The research 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 reclaimed 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 100000 Tissue Culture pineapple plants and 30000 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 subsite under the Kerala Agricultural University main site in June 2010. The website of the station is regularly updated with more relevant and useful information for the public facilitating free download of the publications of the centre.

Following are the specific achievements of the station over the years obtained through continuous concerted efforts and surveillance:

- Scientific technology for commercial cultivation of Kew and Mauritius (Vazhakulam Pineapple)
- Pure cropping and Intercropping in rubber and coconut and in reclaimed paddy fields and organic practices were recommended to the growers
- Vazhakulam pineapple has been registered in the Geographical Indication Registry to boost the export of pineapple
- Produced and sold pineapple (Mauritius, Kew, MD-2, *A. nanas*) and passion fruit (134P, Purple, Yellow, Kaveri, Giant granadilla) planting materials to farmers
- Sold out more than one lakh MD-2 pineapple tissue culture plants, 30,000 passion fruit planting materials and 20,000 banana tissue culture plants
- Identified the presence of Pineapple Mealybug Wilt Associated (PMWA) virus at Vazhakulam and suggested preventive measures
- Identified 134P passion fruit variety with better yield, quality and disease tolerance and recommended for the commercial cultivation in the mid lands of Kerala
- Consultancy and training for production, shelf life studies, processing, preservation, value addition, export of pineapple and passion fruit varieties
- Quality analysis of pineapple and passion fruit varieties with authentic reports
- Introduced a European pineapple variety, MD-2 having more shelf life and less core browning for export

- The centre's activities are being published through newspaper, magazines, TV and radio
- Active presence in digital world with its own website (http://prsvkm.kau.in)
- Live discussions and problem solutions through whatsApp groups

All the technologies developed are being transferred to the concerned extensively.

Vazhakulam pineapple

Pineapple has been commercially grown in Vazhakulam area for more than 60 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 other states. It is extensively 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), The Kerala Agricultural University, Vellanikkara, and Pineapple Farmers' Association Vazhakulam, Kerala. The GI registration has boosted the export of pineapple from the state considerably, besides the high reputation fetching premium price in the international market.

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 months. The average fruit weight is 1.5-2.0 kg. 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 14-18°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.

MD-2 pineapple

MD-2 is a hybrid pineapple originated in the breeding program of the now-defunct Pineapple Research Institute in Hawaii, which conducted research on behalf of Del Monte, Maui Land and Pineapple, and Dole. It can be harvested by 13 months. It is the standard for the international market because of its colour, flavour, shape, lifespan and ripeness. It has excellent fruit qualities like high brix value (18 for ripe fruit), low acidity (0.4-0.5%), medium fruit size (1.5 to 2.0 kg), cylindrical shape with square shoulder, small core size, resistant to internal browning, very long shelf life (about 30 days) etc. Its sucker production is meagre and is susceptible to fruitlet core rot and more sensitive to Phytophthora rot. MD-2 will be the best pineapple variety that can be imported for cultivation in Kerala which will increase the export share of the pineapple produced in the state. IPR rules are not applicable to MD-2 variety as it is not a patented variety. MD-2 variety can be imported from Costa Rica, Ghana, Cuba, France etc. The field performance of MD-2 pineapple is established by the station and its plantlets are sold from the centre.

Amritha pineapple

Amritha is a hybrid between Kew and Ripley queen, released by Kerala Agricultural University. It has spiny leaves and 12 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. Research activities on Amritha are continuing at the centre.

134P passion fruit

As an outcome of Kerala State Council for Science Technology and Environment (KSCSTE) project "Evaluation of passion fruit types for commercial cultivation in Kerala" a purple passion fruit type obtained from Seven Mally Estate, TATA Tea Limited, Munnar-685612 showed superior growth, yield and quality parameters and recommended for commercial cultivation in the mid lands of Kerala. The passion fruit accession 134P rooted cuttings were supplied to all the KAU research centres and farmers for evaluation as per 37th ZREAC recommendation.

Operating environment

- Two permanent employees and few contract staff
- Plant Biotechnology, Phytochemistry, Plant Pathology and Food Technology Labs strengthened with almost all the relevant equipment
- Leased land for field experimentation
- Specialized books and periodicals
- Training hall with projector system
- Student projects and trainings for both UG and PG students of other universities
- Sales centre for sale of tissue culture plants, rooted cuttings and seedlings of passion fruit, banana and pineapple
- Effective eGovernance through UFAST, ORMIS, Website and WhatsApp Groups
- Right vision of 'Quality People, Infrastructure & work culture for Quality Technology, Products & Services'

Research

The research institute 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, KSCSTE, KPM etc.

Projects

I. Completed projects

Name, Code no, period, agency, outlay, objective and outcome of projects are given below

1. Kerala Agricultural University Projects

1.1 Name: Evaluation of organic manures with biofertilizers for maximizing the yield and quality in pineapple var. Mauritius; **FRC code:** FR-09-00-04-2001/VZK (10) KAU; **Period:** 2000-2003; **Agency:** Kerala Agricultural University; **Objective:** To compare the effect of various forms of organic manures and biofertilizers on yield and quality of pineapple var. Mauritius; **Outcome:** NPK 8:4:8 g/plant + FYM 25 t/ha + Azospirillum 2.5 kg/ha + Phosphobacter 2.5 kg/ha gave the highest yield.

1.2 Breeding for yield and quality of pineapple

1.2.1 Name: Improvement of pineapple var. Mauritius through hybridization and induced mutation;

File No.: R8/70507/03; **Period:** 1995- ; **Agency:** Kerala Agricultural University; **Objective:** To evolve a high yielding and early maturing pineapple variety suitable to fruit processing industry and table purpose and acceptable to farmers; **Outcome:** 14 hybrid lines were selected based on fruit weight more than 1 kg and brix value and they were planted for planting material production further evaluation.

1.2.2 Name: Intraclonal variability in pineapple var. Mauritius; **Agency:** Kerala Agricultural University; **Objective:** To develop superior clones utilizing the clonal variability available; **Outcome:** one clone suitable for processing was developed and proposed for farm trial.

1.3 Name: Selection of high yielding superior quality pineapple variety for central zone of Kerala in PTD mode; **File No.:** R8/62636/2010; **Period:** 2011-2012; **Agency:** Kerala Agricultural University; **Outlay:** ₹9,40,000/-; **Objective:** To select a high yielding superior quality pineapple variety for central zone of Kerala; O**utcome:** Based on the total yield Mauritius (120 t/ha for 3 yrs) performed the best followed by T3 (89 t/ha for 3 yrs) and MD-2 (59 t/ha for 3 yrs).

1.4 Name: KAU: State Plan Project 2013-14: Station wise funding on ongoing research projects and minor infrastructure support during 2013-14; **File No.:** EP/B1/30896/13**; Period:** 2014-2015**; Agency:** Kerala Agricultural University**; Objective:** 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, to improve infrastructure support of the station; **Outcome:** Tissue culture plants of different varieties of pineapple were produced and distributed; equipment like viscometer, penetrometer, homogenizer, autoclave, precision balance, analytical balance, micropipettes, air curtain, research materials, flag post, display system, computer accessories, refrigerator, UPS 4 kVA were purchased; repair and maintenance of equipment and the station were carried out.

2. Other projects

2.1 Name: Population density of pineapple var. Mauritius as intercrop in coconut and rubber plantations; **FRC code:** FF/15-00-06-95/VZM (15) KHDP; **Period:** 1995-1998; **Agency:** Kerala Horticultural Development Programme; **Outlay:** ₹2,46,000/-; **Objective:** To find out the optimum spacing for planting of pineapple var. Mauritius as intercrop in coconut and rubber plantations; **Outcome:** Individual fruit weight was not influenced by the different plant densities (8,000 – 15,000 in rubber plantation and 15,000 – 30,000 in coconut garden). However, the per hectare yield was maximum at the highest density in each case.

2.2 Name: Evaluation of fungicide 'SAMARTH' (Hexaconazole 2% EC) against collar rot of pineapple; **File No.:** EP/A1/6881/09; **Period:** 01.07.2010 - 31.03.2011; **Agency:** Rallis India Ltd., Bengaluru; **Outlay:** ₹1,65,450/-; **Objective:** To evaluate the bioefficacy of Samarth (Hexaconazole 2% SC) against pineapple collar rot and other diseases; **Outcome:** The evaluation of Samarth (Hexaconazole 2% SC) against pineapple collar rot and other diseases for one season during 2010-11 showed that it is highly effective in controlling the diseases. Hexaconazole 0.5% is more efficient in disease control though it slightly affected plant growth in terms of plant height and leaf length in the early stages with no marked difference thereafter. Hexaconazole 0.4% is safest with good disease control efficiency.

2.3 Name: ICAR adhoc scheme: Evaluation of pineapple hybrids for higher yield, quality and suitability for intercropping; **File No.:** EP/A3/44778/2001; **Period:** 01.01.2002-31.12.2004; **Agency:** Indian Council of Agricultural Research; **Outlay:** ₹2,86,423/- ;**Objective:** To evaluate about 5000 pineapple hybrids available at the Pineapple Research Station, Vazhakulam based on yield and quality parameters to develop an ideal pineapple hybrid suitable for the dual purpose of fresh fruit consumption and processing; it should be suitable for growing as a pure crop in garden land and

reclaimed low lands/paddy fields and as an intercrop in coconut and rubber plantations

Outcome: Out of the total 5000 hybrids maintained at the station, about 2700 hybrids which yielded fruits during the period were evaluated individually for yield and quality characters. Much variability was observed with regard to all characters observed with many of the characters showing wide segregation. However, as most of the characters show seasonal variation, identification of individual hybrids with ideal characters can be achieved only by repeated evaluation over years. For this purpose the hybrids which were evaluated once could be replanted with a minimum of two suckers for further evaluation. The hybrids which are found to be better than the parents based on mean values are under multiplication and replanting for plot evaluation.

2.4 Name: KAU-IPL-KALI and SALZ (Germany) collaborative project: Studies on the use of potassium fertilizers for improving yield and quality of pineapple on main production sites of Kerala State; **File No.:** EP/A1/39320/01; **Period:** 01.11.2001-31.05.2005; **Agency:** Kerala Agricultural University – Indian Potash Limited - KALI + SALZ (Germany); **Outlay:** ₹4,35,270/-; **Objective:** This project aimed to study the response of increasing potassium rates on yield and quality of pineapple variety Mauritius, effect of two sources of potassium, MoP and SoP, on yield and quality of pineapple, impact of balanced nutrients- potassium, sulphur and magnesium on pineapple growth and quality

Outcome: Pineapple fruit yield increased marginally with increase in potassium application and the increase was clear when potassium was applied as SoP and the maximum yield was obtained with the application of 24 g K_2O as SoP/plant/year.

2.5 Name: NAPC-KAU Co-Operative Research Project on Passion Fruit- Collection and evaluation of passion fruit germplasm for selection of varieties for low altitude areas; **File No.:** BG/A1/31889/03 ; **Period:** 01.04.2003-31.03.2009 ; **Agency:** Nadukkara Agro Processing Company and Kerala Agricultural University; **Outlay:** ₹1,60,000/- + ₹40,000/-; **Objective:** To identify a passion fruit variety suitable for low altitude areas in Kerala; **Outcome:** 131 types were planted and evaluated for its yield and quality for the first year. During the next year, two yellow types and one purple types were found to be promising. For a detailed study they were planted extensively. As a result of the evaluation, a yellow type obtained from the Fruit & Vegetable Farm, Nelliampathy was found to perform well than other types and was decided to produce its planting materials and sell to growers.

2.6 State Horticulture Mission Projects

2.6.1 Name: Strengthening of Tissue Culture Laboratory and Related Units for Production of Plantlets of Pineapple and Other Tropical Fruit Crops; **File No.:** EP/A1/8056/06; **Period:** 07/03/2006-31/03/2007; **Agency:** State Horticulture Mission; **Outlay:** ₹8 lakh; **Objective:** The broad objective of the proposed programme was to meet the planting material requirement of pineapple and other tropical fruits crops by producing tissue culture plantlets; **Outcome:** Additional equipment were purchased for the tissue culture lab. Green house and humidity chamber were constructed and work area was improved for the production of tissue culture plantlets of pineapple, banana and other tropical fruit crops.

2.6.2 Name: Small Nursery for Production of Quality Planting Material of Improved Varieties of Pineapple; **File No.:** EP/A3/11633/07; **Period:** 2/4/2007-31/03/2008; **Agency:** State Horticulture Mission; **Outlay:** ₹3 lakh; **Objective:** The broad objective of the proposed programme was to meet the quality planting material requirement of new varieties of pineapple; **Outcome:** Construction of potting shed, purchase of racks, production of tissue culture plantlets of pineapple were carried out. The centre has already sold out more than 1 lakh MD-2 plants, more than 30,000 passion fruit plants and more than 20,000 banana tissue culture plants.

2.6.3 Name: Establishment of Plant Health Clinic at Vazhakulam; **File No.:** EP/A3/26044/07; **Period:** 18/08/2007-31/03/2009; **Agency:** State Horticulture Mission; **Outlay:** ₹14.76 **lakhs**; **Objective:** To give situation specific recommendations to farmers for pest, diseases, nutrient and other management problems; **Outcome:** Partitioning of laboratory and creating facility for installation of equipment, equipment purchase, identification of diseases and pests and soil nutrient estimations were carried out

2.6.4 Name: Establishment of Pest and Disease Forecasting Unit for Pineapple; **File No.:** EP/A3/11520/07; **Period:** 24/3/2007-31/03/2009; **Agency:** State Horticulture Mission; **Outlay:** ₹2.89 lakh; **Objective:** The broad objective of programme was timely identification and control of diseases and pests affecting pineapple cultivation; **Outcome:** Equipment were purchased for training and laboratory. Farmers' fields were visited and diseases and pests problems were identified. Suitable control and preventive measures were suggested. Training programmes were conducted; pest and disease problems were documented and leaflets were prepared. pH meter, flame photometer, UV vis spectrophotometer, electronic balance, laboratory ovens, laminar air flow chamber, ELISA reader & washer, cooling centrifuge, deep freezer, BOD incubator, orbital shaker and microscope were purchased.

2.7 Name: KSCSTE-SRS: Evaluation of passion fruit types for commercial cultivation in Kerala; **File No.:** EP/A1/4077/12; **Period:** 03.03.2012-02.03.2015; **Agency:** Kerala State Council for Science Technology and Environment; **Outlay:** ₹13,03,389/-; **Objective:** To identify a high yielding superior quality passion fruit variety 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 income and better standard of living; **Outcome:** The scheme involved comparative evaluation of 14 promising passion fruit types selected from more than 150 types collected and established at the Pineapple Research Station, Vazhakulam for selecting the best type for commercial cultivation in Kerala. Among the 14 types evaluated in the study, 134P obtained from Seven Mally Estate, TATA Tea Ltd., Munaar- 685612, was identified and selected based on its superior growth, yield and quality parameters and recommended for commercial cultivation in the mid lands of Kerala. 134P had high productivity and juice production. It had single fruit weight 104.54 g, juice recovery 33.54%, yield 24.92 fruits/plant/year, totally weighing 2.52 kg/plant/year or 2800 kg/ha/year, producing 937 kg/ha/year of juice as the mean of first two years. Large scale production and distribution of planting materials of the superior type and popularization of the variety will go a long way in boosting the production of passion fruit in the state improving food and health security of the people.

2.8 Name: Organic versus inorganic nutrient management of pineapple varieties for safe and sustainable production; **File No.:** EP/B3/5256/15; **Period:** 01.06.2015-31.05.2016; **Agency:** Kerala Pineapple Mission; **Outlay:** ₹7 lakh; **Objective:** To evaluate critically organic versus inorganic nutrient management of pineapple varieties for safe and sustainable production; **Outcome:** The maximum yield recorded was 37.89 t/ha for Mauritius with organic treatment. Only the main effect was significant and not the interaction. Organic, inorganic and integrated treatments with the mean yield were all statistically on par. Therefore, organic application has no specific advantage over integrated or inorganic application. Hence Vazhakulam Pineapple (Mauritius) (34 t/ha) or even MD-2 with any source of nutrient application organic, inorganic or integrated can be followed. However the highest benefit: cost ratio of ₹3.82 validates cultivation of Mauritius pineapple with inorganic fertilizers having most economic viability and that is what is followed now. Farmers prefer Mauritius over MD-2 due to profuse suckering and easy marketing of Mauritius. Suckering is very meagre in MD-2 and there is no sure market. Recording of a lower average fruit weight and number of leaves per plant in this field experiment with Package of Practices recommended dose of organic manure and inorganic fertilisers at PRS, Vazhakulam indicates a relatively inadequate nutrition of the plant highlighting the need for more nutrition. This requires a review of the Package of Practices

recommendation and suitable revision of fertiliser recommendation based on different multi-location field experiments with thorough scientific discussion among the crop scientists.

II. Ongoing projects

1. Name: Research on Pineapple; **File No.:** R/8/66091/04; **Objective:** To conduct research on pest and diseases in pineapple and to provide farming assistance to growers**; Work done so far:** overall development in pineapple sector, recommendations to pineapple growers, experimenting in processing technology, production of pineapple tissue culture plants, a major step in transfer of technology through the initiation of pineapple tissue culture protocol transfer.

2. Name: Breeding for yield and quality of pineapple; **File No.:** R 8/70507/03; **Objective:** To develop pineapple varieties suitable for processing and table purpose through hybridization; **Work done so far:** As a result of years of research 14 promising types were selected. They are being evaluated.

3. Name: Research in Passion fruit; **File No.:** R2/60024/12; **Objective:** To give recommendations for improving passion fruit cultivation; **Work done so far:** Passion fruit types collected from different parts of the country are conserved; passion fruit seedlings of purple and yellow types and rooted cuttings of passion fruit varieties are being produced; as per 37th ZREAC recommendations the purple passion fruit type 134P identified and selected based on its superior growth, yield and quality parameters was recommended for multilocation testing at different KAU centres and for commercial cultivation in Kerala. As part of the programme, the planting materials (cuttings and seedlings) were distributed to KAU centres and farmers across the Kerala state. It was identified that passion fruit wilt and rot diseases are caused due to *Fusarium* sp. and *Phytophthora* sp. infections respectively.

4. Name: Organic Versus Inorganic Nutrient Management of Pineapple Varieties for Safe and Sustainable Production; **File No.:** R4/65231/13; **Objective:** To evaluate critically organic versus inorganic nutrient management of pineapple varieties (Mauritius, MD-2, Amritha) for safe and sustainable production; **Work done so far:** The Kerala Pineapple Mission Project on Organic versus inorganic nutrient management for safe and sustainable production was proposed for three years. The first year programme was sanctioned, fund released and executed successfully. The Second year programme was sanctioned but fund release was not effected. Hence the Project was merged with the KAU Plan Project Research on Pineapple and being continued. During the 2nd year of the project, bimonthly applications of the fertilizers are being imposed. How the varieties are affected by the different nutrient applications are being studied.

5. Name: GoK plan - Network centre for planting material production; **File No.:** R8/65991/13; **Objective:** Establishment of new progeny plots and strengthening the existing collections of fruits of the station with recent varieties to enable their multiplication and distribution to farmers; Production and supply of planting materials of fruits; **Work done so far:** Planting materials of pineapple, passion fruit and banana are being produced and distributed to growers throughout the country

6. Name: KAU State Plan project 2015-17. Station wise funding on going research projects and minor infrastructure support during 2015-17; **File No.:** R 8/65516/13; **Objective:** To boost pineapple production and productivity through comprehensive technology; **Work done so far:** Providing recommendations to farmers and young aspiring industrialists, extension of technology through discussions, trainings, palmlets, newspapers, magazines etc.

7. Name: Production of Seed and Planting materials- Revolving Fund mode; **File No.:** R 1/68289/02; **Objective:** To produce tissue culture plants of pineapple and banana and planting materials of passion fruit, to give trainings on nursery technology, tissue culture production, processing technology, value addition and related subjects; **Work done so far:** Planting material production of

pineapple, passion fruit and banana and extension technology activities are being carried out

Pineapple Research Station over the years

Guidelines and action plan for comprehensive development of pineapple sector

PRS Research and Development Efforts ...

Annual Reports ...
