but was named, reportedly, by Spanish Catholic missionaries who saw in the flower, the symbolism of the Passion of Christ where *"Passus"* means "suffering" and *"Flos"* means "flower". Passion fruit should more correctly be referred to as the passion flower fruit, but the trade more commonly uses passion fruit. Passion fruit is known in Hawaii as lilikoi, golden passion fruit in Australia, maracuja peroba in Brazil, and yellow granadilla in South Africa. Most of the species of Passiflora are native to the warmer moist regions of America, and many produce edible fruit. Passion fruit is a perennial, vigorous, climbing, woody vine that produces an edible round or ovoid fruit and has a tough, smooth, waxy dark purple hued rind with faint, fine white specks. Inside, the fruit is more or less filled with an aromatic mass of double-walled, membranous sacs containing orange colored pulpy juice and as many as 250 small, hard, dark brown to black pitted seeds. Its fruits are rich in mineral salts and vitamins, especially A and C, and its juice has a wonderful aroma and flavor. It has many pharmacological properties. Passion fruit is used primarily for fresh consumption and the production of juice. It has become increasingly popular all over the world and it is used in jams, jellies, and fruit juices.

Types

Of the estimated 600 species of *Passiflora* in the family Passifloraceae, only two species are cultivated, *P. edulis* Sims and *P. quadrangularis* L. *P. edulis* Sims, has the exclusive designation of passion fruit, preferably seen growing at an altitude of 800-1500 m above sea level. Within this species, there are two distinct forms, the standard yellow (*Passiflora edulis* f. *flavicarpa* Deg.) and the purple (*Passiflora edulis f. edulis*), differing in pH and starch content between the yellow (pH 2.8 and 0.06% starch) and the purple (pH 4.2 and 0.74% starch), with comparatively higher amylose content in former (8.7%) than latter type (5.8%). In purple passion fruit, cool temperatures are favourable for flower initiation and fruit set(23-18˚C), while relatively high temperatures seem necessary for promoting juice production (23-33˚C) and improvement in quality. Yellow passion fruit grows under lowland tropical conditions, whilst, the purple type tends more to be cultivated in subtropical areas or at higher altitudes in the tropics. The purple passion fruit is native from southern Brazil through Paraguay to northern Argentina. While yellow from is of unknown origin, or perhaps native to Amazon region of Brazil, or is a possible hybrid between *P. edulis* and *P. ligularis or a* mutation from the purple passion fruit *P. edulis.* The characteristics of the three types under cultivation are given in Tables 1 and 2.

Table 1. Fruit characteristics of some passiflora species found in India

Sl. No.	Species	Common name	Characteristics
1	*Passiflora edulis Sims*	Purple Passion Fruit/Mountain Sweet Cup	Round to ovoid fruit (5-8 cm long and 4-8 cm diameter) ,purple in color with tough, waxy smooth rind and orange yellow colored pulpy juice with pleasant and sub-acidic flavored arils

2	*Passiflora edulis Sims f. flavicarpa Degener*	Yellow Passion Fruit/Golden passion fruit	Round to ovoid fruit, larger in size (8-10 cm long and 4-10cm diameter) with smooth, glossy, light and airy thick(3-4mm) rind of yellow to light orange pulp having highly aromatic and acidic juice.
3	*Passiflora quadrangularis Medic*	Giant Granadilla	Oblong-ovoid fruit of very large size (20-30 cm long and 12-15 cm diameter) thick skin, greenish-white to pale yellow color, whitish to yellowish sweet acid arils having mild flavor..

Source: Sema and Maiti, 2006

Table 2. Physico-chemical composition of various species of ripe passion fruits

Characteristics	*P.edulis*	*P. edulis f. flavicarpa*	*P. quadrangularis*
Fruit weight (g)	45-60	80-115	120-480
Fruit length (cm)	3.5-6	8-10	20-30
Fruit diameter (cm)	3.5-7	5-7.5	10-12
Pulp weight (g/100g)	32-44	26-31	22-48
Rind weight (g/100g)	51-65	57-68	42-65
Juice recovery (%)	30-34	24-26	22-26
TSS (^{o}Brix)	14-18.4	12.4-16.4	16-18
Titrable acidity (%)	2.4-3.o	3.4-3.8	2.4-3.2
TSS/Acid ratio	5.8-6.1	3.64-4.31	5.6-6.6
Total sugar (%)	5.8-8.0	5.4-6.8	4-4.8
Reducing sugar (%)	3.5-4.2	4-5.2	3-3.8
Non reducing sugar (%)	1.8-2.5	1.2-2.o	2.2-2.8
Ascorbic acid (mg/100g juice)	22-32	16-20.4	14-18
Weight of residues (g/100g)	3-5	6-12	10-15

Source: Sema and Maiti, 2006

Passion fruit grows well in tropical and subtropical regions, where the climate is hot and humid. Growing passion fruit at altitudes between 100 m and 1,000 m is recommended. Plantations at lower altitudes last for a shorter period of time than those with higher altitudes. Passion fruit can be grown on a range of soils, sands to clay loams. In general, it is recommended that the soil should be deep, relatively fertile and well drained. Development and popularization of improved high yielding varieties will increase productivity and profitability of the crop.

Constituents

As an edible fruit, it contains several components such as acids and sugars, nutrients, and non-nutritive phytochemicals that make passion fruit a tasteful and healthy addition to the diet. Passion fruit is a high acid food (pH~ 3.2) due to the predominance of two acids, citric (~93-96 % of total) and malic (3-6 % of total) acid. Passion fruit also contains about 14.45 g sugar/100g of edible portion, including fructose, glucose and sucrose, along with seven others in trace amounts. The

acids and sugars add to the unique taste and serve as a preservative nature for the tropical fruit. Passion fruit provides a good source of nutrients such as Vitamin C (18.2 mg/100g of edible portion), Vitamin A (2410 IU/100g of edible portion) and potassium (278mg/100g of edible portion) and non-nutritive phytochemicals, carotenoids (9.25 mg/L) and polyphenols (435 mg/L). Vitamin C functions as an antioxidant that reduces free radical damage by scavenging oxyradicals. Vitamin A has important roles in the maintenance of vision and skin care, cell growth, and reproduction. Vitamin A can be obtained directly from the diet or derived from non-nutritive phytochemicals called carotenoids. In addition to being a vitamin A precursors, certain carotenoids such as P-carotene were found to have anticancer properties. In passion fruit, thirteen different carotenoids have been identified, including zeta-, beta- and alpha-carotene, b-cryptoxanthin, and lycopene. Other non-nutritive phytochemicals found in passion fruit are polyphenolic compounds, which have been found to have antioxidant activity as well as anticancer properties. Only some of the polyphenolics such as the phenolic acids have been identified in passion fruit.

Uses

Passion fruit can be grown to eat or for its juice, which is often added to other fruit juices to enhance aroma. The fruit is eaten alone or in fruit salads, sherbets, ice cream, jams, cool drinks and as concentrates. The yellow variety is used for juice processing, while the Purple variety is sold in fresh fruit markets. In Brazil, the majority of fruits in supermarkets are the yellow ones. The fruit has been used by the Brazilian tribes as a heart tonic and medicine, and as a favorite drink called maracuja grande that is frequently used to treat asthma, whooping cough, bronchitis and other tough coughs. Passion fruit still occupies an important place in South American traditional medicine, and in Peruvian traditional medicine the juice is used for urinary infections and as a mild diuretic. In Madeira, the juice of passion fruit is given as a digestive stimulant and treatment of gastric cancer.

Status

International

Passion fruit is grown mostly in tropical and sub-tropical part of the world. Today, passion fruit is grown nearly everywhere in the tropical belt of South America to Australia, Asia and Africa. South America is currently the largest producer of passion fruit. This fruit is native to Brazil and Ecuador, where it is used for medicinal purposes as a sedative, as well as a food source. The total global supply of passion fruit is estimated at 8.52 lakh tons, with major producing countries comprising of Brazil, Mexico, Ecuador, Australia, Zimbabwe, Kenya and Columbia. Over 95% of the production is the yellow form for juice extraction, while purple contributes predominantly for fresh fruit trade.

Passion fruit has a long and colorful history of popularity and extensive cultivation, starting in the late 19th century when it was introduced to Hawaii in 1880. It quickly became a "household word" and, at the turn of the 21st century, Hawaii is the country with the highest per-capita consumption of passion fruit juice in North America. Today, passion fruit is grown nearly everywhere in the tropical belt of South America to Australia, Asia and Africa and plantations are found in California (USA). South America is currently the largest producer of passion fruit worldwide. Native to Brazil, it is immensely popular there; demand is so high that, despite their own passion fruit cultivation, they have to import additional supplies from other countries. Ecuador, having comparative advantage for the growth of passion fruit, is one of the largest producers in the world with a dominant share in the world export market. It is followed by Australia and New Zealand in export of the fruit to other countries. Kenya and South Africa also have a decent production of passion fruit and its area under cultivation is growing rapidly.

Passion fruit is grown in most tropical and subtropical parts of the world, and it is particularly important commercially in Australia, Hawaii, South Africa and Brazil. Brazil is the world's foremost producer of passion-fruit, with about 90% of the production, followed by Peru, Venezuela, South Africa, Sri Lanka and Australia. Brazilian production is around 478,000 t with a yield of about 13.8 t/ha. The northern and north-eastern regions of the country are responsible for more than 80% of the national production. The passion-fruit is used primarily for fresh consumption and the production of juice, which is also exported. The principal market is Europe, which imports more than 90% of the juice. However, there are very good prospects in the American, Canadian and Japanese markets. The purple passion fruit was introduced into Israel from Australia early in the 20th Century and is commonly grown in home gardens all around the coastal plain, with small quantities being supplied to processing factories.

National

India, too, has its place in passion fruit history. India has enjoyed a moderate harvest of purple passion fruit in the Nilgiris, Wynad, Kodaikanal, Shevroys, Coorg and Malabar in the south and in various parts of northern India, especially Himachal and North East states like Manipur, Nagaland Mizoram and Meghalaya. In many areas, the vine has run wild. The yellow form was unknown in India until just a few decades ago when it was introduced from Sri Lanka and proved well adapted to low elevations around Chennai and Kerala. It was quickly approved as having a more pronounced flavor than the purple and producing within a year of planting heavier and more regular crops. The passion-fruit vine is cultivated predominantly in small orchards, on average 1- 4 ha, and is an important source of income for small to medium producers.

In India, passion fruit cultivation is confined to Kerala, Tamil Nadu (Nilgiri hills and Kodai Kenal), Karnataka (Coorg) and northeastern states (Mizoram, Nagaland, Manipur and Sikkim) with an area and production of 9.11 thousand ha and 45.82 thousand tons. The average productivity comes to 5.02 tons/ha, abysmally low to 30-35 tons/ha harvested in the countries like Brazil, Australia, Colombia etc. using off course high planting density (2.0 x 1.25 m within the row and between the rows, respectively, with a plating density of 4000 plants/ha). Poor production management shared predominantly in terms of nutrient management holds the key factor, responsible for such a colossal yield difference. Passion fruit is a highly nutrient responsive perennial crop, grows mostly as vine with a shallow root system (root density remaining confined to top 20 cm soil depth). Passion fruit vine originating from cutting starts fruiting much earlier (7-6 months) than those from seeds (10-12 months)

Surveys have been made to identify the nutrition disorders in passion fruit. In leaf nutrient concentration of passion fruit grown in Nagaland, Mizoram and Manipur in relation to fruit yield/vine showed that vines are severely underfertilized due to sub-optimum concentration of most of the nutrients (Table 3). However, by comparison, the nutrient status is much better in Coorg in addition to fruit yield/vine due to more favourable soil pH (5.8-6.2), allowing easy supply of nutrients. These observations suggest that passion fruit is nutritionally very neglected and needs proper fertilization, if productivity potential is to be exploited to transform passion fruit industry into a high cash earning crop.

Passion fruit juice serves as a rich source of vitamins and minerals (Table 4. The concentration of sodium compared to other fruits is high. While concentration of calcium and magnesium is very low, but carotene is high without any detectable amount of bitter compounds like hesperidin, naringin and limolin. The rind of passion fruit contains 5-6% protein, while seeds yield as high as

23% oil, on par with oilseed crop like sunflower and soya bean.

North East Region of India, covering an area of 2.62 lakh sq.km, accounting for about 8% of the total area of the country is a true frontier region sharing 98 % of its borders with the neighboring countries of China, Nepal, Myanmar, Bangladesh and Bhutan. NER being blessed with congenial atmosphere can grow all kinds of Horticulture crops. Passion fruit is cultivated in the clean and pollution-free hills of Manipur, Nagaland, Mizoram and Meghalaya. In recent years the area and production of passion fruit has increased substantially in the region due to the technological intervention by the government under the Technology Mission for development of Horticulture in Northeast India.

Table 3. Leaf nutrient composition of passion fruit vine in relation to fruit yield in northeast and south India

Location	Leaf nutrient concentration						Yield
	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Zn (ppm)	(kg/vine)
Northeast India							
Nagaland							
- Wokha	2.4-2.8	0.12-0.14	1.2-1.6	1.1-1.6	0.12-0.14	14-16	2-3
- Mokokchung	2.6-3.0	0.11-0.12	1.4-1.6	1.2-1.8	0.10-0.12	13-18	4-5
Mizoram							
- Kolasib	1.8-2.1	0.10-0.14	1.3-1.8	1.2-1.4	0.10-0.14	12-14	5-6
- Aizawal	1.9-2.6	0.11-0.12	1.8-2.0	1.4-1.6	1.3-1.5	12-15	4-6
- Mamit	2.0-2.4	0.10-0.12	0.98-1.1	1.3-1.8	0.11-0.13	15-16	2-3
Manipur							
- Tamenglong	2.6-3.1	0.14-0.16	0.92-1.2	1.3-1.5	0.13-0.15	13-15	3-4
- Ukhrul	2.5-3.4	0.12-0.14	1.1-1.3	1.2-1.4	0.12-0.14	15-18	4-5
South India*							
Karnataka							
Coorg	2.1-2.7	0.06-0.17	2.3-2.9	1.4-1.6	0.18-0.24	-	6-8

Source: Sema and Maiti, 2006

Table 4. Nutritive value of passion fruit juice

Sl.No.	Components	Range
i.	Relative density (20720° C)	1.05-1.07
ii.	^{o}Brix	12.0-18.0
iii.	Total soluble solids (g/litre)	125.8-193.5
iv.	Fiber (g/100 g edible portion)	4.4-15.9
v.	Starch (g/100 g edible portion)	1.0-3.7
vi.	Protein (g/100 g edible portion)	0.6-2.8
vii.	Calories (Kcal /100g edible portion)	32-92
viii.	Vitamin A (mg/100 g edible portion)	650-684
ix.	Vitamin B_2 (mg/100 g edible portion)	0.1-0.2
x.	Vitamin C (mg/100 g edible portion)	20-25
xi.	Titrable acids as tartaric acid (g/litre)	30-55
xii.	L-Malic acid (g/litre)	1.3-5.0
xiii.	Citric acid (g/litre)	25-50

xiv.	Isocitric acid (mg/litre)	170-380
xv.	Glucose (g/litre)	20-55
xvi.	Fructose (g/litre)	20-53
xvii.	Sucrose(g/litre)	10-45
xviii.	Potassium (mg/litre)	2200-3500
xix.	Magnesium (mg/litre)	100-200
xx.	Calcium (mg/litre)	35-150
xxi.	Chloride (mg/litre)	50-300
xxii.	Phosphate (mg/litre)	350-850
xxiii.	Sulfate (mg/litre)	250-400
xxiv.	Iron (mg/litre)	25-30
xxv.	Zinc (mg/litre)	5-10
xvi.	Proline (mg/litre)	150-1500
xvii.	Aspartic acid (mmol/litre)	3-12
xviii.	Alanine (mmol/litre)	1.0-4.5
xix.	y-aminobutyric acid (mmol/litre)	1.5-4.0
xxx.	Histidine (mmol/litre)	0.1-0.4
xxxi.	B-carotene(mg/litre)	7-28

Source: Sema and Maiti, 2006

State

Over fifty passion fruit accessions collected from different areas in Kerala and South India have been conserved and evaluated at the Pineapple Research Station, Vazhakulam for the last several years and the results showed wide variability in their morphological and biochemical characteristics offering great scope for selection of superior types. The descriptive statistics of the passion fruit accessions maintained at the Pineapple Research Station, Vazhakulam are furnished below (Table 5). These elite types require further detailed evaluation for yield, quality and pest and disease tolerance parameters in a replicated field trial for evolving superior variety suited for the plains of Kerala. The yield and quality of a promising passion fruit selection No. 45 over the years 2003-2006 are furnished in Table 6.

Table 5. Descriptive statistics of passion fruit accessions at the Pineapple Research Station, Vazhakulam

Parameter	Fruit wt (g)	Rind wt (g)	Pulp wt (g)	Seed wt (g)	Juice wt (g)	TSS (%)	pH	Reducing sugar (%)	Nonred. sugar (%)	Total Sugar (%)	Ascorbic acid (mg/g)
Mean	74.38	40.65	27.26	6.46	22.41	15.9	3.325	4.159	6.537	10.67	36.74
Median	74.16	40.61	27.4	6	21.96	16	3.29	4	6.115	10.17	36.48
Mode	76.5	38	26	5	20	17	3.19	3	4.79	13.2	31.74
Standard Deviation	17.51	10.12	8.037	3.2	7.561	1.679	0.5	1.182	2.448	3.129	9.492
Sample Variance	306.4	102.4	64.59	10.2	57.17	2.818	0.25	1.397	5.992	9.792	90.1
Kurtosis	-0.02	-0.38	0.268	98.8	-0.2	0.963	23.46	0.187	-0.79	-1.05	-0.16
Skewness	-0.05	0.049	-0.064	7.76	0.249	-0.56	-3.57	0.445	0.398	0.179	0.342
Range	92.64	53.69	49.88	46.6	39.08	11.6	4.57	7.24	11.51	14.58	49.44
Minimum	27.5	11.68	2.875	2.17	4	8.8	0	1.13	1.79	2.95	13.04
Maximum	120.1	65.38	52.75	48.8	43.08	20.4	4.57	8.37	13.3	17.53	62.48

Table 6. Yield and quality of passion fruit selection No. 45

Characters	2003	2004	2005	2006
Yield of fruit (g)	3960	5715.5	4992.5	2974
Weight/fruit (g)	76.2	77.2	68.4	80.4
Rind weight %	56.9	50.1	48.4	56.2
Pulp weight %	33.7	29.9	40.4	34.2
Seed weight %	9.4	11.2	11.3	9.5
Juice weight %	23.8	22.9	32.6	33.4
TSS (%)	18.3	17	17	13.8
pH	3.49	3.91	2.98	3.3
Acidity (%)	2.81	3.39	2.79	2.27
Reducing sugar (%)	4.19	2.82	3.8	4.57
Total sugar (%)	9.2	11.3	9.07	10.68
Non Reducing sugar (%)	5.02	8.48	5.27	6.12
Ascorbic acid (mg/g)	37.29	13.04	42.17	47.19

There is immense potentiality of boosting passion fruit industry in Kerala. The region has all sets of climate and sufficient rainfall for growing a variety of Horticultural crops including passion fruit very successfully. There is a great possibility of expanding its cultivation to the low and mid lands of the state on a commercial scale. Passion fruit in processed form like concentrates and RTS has tremendous scope of market both at national and international level because of its unique and excellent flavor and aroma. Passion fruit and its different parts of plant having numerous medicinal properties has great scope for domestic and export market. Passion fruit industry can bring about a much needed employment opportunity in the region with not only its cultivation but also with setting up of more processing and semi-processing units in the state.

Growing passion fruit can be reasonably remunerative in Kerala. Identification of superior varieties and refinement in techniques involving accurate assessment of nutritional disorders and re-orientation in site specific constraint based-fertilization programme, the heavy returns from passion fruit cultivation could be easily accomplished by bringing the desired improvisation in productivity level from the present scenario and simultaneously prolonging the longevity of productive life, from the present average life of only 3-4 years. While doing so, high density planting with fertigation should be an ultimate aim of production management in the years to come, in order to match with frontline passion fruit growing countries. A concentrated effort on the other hand is much needed in creating awareness, developing market linkages and setting up of semi processing & large scale processing units, post harvest management and creation of proper infrastructure and logistics. The above strategies if taken up would certainly boost the passion fruit cultivation in the state.

Passion fruit is a highly suitable crop for small-scale farmers due to its nutritional and market value and short maturity period. However, its production is constrained by lack of suitable varieties, technical knowhow on crop cultivation, pests and diseases and relatively higher capital investments. Developing suitable varieties and agro-technology and enhancing participatory dissemination of agricultural technologies and information to the farming community with the overall aims of improving food security, reducing poverty and contributing to more sustainable natural resource management will go a long way in popularizing the crop. Developing various marketing channels and organized marketing will pave the way to commercial cultivation of the crop in Kerala. Further, group training is a suitable way of up-scaling technology dissemination to ensure technology adoption and sustainability. Growing and marketing of export quality passion fruit would play a big

role in poverty alleviation through income generation, employment creation and health improvement.

Gap areas

Passion fruit production is constrained by lack of suitable varieties, technical knowhow on crop cultivation, pests and diseases and relatively higher capital investments. Passion fruit having a unique and excellent flavor and aroma has not reached to the majority of the people even within the country due to poor or lack of publicity. Most of the people have not come across this fruit and its processed product which otherwise would have definitely captured their attention and boost the industry in the state. As in many of the Horticultural crops, passion fruit marketing both for fresh as well as processed or semi-processed products is also very weak and almost negligible. Growers are apprehensive to expand the area under its cultivation without assured market for their produce which in turn will result in inadequate volume of raw materials for the processing industries. There are no semi processing units or the state of art facilities for juice extraction and making of concentrates of passion fruit in the state as well which would otherwise ease the transportation cost of bulk quantities of fresh passion fruit. Despite the fact that passion fruit has a great potentiality due to suitable climatic and soil conditions, the productivity and production is very low mainly due to lack of improved varieties. This perhaps is a result of raising plantations with non-descriptive planting materials as well as poor crop husbandry. This crop is noted for its instability and unpredictability in production. Besides, the crop is also susceptible to various diseases and pests. Like for many of the Horticultural crops, post harvest management aspect of passion fruit is also not given due attention, thus resulting in loss of large quantity of the harvested produce and deterioration in quality of the produce.

Passion fruit industry

Processing units

Manipur has two units (Exotic Juices & one new), Nagaland three units (Lungnak -closed down , Fruit &Veg. processing unit -Dimapur -Privatized & new - Mokokchung) and Mizoram one unit (new) for processing passion fruit.

The juice drink "Pasip" manufactured by Exotic Juices Ltd from fruit grown and processed in Manipur, having a capacity of 1.5 million litres is marketed by EcoVerse. Pasip is being marketed in all the major cities of India and will soon be exported . Large scale passion fruit cultivation and setting up of a state of the art processing complex with latest process know-how was made possible with the much needed support from SFAC, NEDFI, APEDA, MOFPI, SBI and Exim Bank.

There is an immense potentiality of boosting passion fruit industry in NER of India based on the following strength of the region.

The region has all sets of climate and sufficient rainfall for growing a variety of Horticultural crops including passion fruit very successfully.
There is a great possibility of expanding its cultivation to the low and mid hill region for commercial scale production as there is still large tract of uncultivated land in the region.
Passion fruit in processed form like concentrates and RTS has tremendous scope of market both at national and international level because of its unique and excellent flavor and aroma.
Passion fruit and its different parts of plant having numerous medicinal properties has great scope for domestic and export market.

Passion fruit industry can bring about a much needed employment opportunity in the region with not only its cultivation but also with setting up of more processing and semi- processing units in the region.

Constraints

Lack of awareness

Passion fruit having a unique and excellent flavor and aroma has not reached to the majority of the people even within the country due to poor or lack of publicity. Most of the people have not come across this fruit and its processed product which otherwise would have definitely captured their attention and boost the industry in the region.

Poor market linkages

As in many of the Horticultural crops, passion fruit marketing both for fresh as well as processed or semi-processed products is also very weak and almost negligible except for the exotic juices which could manage an outlet in some parts of the country and is now in the process of export with the assistance of APEDA. Growers are apprehensive to expand the area under its cultivation without assured market of their produce. In a situation where there is no proper market channel, the growers will not expand the area under its cultivation which in turn will result in inadequate volume of raw materials for the processing industries.

Lack/inadequate processing units

There are only handful of processing units in the region. In fact, there is only one that is having the state of art facilities for juice extraction and making of concentrates of passion fruit. Some new units are coming up now in Mizoram, Nagaland and Manipur, however these are too meager to cater to the need. There are no semi processing units in the region as well which would otherwise ease the transportation cost of bulk quantities of fresh passion fruit.

Poor infrastructure facilities

Poor or inadequate storage facilities and poor road connectivity to the production site results in huge quantitative and qualitative post harvest losses in all parts of NER.

Low production and productivity

Despite the fact that passion fruit has a great potentiality in the region due to suitable climatic and soil conditions, the productivity and production is still very low which perhaps is a result of raising plantations with non- descriptive planting materials as well as poor crop husbandry This crop is noted for its instability and unpredictability in production. Besides, the crop is also susceptible to various diseases and pests.

Lack of post harvest management

Like for many of the Horticultural crops, post harvest management aspect of passion fruit is also not given due attention, thus resulting in loss of large quantity of the harvested produce and deterioration in quality of the produce.

Challenges & Strategies

Creating awareness /Publicity

In order to boost up the passion fruit industry in the region, the first and foremost step to be taken up is to create an awareness among the people and give wide publicity though different means. In this regard, the govt. may initiate some steps to link up the producers/ processors with the airlines and railways in order to have an assured supply chain. Some assistance may also be extended to the producers for advertising their products in T.V. and other mass media.

Developing market linkages

To encourage the growers to grow and produce more in order to get the volume of produce for the processing units, proper and assured market linkages needs to be developed. Govt. should create platform for linkages between the investors / business houses and the producers. Creation of proper market linkages would help in the passion fruit of this region to reach to the consumer in different parts of the country and abroad.

Marketing strategy for Passion Fruit

As the passion fruit is not cultivated commercially not only in region but also in the country, it will take some time to develop the market. However, it is difficult proposition for small farmers to invest into crop without assurance of markets. Therefore, integrated efforts are required from all the possible stakeholders e.g. farmers, government agencies, research institutions and other agencies involved in horticulture development in the region.

Formation of growers cooperative or growers' company can be viable alternate to develop the crop and make it a commercial success. A good successful example of growers' company is MAHAGRAP, Maharashtra based grape growers' association. At the time of introduction of export oriented cultivation of grapes, it was very difficult for the farmers to find markets. There were limited resources with farmers to get knowledge of export requirement, quality parameters, and prescribed practices for cultivation, storage and other post harvest activities. Enterprising farmers of Maharashtra took this challenge and cooperation was answer for this. Under the umbrella of MAHAGRAP, a few progressive farmers joined together. They explored the export markets on their own, got trained on various aspects and implanted the practices back home. Government agencies like APEDA also helped in this initiative by facilitating them in more than one way.

Passion fruit also require such initiative from the farmers to make it a successful crop. However, State governments at the regional level need to take initiatives in forming such group, training the farmers and handholding till these associations become commercially viable enterprises. At initial stage, it is possible that a few progressive farmers can be selected who have sufficient resource to make some investment and sustain the activities till the revenue generation starts.

Private sector can also play a crucial role by investing into post-harvest infrastructure, processing facilities and marketing. Government should explore the possible Public-Private Partnership models attracting private sector investment in enhancing marketability of Passion fruit.

Keeping in mind, the huge potentialities of the region and various bottlenecks that are hindering the growth of this industry in the region, a concentrated effort is much needed in creating awareness, strengthening /developing market linkages, strengthening of existing processing units and setting up

of semi processing & processing units, post harvest management and creation of proper infrastructures and logistics. The above strategies if taken up would certainly boost the passion fruit industry in the region.

Setting up / strengthening of new /existing processing & semi- processing units

There is a need for upgrading and modifying the existing processing units and also set up at least one new processing unit with state of art facility in each state of the region and semi processing units for juice extraction at production sites. There can be a collection centre at the centre point where the producers can bring their produce of both fresh and semi processed products and the wholesaler / processors comes to collect the produce.

Creation of proper storage facilities

Creation of proper storage facilities (low cost storages & Cold stores) at production site, collection centre and at processing units will be vital for judicious utilization of the harvested produce and smooth running of the processing units.

Road connectivity

In most part of the region, transportation is the biggest hurdle for large scale crop production. The transportation cost is very high and this discourages the growers to expand area for more production as the return is not cost effective. In addition to this, Horticultural crops being highly perishable in nature require good transportation system. Road connectivity is very poor; this leads to huge post harvest losses and distress sale of the produce by the growers. Subsidy for domestic transportation needs to be given to the growers to encourage them to expand area under its cultivation and produce volume for making available the required raw materials for the processing units. The Agri /Horti link roads need to be given more emphasis so that the approach road reaches the bulk production site.

Developing package of practices through location specific trials

Even though the production level is good with congenial condition in the region, the productivity level needs to be improved by addressing some key production problems to harness the full potentials of growing area giving maximum benefit to the growers. Agriculture Universities and Research Institutes should be encouraged to develop package of practices based on the location specific trails.

Proper Post Harvest Management

Lot of awareness is needed for the growers about the importance of post harvest management especially with regards to the right stage of harvesting, post harvest treatments to enhance shelf life of fresh as well as semi processed products. Proper trainings need to be given to the extension functionaries, the growers, handlers and processors and facilities for various post harvest treatments need to be established.

Growing passion fruit is highly remunerative especially in hilly terrain whether northeast or south India. With more refinement in techniques involving accurate identification of nutritional disorders and re-orientation in site specific constraint based-fertilization programme, the heavy returns from passion fruit cultivation could be easily accomplished by bringing the desired improvisation in

productivity level from the present scenario and simultaneously prolonging the longevity of productive life, from the present average life of only 3-4 years. While doing so, high density planting with fertigation should be an ultimate aim of production management in the years to come, in order to match with frontline passion fruit growing countries. A concentrated effort on the other hand is much needed in creating awareness, strengthening /developing market linkages, strengthening of existing processing units and setting up of semi processing & processing units , post harvest management and creation of proper infrastructures and logistics. The above strategies if taken up would certainly boost the passion fruit industry in the region.

Reference

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