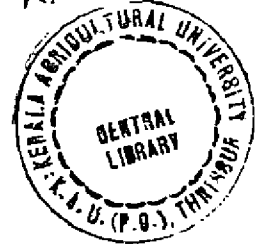


Final Report of State Plan Project – 2014 – 15

809072
IR- KAU 2014-15

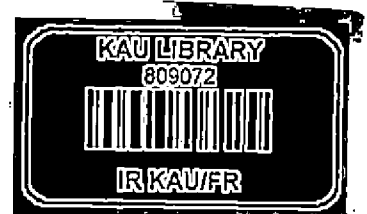


Strengthening Research on pineapple

Submitted by

Dr. M.Asha Sankar

Professor(Hort.)



Kerala Agricultural University

Banana Research Station

Pineapple Research Centre

KAU P.O. Vellanikkara, Thrissur 680656

Sl. No	Contents	Page No
1	Executive Summary	1 -2
2	Detailed final report	3 -42
3	Reference	43 -44

Executive summary

The summary of results of the State Plan Project 2014 -15 of the project 'Strengthening research on pineapple' is given below

This project, 'Strengthening research on pineapple' was implemented as a State Plan project, at Pineapple Research Centre, Vellanikkara, as a comprehensive project including five sub projects, with a financial outlay of 5.75 lakhs. The objectives of the project included enrichment of new germplasm and evaluation, evaluation of performance of pineapple varieties viz; Kew and Mauritius with different types of planting materials, studying the performance of tissue culture plants of pineapple in comparison to suckers and improving the fruit size of variety Mauritius and develop new varieties for table purpose having desirable characters and high yield potential.

Sub project 1 which envisages collection, conservation and evaluation of pineapple germplasm was implemented by enriching the germplasm by collecting new varieties developed in other countries and evaluation of existing and new germplasm .About 30 exotic and indigenous collections were collected and conserved as a part of the project and their morphological, yield and quality characters were evaluated. The exotic variety, MD-2, was added to the germplasm. The variety performed well under Vellanikkara conditions.

Sub project 2 envisages the evaluation of performance of pineapple varieties with different type of planting materials. In recent times, there has been an increasing tendency towards expansion of existing area under pineapple leading to its large scale production. Availability of planting materials to achieve this objective is a major limiting factor due to poor ability of the plants to sucker. Hence a trial was taken up to compare the performance of various planting materials on yield and quality of pineapple varieties, Kew and Mauritius. Kew plants raised through crown and suckers did not reveal any significant differences among each other with respect to vegetative, yield and quality characteristics In the case of Mauritius variety also, experimental plants raised through suckers, crowns and slips, were on par with one another, with respect to vegetative, yield and quality characteristics. Regarding crop duration from planting to harvest, Kew plants raised from crown, took maximum duration followed by Kew plants raised from suckers which were on par with each other. The same trend was noticed in Mauritius variety as well, where plants raised through crowns, registered maximum crop duration and plants raised through suckers, minimum. The results of the studies revealed that apart from suckers, rooted Kew crowns as well as rooted Mauritius slips and crowns, can be used successfully as alternative sources planting materials in pineapple.

In view of the rapid expansion of area under pineapple in the state, conventional propagation techniques are inadequate to meet large scale demand of planting materials. Hence alternate avenues were sought for increased generation of planting materials by exploring the possibility of utilizing tissue culture plants of major varieties of pineapple, which was achieved through **Sub project 3**, wherein, field evaluation of tissue culture plants of pineapple variety, Mauritius, was done. The results reveal that tissue culture plants of Mauritius variety of pineapple were as good as plants raised through suckers, slips and crowns with respect to yield and quality characteristics. These findings are of significance since low rate of multiplication by conventional methods and lack of quality propagules, which are major limitations in pineapple cultivation, could be overcome to a large extent, by the use of tissue culture derived plantlets.

Sub project 4, on breeding pineapple for evolving varieties with high yield and quality, was taken up with the objective of improving the fruit size of variety Mauritius and develop new varieties for table purpose having desirable characters and high yield potential. Crossing was carried out with Mauritius as female parent and Kew as male parent and 97 hybrids were raised. Based on fruit weight and TSS, 30 hybrids were selected and carried forward to the next generation. Among the MXK hybrids which recorded superior characters, H-57 combined in it the high mean fruit weight of its pollen parent, Kew(2.25 kg) with the fruit quality characters as that of Mauritius, like high T.S.S. and golden yellow flesh in both Plant crop 1 and Plant crop 2. From the reciprocal crosses, KXM, 6 hybrids, H-113, H-115, H-118, H-119 AND H-121 exhibited superior characters with respect to fruit weight and quality. However in crosses with Kew as female parent, fruit abnormalities like multiple crown and misshapen fruits were more as compared to crosses with Mauritius as the female parent. Evaluation of both sets of hybrids are being continued.

**Detailed Final Report of the GoK State Plan Project 2014 -15 - Strengthening research on
pineapple**

1. **Project title** : Strengthening research on pineapple
2. a. **Name of the station** : Pineapple Research Centre, Vellanikkara
(under BRS, Kannara)
- b. **Location** : Pineapple Research Centre, Vellanikkara
3. **Principal Investigator** : Dr.A.K.Babylatha, Professor (Hort.), PRC,
Vellanikkara- upto 30-11-2016
Dr. M.Asha Sankar, Professor (Hort.), PRC,
Vellanikkara –from 1-12-16
4. **Co-PI/Associates** : Dr. Rema Menon, Professor & Head,BRS,
Kannara –upto 4-5-16
Dr.P.B. Pushpalatha, Professor & Head,
BRS, Kannara –from 4-5-16
5. **AS&TS details (GO &KAU orders)** : GO(Rt) No.2186/2014/AD dated 11.12.2014
of Agri. (Farms)
No.R8/60610/15 dated 29.01.2015
6. **Financial Sanction details (of Comptroller):** EP/B1/1348/2015 dated 22.04.2015
7. **Date of commencement** : 2015
8. **Date of completion** : 31.03.2017
9. **Total budget and total expenditure of the project :**
 Total budget : Rs. 5,75000
 Total expenditure : Rs574992
10. **Year-wise budget and expenditure (item/ head wise)**

310-31-9579 GOK-Plan Project Strengthening research on pineapple
PRC Vellaikkara

2015 – 16

Head of account	Allocation (Rs.)	Expenditure (Rs.)	Balance (Rs.)
310-31-9579 – 142	100000	98550	1450
310-31-9579 – 210	225000	52893	172107
310-31-9579 – 214	100000	45794	54206
310-31-9579 – 921	150000	117229	32771
Total	575000	314466	260534

2016 – 17

Head of account	Allocation (Rs.)	Expenditure (Rs.)	Balance (Rs.)
310-31-9579 – 142	172100	172100	0
310-31-9579 – 210	54200	54192	8
310-31-9579 – 214	32800	32800	0
310-31-9579 – 921	1500	1500	0
Total	260600	260592	8

11. Back ground of the project :

Pineapple (*Ananas comosus* L.Merr.) belonging to the family Bromeliaceae, is one of the most popular and delicious tropical fruit crops of India and Kerala. The humid tropical climate, product diversification and new avenues of marketing have elevated pineapple cultivation in Kerala to the level of an entrepreneurship. The two important varieties in pineapple are Kew and Mauritius. Considerable research work has been done in pineapple, in Kew variety at KAU. The POP recommendations for pineapple is mainly based on the work done in Kew variety (KAU, 2007). Several research programmes has been initiated in Mauritius variety in KAU as well. Having standardized the Package of Practices recommendations for scientific cultivation of the crop, it was only imperative to

take up studies focusing on the current needs and existing limitations of the pineapple sector of the state. The current project was proposed in this context.

The project was implemented as a comprehensive project including five sub projects. **Sub project 1** which envisaged collection, conservation and evaluation of pineapple germplasm was primarily meant to enrich the germplasm by collecting new varieties developed in other countries and evaluating existing and new germplasm for enrichment of gene pool which will enable accessions showing superior characters to serve as parent plants in future breeding programmes, apart from popularizing the collected accessions per se.

Sub project 2 envisages the evaluation of performance of pineapple varieties with different type of planting materials. Pineapples are vegetatively propagated from crowns, suckers (axillary shoots arising from the base of the plant), or slips (axillary shoots arising from the base of the fruit). Among these, suckers are conventionally used planting materials, mainly due to early fruiting in plants raised through them. However, in recent times, there has been an increasing tendency towards expansion of existing area under pineapple leading to its large scale production. Availability of planting materials to achieve this objective is a major limiting factor due to poor ability of the plants to sucker, which is mainly due to the suppression of lateral bud growth as a result of auxin secretion by shoot apex. This emphasizes the need to explore the possibility of using alternate sources of planting materials other than suckers, especially, when high density planting is adopted. It is in this context that this subproject was envisaged and implemented.

Scarcity of planting materials in pineapple is a major problem faced by the farming community of Kerala since the recommended planting density is 40000 plants per hectare. Presently suckers are the planting materials used for commercial cultivation of pineapple. In view of the rapid expansion of area under pineapple in the state, conventional propagation techniques are inadequate to meet large scale demand of planting materials. Hence alternate avenues have to be sought for increased generation of planting materials. *In vitro* techniques offer exciting possibilities for generation of abundant, uniform, quality planting materials. In addition to facilitating mass multiplication of propagules, micropropagated plants are known to mature and fruit in a synchronised manner. Protocol for rapid multiplication through *in vitro* techniques has been standardized in pineapple. Hence the possibility of utilizing tissue culture plants of major varieties of pineapple has to be explored. Hence **Subproject 3,** 'Field evaluation of tissue culture plants of pineapple varieties' was implemented in this context to assess the acceptability of tissue culture plantlets of pineapple for commercial planting, in comparison with conventionally propagated plants. The major limitation of Mauritius, the most popular pineapple variety of Kerala, for table purpose, is its small fruit size.

Breeding programme carried out in the crop have resulted in many improved varieties like Josapine from Malaysia (Chan and Lee, 1996), Tainung 17 from

Taiwan (Tang *et.al*,2014) etc. Pineapple cultivars are heterozygous and hybridization between them leads to development of fertile seeds that presents a wide spectrum of genotypes (Chan, 2006). The segregating F1 population provides an excellent source of gene recombinants for selection and cloning of new superior individuals. One distinct advantage of hybridization in pineapple for evolving new varieties, is that, emasculation is not necessary in pineapple due to the strong self incompatibility, operating in the crop. Amritha an improved variety released from Pineapple Research Centre, Vellanikkara, Kerala Agricultural University, a derivative of the cross between Kew x Ripley Queen, is the only pineapple hybrid developed in India. This variety has all the desirable traits required for export market. In recent years, the pineapple variety Mauritius become very popular in Kerala due to its excellent qualities as table variety, with golden yellow flesh, sweet taste, good flavour and low acidity however, its fruit size small as compared to the popular variety Kew, with an average fruit weight 2 to 2.5 kg. Hence, combining the fruit size of Kew with the excellent fruit qualities of Mauritius in a single genotype would result in a variety with good consumer acceptance, the commercialization of which, could boost pineapple cultivation in the state Hence **Subproject 4** was taken up with the objective of improving the fruit size of variety Mauritius and develop new varieties for table purpose having desirable characters and high yield potential through systematic hybridization programmes involving Kew and Mauritius.

12. Objectives :

- a. Enrichment of new germplasm and evaluation
- b. Evaluating the performance of pineapple varieties viz; Kew, Mauritius, Amritha and MD-2 with different types of planting materials.
- c. Studying the performance of tissue culture plants of pineapple in comparison to suckers.
- d. Improving the fruit size of variety Mauritius and develop new varieties for table purpose having desirable characters and high yield potential.

13. Technical programme :

Sub projects

- a. Collection, conservation and evaluation of pineapple germplasm
- b. Evaluating the performance of pineapple varieties with different types of planting materials
- c. Field evaluation of tissue culture plants of pineapple varieties
- d. Breeding pineapple for evolving varieties with high yield and quality

a. **Collection, conservation and evaluation of pineapple germplasm**

Technical programme

Enrichment of germplasm and evaluation

The germplasm collection was enriched by collecting new varieties developed in other countries and evaluation of existing and new germplasm was done.

Work done

About 30 collections of different varieties of pineapple (*Ananas comosus*), both introduced and indigenous, were planted in the experimental field of PRC, Vellanikkara. The vegetative, floral and fruit characters of the collected and conserved varieties are given below. (Table 1a and 1b).

Table. 1 a. Salient vegetative, floral and fruit characters of pineapple varieties/ accessions

Sl. No	Name	Vegetative characters	Floral characters	Fruit shape, size and colour	Fruit weight (kg)	TSS (^o B)	Acidity (%)
1	Simhachalam	Height , 90 cm, middle leaf green with red mottling, spines present, no slips.	26 flowers / inflorescence, bracts reddish in colour with green base, trichomes present	Round, 8 cm long, 7.5 diameter, deep yellow to orange colour, golden yellow flesh	0.280	23	0.4
2	Pulimath Local	Height, 41.5 cm, middle leaf green colour, leaf possess piping character, spines and slips present,	54 flowers/ inflorescence, pale yellow bracts with triangular pointed tip; length of the bract 20 mm, trichomes present	Cylinder shape, 12.5 cm long, 9.5 cm diameter, light orange colour, light cream flesh colour, flesh sour in taste,	0.945	9.5	0.3
3	Espanola Roja	Height, 91.3 cm, middle leaf green with red mottling, spines ascendant and reddish, slips absent	67 flowers /inflorescence, trichomes and imbricate bract present, petals are purple in colour with white base	Cylindrical in shape with slight tapering, 13 cm long, 10.5 cm diameter, golden yellow colour, multiple fruit contains grouped fruitlets, sessile like crown surmounting fruit	0.810	23.5	0.5

4	Thaliparamba Local	Height , 105 cm, middle leaf green with yellow mottling, spines ascendant and reddish, slips absent	60 flowers/ inflorescence, bear trichomes, petals triangular and purple with white base	Cylindrical in shape with slight tapering from base, 12.5 cm long, 5.5 cm diameter, orange- red/brown to reddish orange colour, seeds absent	0.560	16	0.4
5	Selangore Green	Height 91.6 cm, middle leaf green, yellow mottling, spines ascendant and reddish, slips absent,	58 flowers/ inflorescence trichomes present on the bract, petals tubular and purple	Round shape, 11 cm long, 10cm diameter, grouped fruitlets, dark green to reddish orange, seeds present, golden yellow flesh,	0.760	20.5	0.2
6	Ripley Queen	Height, 54.8 cm, middle leaf green, yellow mottling, spines ascendant and reddish, slips absent, suckers present	66 flowers/ inflorescence, trichomes present on the bract, petals triangular and purple	Cylindrical in shape and sharp tapering, 16.9 cm long, 12 cm diameter, grouped fruitlets, green to deep yellow/orange, golden yellow flesh	0.800	18	0.1
7	Giant Kew	Height, 58 cm, middle	82 flowers/ inflorescence, bracts	Cylindrical in shape, 18.7 cm	2.010	24.5	0.1

		leaf green, red mottling, reddish ascendant spines, slips present, suckers present	red in colour, trichomes present, sepals, petals tubular in shape and purple and white base	long, 13.4 cm diameter, green to yellow with green mottling, light cream and smooth flush without fibres, seeds absent			
8	Smooth Cayenne	Height 59.05 cm, middle leaf green with red mottling, spines ascendant and reddish, slips and suckers completely absent	96 flowers/ inflorescence, trichomes present on bract, petals tubular and white purple,	Cylindrical in shape with slight tapering from base, 14.5 cm long, 7 cm diameter, green to yellow with green mottling, light cream flush	1.260	22	0.2
9	Mauritius	Height, 57.4 cm, middle leaf green with red colour at the tip, spines ascendant and reddish, slips and suckers present	30 flowers/ inflorescence bracts triangular and red with green base, trichomes present, petals tubular and purple	Cylindrical in shape and sharp tapering, 17.5 cm length, 12.5 cm diameter, dark green to yellow, golden yellow flesh	0.850	16	0.2
10	Mauritius (White)	Height, 57.4 cm, middle leaf	30 flowers/ inflorescence bracts triangular and red with	Round in shape, 8.5 cm length, 8 cm	0.525	23.5	0.4

		green with red colour at the tip, spines ascendant and reddish, , slips and suckers present	green base, trichomes present, petals tubular and purple	diameter , yellowish green to pale yellow, golden yellow flesh			
11	Mauritius Type II	Height 57.4 cm, middle leaf green with red at the tip, spines ascendant and reddish, , slips and suckers present	30 flowers/ inflorescence bracts triangular with red tip and green base, trichomes present, petals tubular and purple	Cylindrical in shape, 13.5 cm length, 10.5 cm diameter, green to yellow with green mottling, light cream flesh	1.135	22.5	0.6
12	Valera Moranda	Height, 59.5 cm, middle leaf red, spines ascendant and purple, slips and suckers absent	98 flowers/ inflorescence bracts triangular with red tip and green base, petals tubular and white purple	Reniform in shape, 21 cm long, 10.5 cm diameter, red purplish to dark red purple, white flesh,	1.575	21	0.1
14	Valera Balanca	Height, 72 cm, middle leaf green with red mottling, spines ascendant and red, slips	67 flowers/ inflorescence bracts triangular with red tip and green base, petals are tubular and white purple in colour	Cylindrical in shape, 14 cm long, 7 cm diameter, green to reddish orange, cream flesh	1.250	16	0.2

		absent, suckers present					
15	Tripura	Height, 68.5 cm, middle leaf green with red mottling, spines ascendant and purple, slips and suckers absent	100 flowers/ inflorescence bracts triangular with red tip and green base, petals tubular and white pink in colour	Cylindrical in shape, 24cm long, 7cm diameter, pale yellow flesh	3.00	15	0.3
16	Kew	Height, 92.5 cm, middle leaf green spines and slips absent	76 flowers/ inflorescence, bracts triangular with pointed tip, petals tubular purple in colour	Cylindrical in shape, 16.5cm long, 12.5cm diameter, unripe green and ripe fruits yellow with green mottling, flesh light cream colour	1.450	13.5	0.3
17	Conical	Height, 97 cm, middle leaf greenish with red margin, spines present, slips and suckers absent	63 flowers/ inflorescence, bracts reddish with green colour, triangular with pointed tip, petals white purple colour.	Elongated and conical shape, 17cm long, 7.5cm diameter, unripe dark green with golden yellow colour when ripe, golden yellow flesh	0.750	19.5	0.3
18	Ornamental type	Height, 58 cm, middle	32 flowers/ inflorescence bracts	Oval shape, 8.5 cm long, 6	0.655	15.5	0.9

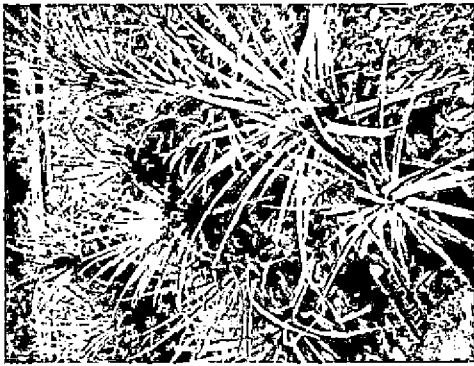
		leaf green with white or purple margin ,spines ascendant and purple, slips and suckers absent	dark red purple and triangular, petals tubular and purple	cm diameter, unripe dark red purple, with ripe fruits reddish colour , flesh white colour			
19	Kallara Local	Height, 57.5 cm, middle leaf green with red mottling spines ascendant and red, slips and suckers absent	65 flowers/ inflorescence, bracts triangular and dark red purple, petals purple, sepals purple/pink	Cylindrical shape;12 cm long, 4.5 cm diameter, yellow flesh, reddish/brown to orange,	1.150	16	0.2
20	MacGregor	Height, 49.5 cm, middle leaf green with red mottling, spines present, slips and suckers absent	32 flowers/ inflorescence, bracts triangular and green, sepals green with reddish tip, petals tubular and purplish white	Round in shape, 10.5 cm long, 8.5 cm diameter, dark green to golden yellow, yellow flesh	1.110	15	0.25
21	Queen	Height, 90 cm, middle leaf green, spines present, slips and suckers	44 flowers/ inflorescence, bracts green with red tip, sepals green with red tip, petals tubular and white	Cylindrical in shape, 15 cm long, 12cm diameter, green to deep yellow/orange, golden yellow	0.950	18	0.1

		absent		flesh.			
22	Alexandra	Height ,58 cm, middle leaf green with red mottling, spines ascendant and red, slips and suckers absent	71 flowers/ inflorescence, bracts triangular and purple, sepals pinkish with green tip, petals absent	Cylindrical in shape, 13 cm long, 6.5 cm diameter, greenish to bright yellow, yellow flesh	0.885	14	0.3
23	Rose scented	Height,60 cm,spiny leaf, no sucker and slips	52 flowers/ inflorescence	Small fruit,round shape,reddish green	0.600	12	0.4

Among the collections, Simhachalam and Espanola Roja, with high Brix and Giant Kew with good fruit weight are potential candidates in future breeding programmes. Additionally seven accessions were procured from Pineapple Research Station, Vazhakulam, as shown below and were added to the germplasm collection of the centre.

Table 1 b Accessions collected from PRS, Vazhakkulam

Sl. No	Accession No	Average fruit weight with crown (kg)	Remarks
1	MTS	1.833	Mauritius type, Mutant type sucker
2	T3	2.025	Big fruited, eyes flat, cylindrical shape, eyes crack in rainy season
3	Ac No.891	1.450	More number of slips
4	Ac No. 800	1.525	-
5	Ac No.932	1.800	-
6	H3	1.572	-
7	H4	1.621	-
8	H5	1.832	-



Thaliparampa local



Alexandra

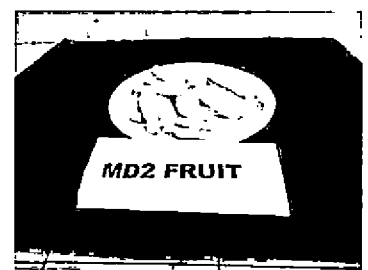
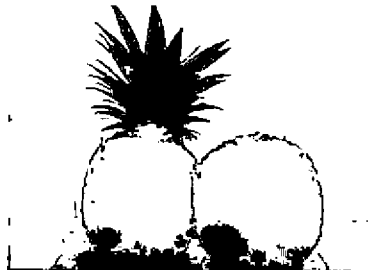


Tripura



Rose scented

The globally renowned exotic variety , MD-2, was added to the germplasm. Performance of MD-2 pineapple was assessed under Vellanikkara conditions . The variety registered impressive performance with respect to yield and quality characters. The mean fruit weight ranged from 1.55 – 2.50 kg. The fruits were typical cylindrical shape, deep yellow with good taste and quality. The mean TSS value of the fruits ranged from 13 to 18 OB and mean content of acidity ranged from 0.31 to 0.49 %. The crop was of 13- 14 months duration



MD -2

b. Evaluating the performance of pineapple varieties with different types of planting materials

Technical programme

The experiment was conducted at Pineapple Research Centre, Vellanikkara, during May,2014, to evaluate the performance of pineapple varieties Kew and Mauritius with respect to yield and quality, with different types of planting materials like suckers, slips and crowns.

Design – RBD

No of treatments – 5

No of replications -4

Treatments

T1 – Kew suckers

T2 –Kew crowns

T3 – Mauritius suckers

T4 - Mauritius crowns

T5 - Mauritius slips

No of plants per treatment -60

The experiment was laid out at Pineapple Research Centre, Vellanikkara

Results and Discussion

Influence of type of planting materials on vegetative and flowering characters of Kew and Mauritius varieties of pineapple are given in Table 2.

Table. 2 Vegetative characters of Kew and Mauritius variety with different types of planting materials

Treatments	Plant height (cm) at 3 months	Plant height (cm) at 6 months	Plant height at flowering (cm)	No of leaves at 3 months	No of leaves at 6 months	No of leaves at flowering
T1 - Kew sucker	50.1	78.4	89.4	22.6	31.2	40.9
T2 - Kew crown	47.6	86.2	91.7	22.6	36.3	41.8
T3 - Mauritius sucker	36.7	67.6	79.7	23.5	32.6	39.6
T4 Mauritius crown	37.5	66.5	79.3	28.4	34.0	41.2
T5 -	35.9	69.4	76.2	22.8	30.5	40.8

Mauritius slip						
CD 0.05	NS	NS	NS	NS	NS	NS

No significant differences were observed between plants raised from suckers and those raised from crown, with respect to mean plant height, in varieties, Kew as well as Mauritius. Regarding mean plant height at 3 months after planting, in variety Kew, plants raised through suckers produced maximum mean plant height of 50.1 cm, which was on par with that of plants raised through crown(47.6 cm). Similarly, Mauritius plants raised through suckers, crown and slips, registered at 3 months after planting, mean plant heights ranging from 35.9 cm to 37.5 cm, which were on par with one another. However, the varietal characters of Kew and Mauritius were evident in the values, wherein, Kew plants were significantly superior to Mauritius plants with respect to mean plant height at 3 months after planting, irrespective of type of planting materials.

At 6 months after planting, same trend was noticed in mean plant height, as that of plant height at 3 months after planting, among plants raised through different types of planting materials in both Kew as well as Mauritius. At flowering, plants raised through suckers and crown were on par with each other, with respect to mean plant height, in varieties Kew as well as Mauritius. (Table 2). Regarding mean number of leaves produced at 3 months after planting, plants raised through crown, in both Kew and Mauritius recorded maximum values. (29.11 cm and 28.4 cm respectively) and were on par with each other. Mauritius plants raised through slips, produced lowest mean number of leaves (22.8), at 3 months after planting. The same trend was noticed at 6 months after planting, as well. At flowering, there was no significant difference between different planting materials, with respect to mean number of leaves, in both Kew as well as Mauritius.

Influence of type of planting materials on crop duration of Kew and Mauritius varieties of pineapple are given in Table 3.

Table.3 Duration of plant crop in Kew and Mauritius variety with different types of planting materials

Treatments	Duration (days)
T1- Kew sucker	493.5
T2- Kew crown	498.9
T3- Mauritius sucker	415.5
T4- Mauritius crown	419.1
T5- Mauritius slip	417.7
CD 0.05	NS

Regarding crop duration from planting to harvest, plants raised from Kew crown took maximum days (498.9 days) for harvest followed by plants raised through Kew suckers (493.5 days), both values being on par with each other. Similarly, Mauritius plants raised through suckers, slips and crowns took 415.5, 417.7 and 419.1 days respectively, for harvest, all values being on par with one another. However Mauritius plants had shorter crop duration as compared to Kew plants, irrespective of type of planting materials.

Influence of type of planting materials on fruit yield and quality characters of Kew and Mauritius varieties of pineapple are given in Table 4.

Table.4 Fruit characters of Kew and Mauritius variety with different types of planting materials

Treatments	Fruit weight (kg)	Fruit weight without crown (kg)	TSS ⁰ B	Acidity (%)
T1 kew sucker	2.43	2.20	15.7	0.534
T2 Kew crown	2.31	2.06	15.6	0.541
T3 Mauritius sucker	1.40	1.31	17.0	0.435
T4 Mauritius crown	1.43	1.29	17.1	0.462
T5 Mauritius slip	1.39	1.25	17.4	0.468
CD 0.05	NS	NS	NS	NS

With respect to mean fruit weight with crown, in Kew, plants raised through suckers produced maximum fruit weight of 2.43 kg, the value being on par with that of plants raised through crown (2.31 kg). Mauritius plants raised from suckers, crowns and slips, registered lower fruit weights with crown, ranging from 1.39 kg to 1.43 kg. Values for fruit weight without crown were highest for Kew plants raised through suckers(2.20 kg) and crown (2.06 kg), both values being on par with each other. In the case of Mauritius variety, experimental plants raised through suckers, crowns and slips, were on par with one another, with respect to fruit weight without crown.

The results of the studies revealed that apart from suckers, rooted Kew crowns as well as rooted Mauritius slips and crowns, can be used successfully as alternative sources planting materials in pineapple. Omotoso (2014), also reported that irrespective of type and weight of propagule, there was no significant difference in fruit yield of pineapple. However, Hotegni et al., (2014),observed that fruits from planting heavy propagules, had higher fruit weight, smaller crowns and larger infrutescences. Regarding crop duration from planting to harvest, Kew plants raised from crown, took maximum duration(498.9 days), followed by Kew plants raised from suckers(493.5 days) and were on par with each other. The same trend

was noticed in Mauritius variety as well, where plants raised through crowns, registered maximum crop observed that in maturity. He further observed the fact that they develop while the parent plant is still in the vegetative phase and since they develop from subterranean buds, they grow into mature plants more quickly

No significant difference was observed among different planting materials in both Kew as well as Mauritius with respect to fruit quality characteristics like acidity and (table 4), an observation, in conformity with that of Hotegni et al.,(2014), who could not observe any significant variation in fruit quality, irrespective of the type of planting materials used.

Studies conducted at KAU showed that there was no significant difference between the size of suckers varying from 500 – 1000 gm and fruit weight in Kew variety under Kerala conditions (Balakrishnan et al.,1981, Varkey et al., 1984). However,,Bindu (1998) reported that when different sized suckers (500 g, 750 g and 1000 g) were used for planting in

to obtain satisfactory performance in plants raised from low vigour slips, which were recuperated by a nursery period, suggesting the possibility of making use of slips as planting materials. Nazzim & Amzad (1988) observed that the total yield was highest in plants propagated from crowns, followed by those from stem suckers and slips.



Suckers



Crowns



Slips



Mauritius sucker raised





Mauritius sucker raised plants



Mauritius slip raised plants



Mauritius crown raised plants



er raised plants



Kew crown raised plants

**valuation of tissue culture plants of pineapple varieties
ical programme**

ions-5

nts-4

T2 – Slips T3 – Crown T4 – Tissue culture plants

No of plants per treatment -60

The experiment was laid out at Pineapple Research Centre, Vellanikkara

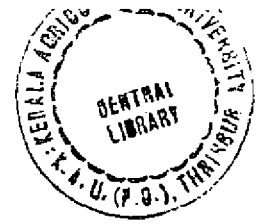


Table.5 Effect of conventional planting materials and tissue culture plants on fruit weight and duration of variety Mauritius

Treatments	Fruit weight with crown (kg)	Fruit wt. without crown (kg)	Duration (days)	T.S.S (^o B)
Mauritius suckers (3-4 months)	1.42	1.28	394	17.3
Mauritius slips (3-4 months)	1.44	1.27	401	17.5
Mauritius crown (3-4 months)	1.39	1.24	399	17.6
Mauritius TC (1 ½ years)	1.38	1.19	399	18.5
CD (0.05)	NS	NS	NS	NS

Results and discussions

Tissue culture plants of pineapple variety, Mauritius, were field planted and compared with plants raised from suckers, slips and crowns. Data on duration of the crop, yield and quality characters were recorded from plant as well as ratoon crop, the mean data of which is presented in Table 5. In the present study, no significant differences among type of planting materials was observed with respect to fruit weight with crown.(Table 5). Plants raised from 3-4 month old Mauritius slips registered maximum mean fruit weight with crown (1.44 kg) followed by plants raised through suckers (1.42 kg). Tissue culture derived plants of Mauritius recorded minimum mean fruit weight with crown (1.38 kg), the value being on par with those recorded by plants raised from suckers, slips and crown. However, pineapple fruits from sucker derived plantlets were smaller than fruits obtained from somatic embryo derived plants, in a study conducted by Salome *et al.*,(2011). Mauritius plants raised from crowns registered a mean value of 1.39 kg as fruit weight with crown.

A similar trend was noticed for mean fruit weight without crown, as well, wherein no significant differences were observed among various treatments. Regarding fruit weight without crown, maximum mean value was registered by Mauritius plants raised through suckers(1.28 kg), while plants raised through slips and crown registered mean weights of 1.27 kg and 1.24 kg respectively, for fruits without crown, all values being on par

with one another. Tissue culture derived plants recorded minimum values for mean fruit weight without crown (1.19 kg).

Plants raised through different types of planting materials produced values on par with one another with respect to crop duration, wherein maximum crop duration was witnessed in Mauritius plants raised through slips(401 days). Tissue culture derived plants as well as plants raised through crowns, registered crop durations of 399 days each, while shortest crop duration was registered by plants raised through suckers (394 days). Mhatre (2004) observed that micropropagated plants matured and set fruits in a synchronized manner, which could minimize the problem of natural flowering in pineapple cultivation. He also pointed out that since all plantlets are developed from a single initial culture in micropropagated plants, most of them should flower and set fruit at the same time when transferred to the field.

Though no significant differences were observed with respect to T.S.S of fruits, among type of planting materials, highest fruit T.S.S.(18.5 B) was recorded by tissue culture derived plants of Mauritius variety of pineapple *In vitro* propagation of pineapple for plantlet regeneration and conservation is well documented.(Kiss *et al.*,1995). Sudhadevi *et al.* ,(1996) have clearly indicated that tissue culture techniques can be successfully used for large scale production of elite planting materials of pineapple.

The results reveal that tissue culture plants of Mauritius variety of pineapple were as good as plants raised through suckers, slips and crowns with respect to yield and quality characteristics. These findings are of significance since low rate of multiplication by conventional methods and lack of quality propagules, which are major limitations in pineapple cultivation, could be overcome to a large extent, by the use of tissue culture derived plantlets as reported by (Farahani, 2014). Pattabiraman, (1999) also reported that the vegetative and yield characters of TC pineapple var.Mauritius were comparable with that of suckers. He also indicated the need for increased fertilizer applications for TC plants of pineapple to boost the yield. As reported by Firoozabady and Gutterson (2003) ,uniform planting materials can be produced in a relatively short period, independent of season through *in vitro* techniques. Also, being raised in bottles, tissue culture derived plants can be easily transported to distant places which can be seen as an additional advantage. Besides,rapid multiplication of select elite types can be effected through this technique as is observed by Danso *et al.*,(2008).

8	H.8	Nil			
9	H.9	Nil			
10	H.10	1.365	12	Selected 3	Sweet, K type
11	H.11	0.905	10	Not selected	M type
12	H.12	Nil			
13	H.13	1.845	13	Selected 4	Sweet, K type
14	H.14	1.940	11	Selected 5	Sweet, K type
15	H.15	1.140	12	Selected 6	Sweet, M type
16	H.16	1.100	11	Selected 7	Sweet, K type
17	H.17	1 kg	12	Selected 8	Sweet, M type
18	H.18	Nil			
19	H.19	1.181	14	Selected 9	Sweet, mixed character
20	H.20	0.625		Not selected	K type
21	H.21	0.963		Not selected	M type
22	H.22	Nil			
23	H.23	0.949			K type
24	H.24	Nil			
25	H.25	1.123	10	Not selected	K type
26	H.26	1.483	9	Not selected	K type
27	H.27	1.050	12	Selected 10	K type
28	H.28	0.963	14	Selected 11	Sweet, M type
29	H.29	0.800		Not selected	K type
30	H.30	1.668		Selected 12	Sweet, mixed character
31	H.31	0.850	10	Not selected	K type
32	H.32	Nil			

33	H.33	0.740		Not selected	K type
34	H.34	0.872		Not selected	K type
35	H.35	0.740	12	Selected 13	Sweet, K type
36	H.36	Nil			
37	H.37	2.300	6	Not selected	K type
38	H.38	1.090	11	Not selected	K type
39	H.39	0.845	10	Not selected	K type
40	H.40	1.465	7	Not selected	K type
41	H.41	0.860		Not selected	K type
42	H.42	0.975		Not selected	K type
43	H.43	1.200	14	Selected 14	M type
44	H.44	0.705		Not selected	K type
45	H.45	Nil			
46	H.46	Nil			
47	H.47	0944		Not selected	K type
48	H.48	1.145	14	Selected 15	Sweet, M type
49	H.49	0.993	16	Selected 16	Sweet, K type
50	H.50	0.800		Not selected	K type
51	H.51	Nil			
52	H.52	0.370		Not selected	K type
53	H.53	0.560		Not selected	K type
54	H.54	1.075	12	Selected 17	Sweet, Mixed charcters
55	H.55	Nil			
56	H.56	Nil			
57	H.57	2.258	10	Selected 18	Sweet, K type, Mixed

					characters
58	H.58	0.750	6	Not selected	K type
59	H.59	1.145	13	Selected 19	Sweet, Mixed characters
60	H.60	0.635	14	Selected 20	Sweet, MD-2 like
61	H.61	Nil			
62	H.62	1.200	13	Selected 21	Sweet, Mixed characters
63	H.63	1 kg	12	Selected 22	Sweet, M type
64	H.64	Nil			
65	H.65	Nil			
66	H.66	1.680	10	Selected 23	K type
67	H.67	Nil			
68	H.68	Nil			
69	H.69	Nil			
70	H.70	0.856	12	Selected 24	Sweet, M type
71	H.71	1.185		Not selected	M type
72	H.72	0.900	9	Not selected	Sour
73	H.73	0.985	7	Not selected	Sour
74	H.74	1.352	7	Not selected	Sour
75	H.75	Nil			
76	H.76	Nil			
77	H.77	0.682	17	Selected 25	Sweet, M type
78	H.78	1 kg	12	Selected 26	Sweet,
79	H.79	1.046		Not selected	Sour
80	H.80	Nil			

81	H.81	0.858		Not selected	
82	H.82	2.010	9	Not selected	Sour, K type
83	H.83	Nil			
84	H.84	1 kg	10	Not selected	Sour, K type
85	H.85	1 KG	14	Selected 27	Sweet, Ktype
86	H.86	1.300	14	Selected 28	Sweet, M type
87	H.87	0.837	7	Not selected	K type
88	H.88	Nil			
89	H.89	Nil			
90	H.90	Nil			
91	H.91	1.290	10	Selected 29	Sweet, K type
92	H.92	0.960	13	Selected 30	Mixed, very tastey
93	H.93	Nil			
94	H.94	Nil			
95	H.95	1.400	8	Not selected	K type
96	H.96	Nil			
97	H.97	Nil			

Based on fruit weight and fruit quality parameters like fruit shape TSS and sweetness. 30 hybrids registering a fruit weight of more than 1 kg and TSS of 10⁰B and above were selected (Table 6) and advanced to the next generation. In Japanese breeding programme on pineapple also, the present selection criteria for fruit characteristics include fruit weights ranging from 1-1.5 kg (Shoda,2011). Primary selection in pineapple focuses on fruit quality characteristics that show high heritability like juice Brix and acidity.(Shoda,2011), the criteria, on which selection to identify superior hybrids was based in the present study as well. The selection criteria have to be adopted to prevent high influence of environmental factors(Louis Cabot,1987). The plant characters of the selected 30 MXK hybrids are given in Table 7..

Hybrids

Table.7 Plant crop I – Plant characteristics of selected (M x K) hybrids

Sl. No	Hybrid (M x K)	Plant characteristics
1	H.1	K type, Spineless,
2	H.7	K type but Spiny leaves
3	H.10	K type, broad leaf, spineless
4	H.13	Mixed character, large spine, large leaves, thin leaf
5	H.14	K type,
6	H.15	M type, long leaves, spiny
7	H.16	Mixed character, broad leaves with spiny
8	H.17	M type, spiny
9	H.19	Mixed character, long leaf, spiny
10	H.27	Mixed character, spiny, dark colour leaves
11	H.28	M type, spiny,
12	H.30	K type, spineless
13	H. 35	K type, spineless
14	H.43	Mixed character, large spine, broad leaf
15	H.48	K type, broad long leaves, spineless
16	H.49	K type, spineless
17	H.54	K type, spineless narrow leaves
18	H.57	Mixed character, broad leaves, spiny
19	H.59	Mixed character, spiny leaves
20	H.60	K type, spineless

21	H.62	M type, broad leaves with spiny
22	H.63	M type, spiny
23	H.66	M type, spiny
24	H.70	K type, long leaves
25	H.77	M type, spiny
26	H.78	K type, broad and spiny leaves
27	H.85	M type, long, thin and spiny leaves
28	H.86	M type, spiny, long and thin leaves
29	H.91	Mixed character with spiny leaves
30	H.92	Mixed character with spiny leaves

Among the thirty selected MXK hybrids, twelve resembled the female parent Kew, with broad and spineless leaves, nine resembled Mauritius, with long and spiny leaves and nine hybrids exhibiting mixed plant characters of both Kew and Mauritius, like spiny nature of leaves, derived from Mauritius genotype and broad leaves, derived from Kew genotype.



The fruit characteristics of 30 selected M x K hybrids are given in Table 8

Table.8 Fruit characteristics of selected M x K hybrids (Plant crop I)

Sl. No	Hybrid (M xK)	Fruit weight (kg)	TSS ⁰ B	Taste and character
1	H.1	1.125	15	Very good, Kew type

2	H.7	1.132	14	Sweet, M type
3	H.10	1.365	12	Sweet, K type
4	H.13	1.845	13	Sweet, K type
5	H.14	1.940	11	Sweet, K type
6	H.15	1.140	12	Sweet, M type
7	H.16	1.100	11	Sweet, K type
8	H.17	1 kg	12	Sweet M type
9	H.19	1.181	14	Sweet, mixed character
10	H.27	1.050	12	K type
11	H.28	0.963	14	Sweet, M type
12	H.30	1.668		Sweet, mixed character
13	H.35	0.740	12	Sweet, K type
14	H.43	1.200	14	M type
15	H.48	1.145	14	Sweet, M type
16	H.49	0.993	16	Sweet, K type
17	H.54	1.075	12	Sweet, Mixed characters
18	H.57	2.258	14	Sweet, K type, yellow flesh, medium juicy
19	H.59	1.145	13	Sweet, Mixed characters
20	H.60	0.635	14	Sweet, MD-2 like (golden yellow)
21	H.62	1.200	13	Sweet, Mixed characters
22	H.63	1 kg	12	Sweet, M type
23	H.66	1.680	10	K type
24	H.70	0.856	12	Sweet, M type
25	H.77	0.682	17	Sweet, M type

26	H.78	1.00	12	Sweet,
27	H.85	1.000	14	Sweet, Ktype
28	H.86	1.300	14	Sweet, M type
29	H.91	1.290	10	Sweet, K type
30	H.92	0.960	13	Mixed, very tasty

On evaluating the hybrids based on fruit characters, the MXK hybrid H-13 with a fruit weight of 1.895 kg and TSS OF 13 resembled Kew in its cylindrical fruit shape and its flesh was sweet as Mauritius. Another MXK hybrid H-14 registered a fruit weight of 1.940 with a TSS of 11⁰B, also resembled Kew in its fruit shape, but was sweet like Mauritius. Among the selected MXK hybrids, maximum fruit weight was recorded by H-57 (2.258 kg) and a TSS of 14⁰B. Pineapple cultivars are heterozygous and hybridization is a valuable method in generating widely variable genotypes through gene recombination. (Wortman and Kerns, 1959). All the above three MXK hybrids can be rated as promising. Hybrids H-85 and H-86, each, with a TSS OF 14⁰B and hybrid, H-77, with a TSS of 17⁰B were sweet, with Mauritius like flesh. However the mean fruit weights of H-85 and H-77 were only 1.000 kg and 0.682 kg respectively, while H-86 registered a medium fruit weight of 1.300 kg. Evaluation of hybrid progenies from biparental hybridization in pineapple indicated that for T.S.S. the range of values often exhibit transgressive segregation i.e. the minimum and maximum values of hybrids exceeded the the lowest and highest values of both the parents, as is reported by Sanewski, (1998).





MXK (Plant crop II)

The yield and quality characteristics of fruits of plant crop I of MXK hybrids are presented in Table 9.

Table 9. Fruit characteristics of M x K Hybrids (Plant crop II)

Sl. No	MxK hybrid	Fruit weight (kg)	TSS ⁰ B	Acidity(%)	Reducing Sugar(%)	Total sugar(%)	Taste and characteristic
1	H – 10-11	1.714	12	0.460	5	18	K type fruit, spiny m type crown, sweet and no sour, cream colour flesh
2	H – 19-11	1.033	12	0.460	5	17	MD – 2 type fruit, spiny m type crown, k type eyes
3	H – 48-11	1.163	12	1.02	5	16	M type fruit, spineless and small crown, golden yellow flesh,
4	H – 57-11	2.200	14	0.435	7.1	19	M type fruit, oval shape, golden yellow flesh, very good taste, m like crown with

							spiny, large eyes
5	H-13-11	1.903	12	0.665	4.4	16	M type fruit and crown. Eyes large. Golden yellow flesh
6	H-54-11	1.070	13	0.435	3.5	14.5	Round shape, Mauritius like fruit with protruded eyes, small, spiny crown, golden yellow flesh, juicy, acidic as well as sweet
7	H-92-11	0.908	11	0.358	3.9	13.7	Mauritius like fruit with bulged eyes, small crown, golden yellow flesh, juicy, bland taste
8	H-27-11	0.928	12	0.716	4.4	14.8	Fruit shape round like MD-2, spiny crown, eyes bulged, golden yellow, flesh, juicy, sweet and acidic taste
9	H-28-11	1.139	11	0.614	4.8	15.3	M type fruit, eyes bulged, small spiny crown, flesh golden yellow, very juicy, sweet and acidic taste
10	H-70-11	0.715	13	0.588	3.6	17.4	Very small multiple crown small round fruit, flesh cream coloured, very sweet

Hybrid, H-57-11, recorded superior characteristics, yielding Mauritius type fruits, weighing 2.20 kg, oval in shape, with large eyes, with a mean eye length of 2.5 cm and golden yellow flesh. Fruits recorded a TSS OF 14⁰B and were sweet with good taste and flavour and low acidity of 0.435. Two promising hybrids, H-10-11 and H-13-11 recorded fruit weights of 1.714 and 1.903 kg respectively. The fruit shape of H-10-11 was Kew like with Mauritius like crown, which is a desirable character. The fruits recorded low acidity of 0.460 per cent and were sweet, with a total sugar content of 18.5. H-13-11 bore Mauritius type fruits with golden yellow flesh with a TSS OF 12⁰B



KXM HYBRIDS

About 30 crosses were made with Mauritius as female parent and Kew as the female parent resulting in 24 KxM hybrids. Plant characteristics of these 24 hybrids are presented in Table 10.

Hybrids

Table.10 Plant characteristics of K x M Hybrids (Plant crop I)

Sl. No	Hybrid (KXM)	Plant characteristics
1	H.98	K type with respect to plant appearance, spiny, thin
2	H.9.9	K type, spineless, broad
3	H.100	K type, spineless, long leaves
4	H.101	K type, spiny, broad leaves
5	H.102	K type, spineless, long leaves

6	H.103	K type, spineless
7	H.104	K type, spiny, long leaves
8	H.105	K type, spiny, long leaves
9	H.106	K type, spiny
10	H.107	K type, spineless
11	H.108	K type, spiny, broad leaves
12	H.109	K type, spiny, dark green leaves
13	H.110	K type, spineless
14	H.111	K type, spiny
15	H.112	K type spiny, long leaves
16	H.113	K type, spineless
17	H.114	K type, spiny
18	H.115	Mixed character, M type, spiny, long leaves
19	H.116	K type, spiny, small leaves
20	H.117	K type spiny
21	H.118	K type, spiny, broad leaves
22	H.119	K type, spiny, long leaves
23	H.120	K type, spiny, long leaves
24	H.121	K type, spiny and broad leaves

Among the 24 KXM hybrids, 23 hybrids recorded Kew like characters, while one hybrid registered mixed characters of Kew and Mauritius.

Table 11 gives the fruit yield and quality characteristics of the above 24 hybrids

Table 11 Fruit characteristics of K x M Hybrids (Plant crop I)

Sl. No	Hybrid (K x M)	Fruit weight (kg)	TSS ⁰ B	Acidity(%)	Reducing Sugar(%)	Total sugar(%)	Fruit characteristics
1	H-98	1.225	16	0.495	5.2	15	M type fruit, sweet, golden yellow flesh, Mauritius like crown
2	H-99	1.200	14	0.545	5.0	14	M type fruit. Mauritius like crown, golden yellow flesh and sweet
3	H-100	1.744	12	0.486	6.4	17	Fruit shape is conical and crown small and spiny like Mauritius, but multiple , flesh cream coloured and juicy, like Kew.
4	H-101	0.650	19	0.486	5	16	K type fruit, m type crown, golden yellow flesh and juicy
5	H-102	1.600	14	0.409	5.7	14	K type fruit, golden yellow and crispy flesh, multiple crown
6	H-103	0.624	12	0.691	3.3	14	K type fruit, m type crown, purple yellow flesh
7	H-104	2.236	15	0.563	5	17	Mixed character, abnormal shape , kew like flesh
8	H-107	1.330	9	0.384	4.8	16	M type fruit, conical shape, eyes

							bulged, small crown without spine, pale yellow flesh
9	H-108	1.700	11	0.665	3.3	14	Cylindrical shaped Kew like fruit, large eyes, multiple crown , juicy, creamy white flesh
10	H-109	1.329	10	0.921	3.3	16	K type and conical shape fruit, m type crown with spiny, eyes bulged, golden yellow flesh
11	H-110	1.200	14	0.486	4.7	23	MD-2 type fruit, round shape, K type crown, tasty
12	H-111	1.313	16	0.409	9.0	22	Fruits round, resembling MD-2, crown, Mauritius like, multiple , with golden yellow flesh.very sweet
13	H-113	1.290	20	0.460	5.0	16	Kew like fruit with flat eyes,small crown with sparse spines
14	H-114	0.719	20	0.665%	10%	23%	K type fruit, M type crown, golden yellow flesh, very sweet
15	H-115	1.650	14	0.423	5.120	24	K type fruit with respect to fruit shape, crown and fruit flesh. Fruits were juicy,sweet, with good taste

16	H-116	1.100	9	0.768%	2.8%	13%	K type round shape fruit, without crown, golden yellow and juicy flesh
17	H-118	1.827	9	0.755	2.9	14	Fruit shape typical cylinder shape resembling Kew, crown also Kew like, fruits juicy, but with golden yellow flesh, resembling Mauritius.
18	H-119	1.100	22	0.384	8.33%	25.8	Fruit Mauritius type, eyes protruded with golden yellow flesh, but cylindrical like Kew, extremely sweet
19	H-120	0.967	12	0.384%	6.8%	13	Mauritius type and conical fruit, multiple and spiny small crown, creamy yellow flesh
20	H-121	2.000	9	0.876	3.1	12	Mauritius type fruit shape with Kew like flesh, Mauritius like crown

Based on fruit weight and fruit quality parameters like fruit shape, TSS and sweetness, -5 hybrids registering higher fruit weight and high TSS and super quality characteristics were selected (Table 11) and advanced to the next generation (Plant crop 2).

Among the selected KXM hybrids, **H-115** with a fruit weight of 1.680 kg and a TSS of 14⁰B, registered a high value for content of total sugars(24 %).Fruits resemble Kew, with respect to fruit shape, crown, juiciness and fruit flesh and were tasty. Two selected KXM hybrids, **H-118** and **H-121** recorded very high fruit weights of 1.827 kg and 2.0 kg respectively, with the former yielding Kew like fruit with typical cylindrical shape, large crown and golden yellow flesh, like Mauritius of TSS 9⁰B and the latter, yielding Mauritius like fruit with respect to shape, but juicy like Kew, with a TSS of 9⁰B. Another promising hybrid, **H - 119** yielded Mauritius type fruit with golden yellow flesh and protruded eyes but with cylindrical fruit shape, like Kew. Fruit is extremely sweet with a TSS of 22⁰⁰B , acidity, 0.384% and reducing sugar, 8.33 %..The other selected hybrid, **H-113**, with a fruit weight of 1.290 kg was extremely sweet, with a TSS of 20⁰B and a low acidity of 0.460%. Fruits were Kew like with flat eyes, but crown was small with sparse spines, resembling Mauritius.



Hybrid, H-100, with a fruit weight of 1.744 kg, was conical shaped, with small spiny crown, like Mauritius and a TSS of 12⁰B. However, fruits were juicy and cream coloured like Kew and multiple crowns were formed. Hybrid, H-111, with a fruit weight of 1.313 kg, registered a high TSS of 16⁰B and high content of total sugar content(22 %). The fruit shape resembled MD-2, with golden yellow flesh and crown, resembling Mauritius

Hybrid H- 98 registered a fruit weight of 1.225 kg. The fruit shape and quality parameters of the hybrid resembled Mauritius with golden yellow flesh registering a high TSS of 16⁰B . Hybrid H-102 yielded Kew like fruit with respect to shape, with a fruit weight of 1.600 kg, but with crispy, not very juicy flesh like Mauritius, with a TSS of 14⁰B. The values for acidity, reducing sugar and total sugar were 0.409, 5.7 and 14.0, respectively. However, multiple crowns were produced by the hybrid. The hybrid, H-110, yielded round fruits, of 1.200 kg, resembling MD-2, tasty with Kew like crown and a TSS of 14⁰B, acidity of 0.486, reducing sugar of 4.7 and total sugar of 23, indicative of its sweetness. Two selected KXM hybrids, H-114 and H-101, though, with lower fruit weight registered very high TSS of 20⁰B and 19⁰B respectively, with the golden yellow fruit flesh of both the hybrids, resembling Mauritius and fruit shape resembling Kew. However, the crown of fruits of both the hybrids was small like Mauritius. The fruits of H-114 were very sweet with a high TSS of 20⁰B and contents of total

and reducing sugars of 23 and 10, respectively. The hybrid H-101, though of low fruit weight, also recorded high TSS of 19⁰B, with a low acidity level (0.486.). The hybrid, H-111, with a fruit weight of 1.313 kg, yielded round fruits resembling MD-2, with small sized multiple crowns, golden yellow flesh with a TSS of 16⁰B and low acidity of 0.409 and total sugar of 22%

In pineapple, important considerations in hybridization include choice of parents, direction of cross, time of crossing and suitable hybrid population size. (Chan, 2006). This observation proved true in the present study, wherein, crosses conducted with Kew as the female parent and Mauritius as the male parent resulted in a greater proportion of abnormal progenies (H-100, H-102, H-104, H-108, H-111, H-120) like those with misshapen fruits and multiple crowns, as compared to the reciprocal crosses.



14. Major equipments purchased :

- a. Honda Brush cutter – Rs.24539/-

15. Major infrastructure created :

- a. Setting up a sprinkler irrigation system in nursery – Rs.7084/-
- b. Truss work for waiting shed of labourers – Rs.8400/-
- c. Widening and deepening of pond – Rs.98550/-

16. Major outcome of the project

As a part of enrichment of new germplasm of pineapple and their evaluation, The exotic variety MD-2 was added to the germplasm and its suitability to be popularized as a commercial variety of pineapple was assessed leading to the conclusion that the variety performed reasonably well under Vellanikkara conditions. As a result of the studies on evaluation of performance of pineapple varieties with

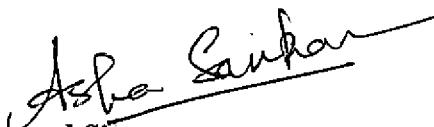
different type of planting materials, it was revealed that apart from suckers, rooted Kew crowns as well as rooted Mauritius slips and crowns, can be used successfully as alternative sources planting materials in pineapple. Exploitation of *in vitro* techniques was identified as a viable alternative for increased generation of planting materials in view of rapid area expansion under pineapple, wherein, tissue culture plants of Mauritius variety of pineapple were as good as plants raised through suckers, slips and crowns with respect to yield and quality characteristics. Breeding trials conducted in the crop for improving the fruit size of variety Mauritius and develop new varieties for table purpose having desirable quality characters of Mauritius and high yield potential of Kew resulted in generating promising hybrids with fruit weight above 2 kg and TSS of more than 20, which are being subjected to further evaluation.


17. Major technological outcome i.e, useful for the farming community as a whole

Adaptability of the super sweet, globally renowned MD2 variety to Kerala conditions was established. A viable solution to the dearth of planting materials, which is a major limitation towards expansion of existing area under pineapple leading to its large scale production, was a major outcome of the project, wherein, it was revealed that apart from suckers, rooted crowns as well as rooted slips and tissue culture plants can be used successfully as alternative sources planting materials in pineapple. Breeding trials conducted in the project, have resulted in generating promising hybrids with good fruit weight and high TSS, which, after repeated evaluation and consistent performance can lead to variety development and their subsequent commercialization.

18. % of achievement (both Scientific& Financial) :

- a. Scientific – 100 per cent
- b. Financial – 100 per cent

Sd/- 
Name and Signature of PI
M.Asha Sankar, Prof.(Hort)
PRC, Vellanikkara

Sd/- 
Signature of Heads of Station
Dr.P.B.Pushpalatha
Professor & Head
BRS, Kannara

References

- Adunga, J.C. 1973. Rooting behaviour of different type of pineapple propagating materials. *Acta Hort.* 33:155-160
- Balakrishnan, S., Nayar, N.R. and Mathew, V. 1981. Effect of size of suckers on growth and yield of pineapple (*Ananas comosus* Merr.) cv. Kew. *J. Agric. Res. J. Kerala* 19(1): 1-4
- Bindu, V. 1998. Influence size of suckers and methods of planting on growth and yield of pineapple var Mauritius. MSc.(Hort) Thesis, Kerala Agricultural University 129P.
- Chan, Y.K. and Lee, H.K. 1996. Josapine: a new pineapple hybrid developed at MARDI. In: Osman, M., Clyde, M.M. and Zamrod, Z. (eds) *The Second National Conference on Genetics: Genetics Society of Malaysia*, UKM, Bangi, pp.217-220.
- Chan, Y.K. 2006. Hybridization and selection in pineapple improvement. The experience in Malaysia. *Acta Hort.* 702:87-92.
- Danso, K.E., Ayah, K.O., Oduro, V., Amiteye, S., Amoatey, H.M. 2008. Effect of 6-BAP and NAA on *in vitro* production of MD-2 pineapple planting materials. *World Appl. Sci. J.* 3(4):614 – 619.
- Farahani, F. 2014. Micropropagation and growth of *in vitro* pineapple (*Ananas comosus* (L.) Merr.) in Iran. *Plant Archives* 14(1):337-341.
- Firoozabady, E. and Gutterson, N. 2003. Cost effective *in vitro* propagation methods for pineapple. *Pl. cell Reports.* 21:844- 850.
- Hotegni, V.N., Lommen, W.J.M., Agbossou, E.K. and Strinck, P.C. Influence of type of planting material on fruit quality and heterogeneity of pineapple (*Ananas comosus* (L.) Merrill). *Front. Pl. Sci.* 5:798.
- Kiss, E., Kiss, J., Gyulai, G., and Heszky, L. 1995. A novel method for rapid micropropagation of pineapple. *HortScience.* 30 :127-129.
- Louis Cabot, C. 1987. Practice of pineapple breeding. *Acta Hort.* 196:25-36.
- Mhatre, M. 2000. Micropropagation of pineapple, *Ananas comosus* (L.) Merr. Protocols for micropropagation of woody trees and fruits.
- Nazzim, M.D. and Amzad, K.M. 1988. Effect of different types of planting materials on the growth and yield of pineapple cv Giant Kew. *Bangladesh Hort.* 16(2):30-34.
- Omotoso, S.O. 2014. Performance of pineapple (*Ananas comosus* (L.) Merr) plantlets as influenced by type and weight of propagules. *Global Advanced Res. J. agric. Sci.* 3:373-378.
- Patabhraman, 1999. Evaluation of *in vitro* multiplied accessions of pineapple cv. Mauritius. Msc.(Hort) thesis submitted to Kerala Agricultural University. pp.125-175.

809072

Reinhardt,D.H.,Souza,A.P.H.,Caldar,R.C.,Alcantara, J.P. and Almeida,A.A. 2003. Management of slips and its effect on growth and production of Perola pineapple plants. *Rev.Bras. Fruitic.* 25 (2): 248-252.

Salome, E.S., Laurent, K., Irenee, J.P., Patricia,K. and Hilaire,T.2011. Comparison of pineapple fruit characteristics of plants propagated in three different ways:By suckers, micropropagation of plants and somatic embryogenesis. *J. Nutrition and Food Sci.* ISSN:2155-9600.

Sanewskij,G.M. 1998.The Australian pineapple fresh market breeding programme In: *Abstracts of third international Pineapple Symposium*, 17-20 November, 1998. Department of Agriculture, Pattaya,, Thailand, p 51.

Shoda, M. 2011. Pineapple: Introduction, industry and current domestic production. *Food Prez. Sci.*3:249-255.

Sudhadevi,P.K. Geetha,C.K., Rajeevan,P.K. and Valsalakumari.P.K. 1996. Performance of *in vitro* developed plantlets of pineapple cv.Kew.S.*Indian Hort.*43:166-167.

Tang,C.,Tsai,M.H.,Tsai,H.W. and Kusan, C.S. 2014. Anew variety of pineapple (*Ananas comosus*(L.) Merr.)" TN 21 Golden". *J. Taiwan Agric. Res.*63:167-177.

Varkey, P.A., Nair,M., George, T.E., Aipe, K.C. and Methew, L.1984. Growth, flowering duration and fruit characteristics as influenced by the size of propagule in pineapple (*Ananas comosus* Merr) cv. Kew. *S. Indian Hort.*32(6):327-329.

Wortman, S. and Kerns, K.R. 1959.The plant breeding programme 1955-1958 *Research Report No 6*, Pineapple Research Institute,Honolulu, Hawaii, 180pp.



809072