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PINEAPPLE RESEARCH STATION
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Dr. P.P.Joy

Research and Development Report 2013-14

Annual Report 2013-14

PINEAPPLE RESEARCH STATION
KERALA AGRICULTURAL UNIVERSITY

PINEAPPLE RESEARCH STATION
VAZHAKULAM

Annual Research and Development Report for 2013-14
(01.04.2013 to 31.03.2014)

Dr. P.P. JOY
Associate Professor & Head

Technical Support

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31.03.2014

EXECUTIVE SUMMARY

The Pineapple Research Station, Vazhakulam aims to become the ultimate authority and provider of excellent quality technology, products and services in pineapple and other tropical fruit crops through concerted research and development efforts sustained by best human resource and infrastructure development in line with its Motto 'Quality People & Infrastructure for Quality Technology, Products & Services and Merit alone counts for Quality suitable for the purpose'. The research and development efforts are fine tuned to this effect.

Protocols for the micro propagation of pineapple and banana have been standardized. Production of tissue culture pineapple is continued. Tissue culture production of Kew and Baby Pineapple are initiated. Micro propagation of pineapple such as MD-2, Kew and banana such as Nendran, Njali Poovan & Poovan were done. Planting materials in the form of seedlings, TC plants and rooted cuttings were mass produced and sold out. Diagnostic team visits were conducted. Pest and disease samples of station field, nursery, and tissue culture lab and of farmers were studied. The samples were sent to CoH, Vellanikara for detailed investigation. Some of the pineapple recipes were tried and exhibited in the Pineapple Fest 2014.

In the field study 'Selection of high yielding superior quality pineapple variety for central zone of Kerala in PTD mode' 11 pineapple types are being evaluated in RBD with 3 replications. Growth, yield and quality observations recorded are presented. Mauritius and MD-2 varieties are showing good results. The study 'Breeding for Yield and Quality of Pineapple' to develop pineapple varieties suitable for processing and table purpose through hybridization was continued and yield and quality observations recorded are presented.

Passion fruit micro propagation was started by standardizing the media combinations. Passion fruit refrigeration studies and shelf life studies were carried out. Preparation of passion fruit syrup was standardized. Fruit characteristics of Giant Passion fruit were studied. Some of the Passion fruit recipes were tried and exhibited in the Pineapple Fest 2014.

The externally aided project on 'Evaluation of passion fruit types for commercial cultivation in Kerala' at a total cost of Rs.12.55 lakh for 3 years sanctioned by Kerala State Council for Science, Technology and Environment to identify a high yielding superior quality passion fruit variety for commercial cultivation in Kerala is in the second year of implementation. The crop was managed well with proper pruning, shading, irrigation, manuring, plant protection, training on pandal, etc. Growth, yield and quality observations recorded are presented. The accession 142P seems to be promising.

A Project Proposal under entitled 'Introduction and Evaluation of High Yielding Superior Quality Pineapple Varieties for Kerala' at a budget of Rs. 10 lakh was submitted to the Pineapple Mission through the Director of Research, Kerala Agricultural University with the objective of boosting the production and productivity of pineapple in Kerala through comprehensive multi-pronged integrated approach in mission mode.

Student projects are also undertaken at the station. Pest and disease problems of 150 farmers were attended to during last year. The station participated and put stall in some of the agricultural fests like Pineapple Fest, Karshikotsav etc. The management problems faced by pineapple farmers are regularly attended by visiting fields, in person, seminars, through telephones, emails etc. Extension activities are mainly done in association with the Pineapple Farmers' Association. The websites of the station www.kau.edu/prsvkm and prsvkm.tripod.com were updated with more relevant and useful information for the public.

A Proposal for development of Pineapple Research Station, Vazhakulam was submitted to the Chairman, Planning, Development & Resource Mobilization committee, Kerala Agricultural University visualizing all-round development of the station and to become the ultimate authority and provider of excellent quality technology, products and services in fruit crops through concerted research and development efforts sustained by best human resources and infrastructure development.

The station is presently managed by a single scientist and a single office assistant as university staff. The various projects and other activities are executed by engaging skilled assistants and labourers on nominal daily wage contract basis. Management of the research projects by them is highly difficult and many times the reliability of the data is questionable due to lack of continuity, commitment and integrity and cannot gain the anticipated success. Until KAU staff is provided, sanction should be granted for creating temporary posts of Research Associates of Farm Officer, Biochemist, Biotechnologist, Microbiologist, Food Technologist and Information Technologist at Rs.18000/month or more and necessary urgent action should be taken for appointing them at the earliest.

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RESEARCH AND DEVELOPMENT REPORT OF PINEAPPLE RESEARCH STATION, VAZHAKULAM FOR 2013-2014

A. STATION AT A GLANCE

The Pineapple Research Station at Vazhakulam was established on 2nd January 1995 to give research and development support to pineapple farmers. Since then, this research centre of the Kerala Agricultural University has been steadily growing and serving as a subvention to the pineapple growers of the state and the country as well. The centre had a humble beginning as "Pineapple Research Station & Pest and disease Surveillance Unit" under Kerala Horticulture Development Programme (KHDP). For the construction of the office-cum-laboratory building of the station, 15 cents of land was transferred from the Revenue Department to Kerala Agricultural University on 24.6.1996. It was delinked from KHDP and became a constituent research centre of Kerala Agricultural University under central zone on 1.7.1997. The present building was occupied on 27.6.1998.

Our Mission

To be the ultimate authority and provider of excellent quality technology, products and services in the pineapple and other tropical fruits sector through concerted research and development efforts sustained by best human resource and infrastructure development

Mandate

- Give research and development support to the pineapple cultivators
- Provide quality technology, products and services to the pineapple sector
- Undertake basic and applied research in pineapple and other fruit crops of Kerala

Achievements

The centre undertakes basic and applied research and development activities in pineapple and other fruit crops of Kerala. The research and development projects are mainly in Participatory technology development (PTD) mode and funded by various agencies as KAU, State and central governments, ICAR, SHM, NHM, KSCSTE, etc. The station has taken up research in pineapple on various aspects like intercropping in rubber and coconut, plant spacing and density, organic and chemical fertilizer requirement etc., besides experiments on development of new varieties. The centre has developed scientific technology for the commercial cultivation of Kew and Mauritius varieties of pineapple, including pure cropping, intercropping in rubber and coconut plantations and in paddy lands. Technology is also developed for organic production. Based on continuous surveillance and laboratory studies the station has identified the presence of pineapple mealy bug wilt associated (PMWA) virus in Vazhakulam area. Based on all the findings, this station has formulated the Package of Practices Recommendations for the popular varieties Mauritius and Kew and included in the KAU POP and all the technology developed are being transferred to the pineapple growers extensively. Tissue culture protocols for various varieties of pineapple, passion fruit and banana are available. Vazhakulam pineapple has been registered in the Geographical Indication Registry to boost the export of pineapple. The station is

pursuing its User Registration. Participatory technology process and product development in association with sister institutions, Nadukkara Agro Processing Co. Ltd. and Pineapple Farmers' Association for the stake holders is a steady and continuing process at the centre. The station has already produced and sold more than 70,000 Tissue Culture pineapple plants and 30,000 passion fruit seedlings. Large scale tissue culture production of banana has been started. Pineapple Research Station launched its own website (www.kau.edu/prsvkm) as a sub site under the Kerala Agricultural University main site in June 2010. The websites of the station www.kau.edu/prsvkm and prsvkm.tripod.com were updated with more relevant and useful information for the public facilitating free download of the publications of the centre.

Facilities

Laboratory: Plant biotechnology, phytochemistry and microbiology labs equipped with Gel documentation unit, ELISA Reader & washer, PCR, UV visible spectrophotometer, UV-Transilluminator, Flame photometer, Centrifuge, Microscopes, Electrophoresis unit, Shakers, ovens, Precision Weighing balances, Deep freezer, BOD incubator, Laminar Air Flow chambers, still, etc.

***Farm*:** 1.2 hectares

***Library*:** Specialised books and periodicals relevant to the sector

***Sales Centre*:** For the public sale of Tissue Culture Plants, Seedlings, Rooted cuttings, Publications, etc.

Research

The centre undertakes basic and applied research and development activities in pineapple, passion fruit, banana and other fruit crops of Kerala. The research and development projects are mainly in Participatory technology development (PTD) mode and funded by various agencies as KAU, State and central governments, ICAR, SHM, NHM, etc.

Participatory Technology Development

The centre has developed scientific technology for the commercial cultivation of Kew and Mauritius varieties of pineapple, including pure cropping, intercropping in rubber and coconut plantations and in paddy lands. Technology is developed for organic production. Tissue culture protocols for various varieties of pineapple are available. GI indication of Vazhakulam Pineapple is registered. Participatory Technology Process and product development in association with sister institutions, Nadukkara Agro Processing Co.Ltd. and Pineapple Farmers' Association for the stake holders is a steady and continuing process at the centre.

Seed & Nursery

The station undertakes large scale production of Tissue Culture Plants of different varieties of Pineapple, Passion fruit and Banana and Seedlings and Rooted cuttings of Passion fruit. They are

available for sale at the centre. Booking for the planting materials can be made with advance payment as Demand Draft in favour of Associate Professor & Head, PRS, Vazhakulam payable at State Bank of India, Vazhakulam-686670, Muvattupuzha, Ernakulam, Kerala (Code No: 7844). Priority is always given to firm orders with advance payment and delivery will be on first-come-first-serve basis.

Extension

Technology transfer is effectively carried out through personal discussions, field visits, phones, emails, website, posts, radios, TVs, news papers, periodicals, publications, pineapple fests, seminars, trainings, etc. Publications such as leaflets, palmlets, books, CDs, DVDs, etc. covering various aspects of cultivation and utilization of the mandatory crops of the station are also being undertaken.

Products

- Tissue Culture Plants of pineapple, passion fruit and banana
- Seedlings of passion fruit
- Rooted cuttings of passion fruit
- Publications

Services

- Agriclinic & advisory
- Training
- Consultancy
- Quality testing
- Project work of U.G. & P.G. students of other Universities
- Large scale Tissue Culture production

Staff

Dr. P. P. Joy, Associate Professor and Head, +919446010905, joyppkau@gmail.com
Sri. Justin T. Jose, Senior Grade Assistant, +919744469876
Ms. Anjana R, Project Fellow (KSCSTE Project on Passion fruit)
Daily wage contract skilled assistants and labourers

Looking ahead

Earnest efforts are also being taken to acquire free government land nearby as a permanent farm for raising various fruit plants, conserving germplasm and conducting field research, besides establishing adequate infrastructure for further development and diversification, renaming the station as Tropical Fruit Crops Research Station (TFCRS). It is also proposed to establish a fruit processing laboratory with FPO registration at the centre for the efficient conversion of leftover fruits to value added products like squash, jam, syrup, etc.

Besides pineapple, since Vazhakulam and neighboring areas are well-known for other fruit crops like banana, mango, jack, papaya, passion fruit, rambutan, mangosteen, etc, and there is no research station in the district catering to the needs of these farmers, Pineapple Research Station, Vazhakulam visualizes to be Tropical Fruit Crops Research Station (TFCRS) in the near future. This advanced research centre of excellence dreams to be the ultimate authority and provider of excellent quality technology, products and services in tropical fruit crops through concerted research and development efforts sustained by best human resource and infrastructure development in line with Our Motto 'Quality People & Infrastructure for Quality Technology, Products & Services and Merit alone counts for Quality suitable for the purpose'.

B. ONGOING PROJECTS

Table 1. Ongoing research projects of the station during 2012-13

Head of Account	Project Title	Funding Agency	PRS File No.	DoR File No.	Finance File No.
321-31-3370	Research On Pineapple	KAU Plan (FF/10-00-02-95/VZM(15) KHDP)	PRS/R16/10	R8/66091/04	
321-31-4449 (Merged with 321-31-3370)	Breeding for yield and quality of pineapple	KAU Plan (FR/09-00-03-2001/VZK(9) KAU)	PRS/R17/10	R8/70507/03	
321-31-8841 (Merged with 321-31-3370)	Selection of high yielding superior quality pineapple variety for central zone of Kerala in PTD mode	KAU Plan	PRS/R32/10	R8/66824/10	EP/B1/10945/11
321-31-3500	Research In Passion Fruit	KAU Plan (under non-plan from 2013)	PRS/R29/10	R6/65723/03	
321-31-9027	Evaluation Of Passion Fruit Types For Commercial Cultivation In Kerala	KSCSTE (File No. 013/SRSAGR/2010/CSTE)	PRS/R33/10	R2/60024/12	EP/A1/4077/12

A development plan was submitted to the university depicting the station at a glance, narrating the urgent felt-needs of the station and proposing a metamorphosis into Tropical Fruit Crops Research Station (TFCRS) in line with Our Motto 'Quality People & Infrastructure for Quality Technology, Products & Services; Merit alone counts for Quality suitable for the purpose and one has know-how only when it is proven in real life'.

C. DETAILED RESEARCH REPORT

1. RESEARCH ON PINEAPPLE

1.1 Micro propagation of Kew

Fresh Inoculation

Objective

To fresh inoculate Kew sucker in fresh inoculation medium

Technical Programme

Explant Source

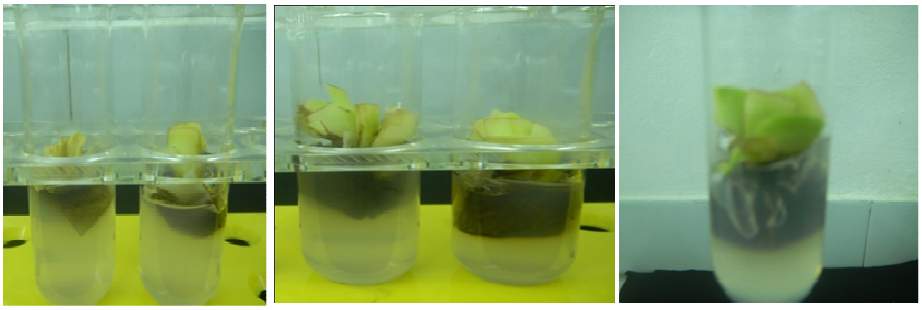
Suckers were obtained from the field of Pineapple Research Station, Vazhakulam. Surface sterilization and fresh inoculation protocol for micro propagation are same as that of MD-2.

Result

Table 2. Periodical Changes of Kew during Fresh Inocculation

After 7 Days	After 14 days	After 21 days
Bulging	Bulging and slight green	Slight green bud

The fresh inoculated Kew cultures were observed for a cycle of 21 days. After 7days they showed bulging. Within 14 days they turned green. 21 days were required to increase the bud number from 1 to 3. The media was changed once for increase in bud size. No callus formation observed in the media. Hence for multiplication another media must be provided. After 21 days green shoot was formed and it was ready for transferring to multiple bud formation media.



a. Kew after 7 days b. Kew after 14 days c. Kew after 21 days

Figure 1. Periodical Response of Kew in Fresh Inoculation Media

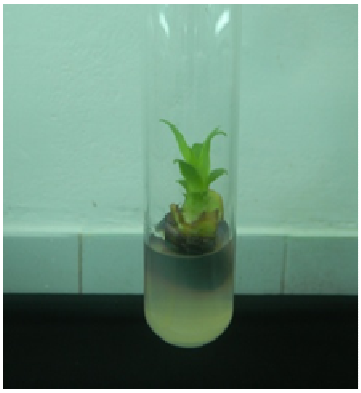


Figure 2. Response of Kew after Media Change

Multiplication in Kew

Objective

To transfer fresh inoculated culture after media change to bud multiplication medium and further to callusing medium

Technical Programme

Kew shoots developed during fresh inoculation were transferred to the multiple bud formation for increase in bud number. After 21 days the buds were separated and inoculated to the multiplication medium for callus formation.

Result

Cultures inoculated in the media showed multiple bud formation. Callus formation was observed but it was not sufficient and media trials were suggested for Kew subculture.

Table 3. Periodical observation of Kew in Bud Multiplication Medium

Plant Variety	After 7 Days	After 14 days	After 21 days
Kew Suckers	4 small bud formed	Bud size and number increased to 6	6-7 Green bud formed

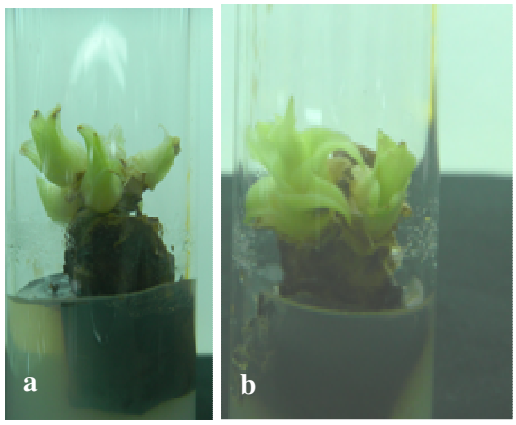


Figure 3. Comparative Response of Kew in Different Multiplication Media
a. Kew in Bud Multiplication Media b. Kew in Subculture Media

Rooting

Objective

To subculture Kew shoots to rooting media

Technical Programme

The green shoots were separated using sterile forceps and inoculated to rooting media. After two months of time, roots were initiated. The development of root in pineapple is very slow, and it takes normally about 3 months, also with the case of Kew. The observations were taken at 30 day interval for 90 days.

Result

Kew shoot formation and elongation was very good in rooting media.

Figure 4. Response of Kew in Rooting Media after 30 Days

1.2 Standardization of Media for Kew Subculture

Objective

To evolve effective media for subculture of Kew

Technical Programme

Following were the media used for trial. Each combination was named alphabetically containing a combination of cytokine and auxin. The media was prepared using 6.5g/l agar as solidifying agent, 30 g/l sucrose as the carbon source and maintained pH of 5.6.

Table 4. Different Media Combinations Used for Standardization

Media	Composition (mg/l)
A	MS +3BA+ 0.5NAA
B	MS +4BA+ 0.5NAA
C	MS +5BA+ 0.5NAA
D	MS +6BA+ 0.5NAA
E	MS +3BA+0.5 IAA
F	MS +4BA+0.5 IAA
G	MS +5BA+0.5 IAA
H	MS+ 6BA+ 0.5 IAA

Result

Multiplication was apt in (B) MS+(4mg/l BA+0.5mg/l NAA) and shoot formation was effective in (E) MS+(3mg/lBA+0.5mg/l IAA) media. Minimum callusing was observed in (A) MS+(3mg/l BA +0.5mg/l NAA) media and browning was observed in (C) MS+5mg/l BA+0.5NAA. (F) MS+(4mg/l BA +0.5mg/l IAA), (G) MS+(5mg/l BA +0.5mg/l IAA) and (H)MS+(6mg/l BA +0.5mg/l IAA media showed minimum response for shooting.

Kew callus

Table 5. Comparative Response of Kew in Various Media

Media used	Observation		
	After 7 days	After 14 days	After 21 days
A	Callusing	Minimum callus	Minimum callus
B	Callusing	medium callus	maximum callus
C	Callusing	Slight green callus	Minimum callus Less slight green shoots
D	Callusing	Slight green	Slight green
E	Callusing , slight green	Slight green medium callus	More green shoots
F	Callusing	medium callus	Less green shoots
G	Callusing, Slight green	Slight green Callus	Minimum callus less green shoots
H	Callusing	Callusing	Minimum callus and browning

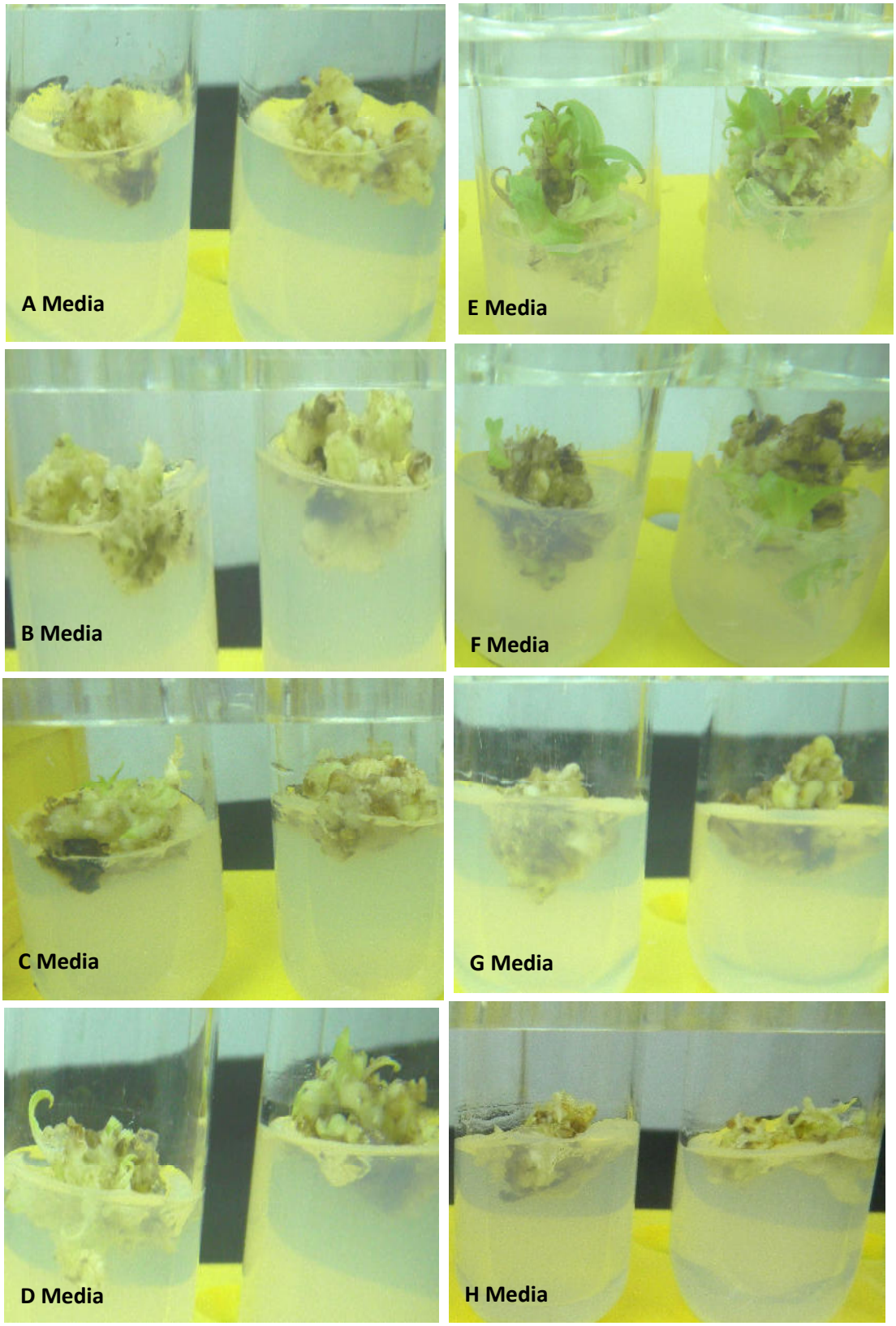


Figure 5. Periodical Response of Kew in Various Media Combinations

1.3 Fresh Inoculation of Baby Pineapple

Objective

To fresh inoculate crown explants of Baby pineapple for micro propagation

Technical Programme

Explant used for fresh inoculation was crown. For surface sterilization the explants were kept under running tap water for 30 minutes, soaked in Tween20 (detergent) for 30 minutes and shaken continuously, treated with fungicides (Fytran 0.1%, Indofil 0.1% and SAAF 0.05%) for 30 minutes each and washed with distilled water to remove fungicide and then treated with antibiotic (Gentamycin) 2mg/l. They were then transferred to laminar air flow chamber for surface sterilization.

Inside the laminar air flow chamber, the explants were treated with 70% ethanol (2 minutes) and then with 0.1% Mercuric chloride for 5 minutes followed by three rinsing of 5 minutes each with sterilized distilled water. The explants were trimmed to a final size of 1 cm in sterile conditions of the inoculation chamber and inoculated to culture medium in test tubes. Tubes were carefully tightened before transferring to incubation room.

Result

The freshly inoculated Baby pineapple cultures were observed for a cycle of 21 days at 7 day interval. After 7 days they appeared in slight green colour. Within 14 days they turned green. By 21 days the bud number increased from 1-2. The responding explants were transferred to fresh medium after 21 days. It was essential to change the medium in every 21 days for the maximum bud formation.

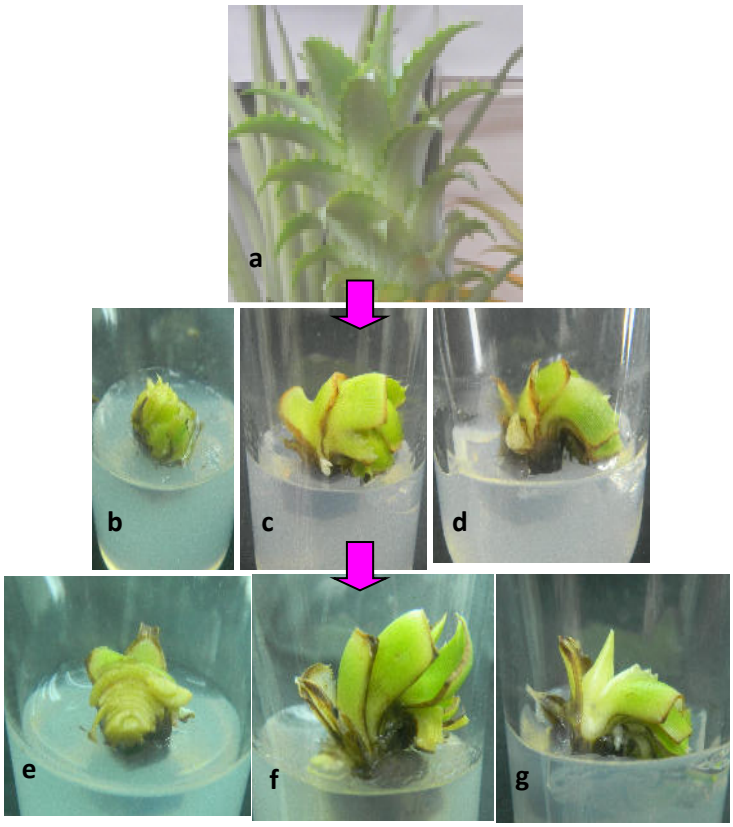


Figure 6. Fresh Inoculation of Baby Pineapple (BP). a. Crown explant (b-d) Periodical Response of BP during Fresh Inoculation and Media Change (e-g)

1.4 Subculture and Rooting of MD-2

Objective

- To subculture MD2 callus cultures in multiplication medium and in shoot initiation medium
- To inoculate MD-2 shoots in rooting medium

Technical Programme

Cultures as callus were sub cultured to multiplication medium for increased callus and bud formation. This stage continued till 6thsubculture. After enough cultures were obtained they were sub cultured to shoot initiation media for shoot formation. For shoot development they were sub cultured in shooting medium. Shoot initiation medium was of no strength to support rooting. Hence rooting medium was formulated for root induction. Green MD2 shoots of 1-2 cm height and 10 shoots of approximate same phenotype were carefully separated and inoculated to the rooting medium.

Callus and shoot initiation cultures were observed for a period of 21 days at 7 days interval while rooting cultures were observed for a period of 90 days at 30 days interval.

Result

- Callus proliferation was effective in multiplication media for MD-2
- The maximum shoot formation was observed in shoot initiation medium
- After 30 days 20 roots were observed and after 90 days 60-65 roots were observed

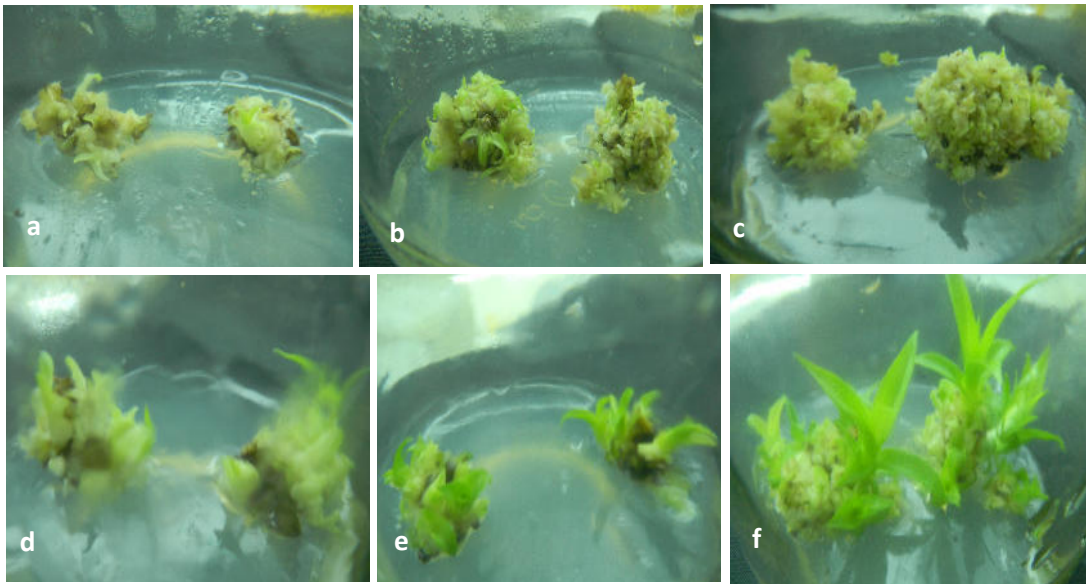


Figure 7. Periodical Response of MD-2 in Multiplication Media (a-c) and Shoot Forming Media (d-f) during 7 days 14 days and 21 days

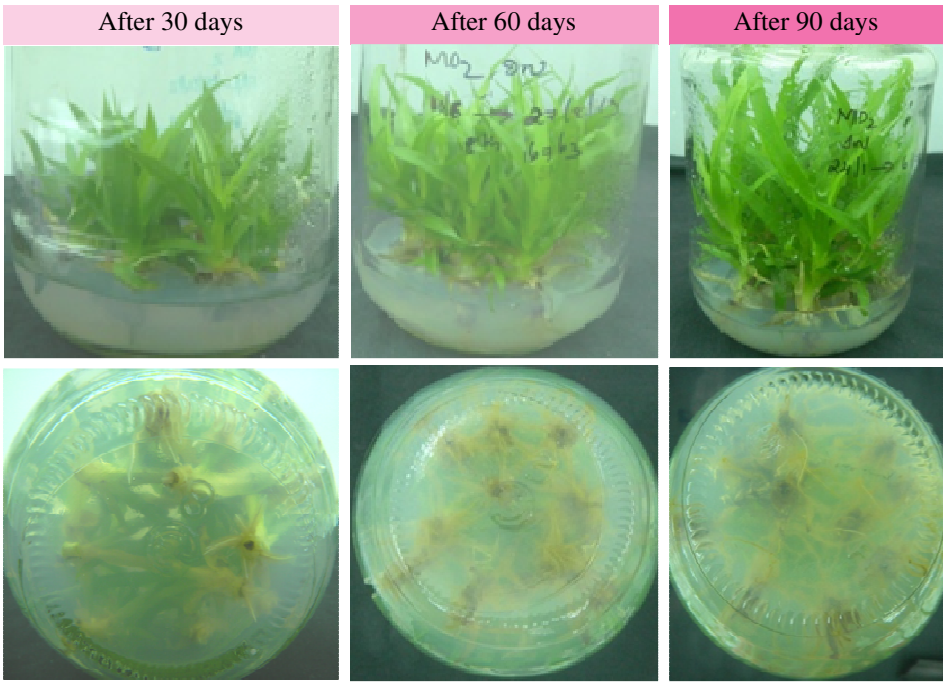


Figure 8. Periodical Response of MD-2 Shoots and Roots in Rooting Media

1.5 Selection of High Yielding Superior Quality Pineapple Variety for Central Zone of Kerala in PTD mode

Objective

To select a high yielding superior quality pineapple variety for central zone of Kerala

Technical Programme

The participatory technology development (PTD) research Programme encompasses a number of modules like survey, collection, screening, evaluation with farmers' participatory approach involving Pineapple Farmers' Association in Kerala. Field experiments are being undertaken to achieve the various objectives of the project.

Survey, collection and conservation of elite pineapple types

The different elite pineapple types available with Pineapple Farmers' Association, farmers and institutions in the state were collected, established and conserved in the research center.

Characterization of elite pineapple types

The different elite types available with Pineapple Farmers' Association, farmers and institutions in the state were established multiplied and used for characterization of plant types. The types were characterized morphologically and biochemically.

Identification of suitable pineapple types for cultivation

The collection of elite pineapple types available at Pineapple Research Station and those collected from Pineapple Farmers' Association, farmers and institutions in the state and established at the center will be evaluated for their growth, yield and quality characteristics and a suitable yield index will be developed involving Pineapple Farmers' Association. The different types will be ranked according to the yield index. The top three promising ones will be evaluated in detail for their quality and acceptance by Pineapple Farmers' Association, farmers and institutions.

Altogether 11 pineapple types are being evaluated in RBD with 3 replications in the field.

Results

Observations were taken every four months and growth parameters were recorded from the date of planting. Now the growth has reached 42 months. Detailed discussions of results are given below.

After 36 months of planting Kew showed highest plant height, canopy spread number of leaves and leaf width. Normal suckers were used as planting material for Kew and the initial growth pace may be because of that. For all other accessions tissue culture plants were used for planting, which is characterized by slow initial growth compared to normal suckers. H2, H4 and Amrutha recorded least growth parameters.

Observation taken after 39 months witnessed MD-2 with the highest values for all growth parameters and was significantly superior to all other accessions. The best performance of MD-2 can be due to the fact that normal suckers were used as planting materials whereas for others tissue culture plants were used for planting. Growth parameters were the poorest for Amrutha.

Growth parameters observed after 42 months displayed the accessions of Kew being superior in plant height, canopy spread, no of leaves and leaf width. Mauritius was significantly superior to all accessions in the leaf length. The accession Amrutha recorded poorest growth followed by H1 and H3.

After 45 months, the accessions of T3, H1, H4, H5 and H2 faired superior in plant height, canopy spread, number of leaves, leaf length and leaf width. The accession Amrutha and MTS recorded poorest growth.

Table 6. Growth Parameters of Pineapple Accessions 36 Months after Planting (cm)

No	Varieties	Plant height (cm)	Canopy spread (cm)	No. of leaves	Leaf length (cm)	Leaf width (cm)
1	Mauritius	075.66	088.20	27.33	54.86	07.17
2	Kew	100.00	101.13	76.13	57.60	04.46
3	MD-2	093.33	093.46	31.20	71.26	04.36
4	MTS	072.33	067.93	31.66	54.86	03.30
5	T3	081.66	092.95	50.53	54.25	04.61
6	H1	064.66	093.93	32.40	49.93	04.63
7	H2	055.11	073.33	22.22	43.44	03.33
8	H3	065.73	079.33	26.80	47.93	03.83
9	H4	061.60	066.66	39.55	32.66	04.30
10	H5	081.60	087.93	40.20	58.86	04.06
11	Amrutha	058.70	066.86	24.86	36.53	03.20
	GM	073.20	082.80	36.63	51.11	04.30
	SEM	005.58	006.69	06.75	04.61	00.86
	CD (0.05)	016.39	019.76	19.91	13.61	02.53
	CV%	013.13	014.01	31.92	15.63	34.64

At 36 months after planting, the pineapple varieties showed statistically significant variations in all the growth parameters observed. Kew recorded maximum plant height of 100 cm which was significantly higher than that recorded by others. Kew was followed by MD-2, H5 and T3. H2 recorded the lowest plant height of 55.10 cm followed by Amrutha, H4, H1 and H3. Canopy spread was highest for Kew which was statistically on par with T3, H1, MD-2, Mauritius and H5. The lowest canopy spread was recorded by H4 (66.66cm) followed by Amrutha, MTS, H2 and H3 which were significantly inferior to all others. Kew followed by T3 recorded highest number of leaves and they were on par. H2 followed by Amrutha, H3, Mauritius, MD-2, MTS, H1, H4 and H5 recorded least number of leaves. Leaf length was highest for MD-2 which was on par with H5 and significantly superior to all others. H4 followed by Amrutha and H2 recorded lowest leaf length.

Leaf width was highest for Mauritius followed by H1 and Kew which were all on par. H2 followed by MTS recorded lowest leaf width. In general, Kew recorded highest growth parameters except leaf width. H2, H4 and Amrutha recorded least growth parameters at 36 months after planting.

Table 7. Growth Parameters of Pineapple Accessions 39 Months after Planting (cm)

No	Accessions	Plant height (cm)	Canopy spread (cm)	No. of leaves	Leaf length (cm)	Leaf width (cm)
1	Mauritius	81.60	099.60	30.87	61.27	04.17
2	Kew	79.87	097.07	75.03	47.00	04.20
3	MD-2	88.20	114.00	31.40	71.80	04.10
4	MTS	72.47	084.20	27.80	59.60	03.13
5	T3	75.71	087.84	39.47	48.78	04.20
6	H1	70.27	090.93	42.80	52.87	05.13
7	H2	60.78	080.89	33.55	45.11	02.89
8	H3	76.33	083.00	45.27	51.73	03.37
9	H4	69.47	074.33	76.93	38.27	04.10
10	H5	87.20	100.13	45.73	59.13	03.70
11	Amrutha	65.90	072.07	27.20	41.28	02.98
	GM	89.46	089.46	43.28	51.58	03.85
	SEM	05.08	005.08	05.39	03.78	00.24
	CD (0.05)	17.95	017.95	18.86	11.16	00.70
	CV%	11.78	011.78	25.59	12.71	10.81

At 39 months after planting, all the growth parameters recorded significant variations among the accessions. The plant height was maximum of 88.2 cm for MD-2 followed by H5. The variety MD-2 was superior to all other types in plant height. H2 recorded the lowest plant height of 60.78cm followed by Amrutha, H4, H1 and MTS. Canopy spread was highest of 114 cm for MD-2 which was the highest, followed by H5, Mauritius and Kew which were all on par. The lowest

canopy spread was recorded by Amrutha (72.07cm) followed by H4, H2, H3, MTS and T3 which were significantly inferior to all others. H4 variety was recorded to have the highest number of leaves followed by Kew which were significantly different and superior to all other varieties. Amrutha was again lowest in the number of leaves. Leaf Length was highest for MD-2 followed by Mauritius and H5 which were on par and was significantly superior to all other varieties. . H4 followed by Amrutha, H2, Kew and T3 recorded lowest leaf length. Leaf width was highest of 5.13 cm for H1 followed by MD-2 which was all on par. H1 and MD-2 were superior to the rest of the varieties in leaf width. H2 followed by Amrutha, MTS and H3 recorded lowest leaf width. In general the variety MD-2 recorded higher growth parameters and Amrutha was poorest in growth performance.

Table 8. Growth Parameters of Pineapple Accessions 42 Months after Planting (cm)

No	Accessions	Plant height (cm)	Canopy spread (cm)	No. of leaves	Leaf length (cm)	Leaf width (cm)
1	Mauritius	082.89	112.00	28.33	68.60	03.84
2	Kew	118.43	127.00	59.83	61.00	05.07
3	MD-2	087.82	099.43	27.87	68.17	03.47
4	MTS	065.80	084.20	19.67	31.53	02.80
5	T3	081.13	100.53	34.53	48.93	04.33
6	H1	069.20	097.47	27.67	52.13	04.77
7	H2	059.45	080.67	24.67	47.33	03.07
8	H3	085.60	086.53	27.27	54.27	03.30
9	H4	067.93	065.73	49.53	34.33	03.73
10	H5	087.20	094.47	34.93	62.40	04.23
11	Amrutha	053.40	076.87	19.87	42.00	02.90
	GM	078.08	093.17	33.11	53.70	03.77
	SEM	008.27	005.91	05.63	04.52	00.43
	CD (0.05)	024.40	017.46	16.62	13.34	01.29
	CV%	018.35	011.00	29.48	14.59	20.21

At 42 months after planting, Kew recorded maximum plant height of 118.43cm which was significantly superior to all other pineapple accessions, which was followed by MD-2, H5, H3, Mauritius, T3, H1, H4 and MTS. Amrutha was recorded to have the minimum plant height followed by H2. Canopy spread was the highest of 127cm of Kew which was followed by Mauritius which were all on par. H4 had the lowest canopy spread followed by Amrutha and H2 which were all on par. Kew recorded the maximum number of leaves and it was significantly superior to all other accessions, which was followed by H4. Amrutha recorded the lowest number of leaves followed by H2, H3, H1, Mauritius, MTS, T3 and H5**.** Leaf length was the maximum of 68.60cm for Mauritius followed by MD-2, H5, and Kew which were all on par. Minimum leaf length was recorded by H4 followed by Amrutha and H2 which were all on par

and inferior to the rest of the varieties**.** Leaf width was the maximum of 5.07cm for Kew followed by H1, T3, H5 and Mauritius which were all on par. Amrutha followed by MTS, H2, H3, H4 and Mauritius had lower leaf width and they were all on par and inferior to the rest of the varieties in leaf width. In general, Kew had the best growth performance while Amrutha and H4 had poor growth performance at 42 months after planting.

Table 9. Growth Parameters of Pineapple Accessions 45 Months after Planting (cm)

No	Varieties	Plant height (cm)	Canopy spread (cm)	No. of leaves	Leaf length (cm)	Leaf Width(cm)
1	Mauritius	68.06	80.93	28.93	55.60	03.63
2	Kew	67.00	70.15	33.61	52.00	04.59
3	MD-2	65.86	79.86	24.40	48.60	03.10
4	MTS	53.41	67.70	19.00	37.48	02.47
5	T3	81.33	76.13	28.20	46.27	04.23
6	H1	64.46	97.60	30.20	56.33	04.70
7	H2	67.00	79.80	21.46	49.13	03.40
8	H3	57.53	80.40	23.86	46.00	03.26
9	H4	53.60	71.73	41.13	35.60	03.86
10	H5	61.40	93.33	26.26	58.20	03.90
11	Amrutha	48.93	64.80	17.13	37.13	02.50
	GM	62.60	78.41	26.74	47.48	03.60
	SEM	05.55	05.92	03.40	04.94	00.26
	CD (0.05)	16.37	20.42	10.05	14.58	00.78
	CV%	15.85	15.29	22.06	18.03	12.71

At 45 months after planting, T3 recorded maximum plant height of 81.33cm which was significantly superior to all other pineapple varieties, which was followed by Mauritius, Kew, H2 and MD-2. Amrutha was recorded to have the minimum plant height followed by MTS, H4, H3, H5 and H1. Canopy spread was the highest of 97.60cm of H1 which was followed by H5, Mauritius, H3, MD-2 and H2 which were all on par. Amrutha had the lowest canopy spread followed by MTS, Kew, H4 and T3 which were all on par. H4 recorded the maximum number of leaves and it was significantly superior to all other accessions, which was followed by H1 and Kew. Amrutha recorded the lowest number of leaves followed by MTS, H2, H3, MD-2 and H5. Leaf length was the maximum of 58.20cm for H5 followed by H1, Mauritius, Kew, H2, MD-2, T3 and H3 which were all on par. Minimum leaf length was recorded by H4 followed by Amrutha, MTS, H3, T3, MD-2 and H2 which were all on par and inferior to the rest of the varieties**.** Leaf width was the maximum of 4.70cm for H1 followed by Kew and T3 which were on all par. MTS, Amrutha and MD-2 had lower leaf width and they were all on par and inferior to the rest of the varieties in leaf width**.** In general, H5 had the best growth performance while Amrutha and MTS had poor growth performance at 45 months after planting.

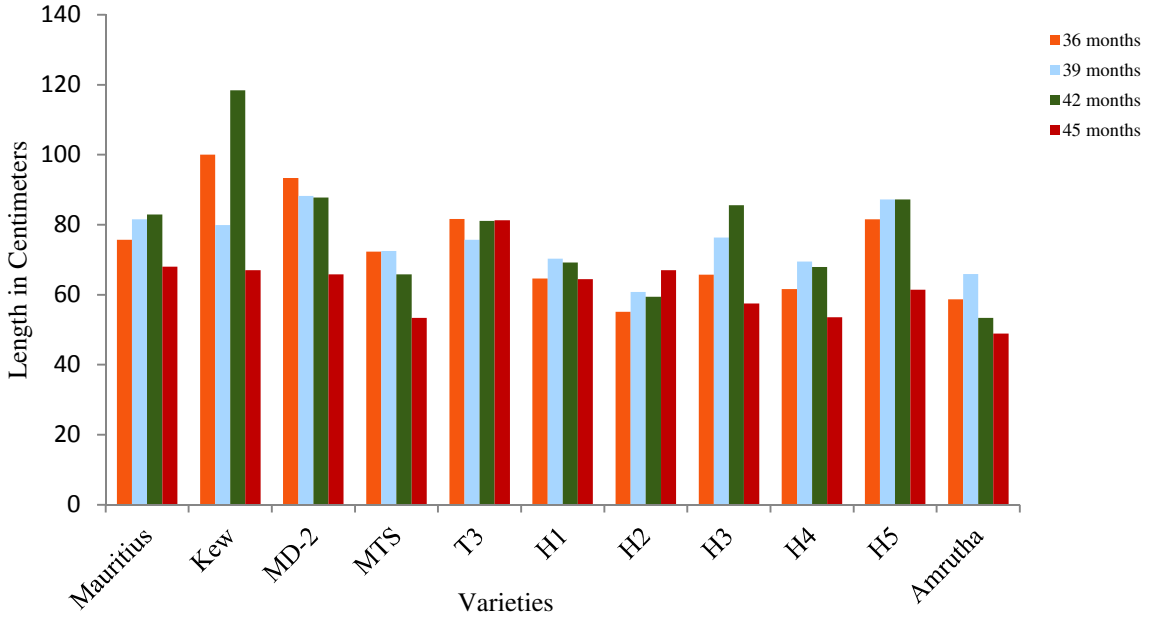


Figure 9. Comparison of Plant Height of 11 Pineapple Varieties (cm)

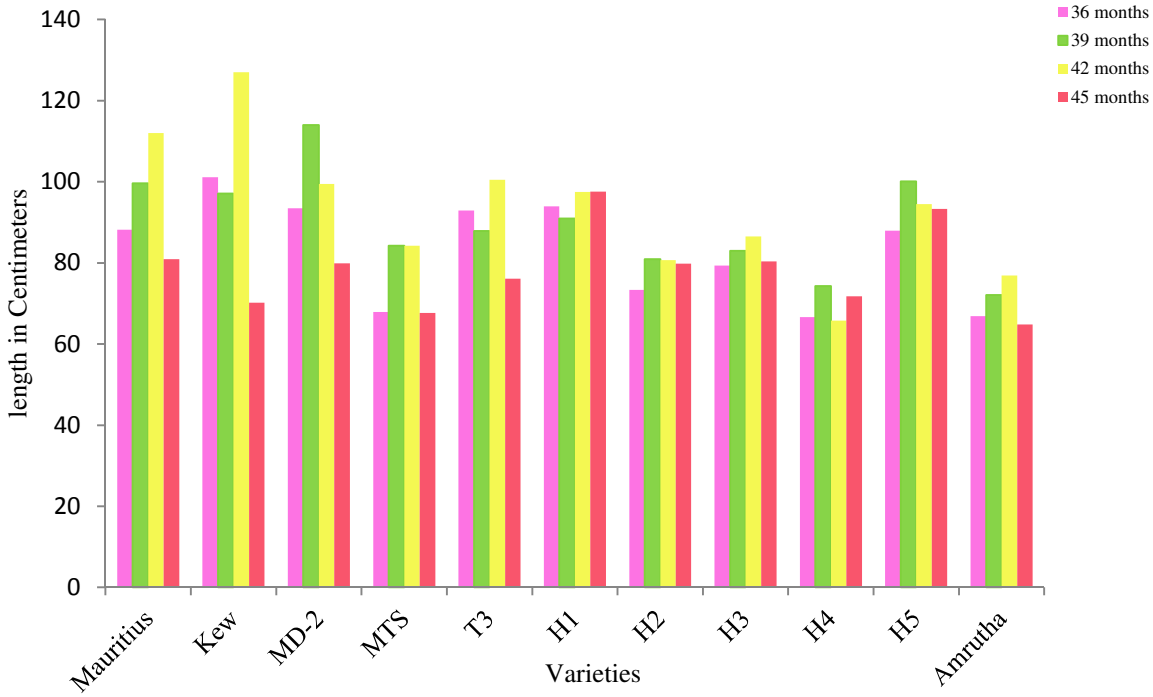


Figure 10 . Comparison of Canopy Spread of 11 Pineapple Varieties (cm)

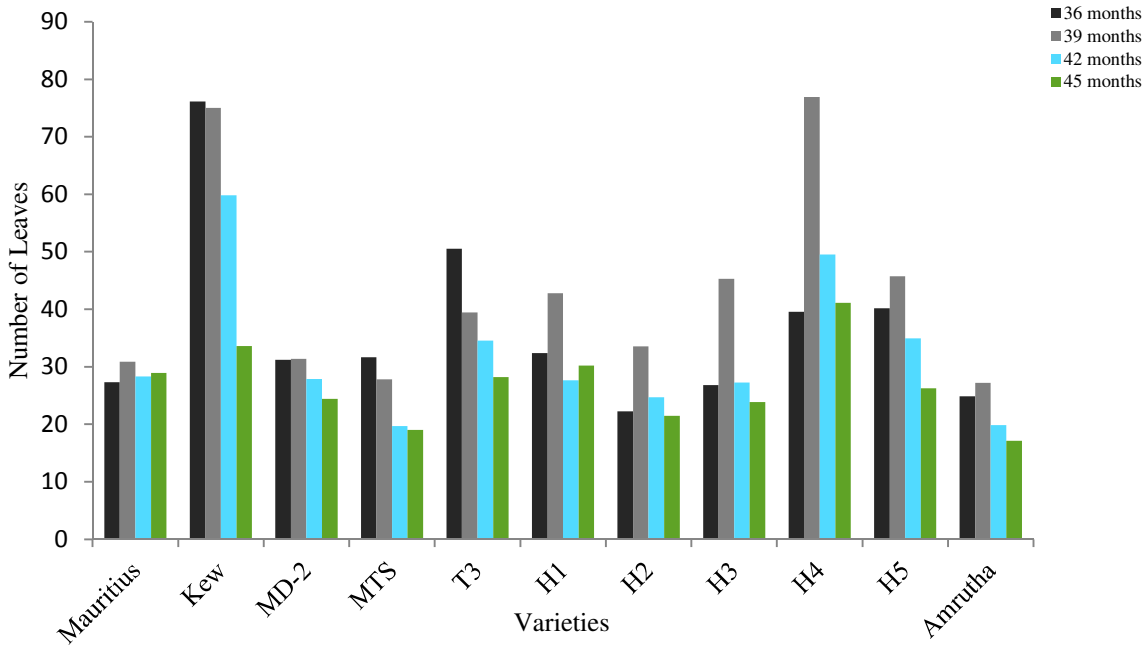


Figure 11. Comparison of Total Number of Leaves of 11 Pineapple Varieties (cm)

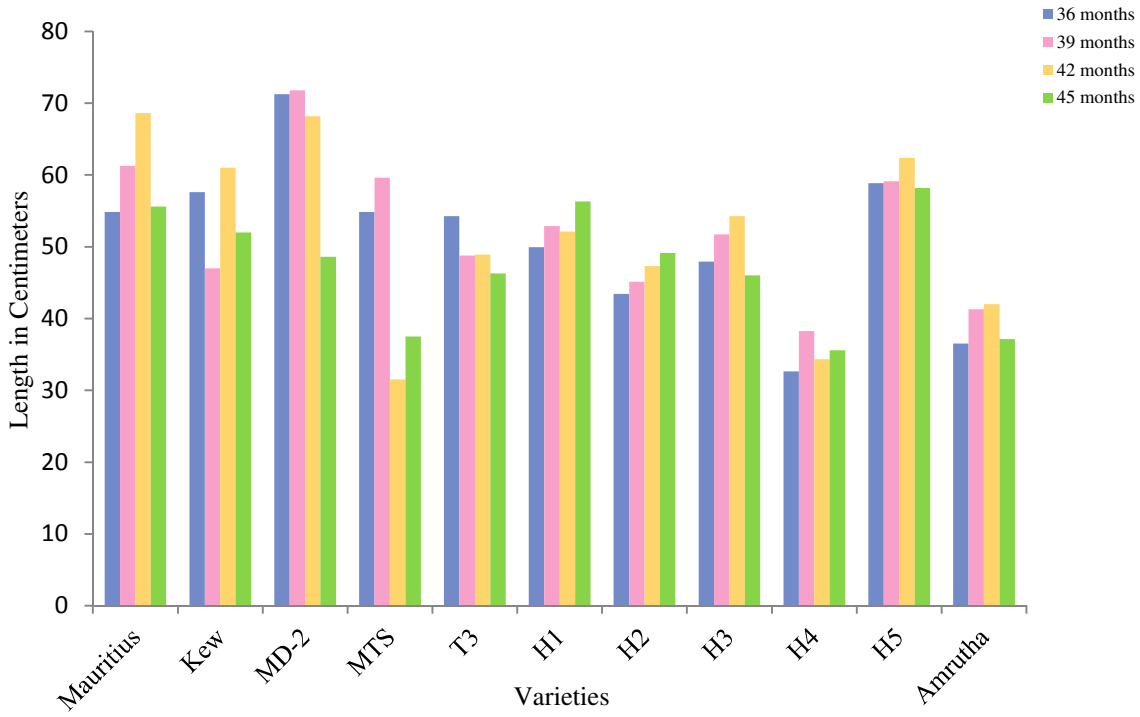


Figure 12. Comparison of Leaf Length of 11 Pineapple Varieties (cm)

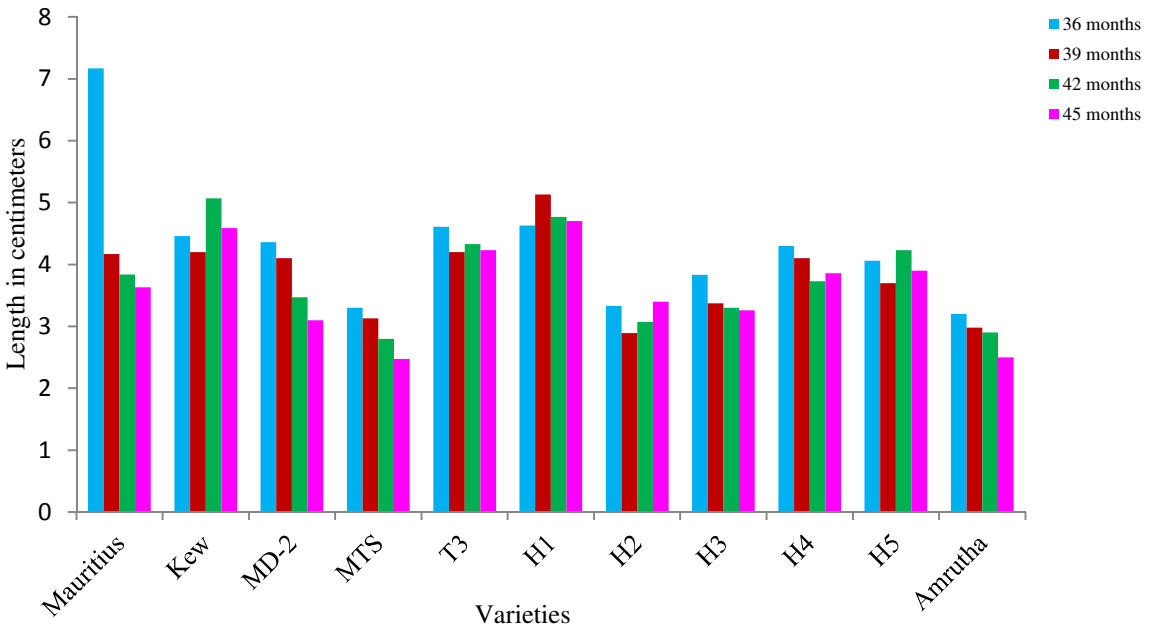


Figure 13. Comparison of Leaf Width of 11 Pineapple Varieties (cm)

Table 10. Total yield Per Plot of Pineapple Accessions (g/plot)

Sl No	Varieties	1st year	2nd Year	3rd Year	4th year	Total	Mean
1	Mauritius	1984.67	17183.67	5009.17	4252.33	28429.84	7107.46
2	Kew	_	_	5147.00	_	05147.00	1286.75
3	MD-2	_	05359.50	6654.17	0584.50	12598.17	3149.54
4	MTS	_	03379.83	3440.33	0514.17	7334.326	1833.58
5	T3	_	02603.00	5498.00	_	08101.00	2025.25
6	H1	_	_	0920.00	0884.66	01804.66	0451.16
7	H2	_	_	_	_	_	_
8	H3	_	_	5875.17	0412.83	06288.00	1572.00
9	H4	_	02265.00	4222.83	_	06487.83	1621.95
10	H5	_	_	5808.67	1522.67	07331.33	1832.83
11	Amrutha	_	_	3462.50	_	03462.50	0865.62

NB 4th year completes only on 31.05.2014 but the data is as on 31.03.2014

Table 11. Total Number of Fruits in Pineapple Accessions (number/plot)

Sl No	Varieties	1st year	2ndYear	3rd Year	4thyear	Total	Mean
1	Mauritius	01.33	13.00	04.67	06.33	25.33	6.3325
2	Kew	_	_	01.67	_	01.67	0.4175
3	MD-2	_	03.00	03.67	01.00	07.67	1.9175
4	MTS	_	03.00	02.33	00.78	06.11	1.5275
5	T3	_	01.00	05.67	_	06.67	1.6675
6	H1	_	_	00.67	00.67	01.34	0.3350
7	H2	_	_	_	_	_	_
8	H3	_	_	03.67	01.22	04.89	1.2225
9	H4	_	01.00	02.00	_	03.00	0.7500
10	H5	_	_	04.00	01.33	05.33	1.3325
11	Amrutha	_	_	02.67	_	2.67	0.6675

NB: Fourth year completes only on 31.05.2014 but the data is as on 31.03.2014

Table 12. Fruit yield of Pineapple Accessions (kg/ha)

Sl No	Varieties	1styear	2nd Year	3rdYear	4th year	Total	Mean
1	Mauritius	9801	84858	24737	20964	140360	35090
2	Kew			25417		025417	6354
3	MD-2		26467	32860	04322	063649	15912
4	MTS		16691	16989	07605	041284	10321
5	T3		12854	76533		089387	22347
6	H1			04543	04361	008904	2226
7	H2						
8	H3		11188	29013	06105	046306	11577
9	H4			20853		020853	5213
10	H5			28685	11260	039945	9986
11	Amrutha			17099		017099	4275

NB Fourth year completes only on 31.05.2014 but the data is as on 31.03.2014

Table 13. Total Number of Fruits in Pineapple Accessions (number/ha)

Sl No	Varieties	1st year	2ndYear	3rd Year	4thyear	Total	Mean
1	Mauritius	6584	64198	23045	26321	120148	30037
2	Kew			8230		008230	02058
3	MD-2		14815	18107	07407	040329	10082
4	MTS		14815	11523	09877	036215	09054
5	T3		4938	27984		032922	08231
6	H1			3292	04938	008230	02058
7	H2						
8	H3			18107	09877	027984	06996
9	H4		4938	9877		014815	03704
10	H5			19753	14814	034567	08642
11	Amrutha			13169		013169	03293

NB: Fourth year completes only on 31.05.2014 but the data is as on 31.03.2014

Table 14. Mean Value of Yield Characters of Pineapple varieties

Sl. No.	Varieties	Stock Length (cm)	Stock diameter (cm)	Fruit length (cm)	Fruit + crown (g)	Crown weight (g)	Fruit weight (g)
1	Mauritius	11.50	3.33	55.00	4252.33	216.16	3010.33
2	Kew	_	_	_	_	_	_
3	MD-2	08.76	1.36	24.66	0584.50	055.66	0550.00
4	MTS	04.16	0.86	17.50	0514.16	042.66	0471.50
5	T3	_	_	_	_	_	_
6	H1	07.33	1.56	118.66	0884.66	178.16	0442.00
7	H2	_	_	_	_	_	_
8	H3	05.33	1.26	14.66	0412.83	038.16	0374.66
9	H4	_	_	_	_	_	_
10	H5	15.93	3.33	53.76	1522.66	190.16	1102.83
11	Amrutha	_	_	_	_	_	_

NB: Varieties Kew, T3, H2, H4, Amrutha have not yielded during the year

Table 15. Mean Value of Yield Characters of Pineapple Varieties

Sl. No	Varieties	Peel Weight (g)	Core Weight (g)	Core Diameter (cm)	Pulp Weight (g)	Pulp Diameter (cm)	Juice Weight (g)
1	Mauritius	757.33	370.33	0.29	2082.10	10.70	1432.43
2	Kew	_	_	_	_	_	_
3	MD-2	091.00	055.66	2.36	1227.66	05.00	0055.83
4	MTS	086.66	033.00	1.00	0289.00	06.00	0314.33
5	T3	_	_	_	_	_	_
6	H1	082.83	422.33	2.60	0422.33	09.16	0222.83
7	H2	_	_	_	_	_	_
8	H3	088.00	041.66	1.46	0255.00	02.23	0109.16
9	H4	_	_	_	_	_	_
10	H5	256.00	129.46	4.93	0788.66	08.50	0277.83
11	Amrutha	_	_	_	_	_	_

NB: Varieties Kew, T3, H2, H4, Amrutha have not yielded during the year

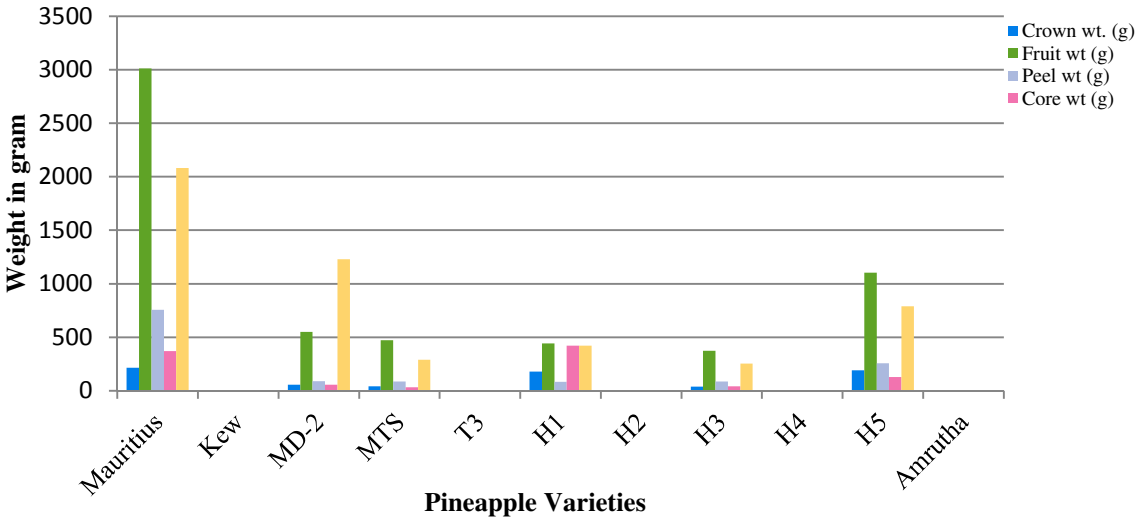


Figure 14. Comparison on yield characters of 11 pineapple varieties (g)

Table 16. Mean Value of Phytochemical Characters of Pineapple Varieties

Sl. No	Varieties	TSS (%)	pH	Acidity (%)	Reducing Sugar (%)	Non Reducing Sugar (%)	Total Sugar (%)	Ascorbic Acid (mg/100g)
1	Mauritius	15.03	08.81	00.31	06.29	31.32	38.22	29.54
2	Kew	_	_	_	_	_	_	_
3	MD-2	13.45	03.88	00.15	06.13	23.64	31.07	28.78
4	MTS	13.70	02.35	00.09	07.18	25.38	30.92	42.42
5	T3	_	_	_	_	_	_	_
6	H1	20.06	03.56	00.11	09.29	18.43	27.72	48.48
7	H2	_	_	_	_	_	_	_
8	H3	21.60	02.44	00.05	07.14	64.29	71.43	18.18
9	H4	_	_	_	_	_	_	_
10	H5	17.47	05.76	00.22	05.97	23.87	30.70	40.40
11	Amrutha	_	_	_	_	_	_	_

NB: Varieties Kew, T3, H2, H4, Amrutha have not yielded during the year

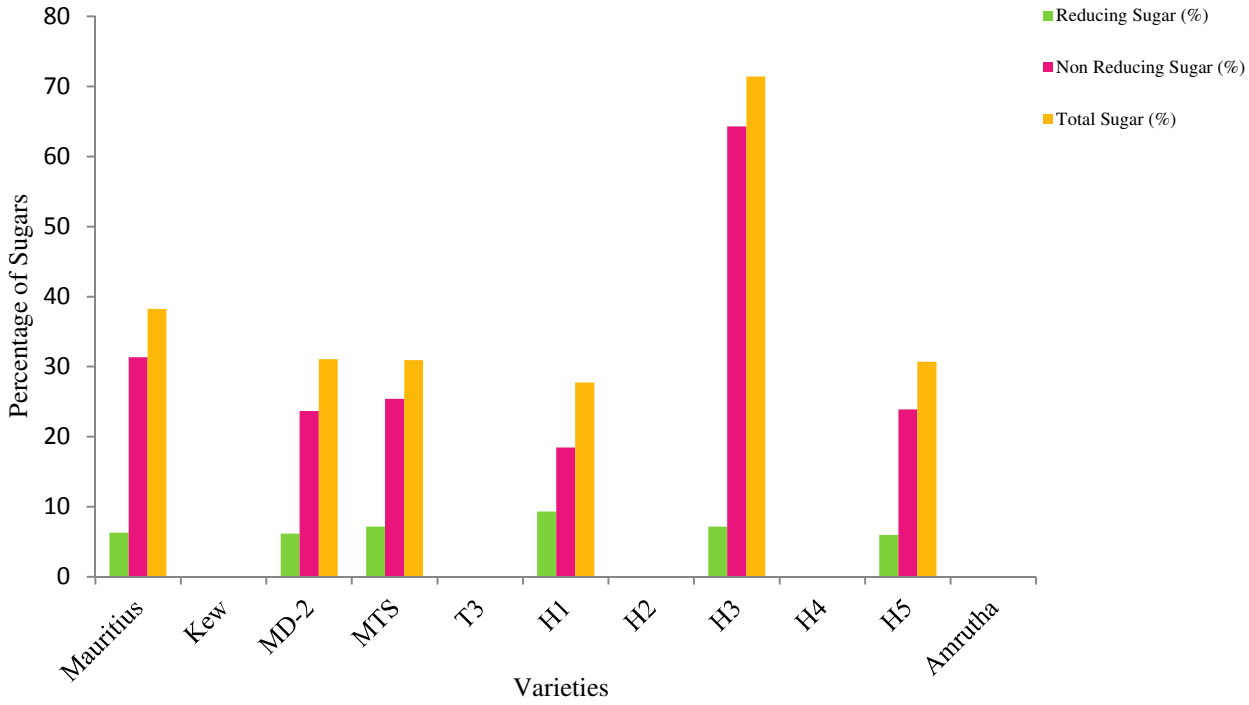


Figure 15. Comparison of Sugar Content of Pineapple Varieties (%)

Table 17. Mean Value of Qualitative Characters Of Pineapple Varieties (0-9 Scale)

Sl. No.	Varieties	Taste	Size	Colour	Smell	Pulp Colour	Juice Colour
1	Mauritius	5.10	4.30	4.10	4.85	3.70	4.00
2	MD-2	6.00	2.25	4.00	6.00	7.00	_
3	MTS	4.00	3.00	5.50	5.00	4.50	4.00
4	H1	6.00	3.66	5.00	6.00	4.00	5.00
5	H3	5.00	2.50	3.00	2.50	3.00	4.00
6	H5	3.87	2.12	2.62	2.62	3.00	3.33

NB: Varieties Kew, T3, H2, H4, Amrutha have not yielded during the year

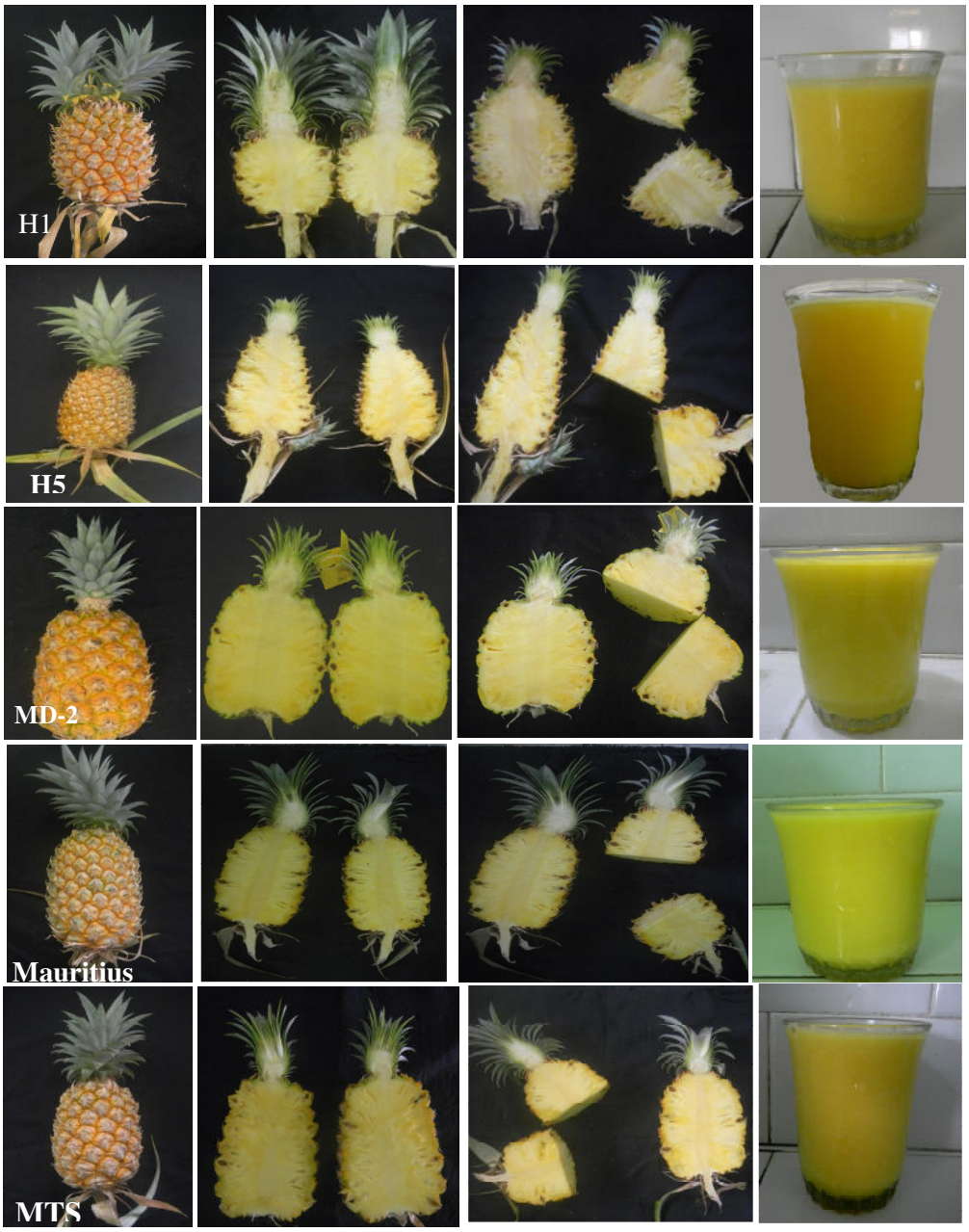


Figure 16. Fruit Characteristics of some Pineapple Varieties

1.6 Breeding for yield and Quality of Pineapple

Objective

To develop pineapple varieties suitable for processing and table purpose through hybridization

Technical Programme

The project was initiated in 2002. The traditional pineapple verities of Kerala Kew and Mauritius were hybridized and F_1 hybrids were planted in the field and selections were made based on favorable yield and qualitative characteristics. The suckers of superior types were subsequently planted in the field and the evaluation is being carried out continuously. Observations on fruit weight with and without crown, crown weight and TSS were being taken and the data were utilized for the selection of superior types.

Result

The following observations were taken and the date corresponding to superior varieties furnished below, twenty one hybrid lines produced fruits having weight more than 1.4 kg and fourteen with TSS more than 20 %. The evaluation is being continued. The planted lines are over three years and need to be replanted.

Evaluation of shortlisted pineapple hybrid lines

Technical Programme

After observing the available data on the progenies recorded in the basic records and field books. The associate Director of Research, RARS, Pattambi during his inspection on 22/07/11 directed to short list the unwieldy number of accessions into manageable groups of 100-200 numbers for the next stage of evaluation. Subsequently the best promising 10-12 numbers can ergonomically evaluated in RBD to arrive at one or two good varieties in pineapple which can be recommended for release.

Accordingly, the data for the last three years ie, 2009-10, 2010-11 and 2011-12 were analyzed and the top 50 performers were selected separately for each year based on fruit weight and brix value. All the accessions for which the detailed quality analysis report was available were included in the list.

Entire accessions which satisfied the criteria were pooled and sorted. Overlapping accessions were checked in the experimental plot for availability of suckers, which can be used for replanting. Finally 186 superior plants were selected for replanting and further evaluation. A maximum number of five suckers (A, B, C, D and E) of the available ones were planted in plot 1. The crop was managed as per the KAU package of practice recommendations.

Experimental programme followed for the entire replanted accession numbers can be broadly classified as analysis of yield characters, phytochemical characters and qualitative characters. Yield characters, phytochemical characters and qualitative characters. Yield character studies included detection of number of fruits under each accession numbers, calculation of fruit weight, rind weight, pulp weight, seed weight and juice weight. Phytochemical analysis quantified the TSS, pH, acidity, ascorbic acid, reducing sugars, non reducing sugars and total sugar. Taste, color, size and aroma of the fruits were qualitatively scored in 0-7 scale.

Table 18. Descriptive Yield Statistics of pineapple Accessions as on march 2014

Statistics	Fruit+ Crown Weight (g)	Crown wt. (g)	Peel Weight (g)	Core weight (g)	Pulp Weight (g)	Fruit wt. (g)	Juice wt. (g)
Mean	1089.27	140.89	128.92	79.68	512.80	738.39	306.84
Standard Error	51.06	13.09	5.36	4.43	22.13	29.64	14.53
Median	993.00	115.50	121.75	78.83	496.00	742.50	322.00
Mode	540.00	69.00	114.00	33.00	615.00	712.50	102.50
Standard Deviation	481.73	123.56	42.87	35.44	177.00	237.15	116.24
Sample Variance	232065.94	15268.43	1838.17	1255.64	31330.76	56241.40	13511.53
Kurtosis	1.2	16.05	0.28	0.39	0.05	0.65	0.25
Skewness	0.90	3.23	0.72	0.49	0.35	0.06	0.14
Range	2583.25	897	191.33	133.50	781.25	1006.75	521.50
Minimum	312.75	3.50	55.00	24.50	174.75	269.75	102.50
Maximum	2583.25	900.50	377.00	206.33	2064.00	2761.00	1298.00
Sum	96945.83	12539.91	8250.67	5099.25	32819.17	47257.00	19637.83
Count	89.00	89.00	89.00	89.00	89.00	89.00	89.00

Table 19. Descriptive Quality Statistics of pineapple Accessions as on march 2014

	TSS	pH	Acidity (%)	Ascorbic Acid	Reducing Sugar (%)	Non Reducing Sugar (%)	Total Sugar (%)
Mean	16.54	3.77	0.16	37.26	5.72	25.03	30.75
Standard Error	0.34	0.02	0.01	1.27	0.16	0.55	0.57
Median	16.93	3.77	0.14	36.36	5.49	23.50	29.25
Mode	10.00	3.70	0.15	42.42	4.90	25.27	27.88
Std. Deviation	3.27	0.19	0.08	12.08	1.52	5.26	5.41
Sample Variance	10.72	0.03	0.01	146.04	2.31	27.69	29.25
Kurtosis	-0.58	-0.17	17.34	5.42	49.77	4.33	4.16
Skewness	-0.31	-0.01	3.36	1.34	6.19	1.83	1.88
Range	13.60	0.90	0.66	78.78	13.84	33.63	32.50
Minimum	9.20	3.36	0.01	18.18	4.28	14.04	21.73
Maximum	22.80	4.26	0.67	96.96	18.12	47.67	54.23
Sum	1505.18	343.23	14.12	3390.59	520.75	2277.71	2798.46
Count	91.00	91.00	91.00	91.00	91.00	91.00	91.00

Table 20. Descriptive Quality Score Statistics of pineapple Accessions as on march 2014

Statistics	Taste (Score 0-7)	Color (Score 0-7)	Size (Score 0-7)	Aroma (Score 0-7)
Mean	4.19	3.37	3.73	3.02
Standard Error	0.12	0.10	0.13	0.08
Median	4.00	3.00	3.67	3.00
Mode	4.00	3.00	3.00	3.00
Standard Deviation	1.23	0.94	1.28	0.80
Sample Variance	1.50	0.88	1.63	0.64
Kurtosis	-0.48	0.45	-0.53	1.46
Skewness	0.29	-0.13	0.32	0.77
Range	5.00	5.00	6.00	4.50
Minimum	2.00	1.00	1.00	1.50
Maximum	7.00	6.00	7.00	6.00
Sum	406.83	326.50	361.33	293.17
Count	97.00	97.00	97.00	97.00

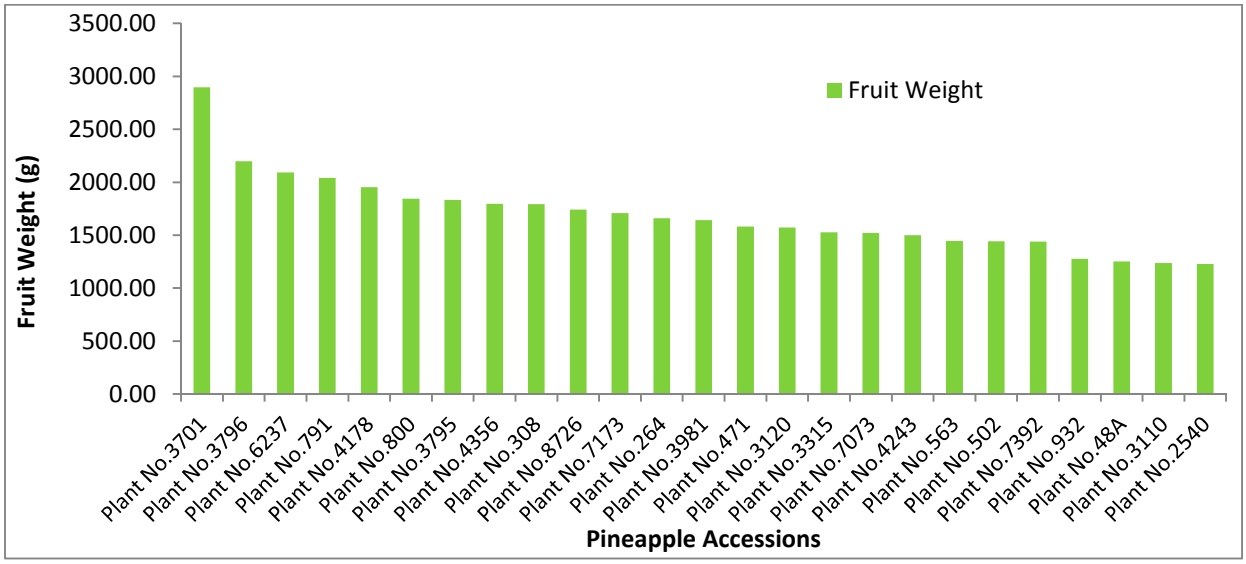


Figure 17. Comparison of Fruit weight of Pineapple Accessions

Table 21. Yield characters of top pineapple Accessions as on march 2014

Sl.No	Plant No.	Weight with Crown (g)	Crown weight (g)	Fruit Weight (g)	Peel weight (g)	Core weight (g)	Pulp weight (g)	Juice weight (g)
1	3701	2896.00	134.17	2761.83	164.67	107.67	1551.67	648.33
2	3796	2196.50	142.00	2054.50	251.00	182.00	1214.00	716.00
3	6237	2091.50	900.50	1191.00	278.00	136.00	657.00	404.00
4	791	2041.50	506.00	1535.50	241.00	109.00	1078.00	618.00
5	4178	1953.00	240.50	1712.50	377.00	172.00	2064.00	1298.00
6	800	1845.33	245.83	1599.50	228.33	149.33	968.00	628.67
7	3795	1833.50	82.25	1751.25	297.00	147.50	1302.50	786.50
8	4356	1796.50	48.50	1748.00	282.50	130.67	1176.33	522.67
9	308	1793.50	183.50	1610.00	256.00	112.00	1220.00	421.00
10	8726	1740.75	49.25	1691.50	188.00	141.00	1355.50	944.00
11	7173	1709.00	89.00	1620.00	235.00	192.00	1109.00	648.00
12	264	1661.50	277.17	1384.33	242.33	202.33	913.00	612.33
13	3981	1641.25	146.50	1494.75	230.00	104.00	1125.00	587.50
14	471	1582.50	210.50	1372.00	215.00	125.67	906.67	563.00
15	3120	1571.50	357.50	1214.00	139.00	184.00	368.00	416.00
16	3315	1527.00	180.25	1346.75	123.50	95.50	991.50	585.50
17	7073	1522.50	115.50	1407.00	180.50	61.00	751.50	538.00
18	4243	1498.75	190.25	1308.50	189.00	95.50	858.00	534.50
19	563	1446.00	366.00	1080.00	148.00	154.00	687.00	461.00
20	502	1444.00	116.00	1328.00	156.00	176.50	878.00	542.50
21	7392	1439.83	125.67	1314.17	156.67	57.00	668.67	408.00
22	932	1276.67	124.33	1152.33	137.67	206.33	766.67	450.67
23	48A	1253.00	91.50	1161.50	185.00	147.00	907.00	547.00
24	3110	1236.50	127.00	1109.50	133.00	133.00	345.00	448.00
25	2540	1229.00	28.50	1200.50	183.00	143.00	884.00	553.00

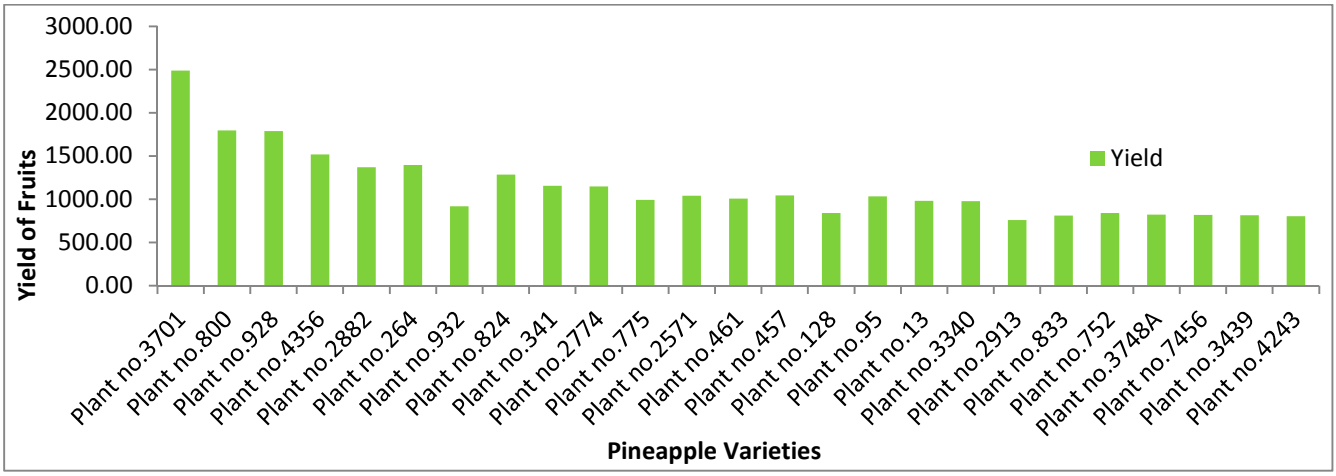


Figure 18. Fruit yield of top Pineapple Accessions

Table 22. Total yield Per Plot of Pineapple Accessions (g/plot)

Sl.No.	Plant Type	Total Fruit Weight (g)	Mean Fruit Weight	Total number of fruits
1	3701	9943.50	2485.88	4
2	800	16145.00	1793.88	9
3	2666	1836.00	612.00	3
5	928	1787.50	1787.50	1
6	4356	4555.00	1518.33	3
7	2882	12311.50	1367.94	9
8	264	6968.50	1393.70	5
9	932	20198.50	918.11	22
10	824	6424.00	1284.80	5
11	341	4611.50	1152.88	4
12	2774	1145.50	1145.50	1
13	775	9915.00	991.50	10
14	2571	18648.00	1038.00	18
16	461	6036.00	1006.00	6
17	457	4175.00	1043.75	4
18	128	16805.80	840.28	20
20	95	8255.50	1031.93	8
21	13	2942.50	980.83	3
22	3340	2934.50	978.17	3
23	2913	7566.50	756.65	10
24	833	18672.50	811.84	23
25	752	3356.50	839.13	4

Table 23. Phytochemical characters of Pineapple accessions as on March 2014

Sl. No	Plant No.	TSS (%)	pH	Acidity (%)	Ascorbic acid (mg/100g)	Reducing Sugar (%)	Non Reducing Sugar (%)	Total Sugar (%)
1	3701	11.33	4.01	0.13	34.34	5.45	24.73	30.18
2	3796	13.60	4.05	0.15	48.48	5.15	22.73	27.88
3	6237	10.00	3.47	0.22	42.42	6.09	23.86	29.95
4	791	20.87	3.85	0.07	42.42	4.58	29.14	33.72
5	4178	10.00	3.86	0.08	30.30	5.26	21.11	26.37
6	800	14.93	3.74	0.13	48.48	5.71	24.56	30.26
7	3795	10.00	3.65	0.11	48.48	4.90	22.48	27.38
8	4356	15.40	3.68	0.11	28.28	5.79	18.52	24.31
9	308	17.20	3.36	0.19	24.24	5.88	38.76	44.64
10	8726	12.50	3.65	0.18	42.42	6.58	22.78	29.36
11	7173	15.20	3.77	0.29	36.36	5.72	24.44	30.16
12	264	20.40	3.37	0.67	26.26	6.12	34.72	40.84
13	3981	12.10	3.55	0.24	36.36	6.17	22.08	28.25
14	471	19.33	3.64	0.16	66.66	5.19	24.01	29.21
15	3120	22.40	3.86	0.12	48.48	4.50	21.53	26.03
16	3315	15.50	3.68	0.13	45.45	5.43	21.10	26.53
17	7073	17.10	4.04	0.10	24.24	5.93	24.69	30.61
18	4243	12.90	3.81	0.13	54.54	6.89	20.41	27.30
19	563	18.00	3.99	0.17	42.42	5.31	21.63	26.94
20	502	19.25	4.14	0.07	24.24	5.74	24.84	30.58
21	7392	16.13	3.74	0.15	28.28	5.45	29.42	34.87
22	932	17.67	3.77	0.15	48.48	5.49	21.77	27.26
23	48A	19.00	3.86	0.13	33.33	4.58	23.78	28.36
24	3110	15.40	3.52	0.18	42.42	5.55	27.71	33.26
25	2540	22.80	3.76	0.17	30.30	5.81	25.27	31.08

Table 24. Qualitative characters of pineapple accessions as on March 2014 (0-7 scale)

Sl.No	Plant No	Taste	Color	Size	Aroma
1	3701	2.67	3.00	5.00	3.00
2	3796	3.00	3.00	6.00	4.00
3	6237	4.00	3.00	5.00	3.00
4	791	5.00	3.00	5.00	4.00
5	4178	3.00	3.00	7.00	3.00
6	800	3.67	2.67	4.00	2.00
7	3795	3.00	3.00	6.00	3.00
8	4356	3.67	4.00	5.83	2.00
9	308	6.00	3.00	5.00	3.00
10	8726	3.50	4.50	6.50	4.50
11	7173	5.00	2.00	5.00	2.00
12	264	3.67	3.67	4.67	3.00
13	3981	5.50	3.50	6.00	3.50
14	471	5.33	4.00	5.67	3.00
15	3120	6.00	3.00	4.00	3.00
16	3315	4.00	4.00	4.00	2.00
17	7073	3.00	4.00	6.00	4.00
18	4243	4.00	4.00	4.00	3.00
19	563	5.00	3.00	5.00	3.00
20	502	3.00	3.00	4.00	3.00
21	7392	5.33	4.00	4.33	3.00
22	932	4.00	3.67	3.00	2.67
23	48A	5.50	4.50	4.00	2.50
24	3110	5.00	4.00	4.00	3.00
25	2540	6.00	6.00	6.00	5.00

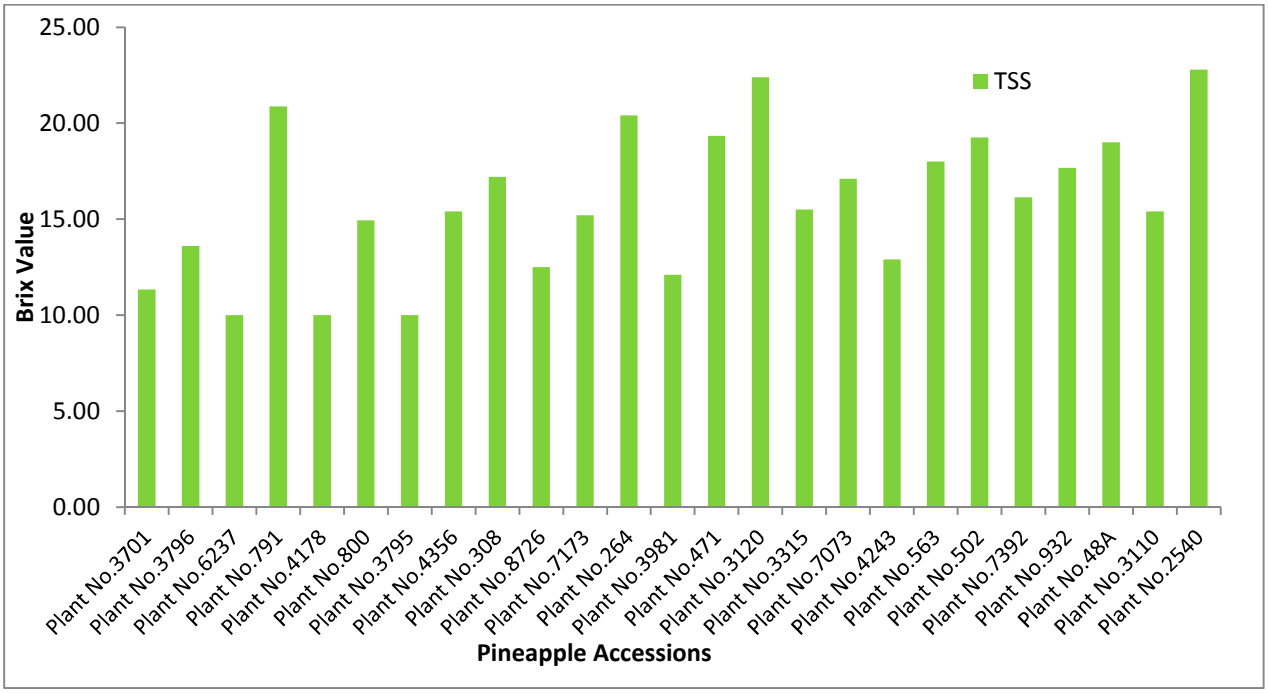


Figure 19. Comparison of Brix value of Pineapple Accessions

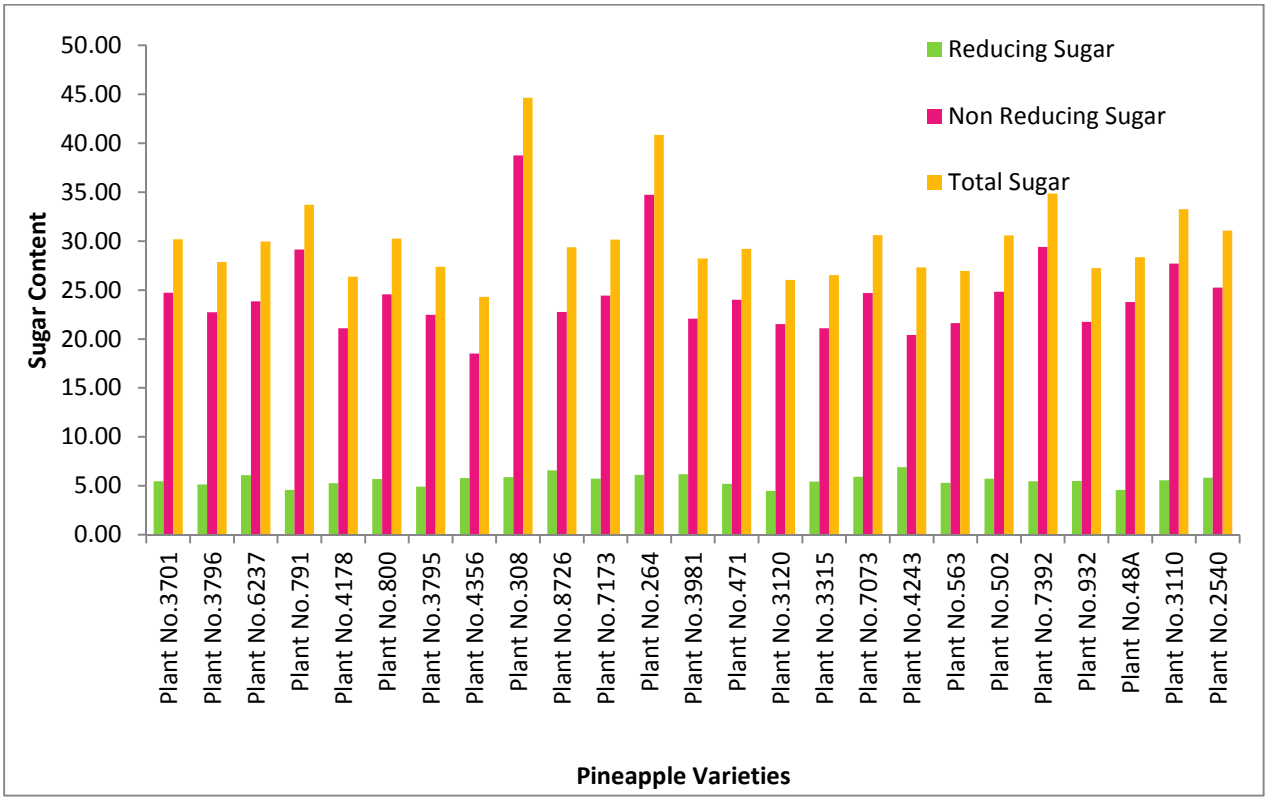
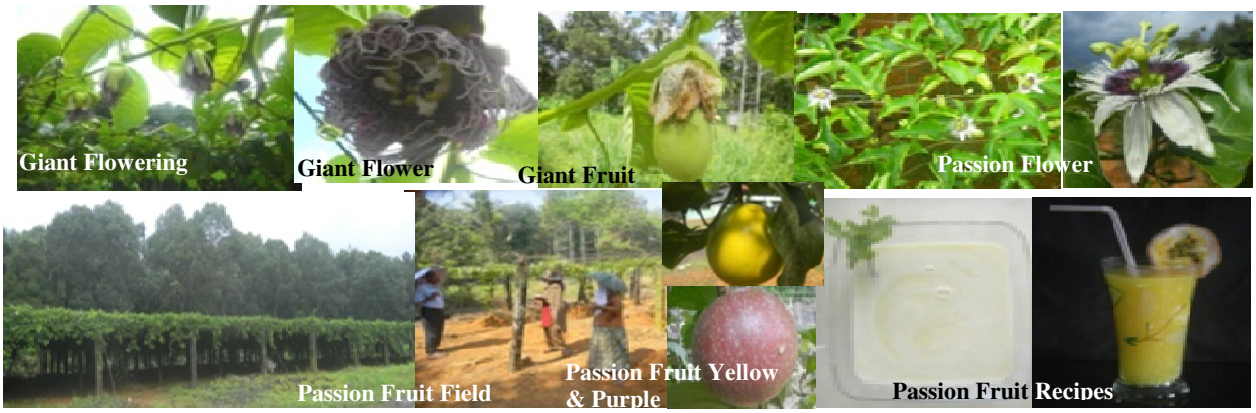


Figure 20. Comparison of Sugar content of Pineapple Accessions

Figure 21. Fruit Images of Some of the Breeding Trial accessions (104 nos.)

2. RESEARCH IN PASSION FRUIT



2.1 Shoot Tip Micro Propagation of Passion Fruit Types

Objective

To produce shoots from the explant shoot tips of different passion fruit types

Technical Programme

The shoot tips obtained from 15 month old passion fruit plants and were used as explant. The sterilization techniques and steps involved are as follows.

Figure 22. Tissue Culture Protocol for Passion Fruit

Observation

Only 142-P, Kaveri, 35Y responded to the media. Others 55Y and 57Y had no response and were fungal contaminated. 142-P showed callusing after 14 days. After 21 days light yellow callus observed for 142P only.

Result

The shoot tip propagation in MS + 2BA media was less effective.

2.2 Media Standardization of Passion Fruit Shoot Tip Culture

Objective

To standardize the protocol for fresh inoculation of passion fruit shoot tip culture and its media concentration

Technical Programme

Table 25. Media Trials for Different Passion Fruit Types

	Media	Passion Fruit Types
A	0.1 µM NAA + 1.00 µM BA + 0.1 µM GA_3	35Y, 143P, 57Y
B	0.2 µM NAA + 0.20 µM BA + 0.2 µM GA_3	142P, Kaveri, 55Y
C	0.2 µM NAA + 0.20µM BA + 0.3 µM GA_3	142P, Kaveri, 143P
D	0.25 µM NAA + 0.25 µM BA + 0.25 µM GA_3	57Y, 55Y, 35Y
	Sugar 30g/l, Agar 6.5g/l, pH 5.6	

Result

Table 26. Observations Obtained for Media Trials

Passion Fruit Types	Media Used	After 21 Days	Result
142P	B	shoot & callus	++++
	C	multiple shoot	+++
Kaveri	B	green	++++
	C	multiple shoot	++ +
57Y	A	multiple shoot	+
	D	multiple shoot	+ +
143P	A	multiple shoot & callus	+
	C	multiple shoot	+++
55Y	B	shoot	++++
	D	green, shoot	+ +
35Y	A	bulging & green	+
	D	bulging	+ +

NB: + + + + best, + + + very good, + + good, + average

After 7 days B media responded well for 55Y, Kaveri and 142P. C and D showed an average performance while A had the minimum growth.

After 14 days B media had the maximum response followed by C, D and A.

After 21 days A media showed multiple shoot while others had a decline in growth.

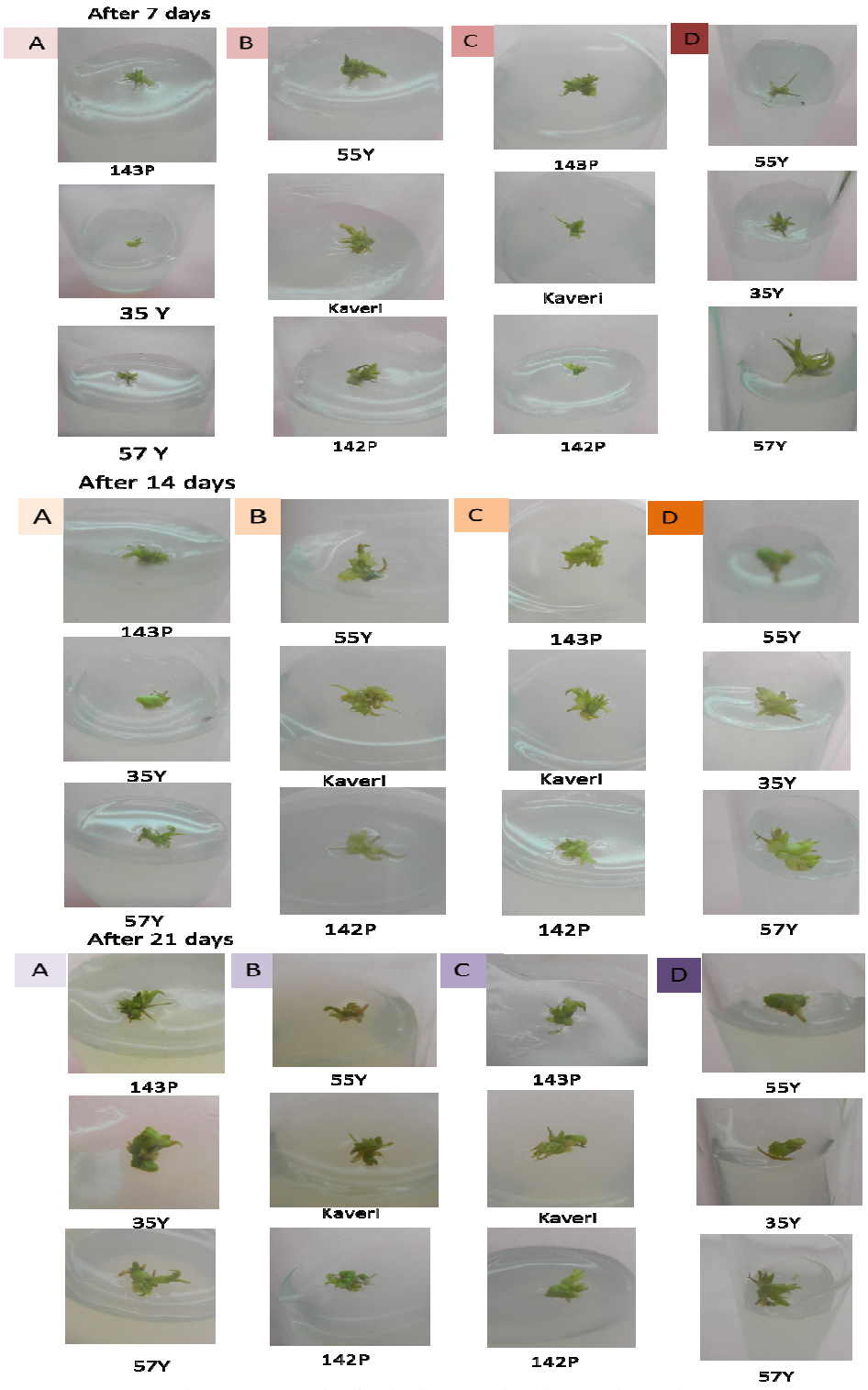


Figure 23. Periodical Changes in Shoot Tip Culture

2.3 Regeneration of Different Passion Fruit types *via* Stem Cuttings

Objective

To study the response of different passion fruit types for production of rooted stem cuttings

Technical Programme

Healthy passion fruit vines of one year old plants were selected for the study. The cuttings were obtained at morning time and were fresh. They were dipped and sprayed with water to avoid moisture loss. The cuttings of three noded types were obtained and dipped in 0.1% IBA solution for half an hour. The potting mixture containing Trichoderma, cowdung, neem cake and soil was used for planting. The polybag with passion fruit cuttings were kept undisturbed in mist chamber. They were watered thrice in a day and the response observed for a period of 30 days at 10 days interval.

The passion fruit types used for the study were Tripunithura yellow (TY), Geetha Purple (GP), 136Y, 31Y, Kaveri, 111Y and 167Y.

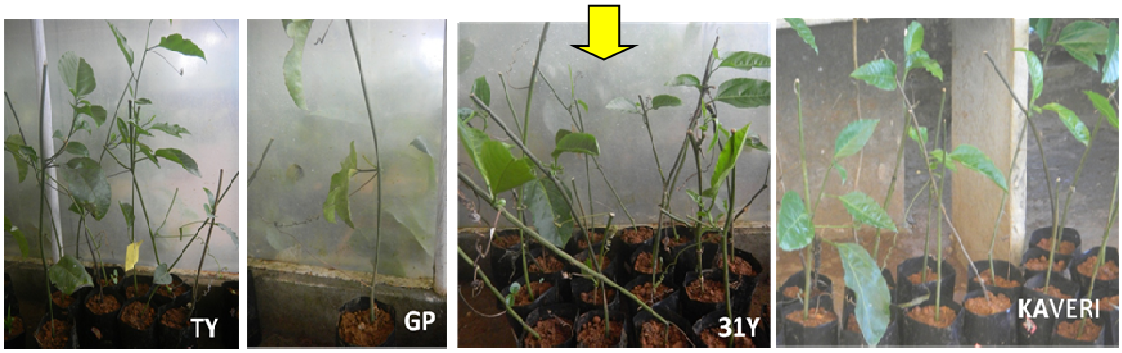
Result

Table 27. Recovery of passion Fruit Stem Cuttings

Passion Fruit Types	0^{th} Day (No.of Cuttings)	Recovery Rate (%)		
		After 10 Days	After 20 Days	After 30 Days
TY	47	085.10	23.40	19.14
GP	21	100.00	33.33	04.76
136Y	31	070.96	09.67	00.00
31Y	87	098.85	37.93	29.88
Kaveri	36	100.00	33.33	33.33
111Y	40	085.00	42.50	00.00
167Y	29	086.20	20.68	00.00

The stem cuttings production was effective in case of Kaveri followed by 31Y.

Passion Fruit Cuttings after 10 Days



Passion Fruit Cuttings after 30 Days

Figure 24. Regeneration of Passion Fruit Types *via* Stem Cuttings

2.4. Refrigeration Studies in Purple Passion Fruit

Objective

To evaluate the refrigeration characteristics of purple passion fruit

Technical Programme

Purple passion fruits of approximately similar size were selected for the studies. They were 36 in three replications. The fruits were evaluated for a period of 21 days in seven day interval.

Table 28. Yield Characteristics of Purple Passion Fruit during Refrigeration Studies Periodically

Period (Days)	Fruit wt (g)	Sack wt (g)	Rind wt (g)	Pulp wt (g)	Juice wt (g)	Seed wt (g)	Rind Thickness (cm)	Fruit Size (cm)
0	346.16	17.50	155.25	163.67	118.50	36.83	0.77	21.67
7	318.33	15.00	135.75	164.50	120.75	30.67	0.70	21.17
14	285.50	12.67	124.25	129.25	099.00	24.33	0.50	22.70
21	315.16	14.00	154.75	116.50	111.00	36.50	0.53	22.50

Table 29. Biochemical Characters of Purple Passion Fruit during Refrigeration Studies Periodically

Period (Days)	Reducing Sugar (%)	Non Reducing Sugar (%)	Total Sugar (%)	Ascorbic Acid (mg/100g)	Acidity (%)	TSS (Brix)
0	16.72	50.45	67.16	40.40	0.395	18.20
7	15.86	54.68	70.54	46.46	0.440	17.93
14	13.65	35.43	49.08	26.26	0.650	18.06
21	14.49	41.06	55.55	22.22	0.480	17.06

Table 30. Fruit Characteristics in Purple Passion Fruit during Refrigeration Studies Periodically

Period (Days)	Fruit Colour (0-9 scale)	Fruit Taste (0-9 scale)	Fruit Smell (0-9 scale)	Fruit Size (cm)
0	7.30	7.00	7.00	21.67
7	8.33	6.33	6.00	21.17
14	6.67	6.00	4.33	22.7
21	6.67	6.00	6.00	22.5

Result

After 21 days the biochemical characteristics like reducing sugar, Non reducing sugar, Total sugar and Ascorbic acid values showed a great reduction. Fruit characters like fruit colour, fruit taste and fruit smell observed lower values after 21 days. Parameters like fruit size and TSS were not so varied after the period of 21 days.

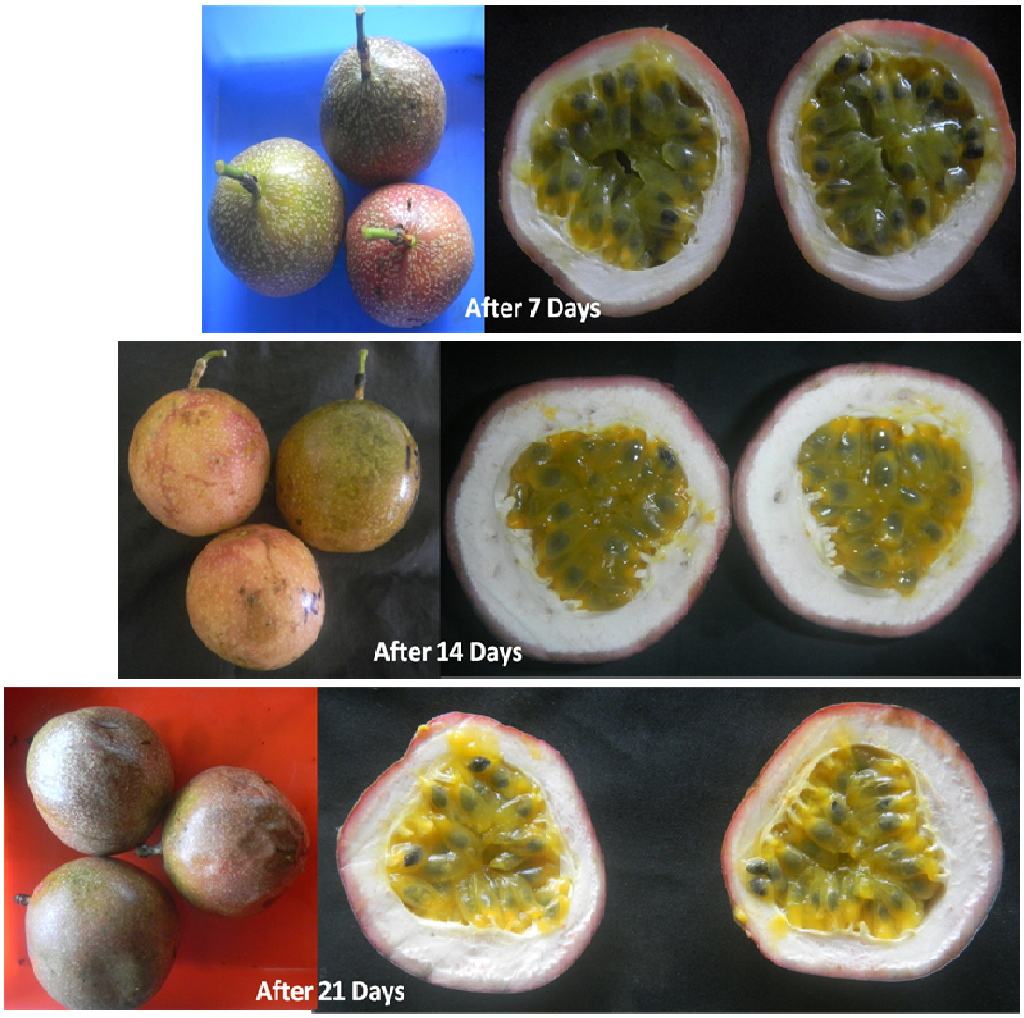


Figure 25. Fruit Character Changes during Refrigeration Studies in Purple Passion Fruit

2.5 Shelf Life Studies in Purple Passion Fruit

Objective

To evaluate the shelf life studies in purple passion fruit

Technical Programme

The fruits of approximately similar size were selected for the study. Observation continued up to 21 days at an interval of 7 days. 36 fruits were selected and grouped as R1, R2 and R3. Every parameter was analyzed during the period of study.

Table 31. Periodical changes in yield characteristics in Purple Passion fruit

Period (Days)	Fruit (g)	Rind wt (g)	Pulp wt (g)	Juice wt (g)	Seed wt (g)	Rind Thickness (cm)	Fruit wt Loss (g)
0	367.83	169.14	195.42	144.63	12.67	0.67	0.00
7	363.67	163.83	176.17	120.33	13.33	0.60	4.17
14	342.17	161.83	111.72	71.50	11.17	0.60	23.70
21	284.67	137.17	90.00	52.67	11.00	0.47	83.10

Table 32. Periodical changes in biochemical characters in Purple Passion fruit

Period (Days)	Reducing Sugar (%)	Non Reducing Sugar (%)	Total Sugar (%)	Ascorbic Acid (mg/100g)	Acidity (%)	TSS (brix)
0	21.25	38.42	59.67	30.30	0.58	17.87
7	17.15	13.87	31.02	24.24	0.52	17.53
14	16.47	32.97	49.43	50.50	0.47	11.47
21	16.40	53.4.30	69.83	48.48	0.45	07.67

Table 33. Periodical changes in fruit characteristics in Purple Passion fruit

Period (Days)	Fruit Colour	Fruit Taste	Fruit Smell	Fruit Size (cm)
0	6.00	3.33	6.33	23.33
7	7.00	6.00	8.00	23.00
14	7.00	1.00	2.00	22.67
21	0.00	0.00	1.00	22.77

Result

After 21 days all the parameters, qualitative and quantitative characters, declined except for sugar content. Shelf life of passion fruits after 7 days is not advisable. The pulp content remains unchanged even for next 7 days.

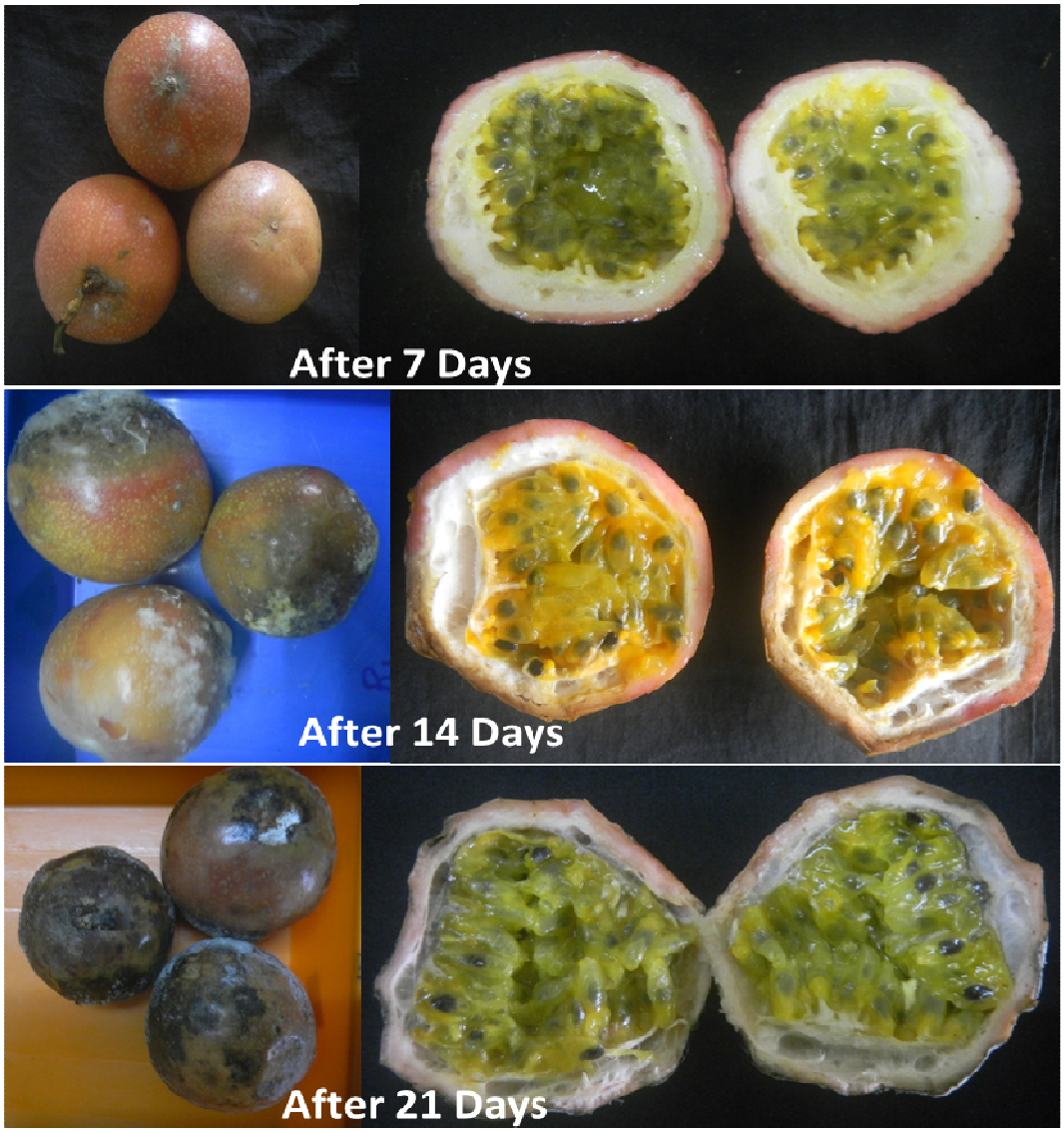


Figure 26. Fruit Character Changes during Shelf Life Studies in Purple Passion Fruit

2.6 Protocol for the Preparation of Passion Fruit Syrup

Objective

To prepare and store passion fruit juice in the form of syrup

Technical Programme

Table 34. Ingredients for Syrup Preparation

Items	Quantity
Passion fruit	1kg
Water	100ml
Sugar	400g

Scooped out the pulp and blended it in processor and strained it (strain I). Added water to the strained and prepared strain II. Boiled the strain II to cook with sugar. Not stirred. Wait to boil till bubbling occurred. Added the strain I and boiled for a minute (not too long). Switched off the flame and cooled. Potassium metabisulphate was added as preservative.

How to be served?

Mix 3-4 tbsp. syrup with 200 ml water and served.

Result

Around 700ml syrup obtained and stored in the fridge.

Figure 27. Passion Fruit Syrup

2.7 Characteristics of Giant Passion Fruit (*Giant Granadilla*)

Figure 28. Giant Plant Growth stages

Figure 29. Flowering Stages of Giant Passion Fruit

Table 35. Fruit Characteristics of Giant Passion Fruit

Fruit Character	Value
Fruit wt.	235g
Pulp wt.	31g
Sack wt.	4g
Skin wt.	44g
Juice wt.	16.50g
Fresh seed wt.	14.00g
Fruit size	24cm
Fruit Taste	4 score
Fruit Colour	1 score
Fruit Smell	7 score
TSS	10.20%
pH	03.47
Ascorbic acid	18.18mg/100g

Figure 30. Fruit Characteristics of Giant Passion Fruit

2.8 KSCSTE Project: Evaluation of Passion fruit types for commercial cultivation in Kerala

2.8.1 Objectives

The objective of the project is to identify a high yielding superior quality passion fruit accessions for commercial cultivation in Kerala so as to harness the full potentials of the growing situation giving maximum benefit to the growers in terms of more employment, higher incomes and better standard of living.

2.8.2 Methodology

Over fifty passion fruit accessions collected from different areas in Kerala and South India has been conserved and evaluated at the station for the last five years and 14 superior accessions have been identified. These selected types will be further evaluated for growth, yield, quality and pest and disease incidence in a replicated field trial for evolving superior accessions suited for the plains of Kerala. Superior passion fruit accessions identified in previous studies will be characterized morphologically and biochemically. The collection of passion fruit types available in the Pineapple Research Station will be evaluated for their growth, yield and quality characters and a suitable yield index will be developed. The different types will be ranked according to the yield index. The fourteen promising ones will be evaluated in detail for their yield, quality and consumer acceptance. Processed products will be developed from different accessions for fresh consumption.

2.8.3 Salient Research Achievements

Summary of Progress for Second Year

Growth pattern, pest and disease incidences were observed for every three months interval. Flowering started after seven months of planting. Initiation of flowering was a mixed response for both yellow and purple accessions. The number of flowers was noted down for each plant on a weekly basis. After eight months of planting, first fruit was observed, moving to flowering and fruiting season from March 2013. The number of fruits was observed from the date of initiation.

2.5ml/l Hilban was applied in the passion fruit field for the control of insects and termites. The plants were irrigated once in two days. In the month of May fertilization was done (Urea 30g/plant + Potash 20g/plant). The fruits' harvest season commenced by the end of May 2013. In June, a combined application of Indofil (3g/l) + Hilban (2.5ml/l) was given for the control of fungal and pest attack. The common pest and disease specimens were sent to College of Horticulture, Vellanikara for identification and recommendations. In July ash 30g/plant was applied to all plants. Also fytolan as a test dose was tried for the control of *Phytophthora* as recommended from College of Horticulture, Vellanikara. Further it was applied in the whole passion fruit field. At the end of July, fertilization was done in the dose Urea 60g/plant + Rajphos 50g/plant + MOP 40g/plant for one year old plants. Due to extreme

heavy rainfall in July – August period plant infection due to *Phytophthora* became a serious threat to plants causing fruit fall, vines decay and even plant loss. Rain caused application of fungicide little effective.

The fruits obtained were sorted and analyzed phytochemically for the fruit character, juice character, qualitative character, yield character etc. The observations like number of fruits and flowers and phytochemical analysis were done. Pseudomonas drenching was done (40g/l) at the end of August and fytolan drenching was done in plant casuality area. In September, Passion fruit trellises were cleared by removing the damaged vines. The evacuated places were replanted using cuttings from the respective type. Trichoderma (20g/l) drenching was carried out in all plants in October. The plant types were fertilized with the same concentration as the previous. Observations of flower number, fruit harvest number and weight were also documented. In the mean time the phytochemical analysis procedures were standardized and analysed. Kocide test doses were applied as recommended from College of Horticulture, Vellanikara in November and found as ineffective. The drenching of fytolan was continued for *Phytophthora sp* infection. Hand weeding was done on a monthly basis. In January the plants were pruned for the second year yield. After 18 months of planting, Trichoderma – cow dung – Neem cake mixture in the ratio 1:100:10 were mixed and 6kg/plant was applied on the field as a fertilizer and bio-control of the fungi.

2.8.4 Field Management

The passion fruit plants were used to be infested by small pests like thrips, termites, ants and sap sucking insects. An effort was taken by the application of 2.5ml/l Hilban to eradicate them.

The passion fruit plants were most of the time under the threat of Fusarium wilt and Phytophthora root rot diseases. The suspected samples were collected from the field by the plant pathologist and efforts were made to identify the pathogens. Wet mounting with lacto phenol cotton blue staining and slide culture confirmed the presence of those fungal pathogens. The field symptoms like root rotting, heavy leaf fall, discolouration of vines and leaves confirmed the presence of *phytophthora sp.* The samples were sent to the Department of Plant Pathology, College of Horticulture (CoH), Vellanikara for detailed examination. Heavy rainfall during the period of June-July made the disease wide spread and deepened the appearance of symptoms.

A team from CoH headed by Dr. Beena, Dept. of Plant Pathology visited the experimental plot and put forwarded suggestions for the application of fungicides. Fytolan 0.2% and Kocide 0.1-0.2% are the fungicides directed for use against Phytophthora root rot. They were field tested and found only fytolan as effective.

Figure 31. Plant Protection Efforts: (a) Diseased samples sent to College of Horticulture (CoH), Vellanikara (b) Dr. Beena & Team, Department of Plant Pathology, (CoH), visiting the field and discussing with Dr .P. P. Joy (c) Hilban application for minimizing pest damages (d) Fytolan drenching for control of *Phytophthora sp*.(e) Fertilizing the plants with Cow dung - Trichoderma mix (f) Replanting done and given shades (g) Pruning done (h) Pseudomonas drenching (i) Application of fertilizer

Glycophan 4ml/l was used for the control of weeds further controlling the attack of pests. The plants died were replaced by suitable cuttings of the healthy plant of the same accessions. Before planting Trichoderma and cow dung mixture was applied on the field as a bio-control of the fungi. Proper irrigation and fertilizer application was done for one year old plants. After 18 months of planting Trichoderma – cow dung – Neem cake mixture was applied on the field as a fertilizer and bio-control of the fungi.

Table 36: Details of the Specimens Identified from CoH, Vellanikkara

Plant Parts	*Major Symptoms*	*Causative Organism*
Fruit	Dark brown corky outgrowth, goes deep into the internal tissue.	*Diplodia* sp.
Fruit	Dark brown lesion on the stalk of fruits resulting in the fruit drop.	*Colletotrichum gloeosporioides*
Fruit	Water soaked lesion with white fluffy growth of mycelium on fruit surface leading to severe fruit drop.	*Phytophthora* sp.
Leaves	Dark brown circular to irregular lesions with prominent margins, leading to leaf blight	*Colletotrichum gloeosporioides* In addition , the perfect stage of the fungus *Glomerella cingulata* was observed on the diseased portion
Root of wilted plants	Wilting and drying up of plants, drying and withering of roots.	*Fusarium* sp.

Table 37: Details of Plant Casualty

Accessions with plant no:	*Replication*	*Disease*	*Pathogen*	*Remarks*
66 Y-10,11,12	R3	Fusarium wilt	*Fusarium sp.*	Replanted
88 Y-10,11	R3			
55 Y-8	R2	Phytophthora Root Rot	*Phytophthora sp.*	Replanted
55 Y-9	R3			
VP-6	R2			Recovered by Fungicide application
VP-7	R2			
VP-8	R2			
VP-9	R3			
VP-10	R3			
VP-12	R3			
35 Y-12	R3			Replanted
125 Y-6	R2			
125 Y-7	R2			
125 Y-8	R2			
125 Y-10	R3			
125 Y-11	R3			

2.8.5 New observations

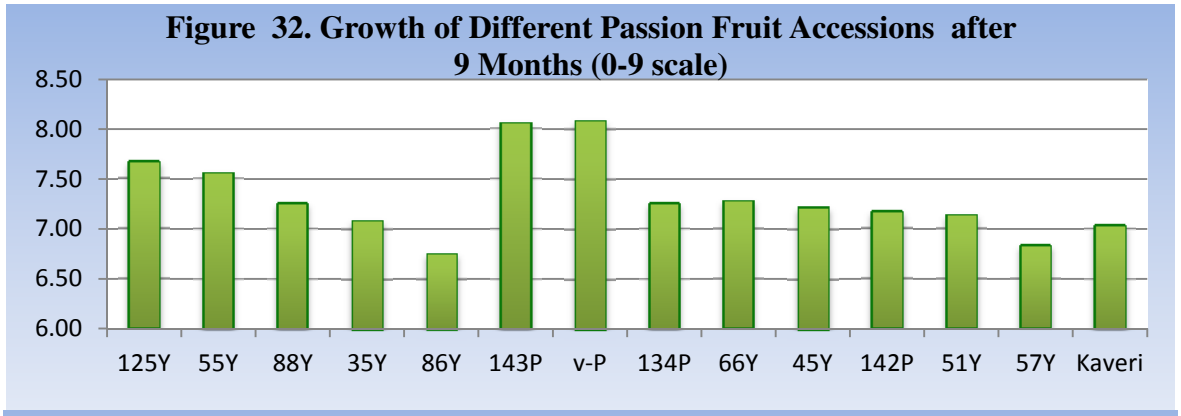
1. **Growth Observations**

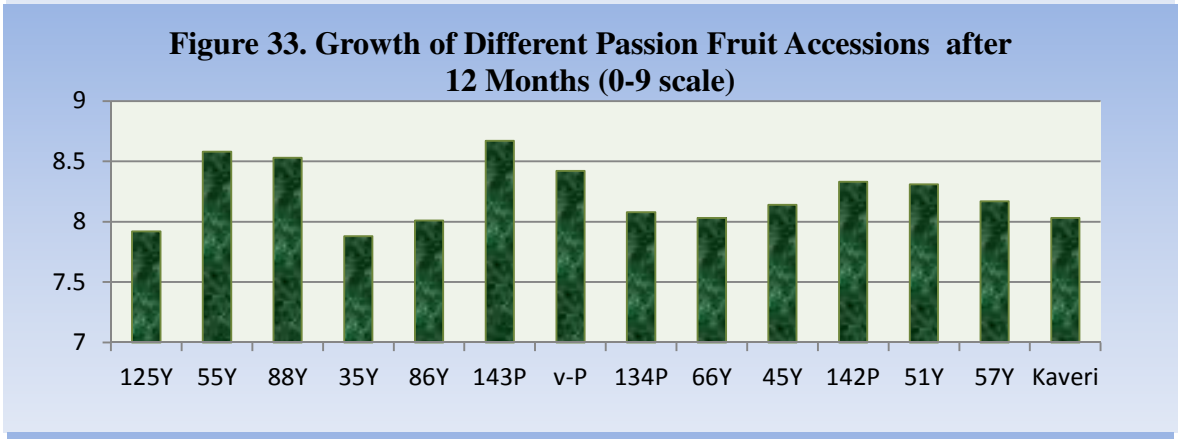
Growth observations of passion fruit accessions were done at three months interval. After nine months the passion fruit vines were thickly grown and it become a herculean task to take observations of each of the plant parts. Hence for the convenience the whole plant growth of the accessions depending on its spread over the trellises were evaluated. The highest score was given for the one which fully spread over the trellises and vice versa. The observations after nine months, twelve months and fifteen months were depicted as follows.

After nine months, VP showed maximum growth and 86Y the least. At 12 months after planting 143P showed maximum growth while 35Y the minimum and all others fell in between. At 15 months after planting 57Y obtained the utmost growth stage while 88Y the least. All others were having the growth with minor differences.

Table 38: Growth of Different Passion Fruit Accessions After 9, 12 and 15 Months of Planting (0-9 Scale)

Sl.No.	*Accessions*	*Growth after 9 months*	*Growth after 12 months*	*Growth after 15 months*
1	125Y	7.67	7.92	6.42
2	55Y	7.56	8.58	6.78
3	88Y	7.25	8.53	6.25
4	35Y	7.08	7.88	6.75
5	86Y	6.75	8.01	6.94
6	143P	8.06	8.67	6.92
7	VP	8.08	8.42	6.31
8	134P	7.25	8.08	6.75
9	66Y	7.28	8.03	6.42
10	45Y	7.22	8.14	6.81
11	142P	7.17	8.33	6.92
12	51Y	7.14	8.31	6.92
13	57Y	6.83	8.17	7.00
14	Kaveri	7.03	8.03	6.70
Date of Planting: 13/07/2012	Mean	7.31	8.22	6.71
	SEM	0.294	0.227	0.203
	CD	0.854	0.661	0.590
	CV%	6.964	4.779	5.242





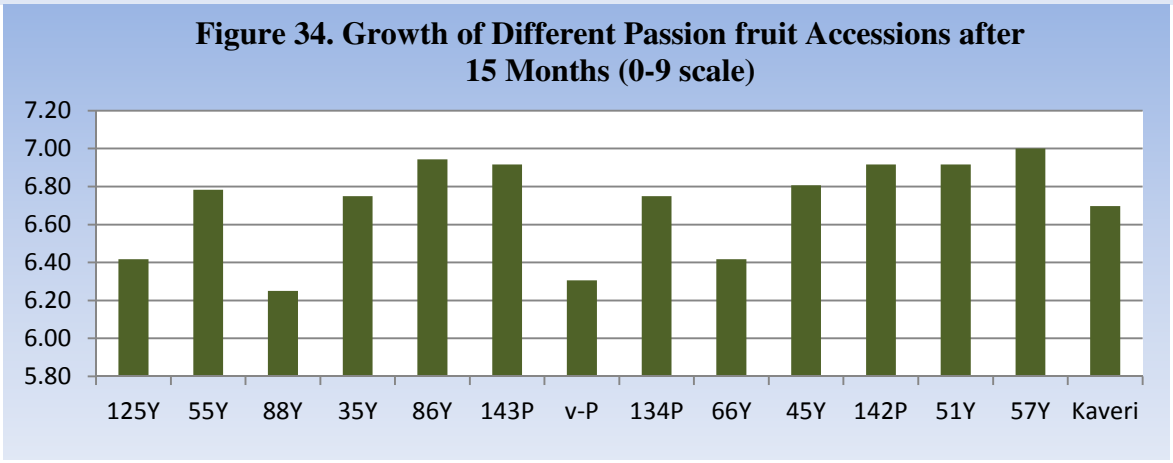


Figure 35. Growth of Passion fruit Varieties: a) after 9 months 143P b) after 12 months 125Y c) after 15 months VP

Figure 36. Passion Fruit Plant Spreading on Trellises during the past 18 months

2. **Disease Incidence**

Disease incidences were observed for a period of three months interval. The observation was done based on the predominant disease. The accessions with high score denoted the one with more susceptibility and the other with more tolerance.

At nine months after planting Fusarium wilt disease, Phytophthora root rot and scab diseases were common and scoring was based on Fusarium wilt disease since it was the dominant one. VP followed by 125Y and 35Y recorded least wilting and they were on par which was followed by Kaveri. All these accessions were significantly superior to all other accessions in wilt tolerance. 88Y, 66Y and 45Y showed maximum wilt affected and they were on par. At 12 months after planting Kaveri followed by

57Y, 88Y etc recorded least Phytophthora root and vine rot disease and they were all on par where as VP followed by 55Y and 35y showed the maximum susceptibility to this disease and they were all significantly inferior to all other varieties in terms of tolerance to root and vine rot. At 15 months also Phytophthora wine and root rot dominated other type of diseases and142P, 51Y, Kaveri, 45Y were on par recording lower vine rot disease incidence. The accessions 143P, 35Y, 86Y recorded higher vine rot disease incidence.

Table 39: Disease Incidence of Different Passion Fruit Accessions after 9, 12 and 15 Months of Planting (0-9 scale)

Sl.No.	Accessions	After 9 Months (0-9)	After 12 Months (0-9)	After 15 Months (0-9)
1	125Y	1.67	1.83	7.92
2	55Y	5.56	7.00	8.08
3	88Y	7.36	1.17	7.42
4	35Y	2.33	6.83	8.17
5	86Y	6.25	1.50	8.17
6	143P	4.73	4.58	8.25
7	VP	1.67	8.08	7.33
8	134P	5.61	1.33	3.08
9	66Y	7.05	3.92	4.33
10	45Y	6.31	3.25	3.00
11	142P	5.00	2.22	2.17
12	51Y	6.31	3.08	2.28
13	57Y	5.92	0.75	3.17
14	Kaveri	3.08	0.25	2.44
Date of Planting: 13/07/2012	Mean	4.92	3.27	5.41
	SEM	00.482		00.414
	CD	01.401		01.204
	CV%	16.978		13.244

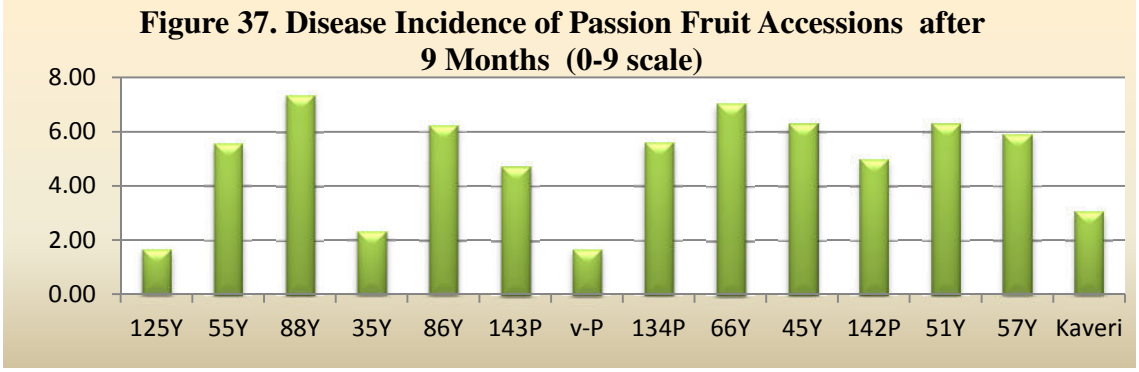


Figure 38. Disease Incidence of Passion Fruit Accessions after 12 Months (0-9 scale)

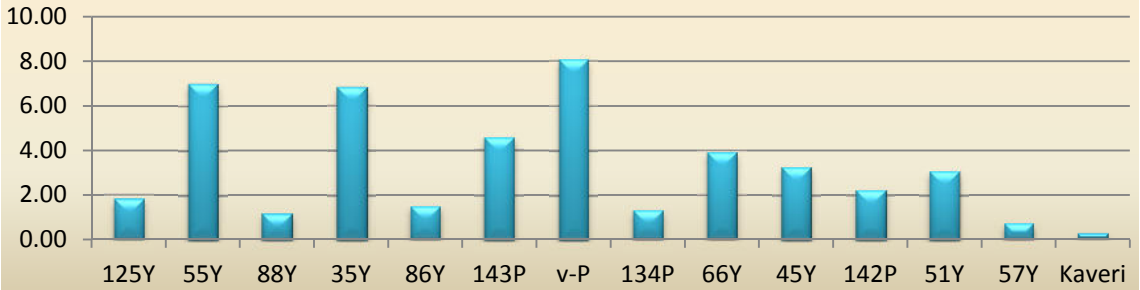
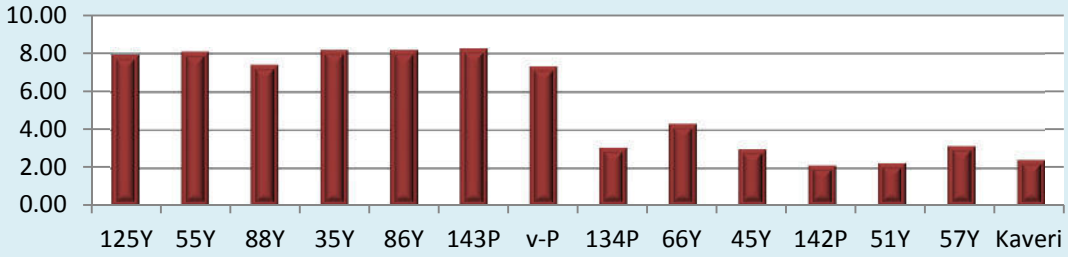


Figure 39. Disease Incidence of Passion Fruit Accessions after 15 Months (0-9 scale)



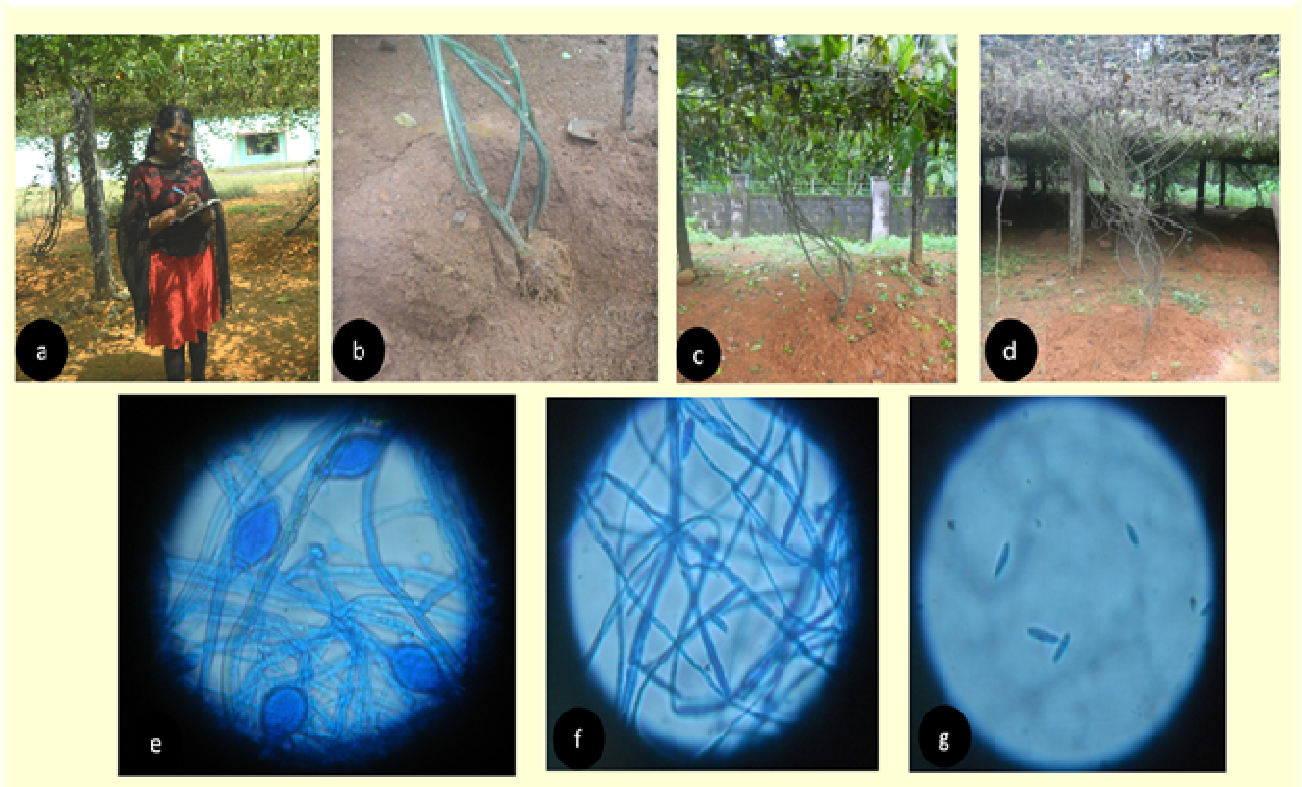


Figure 40. Passion Fruit Disease Incidence (a) Disease Observation (b) & (c) Phytophthora Root Rot (d) Fusarium Wilt (e) Microscopic view of *Phytophthora sp.* (f) & (g) Microscopic view of *Fusarium oxysporum*

3. Pest Incidence

Pest incidences were noted and scored in 0-9 scale at three months interval. Thrips, termites and ants were the common pest infesting passion fruit plants at the 9 months period. Among them thrips caused wide spread attack and hence scored based on that. VP recorded the lowest thrips incidence followed by 143P, 55Y and 134P which were on par. The highest incidence was noted in Kaveri which was on par with 45Y. Other varieties fell in between. At 12 months period pest attack on fruits were predominating and the scoring was based on that. High score was given for plants with more number of fruits infested. The scores reflected the severity and number of fruits affected. 57Y showed least incidence followed by Kaveri, 134P, VP etc which were all on par. 88Y and 125Y were recorded the highest incidence and they were on par. At 15 months after planting sap sucking insect pests were noted and the accession 88Y followed by 55Y and 86Y showed least incidence and they were on par. 142P showed maximum incidence followed by 51Y, 143P etc which were all on par.

Observation after nine months resulted in assessment of Kaveri mostly infested by thrips and V-P the less. The pest damage on fruits was maximum for125Y and least for 57.

Table 40: Pest Incidence of Different Passion Fruit Accessions after 9, 12 and 15 Months of Planting (0-9scale)

Sl.No.	*Accessions*	*After 9 Months(0-9)*	*After 12 Months(0-9)*	*After 15 Months(0-9)*
1	125Y	1.67	6.14	2.48
2	55Y	0.67	5.42	2.37
3	88Y	1.67	5.53	3.30
4	35Y	2.00	3.03	1.75
5	86Y	2.33	3.94	2.42
6	143P	0.67	3.92	3.50
7	VP	0.33	3.03	3.33
8	134P	1.17	2.75	3.00
9	66Y	2.67	3.11	3.25
10	45Y	2.83	3.25	2.94
11	142P	1.67	3.83	3.92
12	51Y	1.33	3.25	3.75
13	57Y	1.67	2.25	3.25
14	Kaveri	3.67	2.53	2.50
Date of Planting: 13/07/2012	Mean	1.74	3.78	2.98
	SEM		00.355	00.247
	CD		01.031	00.717
	CV%		16.243	14.317

Figure 41. Pest Incidence of Passion Fruit Accessions after 9 Months (0-9 scale)

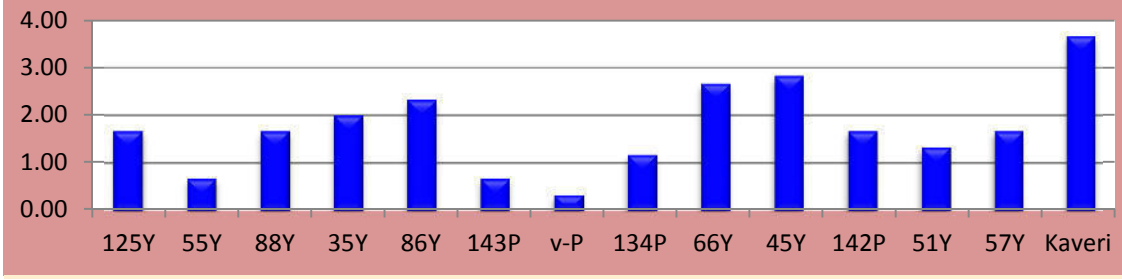


Figure 42. Pest Incidence of Passion Fruit Accessions after 12 Months (0-9 scale)

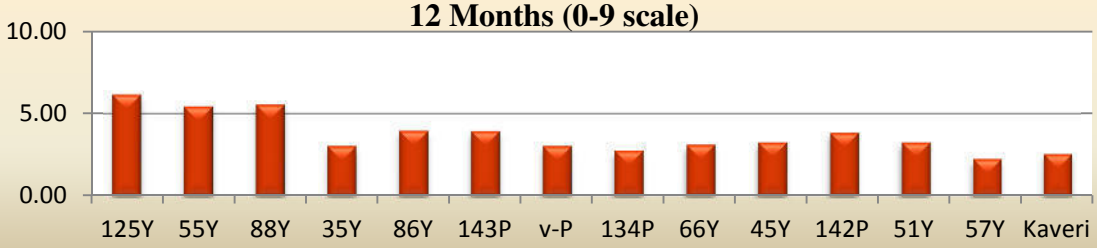


Figure 43. Pest Incidence of Passion Fruit Accessions after 15 Months (0-9 scale)

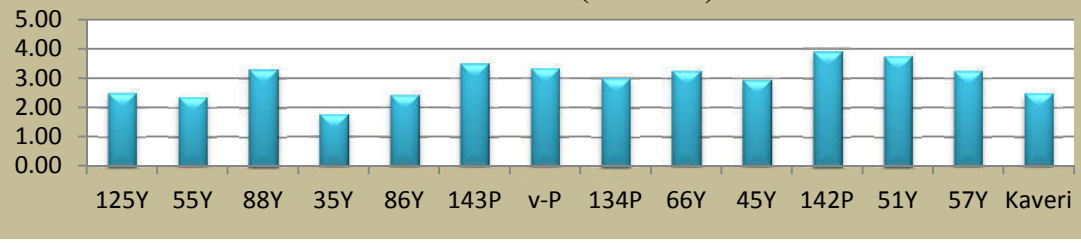


Figure 44. Pest Damages in Passion Fruit: (a) Pest attack on the fruits (b) Thrips attack on the leaves

4. First Flowering and First Fruiting

First flowering and first fruiting observations depicted the number of days required for the plant to flower or fruit from the date of planting (13.07.2012).

The flowering was noted first in the month of February in Kaveri (222.47 days) after planting followed by 51Y (230.83 days), 142P (233.06 days) and 134P (240.58 days) which were all on par. VP followed by 143P came to flowering last (287.5 days, 284.17 days respectively) in April. They were all on par and significantly late in flowering compared to all other accessions. Thus the early flowering types were Kaveri (222.47 days), 51Y (230.83 days), 142P (233.06 days) and 134P (240.58 days). The types which flowered in mid season were 125Y (243.92 days), 66Y (245.17 days), 88Y (245.58 days), 45Y (251.1 days), 55Y (253.42 days), 35Y (253.67 days), 57Y (259.08 days), 86Y (259.11 days) and the late flowering types were 143P (284.17 days) and VP (287.5 days).

The fruiting was noted first in the month of March in Kaveri (245.17days) after planting followed by 125Y (253.42 days) and 66Y (255 days) which were all on par. 143P followed by 134P came to fruiting last (331.83 days, 330.25 days respectively) in June. They were all on par and significantly late in fruiting compared to all other accessions. Thus the early fruiting types were Kaveri (245.17 days), 125Y (253.42 days) and 66Y (255days) and the late fruiting types were 143P (331.83 days), 134P (330.25 days), 142P (327 days), 45Y (321.39 days), VP (321.03 days), 57Y (319.83 days), 88Y (319.32 days), 86Y (316.25 days), 55Y (311.5 days), 51Y (310.33 days) and 35Y (307.75 days).

Table 41: First Flowering and First Fruiting Observations of Different Passion Fruit Accessions (Days)

Sl.No.	*Accessions*	*1st Flowering (Days)*	*1st Fruiting (Days)*
1	125Y	243.92	253.42
2	55Y	253.42	311.50
3	88Y	245.58	319.32
4	35Y	253.67	307.75
5	86Y	259.11	316.25
6	143P	284.17	331.83
7	VP	287.50	321.03
8	134P	240.58	330.25
9	66Y	245.17	255.00
10	45Y	251.10	321.39
11	142P	233.06	327.00
12	51Y	230.83	310.33
13	57Y	259.08	319.83
14	Kaveri	222.47	245.17
Date of Planting: 13/07/2012	Mean	251.40	305.01
	SEM	06.904	05.468
	CD	20.063	15.890
	CV%	04.756	03.105

Figure 45. First Flowering (days) of Passion Fruit Accessions

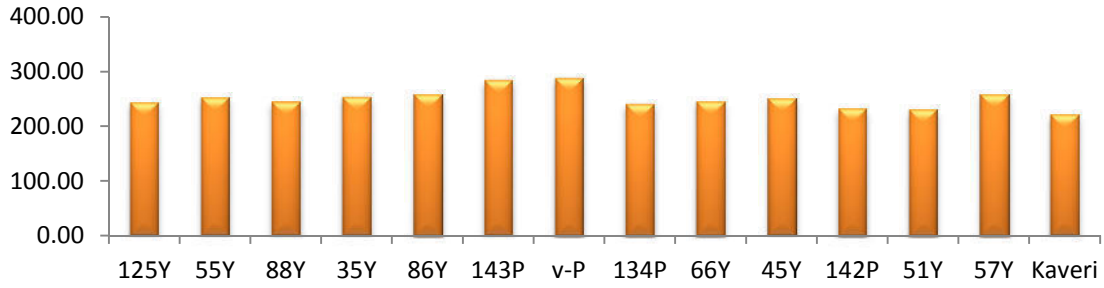
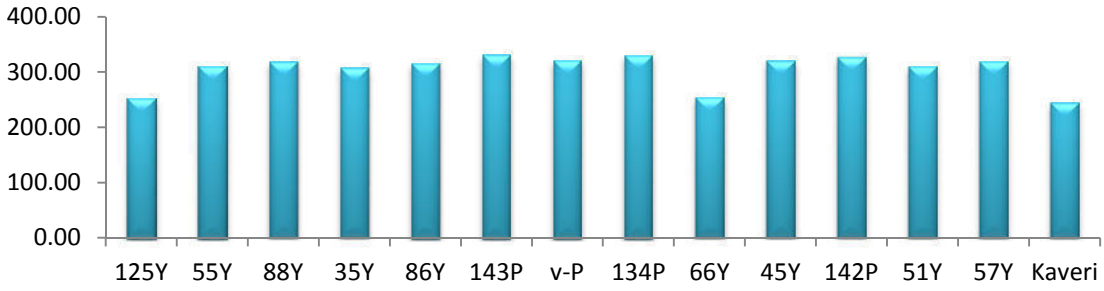


Figure 46. First Fruiting (days) of Passion Fruit Accessions



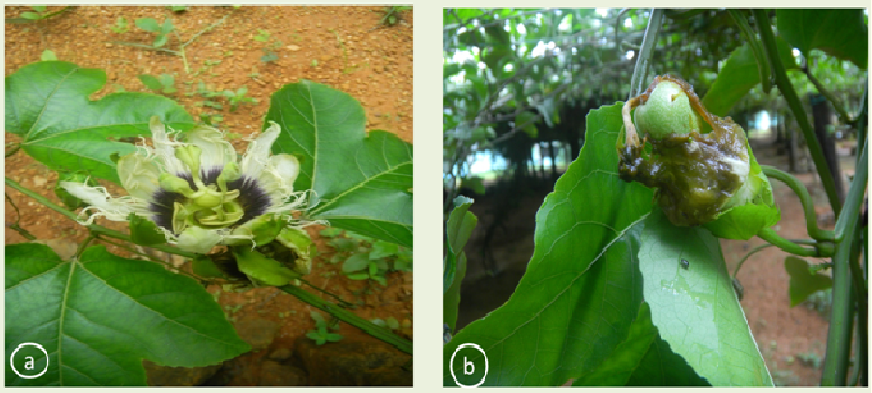


Figure 47. Accession Kaveri - Flowering (a) & Fruiting (b)

5. Number of Flowers

Number of flowers was observed from the date of first flowering. Monthly status of flowers is compared below. Also the individual accessions showed certain peaks in their flowering season.

The flowering peaks were observed mostly in the month of June. The flowers set in high numbers for Kaveri followed by 51Y. Least number of flowers was observed in 143P, 45Y and VP.

143P and 142P exhibited very short flowering season indicated by sharp peaks. 51Y, 57Y, 35Y, 134P, 66Y and 45Y showed long flowering season indicated by flat curve. In general flowering peaked during

June and most of the types showed only one peak while VP, 66Y, 45Y and 57Y showed double peaks. 57Y and 66Y showed two peaks one being a minor one.

Table 42: Monthly Flower Production in Passion Fruit Types (number/plant)

Types	*March*	*Apr*	*May*	*June*	*July*	*Aug*	*Sep*	*Oct*	*Nov*	*Annual flower prodn*	*Annual flower prodn (number/ plot)*
125Y	01.08	06.50	14.00	18.50	19.42	02.50	01.50	00.08	00.00	063.58	254.33
55Y	01.93	07.33	19.94	14.08	08.14	02.50	00.00	00.00	00.00	053.92	215.71
88Y	00.92	10.42	25.44	24.83	11.50	00.75	00.12	00.00	00.00	073.98	295.91
35Y	00.17	05.17	14.22	17.25	08.75	01.75	00.00	00.00	00.00	047.31	189.23
86Y	00.00	04.58	32.61	18.92	04.42	01.05	00.21	00.00	00.00	061.79	247.81
143P	00.00	01.67	01.75	16.62	03.50	00.71	01.13	00.00	00.00	025.38	102.19
VP	00.00	00.25	00.42	10.37	03.92	08.00	03.50	02.03	00.25	028.49	115.28
134P	01.22	02.44	03.89	07.67	18.33	07.11	01.33	02.11	00.33	044.11	177.72
66Y	02.22	05.92	04.61	12.67	07.98	05.17	00.89	00.00	00.00	039.46	157.80
45Y	00.83	01.53	07.33	04.14	08.47	04.17	00.26	00.26	00.00	026.99	107.89
142P	01.78	04.00	08.00	18.33	31.67	15.00	06.00	00.18	00.00	084.96	339.92
51Y	05.58	25.00	33.78	15.53	05.65	05.50	02.42	00.00	00.00	093.46	373.81
57Y	00.00	04.17	11.14	30.92	12.00	14.42	01.75	00.00	00.00	074.40	298.23
Kaveri	00.00	00.00	00.17	10.31	31.06	38.00	16.36	04.25	00.17	100.32	401.56
Mean	01.12	05.64	12.66	15.72	12.49	07.62	02.53	00.63	00.05	58.50	234.10
SEM	00.274	00.487	00.847	00.567	00.375	00.363	00.158			01.475	00.899
CD	00.797	01.417	02.463	01.648	01.090	01.055	00.459			04.207	17.149
CV%	38.848	15.643	12.065	06.826	06.226	09.99	12.474			04.365	04.365

Figure 48. Monthly Flower Production in Passion Fruit Accessions (number/plant)

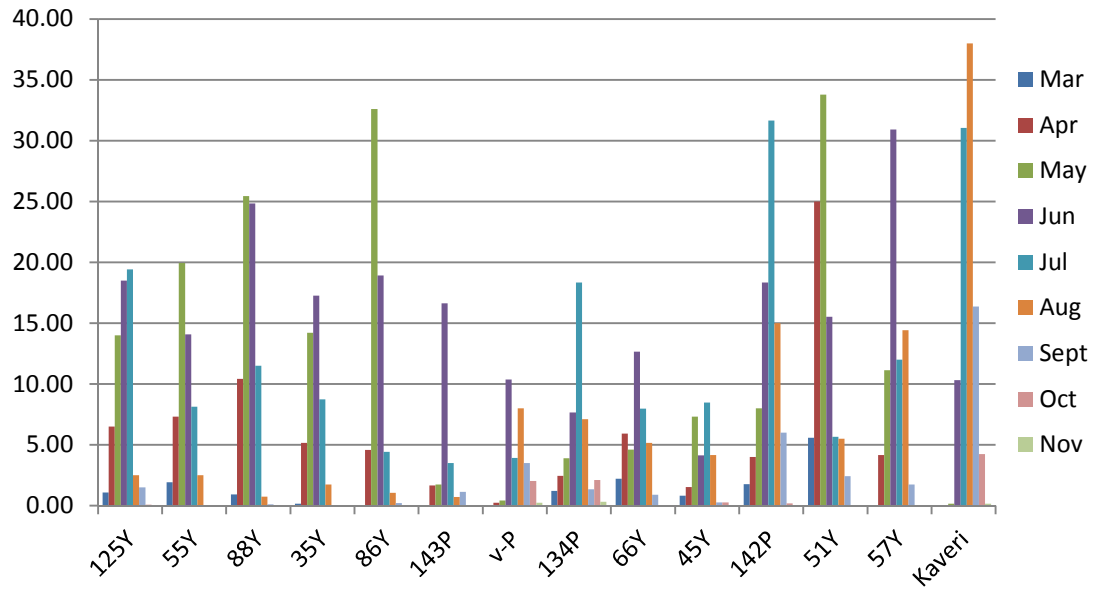
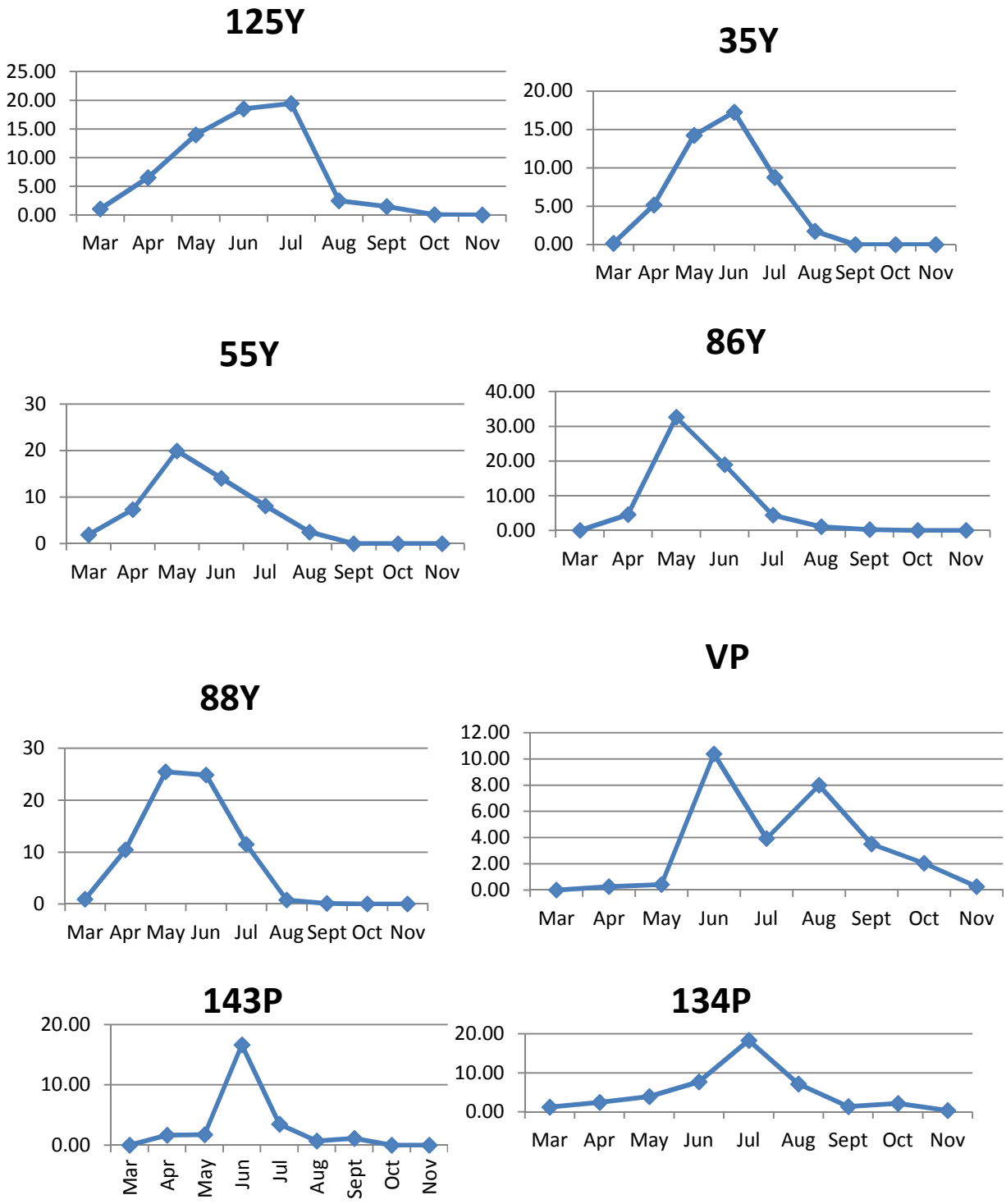


Figure 49. Blooming Pattern of Passion Fruit Types (number/plant/month)



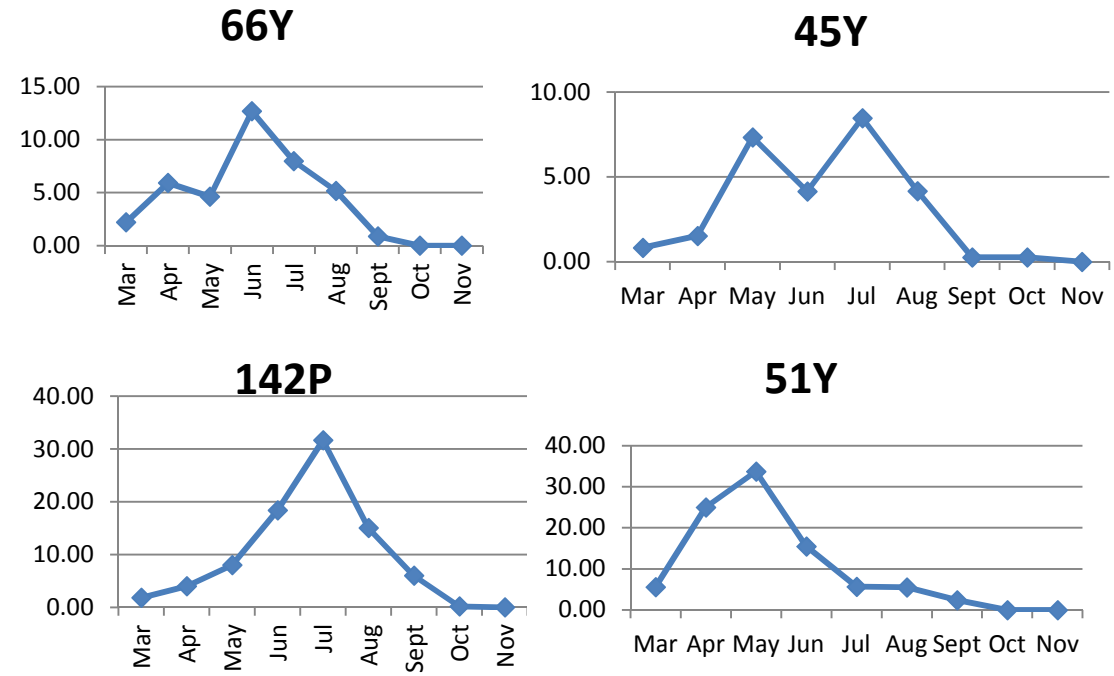


Figure 50. Mean Monthly Flower Production (number/plant)

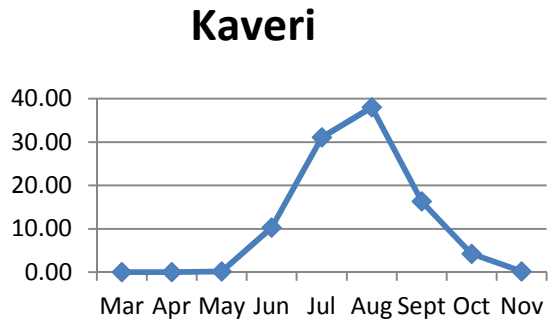
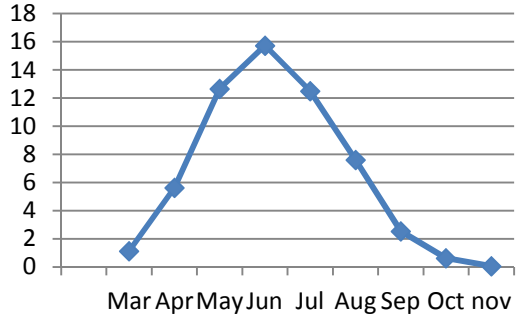


Figure 51. Annual Flower Production in Passion FruitAccessions (number/plant)



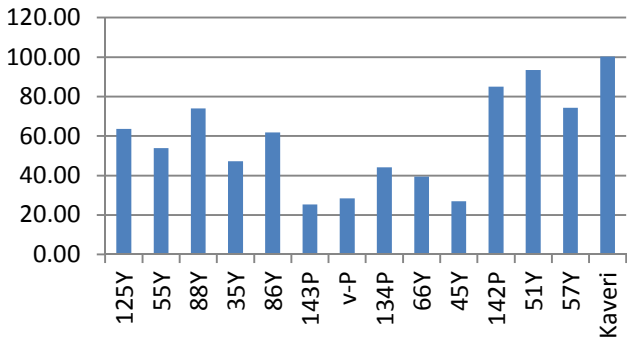


Figure 52. Flower of Purple Passion Fruit

Figure 53. Flower of Yellow Passion Fruit

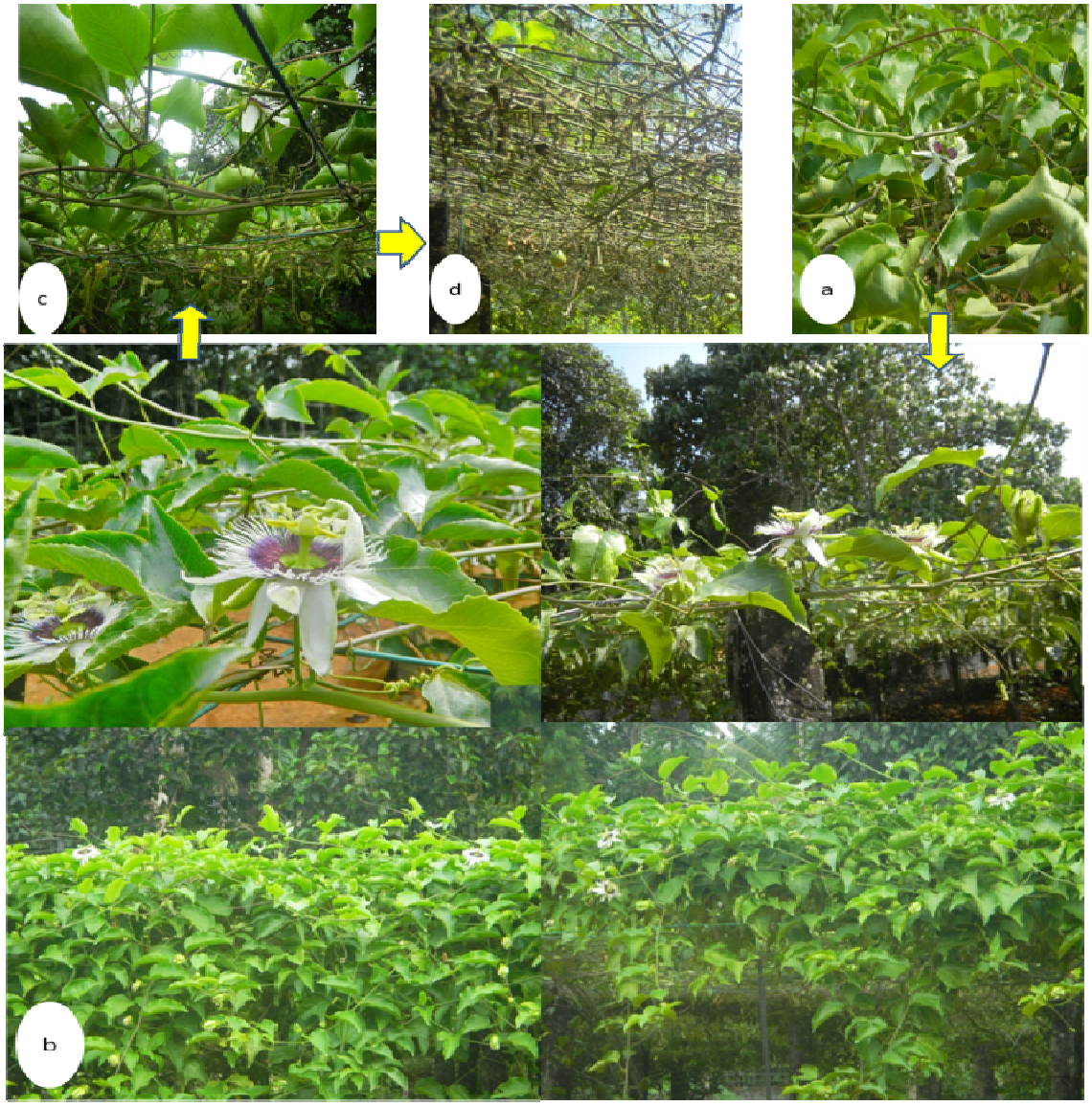


Figure 54. Stages Of Flowering: (a) Initial Flowering (b) Gradually proceeds to peak flowering (c) Flowering lowers (d) End of the season

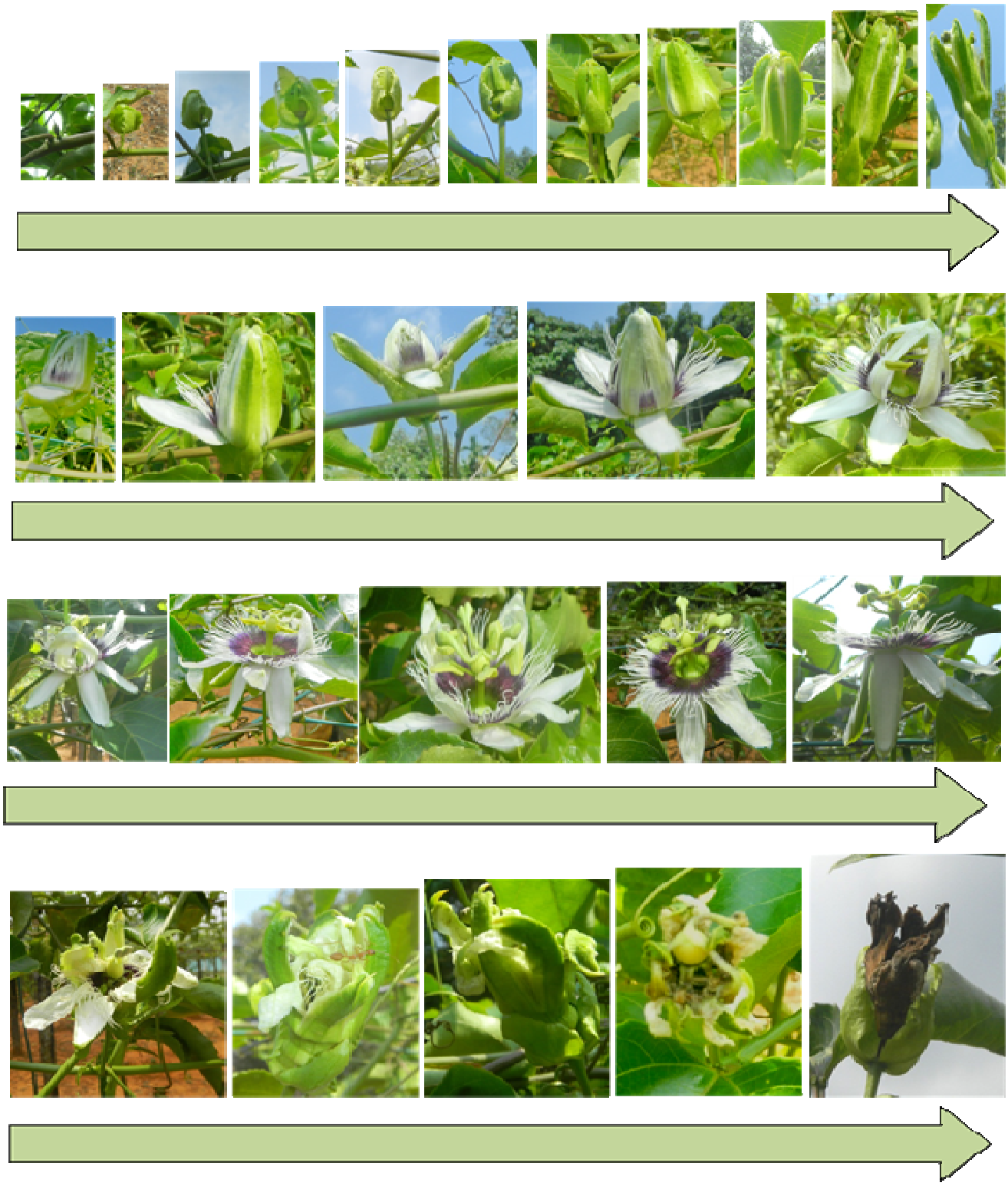


Figure 55. Stages of Passion Fruit Blooming from Bud to Withering (12-15 days)

7. Passion Fruit Harvest

Number of passion fruits harvested was obtained at the time of harvest. The period of July- August showed good harvest season. 142P topped the one with highest number of fruits harvested followed by Kaveri and 134P. The lowest fruit number was for 86Y followed by 35Y. All other accessions were in between them.

The harvest duration was from May to December. Single harvest peak in number of fruits was observed for 86Y, 134P, 45Y, 142P and Kaveri. Some among the accessions showed double peaks. The types 55Y, 88Y, 35Y, 66Y and 51Y showed double peaks with one being a minor one depicting two harvesting season with one for a long period and another for a shorter period. In case of 143P and 57Y the double peaks were of same height and hence be concluded for having same period of harvesting season. 125Y showed a flat curve showing the same harvest for two consecutive months. Prolonged harvest season was found in 143P. Fruiting season was from 20th May to 15 th December 2013.

Table 43: Monthly Fruits Production of Passion Fruit Types (number/plot)

Types	*May*	*June*	*July*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual fruits prodn*	*Annual fruits prodn (no/plant)*
125Y	03.00	08.00	32.33	32.33	05.00	00.33	00.00	00.00	81.00	20.25
55Y	01.00	01.67	43.00	04.00	12.33	03.67	00.00	00.00	065.67	16.42
88Y	00.67	00.33	16.33	03.67	02.33	05.33	00.00	00.00	028.67	07.17
35Y	00.00	00.33	06.33	02.67	00.33	03.00	00.00	00.00	012.67	03.17
86Y	00.00	00.00	11.00	01.33	00.00	00.00	00.00	00.00	012.33	03.08
143P	00.00	02.33	05.00	08.00	03.00	07.33	00.33	00.00	026.00	06.50
VP	00.00	00.00	01.33	02.67	09.00	07.00	03.00	03.33	026.33	06.58
134P	02.33	01.33	05.67	23.67	42.33	21.33	00.00	00.67	097.33	24.33
66Y	02.67	00.67	21.67	03.67	03.67	05.00	00.00	00.00	037.33	09.33
45Y	00.00	00.67	06.67	15.33	22.00	12.00	00.00	00.00	056.67	14.17
142P	00.00	00.67	00.67	42.33	62.67	32.00	00.00	00.00	138.33	34.58
51Y	00.00	00.67	13.00	02.67	04.33	03.33	00.00	00.00	024.00	06.00
57Y	00.00	00.33	03.67	15.33	13.67	15.00	00.00	00.00	048.00	12.00
Kaveri	00.00	00.00	00.00	23.00	31.67	50.67	05.67	02.33	113.33	28.33
Mean	00.69	01.21	11.90	12.90	15.17	11.86	00.64	00.45	054.83	13.71
SEM									19.179	04.795
CD									55.750	13.938

Figure 56. Monthly Fruit Production in Passion Fruit Accessions (number/plot)

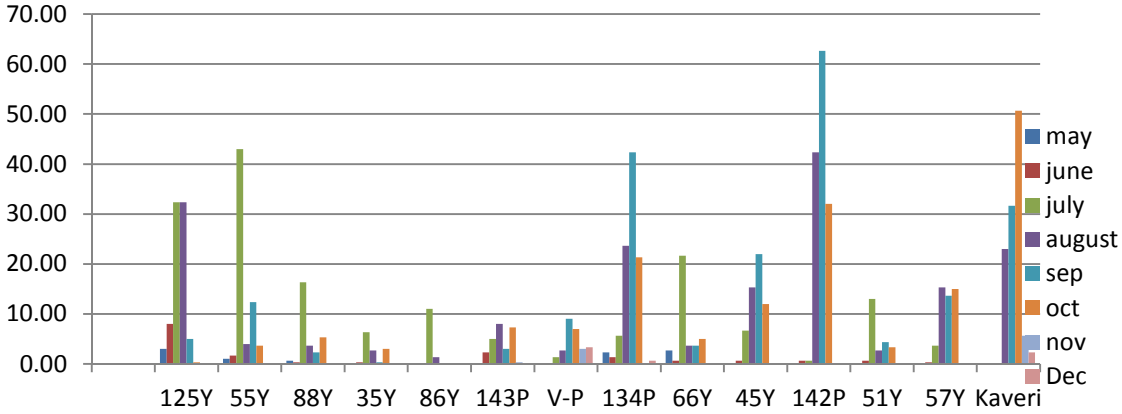


Figure 57. Annual Fruit production in Passion Fruit Accessions (number/plot)

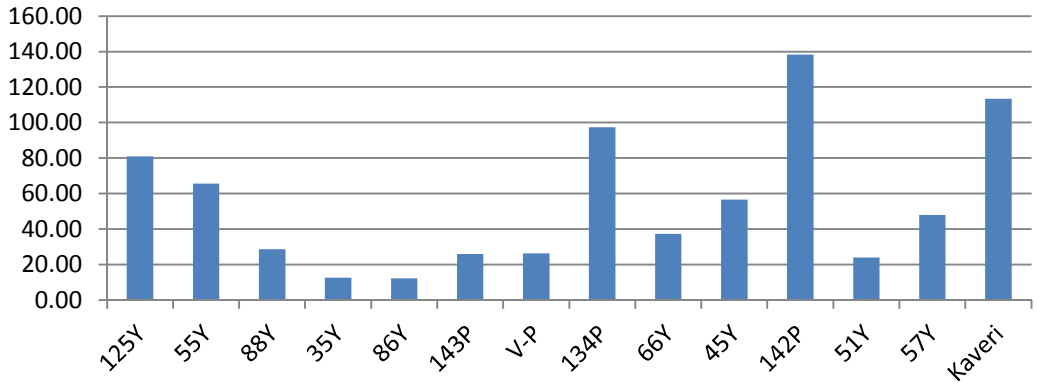
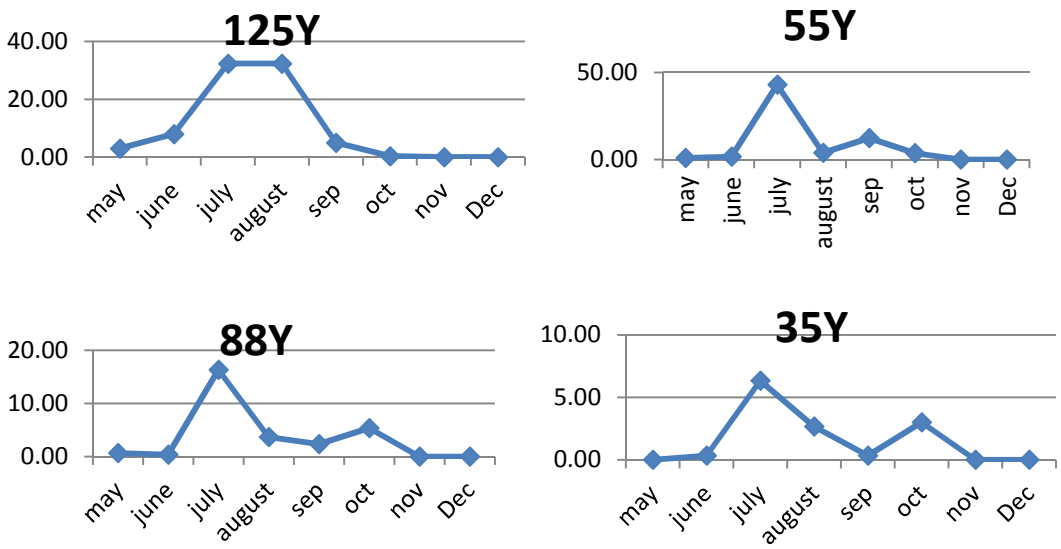
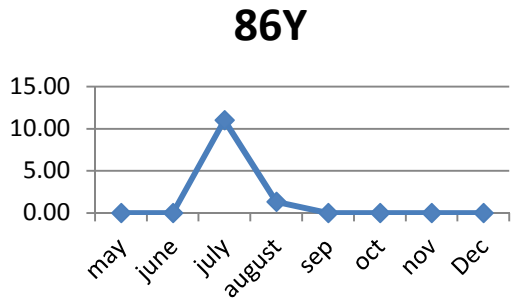


Figure 58. Monthly Passion Fruit Production (number/plot)

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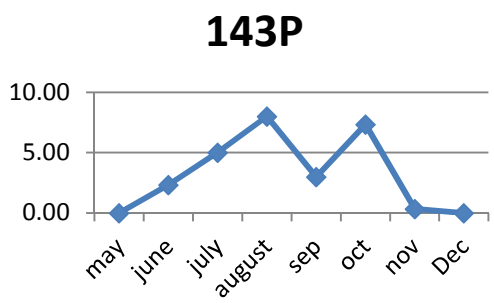
5.00
0.00
may
june
july
august
sep
oct
nov
Dec


143P
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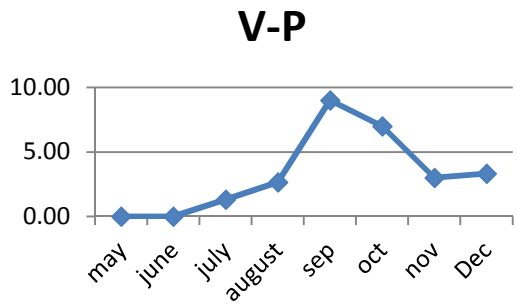
0.00
may
june
july
august
sep
oct
nov
Dec


V-P
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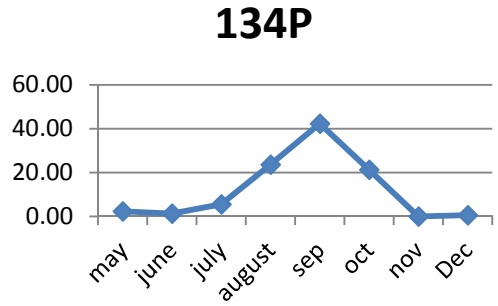
5.00
0.00
may
june
july
august
sep
oct
nov
Dec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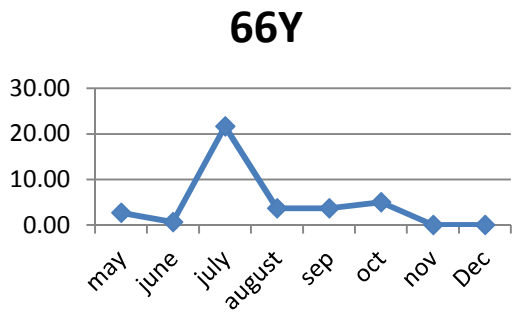
40.00
20.00
0.00
may
june
july
august
sep
oct
nov
Dec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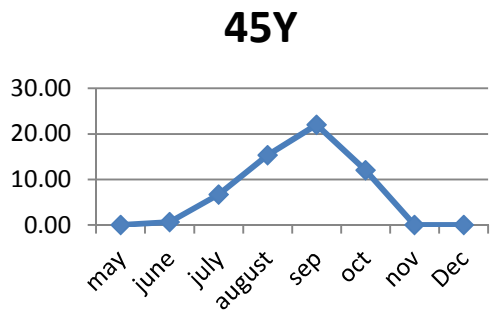
june
july
august
sep
oct
nov
Dec


45Y
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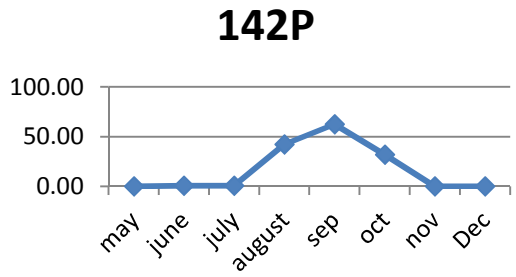
20.00
10.00
0.00
may
june
july
august
sep
oct
nov
Dec


142P
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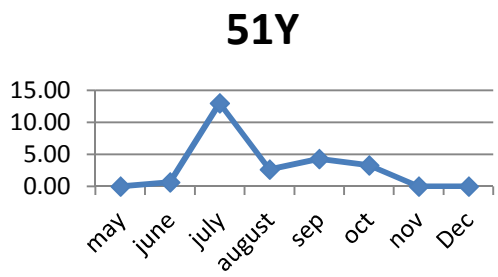
july
august
sep
oct
nov
Dec


51Y
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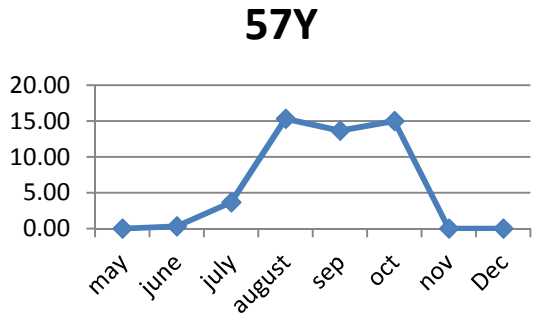
5.00
0.00
may
june
july
august
sep
oct
nov
Dec


57Y
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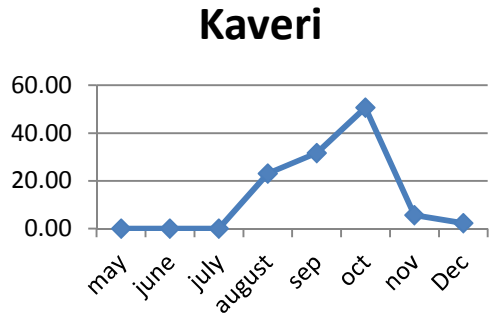
15.00
10.00
5.00
0.00
may
june
july
august
sep
oct
nov
Dec


Kaveri
60.00
40.00
20.00
0.00
may
june
july
august
sep
oct
nov
Dec

8. Passion Fruit Yield

Weight of fruits harvested was observed at the time of harvest. Total weight of the fruits was at the epitome level in the month of August. 142P was the one with increased total weight of fruits per plot. This was followed by Kaveri and 134P. The fruits number and weight were dependent on each other and directly proportional.

When the monthly weight of fruits harvested was analysed the harvesting peaks were almost the same with the number of fruits harvested with slight differences in case of 143P showing one minor peak of harvest and 125Y showing a sharp peak. Kaveri and 143P showed a prolonged harvest season.

Table 44: Monthly Passion Fruit Production (g/plot)

Types	*May (g)*	*June (g)*	*July (g)*	*Aug (g)*	*Sep (g)*	*Oct (g)*	*Nov (g)*	*Dec (g)*	*Annual Fruits prodn (g/plot)*	*Annual fruits prodn (g/plant)*
125Y	238.50	809.33	2832.67	2076.17	0469.33	0034.17	000.00	000.00	06460.17	1615.04
55Y	046.17	132.00	1220.17	0309.67	1464.83	0298.00	000.00	000.00	03470.83	0867.71
88Y	043.50	021.50	1051.33	0363.33	0109.67	0296.17	000.00	000.00	01885.50	0471.38
35Y	000.00	018.33	0367.67	0211.33	0009.17	0134.50	000.00	000.00	00741.00	0185.25
86Y	000.00	000.00	0745.17	0072.50	0000.00	0000.00	000.00	000.00	00817.67	0204.42
143P	000.00	193.50	0385.17	0774.33	0265.67	0529.17	035.67	000.00	02183.50	0545.88
VP	000.00	000.00	0125.33	0245.67	0856.67	0551.83	287.17	188.83	02255.50	0563.88
134P	102.50	126.33	0584.67	2005.00	4677.33	2127.00	000.00	051.17	09674.00	2418.50
66Y	153.67	060.33	2051.67	0252.50	0352.17	0469.17	000.00	000.00	03339.50	0834.88
45Y	000.00	025.17	0196.50	1537.83	1755.33	0953.33	000.00	000.00	04468.17	1117.04
142P	000.00	048.67	0066.00	3629.50	6130.50	2732.00	000.00	000.00	12606.67	3151.67
51Y	000.00	053.00	0901.33	0190.33	0577.50	0260.17	000.00	000.00	01982.33	0495.58
57Y	000.00	022.00	0426.33	1339.33	0836.17	1247.33	000.00	000.00	03871.17	0967.79
Kaveri	000.00	000.00	0000.00	1701.67	2545.50	6041.50	183.83	144.33	10616.83	2654.21
Mean	0041.74	107.87	0782.43	1050.65	1432.13	1119.60	036.19	027.45	04598.06	1149.51

Figure 59. Monthly Fruit Production in Passion Fruit Accessions (g/plot)

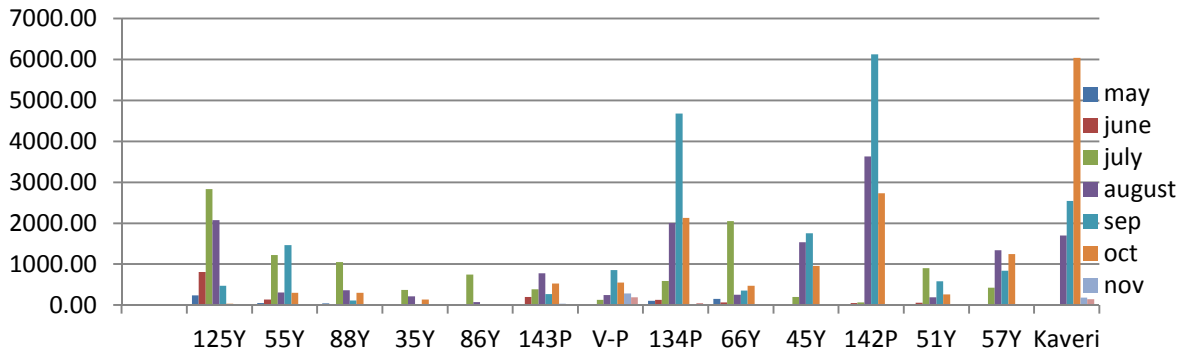


Figure 60. Annual Fruit Production in Passion Fruit Accessions (g/plot)

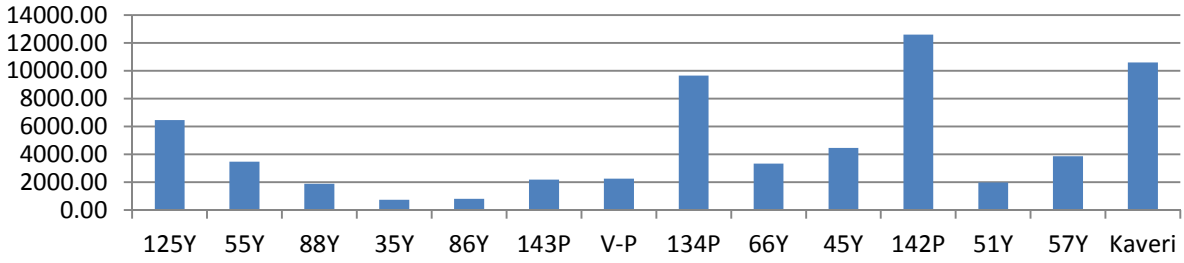
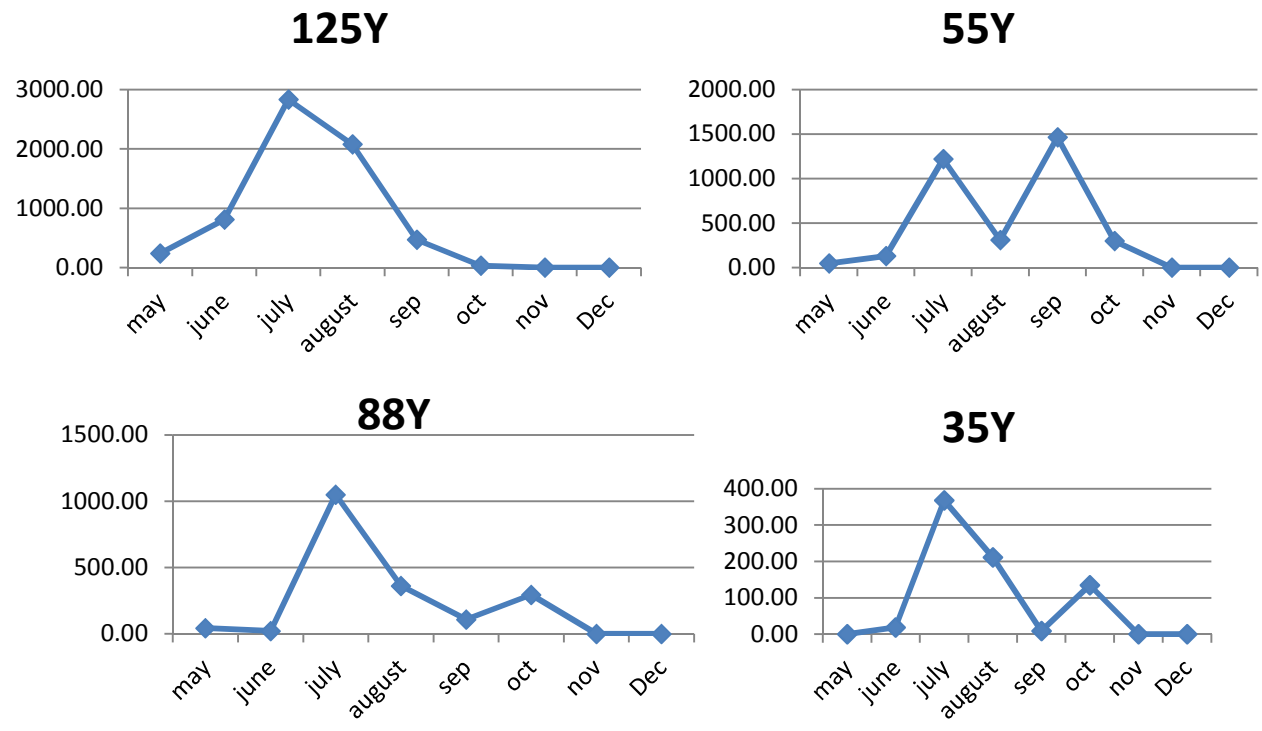
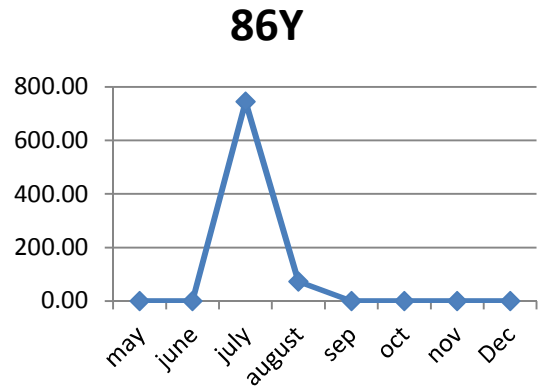


Figure 61. Monthly Passion Fruit Production (g/plot)

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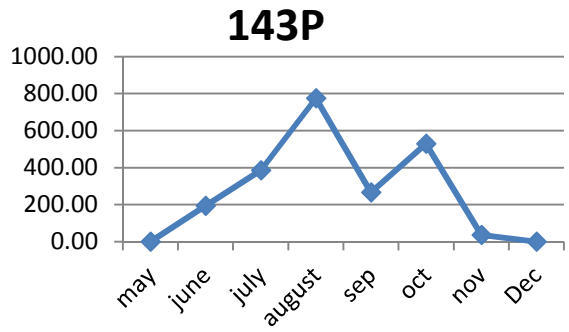
600.00
400.00
200.00
0.00
may
june
july
august
sep
oct
nov
Dec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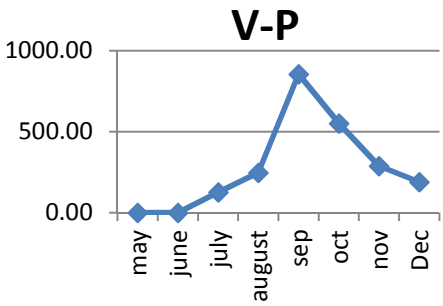
600.00
400.00
200.00
0.00
may
june
july
august
sep
oct
nov
Dec


V-P
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500.00
0.00
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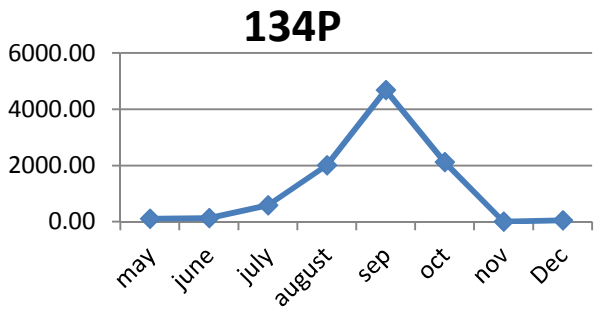
nov
Dec


134P
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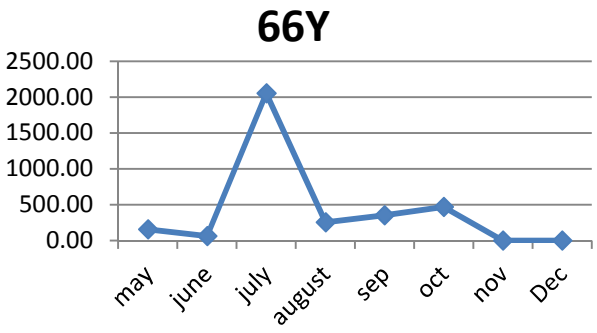
2000.00
0.00
may
june
july
august
sep
oct
nov
Dec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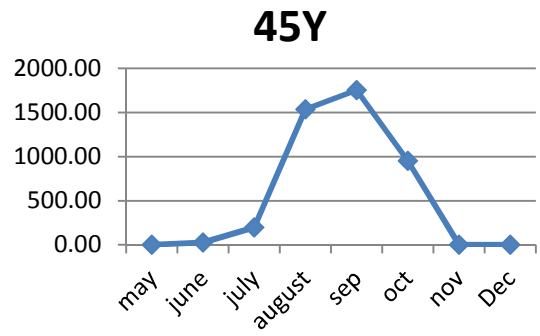
Dec


45Y
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0.00
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july
august
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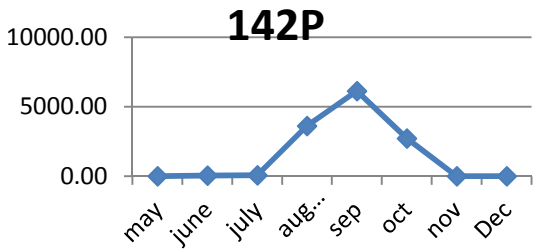
Dec


142P
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0.00
may
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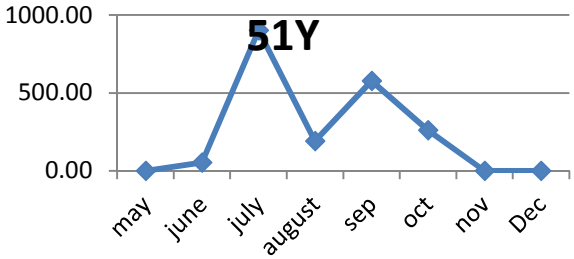
sep
oct
nov
Dec


51Y
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500.00
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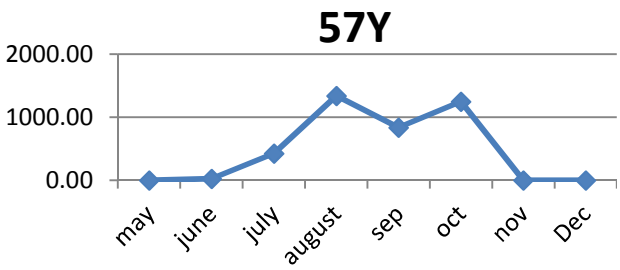
sep
oct
nov
Dec


57Y
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may
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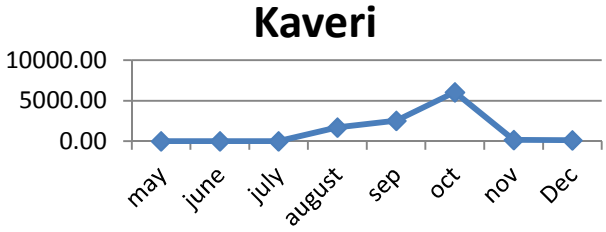
sep
oct
nov
Dec


Kaveri
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august
sep
oct
nov
Dec

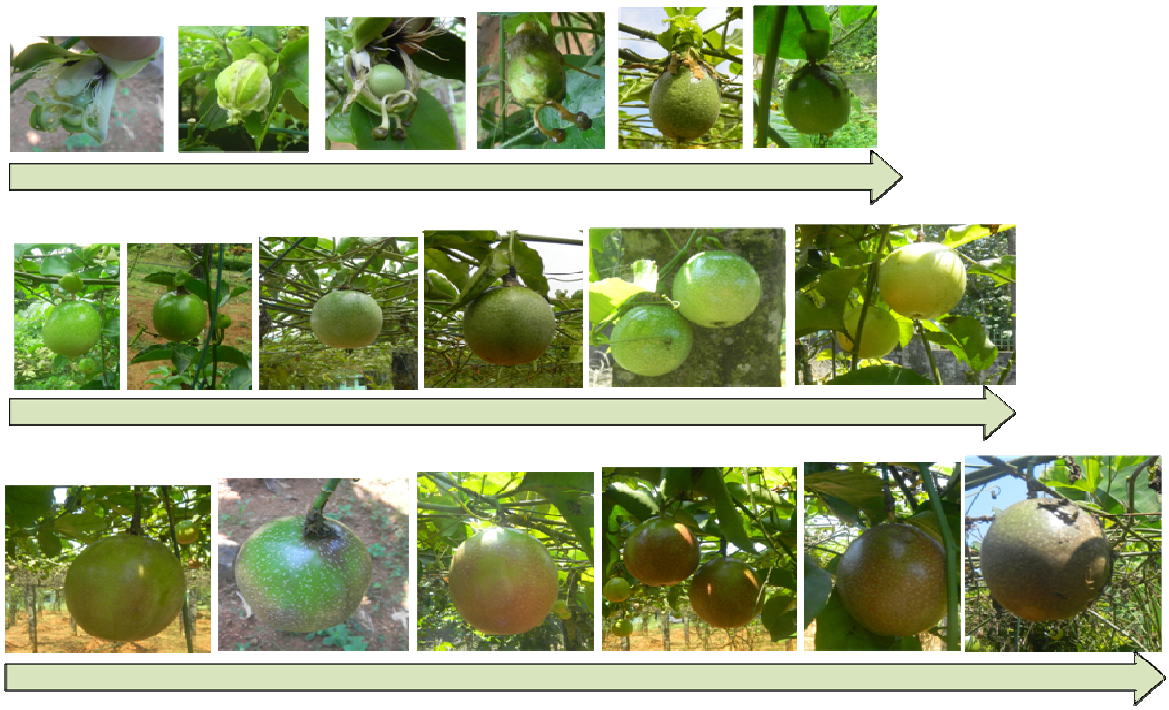


Figure 62. Stages of Fruit Initiation to Ripening (60-65 days)

Figure 63. Stages of Fruiting from Initial fruiting to peak fruiting and End of the Season

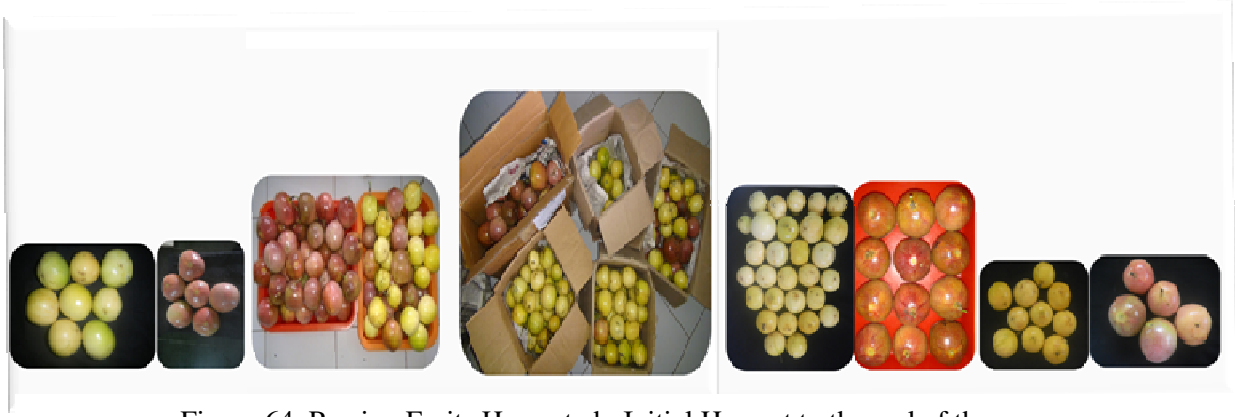


Figure 64. Passion Fruits Harvested : Initial Harvest to the end of the season

9. Post-harvest handling

The harvested fruits are sorted at the lab for each accession specifically. The fruits are observed for its phytochemical characters, qualitative characters, sugar content, yield content and consumer acceptability. As the preliminary step, the fruits were sectioned and the pulp scooped out. The pulp is analyzed for the sensory evaluation. With a clean plastic net with small pore size the pulp squeezed for the juice content. The juice is further used for the detailed phytochemical evaluation. The protocol for all the stages of fruit and juice analysis was standardized and carried out.

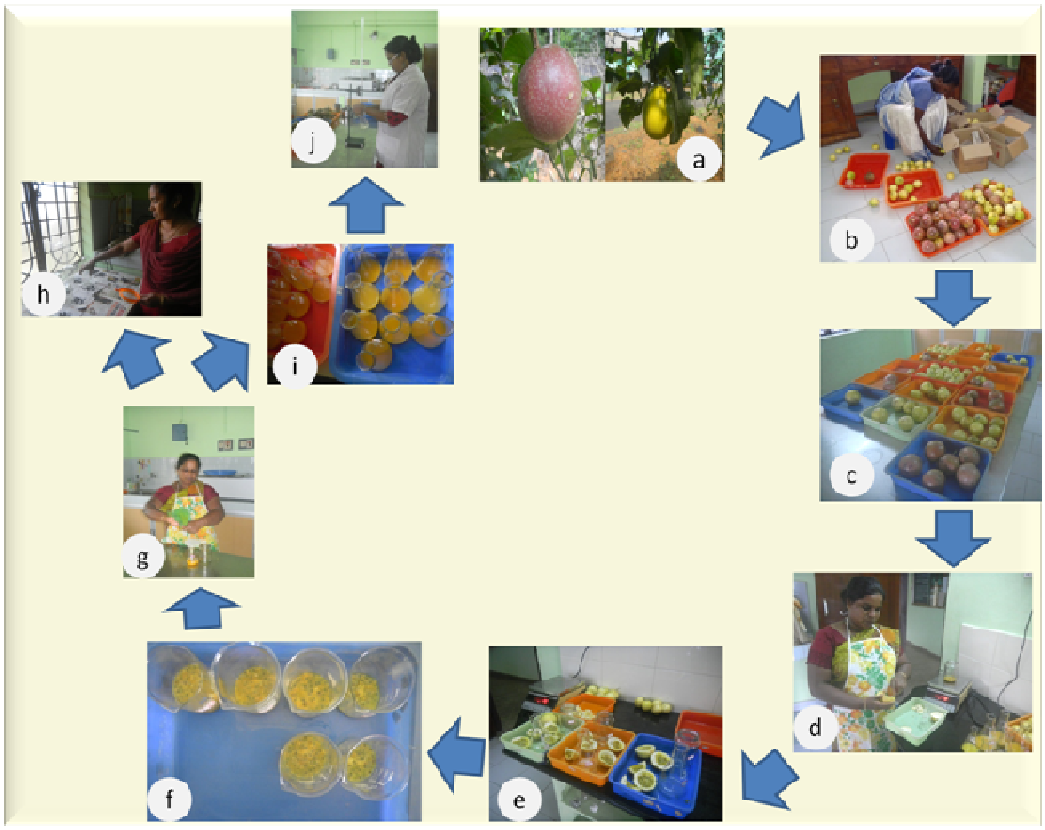


Figure 65. Passion Fruit Analysis: (a) Fruits ready for harvest (b) Fruits sorting (c) Fruits sorted (d) Fruit sectioning (e) Fruit Sectioned (f) Pulp Separated (g) Passion fruit pulp extraction (h) Passion Fruit Seeds kept for Drying (i) Juice Ready for analysis (j) Phytochemical Analysis of the Juice Sample

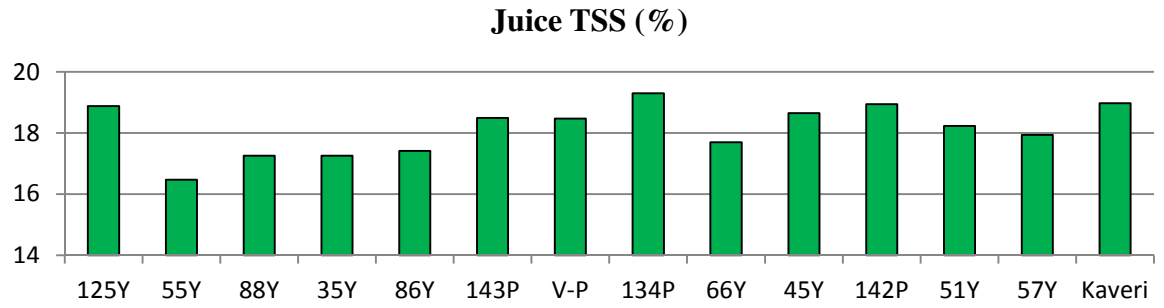
9.1. Quality Characters

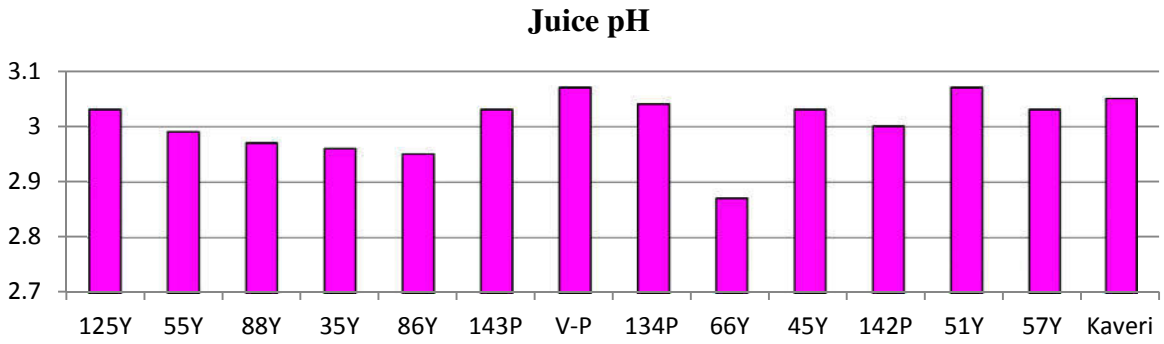
The character analysed included TSS, pH, Reducing Sugar, Non Reducing Sugar, Total Sugar, Ascorbic Acid, Starch and Acidity.

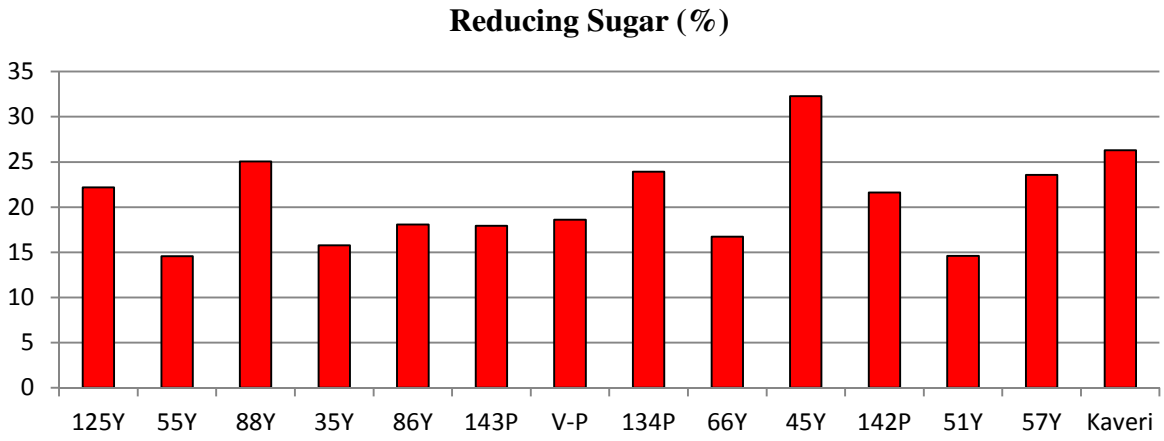
TSS was observed lowest for 55Y and is statistically distinct with others. The highest TSS was obtained for 134P, Kaveri, 142P, 125Y and 45Y. They were statistically on par and others TSS were in between them. The pH was the lowest in case of 66Y showing it as more acidic in nature and is statistically distinct. The high pH was observed for VP, 51Y, Kaveri, 134P, 45Y, 143P, 57Y and 125Y and was statistically on par. Reducing sugar was the least in 55Y, 51Y and 35Y and was statistically on par. The type 45Y was obtained with high amount of reducing sugar and is statistically distinct. 55Y also obtained lower non reducing and total sugar values. While 88Y and 142P showed greater amount of non reducing sugar and were statistically on par. 45Y and 88Y showed higher Total Sugar content. Ascorbic acid was lowest for 57Y, 35Y, 66Y and 55Y. 51Y showed the highest amount of Ascorbic acid and is statistically distinct with others. Starch content was in high amounts for 86Y, VP and 142P and was statistically on par compared with others. Lower acidity was observed for Kaveri, 125Y and 134P and was statistically on par comparing with other types. 35Y, 66Y, 86Y and 88Y were having high acidity.

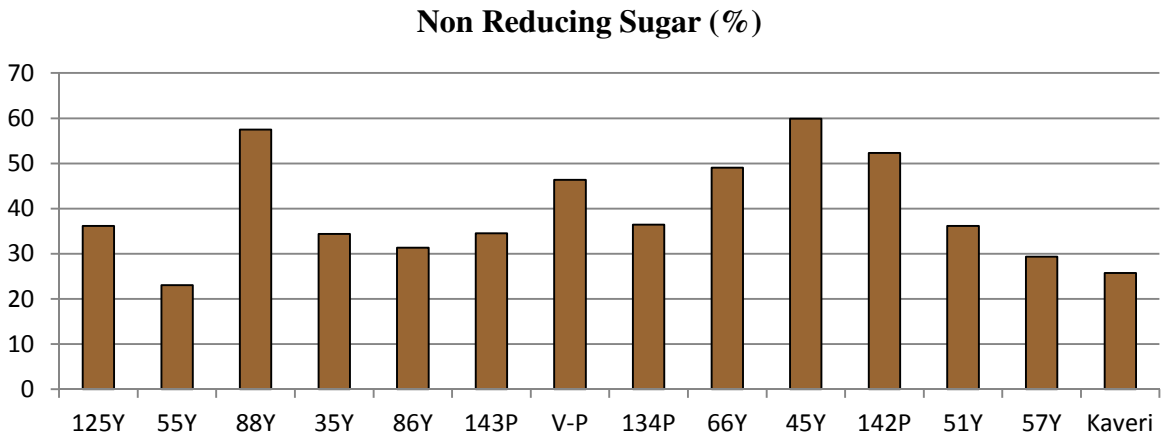
Table 45: Quality Characteristics of Passion Fruit Accessions

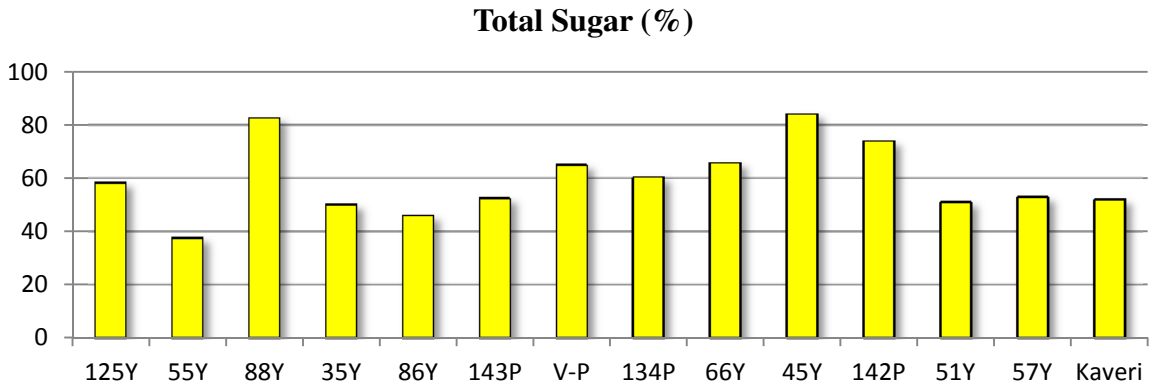
Accessions	*TSS (%)*	*pH*	*Reducing Sugar (%)*	*Non Reducing Sugar(%)*	*Total Sugar (%)*	*Ascorbic Acid (mg/100g)*	*Starch (mg/100g)*	*Acidity (%)*
125Y	18.88	3.03	22.20	36.15	58.35	37.27	0.08	0.42
55Y	16.47	2.99	14.57	23.08	37.65	32.22	0.08	0.55
88Y	17.26	2.97	25.04	57.48	82.53	42.99	0.11	0.61
35Y	17.26	2.96	15.77	34.42	50.19	30.30	0.08	0.62
86Y	17.41	2.95	18.09	31.33	46.06	39.39	0.17	0.62
143P	18.49	3.03	17.93	34.53	52.45	36.14	0.06	0.49
VP	18.47	3.07	18.59	46.38	64.97	42.38	0.16	0.48
134P	19.3	3.04	23.91	36.44	60.35	37.54	0.10	0.43
66Y	17.7	2.87	16.73	49.09	65.82	30.81	0.12	0.62
45Y	18.65	3.03	32.27	59.9	84.18	35.85	0.08	0.49
142P	18.94	3.00	21.62	52.34	73.96	37.37	0.14	0.48
51Y	18.23	3.07	14.6	36.16	50.96	56.26	0.09	0.56
57Y	17.94	3.03	23.56	29.36	52.93	29.32	0.08	0.52
Kaveri	18.98	3.05	26.30	25.77	52.07	32.57	0.07	0.40
Mean	18.14	3.01	20.80	39.46	59.46	37.17	0.10	0.52
SEM	0.251	0.024	0.932	1.783	1.916	1.792	00.012	0.017
CD	0.730	0.069	2.709	5.184	5.571	5.209	00.036	0.051
CV%	2.406	1.359	7.760	7.942	5.583	8.350	021.32	5.765

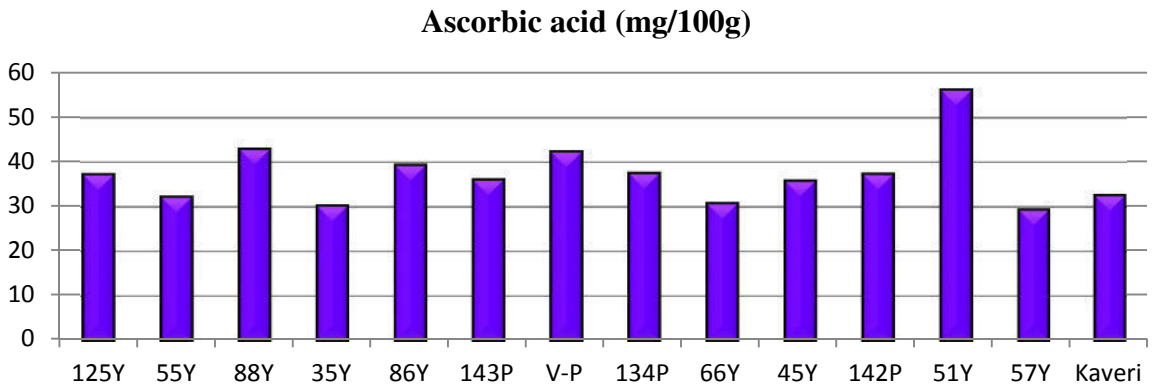

Juice TSS (%)
20
18
16
14
125Y 55Y 88Y 35Y 86Y 143P V-P 134P 66Y 45Y 142P 51Y 57Y Kaveri

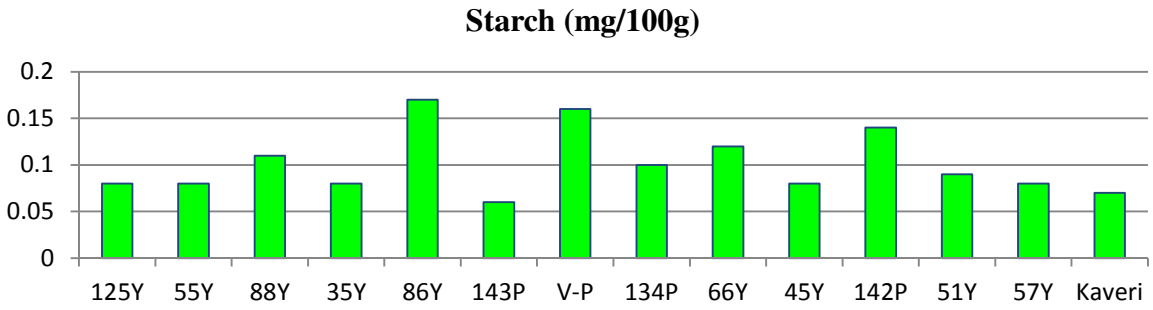

Juice pH
3.1
3
2.9
2.8
2.7
125Y 55Y 88Y 35Y 86Y 143P V-P 134P 66Y 45Y 142P 51Y 57Y Kaveri


Reducing Sugar (%)
35
30
25
20
15
10
5
0
125Y 55Y 88Y 35Y 86Y 143P V-P 134P 66Y 45Y 142P 51Y 57Y Kaveri


Non Reducing Sugar (%)
70
60
50
40
30
20
10
0
125Y 55Y 88Y 35Y 86Y 143P V-P 134P 66Y 45Y 142P 51Y 57Y Kaveri







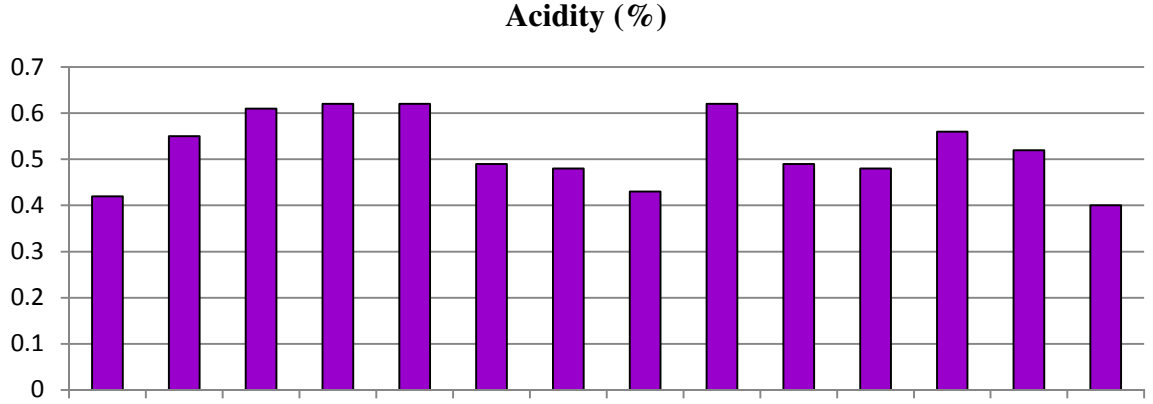


Figure 66. Quality Characteristics of Passion Fruit Accessions

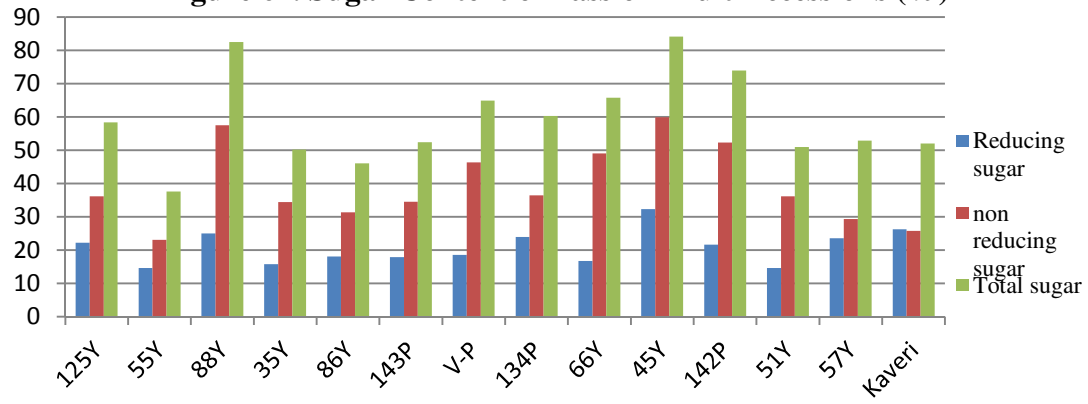
9.2. Sugar Content

The total sugar content of every fruit is a stand out parameter from others because of its significance both in a common man's view point and in scientific community. 45Y showed the best in total sugar content of the fruit and 55Y the last one in sugar content.

Table 46: Sugar Content In Passion Fruit Accessions (%)

Sl.No.	Accessions	Reducing Sugar(%)	Non Reducing Sugar(%)	Total Sugar(%)
1	125Y	22.20	36.15	58.35
2	55Y	14.57	23.08	37.65
3	88Y	25.04	57.48	82.53
4	35Y	15.77	34.42	50.19
5	86Y	18.09	31.33	46.06
6	143P	17.93	34.53	52.45
7	VP	18.59	46.38	64.97
8	134P	23.91	36.44	60.35
9	66Y	16.73	49.09	65.82
10	45Y	32.27	59.90	84.18
11	142P	21.62	52.34	73.96
12	51Y	14.60	36.16	50.96
13	57Y	23.56	29.36	52.93
14	Kaveri	26.30	25.77	52.07
Mean		20.80	39.46	59.46
SEM		0.932	1.783	1.916
CD		2.709	5.184	5.571
CV%		7.760	7.942	5.583

Figure 67. Sugar Content of Passion Fruit Accessions (%)



9.3. Yield Characters

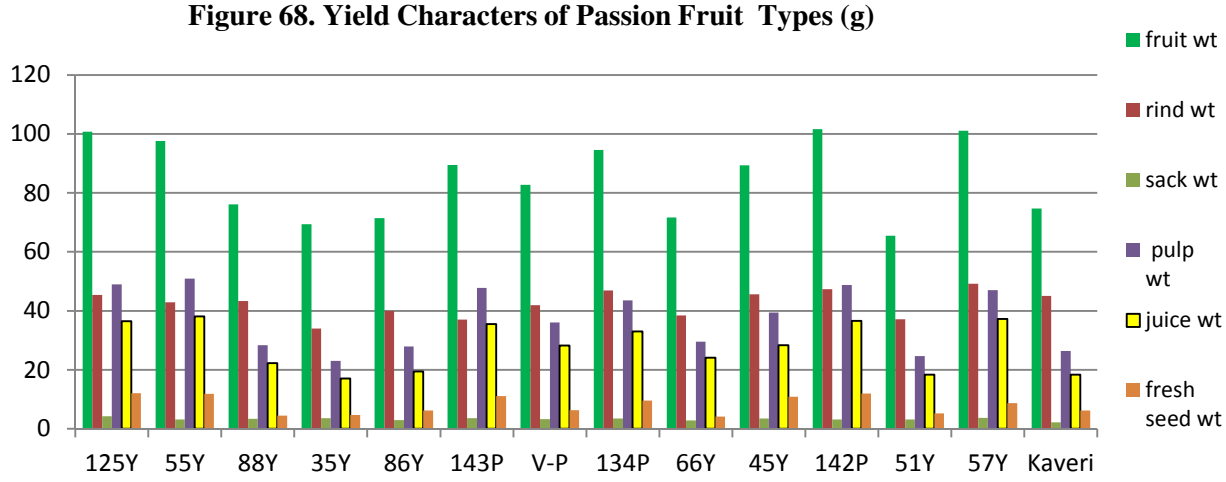
The yield characters included fruit weight, rind weight, sack weight, pulp weight, juice weight and fresh seed weight.

The best fruit must be of increased fruit weight with high pulp content and juice content and low rind weight, sack weight and seed weight. The fruit weight, rind weight and juice weight was at the top level for 142P. 35Y was of the lowest in the weight and 57Y the one high in rind weight. 35Y was the lowest in juice weight.

Table 47: Yield Characteristics of Passion Fruit Types (g)

Accessions	Fruit Weight (g)	Rind Weight (g)	Sack Weight (g)	Pulp Weight (g)	Juice Weight (g)	Fresh Seed Weight (g)
125Y	100.75	45.40	4.32	48.95	36.50	12.11
55Y	097.57	42.90	3.18	50.91	38.09	11.82
88Y	076.11	43.36	3.46	28.37	22.32	04.49
35Y	069.41	33.97	3.57	23.00	17.12	04.68
86Y	071.40	39.94	2.93	27.91	19.48	06.26
143P	089.48	37.10	3.60	47.78	35.58	11.09
VP	082.75	41.95	3.27	36.03	28.30	06.33
134P	094.61	46.89	3.49	43.51	33.00	09.62
66Y	071.68	38.46	2.89	29.58	24.13	04.14
45Y	089.30	45.61	3.55	39.42	28.40	10.85
142P	101.58	47.37	3.14	48.80	36.60	12.03
51Y	065.49	37.19	3.14	24.69	18.36	05.25
57Y	101.07	49.20	3.69	47.06	37.26	08.74
Kaveri	074.65	45.08	2.17	26.46	18.35	06.24
Mean	84.70	42.46	3.31	37.32	28.11	08.12
SEM	2.653	1.556	0.150	1.535	1.334	00.653
CD	7.711	4.815	0.464	4.461	3.878	01.897
CV%	5.466	6.758	8.518	7.123	8.210	13.928

Figure 68. Yield Characters of Passion Fruit Types (g)



9.4. Consumer Acceptability

The character partitioned here is juice taste, juice smell and juice consistency. These factors are significant in a consumer aspect. These are done by scoring in a range of 0-9 scale.

66Y type was observed as the deep sour one followed by 55Y. The juice taste was sweet in case of 134P followed by Kaveri, 88Y and VP. They were statistically on par and all others fell in between. In general purple fruits dominated the yellow one in juice taste. The juice colour was yellow the lowest for 142P and VP. Orange colour was observed for 86Y, 88Y, 66Y, 55Y and 57Y. They were statistically on par and all others fell in between. The juice smell was almost pleasant in all the types with only minor differences. The least pleasant was of 88Y, 35Y, 66Y, 45Y, 86Y, and 142P. The type Kaveri, 57Y and 125Y were observed with the more pleasant smell. The inconsistent juice was observed for 66Y, VP, 143P and 125Y. They were statistically on par when compared with other types. The consistent juice was observed for Kaveri which was statistically distinct from others.

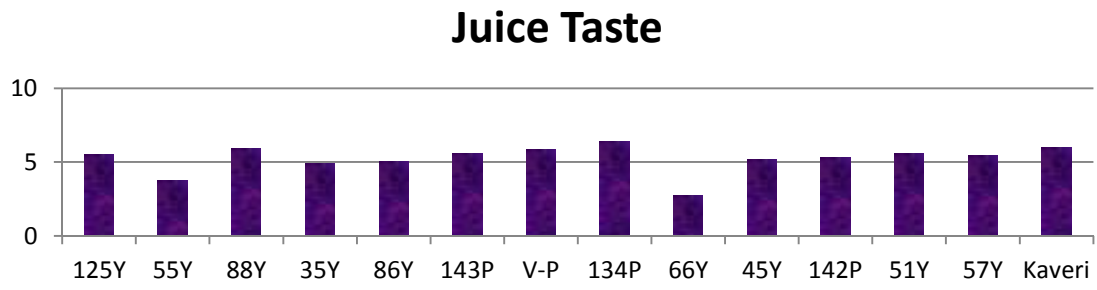
Among all the parameters of consumer acceptability of Kaveri performed well.

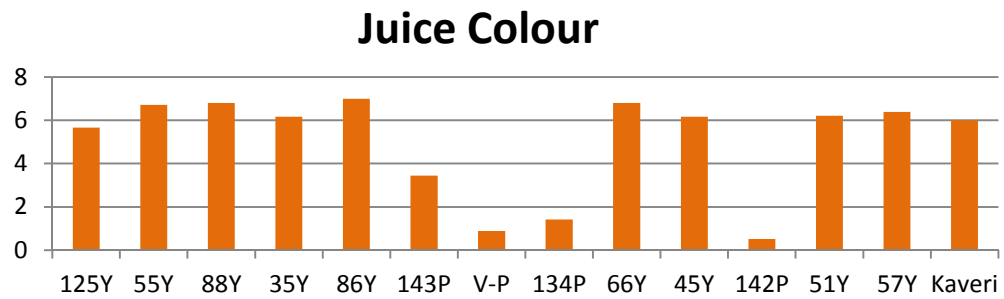
Scoring legend

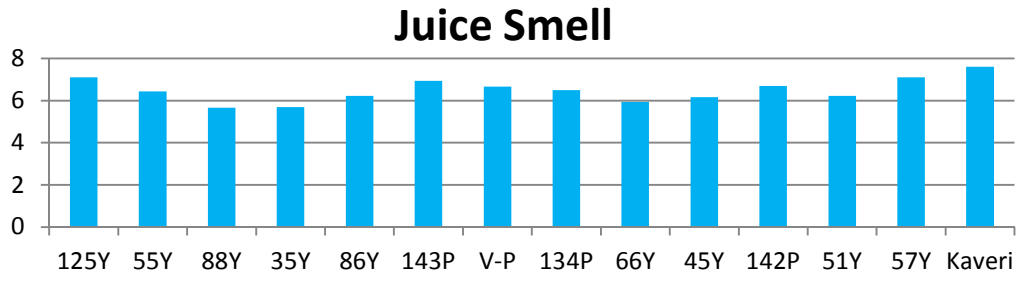
Juice taste: 0-2 deep sour;3- 4 sour; 5- not sweet or sour;6-7 sweet; 8-9 more sweet
Juice colour: 0-1 yellow; 2- 4 slight yellow; 5- not yellow not orange; 6-7 slight orange; 8-9 orange
Juice smell:0 no smell; 1-4 less pleasant; 5-8 pleasant; 9 more pleasant
Juice consistency: 0-3 inconsistent; 4-6 less consistent; 7-9 consistent

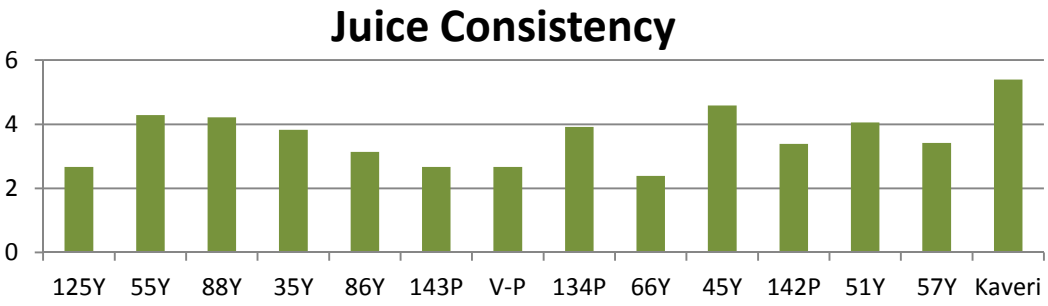
Table 48: Consumer Acceptability of Different Passion Fruit Types (0-9 scale)

Sl.No.	Accessions	Juice Taste (0-9)	Juice Colour (0-9)	Juice Smell (0-9)	Juice Consistency (0-9)
1	125Y	5.50	5.67	7.11	2.67
2	55Y	3.72	6.72	6.44	4.28
3	88Y	5.95	6.81	5.67	4.22
4	35Y	4.89	6.17	5.70	3.83
5	86Y	5.00	7.00	6.22	3.14
6	143P	5.61	3.44	6.94	2.67
7	VP	5.83	0.89	6.67	2.67
8	134P	6.42	1.42	6.50	3.92
9	66Y	2.72	6.81	5.94	2.39
10	45Y	5.17	6.17	6.17	4.58
11	142P	5.31	0.51	6.69	3.39
12	51Y	5.55	6.22	6.22	4.06
13	57Y	5.42	6.39	7.11	3.42
14	Kaveri	6.00	6.00	7.61	5.39
Mean		5.22	5.02	6.50	3.62
SEM		0.227	0.256	0.223	00.249
CD		0.660	0.743	0.663	00.723
CV%		7.536	8.817	0.658	11.805









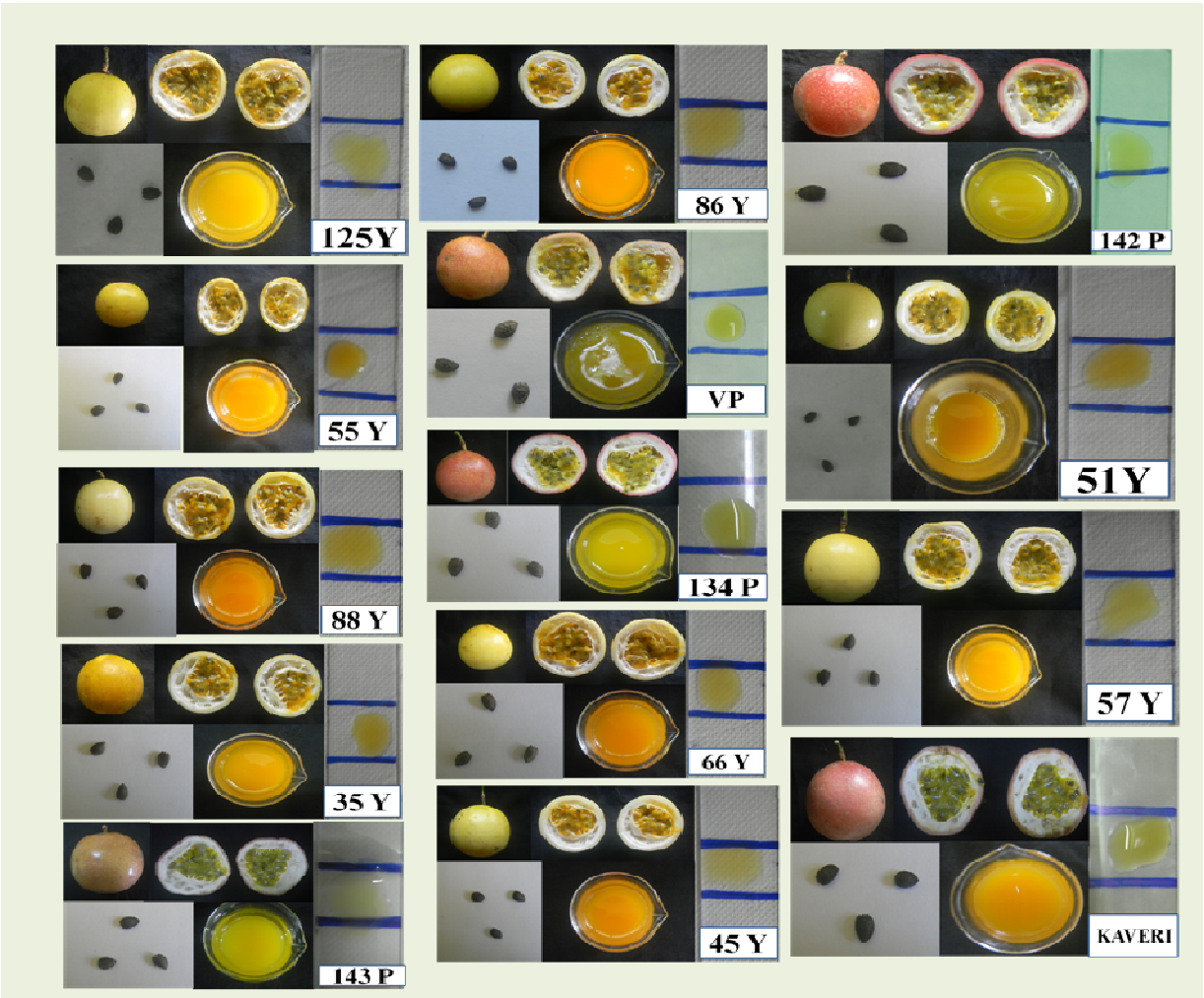


Figure 69. Fruit Characteristics of Different Passion Fruit Accessions

9.5. Fruit Characters

The main qualitative characters analyzed were fruit size, fruit taste, fruit colour and fruit smell. They decide the overall appeal of the fruit. Among them fruit taste, colour and smell were assessed by scoring from 0-9 scale. The fruit size was measured by observing the circumference of the fruit in cm.

Among the passion fruit types 134P appeared to be the biggest one and 51Y the smallest. The fruit taste was more sweet for 125Y and sour for 66Y. The fruit colour was true yellow for 35Y and true purple for Kaveri. The fruit smell more pleasant for Kaveri and less pleasant for 66Y.

Scoring Legend

Fruit taste: 0-2 deep sour;3- 4 sour; 5- not sweet or sour;6-7 sweet; 8-9 more sweet
Fruit smell:0 no smell; 1-4 less pleasant; 5-8 pleasant; 9 more pleasant
Fruit colour: 0-yellow; 1-4 slight yellow; 5-8 slight purple; 9 purple

Table 49: Fruit Characters of Passion Fruit Accessions (0-9 scale)

Accessions	Fruit Size (cm)	Fruit Taste (0-9)	Fruit Colour (0-9)	Fruit Smell (0-9)
125Y	20.34	6.83	0.44	6.72
55Y	19.47	4.33	0.35	6.31
88Y	19.08	5.67	0.30	5.89
35Y	18.84	5.22	0.24	6.53
86Y	19.69	5.06	0.61	6.10
143P	19.51	5.44	5.53	5.22
VP	21.46	5.94	6.53	6.83
134P	21.69	6.08	6.47	6.50
66Y	19.99	3.72	0.64	5.50
45Y	20.04	4.33	4.25	5.92
142P	21.19	6.50	6.44	6.36
51Y	18.30	6.22	0.61	5.55
57Y	21.17	6.11	4.06	6.67
Kaveri	20.37	6.67	7.11	7.78
Mean	20.08	5.58	3.11	6.28
SEM	0.341	0.253	0.215	0.24
CD	0.991	0.756	0.626	0.697
CV%	2.935	7.86	11.976	6.545

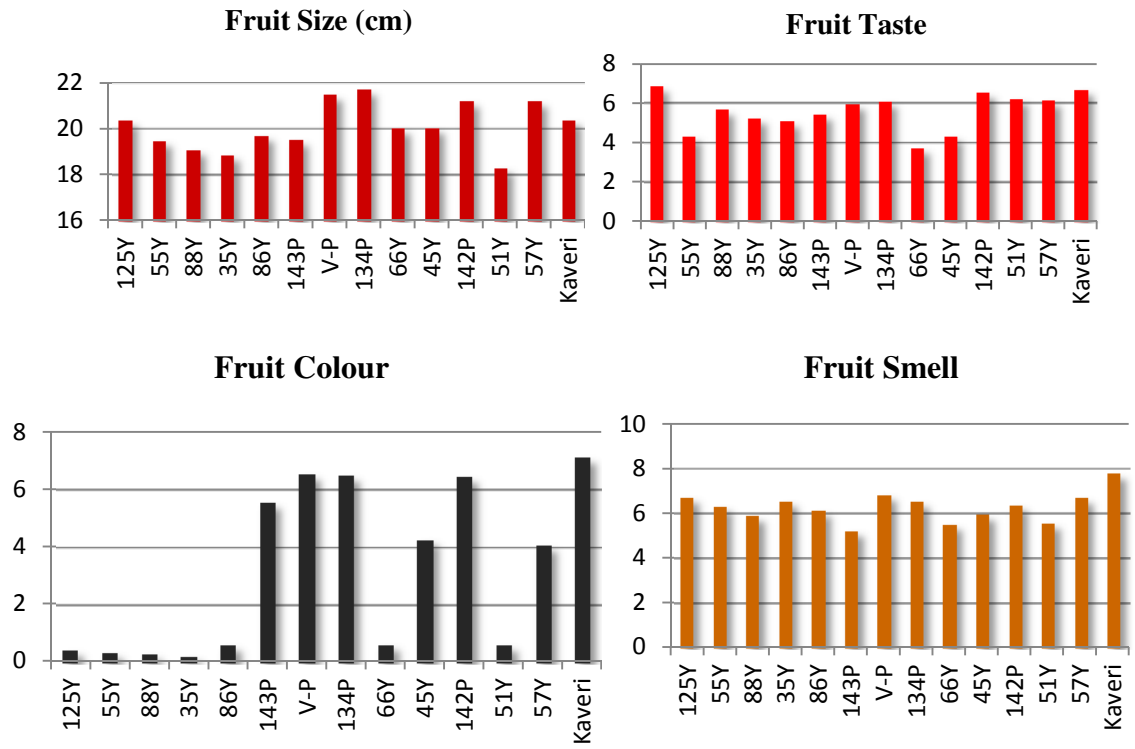


Figure 70. Fruit Characters of Passion Fruit Accessions (0-9 scale)

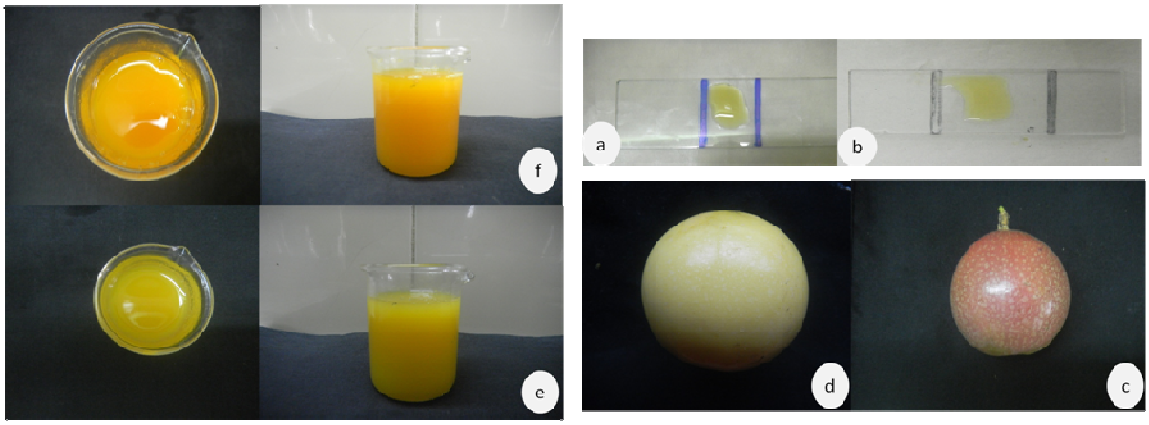


Figure 71. Characteristics of Passion Fruit: (a) Juice Consistency of Kaveri (b) Juice Consistency of 66Y (c) Fruit Colour of Kaveri (d) Fruit Colour of 35Y (e) Juice Colour of 142P (f) Juice Colour of 86Y

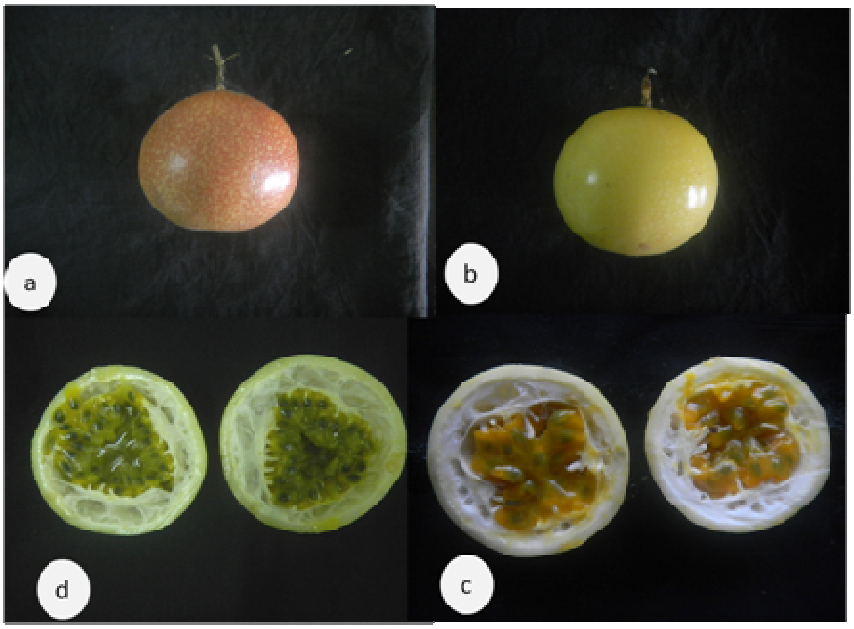


Figure 72. Passion Fruit purple and yellow contrasted: (a) Fruit size of 134P (b) Fruit size of 51Y (c) Pulp content of 35Y (d) Pulp content of 55Y

9.6. Rind Thickness

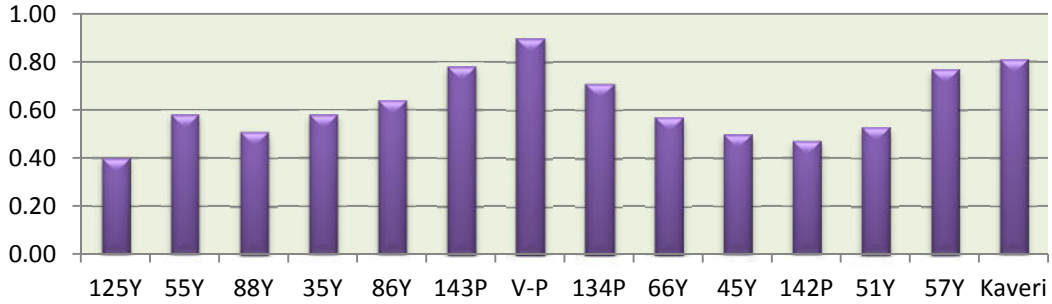
Rind thickness is separately analysed since there is greater variation among purple and yellow fruit types. Increased rind thickness consumes more in its weight thus leaving the fruit with less pulp content. On the other half, increased rind thickness makes the fruit with higher shelf life period.

VP showed the one with more rind thickness and 125Y the one with less thickness.

Table 50: Rind Thickness of Passion Fruit Accessions (cm)

Accessions	Rind Thickness (cm)
125Y	0.40
55Y	0.58
88Y	0.51
35Y	0.58
86Y	0.64
143P	0.78
VP	0.90
134P	0.71
66Y	0.57
45Y	0.50
142P	0.47
51Y	0.53
57Y	0.77
Kaveri	0.81
Mean	0.63
SEM	00.047
CD	00.136
CV%	12.933

Figure 73. Rind Thickness of Passion Fruit Types (cm)



10. Annual juice Production

The selection of most promising type is justified by quantifying annual juice production which involves juice percentage and annual fruits number. Among the fourteen types 142P is the one with higher annual juice production, 134P and Kaveri followed 142P in the order.

Table 51: Annual Juice Production of Passion Fruit Accessions

Accessions	Annual fruits (number/plot)	Annual Fruit Wt.(g/plot)	Fruit Wt (g)	Juice Wt. (g)	Juice (%)	Annual juice prodn./plot (%)
125Y	81.00	6460.17	79.76	36.5	36.23	2307.32
55Y	65.67	3470.83	52.86	38.09	39.04	1354.97
88Y	28.67	1885.50	65.77	22.32	29.33	552.94
35Y	12.67	741.00	58.50	17.12	24.67	182.77
86Y	12.33	817.67	66.30	19.48	27.28	223.08
143P	26.00	2183.50	83.98	35.58	39.76	868.23
VP	26.33	2255.50	85.65	28.3	34.20	771.37
134P	97.33	9674.00	99.39	33	34.88	3374.29
66Y	37.33	3339.50	89.45	24.13	33.66	1124.19
45Y	56.67	4468.17	78.85	28.4	31.80	1421.01
142P	138.33	12606.67	91.13	36.6	36.03	4542.27
51Y	24.00	1982.33	82.60	18.36	28.03	555.74
57Y	48.00	3871.17	80.65	37.26	36.87	1427.13
Kaveri	113.33	10616.83	93.68	18.35	24.58	2609.76

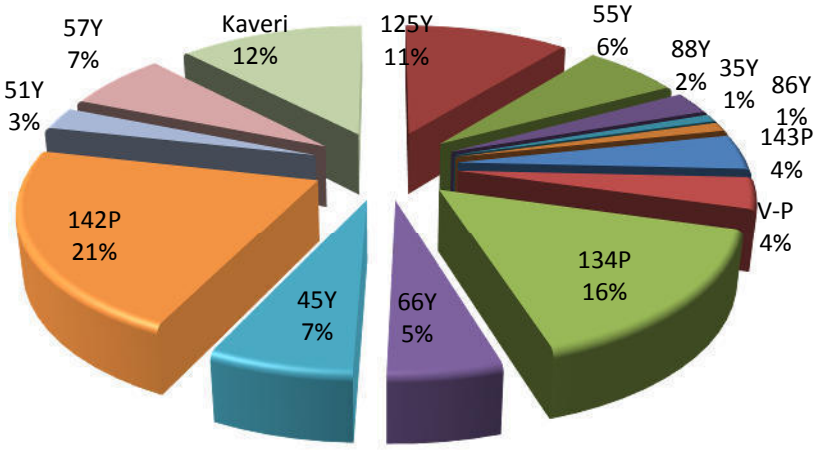


Figure 74. Annual Juice Production

3. PLANT PROTECTION STUDIES

3.1 Efforts for Maintaining Contamination Free Tissue Culture Lab

Plant tissue culture requires aseptic conditions for trouble free maintenance. Cleanliness is the most important factor in a tissue culture laboratory. Even under strict vigilance there are chances for contamination to occur.

Causes of Tissue culture Contamination

Contamination of tissue culture is the most common problem encountered in tissue culture laboratories, sometimes with very serious consequences. The main sources of contamination are the explant or culture itself, the culture vessels, the culture media, the lab environment and the instruments used in handling tissues.

Types of contamination

The main type of contamination identified was fungal contaminations. The dominating fungal contaminants were *Penicillium* sp., *Aspergillus* sp., *Fusarium* sp.

Identification of Fungal Contaminants in Plant Tissue Culture Lab

Fungi are unicellular or multi cellular organisms which live either as saprophytes or parasites. They are the major contaminating organisms in the tissue cultures because of their simple rapid reproductive processes through asexual and sexual spores. Elimination of contaminants is crucial for the successful tissue culture production as the fungi species during their rapid growth utilize the culture media and destroy the cultures.

Objective

To identify various fungal contaminants in plant tissue culture lab

Technical Programme

Lacto Phenol Cotton Blue (LPCB) of tear mount staining technique was employed for identification. Two methods were employed for LPCB staining namely, Tear Mount Method and Slide Culture Method. In LPCB staining, blue colour appeared for cytoplasm against light blue background, walls of hyphae could be visualized easily. Phenol acted as fungicide and lactic acid act as clearing agent. For tear mount method, one or two drops of Lacto phenol cotton blue stain was added to a clean slide. Using a flame sterilized needle a few fungal mycelia was placed on the stain and the mycelia was gently teased and spread using a sterile needle. Cover glass was carefully placed taking extra caution to avoid air bubbles. Excess stain was removed using tissue paper and observed under 10X and 45X objectives of microscope. Various fungal smears were identified based on their morphological characteristics from the banana, pineapple and passion fruit tissue culture bottles. Contaminations were also studied using slide culture method for a double confirmation. Slides were arranged over the V- shaped tube in a petriplate. 1 cm x 1 cm square block of Sabouraud's Dextrose Agar (SDA) was carefully placed on the center of the

glass slide block. Cover slip was placed with sterile forceps and moistened cotton in petriplate was kept for promoting the fungal growth. After two to three days incubation, agar block was carefully placed on a glass slide containing Lacto phenol cotton blue staining. Block was later observed under 10X and 45X magnifications of microscope.

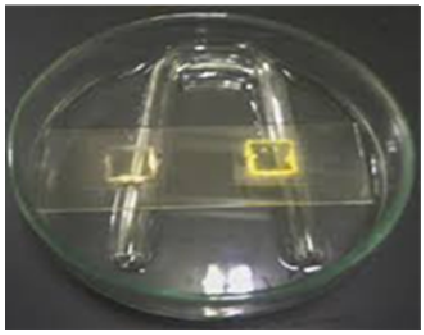


Figure 75. Slide Culture Technique

Results

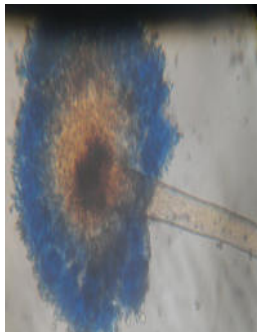
A wide range of microorganisms cause contamination in tissue culture laboratory, fungi, yeast, molds and bacteria were the predominant microbes. Among them fungi were the major contaminants with 73.14% and of bacteria with 26.87%.

Table 52. Cultural Characteristics of Some Fungal Contaminants

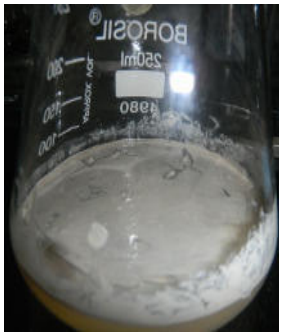
Samples	Macroscopic Observation	Microscopic Observation	Organism
nf BA2 43b4a1c1	White color, creamy growth on the media surface	Pink color large cells obtained by Gram's Staining large, oval, budding cells obtained by LPCB staining	*Yeast* sp.
nf BA2 40b3a1	Pinkish , white, creamy Growth	Gram positive cells, Large, Oval, budding cells by LPCB	*Yeast* sp.
nf BA2 14 a2d2	Off white, Waxy growth (creamy)	Gram positive cells, large, oval, budding cells by LPCB	*Yeast* sp.
nf BA2+G 8cd	Off white , waxy, growth (creamy)	Gram positive cells, large, oval, budding cells by LPCB	*Yeast* sp.
MD-2 3a3c4	Blackish- brown, rough colonies spread all over the media	Mycelium is septate and branched. Conidia developed as a stalk and heads from foot cells	*Aspergillus* sp.
nf (p) BA2 74d2a3a	Greyish - green colour colonies, smooth colonies	Brush like conidiophores and branched mycelium spores arranged on conidiophores	*Penicillium* sp.
MD-2 5d4d5	Greyish – green centrally raised smooth colonies. Spread all over the surface of the media	Brush like conidiophores and branched mycelium spores arranged on conidiophores	*Penicillium* sp.
nf BA2+G	Creamy white colour growth all over the surface	Gram positive large cells Large, Oval, budding cells got in LPCB staining	*Yeast* sp.

NB: nf- Nendran Inflorescence, BA2- Media for Subculture, BA2+G- Media with Gentamycin added

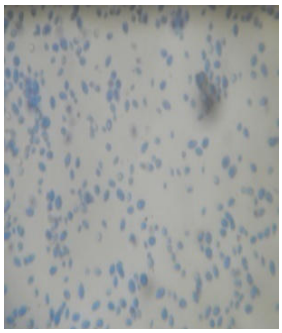
Macroscopic observation of *Aspergillus* sp.



Microscopic observation of *Aspergillus* sp.



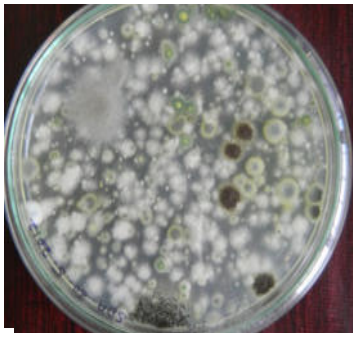
Macroscopic observation of *Yeast* sp.



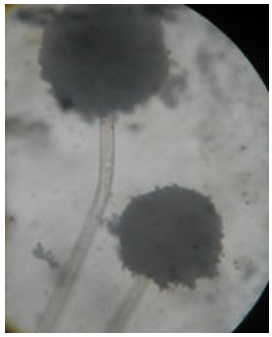
Microscopic observation of *Yeast* sp

Macroscopic observation of *Penicillium* sp.

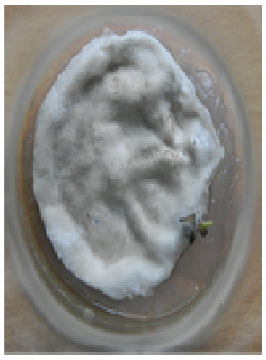
Microscopic observation of *Penicillium* sp.



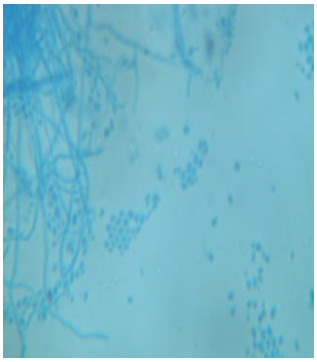
Macroscopic observation of *Rhizopus* sp.



Microscopic observation of *Rhizopus* sp.



Macroscopic observation of *Fusarium* sp.



Microscopic observation of *Fusarium* sp.

Macroscopic observation of *Phytophthora* sp.

Microscopic observation of *Phytophthora* sp.

Figure 76. Macroscopic and Microscopic Observations of Tissue Culture Contaminations

Precautions Suggested for the maintenance of tissue culture lab

1. Aseptic Techniques

For the best results in tissue culture, we want to work to keep microbial (bacteria, yeast and molds) contamination to a minimum. To do this, there are certain things we must be aware of. They are

- Work in a culture hood set-aside for tissue culture purposes. Most have filtered air that blows across the surface to keep microbes from settling in the hood. Turn off the UV/antimicrobial light and turn on the hood 30minutes prior to entering the hood.

- Wear short sleeves or roll your sleeves. Tie long hair back and remove rings and watches
- Wash hands with soap and water before beginning the procedure and rewash if touch anything that is not sterile or within the hood.
- Spray down the hands, work surface and anything that will go into the hood with 70% ethanol. Re-wipe at intervals if working in a long time in the hood. This will reduce the number of bacteria and molds considerably.
- Do not breathe directly into the cultures, bottles of media. This also means to keep talking to a minimum. No mouth activities.
- Keep bottles and flasks closed when we are not working with them. Avoid passing arm or hands over an open bottle.
- Use only sterilized pipettes, plates, flasks and bottles in the hood for procedures.
- Take special precautions with the sterile pipettes. Remove them from the package just before use. Never mouth-pipette, use the pipetting aid. Change pipette for each manipulation. If the tip of the pipette touches something outside of the flask or bottle, replace with a new one. Never use a pipette twice.
- Spray spirit in LAF before and after the work

2. Safe Work Practices

- Maintain a clean, uncultured work area
- Know the locations of the nearest emergency exit and safety equipment (shower, eye wash)
- Keep maximum cleanliness by each and every worker

3. Good laboratory practices

- No smoking, no food or beverages in the lab
- Required PPE (Personal Protection equipment's) must be worn while in the lab
- Lab benches must be cleaned, disinfected or decontaminated after work is completed
- Do not use hoods for storage
- Glassware is free from crack , breaks or chips
- Heavy objects are confined to lower shelves

3.2 Identification of Contaminations in Nursery

Identification of Fungal Pathogens in Passion Fruit Roof Top Nursery

Objective

To identify the infective agent on passion fruit seedling from roof top nursery.

Technical Programme

The soil and plant samples were collected from the roof top nursery and weighed 1g of it and suspended to 9 ml sterile distilled water tubes (10^{-1}). Arranged 5 sets of tubes, each set contained 9ml of sterile distilled water. Shaked and homogenized the first and transferred 1ml

from it to the second. Similarly, 1ml sample was serially transferred 10^{-2} dilutions into third tube containing 9ml of sterile water to get a final dilution of 10^{-3}. Repeated the procedure for 10^{-4}, 10^{-5}, 10^{-6} dilutions. The same procedure was followed in plant samples. Aseptically poured 1ml soil suspension from 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} into sterile petriplate mixed with 15 ml of SDA at 45-50°C and mixed well. Incubated the plates at room temperature for 4-5 days. After proper incubation stained the colonies using LPCB staining method.

Results

Table 53. Soil Sample Observations in Different Dilutions

Dilutions	Macroscopic	Microscopic
10^{-1}	White cottony appearance	*Fusarium* sp.
10^{-2}	White fluffy large colonies	*Fusarium* sp.
10^{-3}	White fluffy large colonies Green colored colonies	*Fusarium* sp. *Penicillium* sp.
10^{-4}	White fluffy large colonies Black powdery colonies	*Fusarium* sp. *Aspergillus* sp.
10^{-5}	White fluffy large colonies	*Fusarium* sp.

Table 54. Plant sample Observations in Different Dilutions

Dilutions	Macroscopic	Microscopic
10^{-1}	White cottony appearance Green colored colonies	*Fusarium* sp. *Penicillium* sp.
10^{-2}	White fluffy large colonies Green colored colonies	*Fusarium* sp. *Penicillium* sp.
10^{-3}	White fluffy large colonies Green colored colonies	*Fusarium* sp. *Penicillium* sp.
10^{-4}	White fluffy large colonies Green colored colonies	*Fusarium* sp. *Penicillium* sp.
10^{-5}	White fluffy large colonies Black powdery colonies Green colored colonies	*Fusarium* sp. *Aspergillus* sp. *Penicillium* sp.

Result

Fusarium sp. was found to be in large number in both plant and soil samples studied. This is the reason for the damping off seedlings in passion fruit planted in roof top nursery.

Preventive Measures

- Sowing seeds in a sterilized growing medium can be effective
- Maintaining drier condition with better air circulation helps prevent the spreading and slow down the germination
- Spraying or drenching the soil with antifungal treatment such as copper oxychloride also helps suppress the disease

3.3 Identification of Pathogens in Field

Identification of pathogen in Passion Fruit Plants

Objective

To identify the disease causing pathogens for infected plants 55-8, 55-9,Vazhakulam purple variety plants 12, 10, 9, 8, 7 and 6, 86-7, 134-4, 55-5 and 125

Requirements

SDA, Nutrient Agar (NA) plates, sterile distilled water, test tubes and routine lab equipment's

Technical Programme

As per the information from the field, that the passion fruit plants were started to wilt, plant pathologist visited the field and collected the soil samples, stem samples etc. Aseptically collected the samples and packed well and analyzed the symptoms of the disease.

Figure 77. *Fusarium* sp. (45X)

Symptoms

Sample varieties showed wilting, root rot, stem rot, and stem discoloration. During that time leaves were falling from the plant. When removed the soil near by the root system had shown rotting except tap root.

Techniques Include

1. Surface sterilization of the sample
2. Serial dilution of the soil sample
   - Serial dilution
   - Plating (Spread plate)
   - Colony Counting
   - Sub culturing (Streaking)
   - Gram's Staining

- Biochemical tests (if applicable)

3. Inoculation of leaf, stem, root samples on SDA plates
   - Preparation of SDA
   - Inoculation of samples
   - LPCB for fungal identification
4. Gram Staining
5. Hanging Drop Motility

Surface Sterilization of the samples

- Washed the samples (root & stem samples collected from the diseased plants) in running tap water for few minutes.
- Washed again using sterile distilled water.
- Rinsed the samples using 70% alcohol.
- Washed again using distilled water for removing the alcohol.
- Rinsed the samples using 0.1% Mercuric chloride ($HgCl_2$)for 1 minute
- Washed the samples with distilled water for removing the excess mercuric chloride

Serial dilution

Weighed 1 g of soil sample and added it to 10 ml sterile distilled water and mixed well. The sample was serially diluted up to 10^{-4} by transferring 1ml. First three dilutions were spread on 3 Nutrient Agar (NA) and 3 SDA plates by transferring 1ml of each dilution. Incubated NA plates in incubator at 37°C for 24 hrs and also incubated SDA plates at room temperature for 3-4 days.

Result

Table 55. Serial dilution of 55-8, 55-9 on NA plates

Sample	Dilutions	No. of Colonies	Cultural Characters
55-8	10^{-1}	TNTC	Off White, Mucoid, Round, Small, Opaque, Flat Colonies
	10^{-2}	110 Colonies	
	10^{-3}	No Growth	
55-9	10^{-1}	TNTC	
	10^{-2}	TFTC	
	10^{-3}	TFTC	

N B: TNTC - Too Numerous to Count
TFTC – Too Few to Count

Sub cultured the colonies for getting pure culture by streak plate method and performed Gram staining.

Gram staining result

Purple-rods were obtained by Gram staining (Gram positive bacteria). Both 55-8 and 55-9 had the same bacteria. It's a common soil microbe, which is not responsible for this infection.

Table 56. Observation of Serial Dilution on SDA plates

Sample	Dilutions	No: of colonies	Cultural characters
55-8	10^{-1}	TNTC	white puffy, yellow puffy, blackish- brown, off- white, large, fibrous colonies
	10^{-2}	TNTC	
	10^{-3}	TNTC	
55-9	10^{-1}	TNTC	
	10^{-2}	TNTC	
	10^{-3}	TNTC	

NB: TNTC - Too Numerous to Count
TFTC - Too few to Count

Performed LPCB for the fungal growths obtained from leaf and root samples on SDA plates. Macroscopic observations of the fungal growth obtained from leaf and root samples on SDA plates are discussed below.

Table 57. Observations of Passion Fruit Samples on SDA plates

Macroscopic observations	Microscopic observations
Off white colored, fibrous, spreading colonies all over the surface with yellowish base	Mycelium with highly branched hyphae, single or many branched sporangiospores are present. Lemon or egg shaped sporangia.

LPCB Result

The fungal pathogen was *Phytophthora* sp.

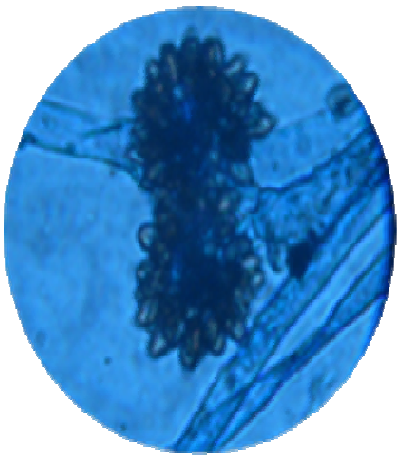
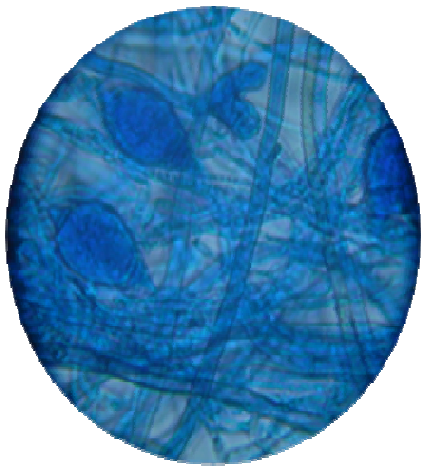


Figure 78. *Phytophthora* sp. (45X)



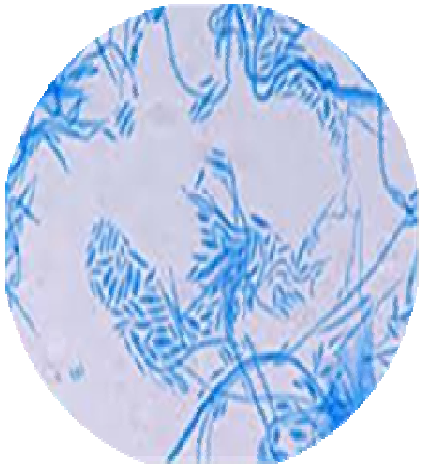


Figure 79. *Fusarium* sp. (45X)

Table 58. Observations of Passion Fruit Samples Analyzed

Sample	LPCB Result	Gram's Staining	Hanging drop
86Y-R2 Root	*Fusarium* sp.	Gram +ve cocci	Non Motile
86Y-R2 Leaf	*Fusarium* sp.	Gram +ve rods	Non Motile
134P-R1 Root	*Mucor* sp.+ *Fusarium* sp.	Gram +ve cocci	Motile
134P-R1 Leaf	*Fusarium* sp.	Gram +ve cocci	Non Motile
134P-R1 Root	*Fusarium* sp.	Gram +ve rods	Motile
134P-R1 Leaf	*Fusarium* sp.	Gram +ve cocci	Motile
125Y-R1 Leaf	*Fusarium* + *Mucor* sp.	Gram +ve cocci	Non Motile
55Y-R2 Root	*Fusarium* sp.	Gram +ve cocci	Non Motile
66Y-R1 Root	*Fusarium* sp.	Gram +ve rods	Motile

Table 59. Macroscopic and Microscopic Observations of Different Passion Fruit Samples

Macroscopic Observation	Microscopic Observation
White, cottony, rhizoid, irregular growth all over the media	Short and branched conidiophores are present. Microconidia, Microconidia and kidney shaped spores are present. Chlamydospores are produced at terminal position with dark, thick wall

Discussion

The root rotting and plant wilting were caused by the *Phytophthora* sp., bacterial culturing and Gram's staining were performed but we got only non-harmful Gram positive rods, which already existed in soil. So the disease is strictly due to *Phytophthora* sp. It was suggested to use a systemic fungicide for the escape of plant from wilt. Indofil was applied but the plant got seriously diseased and wilted completely. Hence recommended to root up the plant and replant the same variety. *Fusarium* sp. affected plants were treated with 2% Phytolan. The dose was effective and plants resumed from wilting.

3.4 Diagnostic Team Visits

Serious diseases and insct pests were observed both in pine apple and passion fruit. In pineapple heart rot and fruit rot were more serious diseases especially in humid rainy conditions. Mealy bug and scale insects were the dominant insect pests especially during summer. In passion fruit wilt disease was very serious and the affected plants could not be successfully recovered by any fungiside treatments such as phytolan, mancozeb, bavistin, saaf, contaf, hexaconasole and kocide so far. The problems were widely circulated through KAU mail groups of announce, teachers and employees and reported to RARS, Pattambi and Department of Plant Pathology, College of Horticulutre, Vellanikkara for proper diagnosis and control. Diagnostic teams from RARS, Pattambi and College of Horticulture visited the experiment plots, took requires samples and offered necessary help in diagnosis and control.

Figure 80. Dr. Beena and Team of Department of Plant Pathology, CoH, Vellanikara visiting the PRS Field and Tissue Culture Lab giving recommendations

Figure 81. Dr. Babylatha and Team visiting Pineapple Field of the Station and collecting diseased samples

4. MICRO PROPAGATION OF BANANA

Explants used for tissue culture of banana were inflorescences. They were collected from healthy plants, after the blooming of all female flowers. Micro propagation of banana includes four main stages like Initiation (Fresh Inoculation), Multiplication (subculture), Rooting and Hardening (Plant out).

4.1 Fresh Inoculation of Banana Inflorescence and Standardization of Surface Sterilization

Objective

- To standardize the surface sterilization protocol
- To fresh inoculate banana varieties (Nendran, Njalipoovan and Poovan)

Technical Programme

Explant preparation

Healthy banana inflorescences were selected as the source for micro propagation. Chopped off the inflorescence cut end and carefully separated the tepal sheathstill it reached the creamy white inner portions, finallyreached the size of 3 cm. They were grown in open environment and hence possibility for air borne pathogens. They might be in touch many of the soil borne pathogens during handling. Hence an effective surface sterilization protocol was needed to be standardized and followed.

Figure 82a. Inflorescence Explants in Running Tap Water

The explants were kept in running water for 30minutes. Soap wash was given and shaken continuously in an orbital shaker to clean the explants for 30 minutes.

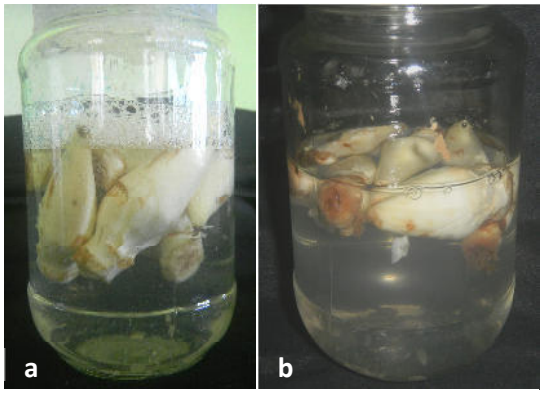


Figure 82b. Inflorescence Explants in Cleansol (a) and Tween 20 (b) Solutions

Table 60. Effect of Soaps during sterilization

Detergent/Soap	Response
Cleansol	++
Tween 20	+++

NB: Medium Response(++),Maximum Response (+++)

They were washed several times with distilled water till the removal of soap. Further fungicide treatment was applied for another 30 minutes.

Table 61. Response of Fungicides in Surface Sterilization

Fungicide Alone/combination	Concentration (%)	Response
Fytran	0.15	++
Fytran, Indofil+SAAF	0.1,0.1+0.05	+++
Fytran,Indofil	0.2,0.2	+
Indofil+SAAF	0.15+0.1	++
Indofil+Bavistin	0.2+0.2	-

NB: No Response (-), Minimum Response (+), MediumResponse (++), Maximum Response(+++)

Figure 83. Inflorescence Explants in different Fungicide

They were washed several times with distilled water till the removal of traces of fungicide. Then antibiotic (Gentamycin 2ml/l) 400 µl treatment was done.

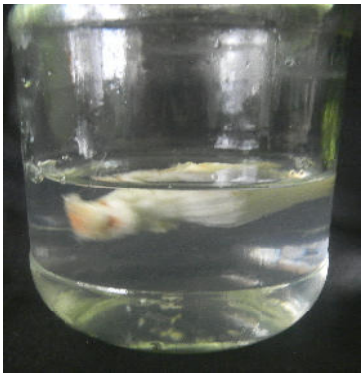


Figure 84. Antibiotic treatment

Table 62. Effect of Varying Time period in Antibiotic Treatment

Concentration (2ml/l)	Time Duration	Response
400 µl	2hr	-
400 µl	1hr	-
400 µl	45’	+
400 µl	30’	+++

NB: No Response (-), Medium Response (+), Maximum Response (+++)

Prior to inoculation, the explants were subsequently surface sterilized in the laminar airflow chamber with 70% alcohol for 2 minutes. It was followed by treatment with 0.1% (w/v) aqueous Mercuric chloride solution for 5 minutes with continuous shaking. Consequently, 3 rinses in sterile distilled water were given, each rinse lasting for about 5minutes. The exposed portions were cut off. The explants were dipped in antibiotic solution containing Gentamycin (2 ml/l).The surface sterilized explants were thus ready for fresh inoculation.

Figure 85. Inflorescence in Fresh Inoculation Media

The explants were trimmed to a final size of 1 cm in sterile conditions of the inoculation chamber, and inoculated on to the culture medium. Banana inflorescences were inoculated to the media and kept in dark for 21 days. The cultures were observed at an interval of 7 days.

Result

Tween 20 preferred for soap wash and Fytran, Indofil+SAAF (0.1+0.1+0.05%) as fungicide treatment. Gentamycin 400 µl for 30' was found effective.

The fresh inoculated banana inflorescence cultures were observed for a cycle of 21 days. After 7 days bulging started and within 14 days buds sprouted. 21 days were required to increase the bud number. No callus formation was observed in the medium. Also the same medium was used for media change of the cultures for increase in buds number.

4.2 Media Change of Banana Inflorescence

Objective

To Media change Banana inflorescence in fresh media

Technical Programme

Responding cultures were transferred to fresh medium after 21 days of incubation in dark conditions. It was essential to change the medium in every 21 days for 3 months; otherwise the phenols formed will inhibit growth. The inflorescence tips were carefully removed from the fresh inoculation media and inoculated to fresh medium. The observation was noted at the end of each media change.

Result

The explants were successfully transferred to the fresh medium. After 90-120 days, multiple shoots initiated were divided into clusters of 4-6 shoots.

4.3 Subculture of Banana Inflorescence

Objective

To subculture buds and shoots developed during media change in multiplication medium

Technical Programme

The buds and shoots were separated using sterile scalpel and inoculated to the subculture media. Depending upon the number of buds and shoots obtained in the mother culture the subculture bottles were increased. It might be even up to 8- 10 numbers. Those individual cultures were observed for a period of 21 days at 7 days interval.

Result

The sub cultured banana inflorescences in the multiplication medium showed maximum response with increased buds and shoots proliferation.

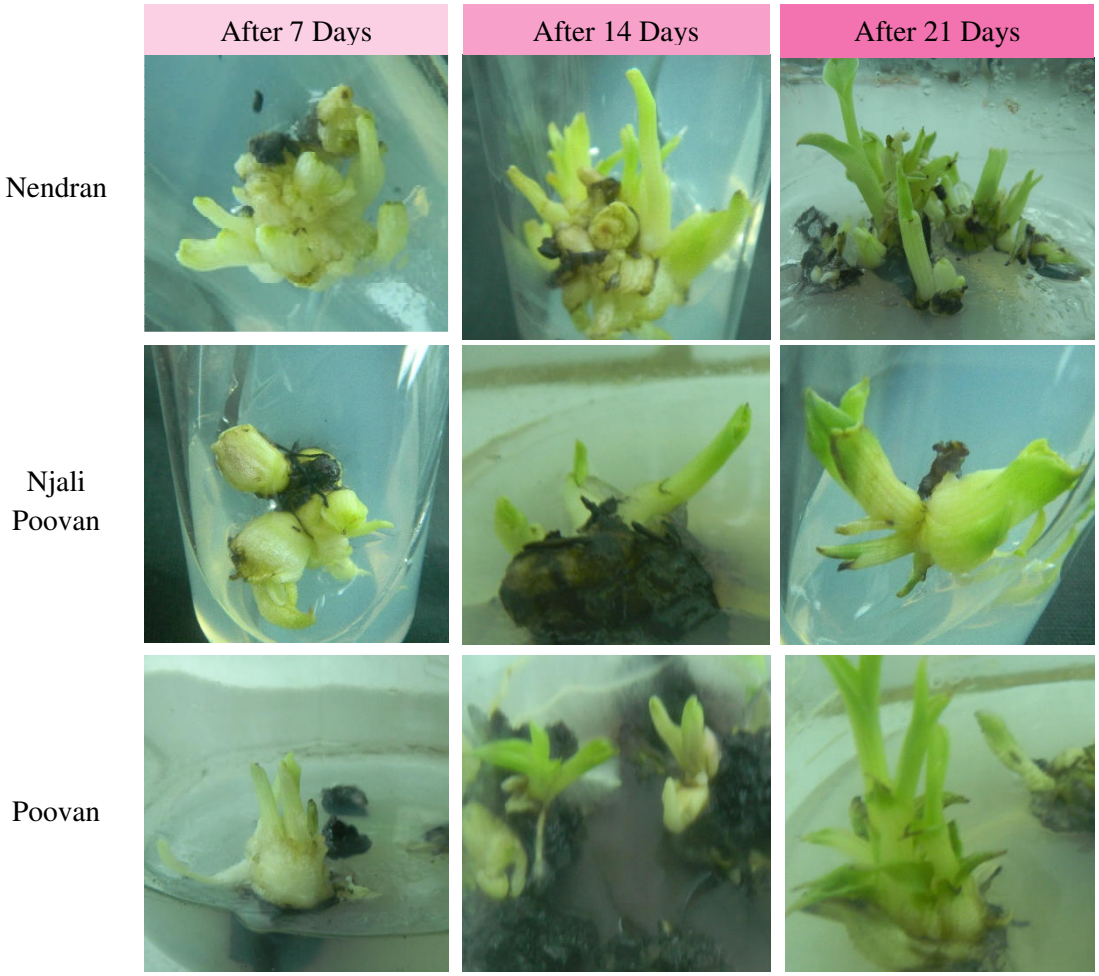


Figure 86. Periodical Response of Various Inflorescences during Subculture

4.4 Rooting of Banana Inflorescence

Objective

To inoculate fully developed banana shoots to rooting medium

Technical Programme

Explants with enough leaves and shoots were separated carefully and transferred to rooting medium for the generation of roots. They were observed for a period of 30 days at 10 days interval.

Result

The banana shoots were fully rooted by the end of 30 days. Rooting was efficient in MS Basal medium itself. Poovan cultures were not so grown enough to be inoculated to the rooting medium.

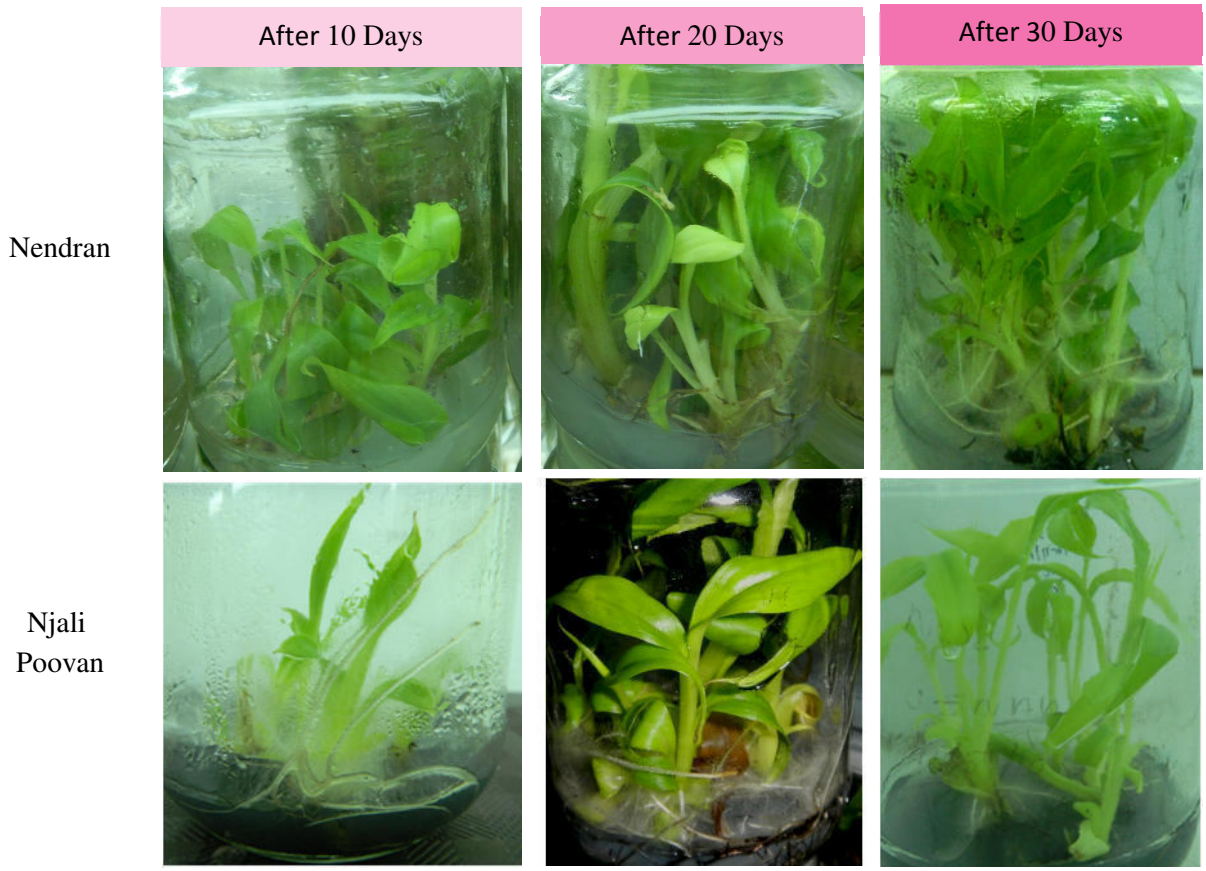


Figure 87. Periodical Response of Different Inflorescences Types in Rooting Media

NB: Poovan shoots have not developed enough for rooting

4.5 Hardening of Banana Inflorescence

Objective

To plant out fully rooted healthy banana plants in potting mixture

Technical Programme

Potting mixture was made by mixing 100kg solarized soil+10 kg Cow dung+1 kg Neem Cake+1kg Trichoderma. Prior mixing 10 kg Cow dung+1 kg Neem Cake+1kg Trichoderma was mixed well and irrigated for a week time. The mixture was thoroughly mixed with 100kg solarized soil and irrigated well. The mixture was kept covered for one week and irrigated at 2 days interval.

Fully rooted plants *in vitro* were selected for plant out. The plants were first grown in mist chamber for acclimatizing with climate outside lab. After 2-3 weeks time they were moved to green house to get adjusted with field conditions. Healthy plants were treated with 20g/l for 20 minutes and planted. Fungal contaminated plants were treated with 2g/l SAAF for 30minutes and planted. Tissue culture plants were planted in potting mixture. After 2-3 months the plants are ready for field planting. For the planting of a mature hardened plant to the field, we required a total of 9 months duration from the date of inoculation.

The plants were observed for recovery percentage after one month and made ready for sale.

Result

The plants were grown healthy in the potting mixture.

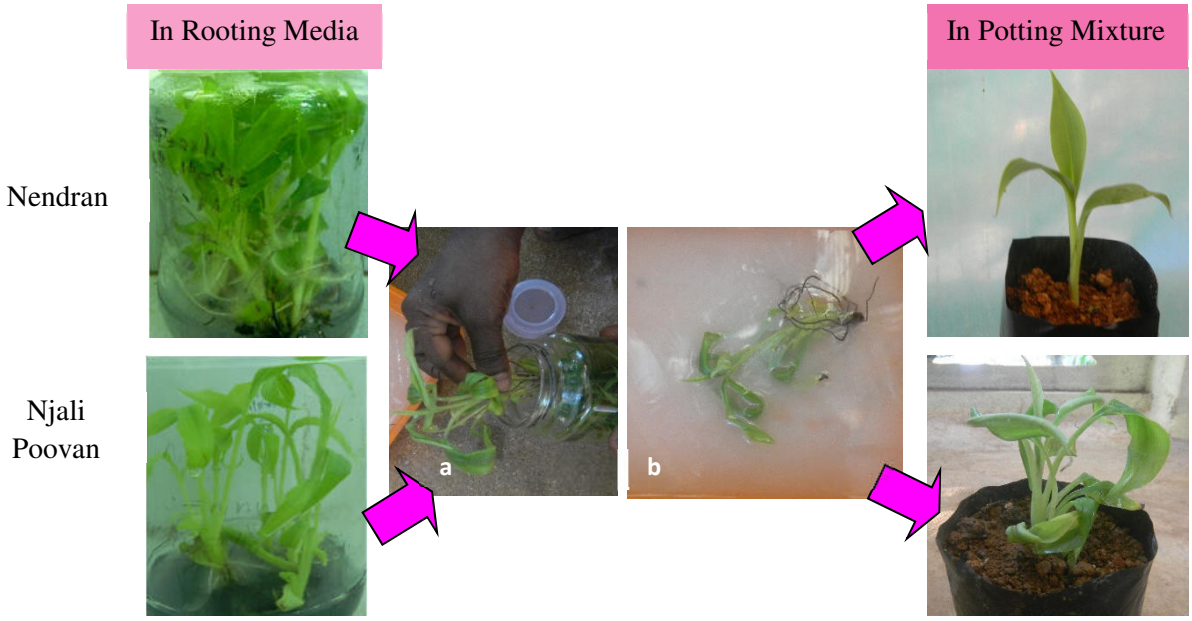


Figure 88. Hardening Protocol a. Tissue Culture Plants washed in tap water
b. Plants dipped in Pseudomonas

5. MASS PRODUCTION, SALE, EXPENDITURE AND RECEIPTS

Efforts were taken for the large scale production of pineapple tissue culture plants, passion fruit seedlings and rooted cuttings and banana tissue culture plants. However, the programme was seriously hampered by the stoppage of plan projects which was the only source of fund for the station. Hence the planting material production and tissue culture programme could not gain the anticipated success during the year. Moreover, absence of regular staff in the farm and labororatories of the station very seriously affects the successful implimentation of these programmes.

The station is presently managed by a single scientist and a single office assistant as university staff. The various projects and other activities are executed by engaging skilled assistants and labourers on nominal daily wage contract basis. Management of the research projects by them is highly difficult and many times the reliability of the data is questionable due to lack of continuity, commitment and integrity and can not gain the anticipated success. Until KAU staff is provided, sanction may be granted for creating temporary posts of research associates of Farm Officer, Biochemist, Biotechnologist, Microbiologist, Food technologist and Information Technologist at Rs.18000/month or more and necessary action may be taken for appointing them at the earliest.

The planting material production and tissue culture status, targets, receipts and stock situation of the current year are furnished below.

Table 63. Planting Material Production, Receipt, Target etc. for 2013-14

Crop/Variety	Target (No.)	Production (No.)	Unit Price (Rs.)	Sale (No.)	Receipt (Rs.)	Stock balance (No.)
Pineapple TC	2,000	1,000	15	340	5,100	800
Passion fruit Seedlings	2,000	2,000	10	1,185	11,850	1,600
Passion fruit TC & Rooted cuttings	500	1,00	10	22	220	50
Banana TC	2,000	50	15	578	8,670	25
Banana TC Nendran	1,200	50	20	92	1,840	25
Banana TC bottle with 10 plantlets	1000	100	100	100	9,375	0
Total	**7,700**	**3,200**	**170**	**2,217**	**37,055**	**2,500**

Figure 89. Mass Production and Sale of Planting Materials a. Passion Fruit Cuttings b. Giant Passion Fruit Cuttings c. Tissue Culture Nendran d. Seedlings of Kaveri e. Passion Fruit Seedlings Germinated in Mist Chamber f. Tissue Culture Nanas plants g. Yellow Passion Fruit Seedlings h. Purple Passion fruit Seedlings i. Tissue Culture MD-2 plants j.& k.Sale of Passion Fruit Seedlings. Sale of Tissue culture Banana plants

Station Receipt and Expenditure

Table 64. Station Receipt and Expenditure

Project	Budget Estimate (Rs.lakh)	Revised Estimate (Rs.lakh)	Expenditure (Rs.)	Receipts (Rs.)
0034: Non-Plan	32.03	26.31	2338527	
3370: Research on pineapple		5.00	326653	
9550: Infrastructure support		4.00	399985	
9027: KSCSTE SRS – Evaluation of Passion fruit types for commercial cultivation in Kerala	2.95	2.95	295000	
Total	34.98	38.26	3360165	102243
Suspense Amount			168024	
Net Expenditure			3192141	

Station Receipts (Rs.)

Table 65. Station Receipts

Items	**Receipts (Rs.)**
Planting material sales	37055
Farm produce sales	9566
Delayed receipts	55622
Others	
Total	102243
Student Projects (DD to Comptroller)	7866
Total revenue generation	110109

Abstract of Accounts (Rs.)

Table 66. Abstract of Accounts

Items	**Expenditure SB A/c No.10601002376**	**Receipt SB A/c No.10601002354**
Opening balance	2221.94	38867.53
Receipts from Comptroller, KAU	3366600.00	
Advance repaid	12723.00	
Interest accrued	5678.00	3785.00
Total Accrual	3387222.94	
Withdrawals	3192141.00	
Less withdrawals	195081.94	
Bank charges	596.00	
Office balance	194485.94	
Balance as per bank	447881.94	
Difference	253396.00	
Uncashed cheques	253391.00	
Station Receipts		102243.00
Payment to Comptroller, KAU		100000.00
Closing balance	447881.94	4485.53

6. EXTENSION ACTIVITIES

Technology transfer is effectively carried out through personal discussions, field visits, phones, emails, website, posts, radio, TVs, newspapers, periodicals, publications, pineapple fests, seminars, trainings, etc. Publications such as leaflets, palm lets, books, CDs, DVDs, etc. covering various aspects of cultivation and utilization of the mandatory crops of the station are being undertaken.

6.1 Training Programmes Organized

Table 67. List of Training Programmes Organized

Date	Training Programmes Organized
04/05/2013	Training given to 30 farmers from Maharashtra on Pineapple Cultivation Techniques by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam
19/06/2013	Training on Engineering Aspects for Pineapple and Passion Fruit Cultivation led by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam to Teachers & Students of KCAET, Thavanur
22/10/2013	Training on technical aspects of Tissue culture, Phytochemistry-fruit analysis and Pathology was given to 50 VHSE Students from GVHSS, Muvattupuzha
03/12/2013	A class on Scientific Pineapple Cultivation carried out by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam Karshikotsav 2013, Muvattupuzha
19/01/2014	A seminar on Pineapple Cultivation & Fertilizer Application in pineapple was taken by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam and the event was organized by Pineapple Merchants Association
19/01/2014	Training on Pineapple Recipe Preparation led by Ms. Anjana R, Research Fellow, PRS, Vazhakulam at Pineapple Fest 2014organized by Pineapple Merchants Association, Pineapple Farmers Association and Pineapple Mission
17/02/2014	A training Programme was organized by Avoly panchayath Kudumbasree Unit. A class on Pineapple Recipe Preparation was taken by Ms. Rashida Rajuva, Research Assistant, PRS, Vazhakulam
18/02/2014	A class on Pineapple Cultivation was taken by Ms. Anjana R., Research Fellow, PRS, Vazhakulam to Kudumbasree members from Avoly Panchayath
26/02/2014	A class on Pineapple Cultivation under the leadership of Dr. P.P. Joy, Assoc. Prof.& Head, PRS, Vazhakulam at Krishibhavan, Vengoor
24/03/2014	A seminar on Pineapple Cultivation was taken by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam to 40 pineapple farmers from Palakkad
26/03/2014	A class on Pineapple Cultivation led by Dr. P.P. Joy, Assoc. Prof.& Head, PRS, Vazhakulam at Krishibhavan, Ayavana

Dr.P.P. Joy, Assoc. Prof & Head, PRS, Vazhakulam taking class on pineapple cultivation and overall activities of the station to VHSE students

Ms. Anjana R., Research Fellow, PRS, Vazhakulam explaining about pineapple tissue culture methods

Ms. Anjana R, Research Fellow, PRS, Vazhakulam giving class on Scientific Cultivation of Pineapple to Kudumbasree

Ms. Rashida Rajuva, Research Assistant, PRS, Vazhakulam taking class on Pineapple Recipes Preparation

Hands on experience given to 30 Kudumbasree members on pineapple Recipes Preparation

Giving training Certificates to Kudumbasree members, sponsored by Canara Bank

Figure 90. Training Programmes conducted at the Pineapple Research Station, Vazhakulam

Figure 91. Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam, rendering class on Pineapple Cultivation & Fertilizer application to 50 Pineapple farmers from Palakkad Dist.

6.2 Events Organized/Participated

Table 68. List of Events Organized/Participated

Date	Events
20/04/2013	Vazhakulam Pineapple Growers & Processors Pvt ltd. Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam attended the inauguration at Agropark, Vazhakulam
12/06/2013	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam participated in Seed & Nursery Workshop at KAU Head Quarters, Vellanikara
28/06/2013	Mr. Zulficker Ali carried Passion fruit Samples to CoH, Vellanikara for detailed Pathological Analysis
03/07/2013	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam attended 35th Pre ZREAC Workshop at ARS, Mannuthy
09/07/2013	Pineapple Field Visit by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam of Sri. George, Muzhavanoor
18/07/2013	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam participated in 35th ZREAC Workshop Meeting at RARS, Pattambi
30/07/2013	Visit to PAO by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam for Development Projects discussion
25/08/2013	Auditing of Station Accounts by Mr. Sreejith & Mr. Arun
13/09/2013	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam visited AMPRS Odakkali and discussed on Plan Project Preparation
19/09/2013	Pineapple Field visit by Dr. P. P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam Problem Diagnosis & Recommendation given to the farmer
31/10/2013	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam was involved in Project Discussion with Chemists & Entomologists at AMPRS, Odakkali

08/11/2013	Local Fund Audit
20/11/2013	A team headed by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam visited Inchiyum & Monipally to select best pineapple farmer
23/11/2013	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam attended Manorama Sponsored Agricultural Seminar at FAS Auditorium
26/11/2013	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam along with Mr. Justin T. Jose, Sr. Gr. Asst. PRS, Vazhakulam went for KSCSTE Project auditing at AMPRS, Odakkali
28/11/2013	A team led by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam visited pineapple field to select Best Farmer, Arakunnam
29/11/2013	A Project discussion by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam with Scientists of AMPRS, Odakkali
30/11/2013	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam visited pineapple field to select Best Farmer, Thodupuzha
03/12/2013	A team led by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam taken Class & put stall in Karshikotsav 2013, Muvattupuzha
11/12/2013	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam attended Development Committee at ARS, Anakayam & ZREAC Reviewed at RARS Pattambi
20/12/2013	Pineapple Mission Conducted Walk In Interview for Project Co-ordinator & Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam was in the interview board at NAPF, Vazhakulam
21/12/2013	A team of officers led by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam visited pineapple field, Punaloor for Best Farmer Selection
23/12/2013	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam & Mr. Justin T. Jose, Sr. Gr. Asst. PRS, Vazhakulam attended Budget Discussion at AMPRS, Odakkali
26/12/2013	Pineapple field visit by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam at Muttam
19/01/2014	Pineapple Research Station Team taken Classes & put stall in Pineapple Fest 2014, Vazhakulam
30/01/2014	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam & Mr. Justin T. Jose, Sr. Gr. Asst. PRS, Vazhakulam were involved in a meeting with Honourable MLA, Joseph Vazhakkan & discussed on PRS Development
20/02/2014	P.I., Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam, presented KSCSTE 2nd Year Report at KSCSTE, Thrivananathapuram
26/02/2014	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam taken Class & Attended Seminar at Krishibhavan, Vengoor
15/03/2014	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam discusssed with Comptroller & Director of Research, KAU, Vellanikara, also forwarded KSCSTE 2nd Year Report
22/03/2014	A team of Scientists headed by Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam visited pineapple field, Diagnosing Pineapple Field Problems & put forwarded Recommendations at Kolencherry
26/03/2014	Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam taken class & rendered Seminar on Pineapple Cultivation at Krishibhavan, Ayavana

Figure 92. Inauguration of Pineapple Mission by Honourable Minister for Agriculture, Animal husbandry, Printing & Stationery, Sri. K.P. Mohanan & Glimpses of the Event

Figure 93. Glimpses of Pineapple Fest 2014 Vazhakulam

Figure 94. Highlights of Muvattupuzha Karshikotsav 2013

6.2 Media Coverage

Figure 95. Media Coverage (a) *Flower World*, July 2013, Vol 2., 6., P48-49 (b) *Mathrubhumi* 20th May 2013

6.3 Publications

The following are the publications brought out during the year.

1. Joy P.P., Justin T. Jose & Anjana R., Leaflet on PINEAPPLE - Malayalam (revised). 2014. Pineapple Research Station (Kerala Agricultural University), Vazhakulam - 686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm
2. Joy P.P., Justin T. Jose & Anjana R., Leaflet on PINEAPPLE. 2014. Pineapple Research Station (Kerala Agricultural University), Vazhakulam - 686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm

3. Joy P.P., Rashida Rajuva., Leaflet on PINEAPPLE RECIPES (Malayalam). 2014. Pineapple Research Station (Kerala Agricultural University), Vazhakulam - 686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm
4. Joy P.P., Rashida Rajuva, Leaflet on PASSION FRUIT RECIPES (Malayalam). 2014. Pineapple Research Station (Kerala Agricultural University), Vazhakulam - 686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm

5. The following four chapters are submitted for the Book entitled "Realistic Approaches in Fruit Pest Management (with ISBN)" which is going to be published shortly under supervision of Dr. A. K. Pandey. DEPARTMENT OF ENTOMOLOGY, College of Agriculture, G. B. Pant University of Agriculture & Technology, Pantnagar, Udham Singh Nagar – 263145 (Uttarakhand)

   1) Joy P. P. & Sherin C. G., DISEASES OF PASSION FRUIT (*Passiflora edulis*) Pathogen, Symptoms, Infection, Spread & Management, Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670 Muvattupuzha, Ernakulam, Kerala, India, Tel. & Fax: +914852260832, Email: prsvkm@gmail.com

   2) Joy P. P. & Sindhu G., DISEASES OF PINEAPPLE (*Ananas comosus*) Pathogen, symptoms, infection, spread & management Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670, Muvattupuzha, Ernakulam, Kerala, India, Tel. & Fax: +914852260832, Email: prsvkm@gmail.com

   3) Joy P. P. & Sherin C. G., INSECT PESTS OF PASSION FRUIT (*Passiflora edulis*): Hosts, Damage, Natural Enemies and Control, Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670 Muvattupuzha, Ernakulam, Kerala, India, Tel. & Fax: +914852260832, E mail: prsvkm@gmail.com

   4) Joy P.P., Anjana R. & Soumya K.K., PESTS OF PINEAPPLE AND THEIR MANAGEMENT. Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm

6. Joy P.P. & Anjana R., BLOOMING PATTERN OF PASSION FRUIT (*Passiflora Edulis*) IN KERALA PLAINS, Pineapple Research Station (Kerala Agricultural University), Vazhakulam - 686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm
7. Joy P.P. & Rashida Rajuva., PASSION FRUIT RECIPES (*Malayalam*), Pineapple Research Station (Kerala Agricultural University), Vazhakulam - 686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm

8. Joy P.P. & Rashida Rajuva., PINEAPPLE RECIPES (*Malayalam*), Pineapple Research Station (Kerala Agricultural University), Vazhakulam - 686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm
9. Joy P.P. & Rashida Rajuva., PASSION FRUIT RECIPES, Pineapple Research Station (Kerala Agricultural University), Vazhakulam - 686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm

10. The following articles are submitted for publication in PINEAPPLE DIRECTORY 2014 by Pineapple Farmers' Association & Pineapple Merchants' Association, Vazhakulam
    1) Joy P.P., PROTOCOL FOR PINEAPPLE "KERALA MAURITIUS" VARIETY FOR EXPORT TO SHORTER DURATION (15-18 DAYS), Pineapple Research Station (Kerala Agricultural University), Vazhakulam - 686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm
    2) Joy P.P., PRODUCTION TECHNOLOGY FOR VAZHAKULAM PINEAPPLE (MAURITIUS), Pineapple Research Station (Kerala Agricultural University), Vazhakulam - 686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm
    3) Joy P.P., VAZHAKULAM PINEAPPLE, Pineapple Research Station (Kerala Agricultural University), Vazhakulam - 686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm
    4) Joy P.P., Anjana R. & Soumya K.K., PESTS OF PINEAPPLE AND THEIR MANAGEMENT, Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm
    5) Joy P.P., AD-HOC RECOMMENDATION FOR ORGANIC PRODUCTION OF THE PINEAPPLE VARIETY MAURITIUS, Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670, Muvattupuzha, Ernakulam, Kerala, India. Tel. & Fax: +914852260832, Email: prsvkm@gmail.com, Web: www.kau.edu/prsvkm
    6) Joy P.P., Minu Abraham, FRUITS, BENEFITS, PROCESSING, PRESERVATION AND PINEAPPLE RECIPES, Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670, Muvattupuzha, Ernakulam, Kerala, India, Tel. & Fax: +914852260832, E mail: prsvkm@gmail.com
    7) Joy P. P. & Sindhu G., DISEASES OF PINEAPPLE (*Ananas comosus*) Pathogen, symptoms, infection, spread & management, Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670, Muvattupuzha, Ernakulam, Kerala, India, Tel. & Fax: +914852260832, E mail: prsvkm@gmail.com

8) Joy P.P., BENEFITS AND USES OF PINEAPPLE, Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670, Muvattupuzha, Ernakulam, Kerala, India, Tel. & Fax: +914852260832, E mail: prsvkm@gmail.com
9) Joy P.P., Anjana R., Prince Jose, PROTOCOL FOR MICROPROPAGATION OF PINEAPPLE, Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670, Muvattupuzha, Ernakulam, Kerala, India, Tel. & Fax: +914852260832, E mail: prsvkm@gmail.com
10) Joy P.P., Anjana R., PINEAPPLE VARIETIES, Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670, Muvattupuzha, Ernakulam, Kerala, India, Tel. & Fax: +914852260832, E mail: prsvkm@gmail.com
11) Joy P.P., PINEAPPLE SECTOR IN KERALA: STATUS, OPPORTUNITIES, CHALLENGES AND STAKE HOLDERS, Pineapple Research Station (Kerala Agricultural University), Vazhakulam-686 670, Muvattupuzha, Ernakulam, Kerala, India, Tel. & Fax: +914852260832, E mail: prsvkm@gmail.com
12) ബേബിലത, **പൈനാപ്പിൾ സംസ്കരണം**, പൈനാപ്പിൾ റിസർച്ച് സെന്റർ, വെള്ളാനിക്കര
13) ബേബിലത, **പൈനാപ്പിൾ കൃഷിരീതികൾ**, പൈനാപ്പിൾ റിസർച്ച് സെന്റർ, വെള്ളാനിക്കര
14) ജോയ് പി.പി., അഞ്ജന ആർ., **വളപ്രയോഗം പൈനാപ്പിളിൽ**, പൈനാപ്പിൾ ഗവേഷണ കേന്ദ്രം, വാഴക്കുളം
15) ജോയ് പി.പി., ദിവ്യ സി.ജി., അഞ്ജന ആർ., **പൈനാപ്പിൾ ടിഷ്യൂ കൾച്ചർ,** പൈനാപ്പിൾ ഗവേഷണ കേന്ദ്രം, വാഴക്കുളം
16) ജോയ് പി.പി., അഞ്ജന ആർ., **പൈനാപ്പിളിലെ രോഗങ്ങളും അവയുടെ നിയന്ത്രണവും,** പൈനാപ്പിൾ ഗവേഷണ കേന്ദ്രം, വാഴക്കുളം
17) ജോയ് പി.പി., **വാഴക്കുളം പൈനാപ്പിൾ ഭുസൂചിക**, പൈനാപ്പിൾ ഗവേഷണ കേന്ദ്രം, വാഴക്കുളം
18) ബേബിലത, **ഹോർമോൺ പ്രയോഗം പൈനാപ്പിൾ കൃഷിയിൽ**, പൈനാപ്പിൾ റിസർച്ച് സെന്റർ, വെള്ളാനിക്കര
19) ജോയ് പി.പി., ഹസിത എം.എം., **പൈനാപ്പിളിന്റെ ഗുണങ്ങൾ,** പൈനാപ്പിൾ ഗവേഷണ കേന്ദ്രം, വാഴക്കുളം
20) ബേബിലത, ജോയ് പി.പി., അഞ്ജന ആർ., **കൈതചക്ക ഇനങ്ങൾ,** പൈനാപ്പിൾ റിസർച്ച് സെന്റർ, വെള്ളാനിക്കര, പൈനാപ്പിൾ ഗവേഷണ കേന്ദ്രം, വാഴക്കുളം
21) ജോയ് പി.പി., സുൾഫിക്കർ അലി, അഞ്ജന ആർ., **വിവിധ ഇനം പൈനാപ്പിളുകളുടെ വിലയിരുത്തൽ**, പൈനാപ്പിൾ ഗവേഷണ കേന്ദ്രം, വാഴക്കുളം
22) ജോയ് പി.പി., അജു കെ. ബാലൻ, അഞ്ജന ആർ., **പൈനാപ്പിളിന്റെ ചരിത്രവും ഇന്നത്തെസ്ഥിതിയും**, പൈനാപ്പിൾ ഗവേഷണ കേന്ദ്രം, വാഴക്കുളം
23) ജോയ് പി.പി., സുൾഫിക്കർ അലി, അഞ്ജന ആർ., **പൈനാപ്പിളിന്റെ ഗുണമേന്മ നിർണയം,** പൈനാപ്പിൾ ഗവേഷണ കേന്ദ്രം, വാഴക്കുളം

24) ജോയ്പി.പി.,അഞ്ജന ആർ., **പൈനാപ്പിളിന്റെ സധ്യതകളും വെലുവിളികളും**, പൈനാപ്പിൾ ഗവേഷണ കേന്ദ്രം, വാഴക്കുളം

25) ജോയ് പി.പി.,അഞ്ജന ആർ., **കൈതെച്ചക്കയിലെ കീടങ്ങളും അതിനുള്ള പ്രതിവിധിയും**, പൈനാപ്പിൾ ഗവേഷണ കേന്ദ്രം, വാഴക്കുളം

6.4 Student Projects

Table 69. Student projects undertaken during the year

Discipline	Name of the Student	Name of the University	Major Advisor	Title of the Thesis
M.Sc. Food Science & Technology	Ashamol Salam	Calicut University College, Thenjipalam	Dr.P.P.Joy	Passion Fruit (*Passiflora edulis*): Benefits, Processing, Preservation & Product Development
B.Sc. Biotechnology	Acsa Mathew	Al- Azhar College of Arts and Science, Thodupuzha, MG University	Dr.P.P.Joy	Isolation & Identification of Predominant Bacteria & Fungal Contaminations from Tissue Culture Media & Antifungal Activity

6.5 New Project proposals

1. Project Proposal under RKVY (2013-14) entitled TISSUE CULTURE PRODUCTION OF PLANTING MATERIALS submitted to the Director, Agriculture (PPM Cell) Department, Secretariat, Thiruvananthapuram through the Director of Research, Kerala Agricultural University
2. Project proposal under KAU Plan (2013-14) entitled RESEARCH ON PINEAPPLE submitted to the Director of Research, Kerala Agricultural University
3. Project entitled INTRODUCTION AND EVALUATION OF HIGH YIELDING SUPERIOR QUALITY PINEAPPLE VARIETIES FOR KERALA under Pineapple Mission (2013-16) submitted to Pineapple Mission through Director of Research, Kerala Agricultural University
4. Project entitled INTRODUCTION AND EVALUATION OF HIGH YIELDING SUPERIOR QUALITY PINEAPPLE VARIETIES FOR KERALA under Pineapple Mission (2014-15 Revised) submitted to the Director of Research, Kerala Agricultural University
5. Proposal for DEVELOPMENT OF PINEAPPLE RESEARCH STATION, VAZHAKULAM (2013) submitted to the Chairman, Planning, Development & Resource Mobilization committee, Kerala Agricultural University

7. VISITORS

Table 70. Important Visitors to the Station during the Year 2013 - 2014

Date	Visitors
04/05/2013	Mr. Vrushali Afkar, Mr. Ajay Afkar, Optometrists, Thergaon, Pune
17/05/2013	Dr. N. Pradeep Kumar & Dr. K. N. Vijayakumar, VCRC (ICMR) Mr. Noble John, Director, Pineapple Growers & Processors, PVT Ltd; Mr. Josekalapura, President, Pineapple Farmers Association, Mr. V. P. Chackochan, Vice President, Pineapple Farmers Association.
20/05/2013	Mr. Bibin K Baby, Rajakkadu
24/05/2013	Ms. Ashi Susan Nincen, Field Officer, Agri Commercial Branch, Ernakulam
25/05/2013	Mr. M. Ravinder, Research Fellow, Hyderabad
31/05/2013	Mr. K. D. James, Section Officer, DPP, KAU
01/0/6/2013	Ms. Nisha.A. P., Research Scholar, Department of Botany, University of Kerala
19/06/2013	Teachers & Students, KCAET, Thavanur, KAU
19/06/2013	Bhoomithra Organic Manure, Sales Manager
12/07/2013	Dr. S. Beena, Professor of Plant Pathology, Vellanikkara & Ms. Rani Varghese, Ms. Mahia, Research Assistants
24/07/2013	M. Padma Kumar & Team, Pest Control, Pvt Ltd.
02/09/2013	Mr. P. Shamsudheen, State Marketing Manager, IFFCO, Ernakulam Mr. V. V. Muraleedharan, Deputy Field Manager, IFFCO, Ernakulam
20/09/2013	Mr. Murugadoss R. M. M., Mr. Ramakrishna Rae, Mr. Pandian, Kumily, Mr. Ashish Kumar, Kottayam
24/09/2013	Mr. Raj Jacob, Koovaplackal, Meenkunnam, Muvattupuzha
04/10/2013	Mr. Ajay Afkar & Team, Pune
10/10/2013	Mr. K.Sreekumar & Mr. Vinod, Mudakuzha, Akanadu
22/10/2013	Teachers & Students Govt. VHSS, Muvattupuzha
24/10/2013	Mr. K.G.S Nair, Consultant Food Technologist
29/10/2013	Dr. A.K Babylatha, Prof & Head, PRC, Vellanikkara, Dr. Lyla K.R, Prof & Head, AICRD, Vellanikkara, Mr. Gregory Zacharia, Assoc. Prof, Vellanikkara
08/11/2013	Mr. Saneesh Salim, B2N Consulting, Palarivattom, Kochi
04/12/2013	Ms. Namitha Shivasanjkaran, Institute of Rural Management, Anand , Gujarat
07/12/2013	Mr.Ajith Kannan, Reporter, The New Indian Express
10/1/2014	Mr. Saneesh Kumar T.K, Mr. Abdulla N.V.K & Mr. Sajeesh .S, Unipulp Agri Industries, Calicut
14/02/2014	Dr. D. Kubedran, Mr. Murugadoos & Mr. Pandiya, Bayer Crop Science, Coimbatore
17/02/2014	Smt. Priya, Chief Coordinator, Canara Bank, Trivandrum; Smt. Mymoon, Manager, Canara Bank, Vazhakulam
10/03/2014	Dr. Aninedhu A. Kulkarni, Manager-Projects and strategy, Thane, on behalf of Council For Food Research Development Corporation
21/03/2014	Agricultural officer and farmers from Puthukkode Krishibhavan, Palakkad

Mr. Vrushali Afkar & Mr. Ajay Afkar from Thurgau, Pune discussing on introduction of pineapple cultivation in Pune

Mr. Ravinder from Hyderabad interacting with Dr. P.P. Joy regarding cultivation of Pineapple and Banana

Teachers & Students, KCAET, KAU interacting with Head of the station

Mr. Ajith Kannan from The New Indian Express discussing with Dr.P.P. Joy

Dr. N. Pradeep Kumar & Dr. Vijayakumar from VCRC, ICMR discussing with Dr. P.P. Joy & Pineapple Farmers Association on management of vector breeding in pineapple

Mr. K.D. James, Section Officer, DPP, KAU, Vellanikkara visiting the roof top nursery at the station

Figure 96. Visitors to the station during the year

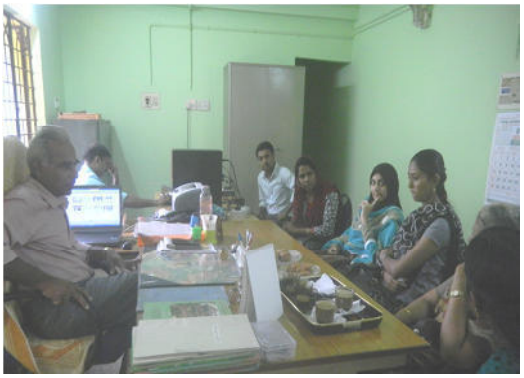
Smt. Priya, Chief Coordinator, Canara Bank, Trivandrum, Smt. V. M. Mymoon, Manager, Canara Bank, Vazhakulam inaugurating the training programme

Dr.P.P. Joy, Head of the station interacting with the farmers from Palakkad dist.

Dr. Babylatha & Team visiting the station & discussing about Pineapple field diseases with Dr. P.P. Joy, Assoc. Prof. & Head, PRS, Vazhakulam

Mr. Aninedhu A. Kulkarni, Manager-Projects & strategy, Thane, on behalf of Council for Food Research Development Corporation interacting with Dr. P.P Joy

Teachers & Students, GVHSS, Muvattupuzha interacting with the Head of the station



Dr. Beena & Team visiting the Station & discussing about Passion Fruit Diseases with Research Assistants & Head of the Station, PRS, Vazhakulam

Figure 96. Visitors to the station during the year (continued)

8. APPENDICES

8.1 Pests of Pineapple and their Management

Pests of Pineapple and their Management

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Pineapple is one of the most important fruit crops of Kerala. It belongs to family Bromeliaceae. It grows in the soil and resembles epiphytes in that their roots are intolerant of poor soil aeration (Joy and Sindhu, 2012). This fruit is native to southern Brazil and Paraguay where its wild relatives occur. Portuguese had introduced the pineapple to India and Java, and the fruit, delighted with the climate that so closely mirrored its conditions of origin, spread throughout the Far East. The Indians carried it to the West Indies before Columbus arrived. In 1493, Columbus found the fruit on the island of Guadeloupe and carried it back to Spain and it was spread around the world on sailing ships that carried it for protection against scurvy. The Spanish introduced it into the Philippines and may have taken it to Hawaii and Guam early in the 16th Century. The pineapple reached England in 1660 and began to be grown in greenhouses for its fruit around 1720.

Figure 1. Pineapple (*Ananas comosus*)

Pineapples are infested by a variety of insect pests. Some pests that affect pineapple plants are mealy bugs, scale insects, thrips, fruit borer, bud moths, midgets, fruit flies, white grubs, beetles, weevils, termites and mites as described below. Mealy bugs are the most important insect pest of pineapple in many countries while others may reach threshold levels in certain favourable situations causing serious crop damage. Soil and climatic factors, crop stages and crop management practices affect the intensity of pest infestation. An integrated approach comprising

Pineapple Mealy Bug

Figure 2. Pineapple Mealy Bug

Source: www.bugwood.org, retrieved on 14 Oct 2013

prophylatic, cultural, mechanical, biological (use of bio-agents and bio-pesticides) and need based chemical measures is most ideal in managing most of the pests and keeping their population below the threshold level so as to avoid serious crop losses.

Description and Identification

Mealy bugs belong to the class: Insecta, order: Hemiptera, Family: Pseudococcidae, Genus: *Dysmicoccus,* Species: *brevipes* - (cockerell). They appear as cottony, small, oval, soft-bodied sucking insects. They are in variety of forms, of which pink coloured ones are commonly referred to as pineapple mealy bug. They mainly inhabit on seed material (Bartholomew, *et al.,* 2003). These bugs have mobility only at younger stage (Carillo, 2011).

Adult mealy bugs are elliptical in shape and are identified with 17 pairs of wax filaments (Tanwar *et al*, 2007). They are soft-skinned insects with waxy secretions, which give their body surfaces a chalky appearance. They also have white, waxy filaments of various lengths extending from the lateral margins of their bodies. They are mainly seen as colonies of more than 20. The first-stage (or first-instar) crawlers (0.6–0.7 mm) are typically the most active stage, and they move around the host plant seeking a place to get rested. Further they excrete honey dew which makes ants to get attracted and transport them to nearby areas. The honey excreta accumulated in large quantities may support the growth of sooty mould, *Capnodium* sp.

The adult stage produces a fluffy wax mass which holds its golden-coloured eggs. Mealy bugs first appear on roots and hence it is difficult to tackle it at its early stages. The roots cease growing and result in collapse of the tissue. They are also found on the aerial parts of the plant, mainly in the leaf axils and on the developing fruit. Mealy bugs feed on plant sap in the phloem of their host plants.

Biology

Pineapple Mealy bugs are ovoviviparous *i.e.*, the eggs hatch within the female and give birth to larvae. The life cycle of *D. brevipes* was extensively studied (Ito, 1938). It includes three stages. Its life span counts to 95 days.

Eggs*:* These are minute, varying from 0.3 to 0.4 mm in length. Its development takes between three and nine days.

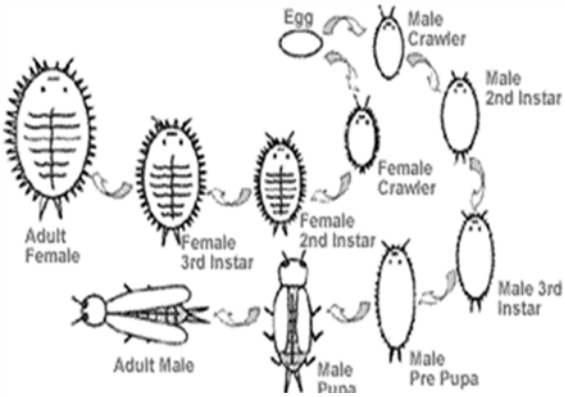

Figure 3. Life cycle of mealy bug

(Annecke and Moran, 1982)

Larvae: The larval stage contributes to complete dispersal of the bugs since their body is extensively covered with hairs. Hence they are called crawlers. The larval period extends up to 40-50 days. The first, second and third instars of larval stages last for 10 to 26 days, 6 to 22 days and 7 to 24 days respectively. Larvae only feed as a first instar and in the early part of the second instar.

Adults: Adult females have soft, convex, pinkish body. Also their body is surrounded by 17 pairs of wax filaments. Lateral wax filaments are usually less than one fourth as long as the breadth of the body, and those towards the back of the insect are one-half as long as the body. The prelarviposition period for adult females lasts for around 27 days. The larviposition (giving birth to larvae) period lasts for an average of 25 days. They give birth to about 234 progenies but may produce up to 1000 crawlers. She may then live for another 5 days before dying. Duration of adult female varies from 31-80 days with an average of 56 days (Balachowsky, 1957). There may be as many as 15 generations. Adult males are having a distinguishable number of eight antennal segments.

The species survives in cold as eggs or other stages, both on the host plant and in the soil. In warm climates, the insects stay active and reproduce round the year (Tanwar *et al*., 2007).

Nature of Damage

Mealy bugs become lethal when their population gets increased since the bugs suck the sap from leaves causing the plant to wilt.

Figure 4. (a) Mealy bugs infested pineapple sucker (b) Ant interaction with mealy bugs (c) Mealy bug Infested Pineapple fruit (d) Pineapple Mealy bug Wilt Associated Virus attacked pineapple field.

Source: a. www.forestryimages.org, b. ucce.ucdavis.edu, retrieved on 12 Oct 2013

They are dispersed by ants. The sugary secretions of the mealy bug attract ants and they carry them making it vast spread. Also the excretion of honey inhibits the plants ability to manufacture food, form chlorosis of underlying plant tissues and cause rotting and leaking of fruits. When fruits are infested they become entirely covered with white, waxy coating making it unfit for marketing. Leaves appear pale green to yellow streaks; tips become brown. The predominant symptom is wilting of leaves commencing from the leaf tips. Reddish-yellow

colour manifests in the wilting areas. Mealy bug causes quick wilt (result in yellow or red leaves) under heavy infestation or slow wilt (no definite colour change) in mild attack due to root damage. (ncof.dacnet.nic.in/Books_on_Organic_Package_of_Practices/POP_NERegion.pdf).

Management

Mealy bugs infest commercial pineapple plantings worldwide, impacting pineapple production in several ways (Beardsley, 1993). Their greatest impact is associated with the disease mealy bug wilt of pineapple (MW) (Rohrbach *et al.*, 1988). They may infest developing plants and fruit, thereby becoming serious pests to the crop, reducing fruit quality and quantity by infuencing plant development (Carter, 1933). Mealy bug stripes appear in plants because of their feeding (Carter, 1967). They greatly affect the growth of young pineapple seedlings (Carter, 1962). Sometimes mealy bugs are found as contaminants in canned fruit and their presence on fresh market fruit may violate quarantine restrictions at port entrances.

Prevention*:* Pre-planting treatments are effective in controlling pineapple mealy bugs. Pineapple cultivation using five to six years old suckers should be avoided. Selection of healthy suckers is inevitable. Before planting, suckers can be dipped in insecticidal solution for about 5 minutes, for example a diazinon base (900 ml of commercial product/600 l of water/ha) or botanical extracts (1200 ml/600 l of water/ha) in organic agriculture (Carillo, 2011).

Biological Control**:** There are many natural enemies for this mealy bug and they can be introduced to mealy bug infested fields for their control. Some are discussed here.

*Rhinoleucophenga***:** A new species of *Rhinoleucophenga*, a potential predator of pineapple mealy bugs (Culik, 2009) was introduced in Brazil. They are larval predators of scale insects (Vilela, 1990; Grimaldi, 1993). *Rhinoleucophenga* species are present in areas such as Espírito Santo.

*Cryptolaemus montrouzieri***:** It is commonly called as the redheaded ladybird beetle or the mealy bug destroyer. It has been introduced in Karnataka to reduce large populations of pink mealy bug. The adult female lady bird beetle lays egg among mealy bug egg masses. The larvae of the beetle grow up to 1.3 cm in length and have wooly appendages of wax making them similar to mealy bugs. The beetle larvae feed on mealy bug eggs and young crawlers. The life span of the *C. montrouzieri* is two months within which they lay up to 400 eggs. It is capable of eating up to 5,000 mealy bugs in various life stages.

*Anagyrus kamali****:*** They are parasites from China and introduced in Karnataka for the control of pink mealy bugs. It feeds on mealy bug in two ways: (i) the female wasp punctures the bug and sucks the sap and (ii) it lays egg within the bug. When the egg matures it comes out of the bug's body. The entire process takes only half the entire life span of mealy bugs.

Anagyrus ananatis Gahan: These parasites help to control the alarming mealy bug populations leading to mealy bug wilt associated disease (Gonzalez-Hernandez, 1995). This strategy depends on the continued annual approval of the Environmental Protection Agency and the Hawaii Department of Agriculture which permit this product to be used on a special need basis.

Verticillium lecanii / *Beauveria bassiana:* Foliar spray of *Verticillium lecanii* or *Beauveria bassiana* (2×10^8 cfu/ml) at 5 g/ml per litre of water is effective during high humid months in reducing the population of mealy bugs (Tanwar *et al.*, 2007).

Cultural Control: Mealy bug spread can be minimized by the destroyal of ant population. The mealy bug infested fields must be prepared by removing all the plant residues and incinerating them. Also weeds present in the field support a hike in mealy bug population by giving them food resources. Also removal of alternate hosts like *Hibiscus*, custard apple, guava in and nearby crop is also essential. Use of sterile equipment when applying in an uninfested field is advisable.

***Chemical Control*:** As a final attempt for the control of mealy bugs chemical practices are to be followed.

- Apply Chlorpyriphos (Hilban 20EC, 2.5 ml/l), Imidacloprid (Tatamida 200SL, 0.3 ml/l) or Quinalphos (Ekalux 25EC, 2 ml/l) at 500-600 l/ha.
- Indirect control of mealy bugs can be achieved by treating the soil either with 2.75 kg/ha of chlordane or heptachlor (2.25 kg/ha) to kill the ants.
- Basal portions of the planting materials have to be dipped in 0.02-0.04% methyl parathion as a prophylactic measure (megapib.nic.in/pppineapple.htm.)
- Locate ant colonies and destroy them with drenching of chlorpyriphos 20 EC at 2.5 ml/l or apply 5% malathion dust at 25 kg/ha (Tanwar *et al.*, 2007).
- Diazinon is applied once or twice to a few fields (2%). Also a preplant dip in diazinon doubles the shield (Sipes, 2000).

Scale Insects

Description and Identification

The pineapple scale, belongs to Order: Hemiptera, Family: Coccoideae, *Diaspis bromeliae* (Kerner), is likely to be found on upper leaf surfaces of pineapple leaves and fruit worldwide (Waite, 1993). It has varying appearance; some are very small organisms (1–2 mm) that grow beneath wax covers (some shaped like oyster shells, others like mussel shells), to shiny pearl-like objects (about 5 mm), to creatures covered with mealy wax. Adult female scales are almost always immobile (aside from mealy bugs) and permanently attached to the plant they have parasitized. They secrete a waxy coating for defense; this coating causes them to resemble reptilian scales or fish scales, hence their common name. Yellow spots may develop on leaves when scale densities are low (Waite, 1993). Other scales have been reported infesting pineapple but these are not normally a problem. The brown (or red) pineapple scale, *Melanaspis bromeliae*, is similar in appearance to *Diaspis bromeliae*, but it is a chocolate-brown colour with an elevated centre (Carter, 1967). Nigra scale, also known as black coffee scale, *Parasaissetia nigra*, may be found on pineapple (Zimmerman, 1948).

The group shows high degrees of sexual dimorphism; female scale insects, unusually for Hemiptera, retain the immature external morphology even when sexually mature, a condition known as neoteny. Adult males usually have wings (depending on their species) but never feed, and die within a day or two.

Figure 5. Left: Melanaspis bromeliae, Right: Diaspis bromeliae
Source: www.sel.barc.usda.gov, retrieved on 23 October, 2013

Biology

Scale insects have three distinct life stages (egg, immature, adult) and may complete several generations in a single year. The first instars of most species of scale insects emerge from the egg with functional legs and are informally called "crawlers". They immediately crawl around in search of a favourable spot to settle down and feed. There are many variations on such themes, such as scale insects that are associated with species of ants that act as herders and carry the young ones to protected sites to feed. In either case, many such species of crawlers, when they change their skins, lose the use of their legs. Only the males retain their

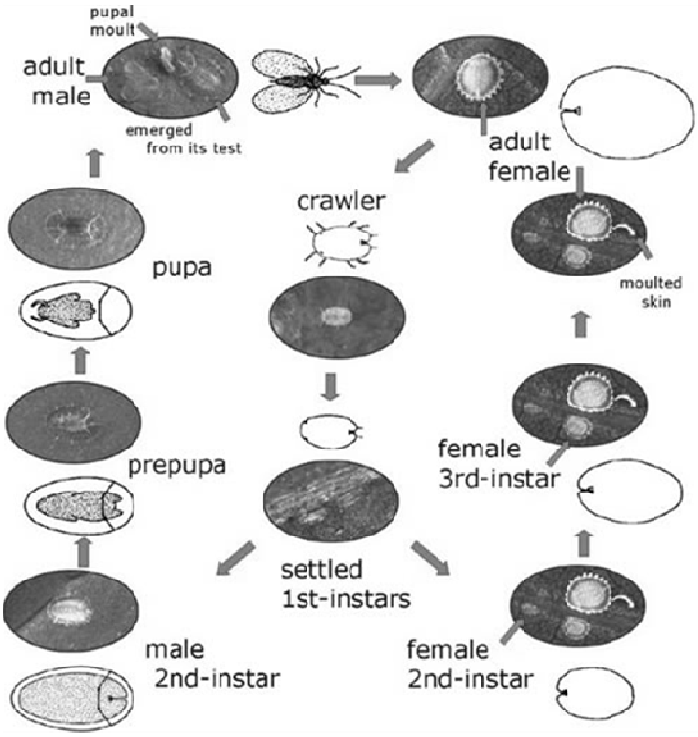

Figure 6. Life cycle of Scale insects
Source: www.landcareresearch.co.nz, retrieved on 23 Oct 2013

legs and use them in seeking females for mating. The essentials of their reproductive systems vary considerably within the group, including hermaphroditism and at least seven forms of parthenogenesis.

Eggs: Adult females produce eggs beneath the scale covering or in a cottony material, and in many cases spend the cold winter months in this stage.

Larvae: Tiny six-legged crawlers emerge from the eggs, move to newer growth on the plant, insert their mouthparts and begin to feed. A scale-like covering produced from waxy filaments and feces then forms over each individual scale.

Adults: Scale species are identified by the colour and shape of the covering. The covering protects scales from predation by other insects and from insecticides. The male scale is often a slightly different shape than the female and passes through a tiny, winged stage. The casual observer seldom sees winged stages. Females are wingless and usually remain in one place after inserting their mouthparts into plant tissues.

Nature of Damage: A symptom of an attack is rust coloured spots. The insect is found beneath secretion, which serves as a shield. In the case of this insect the scale or protective armor is made up partly of a waxy secretion of the insect and partly of molted skins. The insect itself in the adult stage is quite well buried beneath the epidermis of the plant and hence there is necessity of combating the pest in its early stages. During periods of large populations, some scales become so abundant that an infested plant tissue is totally encrusted with insects.

Management

***Biological Control*:** This pest may be biologically controlled by natural enemies (Waite, 1993). Tiny wasps, including *Aphytis chrysomphali* (Mercet), *Aphytis diaspidis* (Howard) and *Aspidiotiphagus citrinus* (Craw) (Hymenoptera: Aphelinidae), parasitize the scales, resulting in scale death (Zimmerman, 1948). Ladybirds, such as *Rhyzobius lophanthae* Blasid. and *Telsimis nitida* Chapin (Coleoptera: Coccinellidae), also prey upon the scales (Carter, 1967; Waite, 1993).

At the same time, a few scale insects are biological pest control agents in their own right, such as various species of *Dactylopius*, the cochineal genus, that attack pest species of Opuntia.

***Chemical Control*:** A light, superior oil/insecticide mixture as for mealy bugs may be applied just as plants begin to grow to control emerging crawlers. This time period usually lasts only a few days, so timing is critical. The oil must be applied before leaves open, yet late enough so that this mixture will kill the crawlers. The best time to apply any insecticide is when crawlers are present, as this stage does not have a protective covering, and is therefore vulnerable to almost any chemical registered for this use. Several conventional insecticides and insecticidal soaps are registered for crawler management. The plant must be thoroughly covered to kill the crawlers with one application. Systemic insecticides, applied as a foliar spray, can help control adult scale insects during the growing season. Each situation is unique, so it is important to know which scale species is present overly successful or practical control.

Thrips

Figure 7. Left: Thrips tabaci, Right: Frankliniella occidentalis
Source: ecoport.org, retrieved on 23 Oct 2013

Description and Identification

Thrips belongs to the Order: Thysanoptera (Thrips), Family: Phlaeothripidae, *Holopothrips ananasi* known as pineapple thrips causing serious damages to pineapple (Cavalleri and Kaminski, 2007). As many as 39 species of thrips have been reported worldwide in and around pineapple fields (Sakimura, 1937; Carter, 1939; Petty, 1978d). These are small (1.5 mm long), slender, brown insects with pale yellow hind wings that appear as a yellow line down the back of the body when the insect is at rest. Adult thrips have characteristic wings; the transparent wings have a fringe of hairs around the outside edge standing out in the same plane as the wing. *Thrips tabaci, Frankliniella schultzei* are also considered as important pests of pineapples. The blossom thrips feeds mainly on flowers and its feeding results in the development of "dead-eye" in the fruit. Thrips feeding on the crown of fruits results in concentric ring patterns developing on crown leaves. Thrips are mobile and are able to ride great distances with wind. Water and high moisture seem to be very important for thrips. If there are moisture places thrips will readily move into these like, mulched areas. Thrips remain active the year round.

Biology

The life cycle of thrips is unique and fast.

Eggs: Females have a saw-like structure that helps to make an incision in plant tissue for egg laying. Usually eggs are laid into incisions in the epidermis of the leaves and stems of young plants. Eggs are elliptical, white, approximately 0.02 cm in length, placed singly, just under the epidermis of succulent leaf, flower, stem or bulb tissue. They are whitish at deposition and change to an orange tint as development continues. It

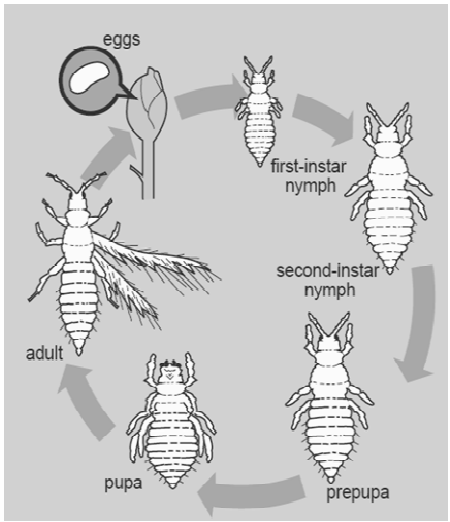

Figure 8. Life cycle of Thrips
Source: www.cep.unep.org, retrieved on 23 Oct 2013

will hatch within 4 to 10 days. Hatching young will immediately begin to suck sap and fluids containing nutrition.

Larvae: Larvae as well as the adult insects pierce the leaves and swallow the sap. Pupation takes place in the ground. The emerging adult is about 1 mm long and has a yellow-brown colour with dark cross stripes on the body. There are two larval stages and besides the adults they are the only damaging stages. Larval development is completed in about 9 days. There are two non-feeding stages called the prepupa and pupa. They do not feed and occur primarily in the soil. Combined prepupal and pupal development is completed in 4-7 days.

Adults: Adults are 0.02 cm long. Their body colour ranges from pale yellow to dark brown; wings are unbanded and dirty grey. In Hawaii, this species has a darker form during the rainy season. Males are wingless and exceedingly rare. Females live for about two to three weeks and each can lay about 80 eggs. Mating for reproduction is not necessary. Females produce only female offspring without mating. Females can produce up to 80 eggs, that is why large populations can be generated within a short period. The entire life cycle is estimated as three weeks producing 5-10 generations in a year.

Nature of Damage

Thrips feed on the plant sap by damaging the leaves. The typical appearance of the damage is a silvery-flecked leaf surface which in severe cases turns brown. These leaves can not sufficiently photosynthesise. Small black spots on the leaves, the excrements of the insects, are a sign of thrips infestation. Most thrips rest tightly against leaf veins or in crevices. They are primarily active during the daylight hours. Thrips are responsible for the transmission of many fungal and viral diseases in plants. When infestations are heavy, people and animals will be troubled with stinging thrips. These can also have positive effects on plants. A few species prey on destructive mites and scale insects, resulting in the formation of leaf mould. A few others may aid in the pollination of flowers. These are preyed upon by many insects (including other thrips), mites, birds, salamanders and lizards. Heavy rains, winds and dust are, however, probably as destructive to thrips as are predators. Natural parasites are minute parasitic wasps (Eulophidae) that attack the larvae.

Thrips feed by piercing individual cells and sucking the contents. These cells lose their normal colour, and when many adjacent cells are damaged, the tissue appears as whitish spots or silvery spots or streaks. In advanced injury the leaves take on a blasted appearance. As is common with many thrips species, onion thrips deposit small dark specks of excrement on the surface of tissue where they feed. Substantial damage can be done to young plants especially to varieties grown in seed beds.

Besides direct damage caused by feeding of larvae and adults, this pest is also important as a vector of tomato spotted wilt virus and has been involved in transmitting the disease in pineapple, tomatoes and certain other crops.

Management

Prevention: Thrips are most infestive during drought but not in rainy seasons. Irrigation might reduce thrips population. They move by wind. Establishment of windbreaks reduces thrips population. Recommended economic threshold for small scale farmers is when 20% of the plants are infested with thrips.

***Biological Control*:** Plants that have a natural repellence to thrips are citronella, garlic and pyrethrum. A spray made of garlic and pepper will control thrips. Two bulbs of garlic and some hot chilli peppers should be blended in some water. After blending the solid parts should be filtered. Add water up to 5 litres and this solution can be applied. Mix 2 kg of fresh plant material of *Andrographis paniculata* with 250 ml of water and grind it well. Add 21 litres of cow urine and 10 g of crushed dried chilli fruits. Add 10 litres of water and leave the solution for some time. Filter the solution and it is ready for spraying. Wash fresh roots of *Derris eliptica* and cut them into short pieces of 5 cm length. Add small amount of water and pound the roots until they are finely shredded. Filter the solution. Dilute with soap and water at a ratio of 1 part soap: 4 parts root solution: 225 parts water. Apply immediately.

Cultural Control: Remove weeds, Follow crop rotation, Mulching reduces thrips infestation considerably, Plough deep after harvest to bury the pupae.

***Chemical Control*:** A soap spray will kill thrips which needs to be repeated twice a week.

Description and Identification

Pineapple Fruit Borer

Figure 9. Fruit borer *Strymon megarus*
Source: neotropicalbutterflies.com, retrieved on 23 Oct 2013

It belongs to Order Lepidoptera and Family Lycaenidae. The pineapple fruit borer, *Strymon megarus,* is a pest that affects pineapple fields from Mexico to Argentina. Fruit borer affected fruits show alteration in their shape and galleries in the pulp.

S. megarus is present in all pineapple growing regions causing yield losses that vary according to pest population and environmental conditions. All pineapple varieties are affected. Recent evidence, however, has indicated that the insect is able to attack fruits even after the dry petal stage and to affect developing slips as well.

The pineapple fruit borer is considered as one of the principal pests of pineapple in Brazil. The larvae bore into the fruit causing holes and uneven fruit development. Damage from this pest varies greatly but can reach more than 90% and drier climates seem to favour borer attack. In most cases fruit borer attacks occur during flowering and formation of the fruit, though this borer can attack slips and rarely act as a leaf miner.

Biology

Eggs: Eggs are white, circular and slightly flat and approximately 0.8 mm in diameter.

Larvae: Larvae complete their development within the fruit. Burrowing and feeding activities produce visible damage in the form of frass production and a sticky, gummy exudate.

Adults: The reddish coloured caterpillar penetrates the inflorescence and remains in the tissue for 15 days, tunnelling and destroying the tissue. After this phase it moves to the base of the peduncle changing into a pupa 12 mm long and 5 mm wide with a brown colour and a few dark spots and emerges 7 to 10 days later as a butterfly. As the caterpillar destroys the tissues of the inflorescence a resin coloured liquid gum is exuded from between the fruitlets, which in contact with the air becomes reddish coloured and as it solidifies, turns dark brown. The adult moth has a greyish upper wing surface and a cream colour underneath with a wingspan of 28 mm to 35 mm. The adult can be found during the day or night, flying in a rapid and haphazard fashion. Eggs are laid on flowers from emergence to the end of flowering.

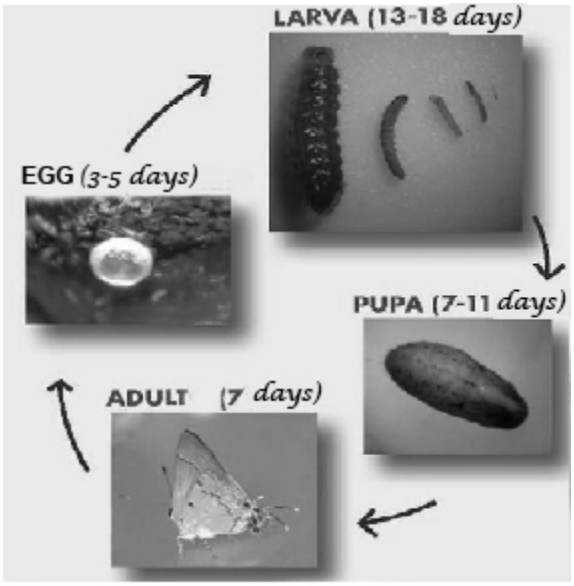

Figure 10. Life cycle of fruit borer
Source: www.cep.unep.org, retrieved on 23 Oct 2013

Management

***Biological Control*:** Based on the results of this study, *Bacillus thuringiensis* appears to be an acceptable biological alternative to carbaryl for control of *S. megarus* on pineapple.
***Chemical Control*:** Apply Chlorpyriphos (Hilban 20EC, 2.5 ml/l) at 500l/ha to control the borer.

Banana Bud Moth

Figure 11. Banana Bud Moth
Source: http://itp.lucidcentral.org/id/palms/sap/Moths_and_Butterflies.htm, retrieved on 28 Sep 2013

Description and Identification

Banana Bud Moth belongs to the order: Lepidoptera, Family: Tineidae, *Opogona sacchari* (Bojer) is native to the humid tropical and subtropical regions of the world infecting banana, pineapple, sugar cane and some ornamental crops. They were originally reported from the Mascarene Islands in the Indian ocean by Bojer in 1856 (Davis *et al*, 1990). The levels of *O. sacchari* infestation vary with location, age of the plant and propagation material. The larvae bore the plant base making an easy path for fungi and bacteria. Also it produces carbohydrate based exudates on the fruit surface

(Vorsino, 2005).

The identification of the pest can be easily achieved by the characteristic features of the developmental stages. The larvae appear as dirty-white and somewhat transparent and have a bright reddish-brown head with one lateral ocellus (small eye) at each side and clearly visible brownish thoracic and abdominal plates. They measured 21-26 mm in length having a diameter of 3 mm. The presence of older larvae can be detected by characteristic masses of bore-meal and frass (excreta) at the openings of bore-holes. The pupae are brown coloured and are of 10 mm and formed in a cocoon of 15 mm size. As the maturation progresses the pupae works itself to move to the next adult stage. The adult is nocturnal and having a length of 11 mm with a wing span of 18-25 mm. They are bright yellowish brown. The forewings may show longitudinal darker brown banding and in the male a dark-brown spot towards the apex. The hind wings are paler and brighter (Süss, 1974; Aguilar and Martinez, 1982). When they are at rest their antennae are pointed forwards.

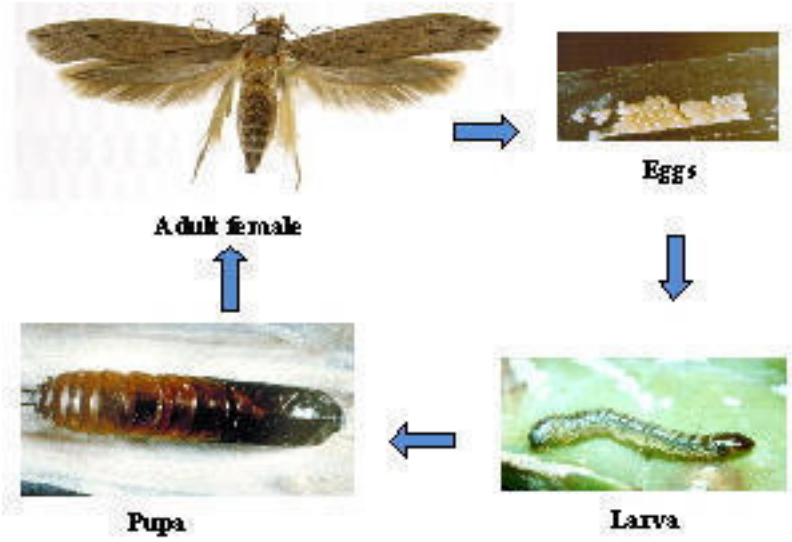

Figure 12. Life Cycle of Banana Bud Moth

Biology

The life span of banana bud moth lasts for three months. Similar to all other arthropods they also go through the stages like eggs > larvae > pupae > adult.

Eggs: The eggs are hatched in 12 days.

Larvae: The eggs develop to larvae within 50-60 days. They are mobile and avoid light. The organism is infectious at this stage. It has seven instars of growth.

Pupae: This stage lasts only for 20 days.

Adult: Its life is only for 6 days (Veenenbos, 1981).

The life span totally depends on temperature and it gets shortened at warmer conditions causing only eight generations per year (Giannotti *et al.,* 1977; Heppner *et al.*, 1987).

The females lay eggs in crevices of the plant tissue. It lays approximately 200 eggs.

Nature of Damage

The infestations of banana bud moth are exclusively dependent on optimal conditions of soil moisture, age and type of planting material, temperature, relative humidity, limited insecticide usage etc.

a. Banana bud moth's larvae normally feed on decaying plant parts and further infesting surrounding healthy tissue. Also it attacks leaves and thus destroying the xylem tissues causing the leaves to wilt.
b. The total growth of the plant retarded and further the whole plant perished.
c. A secondary infection of plant parasites and fungal pathogens make the effect more critical.
d. When they attack on mature fruit they bore into the peel of the fruit causing exudation of secondary metabolites like gum.

Management

Chemical control: The control of the pests is mainly by the application of suitable chemicals which has been successful in several European countries. The adult moths can be controlled by placing dichlorvos strips (one strip per 30 m^3, for 3 months). Thus the adult moths can be eradicated before they lay eggs. The pest infested poly house must be cleared and the soil should be steamed to eliminate all the pupae (Billen, 1987).

Sugar cane midget

Figure 13. Sugar Cane Midget
Source: bugguide.net/node/view/451773/bgimage, retrieved on 28 Sep 2013

Description and Identification

The sugar cane midget (Order: Lepidoptera, Family: Noctuidae, Genus: *Elaphira,* Species: *nucicolora)* also takes the common names like Thecla moth, Elaphira moth etc. Their main hosts are sugar cane and pineapple. It is mainly found in South-Eastern United States, South America, Oahu, Maui and Hawaii regions (Py *et al.*, 1987; Sanches, 1999). The females lay eggs on the inflorescence before anthesis. No eggs are laid in the fruit. The larvae formed infest the fleshy areas of the fruit and feeds within the developing inflorescence. They dig varying holes in the developing fruit. This cause deformed fruit development with no appeal (Py *et al.*, 1987). The attack of larvae causes exudates of gum on the fruit called gummosis which become hard when contact with air. This can easily bring out secondary infections with pathogens like *Fusarium moniliforme* var. *subglutinans* (Collins, 1960). The pupae are dark brown coloured.

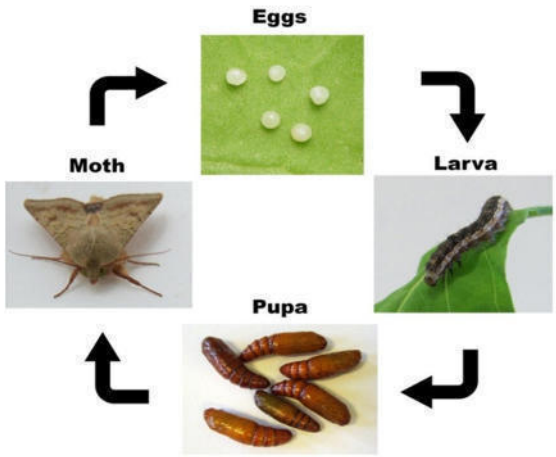

Figure 14. Life Cycle of Sugar Cane Midget

The caterpillar is nearly uniform in colour with dark fuscous, variegations in black. Adults have a wing spread of 12.7 cm.

Biology

Life cycle involve eggs, larvae, pupae and adult stages.

Eggs*:* The females lay single eggs. They hatch in five days.

Larvae*:* The eggs develop into larvae. They take 23 days in the life span. They are up to 7.6 cm in length. *Pupae:* This stage takes five days.

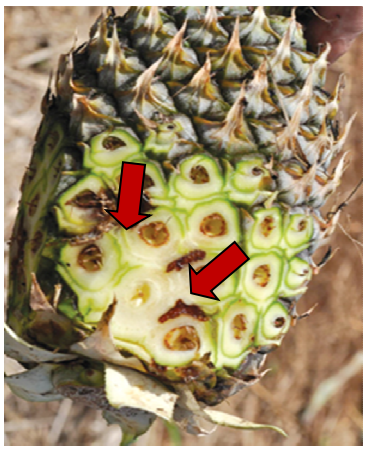

Figure 15. Sugar Cane Midget Larvae Infesting the Fruitlets
Source: microbials.valentbiosciences.com, retrieved on 28 Sep 2013

Adult*:* This stage lasts for ten days.

Nature of Damage

The larvae form galleries in the fruit The galleries open door for the attack of *Fusarium subglutinans*. The fruit pulp is attacked by the pest producing colourless appearance of the fruit pulp. The pest scrape the fruit rind and exudates gum called as gummosis.

Management

***Cultural Control*:** Strict monitoring required after forcing done. Hence applications must be intensified by the time.

Biological control: The aizawaii strain of *Bacillus thurigiensis*, has produced excellent results in combating this pest.

Pineapple Fruit Fly

Figure 16. Pineapple Fruit Fly
Source: www.mrjacksfarm.com/dnn/Resources/PestControl/tabid/634/Default.aspx, retrieved on 14 Sep 2013

Chemical control: The chemicals like diazinon, chlorpyrifos or lambda-cialothrin can be applied with suitable recommendation from the Agronomist (Carrillo, 2011).

Description and Identification

Pineapple fruit flies (Order: Diptera, Family: Richardiidae, Genus: *Melanoloma,* Species: *canopilosum, viatrix*) are found mainly in Paraguay and Peru**.** Their main host is *Ananas comosus* (pineapple) infecting the plant part, fruit (Bello, et *al*., 1997; Julca, *et al*., 1992). They are mostly neotropical in nature. Their distinctive features can be explained by their different life stages. The eggs are white and are tapered at the ends with a length of about 1.2 mm. They appear in colonies. The larvae develop are yellowish white, vermiform and devoid of legs. Their total length is approximately 9.5 mm which is made up of 11 segments. Of which three

pairs are at the thoracic region and there is a head region and the eighth at the abdominal region. The head region has small retractable cone shape with internal mandibular hooks. The first segment of the thorax has a pair of anterior spiracles with short extensions 12 to 14 digits. At the caudal region pair of posterior spiracles present. Each of them has three openings surrounded by esclerotizada. At the outward area from them form a series of projections in the form of hairs called inter spiracular processes. The larvae mainly inhabit at the shell and fleshy part of the fruit. The pupae are reddish brown, cylindrical capsule also with 11 segments. They project to a length of 5 mm with a diameter of 1.8 mm. The spiracles present are distinctive in nature and have well defined cephalic area. Adult grows up to 5- 6.5 mm long having wingspan of about 1 cm. They are black coloured with abundant micropubescecias. They have wide and short scuttellum. They presents with thorny hind femora of equal thickness. Their wings are clear devoid of any protrusions. It has a dark spot along its entire length. This extended to the wing margin and divide at the subcosta. The radial vein appears dark and cubitoanal cell is somewhat round (Arevalo and Osorio, 1995).

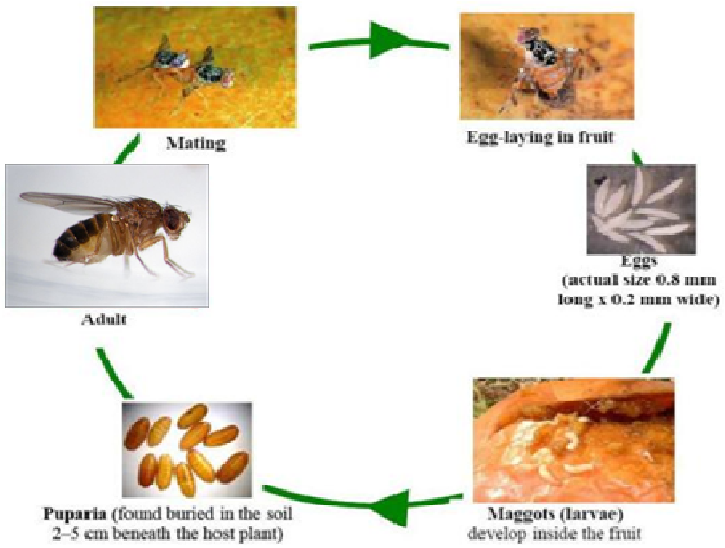

Figure 17. Life Cycle of Pineapple Fruit Fly
Source: www.infonet-biovision.org/default/ct/93/pests, retrieved on 14 Sep 2013

Biology

The life cycle involves the stages such as egg, larvae, pupae and adult.

Egg: The female flies lay eggs within the fruit.

Larvae: They are plant feeders. Sometimes they behave as saprophages invading decayed plant material. They also infest on fruits. They form cavities within the fruit which grow and coalesce and are called "spot with galleries". All further development of the larvae takes place within the fruit. This further causes fermentation of the fruit (Bello, *et al.,* 1997).

Pupae: Larvae continued to inhabit in fruits until the pupa state. Pupa stage lasts 15 to 20 days under laboratory conditions.

Adult: They have conspicuously pictured wings with metallic blue or greenish colour on the body and legs. Also they are ovipositors and lay eggs in fruits.

Nature of Damage

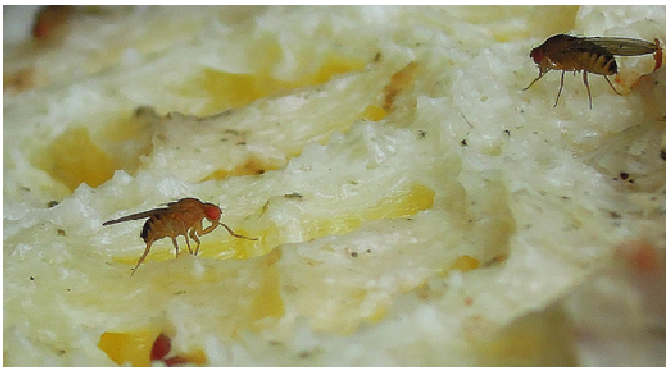

Figure 18. Pineapple Fruit Fly Infesting the Fruit
Source: www.flickr.com, retrieved on 14 Sep 2013

Pineapple fruit fly as the name defines it mainly infests fruits. The fruit damage starts when the female fruit fly punctures the fruit with its long and sharp ovipositor. The fruit skin is breached, and bacteria enter and the fruit starts to decay. The larvae that hatch from the eggs feed on the decaying fruit tissue, and on the yeasts and bacteria that multiply in it (ipm.ait.asia). Also the larvae groove into the pineapple fruit creating burrows. This causes discoloration, uneven ripening, early maturation and fermentation of fruit and further decay (Martínez *et al*., 2000).

Management

Prevention: Plucking off infested fruits is an important control of fruit flies. Fermented fruits must be cleared up. Or it can be exposed to sun for death of larvae and decomposition of fruit. Also the fruit stalls leftover fruits form the breeding places for these flies.

***Natural Methods*:** Traps containing fermented fruit covered with an inverted funnel can be placed near its breeding sites. Also bagging and netting of fruits are advisable.

Adults require protein for their reproduction hence the beer wastes impregnated with insecticides can kill the flies. Also harvesting of fruits without much ripening can restrict its attack (ipm.ait.asia).

White Grubs

Figure 19. Left: Masked chafer, Right: **May - June beetle**

Description and Identification

The white grubs (larval stage) of several beetle species in the family Scarabaeidae of Order : Coleoptera, commonly infest the roots of pineapple plants. Scarab species reported feeding on pineapple roots include, in Australia: the southern one-year canegrub, *Antitrogus mussoni* (Blackburn), Christmas beetle, *Anoplognathus porosus* (Dalman), rhopaea canegrub, *Rhopaea magnicornis* Blackburn, squamulata canegrub, *Lepidiota squamulata* Waterhouse (= *Lepidiota darwini* Blackburn, *Lepidiota leai* Blackburn, *Lepidiota rugosipennis* Lea), noxia canegrub, *Lepidiota noxia* Britton, and *Lepidiota gibbifrons* Britton (Waite, 1993); in South Africa: *Adoretus ictericus* Burmeister, *Adoretus tessulatus* Burmeister, *Trochalus politus* Moser and *Macrophylla ciliata* Herbst; and in Hawaii. Chinese rose beetle, *Adoretus sinicus* Burmeister, and *Anomala* beetle, *Anomala orientalis* Waterhouse (Carter, 1967). White grubs are responsible for a large part of the damage to the roots of pineapple plants, and infestations of 20 grubs per plant are sufficient to reduce the root system, leading to stunting, wilting and yellowing of the plant (Petty 1976, 1977, 1978; Le Roux, 1992).

The adults are fairly heavy-bodied insects; most of them with long, spindly legs. They range in colour from light, reddish-brown to shiny black and in size from 12-25 mm in length. The grubs are white with a brown head and legs and with a darker area at the tip of the abdomen. They curl up in a C-shape when disturbed. Fully grown grubs of larger species are 2.5 cm or more in length.

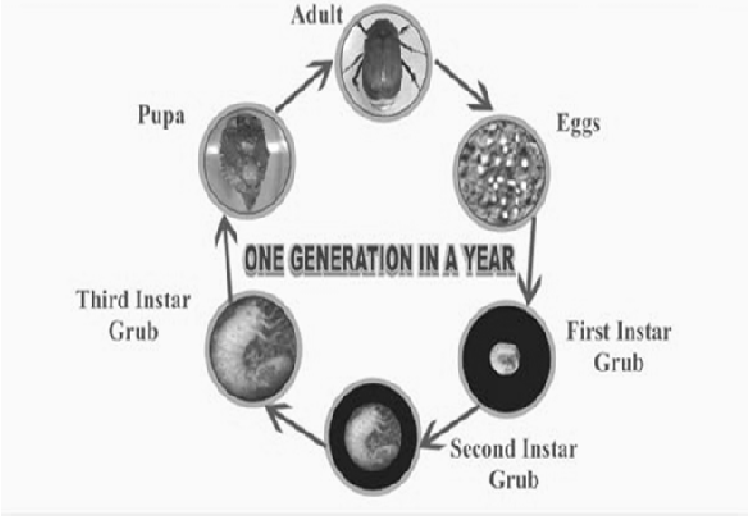

Figure 20. Life cycle of White Grubs
Source www.entnemdept.ufl.edu, Retrieved on 23 Oct 2013

Biology

The usual duration of one complete generation (adult to adult) is 2 to 4 years depending upon latitude. Generations, however, are staggered so that grubs and beetles are present every year. Grubs are usually most numerous and damaging the second season following a large beetle flight. With the exception of the common May or June beetle, which has a three-year life cycle, the life history of the beetles mentioned above is completed in 12 months.

Eggs: Eggs are usually 1.5 to 3 mm in diameter, oval in shape (Waite, 1993) and found encased in soil aggregates. The egg is dull, small, spherical, pearly white that darkens just before hatching. The 20-24 mm long pupae may be creamy white, pale yellow or dark brown.

Larvae: Older scarab larvae develop within the soil among the roots of their host plants (e.g. pineapple). They feed upon organic matter within the soil as well. Although white grubs are not

immobile, they do not disperse far from where the eggs were laid. White grubs are easily identified by their white or ivory-coloured, 'C'-shaped bodies, which are soft and plump. The posterior quarter to third of the larval abdomen is commonly a dark blue-grey colour, due to the contents of the digestive system. Grubs have three pairs of legs near their anterior end and a tan to dark brown head capsule (Waite, 1993).

Adults: Adult beetles differ considerably in colour markings, shape, and size. They are robust, oblong, and hard-shelled. May beetles are about 12 to 25 mm long. The adults often are yellow to dark reddish-brown to black, robust, oblong, shining beetles. The June beetle is dull velvety green on top, brownish yellow on the sides, and shiny green and orange yellow underneath. Japanese beetle adults are brilliant metallic green, 12-25 mm long, bearing coppery brown wing covers, with five lateral spots with white hairs on each side of the abdomen, and short grey hairs covering the underside of the insect.

Nature of Damage: White grub infestations can destroy roots, causing the affected area to become spongy, which allows the sod to be rolled back like a piece of carpet. Evidence of grub damage, including patches of dead or dying turf, are visible during spring (April and May) and late summer and fall (September and October).

Management

Prevention : Adult northern masked chafers can be monitored by using a black light trap, while Japanese beetle adult flight activity can be observed by using a sex pheromone floral lure trap.

***Biological Control*:** Natural enemies of these pests do exist (insect predators, parasitoids and pathogens, as well as birds, toads, wild pigs and rodents), but the levels of control are not typically adequate (Carter, 1967; Petty, 1976b).

Cultural Control: The cultural practices of late-spring and early-fall ploughing or disking provide control. Crop rotation, however, is the most effective cultural control method. Watering in the areas previously sampled is advantageous to prevent the area from drying out and dying.

***Chemical Control*:** Preventive control requires the use of long residual insecticides, such as imidacloprid, thiamethoxam, halofenozide, clothianidin or chlorantraniliprole. These products give good control of newly hatched grubs. The best application period is during the month or so before egg hatch until the time when very young grubs are present. Preventive control requires the use of long residual insecticides. Professional combination products have a pyrethroid and a neonicotinoid insecticide premixed together, which could be used to try to reduce both adult and larval populations.

Fig beetle

Figure 21. Fig Beetle
Source: www.mylespaul.com, retrieved on 14 Sep 2013

Description and Identification

Fig beetle, (Order: Coleoptera, Family: Scarabaeidae, Genus: *Cotinis,* Species: *mutabilis)* green fig beetle, peach beetles are all members of the scarab beetle family. They are mostly found in South Western United States and Mexico. They host on variety of plant species like pineapple (Camino-Lavín *et al*., 1996), peech, grapes etc. They mainly feed on fruit and the larvae damage roots (Camino-Lavín *et al*., 1996; Moron and Deloya, 1991). This beetle is very variable in colour. They lay their eggs in soil. They are white coloured and large sized approximately 12-50 mm in size (Stone, 1982). They feed on organic matter in soil surfaces (Coviello and Bentley, 2000). When the larvae get matured they become 2 inches long and become cream coloured. The body of larvae are stiff with brown hairs at the back of the thorax. These hairs are used for locomotion. They form hollow cells in the soil and pupate there (Coviello and Bentley, 2000). The pupae are of size 15 X 25 mm. They are whitish at initial stages and further change to cream coloured as that of larvae stage. At the maturing stages they slightly shift the colour to green. Adults are velvet green in colour. They occupy brownish bands around the edge of the wings and a bright metallic green at the ventral side. Adult females are 17 X 25 mm and adult males are 13 X 22mm size. At the head portion they are equipped with horn like projections for penetrating into the fruit skin (Stone, 1982). Adults are tremendous fliers (Chappell, 1984).

Biology

Eggs: Females lay eggs (app. 60) in August and the eggs develop into larvae after 12 days and are especially attracted to compost and manure piles. Their eggs are whitish in appearance and be easily found over the soil (Stone, 1982).

Larvae: They have head and legs. They live on soil surface and have a length of 2 inches. Their life includes three instars of which first and second get completed by autumn and the final in the spring season of second year. At rest they curl into C shape.

Pupae: After a few days it reaches a size of 12-50 mm. They develop by June- July. Its duration extends from 25-27 days.

Figure 22. Life Stages of Fig Beetle
Source: en.wikipedia.org/wiki/Figeater_beetle, retrieved on 14 Sep 2013

Adult: They develop by June- November (Stone, 1982).

Nature of Damage

The plant part affected mainly includes flower parts like pollen, nectar and petals, fruit and larvae damage roots.

Pineapple weevil

Figure 23. Pineapple Weevil
Source: www.forestryimages.org, retrieved on 14 Sep 2013

Figure 24. Ventral View of Pineapple

Description and Identification

Weevils, Order: Coleoptera, Family: Curculionidae, are one of the most common insects attacking bromeliad family. They include species like *Cholus spinipes, Cholus vaurieae, Diastethus bromeliarum Champion, Cactophagus lojanus, Cactophagus miniatopunctatus, Metamasius dimidiatipennis* (www.bromeliads.info/archieves/bromeliad-eating-weevils). The pineapple weevils are distributed in Northern Venezuela (O'Brien, 1994; Salas and O'Brien, 1997). It affects the parts of the plant like crown, flower stalk, fruit, leaf (O'Brien, 1994). The family has the characteristic, head prolonged forward as a rostrum (beak). It has the life history involving egg, larvae, pupae and adult stages. The female weevils lay eggs inside a hole within the plant part like base of the crown or base of the shoots. The eggs are oval, dull, white and semi transparent. The larvae are white except its head which is brown coloured. It grows to a size of 2.5 cm. The larvae of the pest are infective. It is motile and move up and down destructing the inner tissue of the flower stalk (O'Brien, 1994). This affects the normal growth of the fruit causing lack of crown. Adults appear 10.6 – 18.2 mm long. They are black or brown coloured with no scales over the body. They feed on leaves causing necrotic edges. Sometimes the fruits they attack rot (O'Brien, 1994; Salas and O'Brien, 1997)

Biology

The life cycle completed within 3 – 4 months (Gowdey, 1922).

***Egg**:* The eggs are oviposited singly in shallow excavations made usually in the fruit stalk at the junction of the stalk and fruit of the pineapple. More rarely, females lay eggs at the base of the crown and in the basal shoots (O'Brien, 1994).

Larva: The larvae hatch in eight to ten days and tunnel upward in the rootstock or fruit stalk or in the fruit itself. The larval stage lasts for eight to ten weeks.

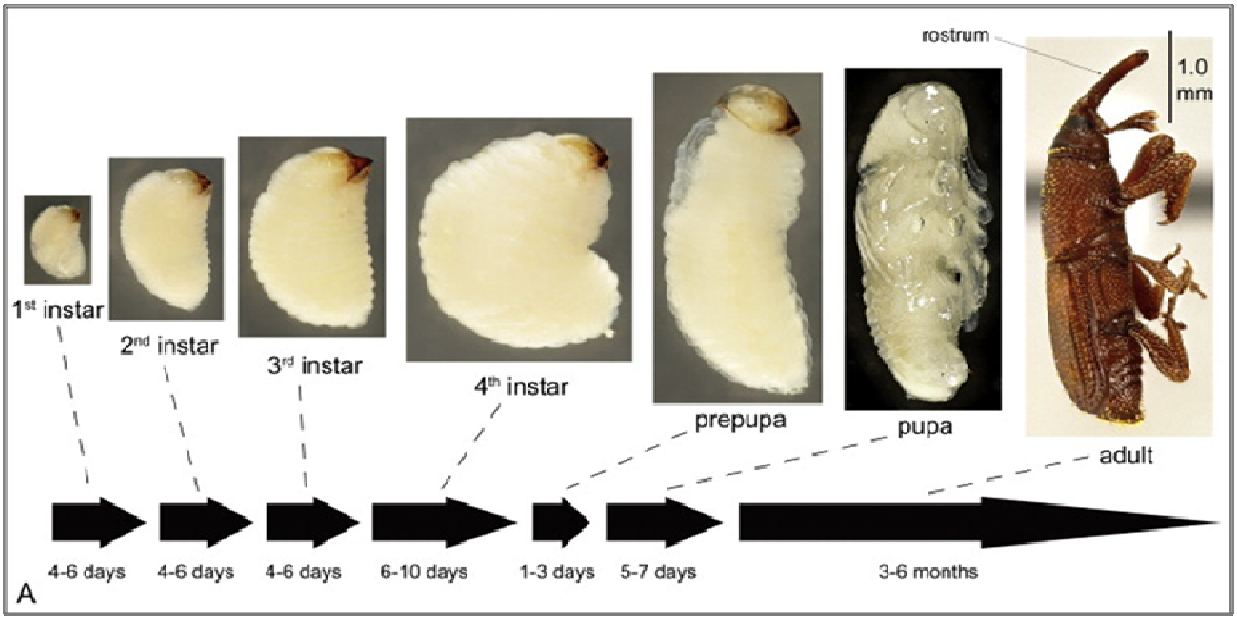

Figure 25. Life Stages of Pineapple Weevil
Source: www.sciencedirect.com, retrieved on 14/09/2013

Pupa: The pupa is formed at the extremity of the tunnel lasting 18 – 24 days.

Adult: The adults are poor fliers and require a great deal of protection from the direct rays of the sun. It prefers a very humid environment as it shows a preference for the recesses of dense vegetation. They are approximately 16.5mm – 22mm long.

Nature of Damage

The whole life span of the weevil occurs in the same plant. The female lays single egg in the slit created by them in the plant leaves. The larvae move to the stem causing tunnels in the plant. The larvae pupate in the central stem. There they make cocoon around the body for its growth. If the plant tissue remains enough the adult develops on the same host plant. The infestation causes the exudation of a gelatinous material which is protective for the weevil slits. The damage to the host plant includes adult feeding marks on the leaves, leaves browning, decomposition of base of central leaves

Figure 26. Pineapple weevil larva feeds on pineapple plant
Source: edis.ifas.ufl.edu, retrieved on 16 Oct 2013

(Barbra and Howard, 2010).

Management

***Natural Control**:*

1. Pineapple fields must be cleared of weeds.
2. The planting should be done in shade free areas.
3. After two crop cycles replant the suckers
4. Use fresh disease free samples for planting
5. Incinerate the bio-wastes in and around the field.
6. Dip the fresh plants in Malathion or Diazinon
7. Apply crop rotation with non host plants
8. Restrict the movement of infected samples to other areas (Sherwood, 2010)

Biological control: Biological control agents like *Lixadmontia franki* and *Bacillus thuringiensis* offer the most likely success in management of the weevils.

Lixadmontia franki

A potential parasitoid was discovered in Honduras as the control for bromeliad eating weevil (Cave, 1997; Wood and Cave, 2006) called *Lixadmontia franki.* The female fly lay eggs at the same place were the weevils' oviposits. The larvae of the fly feed on the pests' larvae and thus they won't reach the pupae stage (Frank and Cave, 2005). The effect of the predator is not proved yet in comparison with the weevils' population.

Bacillus thuringiensis

Bacteria also has been used as a biological control against the weevils. The effect of the bacteria *Bacillus thuringiensis* Berliner (Bt) has been studied as pest control (Lacey et al., 2001). The main target pests are of Lepidoptera, Coleoptera, and Diptera species. The pesticidal effect of the bacteria and its ecofriendly nature are well studied (Lacey and Siegel, 2000). The mechanism of action includes insecticidal activity of the delta-endotoxins located in parasporal inclusion bodies (or parasporal crystals). These inclusion bodies are produced at sporulation stage and get activated only when ingested by the pests.

Termites

Figure 27. *Mastotermes darwiniensis*
Source: www.en.wikipedia.org, retrieved on 23 Oct 2013

Description and Identification

It belongs to Order: Blattaria, Family: Mastotemitidae, a very peculiar insect, the most primitive, it shows uncanny similarities to certain cockroaches. These similarities include the anal lobe of the wing and the laying of eggs in bunches, rather than singly. It is the only living

member of its genus *Mastotermes* and its family Mastotemitidae. *Mastotermes darwiniensis* is usually not very numerous, nor are the colonies large when left to natural conditions. However, when given abundant water (such as regular irrigation) and favourable food and soil conditions, populations can be enormous, numbering in the millions, quickly destroying their host. *Mastotermes darwiniensis* is the only known host of the symbiotic protozoan *Mixotricha paradoxa*, remarkable for its multiple bacterial symbionts.

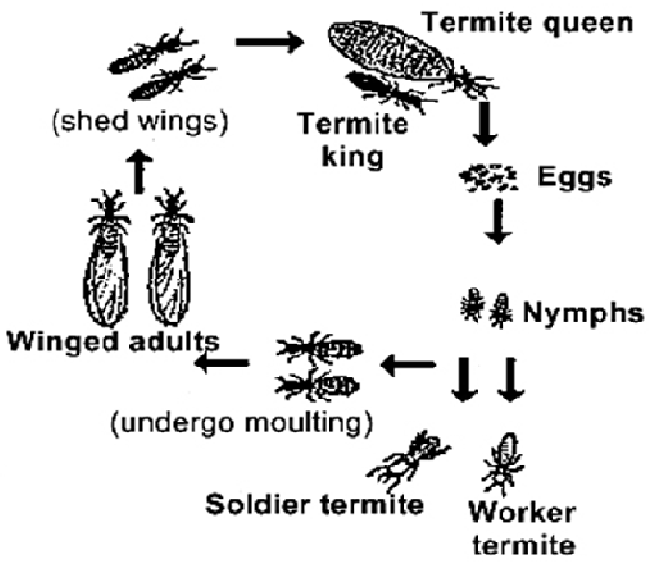

Figure 28. Life cycle of Termite
Source: fzi.uni-freiburg.de, retrieved on 23 Oct, 2013

Pest Biology

The life cycle of termites is described as "incomplete metamorphosis" with egg, nymph and adult stages. In the nymph stage termites grow through a series of moults. The life cycle of true ants is known as "complete metamorphosis"; with egg, larvae, pupa and adult stages. ***Eggs:*** Queen lays eggs in batches of approximately 20 joined together to form one mass. A nymph after hatching passes through 4-7 moults before becoming a mature worker, soldier or winged reproductive. Nymphs resemble the adults or mature castes. Nymphal stage lasts approx 2-3 months, depending on food and climatic conditions. No pupal stage exists. Soldiers and nymphs live 1-2 years. Kings and Queens live longer (often over 20 years. There are some records of original queen living for 50 years).

Larvae: Larvae are short-haired, but the first eight nymphal stages bear dense, long hair. The nymphal integument becomes pale brown by the sixth stage; wing buds are evident in the fourth nymphal stage. Eye pigment first appears in sixth-stage nymphs. The ninth and later stages have whitish integument and short hair.

Adults: There are four different castes of adults

Queen and King**:** The queen and king are the original winged reproductives (alates). When a new colony is formed the pair must feed and care for the young until there are sufficient soldiers and workers to take over the duties of the colony.

Nymph (Pseudergate): This caste is 'worker like' the most abundant caste in the colony, performing all the tasks in the colony except defense and reproduction. It is this caste that does the damage to crops.

Soldier: Most distinctive caste and the easiest caste from which to identify a species. The role of this caste is to defend the colony. Males and females whose sexual organs and characteristics have not developed, like workers, are susceptible to desiccation and seldom leave the colony or shelter tubes. The fontanelle is used to discharge a secretion associated with defence, since it is a repellent to ants and other enemies of termites.

Reproductive: The future kings and queens having compound eyes are darker in colour and have a denser cuticle than workers and soldiers. They are often larger. Fully winged (alates) ones will have colonising flight when humidity and temperature conditions outside approximate the conditions inside the colony, normally in summer months.

Nature of Damage: The most destructive species within its range of occurrence. It also ringbarks and kills living trees and damages crops such as sugarcane, pineapple, etc. The nymphs are the caste that causes the damage.

Management

Prevention : Selecting low-risk sites, use of species suitable for a region or resistant species, reduction of mechanical damage, maintenance of plant vigour, removal of nests, increasing biodiversity, inter-planting can be done as preventive measures.

***Biological Control*:** Biological control of termites has largely focussed on the use of fungi (e.g. Metarhizium) and nematodes. It is not easily achieved in the field because of the tendency of termite colonies to cut off and avoid infected areas as soon as disease sets in.

Cultural Control: Clear the area of material that could attract termites before planting trees. Burn or completely remove tree stumps. In areas of high termite activity, the hole and soil may need treatment with bifenthrin or chlorpyrifos during planting.

Pineapple Mites

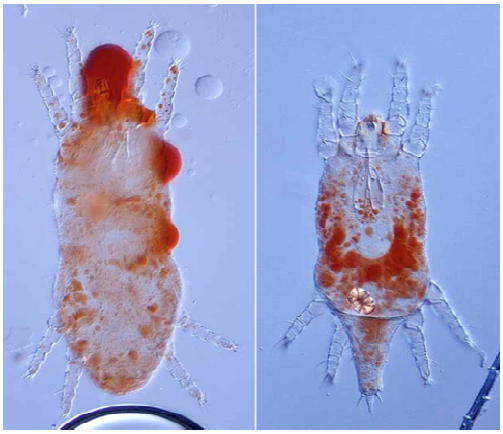

Figure 29. ***Dolichotetranychus floridanus***
Source: www.kau.edu retrieved on 23, Oct, 2013

***Chemical Control*:** If termite activity or damage is located in the premises, repellent termiticides (e.g. Bifenthrin) will NOT be made available as an option. This is to avoid the situation where termites can be 'locked in' rather than use their natural habits and biology against them (which is the benefit of non-repellent termiticides). Drenching of Chlorpyriphos (Hilban 20EC, 2.5 ml/l) is suggested in serious cases.

Description and Identification

The pineapple red mite, *Dolichotetranychus floridanus,* Order: Acarina, Family: Tenuipalpidae, is the largest mite found on pineapple and bright orange to red colour. It is only found in Florida, Cuba, Puerto Rico, Panama, Honduras, Mexico, Central America, Hawaii, the Philippine Islands, Japan, Okinawa and Java (Jeppson *et al.,* 1975).

The adult mite is approximately 0.3–0.4 mm long and 0.1 mm wide. When present on the plant, the mite is always found on the white basal portion of the leaves, where it feeds, particularly on the crown. (Petty, 1975, 1978c). The blister mite, pineapple fruit mite, *Phyllocoptruta sakimurae,* Family: Eriophyidae, is the smallest mite (0.1 mm long and 0.033 mm wide) found on pineapple in Hawaii (Carter, 1967). Individuals are chalky in colour and only have two pairs of legs located near the head. They may be found on detached crowns that are stored for planting. They originate from prior infestations on the ripe fruit from which the crowns were derived. They normally disappear after the crowns are planted, but may be found later on fruit after the flat-eye stage of fruit development (Carter, 1967). The pineapple tarsonemid mite (also known as pineapple mite, pineapple fruit mite, pineapple false spider mite), *Steneotarsonemus ananas,* Family: Tarsonemidae, may be found infesting pineapple later in the plant's phonological cycle.

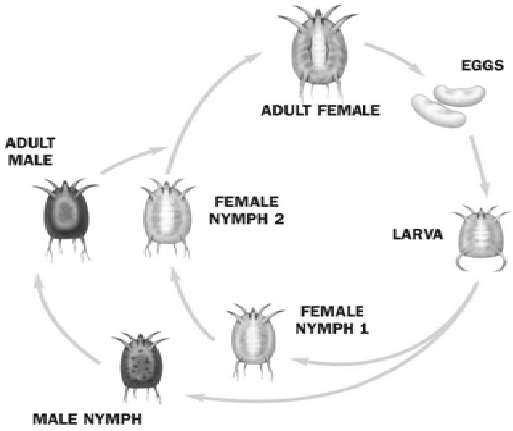

Figure 30. Life cycle of mites
Source:www.farmanimalhealth.co.uk, retrieved on 23 October, 2013

Biology

Adults, nymhs and eggs of this species are bright orange in colour when alive. The tiny eupathidium on the palp tarsus has been recorded which is very difficult to see.

Eggs: Orange in colour

Larvae: The larvae are pale and almost translucent. They often have three pairs of legs in the larval stage and four pairs of legs in the nymph and adult stages.

Adults: Adults, nymph and eggs of this species are bright orange in colour when alive.

Nature of Damage:

These cause damage to leaves and fruits. Severe infestations produce large, dark brown lesions that almost cover the basal white tissue which can lead to necrosis and death of the leaves. In pineapple-production areas, it may frequently cause severe damage to recently established plants in the field. Plants that are infested in the early stages remain small and fruit production is either curtailed or non-existent. Heavily infested plants may die before producing fruit (Jeppson *et al.*, 1975). It feeds the epidermal tissue to dry and crack which allows fungus and bacteria to enter the plants and cause the tissue rot and scarring and tissue malformation.

Management

Prevention: Control programs are based on crop monitoring – looking for colonies on the basal white tissue of leaves and/or the leaf indentations and "rusty" feeding sites. Three stages in the crop cycle should be monitored – planting, flower initiation and near fruit harvest. Timing of treatments is critical for successful control.

***Biological Control*:** The fungus *Hirustella thompsoni* has been successfully used to control this mite.

Cultural Control: The best management action is to plant only mite-free seed-plant material (Jeppson *et al.*, 1975). Population densities of *D. floridanus* were reduced by routine pesticides and lower or minimal fertilizer treatments.

***Chemical Control*:** Need based repeated spray application of Dicofol 4 ml/l at 500 l/ha is recommended. At flower induction, four sprays may be applied at fortnightly intervals.

Some Organic Practices that can be Adapted for Pest Management

- Cow Urine: Dilute one litre of cow urine in ten litres of water and wet the whole plant at the rate of 200–300 l/ha at regular intervals.
- Cow Dung: 12.5 kg of fresh cow dung and 12.5 litres of cow urine are collected in an earthen pot and mixed thoroughly with 12.5 litres of water. The pot is covered and the mixture is allowed to ferment for a week. Occasionally it is stirred with a stick. After a week of fermentation, the mixture is filtered and 100 g of lime is added. The concentration is diluted with water in a 1: 10 ratio and sprayed on the crop at 200–250 l/ha.
- Neem Oil Spray: Neem oil spray: 2% neem oil is mixed with any detergent powder at 40–50 g/ 100 l and used as a spray solution.
- Neem Seed Kernel Extract (NSKE): It can be used as a prophylactic before the onset of pests.
- Chili Garlic Spray: Chili garlic spray is an effective insect repellent.
- Herbal Mixture Spray: About 500 g of tobacco leaves, 1 kg of neem kernel, 500 g lime powder, 500 g *Datura* leaves and 500 g pods and seeds of oleander (*Nerium oleander)* are powdered and mixed together, then soaked in 15 litres of water for 15 days. On alternate days, the mixture needs to be stirred with a stick. After 15 days, one litre of filtrate is mixed in 15 litres of water and sprayed on the crop. It is enough for 2.5 ha and is a multi-pest repellent.
- Tobacco tea - Tobacco tea is effective against most pests.

(Package of Organic Practices from Assam, Manipur, Meghalaya and Nagaland for Pineapple, *Prepared by North Eastern Region Community Resource Management Project (NERCORMP) for Upland Areas (IFAD & GOI/DoNER/NEC), Shillong)*

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8.2 Blooming pattern of passion fruit (*Passiflora edulis*) in Kerala plains

Blooming pattern of passion fruit (*Passiflora edulis*) in Kerala plains

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INTRODUCTION

Passion fruit (*Passiflora edulis*) of the family *Passifloraceae*, commonly called as purple passion fruit, is the universal variety. The purple passion fruit is a native of Tropical America and another variety *Passiflora edulis flavicarpa* (yellow passion fruit) is known to be evolved from the purple one and a related species (Akamine and Girolami, 1959). The whole plant, especially the leaves contain a number of phytoactive chemicals like alkaloids, glycosides and flavonoids. Passion fruit is proved to have analgesic, anti-anxiety, anti-inflammatory, central nervous system depressant, diuretic, hypotensive and sedative activities. It has promising and powerful effects on neurological disorders and chronic diseases such as heart disease and cancer (Joy, 2010). The fruit is edible and is a rich source of sugars, vitamin C, vitamin A, Niacin, Potassium and fiber and it is low in Sodium, cholesterol and saturated fats. The use of passion flowers as ornamental plants has existed since the 15th century (Vanderplank, 2000) and currently continues in European and North American countries in the hybrid seedling market.

Passion fruit flowers are solitary. In androecia, the anther and filament constitute the stamen, with pollen emerging from the anthers (Das, et al., 2013). In gynoecia, the ovary is borne over androgynophore. When the fruit develops it will still have its stalk attached. The ovary and triple-branched style form a prominent central structure (Vanderplank, 1996). Passion fruit flowers are protandrous, as anther dehisces before stigma becomes receptive (Cox, 1957). Yellow passion fruit flowers have both male and female parts but are self-sterile. Hand pollination is the easiest way which ensures fruit production and it hikes the production (Das, et al., 2013). The flowers of purple passion fruit can self-pollinate (Morton, 1987). The passion vine has the capacity of flowering all year round and has the abundance of blooms and exuberant foliage (Ulmer and Macdougal, 2004). It is a photosensitive fruit crop and a long day plant where day length required for flowering is more than 10.5 h (Ullah, et al., 2009). It has a special type of blooming pattern rather different from other alien fruit crops. The period of flowering varies among species and regions. The flowering cycle of *P. edulis* is documented by Meletti and others (2010). Detailed information about floral morphology, reproductive biology, flower visitors and pollination of some *Passiflora* species are published (Faria, 2010; Varassin, et al., 2001; Garcia, 1999; Garcia, 1998, 1997; Koschnitzke, 1997). The blooming pattern of passion fruit under varied flashes in Bangladesh is reported (Das, et al., 2013). The pattern of flowering like its initiation and flower number has greater significance in fruiting capacity. In this regard, the response of the different passion fruit types shows variations in different regions of the world. A vivid knowledge is required in this area to improve or

enhance the existing qualities of the passion fruit vines grown in a particular region. This study surely is a stepping stone for further studies in this line.

MATERIALS AND METHODS

Over fifty passion fruit accessions were collected from different areas in Kerala and South India and have been conserved and evaluated at Pineapple Research Station, Vazhakulam for the last many years and 14 superior types have been identified. These selected types were further evaluated in a replicated field trial for further detailed studies for evolving superior variety suited for the plains of Kerala. Passion fruit is a cross pollinating fruit crop and to ensure variety specificity, rooted stem cuttings were raised from the promising types in the experimental field of Pineapple Research Station, Vazhakulam. Three, four and five noded stem cuttings were selected from healthy mature passion vines. They were grown in potting mixture (50 kg soil, 10 kg cow dung, 100 g Neem cake and 100 g Trichoderma). Stem cuttings were kept in greenhouse with mist at every three hours interval. Stem cuttings started rooting in twenty to thirty days. Trellises were constructed in the field. The experimental area was tilled for planting and pits (50 cm deep) were made at a distance of 3.5 m, seven days before planting. Potting mixture was applied in the pit to ensure nutrient supply to the young plants. 13 accessions from different regions of Kerala were planted on 13 July 2012 in a randomized block design (RBD) with three replications. Planted passion fruit types included nine yellow types (35Y, 45Y, 51Y, 55Y, 57Y, 66Y, 86Y, 88Y and125Y) and five purple types (134P, 142P, 143P, VP and Kaveri). Proper irrigation, weeding and fertilizer application was done on a regular basis. Analysis of Variance was conducted following Gomez and Gomez (1984).

Flowering pattern of passion fruit vines in the plains of Kerala is a study for the first time in the crop. Date of first flowering and number of flowers produced for a period from February – November 2013 were considered for the study. The first flowering was observed after seven months of planting. The number of days was calculated from the date of planting till the date of blooming. The number of flowers was observed from the date of first flowering for each accession in a particular month.

RESULTS AND DISCUSSION

1. First Flowering

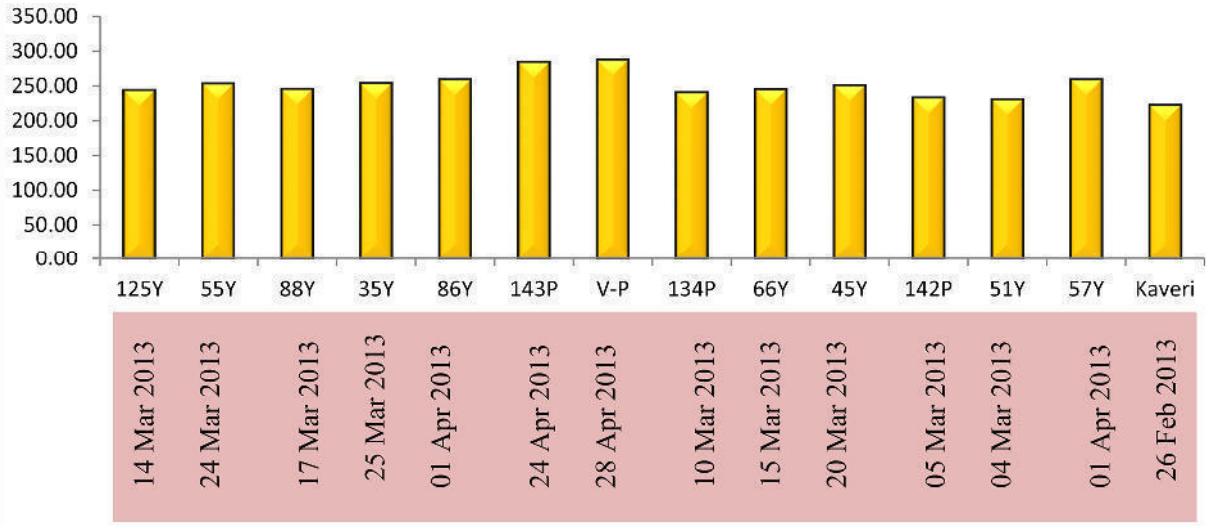
The passion fruit plants were planted on the field on 13 July 2012. The type Kaveri came to flowering first, on 26 February 2013 (222.47 days after planting) and the last type to produce flower was VP which flowered on 28 Apr 2013 (287.50 days after planting). Thus there is a difference of 65.03 days (more than two months) in the inception of flowering of various types during the first year of flowering. The passion fruit types took an average of 252.86 days for producing first flower which was on 15 March 2013. (Table 1.,Fig.1.). Accordingly the accessions Kaveri, 51Y, 142P, 134P, 125Y, 66Y, 88Y, 45Y showed

early flowering characteristics. VP followed by 143P was distinctly late in flowering and statistically different from others in their late flowering habit. Others (55Y, 35Y, 86Y, 57Y) fell in between.

Table 1. First Flowering Date of Different Passion fruit Accessions

Sl.No.	*Accession*	*1st flowering (days after planting)*	*Date of flowering*
1	125Y	243.92	14 Mar 2013
2	55Y	253.42	24 Mar 2013
3	88Y	245.58	17 Mar 2013
4	35Y	253.67	25 Mar 2013
5	86Y	259.11	01 Apr 2013
6	143P	284.17	24 Apr 2013
7	VP	287.50	28 Apr 2013
8	134P	240.58	10 Mar 2013
9	66Y	245.17	15 Mar 2013
10	45Y	251.10	20 Mar 2013
11	142P	233.06	05 Mar 2013
12	51Y	230.83	04 Mar 2013
13	57Y	259.08	01 Apr 2013
14	Kaveri	222.47	26 Feb 2013
Date of Planting: 13/07/2012	*Grand Mean*	*252.86*	
	SEM	*6.904*	
	CD	*20.063*	
	CV%	*4.756*	

Fig.1. Number of Days for first flowering in Different passion fruit Accessions



2. Monthly Production of Flowers

On an average, the flowering started in March slowly progressing through April and peaking in June. During July – Nov flowering declined progressively, with slight differences in the blooming pattern of the various types (Fig.2.,3.,Table.2.).

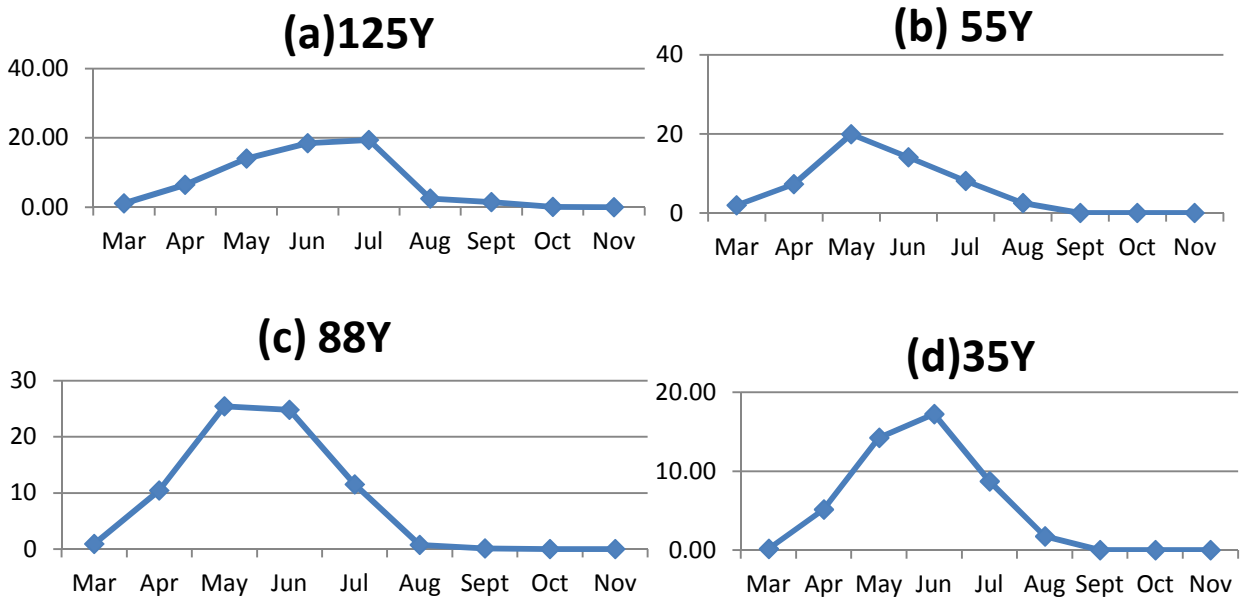
143P and 142P exhibited very short flowering season indicated by sharp peaks (Fig.2. (f, k)). 51Y, 57Y, 35Y, 134P, 66Y, 45Y and Kaveri showed long flowering season indicated by flat curve (Fig.2. (l, m, d, h, I, j & n)). In general the flowering peaked during June and most of the types showed only one peak while VP and 45Y showed double peaks (Fig.2. (g, j)). 57Y and 66Y showed two peaks one being a minor one (Fig.2. (m, i)). During April, 51Y followed by 88Y produced the maximum number of flowers, which were superior to all others and statistically different from each other (Table.2.). During May, 51Y and 86Y produced more number of flowers than others and they were statistically on par. They were followed by 88Yand 55Y which were statistically on par and superior to the rest of the types. In June, 57Y followed by 88Y produced more number of flowers than other types and they were statistically different from each other. In July, 142P followed by Kaveri produced more number of flowers than other types and they were statistically different from each other. In August, Kaveri followed by 142P produced more number of flowers than other types and they were statistically different from each other. In September, Kaveri produced more number of flowers than other types and was statistically different from each other. During October, Kaveri followed by 134P produced more number of flowers. In November, 134P followed by VP produced more number of flowers (Table.2.). It is observed that Passion vine blooms 10-

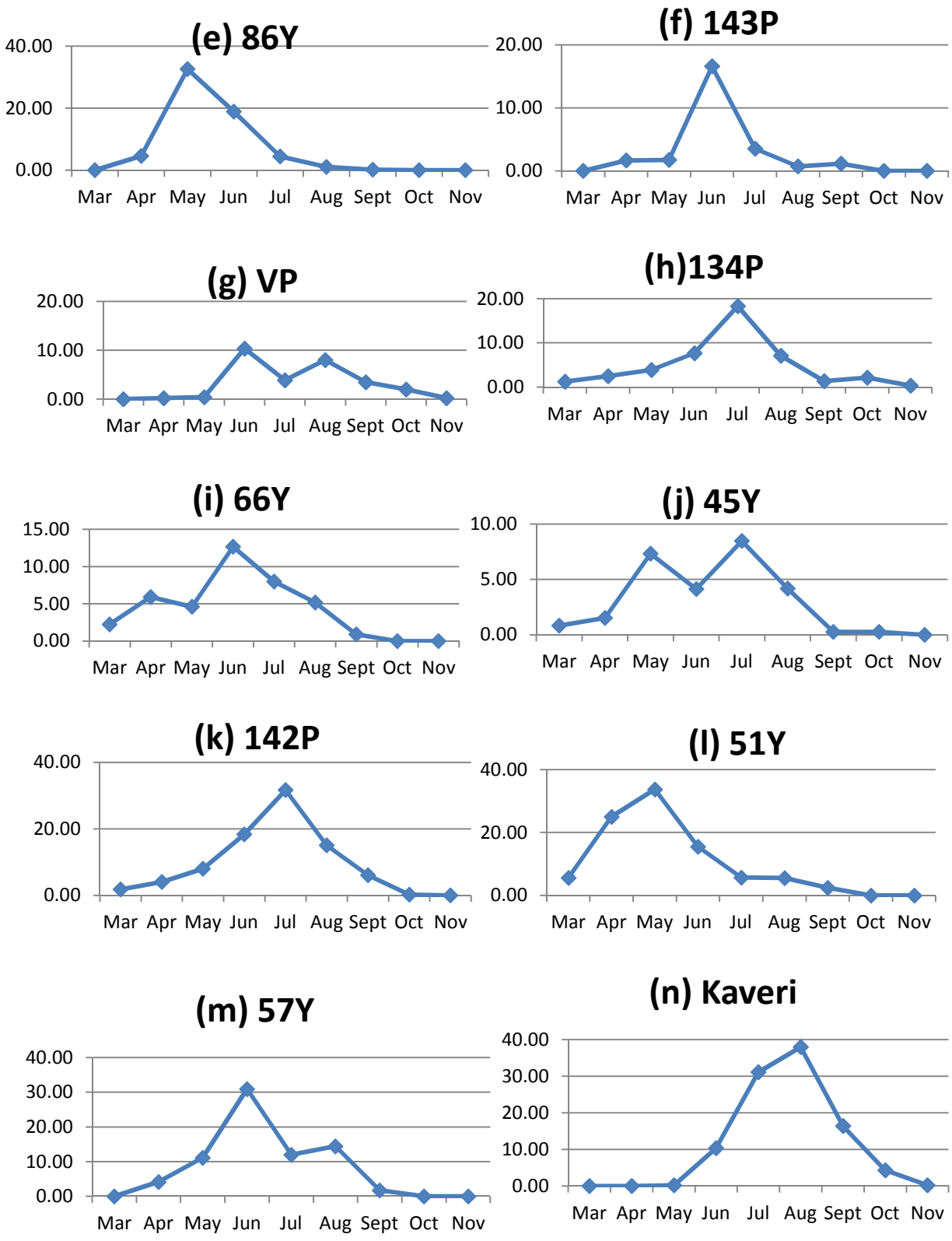
15 days after flower bud initiation. Flowering initiated from 10.30 – 11.00am. Flower opening was maximum during 12.00 - 1.00 pm.

Table 2: Monthly Flower Production in Passion Fruit Types (number/plant)

Types	*March*	*Apr*	*May*	*June*	*July*	*Aug*	*Sep*	*Oct*	*Nov*	*Annual flower prodn*
125Y	01.08	06.50	14.00	18.50	19.42	02.50	01.50	00.08	00.00	063.58
55Y	01.93	07.33	19.94	14.08	08.14	02.50	00.00	00.00	00.00	053.92
88Y	00.92	10.42	25.44	24.83	11.50	00.75	00.12	00.00	00.00	073.98
35Y	00.17	05.17	14.22	17.25	08.75	01.75	00.00	00.00	00.00	047.31
86Y	00.00	04.58	32.61	18.92	04.42	01.05	00.21	00.00	00.00	061.79
143P	00.00	01.67	01.75	16.62	03.50	00.71	01.13	00.00	00.00	025.38
VP	00.00	00.25	00.42	10.37	03.92	08.00	03.50	02.03	00.25	028.49
134P	01.22	02.44	03.89	07.67	18.33	07.11	01.33	02.11	00.33	044.11
66Y	02.22	05.92	04.61	12.67	07.98	05.17	00.89	00.00	00.00	039.46
45Y	00.83	01.53	07.33	04.14	08.47	04.17	00.26	00.26	00.00	026.99
142P	01.78	04.00	08.00	18.33	31.67	15.00	06.00	00.18	00.00	084.96
51Y	05.58	25.00	33.78	15.53	05.65	05.50	02.42	00.00	00.00	093.46
57Y	00.00	04.17	11.14	30.92	12.00	14.42	01.75	00.00	00.00	074.40
Kaveri	00.00	00.00	00.17	10.31	31.06	38.00	16.36	04.25	00.17	100.32
Mean	01.12	05.64	12.66	15.72	12.49	07.62	02.53	00.63	00.05	058.50
SEM	00.274	00.487	00.847	00.567	00.375	00.363	00.158			01.475
CD	00.797	01.417	02.463	01.648	01.090	01.055	00.459			04.207
CV%	38.848	15.643	12.065	06.826	06.226	09.99	12.474			04.365

Fig. 2. Blooming Pattern of Passion Fruit Types (number/plant/month)




(e) 86Y
40.00
20.00
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Mar Apr May Jun Jul Aug Sept Oct Nov
(f) 143P
20.00
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Mar Apr May Jun Jul Aug Sept Oct Nov
(g) VP
20.00
10.00
0.00
Mar Apr May Jun Jul Aug Sept Oct Nov
(h)134P
20.00
10.00
0.00
Mar Apr May Jun Jul Aug Sept Oct Nov
(i) 66Y
15.00
10.00
5.00
0.00
Mar Apr May Jun Jul Aug Sept Oct Nov
(j) 45Y
10.00
5.00
0.00
Mar Apr May Jun Jul Aug Sept Oct Nov
(k) 142P
40.00
20.00
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Mar Apr May Jun Jul Aug Sept Oct Nov
(l) 51Y
40.00
20.00
0.00
Mar Apr May Jun Jul Aug Sept Oct Nov
(m) 57Y
40.00
30.00
20.00
10.00
0.00
Mar Apr May Jun Jul Aug Sept Oct Nov
(n) Kaveri
40.00
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20.00
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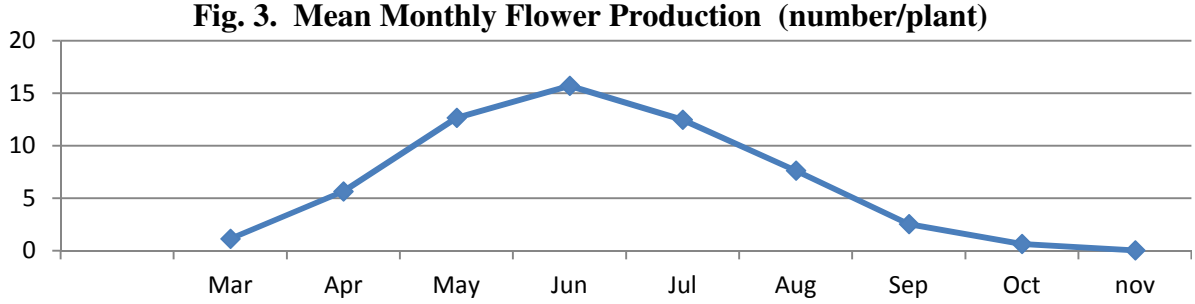
Mar Apr May Jun Jul Aug Sept Oct Nov

Fig. 3. Mean Monthly Flower Production (number/plant)



2.1 Mean Number of Flowers Produced in a Month

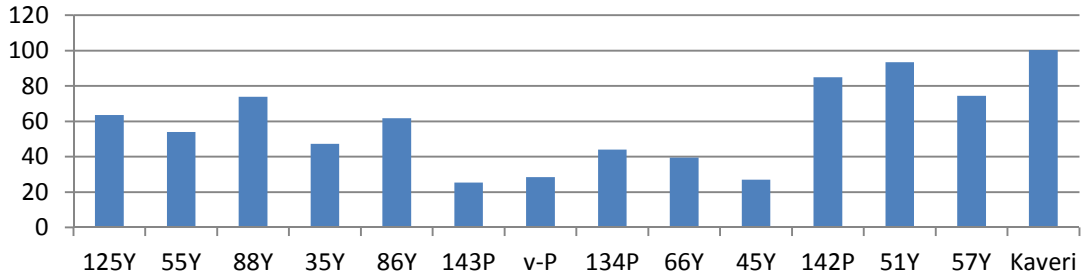
Maximum number of flowers was bloomed in the month of June (15.72) followed by May (12.66) and July (12.49). The least number of flowers was observed in the month of November (0.05), March (01.12) and October (0.63) showing the commencing and ceasing of the season. Medium Flowering was reported in April (5.64) and August (7.62) (Table.2.,Fig.3.).

2.2 Production of Flowers in Each Type

For the time period from March –November, profuse flowering was observed for Kaveri (100.32) and least blooming number for 143P (25.38).

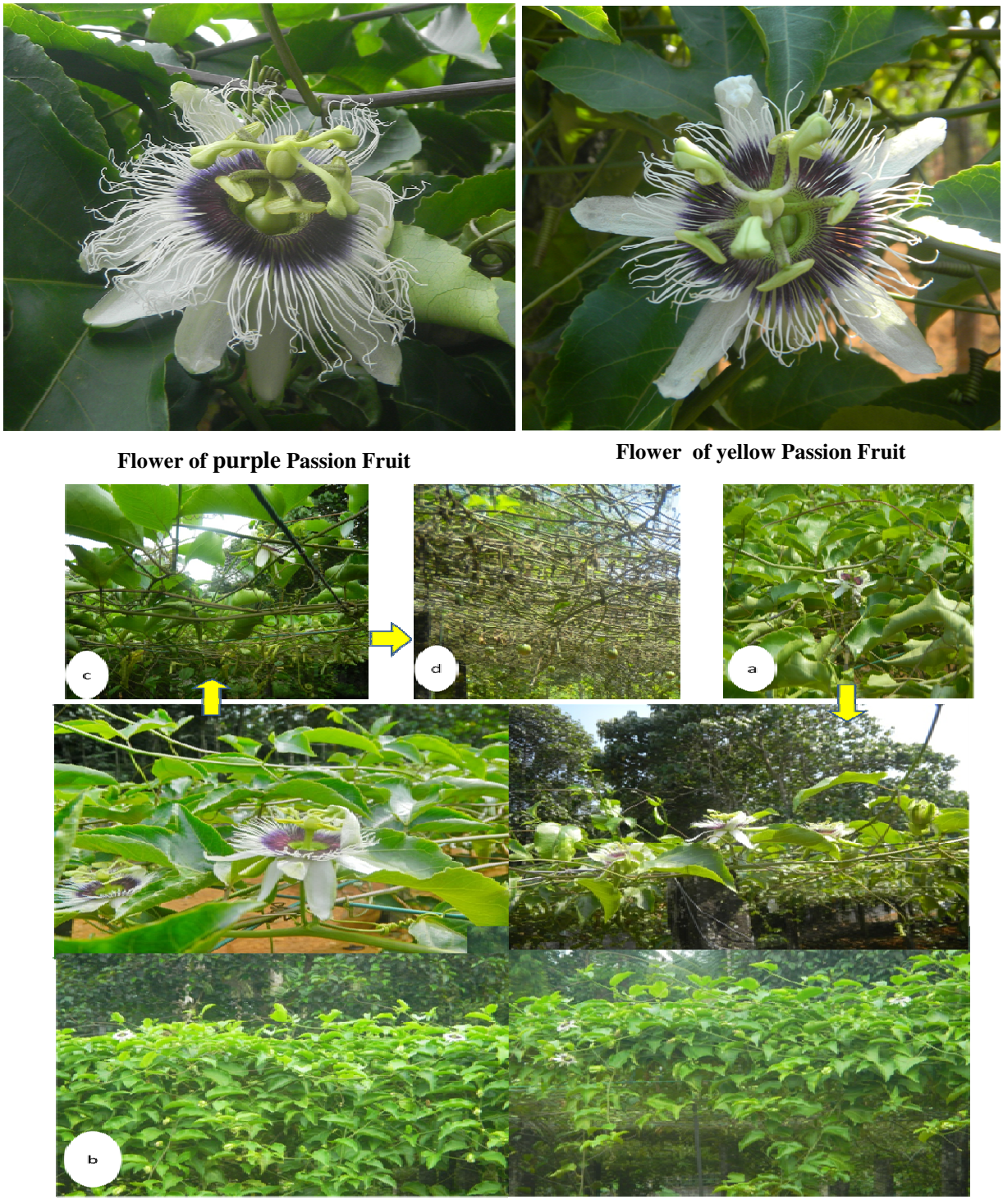
66Y (39.46), V-P (28.49) and 45Y (26.99) also showed low number of flowers. 142P (84.96), 57Y (74.4), 88Y (73.98), 125Y (63.5), 86Y (61.79), 55Y (53.92), 35Y (47.31), 134P (44.11) showed medium flowering (Table.2.Fig.4.).

Fig.4. Annual Flower Production in Passion FruitAccessions (number/plant)



The passion fruit types studied showed differences and some sort of similarities in their blooming pattern. It is supported with the study of Kishore *et al.* (2010) who reported that different species of cultivated *Passiflora* spp. respond differently. Flowering behavior is an important criterion for plant breeder in variety development. Time required from bud initiation to flower opening ranged from 10.00 to15.00 days at different flashes studied by Banu *et al*. (2009). In the present study it was 10-14 days. Montero et al, (2013) reported that the first blooming in Passiflora edulis was observed on 34 weeks (238 days) after

transplanting and it took 12-15 days from flower bud initiation to flowering as against 253 days and 10-12 days respectively in this study. The peak flowering in this study was observed during June-August as against peak flowering period of March – June as reported by Kishore and others (2010).



Flower of purple Passion Fruit **Flower of yellow Passion Fruit**

Fig.5. Stages Of Flowering: (a) Initial Flowering (b) Gradually proceeds to peak flowering (c) Flowering lowers (d) End of the season

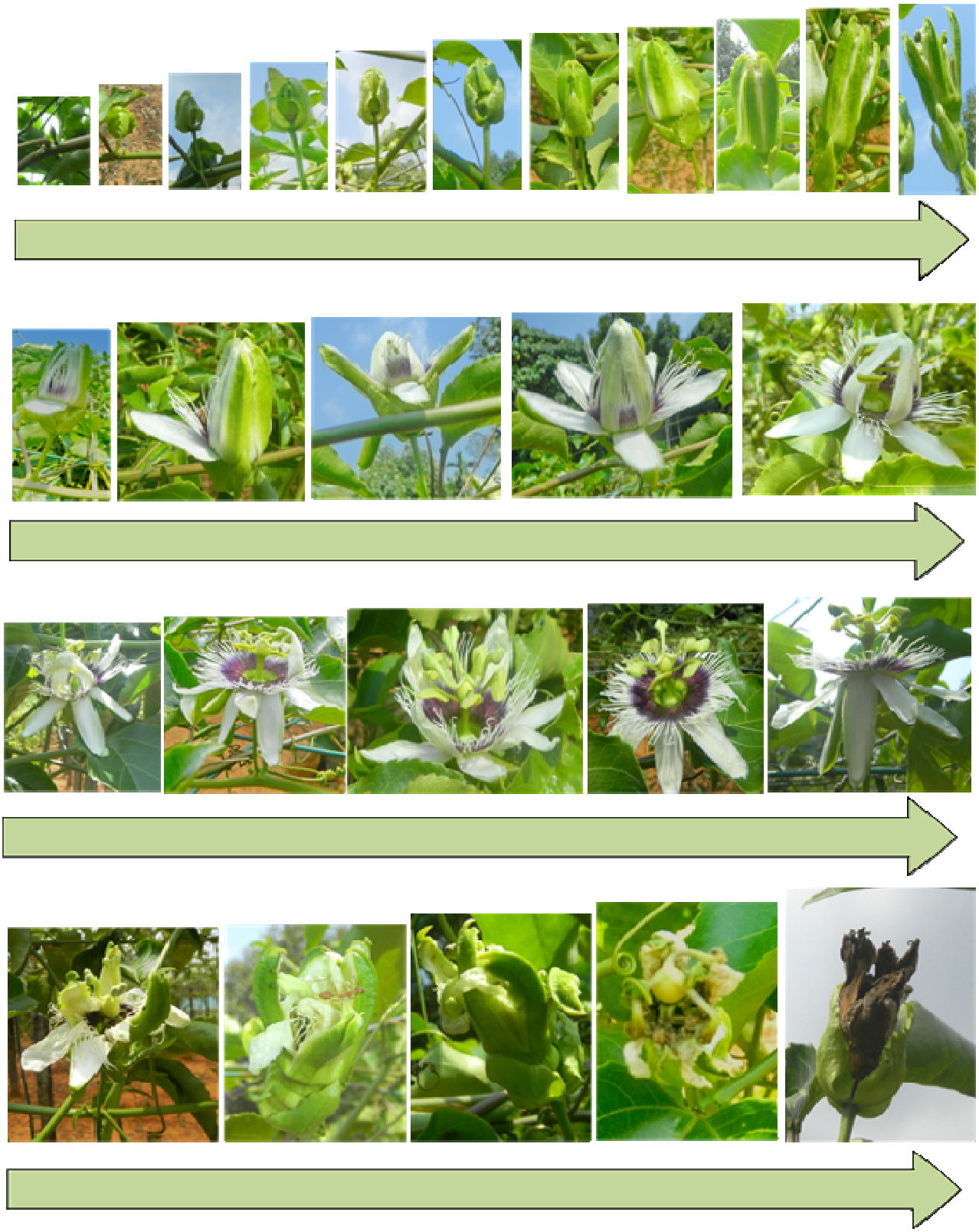


Fig.6. Stages of Passion Fruit Blooming from bud to Withering

CONCLUSION

Among the passion fruit types studied, Kaveri and 51Y produced more number of flowers. The flower number was significant for fruit setting behaviour of the types. Those types were prioritized for selection of superior variety since they had the potential for higher fruit yield. Even when self pollination or natural pollination failed (yellow passion fruit types not self pollinating) there were chances for hand pollination which was already proved effective in case of passion fruit. Also the blooming pattern help the breeder to adopt breeding programmes like inter specific hybridization. The first flowering data was also important as the early flowering type produced more number of flowers. The long period of flowering was also essential as it showed the type was more active throughout the season with no gaps. The above furnished data would be a stepping stone for more breeding studies in passion fruit types in Kerala plains.

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8.3 Pineapple Recipes

PINEAPPLE RECIPIES

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PINEAPPLE: NATURE'S HEALING FRUIT

Pineapple is one of the popular fruits and is liked by majority of the people irrespective of their age group. Pineapple is an important food which can be eaten fresh or eaten in a processed form. It is composed of nutrients which are good for human health. Pineapples are nutritionally packed members of the bromeliad family. This delightful tropical fruit is high in the enzyme Bromelain and the antioxidant vitamin C, both of which play a major role in the body's healing process. Bromelain is a natural anti-inflammatory that has many health benefits and encourages healing. Pineapple fruit is very low in saturated fat, cholesterol and sodium. It is a good source of Dietary Fiber. Pineapples are packed full of vitamin C and fiber – important for the immune and digestive systems.

DELICIOUS PINEAPPLE RECIPIES

1. Pineapple Juice
2. Pineapple Lime
3. Pineapple Ginger Sprite
4. Pineapple Mixed Fruit Juice
5. Pineapple Juice Concentrate
6. Pineapple Squash
7. Pineapple Syrup
8. Pineapple Jam
9. Pineapple Pickle
10. Pineapple Halwa
11. Pineapple Candy
12. Pineapple Chips
13. Pineapple Kesari
14. Pineapple Ada
15. Pineapple Payasam
16. Pineapple Pudding
17. Pineapple Upside down Cake
18. Pineapple Ice cream
24. Tropical Pineapple Colada Cocktail
25. Pineapple Wine
26. Pineapple Vodka
27. Pineapple Lassy
28. Pineapple Ball
29. Pineapple Bolly
30. Pineapple Sweet Curry
31. Pineapple Pulissery
32. Pineapple Pachady
33. Pineapple-Capsicum Chutney
34. Spicy Grilled pineapple
35. Pineapple Pops
36. Pineapple Caramel
37. Carrot-Pineapple-Raisin Salad
38. Pineapple-Mango chutney
39. Pineapple- Passion fruit soda
40. Pineapple Vinegar

1. PINEAPPLE JUICE

Pineapple juice tastes best when chilled and it is an ideal fruit drink to consume during the hot summer days. Fresh pineapple juice contains about 75% of vitamin C. It acts as a natural antioxidant. It promotes cell growth and tissue repair. Pineapple juice also contains vitamin B6, which helps our body to regulate blood sugar and also promote a healthy immune system.

Ingredients (for 750 ml):

Pineapple	:	500 g
Sugar	:	250 g
Water	:	250 ml
Crushed Ice	:	½ cup

Method of preparation:

- Peel the skin and cut into small pieces
- Blend the pineapple pieces, sugar and required amount of water in a blender
- Then filter it to get the clear juice
- Transfer into glass and add some crushed ice
- Serve chilled

2. PINEAPPLE LIME

Pineapple Lime

Ingredients (for 750 ml):

Pineapple	:	500 g
Sugar	:	250 g
Water	:	50 ml
Lime	:	250 g

Method of preparation:

- Peel the skin and cut into small pieces
- Cut the lime into small pieces
- Blend the pineapple pieces, sugar, lime and required amount of water in a blender
- Then filter it to get the clear juice
- Transfer into glass and add some crushed ice
- Serve chilled

3. PINEAPPLE GINGER SPRITE

Pineapple ginger sprite

Ingredients (for 750 ml):

Pineapple Juice	:	1 cup
Soda	:	¼ Cup
Chopped Ginger	:	2 tsp

Method of preparation:

- Blend the pineapple juice and ginger in a blender until nearly smooth
- Then filter it to get the clear juice
- Transfer into glass and add some crushed ice
- Serve chilled

Mixed fruit juice

4. PINEAPPLE MIXED FRUIT JUICE

Ingredients (for 350 ml):

Pineapple juice	:	250 ml
Grape juice	:	100 ml

Method of preparation:

- Blend the pineapple pieces in a blender
- Then filter it to get the clear juice
- Blend the grapes and filter to get clear juice
- Mix well the two fruit juices and serve chilled

5. PINEAPPLE JUICE CONCENTRATE

Ingredients (for 1 kg):

Pineapple	:	500 g
Sugar	:	500 g
Water	:	50 ml
Citric acid	:	3 g
Sodium benzoate	:	1 g

Juice concentrate

Method of preparation:

- Peel the skin and cut into small pieces
- Blend the pineapple pieces in a blender
- Then filter it to get the clear juice
- Cook the pineapple juice with sugar and citric acid
- Boil it well by stirring continuously
- When the sugar dissolve continuously, add dissolved sodium benzoate
- Take off from fire and allow to cool
- Pour into sterilized bottles and seal

6. PINEAPPLE SQAUSH

Pineapple squash should be prepared from fully matured and ripe pineapple fruits free from insect infestation, diseases etc. For preparing this juicy and delicious pineapple squash, firstly clean the pineapple and peel the skin thickly. Grate the pineapple and filter the grated pineapple through a clean cloth and collect the juice out of it and keep it aside. Squash is a concentrated form of fruit drink. The pineapple squash is generally diluted 2-3 times with water

at the time of consumptions and chilled with ice cubes and served. Preparing the Pineapple squash is very simple and easy to prepare.

Ingredients (for 500 ml):

Fresh Pineapple Juice	:	1 cup
Sugar	:	2 cup
Water	:	1 cup
Citric acid	:	1 tsp
KMS (Potassium meta bisulphate)	:	1/8 tsp
Yellow food color	:	1/8 tsp

Method of preparation:

- Bring the sugar and water to boil in a deep vessel
- Simmer to make sticky syrup, which is not one thread
- Add dissolved citric acid, take off from fire
- Cool and add juice, dissolve KMS
- Stir till well blended
- Pour into sterilized bottles and seal
- Refrigerate opened bottle

Serving: Add 1 tbsp of squash in 150 ml water and serve

7. PINEAPPLE SYRUP

Pineapple Syrup

Ingredients (for 1 litre):

Fresh Pineapple Juice	:	600 ml
Sugar	:	800 g
Water	:	200 ml

Method of preparation:

- Bring the water to boil in a deep vessel and dissolve sugar
- Add pineapple juice to the boiling sugar syrup
- Boil till the solution becomes a thread form and take off from fire
- After cooling pour the syrup into sterilized bottle

8. PINEAPPLE JAM

Pineapple jam is a nutritious spread on various foods. It imparts wonderful flavor to varied number of dishes. Despite the ready availability of commercially prepared jams and preserves, there are still advantages to making them at home. We can tailor the recipe to suit our taste -- we can regulate the sweetness of the product etc.

Ingredients (for 350 g):

Pineapple	:	250 g
Sugar	:	250 g
Citric acid	:	½ tsp
Pectin powder	:	½ tsp
Lemon yellow color	:	¼ tsp
Pineapple essence	:	½ tsp
Water	:	2 ½ cups

Pineapple Jam

Method of preparation:

- Cook the pineapple pulp with water on a low fire
- Stir it continuously with a wooden ladle
- While it boils, slowly add sugar into it. Boil it well by stirring continuously
- Add pectin powder and stir continuously
- When the jam is done, add citric acid, lemon yellow color and pineapple essence to it
- Remove from fire and pour into a bottle
- When the jam cools, close the mouth of the bottle

9. PINEAPPLE PICKLE

Pickling is the process of preserving food by anaerobic fermentation in brine or vinegar. The resulting food is called a pickle. This procedure gives the food a salty or sour taste. Pineapple pickle is very tasty and delicious item consumed without any age bar.

Ingredients (for 500 g):

Pineapple	:	250 g
Coconut oil	:	3 tbsp
Ground mustard seeds	:	1 tsp
Mild chilly powder	:	½ tsp
Turmeric	:	¼ tsp
Green chilly	:	50 g
Small onion	:	25 g
Black pepper	:	¼ tsp
Garlic	:	50 g
Sugar	:	100 g
Vinegar	:	100 ml

A few springs of fresh curry leaves

Pineapple Pickle

Method of preparation:

- Peel the skin and cut the pineapple into eight long wedges, and then remove the tough core from each wedge
- Chop each pineapple wedge into small pieces, about the size of a dice

- Heat the coconut oil in a sauce pan, add the spices and fresh curry leaves, when they fizzle add the pineapple
- Add sugar and vinegar and cook gently until the mixture is thick and slightly jammy
- Transfer the pickle into a bowl

10. PINEAPPLE HALWA

Pineapple halwa is a pineapple flavored mouth watering sweet dish. It is a delicious dessert dish which can be served as a snack or after meal. It is very tasty and easy to prepare.

Ingredients (for 400 g):

Pineapple	:	1- 1 ½ cup (grated)
Sugar	:	150 g
Khoa	:	½ cup (grated)
Milk	:	½ cup
Cardamom powder	:	½ tsp
Ghee	:	2 tbsp
Water	:	½ glass
Almond	:	2 or 3

Pineapple Halwa

Method of preparation:

- Take water in a pan and heat it on a medium flame. Now add the grated pineapple in it for boiling
- Then add sugar and ghee. Stir continuously. Then add milk and Khoa and mix gently till the water evaporates
- Cook it for at least 10 minutes in a low flame
- Now remove from flame and sprinkle cardamom powder
- Finally garnish with almond and serve hot

11. PINEAPPLE CANDY

Candy is a very sweet food. Sugar syrup and fruits are its basic ingredients. Pineapple candy is one of the delicious fruit products and increases the shelf life of candy by drying process.

Ingredients (for 500 g):

Pineapple	:	500 g
Sugar	:	4 cups
Water	:	250 ml

Method of preparation:

- Peel the pineapple, remove eyes, core and wash
- Slice into cubes
- Prepare the syrup, dissolving 2 parts sugar into 1 parts water
- Boil the pineapple in syrup for 20 minutes
- Soak in syrup overnight
- Strain and wash well in water
- Dry in solar dryer for 16-20 hrs
- Let cool
- Roll over sugar and wrap in cellophane
- Put in plastic bags, seal open end of bag with the flame of candle

13. PINEAPPLE CHIPS

Ingredients (for 250 g):

Pineapple	:	250 g
Coconut oil	:	to fry

Method of preparation:

- Remove the core, peel and cut into small pieces
- Dry the pineapple pieces under sun
- Fry the pieces in hot coconut oil and serve

Pineapple Chips

13. PINEAPPLE KESARI

Semolina (rawa) kesari is simple South-Indian dessert mainly prepared during festive and special occasions. Adding fruits make it tastier. Fresh pineapple chunks are being used for this recipe. *Pineapple kesari* is a delightful delicious in South Indian sweet Recipe.

Ingredients (for 500 g):

Pineapple	:	500 g
Sugar	:	1 ¼ cup
Rava	:	1 cup
Ghee	:	½ cup
Water	:	2 cups
Cardamom powder	:	¼ tsp
Cashew and raisins (fried in ghee)	:	2 tbsp

Pineapple Kesari

Salt	:	A pinch
Pineapple essence	:	A few drops

Method of preparation:

- Peel the pineapple, cut and grind partially, powder cardamom
- Heat a pan (no ghee), put the rava into the pan and heat it until golden brown with constant stirring. Put the rava into a dry plate
- Put 1 tea spoon of ghee from ½ cup given, fry cashew nuts, raisins and keep
- In the same frying pan add rava, fry for 2 seconds, add 2 cups of water, mix well and bring to boil, boil in low flame, till rava is half cooked, add ground pineapple pieces, mix well and cook for few seconds
- Add sugar, cardamom powder and mix well, add ghee, stir well, cook till the mix is thick and leaves the side of the pan
- Transfer kesari onto a big bowl and garnish with fried cashew nuts and raisins, serve hot or cold

14. PINEAPPLE ADA

Ingredients (for 800 g)

Pineapple	:	250 g
Jaggery	:	150 g
Rice Flour	:	250 g
Cardamom powder	:	¼ tsp
Cumin seeds	:	¼ tsp
Salt	:	A pinch
Grated coconut	:	150 g

Pineapple Ada

Method of preparation:

- Peel the pineapple, cut and grind into a smooth paste
- Cook the pineapple mix with jaggery
- Add jaggery, rice flour, coconut, cardamom powder and cumin seeds to the pineapple and mix thoroughly
- Spread the prepared mix in small amounts on a banana leaf piece and steam cook

15. PINEAPPLE PAYASAM

Payasam / Kheer is an Indian sweet dessert. Pineapple payasam is made with pineapple, chowery (Sago) and milk. Nuts such a pistachio, cashew, and almonds along with raisins, saffron and cardamom are roasted in ghee and added to give a rich feel, taste and good appearance.

Pineapple Payasam

Ingredients (for 1 liter):

Pineapple	:	250 g
Grated jaggery	:	¾ cup
Chowari	:	50 g
Ghee	:	2 tbsp
Water	:	½ cups
Cardamom powder	:	2 tsp
Cashew and raisins	:	2 tbsp
Coconut milk (first milk)	:	1 cup
Coconut milk (second milk)	:	2 cup
Coconut milk (second milk)	:	3 cup

Method of preparation:

- Put 1 tea spoon of ghee from given, fry cashew nuts, raisins and keep
- Boil the pineapple pieces in a thick bottom pan along with little water
- When pineapple is done, add the ghee and fry it well
- Add grated jaggery and cook till the color changes to dark brown
- When it is nicely done, add the third extract of coconut milk and cook till the payasam is thick and add cardamom powder
- Lower the flame and add the second extract followed by the first extract
- When the first extract begins to boil, add the washed chowari
- When the chowari is cooked and payasam is nicely done, remove from low flame
- Add the roasted cashew and raisins
- Remove from flame and allow cooling

16. PINEAPPLE PUDDING

Pineapple pudding is a healthy dessert, as it is made up of pineapple fruit. The fresh ingredients make the dessert even more delicious. For pudding, the pineapple used should be fresh or canned. The best two ingredients of the pineapple pudding dessert are the crushed pineapple and the fresh cream. Pineapple Pudding is a very tasty and easy recipe.

Pineapple Pudding

Ingredients (for 1 kg):

Pineapple	:	250 g
Sugar	:	250 g
Milk	:	350 ml
Soft white bread slices	:	10
Soft butter	:	100 g
Lime juice	:	1 tbsp
Ground nutmeg	:	¼ tsp
Ground cinnamon	:	¼ tsp
Ground clove	:	¼ tsp

Egg white (beaten)	:	2 large
Egg yolk (beaten)	:	2 large
Vanilla essence	:	1 tsp
Cardamom powder	:	1 tsp
Raisins	:	50 g

Method of preparation:

- Preheat oven to 175 ^{o}C
- Cook the pineapple with half cup of water and 2 tbsp of sugar and drain it. Keep the pineapple aside
- Heat a pan, put the milk into the pan and allow to boil with constant stirring
- When the milk is boiling, add the bread powder and cook it for 10 minutes. Keep aside for cooling
- In a medium mixing bowl, combine butter, sugar and egg yolk. Mix well. Add ground cinnamon, nutmeg powder, ground cloves, cardamom powder and vanilla essence. Add cooked pineapple to it. Beat until well mixed
- Pour over cooled milk and bread mixture. Fold the beaten egg white little by little to this mixture
- Place it in a pudding dish and sprinkle with raisins and cashew nuts
- Bake in the preheated oven for 45 minutes, until the surface is golden brown

17. PINEAPPLE UPSIDE DOWN CAKE

An upside-down cake is a cake that is baked in a single pan, then turned over and served upside-down. Usually chopped fruits such as apples, pineapples or cherries and a butter and sugar topping are placed on the bottom of the pan before the batter is poured in, so that they form a decorative topping once the cake is inverted.

Ingredients (for 1 kg):

Maida	:	1 cup
White Sugar	:	½ cup
Baking powder	:	1 tsp
Low fat Milk	:	¼ cup
Salt	:	A pinch
Butter	:	¼ cup
Egg	:	1 large
Vanilla essence	:	1 tsp
For topping:		
Butter	:	1 ½ tbsp
Brown sugar	:	¼ cup
Pineapple slices	:	4-5 (tinned and drained
Glazed cherries	:	6-7

Pineapple upside down cake

Method of preparation:

- Preheat oven to 175 ^{o}C
- Grease and flour a round baking pan. Prepare the topping by melting butter in a pan and add brown sugar. As the sugar melts and foams, cook on a medium flame for a minute and pour into the baking pan. Over this sugar layer, place the pineapple slices and in the centre of each slice, place a glazed cherry. Keep aside.
- Sieve Maida, baking powder and salt in a bowl.
- In another bowl, cream butter and sugar. Use a hand blender to make a smooth creamy mixture. Add the beaten egg and combine well. Add vanilla essence and combine.
- Fold the Maida mixture little by little alternating with milk. Do not overbeat, just fold them dry till there is no trace of any flour.
- Pour batter over the fruit layer. Bake in a pre-heated oven for 45 minutes or till a tooth pick inserted into the cake comes out clean. Place on a wire rack to cool, slice and serve at room temperature

18. PINEAPPLE ICE CREAM

Ice cream is a frozen dessert usually made from dairy products, such as milk and cream, and often combined with fruits or other ingredients and flavors. Pineapple ice cream is a sweet summer treat that is easy to make at home.

Pineapple ice cream

Ingredients (for 1 liter):

Pineapple	:	½ cup
Milk	:	1 liter
Custard powder	:	¼ cup
Condensed milk	:	1 tin
Sugar syrup	:	¼ cup
Pineapple essence	:	2 drops

Method of preparation:

- Boil milk, custard powder and condensed milk to make custard
- Heat the pineapple with sugar syrup till the pineapple gets well cooked
- Mix the custard, cooked pineapple and add pineapple essence to it
- Beat the mixture well using an egg beater
- Convert it to an ice-cream tray and freeze it for 4-6 hrs
- Serve it chilled

19. TROPICAL PINEAPPLE COLADA COCKTAIL


Pineapple cocktail

Ingredients (for 1 litre):

Pineapple juice	:	2 cups
Pineapple	:	1 cup
Rum/Wine	:	½ cup
Coconut cream	:	½ cup
Palm Sugar	:	2 tbsp
Crushed ice	:	1 cup

Method of preparation:

- Put all the ingredients in a blender and blend until smooth
- Transfer to a serving jug and serve immediately over crushed ice

20. PINEAPPLE WINE

Wine is an alcoholic beverage made from fermented grapes or other fruits. Pineapple wine is made from the juice of pineapples. Fermentation of the pineapple juice takes place in temperature-controlled vats. The result is a fruit wine with a strong pineapple flavor.

Ingredients (for 3.5 litres):

Pineapple	:	1 kg
Sugar	:	2 kg
Water	:	10 cup
Yeast	:	2 tbsp

Method of preparation:

- Wash the pineapples and cut into small pieces. Don't remove its skin
- Boil it for about five minutes with water and 1 kg sugar
- When cool, add yeast and store in an air tight mud vessel for 20 days
- Stir the content daily with a wooden ladle
- After 21 days, filter the wine through a fine cloth. Do not squeeze the contents. Add the remaining sugar and store it for another 21 days without stirring

21. PINEAPPLE VODKA

Ingredients (for 500 ml):

Fresh Pineapple	:	250 g
Vodka	:	250 ml

Method of preparation:

- Pour the vodka over the pineapple until all the fruit is covered

- Place a lid and then store in the fridge for 10 days
- Peel and cut your fresh pineapple into chunks, then place these in a glass container that has a lid

22. PINEAPPLE LASSY

Pineapple lassy

Ingredients (for 500 ml):

Chopped Pineapple	:	½ cup
Sour less curd	:	½ cup
Ginger	:	A small piece
Honey	:	1 tbsp
Sugar	:	¼ cup
Crushed ice	:	½ cup

Method of preparation:

- Blend all the ingredients in a blender
- Transfer the juice a glass

23. PINEAPPLE BALL

Pineapple ball is a simple snack dish made with semolina or rava. It is a popular sweet which is prepared from ghee, sugar, rava, cardamom and dry fruits. It can be served any time of the day.

Pineapple ball

Ingredients (for 500 g):

Fresh Pineapple	:	500 g
Rava	:	1 cup
Ghee	:	½ cup
Sesame	:	1 tsp
Sugar	:	1 ¼ cup
Cardamom powder	:	½ tsp
Cashew nuts and raisins	:	2 tbsp (fried in 2 tsp ghee)

Method of preparation:

- Cut the pineapple into small pieces and cook it with low fire.
- Grind the pineapple to make a paste.
- Add ghee to the heating pan. Put the rava into the pan and heat it until golden brown with constant stirring.
- Put the rava into a dry plate.
- Put 1 tea spoon of ghee from ½ cup given, fry cashew nuts, raisins and keep.
- Prepare the syrup, 2 parts of sugar to 1 part water
- Boil the pineapple in the syrup for 5 minutes and add rava to it

- When it reaches in the form of making ball add cashew nuts, raisins, powdered cardamom and sesame. Make balls of convenient size and serve into a bowl

24. PINEAPPLE BOLLY

Ingredients (for 500 g):

Fresh Pineapple	:	500 g
Maida	:	200 g
Sugar	:	100 g
Turmeric powder	:	¼ tsp
Coconut oil	:	to fry

Pineapple bally

Method of preparation:

- Cut the pineapple into long pieces
- Mix Maida, sugar, turmeric powder with little amount of water
- Dip the pineapple pieces in the Maida mix and fry in hot oil

25. PINEAPPLE SWEET CURRY

Ingredients (for 500 g):

Fresh Pineapple	:	1 cup
Banana	:	1 cup
Grapes	:	8-10 number
Sugar	:	1 tbsp
Chilly powder	:	A pinch
Turmeric powder	:	A pinch
Curd	:	2 tbsp
Grated coconut	:	½ cup
Mustard	:	1 tsp
Green chilly	:	2
Coconut oil	:	to fry

Pineapple sweet curry

Method of preparation:

- Cook the pineapple in a pan with chilly powder, turmeric powder, salt and 3 spoon water
- Add chopped banana and grapes to the half cooked pineapple
- Make a paste of green chilly and coconut, add to the pineapple mix and boil well
- Add sugar and curd and remove from the fire
- For seasoning fry mustard in a coconut oil and add to the curry

26. PINEAPPLE PULISSERY

Pulissery is a traditional Kerala dish made using curd and grated coconut. Sour curd is used for making pulissery and vegetables or fruits are often added to pulissery to balance the sourness.

Pineapple pulissery

Ingredients (for 1 liter):

Pineapple	:	2 cups
Curd	:	1 cup
Salt	:	to taste
Turmeric	:	½ tsp
Green chilly	:	2

Grind to paste

Grated Coconut	:	1 cup
Cumin seeds	:	½ tsp
Green chilly	:	2
Garlic	:	2 pods

A few springs of fresh curry leaves

For seasoning

Mustard	:	1 tsp
Coconut oil	:	1 tbsp
Dry red chilly	:	4
Fenugreek seeds	:	¼ tsp

Curry leaves a few

Method of preparation:

- Peel the skin and cut the pineapple into small pieces
- Cook the pineapple pieces along with water, turmeric powder, chilly powder and salt until it turns soft and tender
- Grind and make a paste of coconut, cumin seeds, 2 green chilly, 2-3 curry leaves with little water
- Add to the cooked pineapple. Also add whipped curd, mix well and bring to a boil. Cook for a minute. Take off from stove
- For seasoning, heat the coconut oil in a sauce pan, add the mustard, fenugreek seed, whole red chilly and fresh curry leaves. Add to pulissery
- Serve as a side dish with rice.

27. PINEAPPLE PACHADI

Ingredients (for 1 liter):

Pineapple	:	1 small
Curd	:	1 ½ cup
Salt	:	to taste

Chopped onion	:	1 tsp
Chopped ginger	:	½ tsp
Green chilly	:	2
Grated Coconut	:	1 cup
A few springs of fresh curry leaves		
Mustard	:	1 tsp
Coconut oil	:	1 tbsp
Dry red chilly	:	4


Pineapple pachadi

Method of preparation:

- Peel the skin and cut the pineapple into small pieces discarding the core
- Heat oil in a pan and add chopped onion, chopped ginger, green chilly and toss it for a couple of minutes
- Add the pineapple pieces and toss it well
- Add enough water and cook the pineapple until it is soft and tender, but still holds the shape, the water should be completely absorbed and let it cool
- Whisk the curd with salt, add pineapple pieces to the curd and combine it well
- For seasoning, heat oil in a small pan and add mustard seeds. When it pop up add red chilies and curry leaves, fry it for a minute
- Remove from fire and pour over Pachadi
- Serve warm

27. PINEAPPLE-CAPSICUM CHUTNEY

Ingredients (for 500 g):

Pineapple	:	400 g
Red capsicum	:	1 cup
Salt	:	to taste
Lemon juice	:	3-4 tsp
Chilly powder	:	2 tsp
Sugar	:	2-3 tsp
Crushed cinnamon	:	¼ tsp


Pineapple chutney

Method of preparation:-

- Separately grind pineapple and capsicum into fine paste
- In a pan cook pineapple, capsicum paste and cinnamon for a couple of minutes under low flame
- Add sugar, salt, lemon juice and chilly powder to the pan and cook till it become a sauce form
- Transfer into a bottle after cooling and keep it in fridge

- Use after one week of refrigeration

Grilled Pineapple

29. SPICY GRILLED PINEAPPLE

Ingredients (for 500 g)

Fresh Pineapple	:	500 g
Olive oil	:	1 tbsp
Salt	:	to taste
Pepper powder	:	¼ tsp

Method of preparation:-

- Peel the skin, remove the core and cut the pineapple cross wise into round pieces
- Toss the pineapple pieces with olive oil, pepper powder and salt
- Heat the grill to high and brush grates with oil
- Place the tossed pineapple pieces on grill and cook until it become tender, turn the pieces once in the grill
- Serve as a side dish along with grilled fish or meat

Pineapple Pops

30. PINEAPPLE POPS

Ingredients (for 750 g)

Pineapple pieces	:	3 cups
Milk	:	1/3 cup
Sugar	:	¼ cup

Method of preparation:-

- Peel the skin, remove the core and cut the pineapple into small pieces
- Combine pineapple pieces, milk and sugar in a blender until almost smooth, with some pieces of pineapple remaining
- Pour half the mixture into a bowl, blend the remaining mixture until completely smooth and add to the mixture in a bowl
- Pour the mixture into an ice tray and insert wooden sticks on each. Freeze until solid at least 4 hours (cover with plastic wrap)

31. PINEAPPLE CARAMEL

Ingredients (for 500 g):

Pineapple	:	500 g
Butter	:	2 tbsp
Sugar	:	½ cup

Pineapple caramel

Method of preparation:

- Peel the skin, remove the core and cut the pineapple into long wedges
- Heat butter in a nonstick pan over high heat
- Coat the pineapple wedges with sugar, and place in hot pan
- Cook, turning once and shaking pan often until golden brown 8 to 10 minutes, remove from fire
- Stir 3 table spoons of water into pan and heat briefly, sprinkle over pineapple
- Serve with chilled curd

32. CARROT-PINEAPPLE-RAISIN SALAD

Ingredients (for 1 kg):

Pineapple pieces	:	½ cup
Raw carrots	:	500 g peeled and shredded
Raisins	:	½ cup
Mayonnaise	:	½ cup
Powdered Sugar	:	½ cup

Pineapple salad

Method of preparation:

- Soak the raisins in hot water for 10-20 minutes to plum and then drain
- In a bowl combine carrots, pineapple, mayonnaise, raisins and powdered sugar and mix well
- Serve chilled

33. PINEAPPLE-MANGO CHUTNEY

Ingredients (for 1 kg):

Pineapple pieces	:	1 small
Ripe mango	:	3 medium
Coconut oil	:	2 tbsp
Sugar	:	½ cup
Crushed Pepper	:	1 tsp
Chopped ginger	:	1 tsp
Minced onion	:	1 large
Garam Masala	:	1 tsp
Vinegar	:	2 tsp

Pineapple mango chutney

Method of preparation:

- Heat the coconut oil in a large sauce pan, add minced onion and crushed pepper, cook till the onions have softened
- Add chopped ginger and stir for 2-3 minutes.

- Add mango pieces, pineapple, sugar, garam masala and vinegar, bring to simmer and cook for 30 minutes stirring occasionally
- Cool the chutney when it is done and store in airtight containers in the refrigerator

34. PINEAPPLE- PASSION FRUIT SODA

Ingredients (for 1.5 litre):

Pineapple Juice	:	1 ¼ cup
Lemon juice	:	¼ cup
Sugar	:	1 ¼ cup
Passion fruit pulp	:	1 cup
Chilled soda	:	1 ltr

Pineapple passion fruit soda

Method of preparation:

- Heat pineapple juice, lemon juice and sugar in a pan over medium heat, cook stirring until the sugar has dissolved
- Increase heat to high and bring to boil
- Reduce the heat to low and simmer for 15-20 minutes or until slightly thickened, remove from heat
- Stir the prepared juice with passion fruit pulp, pour into glass with chilled soda

Pineapple is a tropical fruit which is consumed fresh or in a processed form. It contains nutrients which are good for human health. It also contains antioxidants and protease. It is useful against malignant cell formation, thrombus formation and inflammation.

Processed pineapples are consumed worldwide and processing industries are trying out or using new technologies to retain the nutritional quality of the pineapple fruit. This is to meet the demand of consumers who want healthy, nutritious and natural products. Pineapple wastes from these processing industries can be utilized to produce methane, animal feed and manure.

Standard Measurements

1/4 tsp	1 ml
1/2 tsp	2ml
1 tsp	5 ml
1 tbsp	15ml (3 tsp)
1/4 cup	50 ml
1/3 cup	75 ml
1/2 cup	125 ml
2/3 cup	150 ml
3/4 cup	175 ml
1 cup	250 ml (225 g)

8.4 Pineapple Recipes (Malayalam)

പൈനാപ്പിൾ വിഭവങ്ങൾ

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പൈനാപ്പിൾ: പ്രകൃതിയുടെ വരദാനം

ഊഷ്മളമായ മണവും, രുചിയും, അരോഗ്യദായകമായ ജ്യൂസുമുള്ള അത്ഭുതകരമായ ഒരു ഉഷ്ണമേഖലാ ഫലമാണ പൈനാപ്പിൾ. പ്രായഭേദമന്യെ ഏവരും പൈനാപ്പിൾ ഇഷ്ടപ്പെടുന്നു. വളരെ പ്രാധാന്യമർഹിക്കുന്ന ഈ ഫലം അങ്ങനെ തന്നെയോ അല്ലെങ്കിൽ സംസ്കരിച്ച രൂപത്തിലോ ഇന്ന വിപണിയിൽ ലഭ്യമാണ. മനുഷ്യശരീരത്തിനാവശ്യമായ ഒട്ടനവധി പോഷകങ്ങൾ ഇതിൽ ധാരാളമായി കണ്ടുവരുന്നു. ഇതിൽ കാൽസ്യം, പൊട്ടാസ്യം, നാരുകൾ, ജീവകം സി എന്നിവയുണ്ട്. ശാസ്ത്രീയപരമായി 'ബ്രൊമിലൈൻ' എന്ന കുടുംബത്തിലാണ പൈനാപ്പിളിന്റെ സ്ഥാനം. ഇതിലുള്ള ബ്രൊമലൈൻ എന്ന എൻസൈം ദഹനപ്രക്രിയയെ ഉത്തേജിപ്പിക്കുകയും ശരീരത്തിലെ വിവിധ കേടുപാടുകളെ നീക്കി സദാ ഉന്മേഷം നൽകുകയും ചെയ്യുന്നു.

പാകമായ പൈനാപ്പിളിന്റെ നീര് ശരീരത്തിന വളരെ പോഷകഗുണമേകുന്ന നല്ല ഒരു ശീതളപാനീയമാണ. ശാരീരികാരോഗ്യം മെച്ചപ്പെടുത്തുന്നതിൽ പൈനാപ്പിൾ വളരെ വലിയ പങ്കു വഹിക്കുന്നുണ്ട്. ശരീരത്തിന്റെ പോഷണത്തിനും രോഗപ്രതിരോധ ശേഷിക്കും ആരോഗ്യം നിലനിർത്തുന്നതിനും പൈനാപ്പിളിലെ ധാതുലവണങ്ങളും വിറ്റാമിനുകളും സഹായിക്കുന്നു. എന്നാൽ ഈ ഫലത്തിന്റെ അരോഗ്യമൂല്യങ്ങളെക്കുറിച്ച് അറിവില്ലാത്ത നാം ഇത് വേണ്ടവിധം ഉപയോഗിക്കുന്നതിൽ താൽപര്യം കാണിക്കുന്നില്ല. തത്ഫലമായി പൈനാപ്പിൾ എന്ന ഈ മധുരക്കനിയിൽ നിന്നും ലഭിക്കുന്ന നിരവധി പോഷകഘടകങ്ങൾ ഉദ്പാദകരായ നമുക്ക് അന്യമാകുന്നു.

പൈനാപ്പിൾ കുട്ടികൾ കൂടുതലായി കഴിച്ചാൽ മോണപഴുപ്പിന കാരണമായിതീരും, മറ്റു ചിലർക്ക് തലവേദനയ്ക്കും അലർജിക്കും കാരണമാവരുണ്ട്. തൊലിപ്പുറത്ത് ചൊറിച്ചിൽ, ചുമന്ന നിറം മുതലായ ലക്ഷണങ്ങൾ ചിലരിൽ കണാറുണ്ട്. അതു പക്ഷേ 'അമിതമായാൽ അമൃതും വിഷം' എന്ന പഴഞ്ചൊല്ലു പോലെ അധികമായാൽ മാത്രം.

പൈനാപ്പിൾ പ്രധാനമായും 3 രീതിയിലാണ ഉപയോഗിക്കുന്നത്; നേരിട്ടും, ക്യാൻ ചെയ്തും, ജ്യൂസായും. പൈനാപ്പിൾ ധാരാളമായി ലഭ്യമാകുന്ന സീസണിൽ അവ സംസ്കരിച്ച് സൂക്ഷിക്കുന്നത് വർഷം മുഴുവൻ നമുക്ക് പൈനാപ്പിൾ ഉൽപന്നങ്ങളുടെ ലഭ്യത ഉറപ്പു വരുത്തുന്നു.

പൈനാപ്പിൾ കൊണ്ട് തയ്യാറാക്കാവുന്ന ഏതാനും ചില വിഭവങ്ങൾ മാത്രമാണ് ഇവിടെ പ്രതിപാദിച്ചിരിക്കുന്നത്. ഇവയുടെ ചേരുവകളിൽ ചെറുതോ വലുതോ ആയ അനുയോജ്യ മാറ്റങ്ങൾ വരുത്തി അനേകം വിഭവങ്ങൾ തയ്യാറാക്കാൻ സാധിക്കുന്നതാണ്. വിപണിയിൽ പൈനാപ്പിൾ മിച്ചമായും വില താണുമിരിക്കുമ്പോൾ ഇത്പോലെയുള്ള ഒട്ടനവധി വിഭവങ്ങൾ തയ്യാറാക്കി ആദായമുണ്ടാക്കാവുന്നതാണ്. ഇങ്ങനെ നമ്മുടെ ആരോഗ്യ ഭക്ഷ്യ സാമ്പത്തിക സുരക്ഷ ഉറപ്പാക്കാം.

രുചികരമായ പൈനാപ്പിൾ വിഭവങ്ങൾ

പൈനാപ്പിൾ ജ്യൂസ്


പൈനാപ്പിൾ ജ്യൂസ്

ചേരുവകൾ: (750 മില്ലി ലിറ്ററിൻ)

പൈനാപ്പിൾ	:	500 ഗ്രാം
പഞ്ചസാര	:	250 ഗ്രാം
വെള്ളം	:	250 മില്ലി ലിറ്റർ
പൊടിച്ച ഐസ്:		1/2 കപ്പ്

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ തൊലികളഞ്ഞ് ചെറുതായി അരിഞ്ഞെടുക്കുക. പൈനാപ്പിൾ കഷ്ണങ്ങളും പഞ്ചസാരയും ആവശ്യത്തിനു വെള്ളവും ചേർത്ത് മിക്സിയിൽ അടിച്ചെടുക്കുക. ജ്യൂസ് അരിച്ചെടുത്ത് ഒരു ഗ്ലാസിലേക്കു പകർത്തി, പൊടിച്ച ഐസ് ചേർത്ത് തണുപ്പിച്ച് കഴിക്കുക.

പൈനാപ്പിൾ ലൈം


പൈനാപ്പിൾ ലൈം

ചേരുവകൾ: (750 മില്ലി ലിറ്ററിൻ)

പൈനാപ്പിൾ	:	500 ഗ്രാം
പഞ്ചസാര	:	250 ഗ്രാം
വെള്ളം	:	50 മില്ലി ലിറ്റർ
നാരങ്ങ	:	250 ഗ്രാം
പൊടിച്ച ഐസ്:		1/2 കപ്പ്

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ തൊലികളഞ്ഞ് ചെറുതായി അരിഞ്ഞെടുക്കുക. പൈനാപ്പിൾ കഷ്ണങ്ങളും പഞ്ചസാരയും നാരങ്ങയും ആവശ്യത്തിനു വെള്ളവും ചേർത്ത് മിക്സിയിൽ അടിച്ചെടുക്കുക. ജ്യൂസ് അരിച്ചെടുത്ത് ഒരു ഗ്ലാസിലേക്കു പകർത്തി ഒഴിക്കുക. പൊടിച്ച ഐസ് ചേർത്ത് തണുപ്പിച്ച് കഴിക്കുക.

പൈനാപ്പിൾ ജിഞ്ചർ സ്പ്രൈറ്റ്


ജിഞ്ചർ സ്പ്രൈറ്റ്

ചേരുവകൾ: (750 മില്ലി ലിറ്ററിൻ)

പൈനാപ്പിൾ ജ്യൂസ്	:	1 കപ്പ്
സോഡ	:	1/4 കപ്പ്
ഇഞ്ചി അരിഞ്ഞത്	:	2 ടീസ്പൂൺ
പൊടിച്ച ഐസ്	:	1/2 കപ്പ്

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ ജ്യൂസും ഇഞ്ചിയും മിക്സിയിൽ നന്നായി അടിച്ചെടുക്കുക. ജ്യൂസ് അരിച്ചെടുത്ത് ഒരു ഗ്ലാസിലേക്ക് പകർത്തി ഒഴിക്കുക. പൊടിച്ച ഐസും സോഡയും ചേർത്ത് തണുപ്പിച്ച് കഴിക്കുക.

പൈനാപ്പിൾ മിക്സെഡ് ഫ്രൂട്ട് ജ്യൂസ്.

മിക്സെഡ് ഫ്രൂട്ട് ജ്യൂസ്

ചേരുവകൾ: (350 മില്ലി ലിറ്ററിൻ)

പൈനാപ്പിൾ ജ്യൂസ്	:	250 മില്ലി ലിറ്റർ
മുന്തിരി ജ്യൂസ്	:	100 മില്ലി ലിറ്റർ

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിളും മുന്തിരിയും വേറെ വേറെ അടിച്ചെടുക്കുക. അതിനു ശേഷം നന്നായി ഇളക്കിചേർത്ത് ഉപയോഗിക്കുക.

പൈനാപ്പിൾ ജ്യൂസ് കോൺസെന്ട്രേറ്റ്

ജ്യൂസ് കോൺസെന്ട്രേറ്റ്

ചേരുവകൾ: (1 കിലോ)

പൈനാപ്പിൾ	:	500 ഗ്രാം
പഞ്ചസാര	:	500 ഗ്രാം
വെള്ളം	:	50 മില്ലി ലിറ്റർ
സിട്രിക് ആസിഡ്	:	3 ഗ്രാം
സോഡിയം ബെൻസോയേറ്റ്	:	1 ഗ്രാം

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ തൊലികളഞ്ഞ് ചെറുതായി അരിഞ്ഞെടുക്കുക. പൈനാപ്പിൾ കഷ്ണങ്ങൾ മിക്സിയിൽ അടിച്ചെടുക്കുക. ജ്യൂസ് അരിച്ചെടുക്കുക. പൈനാപ്പിൾ ജ്യൂസ് പഞ്ചസാരയും സിട്രിക് ആസിഡും ചേർത്ത് തിളപ്പിക്കുക. നന്നായി ഇളക്കുക. പഞ്ചസാര അലിഞ്ഞുതീരുമ്പോൾ സോഡിയം ബെൻസോയേറ്റ് ചേർക്കുക. തീയിൽ നിന്നും വാങ്ങി തണുക്കാൻ അനുവദിക്കുക. തണുത്തതിനു ശേഷം കുപ്പിയിലാക്കി സൂക്ഷിക്കുക.

പൈനാപ്പിൾ സിറപ്പ്

പൈനാപ്പിൾ സിറപ്പ്

ചേരുവകൾ: (1 ലിറ്ററിൻ)

പൈനാപ്പിൾ ജ്യൂസ്	:	600 മില്ലി ലിറ്റർ
വെള്ളം	:	200 മില്ലി ലിറ്റർ
പഞ്ചസാര	:	800 ഗ്രാം

തയ്യാറാക്കുന്ന വിധം:

തിളപ്പിച്ച വെള്ളത്തിലേക്ക് പഞ്ചസാര ഇട്ട് പഞ്ചസാര ലായനി തയ്യറാക്കുക. പാനി നന്നായി തിളച്ചു വരുമ്പോൾ ജ്യൂസ് ഒഴിക്കുക. ഇത് നൂൽ പരുവമാകുമ്പോൾ വാങ്ങി വെക്കുക. ചൂടാറിയതിനു ശേഷം കുപ്പിയിലാക്കി ഉപയോഗിക്കാം.

പൈനാപ്പിൾ സ്ക്വാഷ്


പൈനാപ്പിൾ സ്ക്വാഷ്

ചേരുവകൾ: (500 മില്ലി ലിറ്ററിൻ)

പൈനാപ്പിൾ ജ്യൂസ്	:	1 കപ്പ്
പഞ്ചസാര	:	2 കപ്പ്
വെള്ളം	:	1 കപ്പ്
സിട്രിക് ആസിഡ്	:	1 ടീസ്പൂൺ
പൊട്ടാസിയം മെറ്റാബൈസൾഫേറ്റ്	:	1/8 ടീസ്പൂൺ
മഞ്ഞ കളർ	:	1/8 ടീസ്പൂൺ

തയ്യാറാക്കുന്ന വിധം:

ചുവടു കട്ടിയുള്ള ഒരു പാത്രത്തിൽ പഞ്ചസാരയും വെള്ളവും ചേർത്ത് തിളപ്പിച്ച് പാനി തയ്യാറാക്കുക. സിട്രിക് അസിഡു ചേർത്ത് വാങ്ങുക. ഈ മിശ്രിതം തണുത്തതിനു ശേഷം പൈനാപ്പിൾ ജ്യൂസും പൊട്ടാസിയം മെറ്റാബൈസൾഫേറ്റും ചേർത്ത് നന്നായി ഇളക്കുക. കുപ്പികളിലാക്കി അടച്ച് ഫ്രിഡ്ജിൽ സൂക്ഷിച്ച് ഉപയോഗിക്കാം. ഒരു ടേബിൾ സ്പൂൺ സ്ക്വാഷ് 150 മില്ലി ലിറ്റർ വെള്ളം ചേർത്ത് ഉപയോഗിക്കുക.

പൈനാപ്പിൾ ജാം


പൈനാപ്പിൾ ജാം

ചേരുവകൾ: (350 ഗ്രാമിൻ)

പൈനാപ്പിൾ	:	250 ഗ്രാം
പഞ്ചസാര	:	250 ഗ്രാം
സിട്രിക് ആസിഡ്	:	1/2 ടീസ്പൂൺ
വെള്ളം	:	2 1/2 കപ്പ്
പെക്റ്റിൻ പൗഡർ	:	1/2 ടീസ്പൂൺ
പൈനാപ്പിൾ എസ്സെൻസ്:		1/2 ടീസ്പൂൺ

തയ്യാറാക്കുന്ന വിധം:

ചെറുതായി വേവിച്ച പൈനാപ്പിൾ മിക്സിയിൽ നന്നായി അടിച്ചെടുക്കുക. ഇതിലേക്ക് പെക്റ്റിൻ പൗഡർ ചേർത്ത് നന്നായി ഇളക്കുക. ഇതിലേക്ക് പഞ്ചസാരയും സിട്രിക് ആസിഡും ചേർത്ത് 30 മിനിറ്റ് ജാം പരുവമാകുന്നത് വരെ വേവിക്കുക. ഇതിലേക്ക് പൈനാപ്പിൾ എസ്സെൻസ് ചേർക്കാവുന്നതാണ്. ജാം പരുവമായതിനു ശേഷം തീ കുറയ്ക്കുക. ഒരു ജാറിലേക്ക് പകർത്തി തണുത്തതിനു ശേഷം ഉപയോഗിക്കാം.

പൈനാപ്പിൾ കാൻഡി


പൈനാപ്പിൾ കാൻഡി

ചേരുവകൾ: (500 ഗാമിൻ)

പൈനാപ്പിൾ	:	500 ഗ്രാം
പഞ്ചസാര	:	4 കപ്പ്
വെള്ളം	:	250 മില്ലി ലിറ്റർ

തയ്യാറാക്കുന്ന വിധം:

നന്നായി കഴുകി വൃത്തിയാക്കിയ പൈനാപ്പിൾ ചെറിയ കഷ്ണങ്ങളായി മുറിച്ചെടുക്കുക. പഞ്ചസാരയും വെള്ളവും (2:1) ചേർത്ത് പഞ്ചസാര ലായനി തയ്യാറാക്കുക. ഇതിലേക്ക് എടുത്ത് വെച്ചിരിക്കുന്ന പൈനാപ്പിൾ ചേർത്ത് 20 മിനിറ്റ് വേവിച്ചു ഒരു ദിവസം വെക്കുക. അതിനു ശേഷം തണുത്ത വെള്ളത്തിൽ കഴുകി എടുത്ത് 16–20 മണിക്കൂർ നേരം വെയിലത്ത് വെച്ച് ഉണക്കിയെടുക്കുക. തണുപ്പിച്ചതിനു ശേഷം പഞ്ചസാരയും ചേർത്ത് അവശ്യാനുസരണം ഉപയോഗിക്കാം.

പൈനാപ്പിൾ പുഡ്ഡിംഗ്

ചേരുവകൾ: (1 കിലോ)

പൈനാപ്പിൾ	:	250 ഗ്രാം
പഞ്ചസാര	:	250 ഗ്രാം
പാൽ	:	350 മില്ലി ലിറ്റർ
ബ്രെഡ് സ്ലൈസുകൾ	:	10 എണ്ണം
വെണ്ണ	:	100 ഗ്രാം
നാരങ്ങ നീർ	:	1 ടേബിൾ സ്പൂൺ
പൊടിച്ച ജാതിക്ക	:	1/4 ടീസ്പൂൺ
പൊടിച്ച കറുവപ്പട്ട	:	1/4 ടീസ്പൂൺ
പൊടിച്ച ഗ്രാമ്പൂ	:	1/4 ടീസ്പൂൺ
മുട്ടയുടെ വെള്ള	:	2 വലുതിന്റെ
മുട്ടയുടെ മഞ്ഞ	:	2 വലുതിന്റെ
വാനില എസ്സെൻസ്	:	1 ടീസ്പൂൺ
ഏലക്ക പൊടി	:	1 ടീസ്പൂൺ
ഉണക്ക മുന്തിരി	:	50 ഗ്രാം


പൈനാപ്പിൾ പുഡ്ഡിംഗ്

തയ്യാറാക്കുന്ന വിധം:

ഓവൻ 175 ഡിഗ്രി സെൽഷ്യസ് ചൂടാക്കിയിടുക. പൈനാപ്പിൾ അരക്കപ്പ് വെള്ളവും 2 സ്പൂൺ പഞ്ചസാരയും ചേർത്ത് വേവിച്ച്, വെള്ളം ഊറ്റിക്കളയുക. ഒരു പാനിൽ പാൽ തിളപ്പിക്കുക, തുടരെ ഇളക്കികൊടുക്കണം. തിളച്ചു വരുമ്പോൾ ബ്രെഡ് പൊടിച്ചതും ചേർത്ത് 10 മിനിറ്റ് വേവിക്കുക. തണുക്കാനായി മാറ്റി വെക്കുക. ഒരു ബൗളിൽ വെണ്ണ, പഞ്ചസാര, മുട്ടയുടെ മഞ്ഞ എന്നിവ നന്നായി യോജിപ്പിക്കുക ഇതിലേക്ക് പൊടിച്ച ജാതിക്ക, കറുവപ്പട്ട, ഏലക്ക, ഗ്രാമ്പൂ, വാനില എസ്സെൻസ് എന്നിവ ചേർത്ത് നന്നായി ഇളക്കി വേവിച്ചു വെച്ച പൈനാപ്പിളും ചേർക്കുക. നന്നായി ഇളക്കി യോജിപ്പിക്കുക. ഈ മിശ്രിതം തണുത്ത പാൽ–ബ്രെഡ് കൂട്ടിലേക്ക് ചേർത്ത് മുകളിലായി മുട്ടയുടെ വെള്ള അൽപാൽപം ഒഴിച്ച് കൊടുക്കുക. തയ്യാറാക്കിയ കൂട്ട് പുഡ്ഡിംഗ് ഡിഷിലേക്ക് മാറ്റി, മുകളിൽ ഉണക്കമുന്തിരി തൂകി അലങ്കരിക്കുക. ഓവനിൽ 45 മിനിറ്റോളം വെച്ച് മുകൾവശം സുവർണ്ണ നിറമാകും വരെ ബേക്ക് ചെയ്തെടുക്കുക.

പൈനാപ്പിൾ അപ്സൈഡ് ഡൗൺ കേക്ക്

ചേരുവകൾ: (1 കിലോ കേക്കിൻ)

പാൽ	:	1/4 കപ്പ്
മൈദ	:	1 കപ്പ്
വെണ്ണ	:	1/4 കപ്പ്
വാനില എസ്സെൻസ്	:	1 ടീസ്പൂൺ
പഞ്ചസാര	:	1/2 കപ്പ്
ബേക്കിംഗ് പൗഡർ	:	1 ടീസ്പൂൺ
ഉപ്പ്	:	ഒരു നുള്ള്


അപ്സൈഡ് ഡൗൺ കേക്ക

അലങ്കരിക്കാൻ:

പൈനാപ്പിൾ സ്ലൈസുകൾ	:	4–5 എണ്ണം
ചെറി	:	6–7 എണ്ണം
പഞ്ചസാര	:	1/4 കപ്പ്
വെണ്ണ	:	1 1/2 ടേബിൾ സ്പൂൺ

തയ്യാറാക്കുന്ന വിധം:

ഓവൻ 175 ഡിഗ്രി സെൽഷ്യസ് ചൂടാക്കിയിടുക. ബേക്കിംഗ് ട്രേയിൽ നെയ് പുരട്ടി വെക്കുക. ഒരു പാനിൽ വെണ്ണ ഉരുക്കി പഞ്ചസാര അലിയിച്ചെടുക്കുക. ഈ മിശ്രിതം ബേക്കിംഗ് പാനിൽ ഒഴിച്ച് മുകളിലായി പൈനാപ്പിൾ കഷ്ണങ്ങൾ വെക്കുക. ഓരോ പൈനാപ്പിൾ കഷ്ണങ്ങൾക്കു നടുവിലായി ചെറി വെച്ച് അലങ്കരിച്ച് മാറ്റി വെക്കുക. ഒരു ബൗളിൽ മൈദ, ബേക്കിംഗ് പൗഡർ, ഉപ്പ് എന്നിവ യോജിപ്പിക്കുക മറ്റൊരു ബൗളിൽ വെണ്ണയും പഞ്ചസാരയും അലിയിക്കുക. ഇതിലേക്ക് മുട്ട പതപ്പിച്ചതും വാനില എസ്സെൻസും ചേർത്ത് നന്നായി ഇളക്കുക. ഇതിലേക്ക് മൈദ കൂട്ടും പാലും അൽപാൽപമായി ചേർത്ത് നന്നായി ഇളക്കുക. ഈ മിശ്രിതം നേരത്തേ തയ്യാറാക്കി വെച്ചിരിക്കുന്ന ബേക്കിംഗ് പാനിലേക്ക് ഒഴിച്ച് 45 മിനിറ്റ് ബേക്ക് ചെയ്തെടുക്കുക. തണുത്തതിനു ശേഷം മുറിച്ച് കഴിക്കാം.

പൈനാപ്പിൾ ഹൽവ

ചേരുവകൾ: (400 ഗ്രാം)

പൈനാപ്പിൾ	:	1 കിലോ
പഞ്ചസാര	:	750 ഗ്രാം
നെയ്യ്	:	50 ഗ്രാം
ഡാൽഡ	:	200 ഗ്രാം


പൈനാപ്പിൾ ഹൽവ

തയ്യാറാക്കുന്ന വിധം:

നന്നായി പഴുത്ത കൈതച്ചക്ക തൊലി ചെത്തി കൂഞ്ഞിൽ മാറ്റിയതിനു ശേഷം ചെറുതായി അരിഞ്ഞെടുക്കുക. പിന്നീട് കൈതച്ചക്കയുടെ നീരിൽ തന്നെ വേവിക്കണം. പഞ്ചസാര അലിയാൻ മാത്രം ഉള്ള വെള്ളം ചേർത്ത് സിറപ്പാക്കി കൈതച്ചക്കയിൽ ചേർത്തിളക്കുക. പറ്റുമ്പോൾ ഡാൽഡ

അൽപാൽപം ചേർത്ത് പിന്നീട് നെയ്യും ചേർത്ത് ഇളക്കുക. ഹൽവയുടെ പാകമാകുമ്പോൾ നെയ് പുരട്ടിയ തട്ടത്തിൽ നിരത്തി മുറിച്ച് ചൂടാറുമ്പോൾ ഉപയോഗിക്കാം. അണ്ടിപ്പരിപ്പ് മുകളിൽ വിതറിയാൽ നന്നായിരിക്കും.

പൈനാപ്പിൾ കേസരി

ചേരുവകൾ: (500 ഗാമിൻ)

പൈനാപ്പിൾ	:	500 ഗ്രാം
നെയ്യ്	:	1/2 കപ്പ്
പഞ്ചസാര	:	1 കപ്പ്
വെള്ളം	:	2 കപ്പ്
റവ	:	1 കപ്പ്
മഞ്ഞൾ പൊടി	:	ആവശ്യത്തിനു
ഉപ്പ്	:	ഒരു നുള്ള്
പൈനാപ്പിൾ എസ്സെൻസ്:		1 ടീസ്പൂൺ
കശുവണ്ടി	:	5-6 എണ്ണം നെയ്യിൽ മൂപ്പിച്ചത്


പൈനാപ്പിൾ കേസരി

തയ്യാറാക്കുന്ന വിധം:

പാത്രം ചൂടാക്കി റവ ചെറുതീയിൽ വറുത്തെടുക്കുക. 2 കപ്പ് വെള്ളവും ചേർത്ത് തിളപ്പിക്കുക. പകുതി വേവാകുമ്പോൾ ചെറിയ കഷ്ണങ്ങളാക്കിയ പൈനാപ്പിൾ ചേർത്ത് വേവിക്കുക. പഞ്ചസാരയും മഞ്ഞൾ പൊടിയും ചേർക്കുക. നെയ്യ് അതിലേക്ക് ചേർത്ത് നന്നായി ഇളക്കുക. പൈനാപ്പിൾ എസ്സെൻസും വറുത്ത് വെച്ചിരിക്കുന്ന കശുവണ്ടിയും ചേർക്കുക. ചൂടോടെയോ തണുപ്പിച്ചോ കഴിക്കുക.

പൈനാപ്പിൾ അട

ചേരുവകൾ: (800 ഗാമിൻ)

അരിപ്പൊടി	:	250 ഗ്രാം
പൈനാപ്പിൾ	:	250 ഗ്രാം
ശർക്കര	:	150 ഗ്രാം
ഏലക്ക, ജീരകം:		1/4 ടീസ്പൂൺ
തേങ്ങ	:	150 ഗ്രാം


പൈനാപ്പിൾ അട

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ കഷ്ണങ്ങളാക്കി അരിഞ്ഞ് മിക്സിയിൽ അടിച്ചതിനു ശേഷം ശർക്കരപാനി ഒഴിച്ച് വഴറ്റി എടുക്കുക. അരിപ്പൊടിയും തേങ്ങയും ജീരകവും ഏലക്കയും ചേർത്ത് നന്നായി ഇളക്കുക. ഇലയിൽ പരത്തി ആവിയിൽ വേവിച്ചെടുക്കുക.

പൈനാപ്പിൾ ഉണ്ട


പൈനാപ്പിൾ ഉണ്ട

ചേരുവകൾ: (500 ഗ്രാം)

അരി	:	200 ഗ്രാം
പൈനാപ്പിൾ ജ്യൂസ്	:	1 കപ്പ്
ശർക്കര	:	200 ഗ്രാം
ഏലക്ക, ജീരകം	:	ആവശ്യത്തിന
തേങ്ങ	:	1 എണ്ണം

തയ്യാറാക്കുന്ന വിധം:

തേങ്ങ ചുരണ്ടി വറുത്തതിന ശേഷം അതിലേക്ക് പൈനാപ്പിൾ ജ്യൂസും ശർക്കരപാനിയും ഒഴിക്കുക. നൂലു പരുവമാകുന്നതു വരെ ഇളക്കുക. അതിന ശേഷം ഏലക്ക, ജീരകം ഇവ പൊടിച്ചു ചേർക്കുക. ഇതിലേക്ക് വറുത്തു വെച്ചിരിക്കുന്ന അരി പൊടിച്ച് ചേർത്ത് നന്നായി ഇളക്കുക. പരുവത്തിന ഉരുട്ടി എടുക്കുക.

പൈനാപ്പിൾ ഐസ്ക്രീം


പൈനാപ്പിൾ ഐസ്ക്രീം

ചേരുവകൾ: (1 ലിറ്ററിന്)

പൈനാപ്പിൾ	:	1/2 കപ്പ്
പാൽ	:	1 ലിറ്റർ
കസ്റ്റാഡ് പൗഡർ	:	1/4 കപ്പ്
കണ്ടൻസ്ഡ് മിൽക്	:	1 ടിൻ
പഞ്ചസാര പാനി	:	1/4 കപ്പ്
പൈനാപ്പിൾ എസ്സെൻസ്:		2 തുള്ളി

തയ്യാറാക്കുന്ന വിധം:

പാൽ കസ്റ്റാഡ് പൗഡർ, കണ്ടൻസ്ഡ് മിൽക് എന്നിവ ചേർത്ത് തിളപ്പിക്കുക. ഒരു പാനിൽ പൈനാപ്പിൾ, പഞ്ചസാരപാനി ചേർത്ത് വേവിക്കുക. ഇതിലേക്ക് പാൽ മിശ്രിതവും പൈനാപ്പിൾ എസ്സെൻസും ചേർത്ത് നന്നായി ഇളക്കുക. ഏഴ്ഗ് ബീറ്റർ ഉപയോഗിച്ച് നന്നായി ബീറ്റ് ചെയ്തെടുക്കുക. തയ്യാറാക്കിയ കൂട്ട്, ഐസ്ക്രീം ട്രേയിലാക്കി 4-6 മണിക്കൂർ ഫ്രീസറിൽ വെച്ചു തണുപ്പിച്ച് കഴിക്കാം.

പൈനാപ്പിൾ കോക്കെയിൽ


പൈനാപ്പിൾ കോക്കെയിൽ

ചേരുവകൾ: (1 ലിറ്ററിന്)

പൈനാപ്പിൾ ജ്യൂസ്	:	2 കപ്പ്
പൈനാപ്പിൾ	:	1 കപ്പ്
റം	:	1/2 കപ്പ്
കോക്കനട്ട് ക്രീം	:	1/2 കപ്പ്
പനംശർക്കര	:	2 ടേബിൾ സ്പൂൺ
പൊടിച്ച ഐസ്	:	1 കപ്പ്

തയ്യാറാക്കുന്ന വിധം:

എല്ലാ ചേരുവകളും ഒന്നിച്ചാക്കി മിക്സിയിൽ നന്നായി അടിച്ചെടുക്കുക. ഒരു ഗ്ലാസ്സിലേക്ക് പകർന്ന് മുകളിൽ പൊടിച്ച ഐസ് തൂവി വിളമ്പാം.

പൈനാപ്പിൾ വൈൻ

ചേരുവകൾ: (3.5 ലിറ്ററിൻ)

പൈനാപ്പിൾ	:	1 കപ്പ്
പഞ്ചസാര	:	2 കപ്പ്
വെള്ളം	:	10 കപ്പ്
യീസ്റ്റ്	:	2 ടേബിൾ സ്പൂൺ

പൈനാപ്പിൾ വൈൻ

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ തൊലിയോടു കൂടി മുറിച്ച് കഷ്ണങ്ങളാക്കുക. പൈനാപ്പിൾ കഷ്ണങ്ങൾ വെള്ളവും 1 കിലോ പഞ്ചസാരയും ചേർത്ത് 5 മിനിറ്റ് തിളപ്പിക്കുക. തണുത്തതിനു ശേഷം യീസ്റ്റ് ചേർത്ത് വായു കടക്കാത്ത മൺകലത്തിലാക്കി 20 ദിവസം സൂക്ഷിക്കുക. എല്ലാ ദിവസവും മരത്തവി ഉപയോഗിച്ച് ഇളക്കിക്കൊടുക്കണം. ഇരുപത്തി ഒന്നു ദിവസത്തിനു ശേഷം ഒരു തുണിയിലൂടെ പിഴിയാതെ അരിച്ചെടുക്കുക. ബാക്കിയുള്ള പഞ്ചസാര കൂടി ചേർത്തിളക്കി ഇരുപത്തി ഒന്നു ദിവസം ഇളക്കാതെ വീണ്ടും സൂക്ഷിക്കുക. അതിനു ശേഷം ഉപയോഗിക്കാം.

പൈനാപ്പിൾ വോഡ്ക

ചേരുവകൾ: (500 മില്ലി ലിറ്ററിൻ)

പൈനാപ്പിൾ	:	250 ഗ്രാം
വോഡ്ക	:	250 മില്ലി ലിറ്റർ

പൈനാപ്പിൾ വോഡ്ക

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ മുങ്ങത്തക്കവണ്ണം വോഡ്ക ചേർത്ത് കുപ്പിയിലാക്കി ഫ്രിഡ്ജിൽ 10 ദിവസം സൂക്ഷിക്കുക. അതിനു ശേഷം തൊലി കളഞ്ഞ് കഷ്ണങ്ങളായി മുറിച്ച് ഗ്ലാസിൽ പകർന്ന് ഉപയോഗിക്കാം.

പൈനാപ്പിൾ ബോളി

ചേരുവകൾ: (500 ഗ്രാമിൻ)

മൈദ	:	200 ഗ്രാം
പഞ്ചസാര	:	100 ഗ്രാം
പൈനാപ്പിൾ	:	1 ഇടത്തരം
മഞ്ഞൾ പൊടി	:	1/4 ടീസ്പൂൺ

പൈനാപ്പിൾ ബോളി

തയ്യറാക്കുന്ന വിധം:

നീളത്തിൽ മുറിച്ച പൈനാപ്പിൾ എടുത്ത് വെക്കുക. മൈദ, പഞ്ചസാര, മഞ്ഞൾ പൊടി ഇവ നന്നായി ചേർത്ത് ഇളക്കുക. പൈനാപ്പിൾ കഷ്ണങ്ങൾ ഇതിൽ മുക്കിയെടുക്കുക. വെളിച്ചെണ്ണ ചൂടാക്കി അതിലിട്ട് മൂപ്പിച്ചെടുക്കുക.

പൈനാപ്പിൾ പായസം

പൈനാപ്പിൾ പായസം

ചേരുവകൾ: (1 ലിറ്ററിൻ)

പൈനാപ്പിൾ	:	400 ഗ്രാം
ശർക്കര	:	200 ഗ്രാം
നെയ്യ്	:	2 ടീസ്പൂൺ
കശുവണ്ടി, മുന്തിരി	:	ആവശ്യത്തിനു
ഏലക്ക, ജീരകം	:	2 ടീസ്പൂൺ
തേങ്ങ	:	2 എണ്ണം

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ ചെറുതായി നുറുക്കിയത് നെയ്യിൽ വഴറ്റുക. അതിനു ശേഷം ശർക്കരപാനി ഇതിലേക്ക് ഒഴിച്ച് ഇളക്കുക. ആദ്യം മൂന്നാം പാൽ (തേങ്ങാപാൽ), പിന്നെ രണ്ടാം പാൽ, ഒന്നാം പാൽ എന്ന ക്രമത്തിൽ ചേർക്കുക. ഏലക്കയും ജീരകവും പൊടിച്ചു ചേർക്കുക. കശുവണ്ടിയും മുന്തിരിയും നെയ്യിൽ വറുത്തെടുത്ത് ഇതിലേക്ക് ചേർത്തിളക്കുക. പായസം വേറെ പാത്രത്തിൽ വാങ്ങി ഉപയോഗിക്കാം.

പൈനാപ്പിൾ അച്ചാർ

പൈനാപ്പിൾ അച്ചാർ

ചേരുവകൾ: (500 ഗ്രാമിൻ)

പൈനാപ്പിൾ അരിഞ്ഞത്	:	250 ഗ്രാം
വെളിച്ചെണ്ണ	:	3 ടീസ്പൂൺ
പച്ചമുളക്	:	4 എണ്ണം
മുളക് പൊടി	:	2 1/2 ടീസ്പൂൺ
ഉലുവ പൊടി	:	1/2 ടീസ്പൂൺ
കായപൊടി	:	1/4 ടീസ്പൂൻ
വെളുത്തുള്ളി	:	6–8 എണ്ണം
കറിവേപ്പില	:	ആവശ്യത്തിനു
വിനാഗിരി	:	2 ടീസ്പൂൺ
ഉപ്പ്	:	ആവശ്യത്തിനു
കടുക്	:	1/2 ടീസ്പൂൺ

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ ചെറുതായി നുറുക്കുക. വെളിച്ചെണ്ണ ചീനചട്ടിയിൽ ഒഴിച്ച് ചൂടാക്കിയതിലേക്ക് കറിവേപ്പില, വെളുത്തുള്ളി, പച്ചമുളക് എന്നിവ ചേർത്ത് മൂപ്പിച്ചെടുക്കുക. പൈനാപ്പിൾ ചെറുതായി

അരിഞ്ഞത് നന്നായി മുളകും ഉപ്പും ചേർത്ത് ഇളക്കി വെക്കണം. മൂപ്പിച്ചതിലേക്ക് പൈനാപ്പിൾ കഷ്ണങ്ങൾ നന്നായി ചേർത്തിളക്കുക. വിനാഗിരി ചേർത്ത് ചെറുതായി വേവിക്കുക. നന്നായി ഇളക്കിയതിനു ശേഷം ഒരു ഭരണിയിൽ അടച്ച് സൂക്ഷിക്കാവുന്നതാണു.

പൈനാപ്പിൾ മധുരക്കറി

ചേരുവകൾ: (1 ലിറ്ററിന്)

പൈനാപ്പിൾ	:	1 കപ്പ്
ഏത്തപ്പഴം	:	1 കപ്പ്
കറുത്ത മുന്തിരി	:	8–10 എണ്ണം
പച്ചമുളക്	:	2 എണ്ണം
തേങ്ങ	:	1/2 കപ്പ്
പഞ്ചസാര	:	1 ടീസ്പൂൺ
മുളക് പൊടി	:	ഒരു നുള്ള്
തൈർ	:	2 ടീസ്പൂൺ
ഉപ്പ്	:	ആവശ്യത്തിനു
കടുക്	:	1 ടീസ്പൂൺ


പൈനാപ്പിൾ മധുരക്കറി

തയ്യാറാക്കുന്ന വിധം:

തവ ചൂടാക്കി പൈനാപ്പിൾ, മുളക് പൊടി, മഞ്ഞൾ പൊടി, ഉപ്പ്, 3 ടീസ്പൂൺ വെള്ളം എന്നിവ ചേർത്ത് പകുതി വെന്ത് കഴിയുമ്പോൾ ഏത്തപ്പഴം, മുന്തിരി എന്നിവ ചേർത്ത് നന്നായി വേവിക്കുക. അതിനു ശേഷം പച്ചമുളക്, തേങ്ങ ഇവ നന്നായി അരച്ചെടുത്ത് അതിലേക്ക് ചേർത്ത് തിളപ്പിക്കുക. പഞ്ചസാര ചേർത്ത് ഇളക്കുക. ശേഷം തൈരും പാകത്തിനു ഉപ്പും ചേർക്കുക. ശേഷം കടുക് താളിക്കുക.

പൈനാപ്പിൾ പുളിശ്ശേരി

ചേരുവകൾ: (1 ലിറ്ററിന്)

പൈനാപ്പിൾ	:	150 ഗ്രാം
വെളിച്ചെണ്ണ	:	1 ടീസ്പൂൺ
പച്ചമുളക്	:	3 എണ്ണം
തേങ്ങ	:	150 ഗ്രാം
മുളക് പൊടി	:	1/2 ടീസ്പൂൺ
മഞ്ഞൾ പൊടി	:	1/4 ടീസ്പൂൺ
തൈർ	:	1 കപ്പ്
കറിവേപ്പില	:	ആവശ്യത്തിനു
ഉപ്പ്	:	ആവശ്യത്തിനു
കടുക്	:	1 ടീസ്പൂൺ


പൈനാപ്പിൾ പുളിശ്ശേരി

ഉലുവ	:	1/4 ടീസ്പൂൺ
ഉള്ളി	:	2–3 എണ്ണം
ജീരകം	:	1 നുള്ള്
വെളുത്തുള്ളി	:	2–3 എണ്ണം

തയ്യാറാക്കുന്ന വിധം:

ചൂടാക്കിയ എണ്ണയിലേക്ക് പൈനാപ്പിൾ, കീറിയ പച്ചമുളക്, ഉപ്പ്, കറിവേപ്പില, മുളക് പൊടി, മഞ്ഞൾ പൊടി എന്നിവ ചേർത്ത് നന്നായി വേവിക്കുക. അതിനു ശേഷം തേങ്ങ, ചുവന്നുള്ളി, വെളുത്തുള്ളി, ജീരകം ഇവ നന്നായി അരച്ചെടുത്ത് അതിലേക്ക് ചേർത്ത് തിളപ്പിക്കുക. തിളച്ചു തുടങ്ങുമ്പോൾ തൈരു ചേർത്ത് വാങ്ങുക. ശേഷം എണ്ണയിൽ കടുക്, വറ്റൽ മുളക്, കറിവേപ്പില, ഉലുവ ചേർത്ത് താളിക്കുക.

പൈനാപ്പിൾ പച്ചടി

ചേരുവകൾ: (1 ലിറ്ററിന്)

പൈനാപ്പിൾ	:	200 ഗ്രാം
വെളിച്ചെണ്ണ	:	2 ടീസ്പൂൺ
പച്ചമുളക്	:	3 എണ്ണം
തേങ്ങ	:	100 ഗ്രാം
തൈർ	:	100 മില്ലി ലിറ്റർ
കറിവേപ്പില	:	ആവശ്യത്തിനു
ഉപ്പ്	:	ആവശ്യത്തിനു
കടുക്	:	1 ടീസ്പൂൺ
ചെറിയ ഉള്ളി	:	2–3 എണ്ണം

പൈനാപ്പിൾ പച്ചടി

തയ്യാറാക്കുന്ന വിധം:

തിളച്ച എണ്ണയിലേക്ക് ചെറിയ ഉള്ളി, പച്ചമുളക്, പൈനാപ്പിൾ, കറിവേപ്പില എന്നിവ ചേർത്ത് വഴറ്റുക. ശേഷം തേങ്ങയും ഉള്ളിയും നന്നായി അരച്ച് അതിലേക്ക് ചേർക്കുക. പിന്നീട് തൈരു ചേർത്തു പതുക്കെ ചൂടാവുമ്പോൾ വാങ്ങി കടുക് താളിക്കുക.

പൈനാപ്പിൾ കാപ്സിക്കം ചട്നി

ചേരുവകൾ: (500 ഗ്രാമിന്)

പൈനാപ്പിൾ	:	400 ഗ്രാം
ചുവന്ന കാപ്സിക്കം	:	1 കപ്പ്
നാരങ്ങ നീർ	:	3–5 ടീസ്പൂൺ
കറുവപ്പട്ട	:	1 എണ്ണം
മുളക് തരി	:	2 ടീസ്പൂൺ
പഞ്ചസാര	:	2–5 കപ്പ്
ഉപ്പ്	:	ആവശ്യത്തിനു

പൈനാപ്പിൾ ചട്നി

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിളും കാപ്സിക്കവും വേറെ വേറെ അരച്ചെടുക്കുക. ചുവടു കട്ടിയുള്ള പാത്രത്തിലേക്ക് അരച്ച പൈനാപ്പിളും കാപ്സിക്കവും കറുവപ്പട്ടയും ചേർത്ത് 2 മിനിറ്റ് ചെറുതീയിൽ വേവിക്കുക. ഇതിലേക്ക് പഞ്ചസാര, ഉപ്പ്, നാരങ്ങ നീർ, മുളക് തരി എന്നിവ ചേർത്ത് 10 മിനിറ്റ് സോസിന്റെ പാകമാകുന്നത് വരെ വേവിക്കുക. തണുത്തതിനു ശേഷം ഒരു ഗ്ലാസ് ബോട്ടിലിലേക്ക് മാറ്റുക. ഒരാഴ്ചക്കു ശേഷം ഫ്രിഡ്ജിൽ വെച്ച് ആവശ്യാനുസരണം ഉപയോഗിക്കാം.

പൈനാപ്പിൾ ചിപ്സ്

പൈനാപ്പിൾ ചിപ്സ്

ചേരുവകൾ: (250 ഗ്രാമിന്)

പൈനാപ്പിൾ	:	250 ഗ്രാം
വെളിച്ചെണ്ണ	:	ആവശ്യത്തിനു

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ ചെറുതായി അരിഞ്ഞ് വെയിലത്ത് വെച്ച് ഉണക്കുക. അതിനു ശേഷം എണ്ണയിലിട്ട് വറുത്തു കോരുക.

പൈനാപ്പിൾ ലസ്സി

പൈനാപ്പിൾ ലസ്സി

ചേരുവകൾ: (500 ഗ്രാമിന്)

പൈനാപ്പിൾ കഷ്ണങ്ങളാക്കിയത്	:	1/2 കപ്പ്
പുളിയില്ലാത്ത തൈർ	:	1/2 കപ്പ്
ഇഞ്ചി	:	ഒരു ചെറിയ കഷ്ണം
തേൻ	:	1 ടേബിൾ സ്പൂൺ
പഞ്ചസാര	:	1/4 കപ്പ്
പൊടിച്ച ഐസ്	:	1/2 കപ്പ്

തയ്യാറാക്കുന്ന വിധം:

ചേരുവകളെല്ലാം ഒന്നിച്ചാക്കി മിക്സിയിൽ അടിക്കുക. ഒരു ഗ്ലാസിലേക്ക് പകർത്തി ഉപയോഗിക്കാം.

ഗ്രിൽഡ് പൈനാപ്പിൾ

ഗ്രിൽഡ് പൈനാപ്പിൾ

ചേരുവകൾ: (500 ഗ്രാമിന്)

പൈനാപ്പിൾ	:	ഇടത്തരം ഒന്ന് (500 ഗ്രാ)
വെളിച്ചെണ്ണ	:	1 ടേബിൾ സ്പൂൺ
ഉപ്പ്	:	ആവശ്യത്തിനു
കുരുമുളകു പൊടി	:	1/4 ടീസ്പൂൺ

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ തൊലിയും കൂഞ്ഞും മാറ്റി മുറിച്ചെടുക്കുക. പൈനാപ്പിൾ കഷ്ണങ്ങളിൽ വെളിച്ചെണ്ണ, കുരുമുളക് പൊടി, ഉപ്പ് എന്നിവ കുടഞ്ഞ് വെക്കുക. ഗ്രിൽ എണ്ണ തടവി ചൂടാക്കി വെക്കുക. പുരട്ടി വെച്ചിരിക്കുന്ന പൈനാപ്പിൾ കഷ്ണങ്ങൾ മൃദുവാകുന്നത് വരെ തിരിച്ചും മറിച്ചുമിട്ട് ഗ്രിൽ ചെയ്തെടുക്കുക.

പൈനാപ്പിൾ പോപ്സ്

പൈനാപ്പിൾ പോപ്സ

ചേരുവകൾ: (750 ഗ്രാമിന്)

പൈനാപ്പിൾ കഷ്ണങ്ങൾ	:	3 കപ്പ്
പാൽ	:	1/3 കപ്പ്
പഞ്ചസാര	:	1/4 കപ്പ്

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ തൊലിയും കൂഞ്ഞും മാറ്റി ചെറുതായി മുറിച്ച് വെക്കുക. പൈനാപ്പിൾ കഷ്ണങ്ങളും പാലും പഞ്ചസാരയും മിക്സിയിൽ ചെറുതായി അടിച്ചെടുക്കുക. ഇതിൽ പകുതി മിശ്രിതം ഒരു ബൗളിലേക്ക് പകർന്ന് ബാക്കി നന്നായി അടിച്ചെടുക്കുക. ഇത് നേരത്തേ പകർന്ന ജ്യൂസിനു മുകളിലായി ഒഴിച്ച് ഐസ് ട്രേയിലേക് മാറ്റുക. ഓരോ ഐസ് ക്യൂബിനുള്ളിലും സ്റ്റിക്ക് വെച്ച് 4 മണിക്കൂറെങ്കിലും ഫ്രീസറിൽ വെച്ച് സെറ്റായതിനു ശേഷം ഉപയോഗിക്കുക

പൈനാപ്പിൾ കാരമൽ

പൈനാപ്പിൾ കാരമൽ

ചേരുവകൾ: (500 ഗ്രാമിന്)

പൈനാപ്പിൾ	:	1 ചെറുത്
വെണ്ണ	:	2 ടേബിൾ സ്പൂൺ
പഞ്ചസാര	:	1/2 കപ്പ്

തയ്യാറാക്കുന്ന വിധം:

പൈനാപ്പിൾ തൊലി കളഞ്ഞ് നീളത്തിൽ മുറിച്ച് വെക്കുക. ഒരു തവയിൽ വെണ്ണ ചൂടാക്കുക. പൈനാപ്പിൾ കഷ്ണങ്ങൾ പഞ്ചസാരയിൽ മുക്കി ചൂടായ തവയിലിട്ട് വേവിക്കുക. പൈനാപ്പിൾ കഷ്ണങ്ങൾ സുവർണ്ണ നിറമാകും വരെ തിരിച്ചും മറിച്ചുമിട്ട് വേവിക്കുക. തീയിൽ നിന്നും വാങ്ങി വെക്കുക. 3 സ്പൂൺ വെള്ളം പാനിലേക്ക് കുടഞ്ഞു ചൂടാക്കി പൈനാപ്പിളിനു മുകളിൽ തളിക്കുക. തണുപ്പിച്ച തൈരിനൊപ്പം വിളമ്പാം.

പൈനാപ്പിൾ–മാങ്ങ ചട്ട്ണി

പൈനാപ്പിൾ–മാങ്ങ ചട്ട്ണി

ചേരുവകൾ: (1 കിലോ)

പൈനാപ്പിൾ കഷ്ണങ്ങൾ	:	1 ചെറുത്
പഴുത്ത മാങ്ങ	:	3 എണ്ണം
വെളിച്ചെണ്ണ	:	2 ടേബിൾ സ്പൂൺ
കുരുമുളക്പൊടി	:	1 ടീസ്പൂൺ

ഇഞ്ചി അരിഞ്ഞത്	:	1 ടീസ്പൂൺ
സവാള അരിഞ്ഞത്	:	1 വലുത്
ഗരം മസാല	:	1 ടീസ്പൂൺ
വിനാഗിരി	:	2 ടീസ്പൂൺ
പഞ്ചസാര	:	1/2 കപ്പ്

തയ്യാറാക്കുന്ന വിധം:

ചീനച്ചട്ടിയിൽ എണ്ണ ചൂടാക്കി കുരുമുളക് പൊടി ചേർത്ത് സവാള വഴറ്റുക. അരിഞ്ഞ ഇഞ്ചിയും ചേർത്ത് 3 മിനിറ്റ് നേരം കൂടി വഴറ്റുക. ഇതിലേക്ക് മാങ്ങ, പൈനാപ്പിൾ, പഞ്ചസാര, ഗരം മസാല, വിനാഗിരി എന്നിവ ചേർത്ത് ചെറിയ തീയിൽ 30 മിനിറ്റ് നേരം വേവിക്കുക. ഇടക്കിടെ ഇളക്കിക്കൊടുക്കണം. തണുത്തതിനു ശേഷം വായു കടക്കാതെ ടിന്നിലാക്കി ഫ്രിഡ്ജിൽ സൂക്ഷിക്കാം.

പൈനാപ്പിൾ–പാഷൻ ഫ്രൂട്ട് സോഡ

ചേരുവകൾ: (1.5 ലിറ്ററിൻ)

പൈനാപ്പിൾ ജ്യൂസ്	:	1 1/4 കപ്പ്
നാരങ്ങ നീർ	:	1/4 കപ്പ്
പഞ്ചസാര	:	1 1/4 കപ്പ്
പാഷൻ ഫ്രൂട്ട് പൾപ്പ്	:	1 കപ്പ്
തണുപ്പിച്ച സോഡ	:	1 ലിറ്റർ

പൈനാപ്പിൾ–പാഷൻ ഫ്രൂട്ട് സോഡ

തയ്യാറാക്കുന്ന വിധം:

ഒരു പാനിൽ പൈനാപ്പിൾ ജ്യൂസും നാരങ്ങ നീരും പഞ്ചസാരയും ഒന്നിച്ചാക്കി ചെറുതീയിൽ ചൂടാക്കുക. പഞ്ചസാര അലിഞ്ഞതിനു ശേഷം തീ കൂട്ടിവെച്ച് തിളപ്പിക്കുക. തിളച്ചതിനു ശേഷം ജ്യൂസ് അൽപം കട്ടിയാകുന്നത് വരെ ചെറു തീയിൽ 15 മിനിറ്റ് നേരം വെക്കുക. തീയിൽ നിന്നും വാങ്ങി പാഷൻ ഫ്രൂട്ട് പൾപ്പിലേക്ക് അരിച്ചൊഴിക്കുക. ഒരു ഗ്ലാസിലേക്ക് പകർന്ന് തണുപ്പിച്ച സോഡയൊഴിച്ച് ഉപയോഗിക്കാം.

കാരറ്റ് പൈനാപ്പിൾ സാലഡ്

ചേരുവകൾ: (1 കിലോ)

പൈനാപ്പിൾ കഷ്ണങ്ങൾ	:	1/2 കപ്പ്
കാരറ്റ് ചുരണ്ടിയത്	:	500 ഗ്രാം
ഉണക്കമുന്തിരി	:	1/2 കപ്പ്
മയൊണൈസ്	:	1/2 കപ്പ്
പൊടിച്ച പഞ്ചസാര	:	1/2 കപ്പ്

പൈനാപ്പിൾ സാലഡ്

തയ്യാറാക്കുന്ന വിധം:

ഉണക്കമുന്തിരി 20 മിനിറ്റോളം ചൂടുവെള്ളത്തിലിട്ടു കുതിർത്ത് വെള്ളം ഊറ്റിക്കളയുക. ഒരു ബൗളിൽ ചുരണ്ടിയ കാരറ്റ്, പൈനാപ്പിൾ, മയൊണൈസ്, കുതിർത്ത മുന്തിരി, പൊടിച്ച പഞ്ചസാര എന്നിവ നന്നായി യോജിപ്പിച്ച് തണുപ്പിച്ചതിനു ശേഷം വിളമ്പാം.

8.5 Passion Fruit Recipes

PASSION FRUIT RECIPES

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Passion fruit is a vigorous perennial vine included in the Passifloraceae family. The most popular cultivated varieties are Yellow, Purple and Giant granadilla. The flowers are single and fragrant, 5- 7.5 centimeters wide and borne at a node on the new growth. Fruits are dark- purple or yellow, rounded or egg shaped and contain numerous small, black wedge-shaped seeds that are individually surrounded by deep orange- colored sacs that contain the juice, the edible part of the fruit. Passion fruit develops well in tropical and subtropical regions, where the climate is hot and humid.

PASSION FRUIT JUICE

Passion fruit juice tastes best when chilled and it is best fruit drink to consume during the hot summer days. Fresh passion fruit contains about 20-25% of vitamin C. It acts as an antioxidant. Passion fruit also contain vitamin B_6 which helps our body to regulate blood sugar and also promote a healthy immune system.

Juice

Ingredients: (for 1 liter)

Passion Fruit pulp	:	500 g
Sugar	:	250 g
Water	:	250 ml
Crushed Ice	:	½ cup

Method of preparation

- Scoop out the passion fruit pulp.
- Blend the pulp, sugar and required amount of water in a blender.
- Then filter it to get the clear juice.
- Transfer into glass and add some crushed ice.
- Serve chilled.

PASSION FRUIT JUICE CONCENTRATE

Passion fruit juice concentrate is prepared from fresh, ripened passion fruit to provide essential flavors and nutrition, in a convenient, ready to use ingredient for processed beverage and food application.

Juice concentrate

Ingredients: (for 500 g)

Passion Fruit pulp	:	250 g
Sugar	:	250 g
Citric acid	:	1 tbsp
Sodium benzoate	:	½ tbsp

Method of preparation:

- Scoop out the passion fruit pulp and blend in a blender.
- Then filter it to get the clear juice.
- Boil the juice by continuous stirring, and add sugar.
- When the sugar dissolved completely, add dissolved sodium benzoate.
- Take off from fire and allowed for cool.
- Poured into sterilized bottles and seal.

PASSION FRUIT SQUASH

Passion fruit squash should be prepared from fully matured and ripe passion fruit which is free from insect infestation. Preparing the passion fruit squash is very simple and easy.

Ingredients: (for 1 liter)

Passion Fruit pulp	:	1 cup
Sugar	:	2 cup
Water	:	1 cup
Citric acid	:	1 tbsp
Yellow food color	:	½ tbsp
KMS	:	½ tbsp

Passion fruit squash

Method of preparation:

- Bring sugar and water to boil in a deep vassal.
- Simmer to make sticky syrup, which is not one thread.
- Add dissolved citric acid, take off from fire.
- Cool and add juice, dissolve KMS.
- Stir till well blended
- Pour into sterilized bottles and seal.

PASSION FRUIT PICKLE

Pickles generally spicy, they can also be made sweet by adding sugar, spicy pickles are very important item in Indian meal. Passion fruit can also be used for making pickles.

Ingredients: (for 500 g)

Passion Fruit pulp	:	250 gm
Sugar	:	100 gm
Vinegar	:	100 ml
Coconut oil	:	3 tbsp
Ground mustard seeds	:	1 tbsp
Mild chilli powder	:	½ tbsp

Pickle

Turmeric powder	:	¼ tbsp
Green chilli	:	50 gm
Small onion	:	25 gm
Garlic	:	50 gm
Fresh curry leaves	:	a few
Black pepper powder	:	¼ tbsp

Method of preparation:

- Take passion fruit pulp.
- Heat the coconut oil in a saucepan, add the spices and fresh curry leaves
- When they fizzle add the passion fruit.
- Add sugar and vinegar and cook gently until the mixture is thick and jammy.
- Transfer pickle into a bowl.

PASSION FRUIT HALWA

Passion fruit halwa is a passion fruit flavored mouthwatering sweet dish. It is a delicious dessert dish which can be served as a snack or after meal. It is very tasty and easy to prepare.

Ingredients: (for 500 g)

Passion fruit	:	1 ½ cup
Sugar	:	¼ cup
Khoa	:	½ cup
Milk	:	½ cup
Cardamom powder	:	½ tbsp
Water	:	½ glass
Ghee	:	2 tbsp
Almonds	:	2 or 3

Passion Fruit Halwa

Method of preparation:

- Take water in a pan and heat it on a medium flame.
- Now add the grated passion fruit then filter it to get clear juice.
- Then take it for boiling.
- Add sugar and ghee; stir continuously.
- Add milk, khoa and mix gently till the water evaporates.
- Cook it for at least 10 minutes at low flame.
- Now remove from the flame and sprinkle cardamom powder.
- Finally garnish with almonds and serve hot.

PASSION FRUIT WINE

Wine is an alcoholic beverage made from fermented grapes or other fruits. Passion fruit wine made from passion fruit juice. Fermentation of passion fruit juice takes place in controlled temperature. The result is a soft fruit wine with strong passion fruit flavour and taste.

Passion Fruit Wine

Ingredients: (for 3 liter)

Passion fruit pulp	:	1 kg
Sugar	:	2 kg
Water	:	3 liter
Yeast	:	1 tsp
Egg white	:	1 beat nicely

Method of preparation:

- Take water in a pan and heat it on a medium flame.
- Now add the grated passion fruit then filter it to get clear juice.
- Mix passion fruit pulp, sugar, water and yeast.
- Beat egg white well and mix well with above mix.
- Pour into a clean sterilized bottle (bharani) and tie the bottle with a clean cloth or close with lid little loose keep aside for 41days.
- Stir the mix with a clean wooden spoon every day.
- After 41 days ,strain the mixture through a muslin cloth.
- Keep the wine in the vessel covered with a clean cloth for 6 hour and again strain the mixture and pour it in to in to clean dry bottles and use.

PASSION FRUIT CAKE

Traditional cake flavor gave perfect with passion fruit sour taste and crunchy small passion fruit seeds. Variety cakes are available such as mixed fruit cake, upside down cake etc**.**

Ingredients: (for 500 g)

Passion fruit	:	2 numbers
Egg	:	100 gm
Butter	:	100 gm
Gram flour	:	250 gm
Baking powder	:	1 tbsp
Vanilla essence	:	1 tbsp
Salt	:	A pinch
Glazed cherries	:	7-8


Passion Fruit Cake

Method of preparation:

- Melt butter in a low heat and add sugar and eggs; mix it well.
- Add flour, baking powder, vanilla essence, and salt into the sugar butter mix.
- Add seeds and juice of passion fruit into it and mix thoroughly.
- Spread the prepared mix in a greased baking pan and decorate top with cherries.
- Bake in preheated oven for 45 min at 180 ^{O}C or till a tooth pick inserted into the cake comes out clean.
- Place on a wire rack to cool, cut into squares and serve with tea.

PASSION FRUIT FOAM

It is very sweet and delicious product passion fruit foam with ice cream.

Ingredients: (for 300 g)

Passion fruit	:	1 or 2 number
Sugar	:	1 cup
Water	:	½ cup
Eggs	:	2
Corn flour	:	2 table spoon

Passion Fruit Foam

Method of preparation:

- Put water and sugar to boil, dissolve corn flour into it.
- Passion fruit is scooped into a plate, add egg white and beat it nicely to a stiff foam.
- Pour the boiling mixture over the passion fruit egg foam and continue the beating till it become light and foam.
- Put aside and cool before serving

PASSION FRUIT - MANGO LASSI

It is a refreshing drink with great taste

Ingredients:(for 250 g)

Passion fruit	:	2 numbers
Honey	:	6 tbsp
Curd	:	1 cup
Mint leaves	:	to garnish

Passion Fruit-Mango Lassi

Method of preparation:

- Cut passion fruit into two halves and squeeze out the juice by rubbing the seeds with the help of fingers. Discard the seeds or use it to garnish lassi.
- Blend passion fruit juice, honey, and curd in mixed or juicer till smooth.
- Transfer it to a bowl and add more honey if needed.
- Keep in refrigerator and serve chilled.

PASSION FRUIT PUDDING WITH TOPPINGS

Ingredients: (for 500 g)

For base:

Biscuit powder	:	½ cup
Butter	:	1 tbsp

For pudding layer:

Passion fruit	:	10 numbers
Thick cream	:	1 cup or 110 g
Condensed milk	:	½ cup
Powdered sugar	:	3 tbsp

For topping:

Passion fruit pulp	:	2 numbers of fruit
Sugar	:	2 tbsp

Passion Fruit Pudding

Method of preparation:-

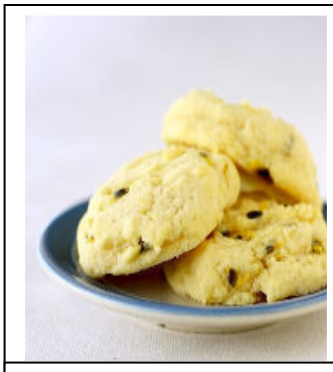
For base:

- In a bowl mix powdered biscuit and butter.
- Press this mixture into a serving glass using a spoon and refrigerate for 10 minutes.
- For pudding:
- Scoop out the fruit into a blender, blend for 2 to 3 seconds, and filter the juice.
- In a mixing bowl combine thick cream, condensed milk, powdered sugar and strained juice.
- Pour the mixture equally on the prepared biscuit base and refrigerate for 1 hour.
- For topping:
- In a small bowl combine together fruit pulp and sugar. Mix well using a spoon until combined.
- Pour this over the pudding just before serving.

PASSION FRUIT COOKIES

Ingredients: (for 500 g)

Fresh passion fruit pulp	:	¼ cup or 60 ml
Baking powder	:	2 tbsp
Flour	:	2 ½ cup
Sugar	:	2/3 cup
Butter	:	½ cup
Egg	:	2 numbers
Salt	:	to taste


Passion Fruit Cookies

Method of preparation:

- Scoop out the pulp to a bowl and strain out the fruit juice.
- Add 2-3 teaspoons of seeds back to the juice for color.
- Preheat the oven to 190 ^{o}C, and grease the baking pan.
- Put light brown sugar into another small bowl and set aside.
- Using an egg beater mix well, butter and sugar.
- Add the egg one at a time, beating well after each one.
- Add passion fruit and beat again, add few tablespoons of flour mixture to the mixing bowl and beat again.
- Using a table spoon drop small drop small amount of soft dough into the light brown sugar.
- Swirl the bowl around until the ball of dough is covered in brown sugar.
- Gently lift the little ball out and place it on the greased cookies sheet.
- Bake in the preheated oven for about 10-12minuts or until the bottom is golden brown.

PASSION FRUIT MIXED FRUIT JUICE

Ingredients: (for 750 g)

Condensed milk	:	1 cup
Cream	:	1 cup
Passion fruit juice	:	1 ½ cup
Apple	:	500 g
Lemon	:	2 numbers
Nuts	:	10 numbers
Vanilla essence	:	½ tbsp

Mixed fruit juice

Method of preparation:

- Mix all the ingredients in a blender and serve chilled.

PASSION FRUIT JAM

Passion fruit jam is made from mature passion fruit which is boiled with sugar and other ingredients**.**

Ingredients: (for 500 g)

Passion fruit	:	250 gm
Sugar	:	250 gm
Citric acid	:	½ tbsp
Pectin powder	:	½ tbsp

Passion Fruit Jam

Lemon yellow color	:	¼ tbsp
Water	:	2 ½ cup

Method of preparation:

- Cook the passion fruit pulp with water on a low fire.
- Stir it continuously with a wooden ladle.
- While it boils, slowly add sugar into it. Boil it well by stirring continuously.
- Add pectin powder and stir continuously.
- When the jam is done, add citric acid, lemon and yellow color.
- Remove from fire and pour into a bottle. When the jam cools, close the mouth of the bowl.

PASSION FRUIT PAYASAM

Payasam/ kheer is an Indian sweet dessert. Passion fruit payasam is made with passion fruit, chowery and milk. Nuts such as pistachio, cashew and almonds along with raisins, saffron and cardamom are roasted in ghee and added to give a rich feel, taste and good appearance.

Ingredients: (for 750 g)

Passion fruit	:	250 gm
Grated jaggery	:	3/5 cup
Ghee	:	2 tbsp
Chowari	:	50 g
Water	:	½ cup
Milk	:	500 ml
Cashew nut	:	15 g
Semiya	:	50 g
Sugar	:	50 g

Passion Fruit Payasm

Method of preparation:

- Roast the nuts and raisins in 1 tbsp of ghee and keep it aside.
- Boil the passion fruit pulp in thick bottom pan, along with a little water.
- When the passion fruit is done, add the ghee and fry it well.
- Add grated jaggery and cook till the color changes to dark brown.
- When it is nicely done, add the extract of the coconut milk and cook till the payasam is thick and add cardamom powder.
- Lower the flame and add the second extract followed by the first extract.
- When the first extract begins to boil, add the washed chowari.
- When the chowari is cooked and payasam is nicely done, remove from flame.
- Add the roasted cashew nuts and raisins.
- Remove from flame and allow cooling.

APPLE – PASSION FRUIT CRUMBLE

Passion Fruit Crumble

Ingredients: (for 500 g)

Apples	:	4 numbers peeled
Passion fruit pulp	:	3-4 numbers
Sugar	:	½ tsp
Arrow root Biscuits	:	3-4 numbers

Method of Preparation:

- Pre-heat the oven to 180 °C.
- Lightly grease a baking dish with butter and set aside.
- Slice the peeled apple into wedges.
- Place the apple wedges in the greased baking dish and sprinkle evenly with sugar.
- Spoon passion fruit pulp evenly over apples.
- Cover baking dish tightly with foil and bake in the oven for 25-30 minutes or until soft.
- Remove baking dish from oven and spoon apple/passion fruit mixture evenly into four small cups.
- Crumble biscuits on on top of fruit and then place back in the oven for 7-10 minutes, or bake until biscuits are golden brown.
- Remove from oven and serve immediately with a scoop of vanilla ice-cream on top.

PASSION FRUIT SOUFFLE

Passion Fruit Souffle

Ingredients: (for 500 g)

Milk	:	1 cup
Vanilla essence	:	½ tsp
Sugar	:	½ cup
Butter	:	4 tbsp
Wheat flour	:	4 tbsp
Egg	:	3 large
Passion fruit pulp	:	¼ cup
Sugar powder	:	for dusting

Method of Preparation:

- Pre-heat the oven to 180 °C.
- Slowly bring the milk, vanilla essence and sugar to a boil over a medium heat.
- Then take it off from the heat and set aside.
- In a saucepan, melt the butter over medium heat.
- Add flour, a little at a time, keep whisking for about a minute.

- Remove from the heat and gradually stir in the milk.
- Return the pan to a medium heat and bring to boil, stirring the whole time.
- Cook sauce for about 40 seconds then remove from heat.
- Cover the surface of the sauce with plastic wrap and set aside to cool slightly.
- Grease small souffle cups with butter and dust with a sprinkling of sugar. Set aside.
- Whisk the egg yolks into the slightly cooled sauce, one at a time, until smooth.
- Next, add the passion fruit pulp and stir well.
- In a bowl, beat the egg whites until stiff with an electric beater.
- Spoon half the egg whites into the sauce with a spoon.
- Fold egg whites through very gently then fold in the remaining egg whites.
- Pour mixture to the top of the souffle cups.
- Level the mixture with a knife so that it's even.
- Bake until risen and slightly golden on top for about 15-20 minutes.
- Dust with icing sugar just before serving.

COCONUT - PASSION FRUIT PUDDING

Ingredients: (for 500g)

Wheat flour	:	1 cup
Sugar	:	½ cup
Desiccated coconut	:	½ cup
Coconut milk	:	2/3 cup
Egg	:	1 number
Butter	:	80 gm
Icing sugar	:	for topping

Passion Fruit Pudding

For sauce:

Sugar	:	½ cup
Corn flour	:	3 tsp
Milk	:	½ cup
Lemon juice	:	2 tsp
Passion fruit	:	3 numbers

Method of preparation:

- Preheat oven to 180 ºC and grease a baking tray and set aside.
- Sift flour into a bowl and stir in sugar and coconut.
- Whisk coconut milk, egg and butter together in a jug, pour into flour mixture.
- Gently stir until combined.
- Spread the prepared mix into the baking tray, smooth the surface with a spoon.

- Make sauce:
- Combine sugar and corn flour in a bowl. Sprinkle over pudding.
- Combine milk and 1/3 cup lemon in a small saucepan.
- Cook, stirring, over medium heat until mixture comes to the boil.
- Remove from heat and stir in passion fruit pulp.
- Pour hot lemon mixture over pudding.
- Bake for 50 to 55 minutes or until a toothpick inserted halfway into pudding comes out clean.
- Dust with icing sugar and serve immediately.

PASSION FRUIT CHEESECAKE

Ingredients: (for 500g)

Finely crushed biscuits	:	100 g
Butter	:	50 g
Ground cinnamon	:	¼ tsp
Cheese	:	100 g
Sugar	:	4 tbsp
Milk	:	2 tsp
Vanilla essence	:	½ tsp
Passion fruit pulp	:	200 g
Gelatin powder	:	¼ tsp

Passion Fruit cheese cake

Method of Preparation:

- Combine the biscuit crumbs, butter and cinnamon in small bowl.
- Divide half the biscuit mixture between two 250ml capacity serving glasses and press firmly to cover the base.
- Place in the fridge to chill.
- Use an electric beater to beat the cheese, sugar, milk and vanilla in bowl until very soft. Spread half the cheese mixture gently over the biscuit mixture.
- Top with the remaining biscuit mixture, then the remaining cheese mixture.
- Stir the passion fruit pulp and sugar in a small bowl until sugar dissolves.
- Place the water in a small heatproof bowl. Sprinkle with gelatine.
- Place the bowl in a small saucepan.
- Add enough boiling water to the pan to come halfway up the side of the bowl. Use a fork to whisk until gelatine dissolves.
- Stir the gelatine mixture into the passion fruit mixture.
- Pour over the cake mix and refrigerate till it sets
- Top the cheesecakes with double cream.

PASSION FRUIT CURD

Passion Fruit curd

Ingredients: (for 500g)

Butter	:	100 g
Sugar	:	150 g
Passion fruit pulp	:	200 g
Egg yolks	:	4

Method of preparation:

- Combine the butter, sugar, passion fruit and egg yolks in a medium saucepan over low heat.
- Cook, stirring, for 10-15 minutes or until the mixture thickens.
- Transfer to a sterilised jar and place in fridge for 1 hour to chill.

CITRUS -PASSION FRUIT PUDDING

Citrus-Passion Fruit

Ingredients: (for 250 g)

Butter	:	50 g
Caster sugar	:	¾ cup
Eggs	:	2
Passion fruit pulp	:	2 tsp
Lemon juice	:	¼ cup
Lemon rind	:	1 tsp
Milk	:	1 cup
Wheat flour	:	¼ cup
Icing sugar	:	to dust

Method of preparation:

- Preheat oven to 180°C.
- Grease a baking dish.
- Using an electric mixer, mix butter and sugar in a bowl until light. Add egg yolks, 1 at a time, beating well after each addition
- Stir in lemon rind, 1/4 cup lemon juice, passion fruit and milk. Sift flour over mixture and stir until combined.
- Beat egg whites in a bowl until soft peaks form. Fold into passion fruit mixture until just combined.

- Pour batter into baking dish. Place dish in a baking pan. Pour boiling water into pan so it comes halfway up sides of dish. Bake, uncovered, for 45 minutes or until pudding is just firm on top and light golden.
- Remove dish from baking pan and stand for 5 minutes. Dust pudding with icing sugar and serve.

PASSION FRUIT CUSTARD SLICE

Ingredients: (for 500 g)

Arrow root biscuits	:	200 g
Custard powder	:	1/3 cup
Milk	:	2 cups
Sugar	:	¼ cup
Passion fruit	:	1

Passion Fruit Custard

Method of preparation:

- Grease a pan.
- Place 12 biscuits, in a single layer, in pan to cover base.
- Combine custard powder and 1/4 cup milk in a saucepan. Whisk until smooth. Pour in remaining milk.
- Add sugar and place pan over medium heat.
- Cook, stirring constantly, for 5 minutes or until custard comes to the boil.
- Cook, stirring constantly, for 2 minutes. Remove from heat.
- Cover surface of custard with plastic wrap. Set aside for 30 minutes to cool slightly.
- Pour warm custard over biscuits. Top with another layer of 12 biscuits.
- Refrigerate for 1 hour or until set.
- Sift icing sugar into a bowl.
- Add 1 tablespoon passion fruit pulp.
- Refrigerate for 1 hour or until icing sets.
- Cut slice into squares, using shape of biscuits and serve.

8.6 Passion Fruit Recipes (Malayalam)

പാഷൻ ഫ്രൂട്ട് വിഭവങ്ങൾ

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പാഷൻ ഫ്രൂട്ട് - ഒരു ഔഷധ കനി

കടുത്ത വേനലിൽ വെന്തുരുകുന്ന ശരീരത്തിനും മനസ്സിനും കുളിർമ പകരാൻ പഴവർഗങ്ങൾ ക്കുള്ളത്ര കഴിവ് മറ്റൊന്നിനുമില്ല. അത്തരത്തിലുള്ള ഒരു ശീതള കനിയാണ് പാഷൻ ഫ്രൂട്ട്. നാവിനെ ത്രസിപ്പിക്കുന്ന മധുരവും ശരീരത്തിനാകെ കുളിർമ പകരുന്ന തണുപ്പും ഇത്രമാത്രം ഉള്ളിലൊതുക്കിയ ഒരു പഴം മറ്റൊന്നില്ല എന്നു തന്നെ പറയാം.

യാതൊരു വൈഷമ്യവുമില്ലാതെ എവിടെയും അനായാസം പടർന്നു കയറുന്ന ഈ വള്ളിച്ചെടിയിൽ സീസൺ ആയിക്കഴിഞ്ഞാൽ നിറയെ കായ്കൾ പിടിക്കും. വിവിധ വർണ്ണങ്ങളിലുള്ള ഇതിന്റെ പൂക്കൾ ആരെയും ആകർഷിക്കും. പാഷൻ ഫ്രൂട്ടിന് നല്ല രുചിയും മണവും ഔഷധ ഗുണവുമുണ്ട്. പാഷൻ ഫ്രൂട്ടിൽ ധാരാളം പൊട്ടാസ്യവും, ജീവകം സി യും, നിയാസിനും, നാരുകളും അടങ്ങിയിരിക്കുന്നു. പാഷൻ ഫ്രൂട്ട് ജ്യൂസിന് വേദന ശമിപ്പിക്കാനും, വിരകളെ അകറ്റാനും, ഹൃദയനാഡീ രോഗങ്ങളെയും കാൻസറിനെയും ശമിപ്പിക്കാനും കഴിവുണ്ട്. ഇതിൽ അടങ്ങിയിരിക്കുന്ന 'പാസ്സിഫ്ളോറിൻ' എന്ന രാസപദാർത്ഥമാണ് വേദന നിവാരണത്തിനും ശാരീരിക ഉന്മേഷത്തിനും കാരണമാകുന്നത്. പാഷൻ ഫ്രൂട്ടിന്റെ ഉണങ്ങിയ പൂക്കൾ തിളപ്പിച്ചെടുക്കുന്ന വെള്ളം വേദന സംഹാരിയായി പല രാജ്യങ്ങളിലും ഉപയോഗിക്കാറുണ്ട്.

ലോകത്തിൽ 600-ൽ പരം പാഷൻ ഫ്രൂട്ട് സ്പീഷീസുകൾ ഉണ്ടെങ്കിലും പ്രധാനമായും 3 ഇനങ്ങളാണ് നമ്മുടെ നാട്ടിൽ കൃഷി ചെയ്തു വരുന്നത്. ചുവപ്പ്, മഞ്ഞ, അകാശ വെള്ളരി എന്ന് വിളിക്കുന്ന 'ഭീമൻ' എന്നിവയാണവ. നല്ല ശുദ്ധിയായ പഴങ്ങൾ 10 ഡിഗ്രീ സെൽഷ്യസിൽ 3 ആഴ്ച വരെ ഗുണമേന്മ നഷ്ടപ്പെടാതെ പോളിത്തീൻ ബാഗുകളിൽ സൂക്ഷിക്കാം. പാഷൻ ഫ്രൂട്ട് പഞ്ചസാര ചേർത്ത് കഴിക്കുകയോ, സ്വാദിഷ്ടമായ പാനീയങ്ങൾ ഉണ്ടാക്കാൻ ഉപയോഗിക്കുകയോ ചെയ്യാം. കൂടാതെ ജ്യൂസ് സംസ്കരിച്ചെടുത്ത് വിപണനം നടത്തുകയോ, ശീതളപാനീയങ്ങൾ, ഐസ് ക്രീം, ബേക്കറി സാധനങ്ങൾ, സാലഡുകൾ, സർബത്തുകൾ, ജാം, ജെല്ലി, സിറപ്പ്, സ്ക്വാഷ്, പഞ്ച്, ക്യാൻഡി, വൈൻ മുതലായവ ഉണ്ടാക്കുകയോ ചെയ്യാം

സ്വാദേറും പാഷൻ ഫ്രൂട്ട് വിഭവങ്ങൾ

പാഷൻ ഫ്രൂട്ട് ജ്യൂസ്

പാഷൻ ഫ്രൂട്ട് ജ്യൂസ്

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട്	:	500 ഗ്രാം
പഞ്ചസാര	:	250 ഗ്രാം
വെള്ളം	:	250 മി.ലി.
പൊടിച്ച ഐസ്:		1/2 കപ്പ്

തയ്യാറാക്കുന്ന വിധം:

പാഷൻ ഫ്രൂട്ട് തുരന്ന് ഉള്ളിലുള്ള മാംസള ഭാഗം പുറത്തെടുക്കുക. ഇത് പഞ്ചസാരയും വെള്ളവും ചേർത്ത് മിക്സിയിൽ നന്നായി അടിച്ചെടുക്കുക. ഈ മിശ്രിതം ഗ്ലാസിലേക്ക് അരിച്ചെടുത്ത് പൊടിച്ച ഐസ് തൂവി ഉപയോഗിക്കാം.

പാഷൻ ഫ്രൂട്ട് ജ്യൂസ് കോൺസന്ട്രേറ്റ്

പാഷൻ ഫ്രൂട്ട് ജ്യൂസ് കോൺസന്ട്രേറ്റ്

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ്	:	250 ഗ്രാം
പഞ്ചസാര	:	250 ഗ്രാം
സിട്രിക് ആസിഡ്	:	1 ടേബിൾ സ്പൂൺ
സോഡിയം ബെൻസോയേറ്റ്	:	1/2 ടേബിൾ സ്പൂൺ

തയ്യാറാക്കുന്ന വിധം:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ് മിക്സിയിൽ നന്നായി അടിച്ചെടുക്കുക. അരിച്ചെടുത്തതിനു ശേഷം പഞ്ചസാരയും ചേർത്ത് തിളപ്പിയ്ക്കുക. പഞ്ചസാര അലിഞ്ഞു തീരുമ്പോൾ സിട്രിക് ആസിഡും സോഡിയം ബെൻസൊയേറ്റും ചേർത്ത് വാങ്ങുക. തണുത്തതിനു ശേഷം കുപ്പിയിലാക്കി ഉപയോഗിക്കാം.

പാഷൻ ഫ്രൂട്ട് സ്ക്വാഷ്

പാഷൻ ഫ്രൂട്ട് സ്ക്വാഷ്

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ്	:	1 കപ്പ്
പഞ്ചസാര	:	2 കപ്പ്
വെള്ളം	:	1 കപ്പ്
സിട്രിക് ആസിഡ്	:	1 ടേബിൾ സ്പൂൺ
പൊട്ടാസിയം മെറ്റാബൈസൾഫേറ്റ്	:	1/2 ടേബിൾ സ്പൂൺ
മഞ്ഞ കളർ	:	1/4 ടേബിൾ സ്പൂൺ

തയ്യാറാക്കുന്ന വിധം:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ് മിക്സിയിൽ നന്നായി അടിച്ചെടുക്കുക. അരിച്ചെടുത്തതിനു ശേഷം, ചുവടു കട്ടിയുള്ള ഒരു പാത്രത്തിൽ പഞ്ചസാരയും വെള്ളവും ചേർത്ത് തിളപ്പിക്കുക. ഒട്ടുന്ന

പരുവത്തിൽ തീ കുറച്ച് സിട്രിക് ആസിഡു ചേർത്ത് വാങ്ങുക. തണുത്തതിനു ശേഷം പൊട്ടാസിയം മെറ്റാബൈസൾഫേറ്റ് ചേർത്ത് നന്നായി ഇളക്കുക. കുപ്പിയിലാക്കി സൂക്ഷിക്കാവുന്നതാണ്.

പാഷൻ ഫ്രൂട്ട് –ഓറഞ്ച് ജ്യൂസ്

പാഷൻ ഫ്രൂട്ട് –ഓറഞ്ച്

ചേരുവകൾ

ഓറഞ്ച്	:	5 എണ്ണം
പാഷൻ ഫ്രൂട്ട്	:	2 എണ്ണം

തയ്യാറാക്കുന്ന വിധം

ഓറഞ്ചും പാഷൻ ഫ്രൂട്ടും മിക്സിയിൽ വേറെ വേറെ അടിച്ച് ജ്യൂസ് എടുക്കുക. അരിച്ചെടുത്തതിനു ശേഷം ആവശ്യത്തിനു പഞ്ചസാരയും ചേർത്ത് തണുപ്പിച്ച് കഴിയ്ക്കാം.

പാഷൻ ഫ്രൂട്ട്–മിന്റ് ജ്യൂസ്

പാഷൻ ഫ്രൂട്ട് – മിന്റ് ജ്യൂസ്

ചേരുവകൾ

പാഷൻ ഫ്രൂട്ട്	:	2 എണ്ണം
പുതിനയില	:	5–6 എണ്ണം
നാരങ്ങ നീര്	:	1 ടേബിൾ സ്പൂൺ
പഞ്ചസാര	:	2 ടേബിൾ സ്പൂൺ
വെള്ളം	:	ആവശ്യത്തിന്

തയ്യാറാക്കുന്ന വിധം

ചേരുവകളെല്ലാം ഒന്നിച്ചാക്കി മിക്സിയിൽ അടിച്ച് ജ്യൂസ് എടുക്കുക. അരിച്ചെടുത്തതിനു ശേഷം തണുപ്പിച്ച് കഴിയ്ക്കാം.

പാഷൻ ഫ്രൂട്ട്– തണ്ണിമത്തൻ ജ്യൂസ്

പാഷൻ ഫ്രൂട്ട് –
തണ്ണിമത്തൻ ജ്യൂസ്

ചേരുവകൾ

പാഷൻ ഫ്രൂട്ട്	:	3/4 കപ്പ്
തണ്ണിമത്തൻ	:	2 കപ്പ്
പഞ്ചസാര	:	ആവശ്യത്തിന്

തയ്യാറാക്കുന്ന വിധം

ചേരുവകളെല്ലാം ഒന്നിച്ചാക്കി മിക്സിയിൽ അടിച്ച് ജ്യൂസ് എടുക്കുക. ആവശ്യത്തിനു പഞ്ചസാര ചേർത്ത് തണുപ്പിച്ച് കഴിയ്ക്കാം.

പാഷൻ ഫ്രൂട്ട് മിക്സഡ് ഫ്രൂട്ട് ജ്യൂസ്

പാഷൻ ഫ്രൂട്ട് മിക്സഡ് ഫ്രൂട്ട് ജ്യൂസ്

ചേരുവകൾ:

കണ്ടെൻസ്ഡ് മിൽക്	:	1 കപ്പ്
ക്രീം	:	1 കപ്പ്
പാഷൻ ഫ്രൂട്ട് ജ്യൂസ്	:	1 1/2 കപ്പ്
ആപ്പിൾ	:	2 കപ്പ്
നാരങ്ങ	:	2 എണ്ണം

കശുവണ്ടി	:	10 എണ്ണം
വാനില എസ്സെൻസ്	:	1/2 ടീസ്പൂൺ

തയ്യാറാക്കുന്ന വിധം:

ചേരുവകളെല്ലാം ഒന്നിച്ചാക്കി മിക്സിയിൽ അടിച്ചെടുത്ത് തണുപ്പിച്ച് കഴിക്കാം.

പാഷൻ ഫ്രൂട്ട് പൈനാപ്പിൾ സോഡ

പാഷൻ ഫ്രൂട്ട് പൈനാപ്പിൾ സോഡ

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ്	:	1 കപ്പ്
പൈനാപ്പിൾ ജ്യൂസ്	:	1 1/4 കപ്പ്
നാരങ്ങ നീര്	:	1/4 കപ്പ്
പഞ്ചസാര	:	1 1/4 കപ്പ്
തണുപ്പിച്ച സോഡ	:	1 ലിറ്റർ

തയ്യാറാക്കുന്ന വിധം:

ഒരു പാനിൽ പൈനാപ്പിൾ ജ്യൂസും നാരങ്ങ നീരും പഞ്ചസാരയും ഒന്നിച്ചാക്കി ചെറുതീയിൽ ചൂടാക്കുക. പഞ്ചസാര അലിഞ്ഞതിനു ശേഷം തീ കൂട്ടിവെച്ച് തിളപ്പിക്കുക. തിളച്ചതിനു ശേഷം ജ്യൂസ് അൽപം കട്ടിയാകുന്നത് വരെ ചെറു തീയിൽ 15 മിനിറ്റ് നേരം വെക്കുക. തീയിൽ നിന്നും വാങ്ങി പാഷൻ ഫ്രൂട്ട് പൾപ്പിലേക്ക് അരിച്ചൊഴിക്കുക. ഒരു ഗ്ലാസിലേക്ക് പകർന്ന് തണുപ്പിച്ച സോഡയൊഴിച്ച് ഉപയോഗിക്കാം.

പാഷൻ ഫ്രൂട്ട് ഫോം

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട്	:	2 എണ്ണം
പഞ്ചസാര	:	1 കപ്പ്
വെള്ളം	:	1/2 കപ്പ്
മുട്ട	:	2 എണ്ണം
കോൺ ഫ്ളോർ	:	2 ടേബിൾ സ്പൂൺ

തയ്യാറാക്കുന്ന വിധം:

പാഷൻ ഫ്രൂട്ട് ഫോം

ചുവടു കട്ടിയുള്ള ഒരു പാത്രത്തിൽ വെള്ളവും പഞ്ചസാരയും ചേർത്ത് തിളപ്പിക്കുക. ഇതിലേക്ക് കോൺ ഫ്ളോർ അലിയിച്ചു ചേർക്കുക. ഒരു ബൗളിൽ പാഷൻ ഫ്രൂട്ട് പൾപ്പും മുട്ടയും ചേർത്ത് നന്നായി ബീറ്റ് ചെയ്ത് പതപ്പിക്കുക. തിളച്ചുകൊണ്ടിരിക്കുന്ന പഞ്ചസാരവെള്ളം പാഷൻ ഫ്രൂട്ട്-മുട്ട പതപ്പിച്ചു വെച്ചിരിക്കുന്നതിനു മുകളിൽ ഒഴിച്ച് വീണ്ടും നന്നായി പതപ്പിക്കണം. മൃദുവായതിനു ശേഷം തണുപ്പിച്ച് കഴിക്കാം.

മാങ്ങ-പാഷൻ ഫ്രൂട്ട് ലസ്സി

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട്	:	2 എണ്ണം
മാങ്ങ	:	2 എണ്ണം
തേൻ	:	6 ടേബിൾ സ്പൂൺ
തൈര്	:	2 കപ്പ്
പുതിനയില	:	3–4 എണ്ണം അലങ്കരിക്കാൻ

മാങ്ങ-പാഷൻ ഫ്രൂട്ട് ലസ്സി

തയ്യാറാക്കുന്ന വിധം:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ് ഞെരടി കുരു കളഞ്ഞ് ജ്യൂസ് എടുക്കുക. പാഷൻ ഫ്രൂട്ട് ജ്യൂസ്, മാങ്ങ, തേൻ, തൈര് എന്നിവ മിക്സിയിൽ നന്നായി അടിച്ചെടുക്കുക. ഇത് ഒരു ഗ്ലാസിലേക്ക് പകർത്തി ആവശ്യമെങ്കിൽ വീണ്ടും തേൻ ചേർത്ത് തണുപ്പിച്ച് കഴിക്കാവുന്നതാണ്.

പാഷൻ ഫ്രൂട്ട് വൈൻ

പാഷൻ ഫ്രൂട്ട് വൈൻ

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ്	:	1 കിലോ
പഞ്ചസാര	:	2 കിലോ
വെള്ളം	:	3 ലിറ്റർ
യീസ്റ്റ്	:	1 ടീസ്പൂൺ
മുട്ടയുടെ വെള്ള	:	ഒരെണ്ണം

തയ്യാറാക്കുന്ന വിധം:

ഒരു പാത്രത്തിൽ വെള്ളം ചൂടാക്കുക. ഇതിലേക്ക് അരിഞ്ഞ പാഷൻ ഫ്രൂട്ട് തൊലി ചേർത്ത് ഇളക്കുക. ഇത് അരിച്ചെടുത്ത് ജ്യൂസ് മാറ്റി വെക്കുക. ഇങ്ങനെ മാറ്റി വെച്ച ജ്യൂസിലേക്ക് പാഷൻ ഫ്രൂട്ട് പൾപ്പും പഞ്ചസാരയും വെള്ളവും യീസ്റ്റും ചേർത്ത് നന്നായി ഇളക്കണം. ഒരു മുട്ടയുടെ വെള്ള നന്നായി അടിച്ചെടുത്ത് ഈ മിശ്രിതത്തിലേക്ക് ചേർക്കുക. ശേഷം വായു കടക്കാത്ത മൺകലത്തിലാക്കി 41 ദിവസം സൂക്ഷിക്കുക. എല്ലാ ദിവസവും മരത്തവി ഉപയോഗിച്ച് ഇളക്കിക്കൊടുക്കണം. 41 ദിവസത്തിനു ശേഷം ഒരു തുണിയിലൂടെ പിഴിയാതെ അരിച്ചെടുക്കുക. ഇങ്ങനെ അരിച്ചെടുത്ത വൈൻ 6 മണിക്കൂർ ഭരണിയിൽ തുണി മൂടിക്കെട്ടി സൂക്ഷിച്ച്വെച്ചതിനു ശേഷം ഒരിക്കൽ കൂടി അരിച്ചെടുത്ത് ഉപയോഗിക്കാം.

പാഷൻ ഫ്രൂട്ട് തൈര്


പാഷൻ ഫ്രൂട്ട് തൈര്

ചേരുവകൾ:

വെണ്ണ	:	125 ഗ്രാം
പഞ്ചസാര	:	150 ഗ്രാം
പാഷൻ ഫ്രൂട്ട് പൾപ്പ്	:	180 മി.ലി.
മുട്ടയുടെ മഞ്ഞ	:	4 എണ്ണം

തയ്യാറാക്കുന്ന വിധം:

ചേരുവകളെല്ലാം യോജിപ്പിച്ച് ചെറു തീയിൽ 10–15 മിനിറ്റ് വേവിക്കുക. തണുത്തതിനു ശേഷം കുപ്പിയിലാക്കി ഫ്രിഡ്ജിൽ വെച്ച് ഉപയോഗിക്കാം.

പാഷൻ ഫ്രൂട്ട് അച്ചാർ


പാഷൻ ഫ്രൂട്ട് അച്ചാർ

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ്	:	250 ഗ്രാം
പഞ്ചസാര	:	100 ഗ്രാം
വിനാഗിരി	:	100 മി.ലി.
വെളിച്ചെണ്ണ	:	3 ടേബിൾ സ്പൂൺ
കടുക്	:	1 ടേബിൾ സ്പൂൺ

മുളക് പൊടി	:	1/2 ടേബിൾ സ്പൂൺ
മഞ്ഞൾ പൊടി	:	1/4 ടേബിൾ സ്പൂൺ
പച്ചമുളക്	:	50 ഗ്രാം
ചെറിയ ഉള്ളി	:	25 ഗ്രാം
വെളുത്തുള്ളി	:	50 ഗ്രാം
കറിവേപ്പില	:	ആവശ്യത്തിന് (താളിക്കാൻ)
കുരുമുളക് പൊടി	:	1/4 ടേബിൾ സ്പൂൺ

തയ്യാറാക്കുന്ന വിധം:

ചീനചട്ടിയിൽ വെളിച്ചെണ്ണ ചൂടാക്കി കടുക്, ഉള്ളി, വെളുത്തുള്ളി, പച്ചമുളക്, മുളക് പൊടി, മഞ്ഞൾ പൊടി, കുരുമുളക് പൊടി, കറിവേപ്പില എന്നിവ താളിക്കുക. ഇതിലേക്ക് പാഷൻ ഫ്രൂട്ട് ചേർത്ത് ഇളക്കുക. തീ കുറച്ച്, പഞ്ചസാരയും വിനാഗിരിയും ചേർത്ത് ജാം പരുവമാകുന്നത് വരെ വേവിക്കുക. തണുത്തതിനു ശേഷം കുപ്പിയിലാക്കി ഉപയോഗിക്കാം.

പാഷൻ ഫ്രൂട്ട് ഹൽവ

പാഷൻ ഫ്രൂട്ട് ഹൽവ

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട്	:	1 1/2 കപ്പ്
പഞ്ചസാര	:	1/4 കപ്പ്
പാൽ	:	1/2 കപ്പ്
ഏലയ്ക്ക പൊടിച്ചത്	:	1/2 ടേബിൾ സ്പൂൺ
വെള്ളം	:	1/2 ഗ്ലാസ്സ്
നെയ്യ്	:	2 ടേബിൾ സ്പൂൺ
പാൽപേട പൊടിച്ചത്	:	1/2 കപ്പ്
ബദാം	:	2–3 എണ്ണം

തയ്യാറാക്കുന്ന വിധം:

ചുവടു കട്ടിയുള്ള ഒരു പാത്രത്തിൽ പാഷൻ ഫ്രൂട്ട് ജ്യൂസ് തിളപ്പിക്കുക. അൽപാൽമായി പഞ്ചസാരയും നെയ്യും ചേർത്തിളക്കികൊണ്ടിരിക്കണം. അതിനു ശേഷം പാലും പാൽപേടയും ചേർത്തിളക്കുക. വറ്റിത്തുടങ്ങുമ്പോൾ തീ കുറച്ച് 10 മിനിറ്റ് വേവിക്കുക. തീയിൽ നിന്നും വാങ്ങി ഏലയ്ക്കാ പൊടി ചേർത്ത് മുകളിൽ ബദാം വെച്ച് അലങ്കരിച്ച് ഉപയോഗിക്കാം.

പാഷൻ ഫ്രൂട്ട് ജാം

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട്	:	250 ഗ്രാം
പഞ്ചസാര	:	250 ഗ്രാം
സിട്രിക് ആസിഡ്	:	1/2 ടീസ്പൂൺ
വെള്ളം	:	2 1/2 കപ്പ്
പെക്റ്റിൻ പൗഡർ	:	1/2 ടീസ്പൂൺ

പാഷൻ ഫ്രൂട്ട് ജാം

തയ്യാറാക്കുന്ന വിധം:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ് വെള്ളം ചേർത്ത് ചെറുതീയിൽ വേവിക്കുക. തുടരെ ഇളക്കികൊണ്ടിരിക്കണം. തിള വരുമ്പോൾ പഞ്ചസാര ചേർക്കുക. ഇതിലേക്ക് പെക്റ്റിൻ പൗഡർ ചേർത്ത് നന്നായി ഇളക്കുക. അതിനു ശേഷം സിട്രിക് ആസിഡു ചേർത്ത്

30 മിനിറ്റ് ജാം പരുവമാകുന്നത് വരെ വേവിക്കുക. ജാം പരുവമായതിനു ശേഷം തീ കുറയ്ക്കുക. ഒരു ജാറിലേക്ക് പകർത്തി തണുത്തതിനു ശേഷം ഉപയോഗിക്കാം.

പാഷൻ ഫ്രൂട്ട് പായസം

പാഷൻ ഫ്രൂട്ട് പായസം

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട്	:	250 ഗ്രാം
ശർക്കര	:	200 ഗ്രാം
നെയ്യ്	:	2 ടീസ്പൂൺ
ചൗവ്വരി	:	50 ഗ്രാം
വെള്ളം	:	1/2 കപ്പ്
തേങ്ങാപ്പാൽ	:	500 മി.ലി.
കശുവണ്ടി	:	15 ഗ്രാം
മുന്തിരി	:	15 ഗ്രാം
സേമിയ	:	50 ഗ്രാം
പഞ്ചസാര	:	50 ഗ്രാം

തയ്യാറാക്കുന്ന വിധം:

കശുവണ്ടിയും മുന്തിരിയും നെയ്യിൽ വറുത്ത് മാറ്റി വെക്കുക. ചുവടു കട്ടിയുള്ള ഒരു പാത്രത്തിൽ പാഷൻ ഫ്രൂട്ട് പൾപ്പ് അൽപം വെള്ളം ചേർത്ത് തിളപ്പിക്കുക. വെന്തു വരുമ്പോൾ നെയ് ചേർത്ത് വഴറ്റുക. ഇതിലേക്ക് ശർക്കര ചുരണ്ടിയത് ചേർത്ത് ഇരുണ്ട നിറമാവും വരെ ഇളക്കുക. അതിനു ശേഷം മൂന്നാം പാൽ ചേർത്ത് കുറുകുന്നത് വരെ ചെറിയ തീയിൽ വേവിക്കണം. അൽപം ഏലയ്ക്കാ പൊടിച്ചത് ചേർക്കുക. പിന്നെ രണ്ടാം പാൽ, ഒന്നാം പാൽ എന്ന ക്രമത്തിൽ ചേർക്കുക. ഒന്നാം പാൽ തിളച്ചു തുടങ്ങുമ്പോൾ കഴുകിവാരിയ ചൗവ്വരി ചേർത്ത് വേവിക്കുക. വെന്ത് കഴിയുമ്പോൾ വറുത്തു വെച്ചിരിക്കുന്ന കശുവണ്ടിയും മുന്തിരിയും ചേർത്ത് വാങ്ങുക. തണുത്തതിനു ശേഷം ഉപയോഗിക്കാം.

പാഷൻ ഫ്രൂട്ട് കേക്ക്:

പാഷൻ ഫ്രൂട്ട് കേക്ക്

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട്	:	2 എണ്ണം
മുട്ട	:	2 എണ്ണം
വെണ്ണ	:	100 ഗ്രാം
കടലമാവ്	:	100 ഗ്രാം
ബേക്കിംഗ് പൗഡർ	:	1 ടേബിൾ സ്പൂൺ
വാനില എസ്സെൻസ്	:	1 ടേബിൾ സ്പൂൺ
ഉപ്പ്	:	ഒരു നുള്ള്
ചെറി	:	7–8 എണ്ണം

തയ്യാറാക്കുന്ന വിധം:

ചെറു തീയിൽ വെണ്ണ, പഞ്ചസാര എന്നിവ ഉരുക്കിയതിനു ശേഷം, അതിലേക്ക് മുട്ട ചേർത്ത് നന്നായി യോജിപ്പിക്കുക. ഇതിലേക്ക് അരിച്ചെടുത്ത കടലമാവ്, ബേക്കിംഗ് പൗഡർ, വാനില എസ്സെൻസ്, ഉപ്പ് എന്നിവ ചേർക്കുക. അതിനു ശേഷം പാഷൻ ഫ്രൂട്ട് പൾപ്പ് ചേർക്കണം. ഈ കൂട്ട് നെയ് പുരട്ടിവെച്ച ഒരു ബേക്കിംഗ് ട്രേയിലേക്ക് പകർത്തി മുകളിൽ ചെറി വെച്ചലങ്കരിക്കുക. ചൂടായിക്കിടക്കുന്ന ഓവനിൽ 180 ഡിഗ്രി സെൽഷ്യസിൽ ഏകദേശം 45 മിനിറ്റോളം ബേക്ക് ചെയ്തെടുക്കുക. തണുത്തതിനു ശേഷം മുറിച്ചുപയോഗിക്കാവുന്നതാണ്.

പാഷൻ ഫ്രൂട്ട് പുഡ്ഡിംഗ്

ചേരുവകൾ:

ബിസ്കറ്റ് പൊടിച്ചത്	:	1/2 കപ്പ്
വെണ്ണ	:	1 ടേബിൾ സ്പൂൺ
പാഷൻ ഫ്രൂട്ട്	:	10 എണ്ണം
ക്രീം	:	1 കപ്പ്
കണ്ടെൻസ്ഡ് മിൽക്	:	1/2 കപ്പ്
പൊടിച്ച പഞ്ചസാര	:	3 ടേബിൾ സ്പൂൺ

അലങ്കരിക്കാൻ

പാഷൻ ഫ്രൂട്ട്	:	2 എണ്ണം
പഞ്ചസാര	:	2 ടേബിൾ സ്പൂൺ

പാഷൻ ഫ്രൂട്ട് പുഡ്ഡിംഗ്

തയ്യാറാക്കുന്ന വിധം:

ഒരു ബൗളിൽ വെണ്ണ, ബിസ്കറ്റ് പൊടിച്ചത് എന്നിവ നന്നായി യോജിപ്പിക്കുക ഈ കൂട്ട് തണുക്കാനായി ഫ്രിഡ്ജിലേക്ക് വെക്കുക. പാഷൻ ഫ്രൂട്ട് പൾപ്പ് മിക്സിയിൽ അടിച്ച് ജ്യൂസ് അരിച്ചെടുക്കുക. മറ്റൊരു ബൗളിൽ ക്രീം, കണ്ടെൻസ്ഡ് മിൽക്, പൊടിച്ച പഞ്ചസാര, പാഷൻ ഫ്രൂട്ട് ജ്യൂസ് എന്നിവ നന്നായി യോജിപ്പിക്കണം. തയ്യാറാക്കിയ ഈ മിശ്രിതം തണുപ്പിച്ച ബിസ്കറ്റ് വെണ്ണ കൂട്ടിനു മുകളിൽ ഒഴിച്ച് ഏകദേശം ഒരു മണിക്കൂറോളം ഫ്രിഡ്ജിൽ വെച്ച് തണുപ്പിച്ച് കഴിക്കുക. പാഷൻ ഫ്രൂട്ട് പൾപ്പ് പഞ്ചസാര ചേർത്ത് പുഡ്ഡിങ്ങിനു മുകളിലായി ഒഴിച്ച് അലങ്കരിക്കാവുന്നതാണ്.

പാഷൻ ഫ്രൂട്ട് കുക്കീസ്

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ്	:	1/4 കപ്പ്
ബേക്കിംഗ് പൗഡർ	:	2 ടേബിൾ സ്പൂൺ
ഗോതമ്പു പൊടി	:	2 1/2 കപ്പ്
പഞ്ചസാര	:	3/4 കപ്പ്
വെണ്ണ	:	1/2 കപ്പ്
മുട്ട	:	2 എണ്ണം
ഉപ്പ്	:	ആവശ്യത്തിന്

പാഷൻ ഫ്രൂട്ട് കുക്കീസ്

തയ്യാറാക്കുന്ന വിധം:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ് മിക്സിയിൽ അടിച്ച് ജ്യൂസ് അരിച്ചെടുക്കുക. ഒരു പാത്രത്തിൽ പഞ്ചസാര വിതറി മാറ്റി വെക്കുക. ഒരു ബൗളിൽ വെണ്ണയും പഞ്ചസാരയും നന്നായി ബീറ്റ് ചെയ്യുക. ഇതിലേക്ക് മുട്ട ചേർത്ത് പതപ്പിച്ചെടുക്കണം. ശേഷം പാഷൻ ഫ്രൂട്ടും ചേർത്ത് നന്നായി യോജിപ്പിക്കുക. ഇതിലേക്ക് അൽപാൽപമായി ഗോതമ്പു പൊടി ചേർത്ത് വീണ്ടും ബീറ്റ് ചെയ്യുക. തയ്യാറാക്കിയ മാവിൽ നിന്നും കുറെശ്ശേ എടുത്ത് പഞ്ചസാരയിൽ ഉരുട്ടി വെക്കുക. തയ്യാറാക്കിയ കുക്കീസ്, ബേക്കിംഗ് ട്രേയിലേക്ക് മാറ്റി ഓവനിൽ 175 ഡിഗ്രി സെൽഷ്യസിൽ 12–15 മിനിറ്റ് സുവർണ നിറമാവും വരെ ബേക്ക് ചെയ്തെടുക്കുക.

ആപ്പിൾ-പാഷൻ ഫ്രൂട്ട് ക്രംബിൾ

ചേരുവകൾ:

ആപ്പിൾ	:	4 എണ്ണം
പാഷൻ ഫ്രൂട്ട് പൾപ്പ്	:	250 ഗ്രാം
പഞ്ചസാര	:	1/2 ടീസ്പൂൺ
ആരൊറൂട്ട് ബിസ്കറ്റ്	:	3–4 എണ്ണം

ആപ്പിൾ -പാഷൻ ഫ്രൂട്ട് ക്രംബിൾ

തയ്യാറാക്കുന്ന വിധം:

ആപ്പിൾ നീളത്തിൽ മുറിച്ചു വെക്കുക. അപ്പിൾ കഷ്ണങ്ങൽ നെയ് തടവിയ ബേക്കിംഗ് ട്രേയിൽ നിരത്തി മുകളിലായി പഞ്ചസാര തൂവുക. അതിനു മുകളിലായി പാഷൻ ഫ്രൂട്ട് പൾപ്പ് ഒഴിയ്ക്കുക. ബേക്കിംഗ് ട്രേ അലുമിനിയം ഫോയിൽ കൊണ്ട് പൊതിഞ്ഞ് ഓവനിൽ 180 ഡിഗ്രി സെൽഷ്യസിൽ 30 മിനിറ്റ് ബേക്ക് ചെയ്യുക. അതിനു ശേഷം ആപ്പിൾ പാഷൻ ഫ്രൂട്ട് കൂട്ടിനു മുകളിലായി പൊടിച്ച ബിസ്കറ്റ് നിരത്തി വീണ്ടും 7–8 മിനിറ്റ് ബേക്ക് ചെയ്തെടുക്കുക. ഇത് വാനില ഐസ്ക്രീമിനൊപ്പം കഴിക്കാൻ നന്നായിരിക്കും.

പാഷൻ ഫ്രൂട്ട് സൂഫ്ളെ

ചേരുവകൾ:

പാഷൻ ഫ്രൂട്ട് പൾപ്പ്	:	1/4 കപ്പ്
പാൽ	:	1 കപ്പ്
വാനില എസ്സെൻസ്	:	1/2 ടീസ്പൂൺ
പഞ്ചസാര	:	1/2 കപ്പ്
വെണ്ണ	:	4 ടീസ്പൂൺ
ഗോതമ്പു പൊടി	:	4 ടീസ്പൂൺ
മുട്ട	:	3 എണ്ണം
പഞ്ചസാര പൊടിച്ചത്	:	2 ടീസ്പൂൺ (അലങ്കരിക്കാൻ)

പാഷൻ ഫ്രൂട്ട് സൂഫ്ളെ

തയ്യാറാക്കുന്ന വിധം:

ഓവൻ 180 ഡിഗ്രി സെൽഷ്യസിൽ ചൂടാക്കിയിടുക. ചെറുതീയിൽ പാൽ, വാനില എസ്സെൻസും പഞ്ചസാരയും ചേർത്ത് തിളപ്പിക്കുക. തിളച്ചതിനു ശേഷം തീയിൽ നിന്നും വാങ്ങി തണുക്കാൻ വെയ്ക്കുക. ഒരു തവയിൽ വെണ്ണ ഉരുക്കി അതിലേക്ക് ഗോതമ്പുമാവു ചേർത്ത് നന്നായി യോജിപ്പിക്കണം. അതിലേക്ക് പാൽ ചേർത്തിളക്കി ചെറുതീയിൽ പാൽ-മാവ് കൂട്ട് തിളപ്പിക്കുക. തുടരെ ഇളക്കിക്കൊണ്ടിരിക്കണം. തിളച്ചതിനു ശേഷം തീയിൽ നിന്നും വാങ്ങി തണുക്കാൻ വെയ്ക്കുക. ഈ മിശ്രിതത്തിലേക്ക് മുട്ടയുടെ മഞ്ഞ ചേർത്ത് നന്നായി പതപ്പിക്കുക. അതിനു ശേഷം പാഷൻ ഫ്രൂട്ട് പൾപ്പ് ചേർക്കണം. നെയ്യ് തടവിയ ബേക്കിംഗ് ട്രേയിൽ തയ്യാറാക്കിയ കൂട്ടൊഴിച്ചു മുകളിലായി മുട്ടയുടെ വെള്ള പതപ്പിച്ചതും ചേർത്ത് 20 മിനിറ്റോളം ഓവനിൽ ബേക്ക് ചെയ്തെടുക്കുക. മുകളിൽ പൊടിച്ച പഞ്ചസാര തൂവി കഴിക്കാവുന്നതാണ്.

കോക്കനട്ട്-പാഷൻ ഫ്രൂട്ട് പുഡ്ഡിംഗ്

ചേരുവകൾ:

ഗോതമ്പു മാവ്	:	1 കപ്പ്
പഞ്ചസാര	:	1/2 കപ്പ്
തേങ്ങ വറുത്തത്	:	1/2 കപ്പ്
മുട്ട	:	ഒരെണ്ണം
വെണ്ണ	:	1/4 കപ്പ്

കോക്കനട്ട്-പാഷൻ ഫ്രൂട്ട് പുഡ്ഡിംഗ്

അലങ്കരിക്കാൻ:

പഞ്ചസാര	:	1/2 കപ്പ്
കോൺ ഫ്ളോർ	:	3 ടീസ്പൂൺ
തേങ്ങാപാൽ	:	1/2 കപ്പ്
നാരങ്ങ നീര്	:	2 ടീസ്പൂൺ
പാഷൻ ഫ്രൂട്ട്	:	3 എണ്ണം

തയ്യാറാക്കുന്ന വിധം:

ഓവൻ 180 ഡിഗ്രി സെൽഷ്യസിൽ ചൂടാക്കിയിടുക. ഒരു ബൗളിൽ ഗോതമ്പുമാവ് വറുത്ത തേങ്ങയും പഞ്ചസാരയും ചേർത്ത് നന്നായി ഇളക്കുക. ഇതിലേക്ക് മുട്ട, വെണ്ണ എന്നിവ ചേർത്ത് യോജിപ്പിക്കണം. തയ്യാറാക്കിയ ഈ കൂട്ട് ബേക്കിംഗ് ട്രേയിലൊഴിച്ച് മുകൾഭാഗം നിരപ്പാക്കുക. മറ്റൊരു ബൗളിൽ പഞ്ചസാരയും കോൺ ഫ്ളോറും യോജിപ്പിച്ച് പുഡ്ഡിങ്ങിനു മുകളിൽ തൂവുക. തേങ്ങാപാൽ, നാരങ്ങ നീരു ചേർത്ത് ചെറു തീയിൽ തിളപ്പിച്ചതിലേക്ക് പാഷൻ ഫ്രൂട്ട് പൾപ്പ് ചേർത്ത് പുഡ്ഡിങ്ങിനു മുകളിലൊഴിക്കുക. തയ്യാറാക്കിയ പുഡ്ഡിംഗ് കൂട്ട് 50 മിനിറ്റോളം ബേക്ക് ചെയ്തെടുക്കുക. മുകളിൽ പൊടിച്ച പഞ്ചസാര തൂവി കഴിക്കാവുന്നതാണ്.

പാഷൻ ഫ്രൂട്ട് കസ്റ്റാർഡ്

പാഷൻ ഫ്രൂട്ട് കസ്റ്റാർഡ്

ചേരുവകൾ:

ആരോറൂട്ട് ബിസ്കറ്റ്	:	200 ഗ്രാം
കസ്റ്റാർഡ് പൗഡർ	:	1/3 കപ്പ്
പാൽ	:	2 കപ്പ്
പഞ്ചസാര	:	1/4 കപ്പ്
പാഷൻ ഫ്രൂട്ട്	:	ഒരെണ്ണം

തയ്യാറാക്കുന്ന വിധം:

ഒരു ട്രേ ബട്ടർ പേപ്പർ കൊണ്ട് ലൈൻ ചെയ്യുക. ഇതിൽ 12 ബിസ്കറ്റ് നിരത്തി വെക്കുക. ഒരു പാനിൽ കസ്റ്റാർഡ് പൗഡർ കാൽ കപ്പ് പാലുമായി നന്നായി ഇളക്കി യോജിപ്പിക്കുക. ബാക്കി പാൽ കൂടി ചേർക്കുക. ഇതിലേക്ക് പഞ്ചസാരയും ചേർത്ത് 5 മിനിറ്റ് തിളപ്പിക്കുക. തീയിൽ നിന്നും വാങ്ങി അൽപം തണുക്കാനായി മാറ്റി വെക്കുക. ഈ മിശ്രിതം ചെറുചൂടോടെ ബിസ്കറ്റ് നിരത്തിയതിനു മുകളിലായി ഒഴിക്കുക. ഈ കൂട്ടിനു മുകളിലും 12 ബിസ്കറ്റ് നിരത്തുക. ഒരു മണിക്കൂർ ഫ്രിഡ്ജിൽ വെച്ച് സെറ്റാവാൻ അനുവദിക്കുക. സെറ്റായതിനു ശേഷം മുകളിലായി പാഷൻ ഫ്രൂട്ട്, പഞ്ചസാര ചേർത്ത് അലങ്കരിച്ച് വിളമ്പാം.

സിട്രസ്-പാഷൻ ഫ്രൂട്ട് പുഡ്ഡിംഗ്

സിട്രസ്-പാഷൻ ഫ്രൂട്ട് പുഡ്ഡിംഗ്

ചേരുവകൾ:

വെണ്ണ	:	50 ഗ്രാം
പഞ്ചസാര	:	3/4 കപ്പ്
മുട്ട	:	2 എണ്ണം
പാഷൻ ഫ്രൂട്ട്	:	2 എണ്ണം
നാരങ്ങ നീര്	:	1/4 കപ്പ്
നാരങ്ങാതൊലി ചുരണ്ടിയത്	:	1 ടീസ്പൂൺ
പാൽ	:	1 കപ്പ്
ഗോതമ്പു പൊടി	:	1/4 കപ്പ്
പൊടിച്ച പഞ്ചസാര	:	1/4 കപ്പ് (അലങ്കരിക്കാൻ)

തയ്യാറാക്കുന്ന വിധം:

ഒരു ബൗളിൽ വെണ്ണയും പഞ്ചസാരയും നന്നായി യോജിപ്പിക്കുക. ഇതിലേക്ക് മുട്ടയുടെ മഞ്ഞ ചേർത്ത് ബീറ്റ് ചെയ്യുക. അതിനു ശേഷം നാരങ്ങാ തൊലി ചുരണ്ടിയത്, നാരങ്ങ നീര്, പാഷൻ ഫ്രൂട്ട്, പാൽ, ഗോതമ്പു മാവ് എന്നിവ ചേർത്ത് ഇളക്കി യോജിപ്പിക്കുക. ഇതിലേക്ക് മുട്ടയുടെ വെള്ള പതപ്പിച്ചു ചേർത്തതിനു ശേഷം ബേക്കിംഗ് പാനിലൊഴിച്ച് 45 മിനിറ്റ് നേരം 180 ഡിഗ്രി സെൽഷ്യസിൽ ബേക്ക് ചെയ്തെടുക്കുക. മുകളിൽ പൊടിച്ച പഞ്ചസാര തൂവി അലങ്കരിക്കുക.

പാഷൻ ഫ്രൂട്ട് ചീസ് കേക്ക്

ചേരുവകൾ:

പൊടിച്ച ബിസ്കറ്റ്	:	50 ഗ്രാം
വെണ്ണ	:	50 ഗ്രാം
പട്ട പൊടിച്ചത്	:	1/4 ടീസ്പൂൺ
ചീസ്	:	100 ഗ്രാം
പഞ്ചസാര	:	4 ടീസ്പൂൺ
പാൽ	:	2 ടീസ്പൂൺ
വാനില എസ്സെൻസ്	:	1/2 ടീസ്പൂൺ
പാഷൻ ഫ്രൂട്ട് പൾപ്പ്	:	50 ഗ്രാം
ജെലാറ്റിൻ പൗഡർ	:	1/4 ടീസ്പൂൺ

പാഷൻ ഫ്രൂട്ട് ചീസ് കേക്ക്

തയ്യാറാക്കുന്ന വിധം:

ഒരു ബൗളിൽ ബിസ്കറ്റ് പൊടിച്ചതും വെണ്ണയും പട്ട പൊടിച്ചതും നന്നായി യോജിപ്പിക്കുക. ഈ കൂട്ട് രണ്ടായി പകുത്ത് ഒരു ഭാഗം പുഡ്ഡിംഗ് ഡിഷിലേക്ക് മാറ്റി ഫ്രിഡ്ജിൽ വെച്ച് തണുപ്പിക്കുക. മറ്റൊരു ബൗളിൽ ചീസ്, പഞ്ചസാര, പാൽ, വാനില എസ്സെൻസ് എന്നിവ നന്നായി മൃദുവാകുന്നത് വരെ ബീറ്റ് ചെയ്യുക. ഇതിൽ പകുതി നേരത്തെ തണുപ്പിക്കൻ വെച്ച ബിസ്കറ്റ് മിശ്രിതത്തിനു മുകളിലായി നിരത്തുക. ഇതിനു മുകളിൽ ബാക്കിയുള്ള ബിസ്കറ്റ് മിശ്രിതവും അതിനു മുകളിൽ ബാക്കിയുള്ള ചീസ് മിശ്രിതവും ഇടവിട്ട് നിരത്തുക. പാഷൻ ഫ്രൂട്ട് പൾപ്പ് പഞ്ചസാര ചേർത്ത് ഇളക്കുക. ഇതിലേക്ക് ജെലാറ്റിൻ അൽപം ചൂടുവെള്ളത്തിൽ അലിയിച്ചു ചേർക്കുക. ഇത് നേരത്തെ തയ്യാറാക്കി വെച്ചിരിക്കുന്ന ബിസ്കറ്റ് ചീസ് കേക്കിനു മുകളിലായി ഒഴിക്കുക. ഫ്രിഡ്ജിൽ വെച്ച് സെറ്റാവാൻ അനുവദിക്കുക. തണുത്തതിനു ശേഷം കഴിക്കാം.

പാഷൻ ഫ്രൂട്ട് കൊണ്ട് തയ്യാറാക്കാവുന്ന ഏതാനും ചില വിഭവങ്ങൾ മാത്രമാണ് മേൽ പ്രതിപാദിച്ചിരിക്കുന്നത്. സ്വയം തൊഴിൽ എന്ന ആശയത്തിനുള്ള ഒരു മുതൽക്കൂട്ടായിരിക്കും മേൽ പറഞ്ഞ വിഭവങ്ങൾ. വീട്ടമ്മമാർക്ക് ഒഴിവു സമയങ്ങളിൽ വീട്ടിലിരുന്നു തന്നെ ഈ വിഭവങ്ങൾ തയ്യാറാക്കാവുന്നതാണ്. ഇവയുടെ ചേരുവകളിൽ ചെറുതോ വലുതോ ആയ അനുയോജ്യ മാറ്റങ്ങൾ വരുത്തി അനേകം വിഭവങ്ങൾ തയ്യാറാക്കാൻ സാധിക്കുന്നതാണ്. പാഷൻ ഫ്രൂട്ട് പോലെയുള്ള നൂതനവിളകൾ ആദായത്തിനും ആരോഗ്യത്തിനും അഭികാമ്യമാണ്. മാത്രമല്ല, ഗ്രാമപ്രദേശത്തുള്ള തൊഴിൽ രഹിതർക്ക് തൊഴിൽദായകവും, വ്യവസായ വളർച്ചയ്ക്ക് സഹായകവുമാണ്. കൂടുതൽ വിവരങ്ങൾക്ക് സ്ഥാപനത്തിന്റെ വെബ്സൈറ്റ് സന്ദർശിക്കുകയോ സ്ഥാപനവുമായി ബന്ധപ്പെടുകയോ ചെയ്യുക.

8.7 Tissue Culture Production of Planting Materials

Project Proposal under RKVY 2013-14

Sector: Seed & Planting Material
Sub-sector: Tissue Culture

Tissue Culture Production of Planting Materials

Submitted by

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Associate Professor & Head

To

The Director
Agriculture (PPM Cell) Department
Secretariat, Thiruvananthapuram

Through

The Director of Research
Kerala Agricultural University

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09.05.2013

Project Proposal under RKVY 2013-14

Sector: Seed & Planting Material
Sub-sector: Tissue Culture

1. Executive Summary

Plant tissue culture is the science of growing plant cells, tissues or organs isolated from the mother plant, on a chemically defined media. It is an inevitable technique in advanced researches especially in plant molecular biology and bioprocess technology. Also tissue culture provides ways to avoid viral infection in plants. The main objective of plant propagation via tissue culture is to propagate plants true-to-type or as clones. The main type of cultures which are to be established are meristem cultures, shoot tip cultures, node cultures, embryo cultures, callus cultures and suspension cultures. The pineapple and banana plants are propagated by means of shoot tips, meristems and callus cultures. Whereas passion fruit is propagated by node cultures, meristem cultures, callus cultures and embryo cultures.

The cultures are started with very small pieces of plants (explants), and thereafter small shoots or buds propagated. Only a small amount of space is required to maintain plants or to greatly increase their number. There are methods available to free plants from infecting viruses. This involves selection of virus free explants and also cultures are always screened for infecting viruses by virus indexing method. By making use of these techniques plants certified as virus – tested can be produced. Plant multiplication in number are independent of any seasonal changes giving a year round supply of planting material.

Tissue culture protocols for the micropropagation of pineapple, banana and passion fruit are to be standardized and optimised. Production of tissue culture pineapple and banana need to be augmented. Micro propagation of pineapple such as MD-2, Kew and banana such as Nendran, Red Banana & Poovan are the one to be expanded in a larger scale. Passion fruit tissue culture is a subject matter under study.

2. Title : Tissue Culture Production of Planting Materials

3. Project Background & Justification

Pineapple is an important tropical fruit showing an increasing demand worldwide, over the years. Pineapple fruits are produced round the year in Kerala. It is grown in 10200 hectares producing 85500 tonnes annually with a productivity of 8.4 t/ha as compared to the all India average of 16 t/ha. Kerala contributes 6% only to national production though it occupies 11.5% in area. At present pineapple cultivation in Kerala is generating employment of about 45 lakh mandays among farmers, agricultural workers, people involved in loading, unloading, transporting, traders, retailers etc. By doubling the area under pineapple cultivation, an additional 45 lakh work days per year can be created. The annual value of pineapple produced in Kerala comes to about 350 crores which may be next to cardamom and coffee. Pineapple in processed form like concentrates and RTS has tremendous scope of market both at national and international level because of its unique and excellent flavour and aroma. Pineapple having numerous medicinal properties has great scope for domestic and export market. Pineapple 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 and marketing of export quality pineapple would play a big role in poverty alleviation through income generation, employment creation and health improvement.
The pineapple varieties suitable for canning industry such as MD-2 and Kew can be mass propagated through tissue culture techniques. Also one of the hurdles facing pineapple sector is the attack of Pineapple Mealy bug Wilt Associated (PMWA) virus. Based on continuous surveillance and laboratory studies the Pineapple Research Station has identified the virus in Vazhakulam area. Virus indexing is a technique which will detect the virus present in the planting material and those tissue culture plants which are virus free are made available for farmers. This will make the farmer rely on virus indexed tissue culture pineapple plants. The above strategies would certainly boost the pineapple cultivation in the state.

Passion fruit is a woody, perennial vine that bears a delicious fruit and occurs in purple- and yellow-fruited forms. A moderate harvest of passion fruit is prevailing in the Nilgiris,Vyanad, kudaku in the South and in various parts of northern India. It is either eaten fresh or used in commercial juice production. The plants live from 3 to 8 years and do not resprout. Passion fruit is high in potassium, vitamin A, vitamin C, niacin and fibre and it is low in sodium, cholesterol and saturated fats. It is mainly used in jams, jellies, and fruit juices. Passion fruit is proved to have analgesic, anti-anxiety, anti-inflammatory, antispasmodic, cough suppressant, aphrodisiac, cough suppressant, central nervous system depressant, diuretic, hypotensive and sedative activities. The propagation of the plant is by means of seeds, cuttings, grafting, layering and tissue culture. True to type is guaranteed only through cuttings and tissue culture techniques. Of which mass propagation within a short period of time is possible via tissue culture. A fruit so much of qualities is an asset and also require much more attention in its utilization of potentials. Passion fruit processing industries need to be developed for more employment opportunities.

Banana is the mostly widely cultivated crop across Kerala. Good quality propagules are always a need for the farmers. Tissue culture provides the techniques to improve the quality and supply of elite varieties of the banana plant. Tissue culture copies the characters of the mother plant and thus provide the farmers with plants of most fruitful varieties.

Also vegetatively-reproduced material can often be stored for longer periods. They consume only less area of space when compared to so much of non tissue cultured plants. Through the method of tissue culture a new characteristic feature will appear in them making it more desirable when compared to the conventionally- raised plants.

Mass production of planting material is possible through tissue culture. This requires standardisation of the protocols and augmentation of tissue culture production facilities at the centre, like renovation of lab, procurement of various TC Lab Equipments, Laminar Air Flow cabinets, TC racks, UPS, etc.

4. Details of similar projects/schemes implemented and the impact created

A small facility for production of tissue culture plants and other planting materials of pineapple and other fruit plants was established at the station with a financial assistance of Rs. 8 lakh during the year 2006. With the available facilities the station has already produced and distributed more than two lakh planting materials so far. The limited production facility could create great interest among the local people and the nearby institutions in fruit cultivation and is

unable to meet the demand from farmers, Agricultural department and other agencies. Further boosting of production facility is very essential to meet at least the local demand.

5.Background of implementing agency and the mode of implementation and the manpower

Address	Pineapple Research Station (Kerala Agricultural University) Vazhakulam, Muvattupuzha Ernakulam District, Kerala, India, PIN-686 670 Tel. & Fax: 0485-2260832, Cell: +919446010905 E-mail: prsvkm@kau.in, prsvkm@gmail.com Web: www.kau.edu/prsvkm, http://prsvkm.tripod.com
Establishment	The station was established in 1995 and was integrated into the Kerala Agricultural University in 1997
Location	The centre is located close to the pineapple market at Vazhakulam, 10 km east of Muvattupuzha on the Muvattupuzha - Thodupuzha road in Ernakulam District, Kerala. It is about 35 km from Cochin International Air port, Nedumbassery; 40 km from Aluva railway station and 60 km from the Cochin harbour.
Activities- Research	• Undertakes basic and applied research in pineapple, Passion fruit, Banana and other fruit crops of Kerala. • Participatory technology development (PTD) mode of research • Funded by various agencies as KAU, State and central governments, ICAR, SHM, NHM,KSCSTE etc.
Development	• Large scale production and distribution of planting materials such as Tissue Culture Plants, Seedlings, Rooted cuttings, of Pineapple, Passion fruit and Banana • Quality evaluation service for fruits • Publications
Extension	• Training of farmers and extension personnel on various aspects of cultivation, processing and marketing of fruit plants • Agriclinic & advisory, Consultancy, Quality testing, Project work of U.G & P.G. students of other Universities

6. Objectives

Mass production of tissue culture plants of different varieties of pineapple, passion fruit and banana for distribution of quality planting materials in the state of Kerala.

7. Technical Programme

The participatory technology development (PTD) research programme encompasses a number of modules like Standardisation of tissue culture protocols, virus indexing, mass production of tissue culture plants and large scale distribution of planting materials with farmers' participatory approach involving various growers and industrial groups in Kerala.

The type of tissue cultures which are to be followed include organized cultures like meristem cultures, shoot tip cultures, node cultures and embryo cultures and unorganized cultures like callus cultures and suspension cultures

Crops and varieties

Tissue culture protocols will be optimized for the following Crops and varieties.
Pineapple: Mauritius, Kew, MD-2
Passion fruit: Yellow, Purple, Giant
Banana: Nendran, Red banana, Robusta, Poovan and Njali poovan

Standardisation of tissue culture protocols

Superior types of various varieties of pineapple, passion fruit and banana will be identified and selected with the help of various growers and industrial groups in Kerala in participatory technology development (PTD) mode. Tissue culture protocols will be optimized for each of the varieties including testing and standardizing various media and incubation conditions of inoculation, multiplication, shoot and root development. Various methods of hardening will also be tested and evaluated for optimum results.

Standardized protocol is available only for one or two varieties of a single crop. For others standardization is required. For a particular lab condition specific protocol should be standardized. Even though a protocol is standardized fine-tuning is every time necessary for better results. New methods are experimented for boosting efficiency and economic feasibility.

In case of passion fruit, tissue culture is the only means of mass propagation by vegetative means.
The propagation through stem cuttings will not be enough in number. Also propagation via seeds result in increased variability. Seed germinated plants are seasonal and inadequate. Passion fruit tissue culture whole protocol is to be standardized for fulfilling its high demand of vegetative propagated planting materials.

***Virus indexing*-Enzyme Linked Immunosorbent Assay- Direct Antigen Coating ELISA**

Virus diseases are very serious problems in pineapple, passion fruit and banana curtailing productivity. The common viruses attacking these crops are Pineapple Mealy bug Wilt Associated Virus (PMWA), Passion fruit woodiness virus (PWV), Cucumber woody virus (CWV) and Banana Bunchy Top Virus (BBTV). Virus indexing of the most prominent viruses can be done.

The procedure involves sample extraction, primary antibody coating, labelled secondary antibody coating and further photometric assessment of the result via software.
The positive samples were identified and eliminated from mass multiplication.
The process is carried out in two specific stages : one is at selection of superior mother plant and second one at first subculture stage.

It is mainly done to control the spread of virus through planting material. Virus indexing is done for most prominent viruses in each crop.

Mass production of tissue culture plants

Mass production of various varieties of pineapple, passion fruit and banana will be regularly undertaken depending upon the demand from growers and industry. There are several stages in mass production as following:

- shoot buds or primordial buds are encouraged to grow and proliferate
- the formation of somatic embryos which resemble the seed embryos of intact plants, are developed to form plant. This process is called somatic embryogenesis.
- large numbers of cultures are obtained as a population where all the individuals have the same genetic constitution as the parent.

Large scale distribution of planting materials

The various varieties of pineapple, passion fruit and banana produced in large scale through tissue culture will be distributed to growers and other needy groups for promoting large scale cultivation in Kerala.

8. Cost- benefit analysis and techno economic feasibility with the help of available income

Pineapple production is constrained by lack of best varieties, technical know how on crop cultivation, pests and diseases and relatively higher capital investments. As in many of the Horticultural crops, pineapple marketing for processed or semi-processed products is also very weak. Despite the fact that pineapple 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. Besides, the crop is also susceptible to various diseases and pests. Like for many of the Horticultural crops, post harvest management aspect of pineapple and 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. Technical knowhow of the fruit products of pineapple and passion fruit is available with Kerala Agricultural University and pineapple products are already marketed from other centres at reasonable price to the consumers. PRS is the only station from where passion fruit based products can be marketed at present.

Availability of planting material in time and in adequate quantities is to be ensured for boosting pineapple production. Mass production of planting material is possible through tissue culture. Timely production and supply of adequate quantity of planting materials will go a long way in boosting the production of pineapple, banana and passion fruit in the state.

9. Anticipated socio economic benefits with facts and figures

It is expected to produce 50 thousand to 80 thousand tissue culture plants at the end of the project. As a result of mass production of good quality tissue culture plants and large scale distribution of planting materials to the growers, industry and other needy groups the cultivation of pineapple, passion fruit and banana will be boosted. Developing various marketing channels and organized marketing will pave the way to commercial cultivation of these crops in Kerala. Growing and marketing of export quality pineapple, passion fruit and banana would play a big role in poverty alleviation through income generation, employment creation and health improvement, helping food security. The vast amount of information generated in this project will be of immense utility for all concerned for further research and development of these crops.

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 of pineapple and passion fruit. 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. These would certainly boost the pineapple and passion fruit production and industrial utilization in the state, besides generating employment and empowering rural youth, especially women.

10. Time frame and phasing

Year	Activity
1-6 months	Renovation of existing Plant Tissue Culture Lab with new racks, air conditioners, Securing of doors and windows with glass frame for contamination free lab, Purchase of equipments, Standardisation of tissue culture protocols for Passion fruit, Virus indexing, Mass Production of Pineapple and banana, Preparation of half yearly report
7- 12 months	Purchase of equipments , Standardisation of tissue culture protocols, Virus indexing, Mass production of tissue culture plants, Large Scale Distribution of Planting Materials, Preparation of half yearly report

11.Financial outlay and source of funding

a. Equipment and other nonrecurring items required for the tissue culture laboratory

No.	Equipment	Cost (Rs. lakhs)	Justification
1.	Automated media preparation equipment	4.00	For mass preparation of media
2.	Millipore	2.50	For pure water for media
3.	Refrigerated microfuge	2.50	For centrifugation
4.	Shaker-Incubator	1.80	For shaking and incubating together
5.	Autoclave	1.50	For sterilization
6.	UPS , battery	1.50	For power backup
7.	Air conditioner	0.60	For providing controlled conditions
8.	Adjustable digital micropipette	0.90	For measuring out ultra low volume liquids/solutions
9.	Tissue culture racks	0.70	For tissue culture
10.	Laminar Flow Cabinet	0.70	For tissue culture
11.	Camera	0.70	For documenting plant characteristics
12.	Computer & accessories	0.50	For documentation, reporting and database development
13.	Vertical gel electrophoresis	0.20	For electrophoresis
14.	Minor equipment	0.50	For tissue culture
15.	Total	17.60	

b. Recurring Contingent Expenditure

Following items of expenditure shall be met from the provision proposed under this head.

Sl.No.	Item	Cost/year (Rs.lakh)
1.	Project Fellows, (MSc. Biotech (2nos) & MSc. Microbiology (1 no) @ 15,000/ month	5.40
2.	Cost of labour	4.32
3.	Consumables	1.88
4.	Stationery items	0.10
5.	POL charges	0.30
6.	Travelling allowance	0.20
7.	Other unforeseen items of minor expenditure	0.20
	Total	12.40

c. Financial outlay (Rs. Lakh)

No	Description	1-6 months	7- 12 months	Total
1	Non Recurring/ Equipment	13.20	4.4	17.60
2	Recurring	6.2	6.2	12.40
	Total	19.4	10.6	30.00

(Rupees Thirty lakh only)

12. Implementation and monitoring

The project will be implemented at the Pineapple Research Station, Vazhakulam and monitored by the Directorate of Research, Kerala Agricultural University and the funding Agency.

Vazhakulam

09th May 2013

Dr. P. P. Joy
Associate Professor & Head & PI
Pineapple Research Station

8.8 Research on Pineapple

Project Proposal under KAU 2013-14

Research on Pineapple

Submitted by

Dr. P. P. Joy
Associate Professor & Head

To

The Director of Research
Kerala Agricultural University

KERALA AGRICULTURAL UNIVERSITY
PINEAPPLE RESEARCH STATION
Vazhakulam, Muvattupuzha, Ernakulam District, Kerala, PIN-686 670
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20.05.2013

KAU Project Proposal 2013-14

1. Project Title : **Research on Pineapple**

2. Implementing agency :

Pineapple Research Station (PRS)
Kerala Agricultural University
Vazhakulam, Muvattupuzha
Ernakulam District, Kerala, India, PIN-686670
Tel. & Fax: 0485-2260832, E-mail: prsvkm@kau.in

3. Principal Investigator :

Dr. P.P. Joy
Associate Professor (Agronomy) & Head
Pineapple Research Station(PRS)
Vazhakulam, Muvattupuzha
Ernakulam Dist, Kerala, India, PIN-686670

4. Estimated Budget : **Rs. 4.0 lakh (Rupees Four Lakh only)**

5. OBJECTIVES

- To study the Intraclonal variability in pineapple var. Mauritius.
- To select a high yielding superior quality pineapple variety for central zone of Kerala
- To develop a dual purpose variety which can replace both Kew and Mauritius variety with farmers' participatory approach involving Pineapple Farmers Association in Kerala
- Mass production of tissue culture plants of different varieties of pineapple for large scale distribution of their planting materials in different parts of the country
- Management of pest and diseases of pineapple in Kerala

3. TECHNICAL PROGRAMME

In breeding programme about 2000 pineapple hybrids, 500 pineapple seedling mutants and 2000 *in vitro* mutants are under evaluation in main field for developing a dual purpose pineapple variety. The pineapple hybrids produced in hybridization programme are being evaluated. Irradiated suckers of pineapple variety Mauritius were evaluated for better fruit quality and the evaluation of better types is continued. The participatory technology development (PTD) research programme encompasses a number of modules like survey ,collection, screening, evaluation with farmers' participatory approach involving pineapple farmers' Association in Kerala. Field experiments will be undertaken to achieve the various objectives for the projects.

The field experiments consist of three replications and the promising types as treatments in randomized plot design.

Survey, collection and conservation of elite pineapple types

The different elite pineapple types available with the Pineapple Farmers' Association, farmers and institutions in the state will be collected , established and conserved in the research centre.

Characterization of the Elite Pineapple Types

The different elite pineapple types available with the pineapple farmers' Association, farmers and institutions in the state will be established , multiplied and used for characterization of plant types. The types will be characterized morphologically and biochemically.

Identification of suitable pineapple types for cultivation

The collection of elite pineapple types available at the pineapple research station and those collected from the pineapple farmers association, farmers and institutions in the state and established at the centre will be evaluated for the growth , yield and quality characteristics and a suitable yields index will be developed. The different types will be ranked according to the yield index. The top three promising ones will be evaluated in detail for their quality and acceptance by pineapple farmers and institutions.

Propagation methods

The plant is mostly propagated vegetatively by the suckers and slips.

Development of Agronomic practices

Field experiment will be carried out for determining the agronomic requirements of the crop such as the time of planting, spacing, depth of planting, response to organic manures, chemical fertilizers, bio fertilizers and integrated nutrients supply. The optimum stage of harvest, post harvest handling requirements and storage will be studied. The best type selected from previous experiments will be used for the study. The optimum agronomic requirements of the plant will be developed based on these field experiments

Pest and disease control

The important pests and diseases of the plant in the different agro ecological situations where the plant is found growing in abundance will be recorded and suitable plant protection package will be developed for the crop.

Quality evaluation aspects

The pineapple types most suitable for cultivation in the agro ecological situation will be tested for the quality and acceptance to the pineapple farmers. The effect of various agronomic practices on the quality of the plant will also be studied. A suitable package of practices on the quality of the plant will also studied. A suitable package of practices for the quality production of pineapple will be developed.

Standardisation of tissue culture protocols

Tissue culture protocols will be standardised for the following crops and varieties:
Pineapple: Kew, MD-2
Passion fruit: Yellow, Purple, Giant
Banana: Nendran, Red banana, Robesta, Poovan and Njali poovan

Efficient tissue culture protocols will be developed for each of the varieties testing and standardizing various media and incubation conditions of inoculation, multiplication, shoot and root development. Various methods of hardening will also be tested and evaluated for optimum results.

Virus indexing

Virus diseases are very serious problems in pineapple, passion fruit and banana curtailing productivity. Healthy virus free plants can be selected through virus indexing technique. Virus indexing protocols will be developed for various varieties of pineapple, passion fruit and banana to mass produce virus free planting materials.

Mass production of tissue culture plants

Once the virus indexing and tissue culture protocols are developed optimising media, incubation and hardening mass production of various varieties of pineapple, passion fruit and banana will be undertaken depending upon the demand from growers and industry.

Large scale distribution of planting materials

The various varieties of pineapple, passion fruit and banana produced in large scale through tissue culture will be distributed to growers and other needy groups for promoting large scale cultivation in Kerala.

4. Expected Outcome

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 of pineapple and passion fruit. 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 pineapple and passion fruit production and industrial utilization in the state, besides generating employment and empowering rural youth, especially women. Developing various marketing channels and organized marketing will pave the way to commercial cultivation of these crops 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 pineapple would play a big role in poverty alleviation through income generation, employment creation and health improvement, helping food security. It is expected to produce 30-50 thousand tissue culture plants annually and over two lakh tissue culture plants by the end of the project. As a result of mass production of good quality tissue culture plants and large scale distribution of planting materials to the growers, industry and other needy groups the cultivation of pineapple, passion fruit and banana will be boosted. The vast amount of information generated in this project will be of immense utility for all concerned for further research and development of these crops. 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.

5. Annual activity of the project

Year	Activity
1-6 months	Purchase of equipments, Survey and collection and conservation of elite pineapple types, Quality evaluation of pineapple types, Standardisation of tissue culture protocols for pineapple, Virus indexing, Mass Production of tissue culture plants
7- 12 months	Purchase of equipments , Survey and collection and conservation of elite pineapple types, Standardisation of tissue culture protocols, Quality evaluation of pineapple, Virus indexing, Mass production of tissue culture plants, Large scale distribution of planting materials

6. Equipment required for the study

Sl. No.	Equipment	Cost (Rs. lakhs)	Justification
1		0.80	
2	Camera	0.60	For documentation of experiments
3	Computer and accessories	0.60	For documentation, reporting and database development
	Total	**2.00**	

7. Recurring Contingent Expenditure

Following items of Recurring Contingent expenditure shall be met from the provision proposed under this head annually.

Sl.No.	Item	Cost/year (Rs. lakh)
1.	Minor equipment	0.30
2.	Cost of labour	1.30
3.	Consumables	0.30
4.	Repair and maintenance of analytical equipment	0.05
5.	Other unforeseen items of minor expenditure	0.05
	Total	**2.00**

8. Financial requirement (Rs. Lakh)

No	Description	1-6 months	7- 12 months	Total
1	Non Recurring/ Equipment	2.0	0.0	2.0
2	Recurring	1.0	1.0	2.0
	Total	**3.0**	**1.0**	**4.0**

(Rupees Four Lakh only)

Vazhakulam,
20th May 2013

Dr. Joy P.P.
Head & Principal Investigator
Pineapple Research Station, Vazhakulam

8.9 Introduction and evaluation of high yielding superior quality pineapple varieties for Kerala

KERALA AGRICULTURAL UNIVERSITY
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Research Project Proposal under Pineapple Mission

1. Title of the project : **Introduction and evaluation of high yielding superior quality pineapple varieties for Kerala**

2. OBJECTIVE

To introduce pineapple varieties from different states of the country and outside and evaluate them to select a high yielding superior quality pineapple variety for commercial cultivation in Kerala

3. TECHNICAL PROGRAMME

The research programme encompasses a number of modules like survey, collection, screening, evaluation with farmers' participatory approach involving Pineapple Mission and Pineapple Farmers' Association in Kerala. Field experiments will be undertaken to achieve the various objectives for the projects.

Survey and Collection and conservation of elite pineapple types

The different elite pineapple types available from different states of the country and outside will be collected, established and conserved in the research centre.

Characterization of the elite pineapple types

The different elite pineapple types available from different states of the country and outside will be established, multiplied, and used for characterization of plant types. The types will be characterized morphologically and biochemically.

Identification of suitable pineapple types for cultivation

The collection of elite pineapple types available at the Pineapple Research Station and those collected from different states of the country and outside and established at the centre will be evaluated for their growth, yield and quality characteristics and a suitable yield index will be developed involving Pineapple Farmers' Association. The different types will be ranked according to the yield index. The top three promising ones will be evaluated in detail for their quality and acceptance by Pineapple Farmers' Association, farmers and institutions.

Field Experiment Details

Design: RBD

Replications: 3

Treatments: 12-15 Pineapple varieties/Types (Mauritius, Kew, MD2, Amrita and those introduced from different states of the country and outside)

Major items of observations

a) Phenological parameters: Time for sprouting of suckers and slips, flowering, fruiting, fruit maturity
b) Growth parameters: Plant height, leaves/plant, suckers and slips/plant, etc.
c) Yield parameters: Weight of fruit, crown, peel, core, pulp, juice
d) Quality parameters: TSS, pH, reducing, non-reducing and total sugar, ascorbic acid
e) Economics of production

4. Expected Outcome

Pineapple fruits are made use of in three segments primarily.
They are (i) Fresh Pineapple for internal market and export (ii) Canned pineapple (iii) Pineapple juice concentrate.
Based on these requirements, three specific varieties of pineapple are needed for each segment.

i. Fresh Pineapple for internal market and export
ii. Pineapple required for canning industry
iii. Pineapple for juice extraction & concentrates.

Desirable fruit characteristics for the above mentioned varieties are the following.

Fresh Pineapple for internal market and export	***Pineapple for canning industry***	***Pineapple for juice extraction & concentrates***
Pleasant flavour	Broad, flat eyes	Homogenous ripening fruit
High sugar content Fibre rich	Flesh- slightly translucent when ripe	High sugar content (18 - 20^0 brix)
Moderate acidity	Small core	Juicy fruit
Firm epidermis	Cylindrical in shape	Less fibre content
Short peduncle	Fruit weight: 1.5 kg	Fruit weight: 1.5 Kg – 1.8 kg
Excellent post harvest shelf life, should retain green skin for a long period even after harvest.		
Should withstand cold storage temperature 8 - 12^0 without internal browning		
Fruit weight: 0.9 – 1.2 kg		

This research project will bring out the most suitable pineapple varieties for each of the user segments, namely, for internal market and export, canning industry and juice extraction and concentrates. Moreover, the segment-wise utility of each variety can be ascertained in the project. Tentative information will be available at the end of this year which can be confirmed in subsequent years because the economic life span is three years for pineapple.

5. Yearly activity of the project

Year	Acivity
1	Purchase of equipment, introduction and conservation of elite pineapple types
2	Conservation of elite pineapple types Identification of suitable pineapple types for cultivation
3	Conservation of elite pineapple types Identification of suitable pineapple types for cultivation, Preparation of annual report

6. Equipment required for the study

Sl. No.	Equipment	Cost (Rs. lakhs)	Justification
1	Automated titration system	5.00	For quality analyses of fruits
2	Deionizer	2.00	For deionized water for lab analyses
3	Muffle furnace	1.00	For estimation of fibre, minerals, etc
4	UPS , battery	1.00	For power backup
5	Camera	0.70	For documenting plant characteristics
6	Computer, accessories	0.60	For documentation, reporting and database development
7	Minor Equipments	0.40	For quality analyses in Lab
	Total	**10.70**	

7. Recurring Contingent Expenditure

Following items of expenditure shall be met from the provision proposed under this head.

Sl.No.	Item	Cost/year (Rs.lakh)
1.	Cost of labour	2.90
2.	Cost of solvents, reagents, chemicals and analytical standards	0.30
3.	Cost of reference materials and services	0.20
4.	Cost of essential items of glassware and minor equipment	0.30
5.	Repair and maintenance of analytical equipment, etc	0.20
6.	Cost of laboratory chairs, tables, cabinets, etc	0.30
7.	Stationery items	0.10
8.	POL charges for collection of elite types and market samples	0.30
9.	Travelling allowance	0.20
10.	Other unforeseen items of minor expenditure	0.20
	Total	**5.00**

8. Financial requirement for three years (Rs. Lakh)

No	Description	**Cost (Rs. Lakh)**			
		I year	**II year**	**III year**	**Total**
1	Project Associate@16000/Month	1.920	1.920	1.920	5.760
2	Non Recurring Contingencies	10.700	--	--	10.700
3	Recurring Contingencies including TA	5.000	5.000	5.000	15.000
	Total	**17.620**	**6.920**	**6.920**	**31.460**
	Overhead/Institutional charges (20%)	3.524	1.384	1.384	6.292
	Grand Total	**21.144**	**8.304**	**8.304**	**37.752**

(Rupees thirty seven lakh seventy five thousand two hundred only)

Vazhakulam,
07 October 2013

Dr. Joy P.P.
Head & Principal Investigator
Pineapple Research Station, Vazhakulam

8.10 Introduction and evaluation of high yielding superior quality pineapple varieties for Kerala (Revised)

KERALA AGRICULTURAL UNIVERSITY
PINEAPPLE RESEARCH STATION
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Tel. & Fax: 0485-2260832, URL: http://www.kau.edu/prsvkm
E-mail: prsvkm@gmail.com, prskm@kau.in

Research Project Proposal under Pineapple Mission

1. Title of the project : **Introduction and evaluation of high yielding superior quality pineapple varieties for Kerala**

2. OBJECTIVE

To introduce pineapple varieties from different states of the country and outside by the Pineapple Mission and evaluate them to select a high yielding superior quality pineapple variety for commercial cultivation in Kerala by the Pineapple Research Station.

3. TECHNICAL PROGRAMME

The research project encompasses the first year programme of a 3 year project involving a number of modules like survey, collection, screening, evaluation with farmers' participatory approach involving Pineapple Mission and Pineapple Farmers' Association in Kerala. Field experiments will be undertaken by the Pineapple Research Station to achieve the various objectives for the projects.

Survey and Collection and conservation of elite pineapple types

The different elite pineapple types available from different states of the country and outside will be collected by the Pineapple Mission, established and conserved in the Pineapple Research Station.

Characterization of the elite pineapple types

The different elite pineapple types available from different states of the country and outside will be established, multiplied, and used for characterization of plant types. The types will be characterized morphologically and biochemically.

Identification of suitable pineapple types for cultivation

The collection of elite pineapple types available at the Pineapple Research Station and those collected from different states of the country and outside by the Pineapple Mission and established at the centre will be evaluated for their growth, yield and quality characteristics and a suitable yield index will be developed involving Pineapple Farmers' Association. The different types will be ranked according to the yield index. The top three promising ones will be evaluated in detail for their quality and acceptance by Pineapple Farmers' Association, farmers and institutions.

Field Experiment Details

Design: RBD
Replications: 3
Treatments: 12-15 Pineapple varieties/Types (Mauritius, Kew, MD2, Amritha and those introduced from different states of the country and outside by Pineapple Mission)

Major items of observations

a) Phenological parameters: Time for sprouting of suckers and slips, flowering, fruiting, fruit maturity
b) Growth parameters: Plant height, leaves/plant, suckers and slips/plant, etc
c) Yield parameters: Weight of fruit, crown, peel, core, pulp, juice (if fruits are available)
d) Quality parameters: TSS, pH, reducing, non-reducing and total sugar, ascorbic acid (if fruits are available)

4. Expected Outcome

Pineapple fruits are made use of in three segments primarily.
They are (i) Fresh Pineapple for internal market and export (ii) Canned pineapple (iii) Pineapple juice concentrate.
Based on these requirements, three specific varieties of pineapple are needed for each segment.

i. Fresh Pineapple for internal market and export
ii. Pineapple required for canning industry
iii. Pineapple for juice extraction & concentrates.

Desirable fruit characteristics for the above mentioned varieties are the following.

Fresh Pineapple for internal market and export	***Pineapple for canning industry***	***Pineapple for juice extraction & concentrates***
Pleasant flavor	Broad, flat eyes	Homogenous ripening fruit
High sugar content Fibre rich	Flesh- slightly translucent when ripe	High sugar content (18 - 20^0 brix)
Moderate acidity	Small core	Juicy fruit
Firm epidermis	Cylindrical in shape	Less fibre content
Short peduncle	Fruit weight: 1.5 kg	Fruit weight: 1.5 Kg – 1.8 kg
Excellent post harvest shelf life, should retain green skin for a long period even after harvest.		
Should withstand cold storage temperature 8 - 12^0 without internal browning		
Fruit weight: 0.9 – 1.2 kg		

This research project will initiate the programme for bringing out the most suitable pineapple varieties for each of the user segments, namely, for internal market and export, canning industry and juice extraction and concentrates. Moreover, the segment-wise utility of each variety can be ascertained subsequently. Tentative information available at the end of the first year can be confirmed in subsequent years because the economic life span is three years for pineapple.

5. Quarterly activity of the project

Quarter	Acivity
1	Purchase of equipment, introduction and conservation of elite pineapple types
2	Introduction and conservation of elite pineapple types, multiplication of elite pineapple types for field experiment.
3	Introduction and conservation of elite pineapple types, multiplication of elite pineapple types for field experiment.
4	Introduction and conservation of elite pineapple types, multiplication of elite pineapple types, layout of field experiment, Preparation of annual report

6. Equipment required for the study

Sl. No.	Equipment	Cost (Rs. lakhs)	Justification
1	Digital burette	1.00	For quality analyses of fruits
2	UPS , battery	1.00	For power backup
3	Micropipettes	0.50	For quality analyses of fruits
4	Minor Equipments	0.20	For quality analyses in Lab
	Total	**2.70**	

7. Recurring Contingent Expenditure

Following items of expenditure shall be met from the provision proposed under this head.

Sl.No.	Item	Cost/year (Rs.lakh)
1.	Cost of labour	2.84
2.	Cost of solvents, reagents, chemicals and analytical standards	0.30
3.	Cost of reference materials and services	0.20
4.	Cost of essential items of glassware and minor equipment	0.30
5.	Stationery items	0.10
6.	Travelling allowance	0.20
7.	Other unforeseen items of minor expenditure	0.20
	Total	**4.14**

8. Financial requirement (Rs. Lakh)

No	Description	Cost (Rs. Lakh)
1	Project Associate@18,000/Month	02.16
2	Non Recurring Contingencies	02.70
3	Recurring Contingencies including TA	04.14
	Total	**09.00**
	Overhead/Institutional charges (Limited to 1 lakh)	01.00
	Grand Total	**10.00**

(Rupees ten lakh only)

Vazhakulam,
03 April 2014

Dr. Joy P.P.
Head & Principal Investigator
Pineapple Research Station, Vazhakulam

8.10 Proposal for development of Pineapple Research Station, Vazhakulam

Proposal for development of Pineapple Research Station Vazhakulam

Submitted To

The Chairman
Planning, Development & Resource Mobilization committee
Kerala Agricultural University

by

Dr. P. P. Joy
Associate Professor & Head

KERALA AGRICULTURAL UNIVERSITY
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12.12.2013

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Preface

The Pineapple Research Station at Vazhakulam was established on 2nd January 1995 to give research and development support to pineapple farmers. Since then, this research centre of the Kerala Agricultural University has been steadily growing and serving as a subvention to the pineapple growers of the state and the country as well.

The centre had a humble beginning on 2.1.1995 as "Pineapple Research Station & Pest and disease Surveillance Unit" under Kerala Horticulture Development Programme (KHDP). For the construction of the office-cum-laboratory building of the station, 15 cents of land was transferred from the Revenue Department to Kerala Agricultural University on 24.6.1996. It was delinked from KHDP and became a constituent research centre of Kerala Agricultural University under central zone on 1.7.1997. The present building was occupied on 27.6.1998.

Pineapple Research Station, Vazhakulam operates under great resource constraints in terms of human resources and infrastructure. The urgent felt needs of the station need to be tackled on a war-footing to attain the mandatory objectives of the station. The station aims at providing research and development support to the pineapple growers, rendering quality technology, products and services to the pineapple sector and undertaking basic and applied research in pineapple and other fruit crops of Kerala.

The proposal depicts the status of pineapple, importance of Vazhakulam pineapple geographic indication, opportunities, challenges and development plan proposing a metamorphosis into Tropical Fruit Crops Research Station (TFCRS) in line with Our Motto: 'Quality People & Infrastructure for Quality Technology, Products & Services'.

The station has both field experiments and tissue culture production of planting materials of pineapple, passion fruit and banana. The station is managed by a single scientist and a single office assistant as university staff. The research projects of this station are undertaken in 0.6 ha of leased farm of NAPF, Nadukara. It is 5 km away and creates problems in management and truthful conduct of the experiments. The lease expires on 30.09.2017. Therefore, a permanent farm with adequate fencing and security is an urgent felt need of the station. Pineapple Research Station Vazhakulam visualizes to be Tropical Fruit Crops Research Station (TFCRS) in the near future. The advanced research centre of excellence dreams to be the ultimate authority and provider of excellent quality technology, products and services in fruit crops through concerted research and development efforts sustained by best human resources and infrastructure development. Though Vazhakulam and neighbouring areas are well-known for fruit crops like pineapple, banana, mango, jack, papaya, passion fruit, rambutan, mangosteen, etc, there is no research station in the district catering to the needs of these farmers.

Lack of own farm and adequate area is the basic hurdle for the development of the station. Free land is available in the nearby Muvattupuzha village in Avoly Panchayat under survey Nos. 71/2 (4.355 Acre), 72/3 (1.235 Acre) and 73/1A (2.265 Acre). Action is being taken for acquiring the land for the station, to have a permanent farm for raising various fruit plants, conserving germplasm and conducting field research, besides establishing adequate infrastructure for further development and diversification. If adequate area and infrastructure are available research and development efforts can be greatly strengthened. Acquisition of nearby free government land for the station as proposed and development of adequate infrastructure will go a long way in the agricultural development of the district and socioeconomic upliftment beside generating rural employment especially for the unemployed youths and ensuring livelihood and fruit security of the people.

Proposal for development of Pineapple Research Station, Vazhakulam

Introduction

Pineapple (*Ananus comosus*, Bromeliaceae) is a wonderful tropical fruit having exceptional juiciness, vibrant tropical flavour and immense health benefits. Pineapple contains considerable calcium, potassium, fibre, and vitamin C. It is low in fat and cholesterol. Vitamin C is the body's primary water soluble antioxidant, against free radicals that attack and damage normal cells. It is also a good source of vitamin B1, vitamin B6, copper and dietary fibre. Pineapple is a digestive aid and a natural Anti-Inflammatory fruit. A group of sulfur-containing proteolytic (protein digesting) enzymes (bromelain) in pineapple aid digestion. Fresh pineapples are rich in bromelain used for tendering meat. Bromelain has demonstrated significant anti-inflammatory effects, reducing swelling in inflammatory conditions such as acute sinusitis, sore throat, arthritis and gout and speeding recovery from injuries and surgery. Pineapple enzymes have been used with success to treat rheumatoid arthritis and to speed tissue repair as a result of injuries, diabetic ulcers and general surgery. Pineapple reduces blood clotting and helps remove plaque from arterial walls. Studies suggest that pineapple enzymes may improve circulation in those with narrowed arteries, such as angina sufferers. Pineapples are used to help cure bronquitis and throat infections. It is efficient in the treatment of arterioscleroses and anaemia. Pineapple is an excellent cerebral toner; it combats loss of memory, sadness and melancholy. Pineapple fruits are primarily used in three segments, namely, fresh fruit, canning and juice concentrate with characteristic requirements of size, shape, colour, aroma and flavour. More over there is great scope for the extraction of strong white fine silky fibre from pineapple leaves and its industrial utilization.

Global scenario

Pineapple exhibits increasing demand world wide, over the years. The global trade is around 50% as fresh fruit, 30% as canned product and 20% as juice concentrate. World trade on fresh pineapple has shown 100 % increase during the last one decade. Even though India is the sixth largest producer of pineapple in the world with a share of about 8% in production, its share in the world market is negligible. The main pineapple producers are Brazil, Thailand, Philippines, Costa Rica, China, India and Indonesia. The different Asian countries and the countries around the Indian ocean are importing about two lakh tonnes of pineapple in a year, mostly coming from distant countries. The leading exporters are Costa Rica, Belgium, Cote d'lvoire, Philippines, Ghana, Netherlands, USA and France. Major importers are USA, Belgium, France, Italy, Germany, Japan and UK. MD2 or Dinar pineapple developed through hybridisation by Del Monte scientists in Costa Rica is the most popular variety in the international market because of its colour, flavour, shape, life span and ripeness being superior to other varieties.

National scenario

India ranked sixth with a share of about 8 % of the world production of pineapples. The total area under pineapple cultivation in India is 89000 hectares with a production of about 1415000 t and productivity 15.9 t/ha during 2010-11. India exports pineapple mainly to Nepal, Maldives, United Arab Emirates, Saudi Arabia, Kazakhstan, Oman, Bahrain, Bangladesh, Zambia, Pakistan and Qatar. 'Kew' and 'Mauritius' are the two varieties of pineapple grown in India. It is grown in Karnataka, Meghalaya, West Bengal, Kerala, Assam, Manipur, Tripura, Arunachal Pradesh, Mizoram, and Nagaland. It is also cultivated on limited areas in the coastal belt of Tamil Nadu, Goa and Orissa. Though Assam has the largest area under pineapple West Bengal is the largest producer. Karnataka, West Bengal and Bihar are the three states reporting high productivity. Overall, Indian productivity of 15.9 t/ha poorly compares with the world average of 22.58 t/ha.

Area, Production and Productivity of Pineapple in India
(1987-1988, 1991-1992 to 2010-2011)

Year	Area ('000 HA)	% of Total Fruit Area	Production ('000 MT)	% of Total Fruit Production	Productivity (In MT/HA)
1987-88	45.7	1.6	578.0	2.1	12.6
1991-92	57.1	2.0	768.5	2.7	13.5
1992-93	59.4	1.9	859.0	2.6	14.5
1993-94	62.2	2.0	1006.7	2.7	16.2
1994-95	66.4	1.5	1055.2	2.7	15.9
1995-96	71.2	2.1	1071.1	2.6	15.0
1996-97	68.7	1.9	924.6	2.3	13.5
1997-98	69.3	1.9	937.1	2.2	13.5
1998-99	74.2	2.0	1006.4	2.3	13.6
1999-00	75.5	1.9	1025.4	2.2	13.6
2000-01	78.1	2.0	1221.1	2.8	15.5
2001-02	77.2	1.9	1182.3	2.7	15.3
2002-03	79.8	2.1	1171.7	2.6	14.7
2003-04	80.9	1.7	1234.2	2.7	15.3
2004-05	82.8	1.7	1278.9	2.6	15.4
2005-06	82.4	1.5	1262.6	2.3	15.3
2006-07	87.0	1.6	1362.0	2.3	15.7
2007-08	80.0	1.4	1245.0	1.9	15.6
2008-09	84.0	1.4	1341.0	2.0	16.0
2009-10	91.9	1.5	1386.8	1.9	15.1
2010-11	89.0	1.4	1415.0	1.9	15.9

Source : Ministry of Agriculture, Govt. of India. (p. 255)

State-wise Area of Pineapple in India
(1987-1988, 1991-1992 and 1996-1997 to 2010-2011) (In ' 000 Hectare)

States/UTs	87-88	91-92	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
West Bengal	9.6	8.9	9.1	9.2	9.6	10.3	10.4	11.5	11.8	11.7	12.9	13.4	13.4	9.5	9.6	9.6	9.9
Assam	4.9	12.1	14	14.1	13.6	13.8	14	14.1	13.9	14.2	12.8	14.6	12.4	12.7	12.9	14.2	14.0
Karnataka	-	-	-	-	-	-	-	2	2.1	2.4	2.144	10.6	3.2	2.9	3.0	2.8	3.0
Tripura	-	#	-	-	-	-	-	3.7	3.7	4.1	5	5.2	6.2	6.3	6.3	6.8	6.8
Bihar	2.1	2.6	3.3	3.3	3.7	3.9	4	4.1	4.1	4.2	4.2	4.2	4.5	4.6	4.7	4.7	4.9
Manipur	6.6	6.5	9.5	9.4	10	10	10	10.3	10.6	10.6	10.6	2.6	12	8.5	8.6	12.1	12.2
Meghalaya	7.9	8.5	9	9.3	9.3	9.4	9.2	9.2	9.4	9.5	9.5	9.5	9.6	9.6	10.8	10.8	9.7
Kerala	-	4.7	5	5	8.6	9	9.5	9.5	11.2	11.5	12.7	12.8	12.5	12.5	12.5	9.8	10.2
Nagaland	-	1	2.1	2.3	1.8	2.5	2.9	3	2	2	2	2	-	-	3.7	3.7	3.7
Arunachal Pradesh	1.1	3.4	7.2	7.2	7.3	7.3	7.3	#	7.7	7.8	7.9	7.9	8.3	9.3	9.3	10.9	10.9
Goa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	0.3	-
Orissa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.7	-
Mizoram	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	0.4	-
Tamil Nadu	-	#	-	-	-	-	-	#	1.24	0.7	0.4	0.7	0.7	0.7	0.8	0.8	-
Andaman and Nicobar Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.2	-
Others	13.5	9.4	9.5	9.5	10.3	9.3	10.9	9.8	2	2.2	2.3	2	3.7	1.9	2.4	2.2	3.5
India	**45.7**	**57.1**	**68.7**	**69.3**	**74.2**	**75.5**	**78.2**	**77.2**	**79.8**	**80.9**	**82.8**	**85.4**	**82.6**	**80.0**	**83.7**	**91.9**	**88.7**

Note : # : Included in Others. Source : National Horticulture Board. (p.54) & Lok Sabha Unstarred Question No. 6238, dated 04.05.2010. & Ministry of Agriculture, Govt. of India. (p.255)

State-wise Production of Pineapple in India
(1987-1988, 1991-1992 and 1996-1997 to 2010-2011) (In ' 000 MT)

States	87-88	91-92	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
West Bengal	177.4	210.8	236.6	246.8	283.9	280.2	279.5	322	340.7	320.6	349.8	379.2	372.1	283.2	283.9	293.8	303.7
Assam	48.9	177.6	207.8	217.3	209	207.8	216.1	220	212.6	220.7	198.6	241	191.9	195.7	225.1	223.0	220.7
Karnataka	-	-	-	-	-	-	-	81.2	86.5	118.2	129.4	88.6	190.5	177.4	186.3	177.2	186.1
Tripura	-	-	-	-	-	-	-	82.7	82.6	93.5	105.1	106.4	115.8	116.9	101.2	117.5	153.3
Bihar	31.2	39.6	84	88	92.1	97	100.5	101.3	90	104.6	122.5	108	121.1	126.8	119.5	125.0	129.4
Manipur	82.2	26	66	66	69.8	69	69.9	75.6	77.2	88.6	88.6	134.5	100.7	72.4	78.5	103.5	104.4
Meghalaya	61.1	74.2	90	80.4	80.4	82.5	81.7	81.7	83.3	91.7	91.7	83.7	85	85.3	106.8	106.8	86.0
Kerala	6.1	46.3	46.7	46.7	57.3	73.7	68.3	68.3	83.9	95	101.9	109.3	102.4	102.4	102.4	80.8	85.5
Nagaland	1.7	12.4	59.2	63.7	60	71.1	82.9	83.2	24.8	24.8	24.8	24.8	-	-	57.5	57.5	57.5
Arunachal Pradesh	5.9	12.9	29.4	29.4	30.2	32	32	#	33.9	35.6	36.3	37	37.8	37.8	-	0.0	34.4
Goa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.6	44.5	-
Odisha	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.0	9.0	-
Mizoram	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.4	2.8	-
Tamil Nadu	-	#	-	-	-	-	-	#	38.4	23.1	14.7	21.7	23.4	22.752	24.8	31.0	-
Andaman and Nicoba Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.1	-
Others	163.5	168.7	104.9	98.8	123.7	112.1	290.2	66.3	17.9	17.8	15.5	18.9	21.5	36.6	41.9	44.8	54.5
India	578	768.5	924.6	937.1	1006.4	1025.4	1221.1	1182.3	1171.7	1234.2	1278.9	1353.1	1362.1	1244.6	1340.8	1386.8	1415.4

Note: # : Included in Others. Source : National Horticulture Board. (p. 54) & (p.103), Lok Sabha Unstarred Question No. 6238, dated 04.05.2010. & Ministry of Agriculture, Govt. of India. (p.255)

Selected State-wise Productivity of Pineapple in India
(1987-1988, 1991-1992 and 1996-1997 to 2010-2011) (MT/Hectare)

States	87-88	91-92	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
West Bengal	18.5	23.7	26	26.8	29.6	27.2	26.9	28	28.8	27.4	27.2	28.3	27.8	29.7	29.7	30.5	30.6
Assam	10	14.7	14.8	15.4	15.4	15.1	15.4	15.6	15.3	15.5	15.5	16.5	15.5	15.4	17.5	15.7	15.8
Karnataka	-	-	-	-	-	-	-	40	40.4	49.3	51.8	8.4	59.9	61.7	61.7	63.3	62.0
Tripura	-	-	-	-	-	-	-	22.3	22.3	22.8	21.1	20.5	18.7	18.6	16.1	17.3	22.6
Bihar	14.9	15.2	25.5	26.7	24.9	24.9	25.1	25	22.1	24.9	29.1	25.5	27.2	27.6	25.5	26.4	26.5
Manipur	12.5	4.0	6.9	7.0	7.0	6.9	7.0	7.3	7.3	8.4	8.4	52.1	8.4	8.5	9.1	8.6	8.6
Meghalaya	7.7	8.7	10	8.6	8.6	8.8	8.9	8.8	8.9	9.7	9.7	8.8	8.9	8.9	9.9	9.9	8.9
Kerala	-	9.9	9.3	9.3	6.7	8.2	7.2	7.2	7.5	8.3	8	8.6	8.2	8.2	8.2	8.2	8.4
Nagaland	-	12.4	28.2	27.7	33.3	28.4	28.6	28.2	28.8	12.4	12.4	12.4	-	4.5	15.5	10.0	15.5
Arunachal Pradesh	5.4	3.8	4.1	4.1	4.1	4.4	4.4	#	4.4	4.6	4.6	4.7	4.6	4.1	4.1	3.2	3.2
Tamil Nadu	-	#	-	-	-	-	-	#	30.9	33	32.9	33.2	33.2	33.1	-	-	-
Others	-	-	-	-	-	-	-	-	-	8.1	6.9	9.7	5.8	19.1	17.3	20.6	15.6
India	**12.6**	**13.5**	**13.5**	**13.5**	**13.6**	**13.6**	**15.6**	**15.3**	**14.7**	**-**	**-**	**-**	**15.8**	**15.5**	**16.0**	**15.1**	**15.9**

Note : # : Included in Others. Source : National Horticulture Board. (p.54) & Ministry of Agriculture, Govt. of India. (p.255)

State scenario

In Kerala, total area under pineapple cultivation is 10200 hectares with a production of about 85500 t and productivity 8.4 t/ha during 2010-11. The congenial humid climate has favoured the cultivation of pineapple. The finest quality 'Mauritius Pineapple' comes from Kerala. The produce of Kerala is very much in demand as a fresh fruit throughout India and also in foreign countries because it is considered the best in quality, sweetness and has good flavour. Although pineapple cultivation is practised in almost all districts, the extent and trend of cultivation differs widely among Kerala's districts. The major pineapple producing district of Kerala, Ernakulam accounts for more than 60% of the area under pineapple cultivation. In Ernakulam district pineapple cultivation is more concentrated in certain areas of Vazhakkulam. Ernakulam district was ranked first having a share of over 60% of the total production.

In Kerala, pineapple is grown mainly as an intercrop in rubber and coconut, and also as pure crop in garden land and in converted paddy fields. Pineapple fruits are produced round the year. There is immense potential to increase the area under pineapple in Kerala as it can be grown as an intercrop in coconut and rubber plantations. Coconut is grown in about 8 lakh hectares and if pineapple is grown as an intercrop in coconut garden it will give an additional income, especially in root wilt affected areas it will be a solace to the farmers. Special attention can be given for intercropping pineapple in coconut in root wilt affected areas. Out of the 5 lakh hectares of rubber grown, about 15000 hectare is replanted every year. Pineapple is grown as intercrop for the first three years in rubber at the time of replanting. Pineapple cultivation in rubber will give income to farmers during the period when there is no income from rubber. However, only less than two percent of the potential area in Kerala is cultivated with pineapple.

Kerala advantage

Kerala has exclusive advantage in producing Mauritius variety, which is highly suitable for export market. The pineapple growers to a large extent are now adopting the modern cultivation practices like high-density planting, hormone application for uniformity in flowering and other management practices. The pineapple fruits are consumed as fresh fruit or made into products like jam, squash, candy etc., for value addition. The variety proposed for cultivation is Mauritius since huge internal market as well as export potential is available. Its advantages include longer shelf life, sweetness and can be consumed as fresh fruits. Sea shipment protocol for export of pineapple has been developed. Supply chain for pineapple from Kerala is identified to be the most competitive for the domestic market due to the varietal advantage as there is price difference in the range of 1-2 Rs./kg between Mauritius and Kew in favour of Mauritius. Consumer preference for Mauritius is huge due to the fact that it is most suitable for table purpose and Giant Kew and Queen are best suitable for processing. Kerala Agricultural University has released a new hybrid pineapple *Amritha*. It is a hybrid between Kew and Ripley queen. It has spiny leaves and 13-15 months duration. Fruit is cylindrical, tapering slightly from near base, weighing 1.5-2.0kg. Crown is small weighing 80-100g; ratio of fruit weight to plant weight is medium. Fruit is green when unripe and uniformly yellow when ripe; fissure and eye corking absent, spirals are left oriented. Fruit is firm with mild external aroma, skin 6 mm thick, flesh firm, non-fibrous, crisp and pale yellow in colour with rich aroma. Taste is good with high total soluble salts and low acidity.

Vazhakulam pineapple

Pineapple has been commercially grown in Vazhakulam area for more than 50 years for its excellent fruit for fresh consumption. Vazhakulam area is ideally suited for the production of pineapple for table purpose. Planting is done in almost all the months, except during the heavy monsoon days. Hence, fruits are available round the year. Vazhakulam is considered as the biggest pineapple market in India from where the fruit is being transported to all the South Indian states and most of the North Indian states. It is grown in the districts of Ernakulam, Kottayam, Pathanamthitta and the low elevation areas of Idukki district in Kerala. It is the centre of pineapple trade in Kerala and India. Vazhakulam pineapple was Registered as Geographical Indication (GI) No. 130 under Agricultural-Horticultural product at the GI Registry, Chennai on 4th September 2009. GI registration is the process of endorsing brand protection under WTO guidelines to the producers of any product known for quality and marketed in the label of a geographic area. The registered proprietors of the intellectual property attached to Vazhakulam Pineapple are Nadukkara Agro Processing Co. Ltd (NAPCL), Avoly P.O., Muvattupuzha-686677; The Kerala Agricultural University, Vellanikkara, KAU Post, Thrissur-680656 and Pineapple Farmers' Association Vazhakulam-686670, Muvattupuzha, Kerala. Vazhakulam pineapple locally known as '*Kannara'* is a Mauritius variety coming under the species *Ananas comosus*. The plant is about 85-90 cm height, leaves spiny, gives yield within 12-13 months. The average fruit weight is 1.2-1.4kg. The fruit has a pleasant

aroma, slightly conical in shape, fruit 'eyes' deeply placed, fruit flesh is crisp and golden yellow in colour, juice is sweet with 14-16° brix and its acidity is 0.50 - 0.70%. The fruit withstands post harvest handling damages and long distance transport. Vazhakulam pineapple is unique in aroma, flavour and sweetness due to its high sugar content and low acidity. The GI registration has boosted the export of pineapple from the state considerably, besides the high reputation fetching premium price in the international market.

Opportunities

The state offers great opportunities for expanding the cultivation of pineapple. Important among them are listed below.

- Some districts are traditional growers of pineapple such as Mauritius and Kew
- Well established and organized Pineapple Farmers' Association
- Research and development support from Kerala Agricultural University
- Industry support especially from NAPCL
- Markets at Vazhakulam and nearby areas and VFPCK markets in all districts available
- GI registration of Vazhakulam pineapple has boosted the export from the state considerably
- Farmers have locally available planting material
- Farmers have knowledge of pineapple cultivation
- Farmers are increasingly following commercial cultivation
- The traders in the market are generally vibrant and relatively organised
- Farmers and promoters are interested in pursuing sustainable agriculture, which reduces costs and increases farmers skills to manage food security concerns
- The opportunity for niche organic market exists
- The production within all the potential areas can be increased.

Challenges

Expanding area under cultivation and increasing productivity are very challenging. Major challenges are listed below.

- Identification of specific varieties for fresh fruit, canning and juice segments suitable for cultivation ensuring sustained economic return.
- Provision of improved technology and production inputs for each segment.
- Post harvest management & value addition
- Storage and marketing support.
- Crop specific training support to the stakeholders
- Exploration of new fields viz .high-density planting, tissue culture, organic farming, vermi-composting, etc.

- Staggering of pineapple production through chemical induction and round the year production, peak synchronizing with summer season when demand is highest.
- Labour resource mobilization especially through NREGS to promote agriculture and food security in rural areas.
- Issues of mosquito-borne infectious diseases as Leptospirosis, Malaria, Dengue, Chikun gunya, etc
- Climate and market uncertainties causing farmers' suicides.
- Risk of ecological/environmental degradation
- Problems of bio- waste management

Tasks ahead

The important tasks before us are the following

- Sustaining past achievements and moving ahead with tempo
- Resource mobilization, especially labour
- Market strengthening and support price fixation and creating storage facilities
- Extending loan facilities for cultivation on leased lands
- Strengthening existing processing units and starting new ones
- Control of emerging infections and lifestyle diseases
- Affordable and accessible and quality health care to all

Pineapple Research Station (PRS)

The Pineapple Research Station at Vazhakulam was established on 2nd January 1995 to give research and development support to pineapple farmers. Since then, this research centre of the Kerala Agricultural University has been steadily growing and serving as a subvention to the pineapple growers of the state and the country as well. The research centre strives to become the ultimate authority and provider of excellent quality technology, products and services in the pineapple sector through concerted research and development efforts sustained by best human resource and infrastructure development.

The centre had a humble beginning on 2.1.1995 as "Pineapple Research Station & Pest and disease Surveillance Unit" under Kerala Horticulture Development Programme (KHDP). For the construction of the office-cum-laboratory building of the station, 15 cents of land was transferred from the Revenue Department to Kerala Agricultural University on 24.6.1996. It was delinked from KHDP and became a constituent research centre of Kerala Agricultural University under central zone on 1.7.1997. The present building was occupied on 27.6.1998. The centre is located close to the pineapple market at Vazhakulam, 10 km east of Muvattupuzha on the Muvattupuzha - Thodupuzha road in Ernakulam District, Kerala. It is about 40 km from Cochin International Air port, Nedumbassery; 50 km from Aluva railway station and 80 km from the Cochin harbour.

The mandate of the research centre is to give research and development support to the pineapple growers, provide quality technology, products and services to the pineapple sector and undertake basic and applied research in pineapple and other fruit crops of Kerala. The station has taken up research in pineapple on various aspects like intercropping in rubber and coconut, plant spacing and density, organic and chemical fertilizer requirement etc. besides experiments on development of new varieties. Based on continuous surveillance and laboratory studies the station has identified the presence of PMWA virus in pineapple in Vazhakulam area. Based on all the findings this station has formulated the Package of Practices Recommendations for the popular variety Mauritius and included in the POP and all the technology developed are being delivered to the pineapple growers extensively. Vazhakulam pineapple has been registered in the Geographical Indication Registry to boost the export of pineapple.

The centre has established good laboratory facilities. The Plant Tissue culture, biochemistry and pathology labs are equipped with Gel documentation, ELISA Reader and washer, PCR, Colourimeter, UV- Transilluminator, Flame photometer, Centrifuge, Microscopes, Electrophoresis, Shakers, ovens, Precision Weighing balances, Deep freezer, BOD, Laminar Air Flow, still, etc. It has a leased farm of two hectares at NAPCL. The library has adequate specialised books and periodicals relevant to the sector. It has a sales counter for the public sale of Tissue Culture Plants, Seedlings, Rooted cuttings, Publications, etc. The centre undertakes basic and applied research and development activities in pineapple and other fruit crops of Kerala. The research and development projects are mainly in Participatory technology development (PTD) mode and funded by various agencies as KAU, State and central governments, ICAR, SHM, NHM, etc.

The centre has developed scientific technology for the commercial cultivation of Kew and Mauritius varieties of pineapple, including pure cropping, intercropping in rubber and coconut plantations and in reclaimed paddy lands. Technology is developed for organic production. Tissue culture protocols for various varieties of pineapple are available. GI indication of Vazhakulam Pineapple is registered. Performance evaluation of MD2 pineapple is in progress at the centre. Participatory technology process and product development in association with sister institutions, Nadukkara Agro Processing Co.Ltd. and Pineapple Farmers' Association for the stakeholders is a steady and continuing process at the centre. Technology transfer is effectively carried out through personal discussions, field visits, phones, emails, website, posts, radio, TVs, news papers, periodicals, publications, pineapple fests, seminars. trainings, etc. The centre produces and sells Tissue Culture Plants, Seedlings, Rooted cuttings and Publications and renders services such as Agriclinic & advisory, Training, Consultancy, Quality testing and Project work of P.G. students.

The centre is looking ahead enthusiastically with pioneering research and development actions in the sector owing to many reasons. The pineapple cultivation in Kerala is dependent on fresh fruit market, supplying most of its produce to outside Kerala. The Mauritius variety grown in Kerala is marketed in about 10 states in India including Delhi. It is also exported to Gulf countries in limited quantities. It is possible to increase its marketing by exploring new markets

and techniques and also by increase in quality and quantity of fruit produced. It is essential to explore the possibility for marine exports to reduce cost. Consumer preference and marketing strategies need to be taken into consideration. There is immense potential to increase the area under pineapple in Kerala as it can be grown as intercrop in coconut and rubber plantations. However, only less than two percent of the potential area in Kerala is cultivated with pineapple. At present pineapple cultivation in Kerala is generating employment of about 45 lakh mandays among farmers, agricultural workers, people involved in loading, unloading, transporting, traders, retailers etc. By doubling the area under pineapple cultivation, an additional 45 lakhs work days per year can be created. Besides pineapple, since Vazhakulam and neighbouring areas are well-known for other fruit crops like banana, mango, jack, papaya, rambutan, mangosteen, etc, Pineapple Research Station, Vazhakulam visualizes to be Tropical Fruit Crops Research Station (TFCRS) in the immediate future. The advanced research centre of excellence dreams to be the ultimate authority and provider of excellent quality technology, products and services in fruit crops through concerted research and development efforts sustained by best human resources and infrastructure development.

Activities and Outcome

Research

The following outcome of research and development activities are reported at this station.

By taking up various research projects, standardization of the management of pineapple in coconut and rubber, effect of various organic manures in pineapple, effect of various levels of NPK in pineapple etc were done.

Under an ICAR adhoc scheme, more than 3000 pineapple hybrids were evaluated in detail and several promising hybrids were identified. These hybrids are under multiplication and evaluation.

One project financed by IPL and Kali Salz (Germany), aimed to study the effect of two sources of potassium, MOP and SOP, on yield and quality of pineapple were undertaken. Another project on passionfruit aims to develop a variety suitable for low altitude areas. One project aims to catalogue the various pests and diseases of pineapple and formulate control measures. Under this project presence of virus disease in pineapple at Vazhakulam area was detected.

The salient results based on the above projects of the station are as follow

1) Formulated package of practices recommendations for the Mauritius variety of pineapple.
2) Developed a pineapple variety suitable for processing industry which is better than the present Kew variety and is in the farm trial stage.
3) Developed a pineapple variety suitable for fresh fruit market which is better than the present Mauritius variety and is in the farm trial stage.

4) Developed a passionfruit variety suitable for fresh fruit and processing and is in the farm trial stage.

Extension

This station is giving Farm Advisory Service to pineapple growers throughout Kerala and also outside Kerala ever since its inception either by visiting the plot, telephone, letter or by the visit of the farmer to the station, as per the situation warrants. This station participates regularly in seminars, radio talks, TV programmes etc. The shareholders (pineapple farmers) of Nadukkara Agro Processing Company were given training in pineapple cultivation. Pineapple farmers under the Agri Export Zone in various districts were given training on pineapple management. Trainings were also given to Agricultural Officers and farmers in association with Dept. of Agriculture. It is associating with the Pineapple Farmers Association at Vazhakulam in all its activities related to the promotion of pineapple cultivation, from 1995 onwards.

c) Income generating activities

This station did not have any land for any income generation from land. Hence the chance for any income is from the technology developed and from the laboratory services. The activities of the station are in this direction and this is a slow process. The efforts so far done had started showing results. The station has started selling the planting material of the new passionfruit variety under development. Also the marketing of the technology developed for Mauritius variety as consultancy services has also been initiated.

d) Suggestions for increasing internal revenue

i) Sale of planting material of the varieties under development
ii) Consultancy services
iii) Commercialization of Tissue culture lab

e) Suggestions for generation of internal receipt

i) Providing project work facility to P.G. students of other Universities charging fees.

Technologies available at PRS, Vazhakulam

The following technologies are available for consultancy service/transfer.

Pineapple

1. Situation specific recommendation for management of pineapple (precision farming). Technology for cultivation of pineapple as pure crop and as intercrop in coconut, rubber and cashew is available. Recommendations under different soil and climatic conditions like reclaimed low lands, nutrient management etc are available.
2. Quality analysis of fruit.
   For export of pineapple, quality analysis may be helpful.
3. Identification of disease and pest of pineapple.

Apart from pests and fungal diseases, identification of virus disease in pineapple by ELISA test is done. (Molecular diagnosis of virus disease is under trial now and it will be available shortly).

4. Protocol for tissue culture propagation of pineapple.

Passionfruit

1. Management techniques of passionfruit.
2. Quality analysis of passionfruit.
3. Small scale production of passionfruit syrup.

Banana

1. Protocol for tissue culture propagation of Nendran, poovan, njalipoovan, red banana, robesta and grandnaine varieties of banana

Internet Presence

Pineapple Research Station launched its own website as a subsite under the Kerala Agricultural University main site in June 2010. Please visit our websites http://www.kau.edu/prsvkm and http://prsvkm.tripod.com to know more about Pineapple Research Station and its R & D goals and activities. Our esteemed readers may please point out the errors and omissions, if any and mail to prsvkm@gmail.com for correction at the earliest. Critical suggestions for improvement, additional relevant information, other useful links, etc are invited. We are most obliged for any constructive comments, suggestions and criticisms mailed to prsvkm@gmail.com.

Planting material production and sale

25000	TC MD-2 sold to NAPCL, Nadukkara
2500	TC Nanas sold to Mr. Rex Paikada
70000	TC pineapple total sold (2008-)
35000	Passion fruit seedlings sold (2004-)
150	Passion fruit rooted cuttings sold (2010-)
10000	TC Banana sold (2010-)

Urgent Felt-Needs of the Station

Pineapple Research Station, Vazhakulam operates under great resource constraints in terms of human resources and infrastructure. The following are the urgent felt needs of the station to attain the mandatory objectives of the station. The station aims at providing research and development support to the pineapple growers rendering quality technology, products and services to the pineapple sector and undertaking basic and applied research in pineapple and other fruit crops of Kerala.

Permanent farm

The research projects of this station are undertaken in the leased farm of NAPCL, Nadukara. It is 5 km away which creates problems in management and truthful conduct of the experiments. Experiment results are realistic and valid only when they are conducted properly as per scientific protocols. The growth, yield and quality attributes are regularly observed, recorded, analysed and interpreted to arrive at logical conclusions. Within the resource constraints of KAU, we take great pains to layout experiments, impose treatments and record observations according to scientific protocols for ensuring the reliability of research results. All our efforts are in vain if the yield estimates are not correct.

We have observed that when the fruits of pineapple and passion fruit ripen, many of them go missing from the leased farm of NAPCL, Nadukara. As a result, we are unable to record the correct yield leading to erroneous results.

Under the circumstances, a permanent farm at walkable distance with adequate fencing and security is an urgent felt need of the station.

Staff

Farm Officer

Scientific staff (Horticulture, Plant breeding, plant pathology)

Research Associates (Biotechnology, Microbiology and Biochemistry)

The station is managed by a single scientist and a single office assistant as university staff. The various projects are executed by engaging skilled assistants and labourers on daily wage contract basis. Management of the research projects by daily wage contract people is highly difficult and many times the reliability of the data is questionable due to lack of continuity, commitment and integrity.

The station has both field experiments and tissue culture production of planting materials of pineapple, passion fruit and banana. The farm, 5km away from the station, needs the full time service of a Farm Officer for effective implementation of various field experiments. Experiment results are realistic and valid only when they are conducted properly as per scientific protocols. Quality evaluation of the experimental samples is a continuous activity at the station requiring the service of a full time biochemist. The tissue culture laboratory needs full time attention of a biotechnologist continuously. The service of a plant breeder/ horticulturist is highly essential for

the purpose. Microbial contamination is the greatest problem hindering large scale production of tissue culture plants in tissue culture lab. This can be tackled only by availing the service of a microbiologist/plant pathologist. Under the circumstances, necessary action may be taken for providing the required scientific staff in Horticulture, Plant breeding, plant pathology. Until KAU staff is provided, sanction may be granted for creating temporary posts of research associates of Farm Officer, Biochemist, Biotechnologist, and Microbiologist and necessary action may be taken for appointing them at the earliest.

Processing lab

Internal revenue generation is a matter of concern for Kerala Agricultural University. The pineapple and passion fruits of different accessions obtained from various experiments at PRS, Vazhakulam are taken for quality analyses on a regular basis. Since a mixture of types is involved and destructive sampling is essential for the purpose, the remaining part of the fruits is not marketable and hence cannot be sold in the market. Though the leftover fruits are not marketable they can be beneficially converted to value added products like squash, jam, syrup, etc if a small scale processing unit with FPO Registration is established at PRS, Vazhakulam.

If small home scale fruit processing units are started in the hot spots of pineapple production, the market fluctuation can be reduced and substantial employment generation is effected especially for the rural youth and women. Establishment of a fruit processing laboratory at PRS, Vazhakulam for the efficient conversion of leftover fruits to value added products like squash, jam, syrup, etc will also cater to function as a demonstration and training unit for the various self-help groups in the state, besides fetching additional revenue for the station.

The existing building has to be renovated with floor and wall tiles, conforming to the guidelines for FPO Registration. Doors, windows and exhausts have to be secured with wire nets to make the unit insect proof. Essential equipment, furniture, storage cans, bottles utensils, tools, raw materials, etc have to be procured for various activities such as juice extraction, pulp production, heating, sterilisation and preparation of squash, jam, syrup, etc. FPO Registration has to be obtained for marketing of the finished products. A vehicle is also required for transportation of raw materials from farm and finished products.

A project proposal to establish a fruit processing laboratory at PRS, Vazhakulam for the efficient conversion of leftover fruits to value added products like squash, jam, syrup, etc at a total cost of Rs.19.90 lakh was submitted for approval under RKVY 2011-12. The project may be approved for implementation at the earliest.

Training unit

Pineapple Research Station has no training facilities presently. The scientific technology on cultivation and utilization of the mandatory crops can be easily disseminated to the target groups through training, demonstrations, interactions, seminars etc. Lot of awareness is needed for the growers about the importance of scientific cultivation and 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 of pineapple and passion fruit. 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. Proper and timely transfer of technology and participatory technology development would certainly boost the pineapple and passion fruit production and industrial utilization in the state, besides generating employment and empowering rural youth, especially women.

A training hall with LCD projection facilities and adequate seating arrangements is an absolute necessity of the station.

Publications

The farmers visiting the station always ask for publications on the relevant technology generated at the station. The technology can be easily disseminated through various publications such as leaflets, palmlets, books, CDs, DVDs, etc covering various aspects of cultivation and utilization of the mandatory crops of the station. Adequate budgetary provision is required for undertaking various works associated with the production of these publications.

Sales counter

A sales counter facing the public road is essential for the public sale of Tissue Culture Plants, Seedlings, Rooted cuttings, Publications, etc with adequate facilities for displaying all these items appropriately and attractively. The mass produced tissue culture plants of pineapple, banana and passion fruit should be sold out/lifted from the station for further augmenting tissue culture production.

Vehicle

The experiments under the different plan and externally aided projects are undertaken in the leased farm of NAPCL, Nadukkara located 5 km away from the station. The management of the farm, labourers, inputs and farm produce is highly difficult and inefficient without a vehicle. Since PRS is not having a vehicle of its own, frequent visits to the farm is not practically possible and the monitoring of the farm is not efficient. Labour turnover is also not satisfactory. The matter has been conveyed to KAU and a vehicle has been requested for repeatedly.

The farm is managed by engaging skilled assistants and labourers on daily wage contract basis, who are all ladies due to socio-economic factors of the locality. A two wheeler (Honda Activa, Hero Honda Pleasure or TVS Scooty) which can be easily managed by ladies is absolutely essential for the daily management of the farm. A four wheeler (Mahindra Bolero) is also required for transporting various farm inputs and farm produce. It is also essential for disposing off the planting materials produced at the station. The station has very limited stocking facilities.

Office renovation

Pineapple Research Station, Vazhakulam was started in 1995 and shifted to the present building in 1998. Since then, no repair works have been undertaken on the building. Office

building is in a very dilapidated situation. The earthen tiles fixed on the top of the sunshade were detached and many of them got damaged. During rainy season, leakage has been observed at various points and walls, both inside and outside, become wet. This may lead to short circuits and other electrical problems. The painting has already been disfigured by fungal growths and other bodies. This is the main cause of contamination in the plant tissue culture lab. The building has a very ugly look at present. The office building has to be renovated and painted urgently. Necessary budget provision may be sanctioned for the repair, renovation, painting and modernization of the office building.

Fund release

Though adequate budgetary provision is made timely release of fund is not happening which hinders prompt implementation of various research and development activities of the station. The pay arrears have not been paid. Even the salary is not paid timely. At times, the mandatory payments of electricity charges, telephone charges, LIC etch which attracts fines, penalties and disconnections due to late payments could not be made in time due to lack of adequate funds released from KAU in time. Release of funds at the fag end of the financial year will lead to hasty implementation of projects without proper planning, commitment, validation and utility. Hence, it is requested to release the various funds provided in the budget in time systematically for the best utilization of the funds.

Career Advancement

Lack of timely career advancement to the deserving ones is the root cause of deterioration of morale leading to poor research and development output.

Development proposal

Presently four plan projects are operational at PRS, Vazhakulam. An externally aided project on 'Evaluation of passion fruit types for commercial cultivation in Kerala' at a total cost of Rs.12.55 lakh for 3 years is sanctioned by Kerala State Council for Science, Technology and Environment. Another project proposal to establish a fruit processing laboratory at PRS, Vazhakulam for the efficient conversion of leftover fruits to value added products like squash, jam, syrup, etc at a total cost of Rs.19.90 lakh was submitted for approval under RKVY 2011-12.

The station has both field experiments and tissue culture production of planting materials of pineapple, passion fruit and banana. The station is managed by a single scientist and a single office assistant as university staff. The research projects of this station are undertaken in 1.2 ha of leased farm of NAPCL, Nadukara. It is 5 km away and creates problems in management and truthful conduct of the experiments. The lease expires on 30.09.2012. Therefore, a permanent farm with adequate fencing and security is an urgent felt need of the station.

Lack of own farm and adequate area is the basic hurdle for the development of the station. Preliminary enquiries show that free land is available in the nearby Muvattupuzha village in Avoly Panchayat under survey Nos. 71/2 (4.355 Acre), 72/3 (1.235 Acre) and 73/1A (2.265 Acre). If action is taken for acquiring the land for the station, the station will have a permanent

farm for raising various fruit plants, conserving germplasm and conducting field research, besides establishing adequate infrastructure for further development and diversification.

If adequate area and infrastructure are available research and development efforts can be greatly strengthened in the following lines for the agricultural development of the district and socioeconomic upliftment and livelihood of the people.

- Identification of specific varieties for fresh fruit, canning and juice segments suitable for cultivation ensuring sustained economic return through research.
- Mass production of planting materials, especially through tissue culture
- Development of improved technology and production inputs for each segment.
- Development of on-farm post harvest management practices & value addition
- Extraction of fibre from pineapple leaves and its industrial utilization.
- Extraction of protein digesting enzyme bromelain for commercial use
- Strategic provision for storage and marketing support.
- Crop specific training support to all the stakeholders
- Exploration of new fields viz .high-density planting, tissue culture, organic farming, vermi-composting, etc.
- Staggering of pineapple production through chemical induction and round the year production, peak synchronizing with summer season in pace with demand.
- Diversification to the research and development of other fruit crops like banana, mango, jack, papaya, passion fruit, rambutan, mangosteen, etc
- Labour resource mobilization especially through NREGS to promote agriculture and food security in the area.
- Alleviation of climate and market uncertainties causing farmers' suicides.
- Reducing the risk of ecological/environmental degradation
- Effective tackling of bio- waste management problems

Earnest efforts are also being taken to acquire free government land nearby as a permanent farm for raising various fruit plants, conserving germplasm and conducting field research, besides establishing adequate infrastructure for further development and diversification, renaming the station as Tropical Fruit Crops Research Station (TFCRS). It is also proposed to establish a fruit processing laboratory with FPO registration at the centre for the efficient conversion of leftover fruits to value added products like squash, jam, syrup, etc.

Besides pineapple, since Vazhakulam and neighboring areas are well-known for other fruit crops like banana, mango, jack, papaya, passion fruit, rambutan, mangosteen, etc, and there is no research station in the district catering to the needs of these farmers, Pineapple Research Station, Vazhakulam visualizes to be Tropical Fruit Crops Research Station (TFCRS) in the near future. This advanced research centre of excellence dreams to be the ultimate authority and provider of excellent quality technology, products and services in tropical fruit crops through concerted research and development efforts sustained by best human resource and infrastructure development in line with Our Motto 'Quality People & Infrastructure for Quality Technology, Products & Services and Merit alone counts for Quality suitable for the purpose'.

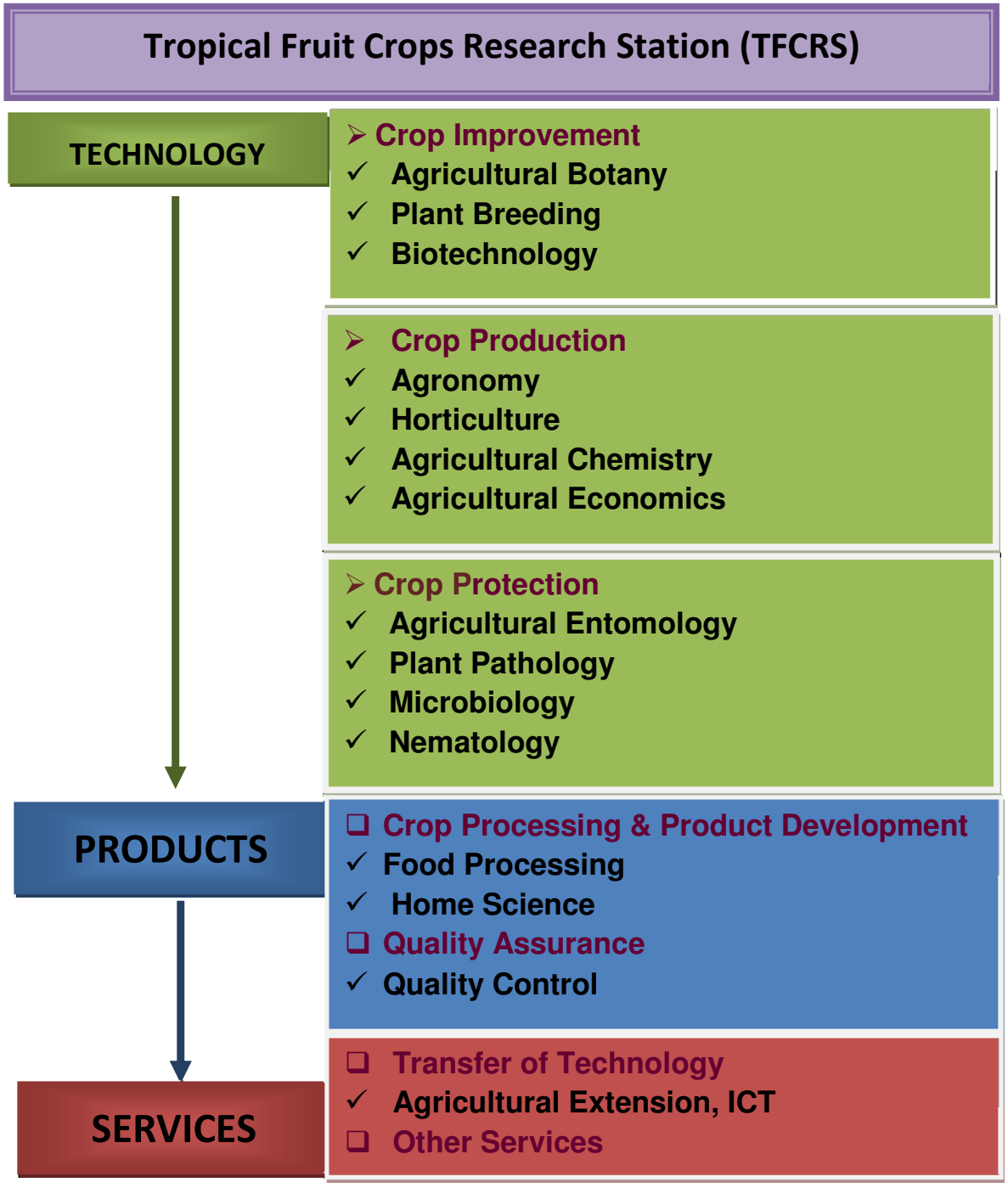

Fig. 1. Prospective Structural Hierarchy of the Tropical Fruit Crops Research Station

PRS envisages steady systematic metamorphosis into Tropical Fruit Crops Research Station (TFCRS) in phases as detailed below.

Phase I

Technology division

- Development of improved varieties of pineapple and their cultivation practices
- Standardization of protocols for micro propagation of pineapple, banana and passion fruit.
- Pest and diseases monitoring.
- Virus indexing.
- Standardization of quality parameters of pineapple.

Product division

- Production of Pineapple squash, jam, syrup
- Large scale production of tissue culture plants of pineapple and passion fruit and seedlings of passion fruit.
- Publications and video CDs on tissue culture of pineapple and passion fruit.

Services division

- Providing quality evaluation reports
- Agriclinic, advisory, training and consultancy.

Human resources development

- Agronomist
- Biotechnologist
- Plant breeder
- Farm officer

Infrastructure development

- Establishment of processing lab
- Library
- Training complex

Phase II

Technology division

- Development of improved varieties of passion fruit and their cultivation practices.
- Standardization of protocols for micro propagation of banana.
- Isolation and detection of microorganisms affecting pineapple, passion fruit and banana.
- Pest and diseases control of pineapple and passion fruit.
- Standardization of quality parameters of passion fruit.
- Biotic stress tolerant pineapple varieties.

Product division

- Augmentation of tissue culture plants of pineapple, passion fruit and banana.
- Pineapple and passion fruit squash, jam, syrup, candy, juice and blended items.
- Publications and video CDs tissue culture of banana.

Services division

- Quality testing of pineapple, passion fruit and banana.
- Project works of PG students.

Human resources development

- Horticulturist
- Microbiologist

- Agricultural chemist
- Pathologist

Infrastructure development

- Information and sales centre.
- Augmentation of microbiology and quality control lab.
- Purchase of equipment like GC, AS, Micro gel unit.
- Electron microscope
- Colony counter.
- Incubator
- Particle bombardment system.
- Vertical gel electrophoresis apparatus.

Phase III

Technology division

- Development of improved varieties of banana and their cultivation practices.
- Standardization of protocols for micro propagation for jack fruit and mango.
- Development of molecular markers for pineapple, passion fruit, banana.
- Abiotic stress tolerant passion fruit varieties

Product division

- Large scale production of tissue culture plants of pineapple, passion fruit, banana, jack fruit and mango.
- Production of banana chips, candies.

Services division

- Custom based tissue culture production of fruit crops.

Human resources development

- Climatologist
- Home scientist
- Agricultural extension scientist
- Entomologist

Infrastructure development

- Weather forecasting station.
- Permanent farm of 5 hectares.
- Virtual database information system.
- Additional tissue culture lab
- HPLC
- 10 KVA UPS system.

Phase IV

Technology division

- Development of improved varieties of other crops like sapota, rambutan etc.
- Micro propagation of other fruit crops
- Pest and disease control of sapota, mango, jack fruit, rambutan etc
- Molecular markers for sapota, mango, jack fruit, rambutan etc

Product division

- Publication and video CDs tissue culture of sapota, mango, jack fruit, rambutan and all other fruit crops.

Services division

- Providing quality evaluation reports.
- Custom based tissue culture production of fruit crops.

Human resources development

- Librarian
- System manager

Infrastructure development

Establishment of full fledged TFCRS block

Budget (Rs.) (for short term only)

Sl.No.	Item	I year	II year	III year	Total
1.	**Manpower**				
i.	Farm Officer (10480-183000)	200000	210000	215000	**625000**
ii.	Research Associates (3 Nos.) @ Rs. 18000/Month	650000	650000	650000	**1950000**
iii	Labour (3 Men & 7 Women)	800000	850000	900000	**2550000**
2.	**Repair & Maintenance**	300000	400000	400000	**1100000**
3.	**Equipment**	500000	500000	500000	**1500000**
4.	**TA**	15000	17000	20000	**52000**
5.	**Contingencies**	200000	250000	300000	**750000**
	Total	**2665000**	**2877000**	**2985000**	**8527000**

(**Rupees eighty five lakh twenty seven thousand only**)

The proposal for development of Pineapple Research Station (PRS) into Tropical Fruit Crops Research Station (TFCRS) is submitted for favour of kind perusal, further necessary action and favourable orders at the earliest.

Place: Vazhakulam
Date: 12.12.2013

Dr. P. P. Joy
Associate Professor & Head

8.12 Bill var expenditure details of Pineaple Research Station, Vazhakulam for 2013-14

321 Pineapple Research Station

321-31-0034 Non Plan

BR.No.	110	121	130	142	210	222	226	223	236	237	300	330	410	418	420	423	812	821	840	Total
01/13-14				14955																14955
02/13-14				14780																14780
03/13-14			25509																	25509
06/13-14									9420											9420
07/13-14							6000													6000
08/13-14																		816		816
09/13-14	103295																			103295
12/13-14				12250																12250
13/13-14				14350																14350
14/13-14				14810																14810
16/13-14			25509																	25509
17/13-14	103295																			103295
20/13-14									6752											6752
21/13-14					5000															5000
24/13-14																		860		860
27/13-14				13875																13875
29/13-14			25509																	25509
30/13-14	127260																			127260
35/13-14									6181											6181
40/13-14																		861		861
46/13-14				14755																14755
47/13-14				14750																14750
49/13-14			25509																	25509
50/13-14	108088																			108088
54/13-14									4212											4212
58/13-14																		833		833
61/13-14				13020																13020
62/13-14				12125																12125
65/13-14				6125																6125
67/13-14			25509																	25509
68/13-14	111328																			111328
71/13-14					5000															5000
73/13-14									6623											6623
76/13-14					165															165
77/13-14																		916		916
79/13-14				14260																14260
80/13-14				12150																12150
81/13-14				11835																11835
84/13-14			25509																	25509
85/13-14	111328																			111328
86/13-14	57459																			57459
89/13-14													12950							12950
90/13-14													10200							10200
91/13-14										500										500
92/13-14				8340																8340
93/13-14									7090											7090
95/13-14			2200																	2200
96/13-14	57864																			57864
97/13-14			10000																	10000
98/13-14																		922		922
99/13-14					5000															5000
102/13-14				13750																13750
103/13-14				10935																10935
104/13-14				10750																10750
106/13-14	55664																			55664
107/13-14														2553						2553
108/13-14			25509																	25509
109/13-14								2286												2286
112/13-14									7352											7352
114/13-14					2470															2470
115/13-14			12546																	12546
116/13-14																				0
117/13-14																				0
118/13-14																				0
119/13-14																				0
122/13-14			26903																	26903
123/13-14	111328																			111328
126/13-14																				0
127/13-14																				0
129/13-14									7514											7514
130/13-14					5000															5000
131/13-14					0															0
132/13-14																		1765		1765
133/13-14			26903																	26903
134/13-14	53869																			53869
142/13-14			26903																	26903
143/13-14	111328																			111328
150/13-14								4732												4732
151/13-14							6113													6113
153/13-14																		861		861
159/13-14				10695																10695
161/13-14			26903																	26903
162/13-14	111328																			111328
163/13-14														1494						1494
168/13-13																		914		914
170/13-14														800						800
171/13-14				13230																13230
172/13-14				12640																12640
173/13-14				12690																12690
174/13-14				14955																14955
176/13-14			26040																	26040
177/13-14	160696																			160696
178/13-14								2316												2316
189/13-14					100															100
191/13-14																		968		968
204/13-14	117499																			117499
205/13-14			41556																	41556
215/13-14						1705														1705
219/13-14													5000							5000
220/13-14																		966		966
226/13-14													5000							5000
228/13-14																	2000			2000
230/13-14								2316												2316
231/13-14						5000														5000
244/13-14											5000									5000
247/13-14													330							330
249/13-14													1500							1500
Total	1501629	0	378517	292025	22735	6705	12113	11650	55144	500	5000	0	34980	4847	0	0	2000	10682	0	2338527

BR.No.	110	121	130	142	210	222	226	223	236	237	300	330	410	418	420	423	812	821	840	Total
321-31-3370 Research on Pineapple																				
116/13-14				12420																12420
117/13-14				8750																8750
118/13-14				12570																12570
119/13-14				14500																14500
135/13-14					1170															1170
136/13-14				12825																12825
137/13-14				14895																14895
138/13-14				11750																11750
139/13-14				5750																5750
140/13-14				11375																11375
14613-14					3481															3481
147/13-14					6331															6331
148/13-14									8538											8538
149/13-14					5000															5000
152/13-14				8375																8375
156/13-14				12995																12995
157/13-14				5750																5750
158/13-14				11625																11625
166/13-14					2790															2790
167/13-14									7144											7144
179/13-14					3300															3300
184/13-14									7136											7136
185/13-14					5000															5000
187/13-14					2850															2850
190/13-14					4798															4798
207/13-14					52															52
208/13-14				4200																4200
209/13-14					5000															5000
214/13-14					5980															5980
216/13-14									7082											7082
218/13-14					4900															4900
223/13-14					4741															4741
224/13-14					3070															3070
227/13-14				5000																5000
229/13-14					1754															1754
236/13-14					2812															2812
238/13-14					2616															2616
239/13-14					5770															5770
240/13-14					7750															7750
243/13-14					5980															5980
246/13-14					14971															14971
248/13-14					7057															7057
252/13-14				14520																14520
253/13-14				8300																8300
254/13-14				13980																13980
Total	0	0	0	189580	107173	0	0	0	29900	0	0	0	0	0	0	0	0	0	0	326653
321-31-9550 Infra Structure Support																				
194/13-14				9045																9045
195/13-14				13365																13365
196/13-14				12460																12460
197/13-14				13410																13410
210/13-14															62500					62500
211/13-14					11250															11250
212/13-14															77200					77200
221/13-14																9075				9075
222/13-14																6375				6375
225/13-14																34550				34550
232/13-14															345					345
233/13-14					1994															1994
234/13-14					46279															46279
235/13-14															23452					23452
237/13-14					6686															6686
242/13-14					13791															13791
245/13-14															36503					36503
250/13-14				12525																12525
251/13-14				9180																9180
Total	0	0	0	69985	80000	0	0	0	0	0	0	0	0	0	200000	50000	0	0	0	399985

BR.No.	110	121	130	142	210	222	226	223	236	237	300	330	410	418	420	423	812	821	840	Total
321-31-9027 Evaluation of Passion Fruit Types for commercial cultivation in Kerala																				
04/13-14		5161																		5161
5/13-14		3548																		3548
15/13-14		10000																		10000
22/13-14					5000															5000
23/13-14					3944															3944
25/13-14				13920																13920
26/13-14				14745																14745
28/13-14		10000																		10000
33/13-14					4331															4331
34/13-14												1310								1310
36/13-14					5000															5000
37/13-14					0															0
38/13-14																			1600	1600
39/13-14					1545															1545
41/13-14					261															261
42/13-14					1815															1815
43/13-14					3959															3959
44/13-14				14030																14030
45/13-14				1750																1750
48/13-14		10000																		10000
51/13-14																			1488	1488
55/13-14					1200															1200
56/13-14					2655															2655
57/13-14					5000															5000
59/13-14					1795															1795
60/13-14																			1900	1900
63/13-14				8360																8360
64/13-14				14530																14530
66/13-14		10000																		10000
70/13-14					3959															3959
74/13-14					2056															2056
75/13-14					648															648
78/12-13											1690									1690
82/13-14				11250																11250
83/13-14		10000																		10000
94/13-14				2200																2200
101/13-14											2685									2685
105/13-14		10000																		10000
120/13-14				3625																3625
121/13-14		10000																		10000
124/13-14					2060															2060
125/13-14					401															401
128/13-14					1975															1975
141/13-14		10000																		10000
155/13-14											1910									1910
160/13-14		10000																		10000
169/13-14					2267															2267
175/13-14		10000																		10000
182/13-14		600																		600
183/13-14				5575																5575
186/13-14												3000								3000
188/13-14					0															0
190(1)/13-14				15	175														12	202
193/13-14												0								0
198/13-14		10000																		10000
199/13-14											16925									16925
200/13-14											1700									1700
201/13-14											90									90
202/13-14												690								690
203/13-14		645																		645
Total	0	119954	0	90000	50046	0	0	0	0	0	25000	5000	0	0	0	0	0	0	5000	295000
Stn Total	1501629	119954	378517	641590	259954	6705	12113	11650	85044	500	30000	5000	34980	4847	200000	50000	2000	10682	5000	3360165