EVALUATION OF *IN VITRO* MULTIPLIED ACCESSIONS OF PINEAPPLE (*Ananas comosus* [L.] Merr.) CV. MAURITIUS

By

S. PATTABI RAMAN

THESIS

Submitted in partial fulfilment of the requirement for the degree of

Master of Science in Horticulture

Faculty of Agriculture

Kerala Agricultural University

Department of Pomology and Floriculture

COLLEGE OF HORTICULTURE

VELLANIKKARA, THRISSUR - 680 656

KERALA, INDIA

1999

DECLARATION

I hereby declare that this thesis entitled **"Evaluation of *in vitro* multiplied accessions of pineapple (*Ananas comosus* [L.] Merr.) cv. Mauritius"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

Vellanikkara

Date 6.12.99

S. Pattabi Raman

Dr. T. Radha
Chairman, Advisory Committee
Associate Professor
Kerala Horticultural Development Programme
College of Horticulture
Vellanikkara

CERTIFICATE

Certified that this thesis entitled **"Evaluation of *in vitro* multiplied accessions of pineapple (*Ananas comosus* [L.] Merr.) cv. Mauritius"** is a record of research work done independently by **Mr. S. Pattabi Raman,** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to him.

Vellanikkara
Date 6.12.99

Dr. T. Radha

CERTIFICATE

We, the undersigned members of the Advisory Committee of **Mr. S. Pattabi Raman,** a candidate for the degree of **Master of Science in Horticulture**, agree that the thesis entitled **"Evaluation of *in vitro* multiplied accessions of pineapple (*Ananas comosus* [L.] Merr.) cv. Mauritius"** may be submitted by **Mr. S. Pattabi Raman** in partial fulfilment of the requirement for the degree.

Dr. T. Radha
(Chairman, Advisory Committee)
Associate Professor
Kerala Horticultural Development Programme
College of Horticulture, Vellanikkara

Dr. P.K. Rajeevan
(Member, Advisory Committee)
Professor & Head i/c
Dept. of Pomology & Floriculture
College of Horticulture
Vellanikkara

Dr. Achamma Oommen
(Member, Advisory Committee)
Professor
Dept. of Plant Breeding & Genetics
College of Horticulture
Vellanikkara

Dr. K. Aravindakshan
(Member, Advisory Committee)
Assoc. Professor
Kerala Horticultural Development Programme
College of Horticulture
Vellanikkara

EXTERNAL EXAMINER

ACKNOWLEDGEMENT

With immense pleasure, I wish to express and place on record my sincere and utmost gratitude to ***Dr. T. Radha****, Associate Professor,* Kerala Horticultural Development Programme, *College of Horticulture and Chairman of my advisory committee for her profound guidance, critical suggestions, keen interest and unswerving support throughout the investigation and preparation of the thesis. The concern bestowed by her in every attempt of this research work was unique.*

I am surpassingly privileged to place my deep sense of gratitude to ***Dr. P.K. Rajeevan****, Professor and Head i/c, Department of Pomology and Floriculture and member of my advisory committee for his kind concern, expert advice, and everwilling help which has helped a lot for the improvement of this work.*

It is my pleasant privilege to oblige ***Dr. K. Aravindakshan****, Associate Professor, KHDP and member of my advisory committee for his expert counsel, sharp and constructive criticism, valuable suggestions and timely support during the entire period of my research.*

I express my gratitude with respect and esteem regards to Dr. Achamma Oommen, Professor and member of my advisory committee for all sort of help rendered by her for the completion of this research.

I express my heartfelt gratitude to Dr. T.R. Gopalakrishnan, Associate professor and Head, KHDP and Dr. Nandhini, Associate Professor, for providing me all the facilities, which was instrumental for the successful completion of this work.

I sincerely acknowledge the relevant suggestions, which I have received from Dr.Babylatha and Dr. Omana Pavunny, Associate Professor, KHDP (R&D). My sincere thanks are also due to Dr. Sarah T. George, Dr. Lila Mathew and Dr. Sajan Kurian, Department of Pomology and Floriculture for their friendly help and constant encouragement.

I gratefully acknowledge the help rendered by Dr. John, Associate Professor, Department of Agronomy and Dr. Augustine, Associate Professor, Department of Biochemistry for rendering the necessary help during the course of my lab analysis. Iam also thankful to Sri. S. Krishnan, Assistant Professor, Department of Agricultural Statistics for his help in the analysis and interpretation of the results.

With all regards I sincerely acknowledge the whole hearted co-operation and generous help rendered by the teaching and non teaching staff and labourers of Dept. of Pomology and Floriculture and KHDP.

I wish to place on record the help rendered to me in pursuit of my study by Manjula, Kalasalingam and Valsala, Research Associates, KHDP for their kind cooperation and timely help.

I owe thanks to my friends, Rao sir, Ajith[3] (K.,B. and C.B.), Ramesha, Murali, Sainu, Sunil, Niranjan, Radha, Laxmi, Karthik, Senthil, Fathima, Annie, Sreeja, Renu, Lalitha, Gouthami and Lavanya, who all extended a helping hand at each and every juncture of my work.

My sincere thanks to Mr.Joy for the prompt and neat typing of the manuscript and Mr.Benny of Copycats, Thrissur for scanning and printing of photographs.

My profound sense of gratitude to my friends Padhu, Madhu, Vidhya, Uma and Veer who all have been the source of inspiration for me at all critical junctures.

A special note of thanks to Mr. Sridaran whose brotherly affection and encouragement had helped a lot in successful completion of this dissertation.

Words cannot express my soulful gratitude to my beloved friends ***Subash*** *and* ***Sridevi****, without whose encouragement and sacrifice, the study would have never seen the light.*

I am forever beholden to my parents and my family members for their boundless affection, support and prayers.

S. Pattabi Raman

Dedicated To My Beloved Brother Ramki

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVATIONS

CGR	-	Crop Growth Rate
DMP	-	Dry matter partitioning
Fig.	-	Figure
LAI	-	Leaf Area Index
LAR	-	Leaf Area Ratio
MAP	-	Month after planting
NAR	-	Net Assimilation Rate
RBD	-	Randomized Block Design
RGR	-	Relative Growth Rate
TC	-	Tissue culture
TDM	-	Total dry matter
TSS	-	Total Soluble Solids

Introduction

1. INTRODUCTION

Pineapple (*Ananas comosus* [Linn.] Merr.), a member of the family Bromeliaceae, is one of the most important commercial fruit-crops of the world. In India pineapple occupies an area of 68,482 hectares with an annual production of 1.07 million tonnes (Das *et. al.*,1999). Exquisite taste, pleasant flavour, aroma and seedlessness qualify pineapple as one of the choicest fruits throughout the world. Pineapple fruit is a good source of vitamins and also minerals like calcium, magnesium, potassium and iron. Besides, it is also rich in a digestive enzyme called bromelin.

The congenial humid tropical climate has favoured the cultivation of pineapple in states like Assam, Kerala, West Bengal, Meghalaya and Karnataka. In Kerala, it is cultivated in an area of 8580 hectares with a production of 57,316 tonnes (FIB, 1999). Kew and Mauritius are the two cultivars grown in the state. Mauritius has a comparative advantage over Kew in terms of better fruit quality, attractive flesh colour, better keeping quality and shorter duration and hence it replaced Kew to a large extent in Kerala in recent years. Due to its high market preference and consumer acceptability commercial cultivation of Mauritius is extensively practiced in Ernakulam, Kottayam and Idukki districts.

Though phenomenal increase in the extent of cultivation of Mauritius pineapple has taken place in recent years, practically no serious research efforts have been undertaken for its improvement. The quest for improvement of this cultivar needs attention due to the demand for greater productivity and better fruit size and quality. Improved cultivar will contribute to higher productivity by permitting higher yields per unit area. For clonal cultivars of vegetatively propagated species like pineapple, steps included in cultivar improvement are, development of population with greater genetic variability for the characters of

interest, evaluation of individual clones, selection, multiplication and distribution of superior clones.

The plant population of Mauritius exhibits high degree of variation in plant and yield characters indicating the scope for improvement through clonal selection of plants for higher yield and other desirable qualities. Selection of elite clones from a population and its evaluation for confirming the superiority can be used as a viable tool for crop improvement in Mauritius pineapple.

As a part of the post graduate project entitled "Refinement of *in vitro* propagation technique in pineapple var. Mauritius and mass multiplication of elite clones" by Jose (1996), a survey was conducted in major Mauritius growing areas of Ernakulam district to identify elite plants. After a thorough field evaluation of plant and yield characters of the initially located plants, five accessions were finally selected and multiplied using the standardized *in vitro* technique and the plantlets were being maintained.

In the present study, the performance of *in vitro* multiplied elite accessions of pineapple cv. Mauritius were compared against conventional suckers and with *in vitro* developed plants of unselected bulk, for testing the superiority of selected accessions and also to check whether they exhibit the characters of their mother plants as described by Jose (1996).

The results of previous experiments with tissue culture plants in crops like banana have revealed that they require higher doses of nitrogen and potassium fertilizers for better performance. Hence in the present study, the selected accessions were evaluated with fertilizer dose equal to the Package of Practices recommendations for pineapple (KAU, 1996) and also with a 50 per cent increased fertilizer dose.

In this context, the present study was undertaken with the following major objectives.

i. To evaluate the growth and development of *in vitro* developed elite accessions of pineapple cv. Mauritius against *in vitro* developed unselected bulk and with conventional suckers.

ii. To isolate the superior accessions based on general performance in the field.

iii. To evaluate the effect of fertilizer doses on growth and development of planting materials.

Review of Literature

2. REVIEW OF LITERATURE

The available literature concerning the studies on "Evaluation of *in vitro* multiplied accessions of pineapple (*Ananas comosus* [L.] Merr.) cv. Mauritius" has been reviewed in the following pages under relevant heads. As there are very limited research work pertaining to the field performance of *in vitro* plants of pineapple, similar works on other fruit crops has been included in the review.

2.1 Clonal variation and selection of elite plants

Clonal variation, selection and multiplication of elite clones offers a viable tool for crop improvement in pineapple. Clonal propagation has a desired advantage in pineapple as it permits faster multiplication and maintenance of any genotype as clones. Any clone which contains a combination of desirable characters can be multiplied and tested under different environments thereby locating the superior clones through selection.

Though pineapple is propagated asexually, reports on existence of variations in both plant and fruit characters in this crop are available. Collins (1960) reported several types of mutations like spiny leaves, multiple crown, enlarged fruitlets, increased fruit length etc. in Cayenne group of pineapple. Marr (1965) also described several mutated forms in this plant and stressed the need for selection of plants for yield and quality. Singh *et al.* (1976) reported that these variations in pineapple are mostly due to spontaneous bud mutations. They also reported chimera and gene mutations for some leaf characters in cultivar Kew. Kew appears to be in a heterozygous form for smooth spiny tip character, wherein a mutation led to homozygous recessive spineless type.

Mathew *et al.* (1979) reported the genetic variability in pineapple for quantitative and qualitative traits. They estimated phenotypic and genotypic variability, coefficients of variation, heritability and genetic advance and found that all were high for leaf number per plant, fruit weight without crown, fruit length:breadth ratio, canning ratio, TSS, nonreducing sugars and sugar:acid ratio.

Lacoeuilhe (1991) stated that there was a great scope for improvement of pineapple cultivars by exploiting the genetic variation. Duval *et al.* (1993) also reported the genetic variability in 89 selected clones of cultivated pineapple for 27 quantitative and 18 qualitative traits. Isozyme polymorphism has also been reported by many authors in pineapple (Dewald *et al.*, 1992 and Arias *et al.*, 1997).

Variations in plant and fruit characters are very often observed in pineapple. Wakasa (1979) studied the variation in the plants differentiated from the tissue culture of pineapple. He stated that variation existed for all the characters studied in plants regenerated from syncarp tissue and it was rare when the plants regenerated from slips and crowns of axillary bud. Varietal variations in pineapple for various morphological and nutritive characters were reported by Nayar and Lyla (1981). According to them, the cultivars Smooth Cayenne and Kew were the best with regard to marketing quality and Mauritius was the best table cultivar. Nayar *et al.* (1981) reported the varietal variation on pollen size and fertility in 15 varieties of pineapple.

Elite types of pineapple are selected based on vegetative and fruit characters. Vegetative vigour of a plant is assessed based on biometric characters like plant height, leaf number, 'D' leaf area, total dry weight, dry matter partitioning to various plant parts etc. and can be used as an index of its yield potential. Brown (1953) indicated a list of characters that should be considered for selecting superior plants in pineapple. It included, general vigour of the plant and large sized fruit with

good fruit qualities. Collins (1960) listed some of the desirable characters like hardy and vigorous plants with good shoot and root system, larger fruit size, good shaped fruits, good flavour and aroma, non-fibrous juicy flesh, high sugar content and resistance to diseases like heart rot and root rot.

Reports on correlation studies between vegetative and fruit characters in pineapple are also available. Su (1958) observed positive correlation of leaf length and width with the fruit weight in pineapple. Chen and Chi (1963) reported that fruit weight decreased with the number of leaves removed for fibre extraction. Wu and Su (1965) reported a positive correlation of 'D' leaf area with fruit weight.

The fruit weight in pineapple was shown to be highly correlated with a number of parameters like plant weight, estimated leaf mass and 'D' leaf weight at the time of floral differentiation (Mitchell, 1962; Py and Lossois, 1962 and Tan and Wee, 1973).

Chadha *et al.* (1977) conducted an extensive study on plant characters affecting fruit weight and quality. Fruit weight was reported to be correlated with number of suckers per plant and number of leaves one year after planting. An increase of single sucker contributed 0.252 kg towards fruit weight. Similarly, an additional leaf at one year after planting contributed 2.8 g to the fruit weight, when the fruit weight was 1.3987 kg and above. Total soluble solids content of the juice was positively correlated with leaf number and also with potential leaf area index.

Prabhakaran and Balakrishnan (1978) reported that the number of leaves, length and width of 'D' leaf, weight of crown and fruit weight were all positively correlated with total yield. An increase in one leaf at the time of flowering would be followed, on an average by an expected increase of 13 g in fruit weight.

According to Wee *et al.* (1979), the length of leaf during tenth month after planting was highly correlated with fruit yield when compared to breadth of leaf, number of functional leaves, leaf number increments measured at every two months during growth. Radha (1989) reported that fruit weight with crown was found to be highly correlated with dry matter accumulation at ten months after planting, at flowering and at the time of harvest and also with Leaf Area Duration at flowering time. Nagatomi *et al.* (1997) reported a highly positive correlation between stomata length, leaf thickness, pollen size and fruitlet weight and also between acidity and brix in fruit quality.

Many researchers have successfully employed clonal selection for crop improvement in pineapple. Masmerah, an improved variety of pineapple evolved through clonal selection from a cultivar population in Malaysia has 50 per cent increased fruit size when compared to that of contemporary Singapore Spanish (Wee, 1974). Clonal selection is also found to be a viable tool for screening the resistant clones against pest and disease attack. Navarro *et al.* (1989) isolated certain resistant clones against red wilt disease in commercial pineapple fields of Mexico. Eeckenbrugge and Duval (1995) opined that clonal selection, mutagenesis, inducing variability in existing clones through tissue culture etc. are some of strategies that could be used in pineapple breeding.

At Kerala Agricultural University a study was conducted to assess the natural variability and to select the promising types in Kew. Out of the 19 clones collected and tested, seven were found to be superior than the local clone, with respect to yield (KAU, 1987).

2.2 Field performance of tissue culture plants

The review of research work on comparative evaluation of field performance of tissue culture and sucker propagated pineapple are highlighted here. As there are limited research work concerning this aspect in pineapple other similar fruit crops especially banana is also reviewed here.

2.2.1 Pineapple

Experiments conducted at Pineapple Research Centre, Kerala Agricultural University showed that the *in vitro* plants of cv. Kew took more duration for flowering i.e. 21.2 months whereas the plants from suckers flowered at 16.5 months. But the fruits of the tissue-culture plants took a lesser period to attain harvesting maturity (126.2 days) whereas the fruits from suckers took 136.5 days. Increased 'D' leaf weight and reduced leaf area were recorded by the tissue culture plants compared to suckers. The average fruit weight was more in suckers (1.9 kg with 281 g crown weight) than the fruit weight of tissue culture plants (1.0 kg with a larger crown of 420 g). Other fruit parameters like pulp/peel ratio, canning ratio, taper ratio and quality attributes of both tissue culture plants and sucker plants were almost similar. Results of the experiment clearly indicated that *in vitro* technique in pineapple could be accepted for large scale production of elite planting material to get quality fruits (Sudhadevi *et al.*, 1996).

Studies conducted by Radha and Aravindakshan (1998) revealed that tissue culture plants exhibited slow growth rate and flower induction was delayed by 35-40 days. But there was no significant difference between the tissue culture and sucker planted crop in terms of the fruit characters and quality parameters. They opined that pineapple can be successfully cultivated by using *in vitro* multiplied plantlets, provided initial growth enhancing treatments have to be standardized to reduce pre flowering duration.

2.2.2 Banana

The growth and development of tissue culture banana plants have been studied in detail by many workers (Daniells, 1988; Pradeep *et. al.*, 1992 and Eckstein and Robinson, 1995).

Robinson (1990) concluded that the number of leaves produced were more for tissue culture plants than the sucker derived plants, the number being 47 and 41 respectively in Grand Naine banana. Eckstein and Robinson (1995) noticed higher photosynthetic rate for tissue culture plants since it had more number of functional leaves than the sucker propagated plants. They also reported that the tissue culture plants showed improved physiological efficiency, which was consistent throughout the entire leaf profile. The larger leaf area of tissue culture plants along with a vigorous root system enabled the tissue culture plants to reach full assimilation potential at an earlier stage of development, with a doubling of mean functional leaf area.

Pradeep *et al.* (1992) reported that, during third and fourth month, the tissue culture plants recorded relative growth rate of 0.03 and 0.02 cms/cm/day whereas the sucker plants recorded 0.01 and 0.02 cms/cm/day respectively. The growth rate during the later periods declined indicating an exponential growth at early stages of growth and development and sigmoidal growth during later stages of tissue culture banana.

Robinson (1992) stated that CGR and NAR a showed seasonal growth pattern. After planting, CGR increased, with a final rapid increase during the bunch filling stage, CGR and NAR exhibited a pronounced increase before bunch harvest. Eckstein *et al.* (1995) reported that NAR and CGR increased rapidly after planting in tissue culture plants of 'Willaims' banana but when the average daily sunshine

hours were very low, NAR and CGR declined rapidly. During the last two months prior to harvest, NAR and CGR decreased.

Earliness in flowering and shorter crop duration of the tissue culture plants over that of conventional sucker were reported by several workers (Hwang *et al.*, 1984; Daniells, 1988; Robinson, 1989 and Zamora *et al.*, 1989). Robinson (1990) reported that the tissue culture plants flowered two to three weeks earlier due to the presence of 14 leaves at six months after planting. In contrary, Pradeep *et al.* (1992) noticed that the number of days taken from planting to flowering were more in tissue culture Nendran banana. The sword suckers flowered 240 days after planting whereas the tissue culture plants took 268 days.

Anil (1994) reported that the total dry matter production per plant was 7.28 kg, of which 53.98 per cent was apportioned to the bunch, 32.43 per cent to the leaf, 5.32 per cent to leaf sheath and 4.68 and 3.71 per cent to the corm and pseudostem respectively. Eckstein and Robinson (1995) reported that tissue culture plants recorded higher dry mass over suckers for all plant parts except rhizome.

Daniells (1988) noticed that the tissue culture plants produce large number of uniform suckers when compared to plants raised from conventional material. These sucker characteristics would be related to the greater number of leaves and associated buds that tissue culture plants have. Epsino *et al.* (1992) observed early and uniform suckering and production of great number of suckers in tissue culture plants resulting in earlier follower crop. Anil (1994) reported that the tissue culture plants of Nendran banana produced 5.8 suckers per plant and the total number of suckers per hectare amounted to 14,500.

Drew and Smith (1990) stated that tissue culture plants established more quickly and had a shorter time to bunch emergence and harvest of plant crop than

conventional planting material. Pradeep *et al.* (1992) reported that the days taken by tissue culture plants from planting to flowering and maturity were higher (346 days) than the days taken by sword suckers plants (314 days).

Kwa and Ganry (1990) noticed that tissue culture plants had advantages like increased vigour, homogenous plant population and higher bunch weight. The superiority in yield tuning to 39 per cent increase with tissue culture plants compared to plants grown from conventional sword suckers was reported by Pradeep *et al.*(1992). The average yield was 22 per cent higher with tissue culture plants than sucker derived plants which was associated with larger bunches and shorter crop cycle as reported by Robinson and Fraser (1992). Eckstein *et al.* (1995) observed that after flowering, dry matter was mostly allocated to the developing bunch at the expense of all other plant parts. In an experiment conducted at Kerala Agricultural University, the tissue culture plants of Nendran recorded an increase in yield of 25.63 per cent compared to that of suckers (Sheela, 1995).

2.3 Nutritional studies

The requirement of fertilizers for pineapple plants vary with their stage of development and greatly influenced both quantitatively and qualitatively by a number of factors like climate, soil, planting material, plant population, vigour of the planting material etc.

Abutiate and Eyeson (1973) reported that the addition of N and K significantly increased yields and mean fruit weight. Highest yields of 38.8 t fruit/ha, followed the application of 224 kg N + 448 kg K_2O/ha compared with 21.2 t/ha in control which was given no fertilizers.

Increased nitrogen levels augmented the number of leaves per plant, weight of 'D' leaf, average fruit weight, fruit size, yield, number of suckers and slips per plant and decreased total soluble solids and acid contents in Kew pineapple (Singh *et al.*, 1977).

In Singapore Spanish variety increasing nitrogen application up to 672 kg per hectare resulted in a positive quadratic response in the mean fruit weight and negative linear response in fruit quality, whereas K application up to 1120 kg K_2O/ha, resulted in a positive quadratic response for both fruit weight and quality. No interaction between the elemental fertilizers were recorded in this study (Tay, 1975).

Verawudh *et al.* (1988) stated that the optimum leaf N level at forcing time was in the range 1.4 to 1.8 per cent. Increasing N level decreased leaf P, K, Ca and Mg level and there was no significant effect of N on fruit weight to plant weight ratio.

Yields of pineapple were highest in plants fertilized with the highest rates of N, P_2O_5, K_2O and induced to flower at 12 months (Arderi, 1986). Nitrogen improved the utilization of phosphorus and potassium in yield increment and the combination of high nitrogen and low phosphorus or high potassium gave high yields (Obiefuna *et al.*, 1987).

Subramanian *et al.* (1977) computed mean N, P and K contents of 'D' leaf in the 5th, 8th and 11th month after planting for pineapple receiving 6 different N/K fertilizer combinations. High N and K contents in the 5th month were correlated with high yields.

Based on the analyses, the critical levels of nitrogen in the middle one third of the basal part of 'D' leaf (base N) sampled at fifth, eighth and eleventh months of plant growth were found to be 1.5, 1.23 and 1.97 per cent (Rao *et al.*, 1977).

Gadelha *et al.* (1986) reported that fruit weight increased significantly with the split application of N, P, K fertilizers at 1, 6, 9 and 13 months after planting. Similar result have been reported by Mitra *et al.* (1994) that split application of fertilizers at 6 and 10 months after planting, resulted in the highest percentage of flowering, yield and good fruit quality.

Detailed studies on the fertilizer requirement and other cultural practices for tissue culture plants are lacking in pineapple. However, in crops like banana, the experiments revealed that tissue culture plants require higher doses of nitrogen and potassium fertilizers in the initial growth period for better performance (Natesh *et al.*, 1993 and Sheela, 1995).

Mavelil (1997) indicated that the application of higher dose of fertilizers recorded 9.0 per cent increase in yield over the recommended dose of NPK per plant in banana. Percentage yield increase was 5.77 when six-split application was resorted to instead of two splits.

Materials & Methods

3. MATERIALS AND METHODS

The present investigations were carried out in the Department of Pomology and Floriculture, College of Horticulture, Kerala Agricultural University, Vellanikkara, Thrissur, during the year 1997-99, with an objective to evaluate the growth and performance of *in vitro* multiplied elite accessions of pineapple cv. Mauritius in comparison with *in vitro* multiplied unselected bulk and also with conventional suckers under two fertilizer doses. The area where the field experiment was conducted enjoys a warm humid tropical climate and located at an altitude of 22.25 m above MSL at 10°32' N latitude and 76°16' E longitude. The soil type is laterite. The meteorological data are presented in Appendix I.

The details of the materials and methods used in the present study are elaborated under the appropriate headings.

3.1 Planting material

The planting material used in the study includes *in vitro* plants of five elite accessions of pineapple cv. Mauritius, *in vitro* plants of unselected bulk and conventional suckers procured from Vazhakulam area of Kerala.

In the earlier study by Jose (1996) selection criteria were used to identify the elite clones. Initially 25 accessions were collected and biometric characters viz., vegetative and fruit characters were tabulated and the average values of all the characters were calculated and compared. Then the plants were given a score of one each for favourable character and zero for unfavourable character. Based on the total score, five elite clones with maximum score were selected. These selected elite clones were then mass multiplied by standardised *in vitro* propagation technique and the plantlets were maintained, which formed the treatments T_1-T_5 in the present

study. The biometric characters of the five selected elite accessions of pineapple are given in Table 1.

The planting material for the treatment T_6 was evolved using standardised *in vitro* technique but no selection criteria were followed and the plants were selected randomly from bulk and multiplied. Uniform sized conventional suckers procured from Vazhakulam area formed the treatment T_7 of the present study.

3.2 Experimental design

The experiment was laid out in factorial RBD with seven plant treatments as factor A and two fertilizer doses as factor B with three replications. The treatments in each replication were represented by a single trench of 9m length and 60 plants were planted per trench. The layout and general view of the experimental field is given in Fig.1 and Plate 1.

3.3 Treatment details

Factor A

Treatments / Accessions: 7

T_1 - TK 3

T_2 - KT 5

T_3 - KT 2

T_4 - KV 17

T_5 - TK 18

T_6 - TC plants of unselected bulk

T_7 - Suckers of unselected bulk

Factor B

Fertilizer doses: 2

Table 1. Plant and fruit characters of five selected elite plants of pineapple

Sl. No.	Characters	Mean value of 25 accessions	Accession numbers TK3	KT5	KT2	KV17	TK18
1	Plant height (cm)	87.00	90.00	89.00	85.00	87.00	87.00
2	No. of leaves	50.92	56.00	54.00	52.00	50.00	48.00
3	Leaf area (cm^2)	286.45	315.38	277.53	307.98	278.04	285.59
4	No. of suckers	2.16	2.00	2.00	3.00	3.00	2.00
5	Wt. of fruit with crown (kg)	2.224	2.380	2.325	2.320	2.315	2.300
6	Wt. of crown (g)	159.80	150.00	150.00	160.00	155.00	125.00
7	Wt. of fruit without crown (kg)	2.064	2.230	2.175	2.170	2.160	2.175
8	Wt. of fruit after peeling (kg)	1.554	1.720	1.675	1.670	1.640	1.675
9	Wt. of pulp (kg)	1.318	1.505	1.455	1.420	1.410	1.475
10	Peel : Pulp ratio	0.39	0.34	0.34	0.35	0.37	0.34
11	Pulp %	63.73	67.45	66.90	65.44	65.28	67.82
12	Juice %	78.69	78.90	79.50	79.20	78.10	78.60
13	Taper ratio	0.79	0.84	0.80	0.82	0.84	0.83
14	L/B ratio	1.91	1.80	1.83	1.85	1.85	1.83
15	TSS ^{0} Brix	15.19	16.00	16.00	16.33	15.66	16.00
16	Acidity %	0.43	0.38	0.39	0.39	0.40	0.40
17	Total sugar %	13.52	13.79	13.81	13.75	13.90	13.75
18	Reducing sugar %	3.59	3.97	3.95	3.83	4.05	3.95
19	Non - reducing sugar %	9.93	9.82	9.86	9.92	9.85	9.80
	Score		**16**	**15**	**14**	**14**	**13**

Jose, 1996.

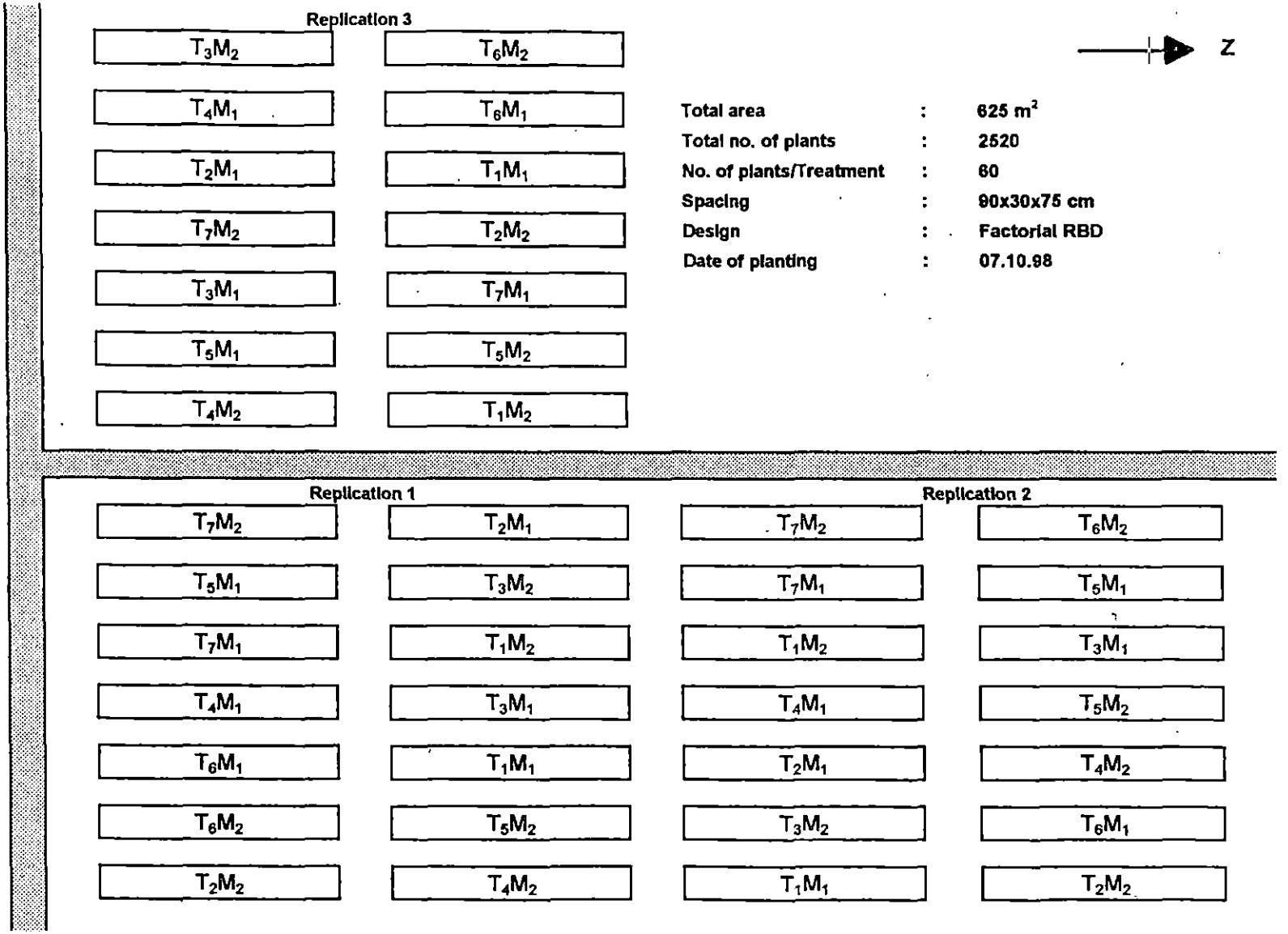


Fig.1 Layout of the experimental field

Plate 1. General view of the experimental field.

M_1 - 8:4:8 g/plant NPK applied in four splits at 0, 3, 6 and 9 months after planting

M_2 - 12:6:12 g/plant NPK applied in six splits at 0, 1, 2, 3, 6 and 9 months after planting

Since the duration of pineapple cv. Mauritius is shorter than that of cv. Kew, the time of application of fertilizers had been changed from the KAU recommendations, in such a way that the plants received the fertilizers at the same stages of growth as recommended for Kew pineapple.

3.4 Planting and cultural operations

Planting was done in October, 1998 at the Kerala Horticulture Development Programme (KHDP), Kerala Agricultural University, Vellanikkara, Thrissur. Total area used for the study was 625 m^2. Treatments were laid out on a levelled ground by taking uniform trenches of size 9 m length, 90 cm width and 15 cm depth. A total of 60 plants were planted in two rows with 30 plants in each row. The spacing adopted was 90 x 30 x 75 cm. Triangular system of planting was followed at a spacing of 30 cm between plants and 75 cm between the rows. Prior to planting cowdung at the rate of 25 t/ha and basal dose of fertilizers as per the technical programme were applied. Straight fertilizers viz. urea, superphosphate and muriate of potash were used. Full dose of phosphorus was applied during basal application. Nitrogen and potassium were applied in four splits at 0, 3, 6 and 9 months after planting (2 g per plant/split with a total of 8 g/plant of N and K_2O) for the treatment M_1 and for the treatment M_2, six split application of nitrogen and potassium at 0, 1, 2, 3, 6 and 9 months after planting (2 g per plant/split with a total of 12 g/plant of N and K_2O) were applied.

The plots were kept free of weeds by regular hand weeding operation. Protective irrigation was given as and when required. To induce uniform flowering,

ethrel (Ethephon) was applied at 39-42 leaf stage, as per package of practices recommendations of the Kerala Agricultural University (KAU, 1996). A combination of 25 ppm ethrel, two per cent urea and 0.04 per cent calcium carbonate was prepared and 50 ml of this solution was applied to the heart of the plant.

3.5 Sampling Technique

Destructive sampling was done at monthly intervals starting from the first month after planting. A total of nine such samplings were taken, of which six were taken during vegetative phase, one each during ethrel application, flowering and harvesting stages. One plant from each treatment was uprooted and used for recording fresh weight, dry weight, dry matter partitioning and 'D' leaf measurements. Twenty plants from each treatment were utilised for recording the plant height, number of leaves, number of suckers and slips and same plants were utilised for recording fruit characters.

3.6 Observations recorded

The observations recorded on the different aspects are given in detail in the following pages.

3.6.1 Vegetative characters

3.6.1.1 Number of leaves

The number of functional leaves per plant was recorded at monthly intervals till flowering.

3.6.1.2 Plant height

The height of the plant from the ground level to the tip of the longest leaf was measured at monthly intervals till flowering and expressed in centimetres.

3.6.1.3 Length and breadth of 'D' leaf

The fourth leaf from the apex of plant was fixed as 'D' leaf. The length and maximum breadth were recorded at monthly intervals and expressed in centimetres.

3.6.1.4 'D' leaf area

The 'D' leaf area was worked out using the formula suggested by Balakrishnan *et al.* (1978).

$$LA = L \times B \times 0.725$$

where,

LA = Leaf area in cm^2

L = Length of 'D' leaf in cm

B = Breadth of 'D' leaf in cm

and 0.725 is a constant.

3.6.1.5 Total leaf area per plant

Total leaf area per plant (m^2) was worked out at monthly intervals for all the treatments by using the formula given below,

Total leaf area = No. of leaves x 'D' leaf area.

3.6.1.6 Total plant fresh weight

At each sampling, the uprooted plants were thoroughly washed with water to remove the soil and total fresh weight was recorded after removing the excess moisture.

3.6.1.7 Chlorophyll content of leaves

The chlorophyll estimation was done as per the standard procedure developed by Hiscox and Israelstam (1979). The chlorophyll content was estimated at three different stages of plant growth viz., five months after planting (vegetative phase), flowering and at fruit maturity stage. The formula used for calculation of total chlorophyll was as follows:

Total chlorophyll (mg/g) = (27.8 x A 652 x v) / (1000 x w)

where,

A 652 - the absorbance value at wave length of 652

W - the fresh weight of the sample (g)

v - the volume of the extract (ml)

3.6.2 Total dry matter production and partitioning

In the first seven sampling, the uprooted plants were separated into leaves, stem, 'D' leaf and root. At the time of flowering, peduncle and inflorescence were also separated. During harvest, the plants were separated into leaves, stem, roots, peduncle, fruit and crown. The different plant parts collected at each sampling were dried in hot air oven at 80°C till constant weight was attained.

The total dry matter production (TDM) per plant at different stages of growth was obtained by adding the dry weights of all the plant parts into which the plants were separated. The dry weight of individual plant parts at each sampling

gave the extent of dry matter accumulation. Based on the total dry matter production as well as dry matter accumulation, the per cent dry matter partitioning (DMP) in different plant parts (per cent to total) for all sampling were estimated. Incremental increase in TDM was also computed from second month onwards by taking first month values as base.

3.6.3 Physiological growth parameters

From the observations on leaf area and total plant dry weight, the following growth parameters were computed.

3.6.3.1 Leaf Area Index (LAI)

LAI is the ratio of the total leaf area of plant to the ground area covered by the plant. LAI was worked out as suggested by Watson (1952) for all the treatments at different stages of growth.

$$LAI = \frac{\text{Leaf area per plant}}{\text{Area occupied per plant}}$$

3.6.3.2 Leaf Area Ratio (LAR)

LAR is the ratio of leaf area to the dry weight of plant expressed as sq.cm/g (Whitehead and Mycersough, 1962).

$$LAR = (LA_1 + LA_2) / (W_1 + W_2)$$

where,

LA_1 and LA_2 = total leaf area per plant at time t_1 and t_2 respectively

W_1 and W_2 = total plant dry weight at time t_1 and t_2 respectively

3.6.3.3 Relative Growth Rate (RGR)

RGR represents the rate of increase in dry matter per unit dry weight already present and is expressed as g/g/day. RGR was calculated by following the formula given by Blackman (1919).

$$RGR = (\ln W_2 - \ln W_1) / (t_2 - t_1)$$

where,

ln = Logarithm to the base 'e' (Naperian constant)

W_2 and W_1 = total plant dry weights at time t_2 and t_1 respectively

3.6.3.4 Net Assimilation Rate (NAR)

NAR is the rate of increase in dry weight per unit leaf area, which is expressed as mg/sq.cm/day. NAR was calculated using the formula suggested by Gregory (1926).

$$NAR = (\ln LA_2 - \ln LA_1) \times (W_2 - W_1) / lA_2 - lA_1) \times (t_2 - t_1)$$

where,

ln - Logarithm to the base 'e' (Naperian constant)

LA_2 and W_2 - Leaf area and dry weight of the plant at time t_2 respectively

LA_1 and W_1 - Leaf area and dry weight of the plant at time t_1 respectively

3.6.3.5 Crop Growth Rate (CGR)

CGR is the absolute growth rate per unit land area per unit time and is expressed as g/sq.m/day. It was calculated by following the formula given by Watson (1952).

$$CGR = 1/(\text{unit land area}) \times (W_2 - W_1)/(t_2 - t_1)$$

where,

W_2 and W_1 - total plant dry weights at t_2 and t_1 respectively

3.6.4 'D' Leaf analysis

'D' leaf was analysed for nitrogen, phosphorus and potassium content at 4 different stages of crop growth, viz. 3 MAP, 6 MAP, flowering and at harvest. For this purpose, 'D' leaves were collected from ten plants in each treatment and the basal one third non chlorophyllous portion was cut and removed. The basal portion was then washed in teepol solution, 0.1 per cent hydrochloric acid and twice in distilled water. The samples were then dried in an oven at 95°C. The dried samples were ground well and used for the analysis.

3.6.4.1 Estimation of nitrogen, phosphorus and potassium

The oven dried 'D' leaf samples were ground in Wiley Mill, fitted with stainless steel blades and passed through 40 mesh sieve. The samples were analysed for macro nutrients as detailed below.

Nitrogen was estimated by microkjeldahl method (Jackson, 1973). For the analysis of phosphorus and potassium, diacid extracts were prepared by digesting one g of the sample in 15 ml of 2:1 concentrated nitric perchloric acid mixture (Johnson and Ulrich, 1959). Aliquots of the digests were taken for the analysis of total P and K.

Phosphorus was determined colorimetrically by vanadomolybdo phosphoric yellow colour method (Jackson, 1973). The yellow colour was read in a

spectrophotometer (Spectronic-20) at a wavelength 470 nm. Potassium was estimated using flame photometer.

3.6.5 Flowering characters

3.6.5.1 Days for initiation of flowering

The mean number of days taken from ethrel application to the appearance of reddish colour at the centre of the plant was observed visually and recorded.

3.6.5.2 Days for 50 per cent flowering

The mean number of days taken from ethrel application to emergence of inflorescence in 50 per cent of the plants in each treatment was recorded.

3.6.5.3 Flowering phase

The number of days taken for the opening of the first flower to the opening of the last flower in an inflorescence was recorded in all the treatments.

3.6.6 Yield parameters

3.6.6.1 Length of the fruit (cm)

At the time of harvest, twenty fruits from each treatment were collected and the length of the fruits was measured in centimetres.

3.6.6.2 Breadth of the fruit (cm)

The maximum breadth of twenty fruits was measured from each treatment and the average was computed.

3.6.6.3 Length/breadth ratio (L/B)

This was calculated using the length and breadth of the fruit measured at the time of harvest (Pantastico, 1975).

3.6.6.4 Taper ratio

Taper ratio was calculated using the formula given below:

$$\text{Taper ratio} = \frac{\text{Circumference of fruit at the top}}{\text{Circumference of fruit at the bottom}}$$

3.6.6.5 Weight of the fruit with crown

The weight of the twenty fruits were recorded along with the crown for each treatment and the average value was computed.

3.6.6.6 Weight of the fruit without crown

The fruit weight was noted down after removing the crown portion and the average of twenty fruits was computed.

3.6.6.7 Weight of the crown

The removed crowns from twenty fruits from each treatment were weighed and the mean was recorded.

3.6.6.8 Peel/pulp ratio

The peel/pulp ratio was calculated using the following formula

$$\text{Peel/pulp ratio} = \frac{\text{Weight of the peel of fruit}}{\text{Weight of the pulp}}$$

3.6.6.9 Estimated yield per hectare

From the fruit weight with crown, the mean fruit yield per hectare was worked out and expressed in tonnes per hectare.

3.6.6.10 Harvest Index

This was expressed as per cent of the economic yield (fruit dry weight) to the biological yield. Harvest index was worked out by the formula of Donald (1962).

HI = (Economic yield) / (total biological yield) x 100

3.6.6.11 Total duration of the crop

The mean number of days taken from planting to harvest was worked out for each treatment.

3.6.7 Quality parameters

The ripened fruits were subjected to qualitative analysis. Twenty fruits were selected from each treatment and composite samples were taken from different parts of the flesh, macerated in a waving blender and used for analysis.

3.6.7.1 Juice content

A known weight of the fruit pulp was squeezed in a muslin cloth to extract the juice. The juice content was then calculated as percentage by using the formula

$$\text{Juice content} = \frac{\text{Weight of juice}}{\text{Weight of the fruit pulp}} \times 100$$

3.6.7.2 Total soluble solids (TSS)

TSS was measured by using a pocket refractometer and expressed as ° Brix.

3.6.7.3 Acidity

The acidity of the fruits was estimated by using the titration method (A.O.A.C., 1980). Acidity was expressed as percentage of citric acid present.

3.6.7.4 TSS/Acid ratio

This was calculated by dividing the TSS percentage by the acidity.

3.6.7.5 Reducing sugars

The reducing sugar content was analysed by Fehlings solution method and expressed as percentage on fresh weight basis (A.O.A.C., 1980).

3.6.7.6 Total sugars

The total sugar content of the fruits were analysed by following the method given in A.O.A.C. (1980) and expressed as percentage.

3.6.7.7 Non-reducing sugars

This was worked out by deducting the reducing sugars from the total sugars estimated.

3.6.8 Number of suckers and slips per plant

3.6.8.1 Number of suckers

The number of suckers per plant was recorded at the time of harvest and mean worked out.

3.6.8.2 Number of slips

The number of slips produced per plant was also recorded at the time of harvest and means were worked out for different treatments.

3.6.9 Statistical analysis

Statistical analysis of the data were carried out using the method suggested by Panse and Sukhatme (1985). Treatment means were compared using DMRT wherever necessary. MSTATC package was used for the statistical analysis.

Results

4. RESULTS

The results of the investigation on 'Evaluation of *in vitro* multiplied accessions of pineapple (*Ananas comosus* [L.] Merr.) cv. Mauritius' are presented below.

4.1 Vegetative characters

4.1.1 Percentage of establishment

In all the treatments, both sucker and tissue culture plantlets showed cent per cent establishment, recorded two weeks after planting.

4.1.2 Number of leaves

Data relating to number of leaves per plant at monthly intervals are given in Table 2.

The data revealed that at one month after planting (1 MAP) the maximum number of leaves was produced by T_7 (14.62) followed by T_2 (14.27) and T_3 (14.09). T_6 had the lowest number of leaves (12.13). The superiority of T_7 with respect to number of leaves continued till 6 MAP and it was on par with treatments T_1 to T_5 (Plate 2). But during ethrel application stage, T_1 recorded the maximum leaf number (41.93) and T_6 recorded the least leaf number (38.98). At the time of flowering and harvest there was no significant difference among the treatments. The number of leaves at the time of harvest decreased slightly in all treatments.

With respect to effect of fertilizer doses, M_2 significantly increased the number of leaves from 14.02 to 36.39 while M_1 recorded 13.21 to 34.08 from 1 MAP to 6 MAP. M_2 attained the physiological maturity for flower induction (39-42

Table 2 : Effect of treatments on number of leaves in pineapple cv. Mauritius

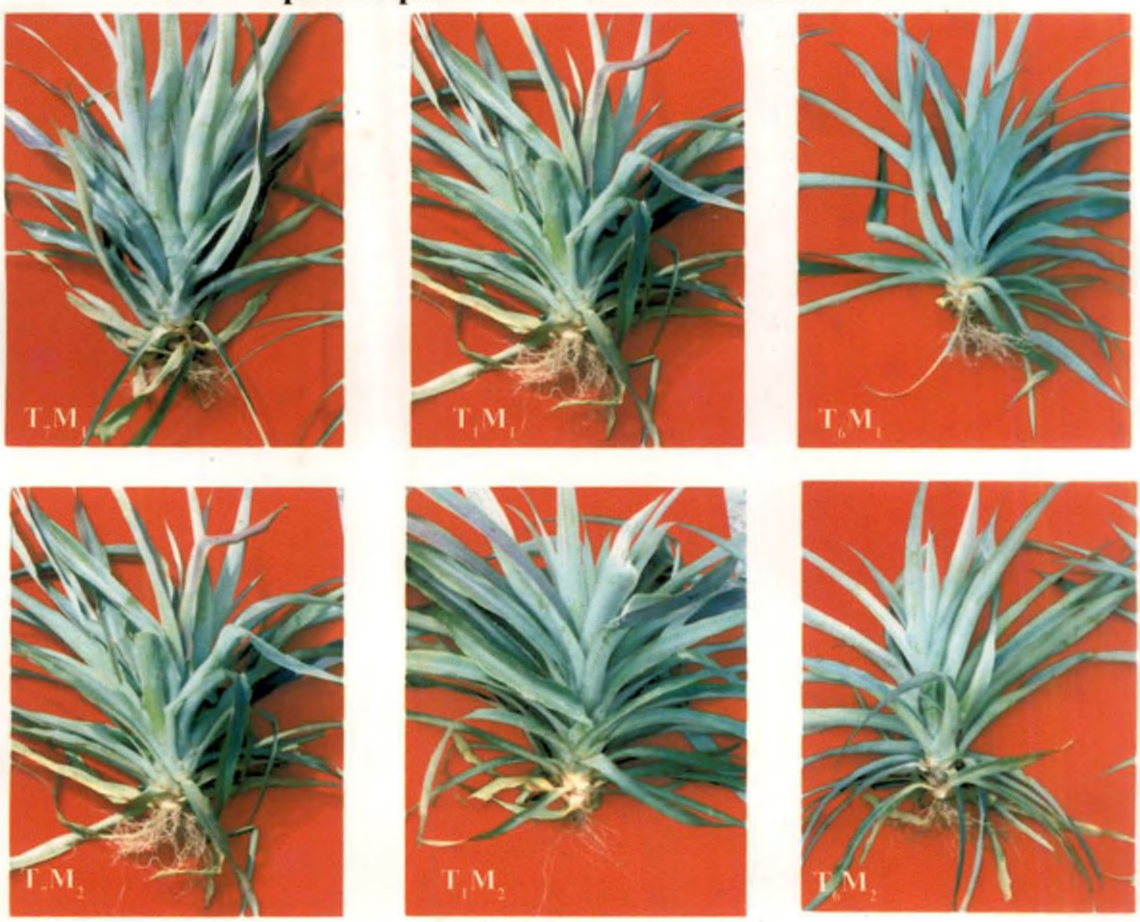
Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP	Ethrel appln.	Flowering	Harvest
T_1	13.48 ^{B}	17.23 ^{C}	20.46 ^{C}	25.06 ^{C}	31.42 ^{B}	35.53 ^{B}	41.93 ^{A}	43.93 ^{A}	40.65 ^{AB}
T_2	14.27 ^{AB}	17.18 ^{C}	20.73 ^{C}	25.47 ^{BC}	31.28 ^{BC}	35.46 ^{B}	41.21 ^{B}	43.34 ^{AB}	40.95 ^{A}
T_3	14.09 ^{AB}	17.05 ^{C}	20.72 ^{C}	25.39 ^{BC}	31.23 ^{BC}	35.63 ^{B}	40.58 ^{C}	42.96 ^{B}	40.37 ^{AB}
T_4	13.45 ^{B}	17.22 ^{C}	20.73 ^{C}	24.98 ^{C}	30.65 ^{C}	35.19 ^{B}	40.73 ^{BC}	43.28 ^{AB}	39.92 ^{B}
T_5	13.30 ^{B}	18.12 ^{B}	21.75 ^{B}	26.17 ^{B}	31.89 ^{B}	35.36 ^{B}	41.31 ^{B}	43.58 ^{AB}	40.40 ^{AB}
T_6	12.13 ^{C}	14.36 ^{D}	18.08 ^{D}	22.73 ^{D}	27.92 ^{D}	31.94 ^{C}	38.98 ^{D}	40.28 ^{C}	38.02 ^{C}
T_7	14.62 ^{A}	19.42 ^{A}	23.08 ^{A}	27.37 ^{A}	34.12 ^{A}	37.53 ^{A}	41.18 ^{B}	42.67 ^{B}	40.25 ^{AB}
M_1	13.21	16.27	19.52	24.23	30.27	34.08	41.10	42.96	40.02
M_2	14.02	18.18	22.06	26.39	32.16	36.39	40.60	42.76	40.13
F Test (5%)	S	S	S	S	S	S	S	NS	NS
T_1M_1	13.08 ^{CDE}	16.63 ^{DE}	19.15 ^{EF}	23.78 ^{DE}	29.75 ^{F}	33.90 ^{CD}	41.80 ^{AB}	43.93 ^{A}	40.73 ^{A}
T_1M_2	13.87 ^{ABCD}	17.83 ^{CD}	21.77 ^{C}	26.33 ^{C}	33.10 ^{BC}	37.15 ^{B}	42.07 ^{A}	43.93 ^{A}	40.57 ^{A}
T_2M_1	13.45 ^{CDE}	16.53 ^{E}	19.67 ^{DE}	24.23 ^{D}	30.18 ^{F}	33.62 ^{D}	41.47 ^{ABC}	43.30 ^{AB}	40.90 ^{A}
T_2M_2	15.08 ^{AB}	17.83 ^{CD}	21.78 ^{C}	26.70 ^{ABC}	32.38 ^{CD}	37.30 ^{B}	40.95 ^{BCD}	43.38 ^{AB}	41.00 ^{A}
T_3M_1	14.23 ^{ABC}	15.95 ^{EF}	19.20 ^{EF}	24.25 ^{D}	30.53 ^{F}	34.78 ^{C}	40.93 ^{BCD}	42.97 ^{AB}	40.33 ^{A}
T_3M_2	13.95 ^{ABCD}	18.15 ^{BC}	22.23 ^{C}	26.53 ^{BC}	31.92 ^{D}	36.48 ^{B}	40.22 ^{DE}	42.95 ^{AB}	40.40 ^{A}
T_4M_1	12.67 ^{CDE}	16.15 ^{EF}	19.42 ^{DEF}	23.55 ^{DE}	29.77 ^{F}	33.93 ^{CD}	40.77 ^{CD}	42.97 ^{AB}	39.83 ^{A}
T_4M_2	14.23 ^{ABC}	18.28 ^{BC}	22.03 ^{C}	26.40 ^{C}	31.53 ^{DE}	36.45 ^{B}	40.70 ^{CD}	43.58 ^{AB}	40.00 ^{A}
T_5M_1	13.15 ^{CDE}	17.03 ^{CDE}	20.03 ^{D}	24.45 ^{D}	30.65 ^{EF}	34.13 ^{CD}	42.05 ^{A}	44.00 ^{A}	40.53 ^{A}
T_5M_2	13.45 ^{BCDE}	19.20 ^{B}	23.47 ^{B}	27.90 ^{AB}	33.13 ^{BC}	36.58 ^{B}	40.57 ^{CD}	43.15 ^{AB}	40.27 ^{A}
T_6M_1	11.83 ^{E}	13.43 ^{G}	17.28 ^{G}	22.67 ^{E}	27.48 ^{G}	31.37 ^{F}	39.47 ^{E}	40.67 ^{C}	37.80 ^{B}
T_6M_2	12.42 ^{DE}	15.28 ^{F}	18.87 ^{F}	22.80 ^{E}	28.37 ^{G}	32.52 ^{E}	38.50 ^{F}	39.88 ^{C}	38.23 ^{B}
T_7M_1	14.07 ^{ABCD}	18.17 ^{BC}	21.88 ^{C}	26.68 ^{ABC}	33.52 ^{B}	36.83 ^{B}	41.18 ^{ABC}	42.90 ^{AB}	40.03 ^{A}
T_7M_2	15.17 ^{A}	20.67 ^{A}	24.28 ^{A}	28.05 ^{A}	34.72 ^{A}	38.23 ^{A}	41.18 ^{ABC}	42.43 ^{B}	40.47 ^{A}

S = Significant, NS = Non Significant ; Treatment means having similar alphabets in superscript do not differ significantly

Plate 2a. Tissue culture plants and suckers immediately after planting

Plate 2b. Uprooted plants under different treatments at 1 MAP

Plate 2c. Uprooted plants under different treatments at 6 MAP



leaf stage) one month prior to M_1. At the time of flowering and harvest there was no significant difference between M_1 and M_2.

The interaction effect of various treatments differed significantly from 3 MAP till the stage of ethrel application. The maximum number of leaves at 3 MAP was produced by T_7M_2 (24.28) and the minimum by T_6M_1 (17.28). At the time of ethrel application T_1M_2 (42.07) and T_5M_1 (42.05) recorded the maximum value, while T_6M_2 had the least value (38.50). There was no significant difference among the treatments during flowering and harvest.

4.1.3 Plant height

The data pertaining to mean plant height at monthly intervals are presented in Table 3.

The data revealed that T_7 recorded the maximum plant height at all the growth stages studied and it increased from 50.58 to 84.67 cm from 1 MAP to flowering. Among the selected accessions, T_5 recorded the maximum value and varied from 49.22 to 85.28 cm. The mean height of T_6 was the least and it increased from 43.42 to 73.65 cm.

The effect of varying doses of fertilizer significantly increased the plant height throughout the vegetative phase. The maximum value was recorded by M_2 which increased plant height from 43.15 to 82.70 cm, whereas M_1 recorded a plant height of 47.62 to 81.72 cm from 1 MAP to flowering. At the time of ethrel application, there was no significant difference among M_1 and M_2 for plant height.

The interaction effect of various treatments on plant height showed that the T_7M_2 recorded the maximum value throughout the vegetative phase and it

Table 3: Effect of treatments on plant height (cm) in pineapple cv. Mauritius

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP	Ethrel appln.	Flowering
T_1	48.40 ^{C}	51.99 ^{B}	55.97 ^{D}	64.25 ^{C}	69.52 ^{D}	73.40 ^{D}	82.77 ^{AB}	84.15 ^{AB}
T_2	47.33 ^{D}	53.95 ^{A}	57.98 ^{C}	66.17 ^{B}	71.37 ^{C}	74.73 ^{C}	82.32 ^{ABC}	83.00 ^{BC}
T_3	48.20 ^{C}	51.13 ^{B}	55.90 ^{D}	63.33 ^{D}	69.77 ^{D}	72.85 ^{D}	80.85 ^{C}	81.97 ^{C}
T_4	48.05 ^{C}	50.88 ^{B}	56.55 ^{D}	63.10 ^{D}	68.93 ^{D}	72.67 ^{D}	81.67 ^{BC}	82.77 ^{BC}
T_5	49.22 ^{B}	53.68 ^{A}	58.73 ^{B}	66.20 ^{B}	73.52 ^{B}	75.98 ^{B}	83.85 ^{A}	85.28 ^{A}
T_6	43.42 ^{E}	47.53 ^{C}	50.90 ^{E}	56.68 ^{E}	61.88 ^{E}	65.63 ^{E}	72.18 ^{D}	73.65 ^{D}
T_7	50.58 ^{A}	54.77 ^{A}	59.77 ^{A}	70.17 ^{A}	78.15 ^{A}	81.70 ^{A}	83.83 ^{A}	84.67 ^{A}
M_1	47.62	51.23	55.41	62.06	67.75	70.99	80.69	81.72
M_2	48.15	52.76	57.68	66.49	73.15	77.28	81.44	82.70
F Test(5%)	S	S	S	S	S	S	NS	S
T_1M_1	48.17 ^{DE}	51.02 ^{E}	54.80 ^{G}	62.00 ^{DE}	66.37 ^{F}	69.90 ^{FG}	82.30 ^{BCD}	83.87 ^{BC}
T_1M_2	48.63 ^{CD}	52.97 ^{CD}	57.13 ^{DE}	66.50 ^{C}	72.67 ^{D}	76.90 ^{CD}	83.23 ^{ABC}	84.43 ^{ABC}
T_2M_1	46.83 ^{F}	53.20 ^{CD}	56.33 ^{EF}	63.27 ^{D}	68.53 ^{E}	71.30 ^{F}	82.17 ^{BCD}	82.50 ^{CD}
T_2M_2	47.83 ^{DEF}	54.70 ^{ABC}	59.63 ^{BC}	69.07 ^{B}	74.20 ^{C}	78.17 ^{C}	82.47 ^{BCD}	83.50 ^{BC}
T_3M_1	47.97 ^{DE}	50.67 ^{E}	54.70 ^{G}	61.30 ^{EF}	67.07 ^{F}	70.50 ^{FG}	80.63 ^{D}	81.10 ^{D}
T_3M_2	48.43 ^{DE}	51.60 ^{DE}	57.10 ^{DE}	65.37 ^{C}	72.47 ^{D}	75.20 ^{E}	81.07 ^{CD}	82.83 ^{BCD}
T_4M_1	47.50 ^{EF}	50.87 ^{E}	55.43 ^{FG}	60.13 ^{F}	65.67 ^{F}	69.40 ^{G}	81.37 ^{CD}	82.53 ^{BCD}
T_4M_2	48.60 ^{CD}	50.90 ^{E}	57.67 ^{D}	66.07 ^{C}	72.20 ^{D}	75.93 ^{DE}	81.97 ^{BCD}	83.00 ^{BCD}
T_5M_1	48.87 ^{CD}	51.90 ^{DE}	57.67 ^{D}	62.83 ^{D}	69.07 ^{E}	70.73 ^{FG}	82.50 ^{BCD}	84.30 ^{ABC}
T_5M_2	49.57 ^{BC}	55.47 ^{AB}	59.80 ^{AB}	69.57 ^{B}	77.97 ^{AB}	81.23 ^{B}	85.20 ^{A}	86.27 ^{A}
T_6M_1	43.63 ^{G}	47.13 ^{F}	50.13 ^{I}	55.60 ^{H}	60.47 ^{H}	64.40 ^{I}	72.63 ^{E}	73.27 ^{E}
T_6M_2	43.20 ^{G}	47.93 ^{F}	51.67 ^{H}	57.77 ^{G}	63.30 ^{G}	66.87 ^{H}	71.73 ^{E}	74.03 ^{E}
T_7M_1	50.40 ^{AB}	53.80 ^{BC}	58.77 ^{C}	69.27 ^{B}	77.07 ^{B}	80.70 ^{B}	83.23 ^{ABC}	84.50 ^{ABC}
T_7M_2	50.77 ^{A}	55.73 ^{A}	60.77 ^{A}	71.07 ^{A}	79.23 ^{A}	86.70 ^{A}	84.43 ^{AB}	84.83 ^{AB}

S = Significant, NS = Non Significant ; Treatment means having similar alphabets in superscript do not differ significantly

increased from 50.77 to 86.70 cm from 1 MAP to 6 MAP. T_7M_1, T_5M_2 and T_1M_2 were on par with T_7M_2. At the time of ethrel application and flowering stages, T_5M_2 recorded the maximum value followed by T_7M_2 and T_1M_2. T_6M_1 recorded the least value and it increased from 43.63 to 73.27 cm from 1 MAP to flowering.

4.1.4 'D' leaf length

Data on 'D' leaf length presented in Table 4 showed that the treatments differed significantly during the growth stages. T_7 had the maximum 'D' leaf length up to 3 MAP and all other treatments were on par with T_7 except T_6, which had the shortest 'D' leaf throughout the growth stages. At 4 MAP and 5 MAP, T_1 had the highest 'D' leaf length (40.45 cm and 43.65 cm respectively), whereas at 6 MAP, T_2 had the highest value (47.51 cm) while T_6 being the lowest (40.45 cm). The same trend was observed at the time of ethrel application and flowering stages.

The effect of fertilizer doses showed significant difference for 'D' leaf length among the treatments during vegetative phase. The 'D' leaf length of M_2 ranged from 26.17 to 48.50 cm and that of M_1 ranged from 24.14 to 43.30 cm from 1 MAP to 6 MAP. During ethrel application and flowering stages, there was no significant difference for 'D' leaf length among the two fertilizer doses.

The interaction effect of different treatments on 'D' leaf length differed significantly at all growth stages. T_7M_2 had the highest 'D' leaf length during first three sampling. However, during subsequent sampling the interaction effect was more pronounced in T_1M_2 and continued till the stage of ethrel application. The maximum 'D' leaf length (57.83 cm) was recorded by T_2M_2 and the minimum by T_6M_1 (48.43 cm)

Table 4: Effect of treatments on D leaf length (cm) in pineapple cv. Mauritius

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP	Ethrel appln.	Flowering
T_1	24.58 ^{CD}	30.93 ^{B}	34.21 ^{B}	40.45 ^{A}	43.65 ^{A}	47.45 ^{A}	55.92 ^{AB}	56.52 ^{AB}
T_2	24.15 ^{D}	28.13 ^{C}	32.95 ^{D}	36.38 ^{C}	40.23 ^{C}	47.51 ^{A}	56.30 ^{A}	57.08 ^{A}
T_3	26.56 ^{B}	29.66 ^{B}	33.11 ^{C}	38.83 ^{B}	41.91 ^{B}	46.88 ^{AB}	54.62 ^{BC}	55.43 ^{BC}
T_4	24.55 ^{CD}	28.28 ^{C}	32.25 ^{CD}	38.68 ^{B}	41.93 ^{B}	46.18 ^{B}	54.02 ^{CD}	54.93 ^{CD}
T_5	25.16 ^{C}	28.33 ^{C}	31.93 ^{D}	38.98 ^{B}	42.45 ^{B}	46.11 ^{B}	53.40 ^{CD}	53.78 ^{D}
T_6	21.81 ^{E}	24.96 ^{D}	27.78 ^{E}	32.53 ^{D}	36.50 ^{D}	40.45 ^{C}	48.00 ^{E}	48.87 ^{E}
T_7	29.25 ^{A}	35.31 ^{A}	36.43 ^{A}	40.15 ^{A}	41.86 ^{B}	46.70 ^{AB}	52.72 ^{D}	53.50 ^{D}
M_1	24.14	27.91	30.75	36.25	39.19	43.30	53.33	54.06
M_2	26.17	30.84	34.33	39.76	43.25	48.50	53.80	54.60
F Test(5%)	S	S	S	S	S	S	NS	NS
T_1M_1	23.76 ^{FG}	29.26 ^{D}	31.50 ^{E}	37.03 ^{F}	39.90 ^{E}	43.03 ^{G}	55.67 ^{ABCD}	56.27 ^{AB}
T_1M_2	25.40 ^{D}	32.60 ^{BC}	36.93 ^{AB}	43.86 ^{A}	47.40 ^{A}	51.86 ^{A}	56.17 ^{AB}	56.77 ^{AB}
T_2M_1	22.96 ^{G}	27.33 ^{EF}	30.76 ^{EF}	34.16 ^{G}	37.76 ^{F}	42.86 ^{G}	55.80 ^{ABC}	56.33 ^{AB}
T_2M_2	25.33 ^{D}	28.93 ^{DE}	33.33 ^{D}	38.60 ^{E}	42.70 ^{D}	52.16 ^{A}	56.80 ^{A}	57.83 ^{A}
T_3M_1	25.46 ^{D}	27.20 ^{EF}	30.06 ^{F}	36.93 ^{F}	40.16 ^{E}	43.76 ^{FG}	54.37 ^{BCDE}	55.43 ^{BC}
T_3M_2	27.66 ^{B}	32.13 ^{C}	36.16 ^{AB}	40.73 ^{BC}	43.66 ^{CD}	50.00 ^{B}	54.87 ^{ABCDI}	55.43 ^{BC}
T_4M_1	24.26 ^{EF}	26.40 ^{F}	30.06 ^{F}	37.43 ^{F}	39.96 ^{E}	44.46 ^{F}	54.20 ^{BCDEF}	54.67 ^{BC}
T_4M_2	24.83 ^{DE}	30.16 ^{D}	34.43 ^{CD}	39.93 ^{CD}	43.90 ^{BC}	47.90 ^{CD}	53.83 ^{CDEF}	55.20 ^{BC}
T_5M_1	23.93 ^{EF}	26.90 ^{F}	30.06 ^{F}	36.90 ^{F}	40.10 ^{E}	43.50 ^{FG}	53.23 ^{EF}	53.97 ^{C}
T_5M_2	26.40 ^{C}	29.76 ^{D}	33.80 ^{D}	41.06 ^{B}	44.80 ^{B}	48.73 ^{C}	53.57 ^{DEF}	53.60 ^{C}
T_6M_1	20.10 ^{H}	23.93 ^{G}	27.13 ^{G}	31.66 ^{H}	35.56 ^{G}	39.50 ^{I}	48.00 ^{G}	48.43 ^{D}
T_6M_2	23.53 ^{FG}	26.00 ^{F}	28.43 ^{G}	33.43 ^{G}	37.43 ^{F}	41.40 ^{H}	48.00 ^{G}	49.30 ^{D}
T_7M_1	28.50 ^{B}	34.33 ^{B}	35.66 ^{BC}	39.63 ^{D}	40.86 ^{E}	45.96 ^{E}	52.07 ^{F}	53.33 ^{C}
T_7M_2	30.00 ^{A}	36.30 ^{A}	37.20 ^{A}	40.66 ^{BC}	42.86 ^{CD}	47.43 ^{D}	53.37 ^{EF}	54.07 ^{C}

S = Significant, NS = Non Significant ; Treatment means having similar alphabets in superscript do not differ significantly

4.1.5 'D' leaf breadth

Data pertaining to 'D' leaf breadth showed the superiority of tissue culture plant (T_1) for the first six months (Table 5). However T_5 and T_7 were on par with T_1 during the vegetative stage. At flowering T_5 had the broadest 'D' leaf (5.30 cm) and T_6 had the narrowest 'D' leaf (4.03 cm).

The effect of two fertilizer doses differed significantly with respect to 'D' leaf breadth at all stages of sampling. M_2 was found to be superior with value ranging from 2.31 to 5.06 cm from 1 MAP to flowering.

Among the interaction effects, there was a considerable difference between the treatments. T_1M_2 had the highest 'D' leaf breadth at 1, 2, 3 and 4 MAP. T_1M_1, T_2M_2, T_4M_2, T_5M_1, T_5M_2 had the next broadest 'D' leaf during the same stages. At 5 MAP T_5M_2 had the highest value (4.26 cm) and T_7M_2 and T_1M_2 were on par with T_5M_2. Similar trend was followed up to flowering. The maximum value for 'D' leaf breadth was recorded by T_5M_2 (5.40 cm) at flowering, while T_6M_1 recorded the minimum value during all stages of growth.

4.1.6 'D' leaf area

Table 6 shows that T_7 had the highest 'D' leaf area up to 4 MAP while T_6 had the lowest 'D' leaf area during the same period. At 5 MAP T_1 was superior(124.7 cm^2) followed by T_5 (122.6 cm^2) and T_7 (122.2 cm^2). At 6 MAP T_1 with a leaf area of 150.3 cm^2 was the highest while T_6 with 104.7 cm^2 was the least. The same trend was observed during ethrel application and flowering stages.

Table 5: Effect of treatments on D leaf breadth (cm) in pineapple cv. Mauritius

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP	Ethrel appln.	Flowering
T_1	2.53 ^{A}	2.83 ^{A}	3.10 ^{A}	3.53 ^{A}	3.91 ^{A}	4.33 ^{A}	5.20 ^{A}	5.27 ^{AB}
T_2	2.21 ^{C}	2.45 ^{C}	2.80 ^{B}	3.25 ^{B}	3.65 ^{B}	4.11 ^{BC}	5.00 ^{BC}	5.12 ^{C}
T_3	2.10 ^{C}	2.35 ^{CD}	2.73 ^{B}	3.26 ^{B}	3.58 ^{B}	4.15 ^{B}	5.08 ^{AB}	5.15 ^{BC}
T_4	1.91 ^{D}	2.28 ^{D}	2.65 ^{B}	3.25 ^{B}	3.63 ^{B}	4.00 ^{C}	4.89 ^{CD}	5.02 ^{C}
T_5	2.36 ^{B}	2.63 ^{B}	3.01 ^{A}	3.58 ^{A}	3.96 ^{A}	4.38 ^{A}	5.20 ^{A}	5.30 ^{A}
T_6	1.90 ^{D}	2.05 ^{E}	2.41 ^{C}	2.91 ^{C}	3.21 ^{C}	3.56 ^{D}	3.82 ^{E}	4.03 ^{D}
T_7	2.50 ^{AB}	2.71 ^{B}	3.16 ^{A}	3.66 ^{A}	4.01 ^{A}	4.38 ^{A}	4.85 ^{D}	5.02 ^{C}
M_1	2.13	2.37	2.69	3.17	3.48	3.86	4.79	4.91
M_2	2.31	2.57	2.99	3.54	3.94	4.40	4.93	5.06
F Test(5%)	S	S	S	S	S	S	S	S
T_1M_1	2.43 ^{ABC}	2.70 ^{B}	2.96 ^{BC}	3.30 ^{BC}	3.60 ^{DE}	4.00 ^{CD}	5.10 ^{AB}	5.17 ^{CD}
T_1M_2	2.63 ^{A}	2.96 ^{A}	3.23 ^{A}	3.76 ^{A}	4.23 ^{A}	4.66 ^{AB}	5.30 ^{A}	5.37 ^{AB}
T_2M_1	2.10 ^{EFG}	2.26 ^{D}	2.60 ^{D}	3.03 ^{DE}	3.36 ^{FG}	3.76 ^{E}	4.97 ^{BC}	5.13 ^{CD}
T_2M_2	2.33 ^{BCD}	2.63 ^{B}	3.00 ^{BC}	3.46 ^{B}	3.93 ^{B}	4.46 ^{B}	5.03 ^{BC}	5.10 ^{CDE}
T_3M_1	2.03 ^{FGH}	2.26 ^{D}	2.60 ^{D}	3.06 ^{D}	3.30 ^{G}	3.83 ^{DE}	5.07 ^{B}	5.07 ^{CDE}
T_3M_2	2.16 ^{DEF}	2.43 ^{C}	2.86 ^{C}	3.46 ^{B}	3.86 ^{B}	4.46 ^{B}	5.10 ^{AB}	5.23 ^{ABC}
T_4M_1	1.76 ^{I}	2.13 ^{D}	2.46 ^{DE}	3.13 ^{CD}	3.50 ^{EF}	3.80 ^{DE}	4.83 ^{CD}	5.00 ^{DE}
T_4M_2	2.06 ^{EFGH}	2.43 ^{C}	2.83 ^{C}	3.36 ^{B}	3.76 ^{BCD}	4.20 ^{C}	4.93 ^{BC}	5.03 ^{CDE}
T_5M_1	2.26 ^{CDE}	2.60 ^{B}	2.90 ^{C}	3.33 ^{BC}	3.66 ^{CDE}	4.00 ^{CD}	5.10 ^{AB}	5.20 ^{BCD}
T_5M_2	2.46 ^{ABC}	2.66 ^{B}	3.13 ^{AB}	3.83 ^{A}	4.26 ^{A}	4.76 ^{A}	5.30 ^{A}	5.40 ^{A}
T_6M_1	1.86 ^{HI}	1.96 ^{E}	2.30 ^{E}	2.83 ^{E}	3.10 ^{H}	3.46 ^{F}	3.77 ^{E}	3.93 ^{G}
T_6M_2	1.93 ^{GHI}	2.13 ^{D}	2.53 ^{D}	3.00 ^{DE}	3.33 ^{FG}	3.66 ^{E}	3.87 ^{E}	4.13 ^{F}
T_7M_1	2.46 ^{ABC}	2.66 ^{B}	3.00 ^{BC}	3.46 ^{B}	3.83 ^{BC}	4.20 ^{C}	4.70 ^{D}	4.90 ^{E}
T_7M_2	2.53 ^{AB}	2.76 ^{B}	3.33 ^{A}	3.86 ^{A}	4.20 ^{A}	4.56 ^{AB}	5.00 ^{BC}	5.13 ^{CD}

S = Significant, NS = Non Significant ; Treatment means having similar alphabets in superscript do not differ significantly

Table 6: Effect of treatments on D leaf area (cm^2) in pineapple cv. Mauritius

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP	Ethrel appln.	Flowering
T_1	45.16 ^{B}	63.33 ^{B}	78.96 ^{B}	104.20 ^{AB}	124.70 ^{A}	150.30 ^{A}	210.80 ^{A}	215.80 ^{A}
T_2	38.39 ^{CD}	50.04 ^{DE}	65.21 ^{D}	88.92 ^{C}	105.60 ^{C}	144.00 ^{BC}	204.10 ^{B}	211.70 ^{AB}
T_3	40.59 ^{C}	50.69 ^{D}	65.89 ^{D}	90.76 ^{C}	109.20 ^{BC}	141.80 ^{C}	201.30 ^{B}	206.70 ^{BC}
T_4	36.06 ^{D}	47.03 ^{E}	63.72 ^{D}	91.21 ^{C}	110.60 ^{B}	134.20 ^{D}	191.10 ^{C}	199.70 ^{CD}
T_5	43.20 ^{BC}	54.17 ^{C}	70.02 ^{C}	101.60 ^{B}	122.60 ^{A}	147.30 ^{ABC}	201.30 ^{B}	206.60 ^{BC}
T_6	29.95 ^{E}	37.14 ^{F}	48.73 ^{E}	69.62 ^{D}	85.19 ^{D}	104.70 ^{E}	132.80 ^{D}	144.90 ^{E}
T_7	52.88 ^{A}	69.60 ^{A}	83.71 ^{A}	106.80 ^{A}	122.00 ^{A}	148.50 ^{AB}	185.50 ^{C}	195.40 ^{D}
M_1	38.08	48.43	60.73	84.42	98.73	121.97	185.92	193.24
M_2	43.84	57.86	75.33	102.19	124.13	155.39	193.20	201.27
F Test(5%)	S	S	S	S	S	S	S	S
T_1M_1	41.93 ^{CD}	57.27 ^{C}	67.76 ^{DE}	88.59 ^{C}	104.10 ^{F}	125.10 ^{E}	205.80 ^{BC}	210.80 ^{BC}
T_1M_2	48.39 ^{BC}	69.40 ^{AB}	90.16 ^{A}	119.80 ^{A}	145.30 ^{A}	175.40 ^{A}	215.80 ^{A}	220.90 ^{A}
T_2M_1	34.93 ^{E}	44.93 ^{E}	58.01 ^{FG}	80.77 ^{D}	89.45 ^{H}	119.10 ^{E}	200.90 ^{BCD}	209.60 ^{BC}
T_2M_2	42.85 ^{CD}	55.14 ^{CD}	72.41 ^{BCD}	97.06 ^{B}	121.80 ^{D}	168.90 ^{AB}	207.20 ^{B}	213.80 ^{AB}
T_3M_1	37.56 ^{DE}	44.70 ^{E}	56.64 ^{GH}	82.11 ^{CD}	96.08 ^{G}	121.60 ^{E}	199.70 ^{BCD}	203.00 ^{BCD}
T_3M_2	43.62 ^{CD}	56.68 ^{C}	75.14 ^{BC}	99.42 ^{B}	122.40 ^{D}	161.90 ^{BC}	202.90 ^{BC}	210.40 ^{BC}
T_4M_1	35.02 ^{E}	40.85 ^{EF}	56.69 ^{GH}	84.98 ^{CD}	101.40 ^{FG}	122.50 ^{E}	189.60 ^{E}	198.00 ^{DE}
T_4M_2	37.09 ^{DE}	53.22 ^{CD}	70.74 ^{CD}	97.45 ^{B}	119.90 ^{D}	145.90 ^{D}	192.50 ^{DE}	201.40 ^{CD}
T_5M_1	39.19 ^{DE}	50.75 ^{D}	63.23 ^{EF}	89.15 ^{C}	106.60 ^{F}	126.10 ^{E}	196.80 ^{CDE}	203.40 ^{BCD}
T_5M_2	47.21 ^{BC}	57.60 ^{C}	76.81 ^{B}	114.10 ^{A}	138.60 ^{B}	168.40 ^{AB}	205.80 ^{BC}	209.80 ^{BC}
T_6M_1	27.17 ^{F}	34.12 ^{G}	45.25 ^{I}	65.72 ^{F}	79.92 ^{I}	99.28 ^{G}	131.10 ^{G}	138.40 ^{G}
T_6M_2	32.72 ^{EF}	40.15 ^{F}	52.21 ^{H}	73.53 ^{E}	90.46 ^{H}	110.00 ^{F}	134.60 ^{G}	151.30 ^{F}
T_7M_1	50.80 ^{AB}	66.40 ^{B}	77.56 ^{B}	99.62 ^{B}	113.50 ^{E}	140.00 ^{D}	177.40 ^{F}	189.50 ^{E}
T_7M_2	54.95 ^{A}	72.80 ^{A}	89.86 ^{A}	114.00 ^{A}	130.50 ^{C}	157.00 ^{C}	193.50 ^{DE}	201.20 ^{CD}

S = Significant, NS = Non Significant ; Treatment means having similar alphabets in superscript do not differ significantly

The fertilizer doses had significant effect on 'D' leaf area at all growth stages. M_2 was superior throughout the sampling period and the value ranging from 43.84 to 201.3 cm^2 from 1 MAP to flowering.

Interaction effects showed that T_7M_2 was superior for the first four sampling stages when compared to other interactions. The interaction effect for 'D' leaf area was found to be the least for T_2M_1 at first and second sampling (34.93 cm^2 and 44.93 cm^2 respectively) while at third and fourth sampling T_6M_1 had the least value (45.25 cm^2 and 65.72 cm^2). From 5 MAP to flowering T_1M_2 recorded the maximum value while T_6M_1 had the least.

4.1.7 Total leaf area per plant

Data on the total leaf area per plant (m^2) are furnished in Table 7. Total leaf area per plant showed an increasing trend till flowering and declined slightly at the time of harvest (Fig.2a) T_7 recorded the maximum value during vegetative phase. However, during the stage of ethrel application and flowering, T_1 had more leaf area (0.8844 and 0.9465 m^2 respectively) followed by T_2 (0.8434 and 0.9163 m^2 respectively). T_6 recorded the least value at all growth stages.

The effect of two fertilizer doses differed significantly at all growth stages (Fig.2b). M_2 being superior to M_1 and the value ranging from 0.0618 m^2 to 0.8634 m^2 from 1 MAP to flowering.

The interaction effect differed significantly during the vegetative phase but did not follow a uniform pattern. However, treatment combinations with M_2 recorded higher total leaf area than treatment combinations with M_1.

Table7: Effect of treatments on total leaf area (m^2 / plant) in pineapple cv. Mauritius

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP	Ethrel appln	Flowering	Harvest
T_1	0.0611 ^{B}	0.1096 ^{B}	0.1630 ^{B}	0.2636 ^{C}	0.3955 ^{B}	0.5374 ^{B}	0.8844 ^{A}	0.9465 ^{A}	0.8773 ^{A}
T_2	0.0554 ^{D}	0.0863 ^{B}	0.1358 ^{E}	0.2272 ^{F}	0.3320 ^{F}	0.5151 ^{E}	0.8434 ^{B}	0.9163 ^{A}	0.8687 ^{A}
T_3	0.0569 ^{C}	0.0870 ^{D}	0.1378 ^{D}	0.2314 ^{D}	0.3421 ^{D}	0.5196 ^{D}	0.8164 ^{D}	0.8892 ^{A}	0.8341 ^{A}
T_4	0.0484 ^{E}	0.0816 ^{E}	0.1330 ^{F}	0.2287 ^{E}	0.3401 ^{E}	0.4740 ^{F}	0.7763 ^{E}	0.8643 ^{A}	0.7970 ^{A}
T_5	0.0575 ^{C}	0.0986 ^{C}	0.1571 ^{C}	0.2681 ^{B}	0.3927 ^{C}	0.5233 ^{C}	0.8311 ^{C}	0.9002 ^{A}	0.8346 ^{A}
T_6	0.0363 ^{F}	0.0536 ^{F}	0.0883 ^{G}	0.1583 ^{G}	0.2381 ^{G}	0.3345 ^{G}	0.5176 ^{G}	0.5836 ^{B}	0.5425 ^{B}
T_7	0.0774 ^{A}	0.1356 ^{A}	0.1939 ^{A}	0.3022 ^{A}	0.4168 ^{A}	0.5577 ^{A}	0.7637 ^{F}	0.8378 ^{A}	0.7864 ^{A}
M_1	0.0506	0.0800	0.1206	0.2054	0.3663	0.4189	0.7664	0.8329	0.7761
M_2	0.0618	0.1064	0.1676	0.2738	0.4018	0.5701	0.7865	0.8634	0.8070
F test (5%)	S	S	S	S	S	S	S	S	S
T_1M_1	0.0549 ^{F}	0.0952 ^{G}	0.1297 ^{I}	0.2107 ^{G}	0.3699 ^{I}	0.4231 ^{J}	0.8606 ^{B}	0.9227 ^{A}	0.8584 ^{A}
T_1M_2	0.0672 ^{C}	0.1239 ^{B}	0.1962 ^{B}	0.3154 ^{C}	0.4811 ^{A}	0.6517 ^{A}	0.9081 ^{A}	0.9713 ^{A}	0.8962 ^{A}
T_2M_1	0.0464 ^{I}	0.0743 ^{I}	0.1140 ^{J}	0.1954 ^{I}	0.2699 ^{L}	0.4001 ^{L}	0.8383 ^{D}	0.9055 ^{A}	0.8608 ^{A}
T_2M_2	0.0647 ^{D}	0.0983 ^{F}	0.1576 ^{F}	0.2189 ^{E}	0.3942 ^{D}	0.6301 ^{B}	0.8485 ^{C}	0.9271 ^{A}	0.8767 ^{A}
T_3M_1	0.0534 ^{FG}	0.0714 ^{J}	0.1087 ^{K}	0.1191 ^{H}	0.2935 ^{K}	0.4360 ^{H}	0.8173 ^{G}	0.8720 ^{A}	0.8185 ^{A}
T_3M_2	0.0604 ^{E}	0.1029 ^{E}	0.1670 ^{E}	0.2638 ^{D}	0.3907 ^{E}	0.6032 ^{D}	0.8156 ^{H}	0.9063 ^{A}	0.8497 ^{A}
T_4M_1	0.0442 ^{J}	0.0660 ^{F}	0.1102 ^{K}	0.2002 ^{H}	0.3021 ^{J}	0.4160 ^{K}	0.7778 ^{K}	0.8106 ^{A}	0.7888 ^{A}
T_4M_2	0.0526 ^{GH}	0.0973 ^{F}	0.1558 ^{G}	0.2572 ^{E}	0.3781 ^{G}	0.5319 ^{F}	0.7837 ^{J}	0.8778 ^{A}	0.8052 ^{A}
T_5M_1	0.0515 ^{H}	0.0865 ^{H}	0.1339 ^{H}	0.2178 ^{F}	0.3263 ^{H}	0.4306 ^{I}	0.8275 ^{F}	0.8649 ^{A}	0.8244 ^{A}
T_5M_2	0.0635 ^{D}	0.1107 ^{D}	0.1803 ^{C}	0.3185 ^{B}	0.4590 ^{B}	0.6160 ^{C}	0.8243 ^{E}	0.9055 ^{A}	0.8447 ^{A}
T_6M_1	0.0320 ^{L}	0.0457 ^{M}	0.0781 ^{M}	0.1489 ^{K}	0.2196 ^{N}	0.3113 ^{N}	0.5142 ^{M}	0.5628 ^{B}	0.5231 ^{B}
T_6M_2	0.0406 ^{K}	0.0614 ^{L}	0.0989 ^{L}	0.1696 ^{J}	0.2565 ^{M}	0.3175 ^{M}	0.5179 ^{M}	0.6032 ^{B}	0.5619 ^{B}
T_7M_1	0.0714 ^{B}	0.1207 ^{C}	0.1697 ^{D}	0.2655 ^{D}	0.3805 ^{F}	0.5152 ^{G}	0.7308 ^{L}	0.8220 ^{A}	0.7585 ^{A}
T_7M_2	0.0834 ^{A}	0.1505 ^{A}	0.2181 ^{A}	0.3350 ^{A}	0.4531 ^{C}	0.6003 ^{E}	0.7966 ^{I}	0.8537 ^{A}	0.8144 ^{A}

S = Significant, NS = Non Significant ; Treatment means having similar alphabets in superscript do not differ significantly

Fig. 2a Total Leaf area of different treatments at critical stages of growth.

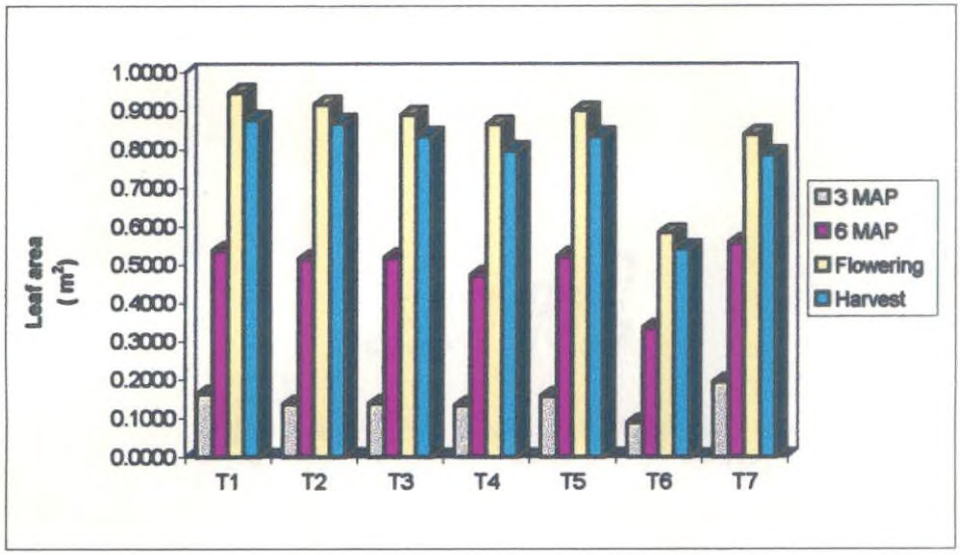
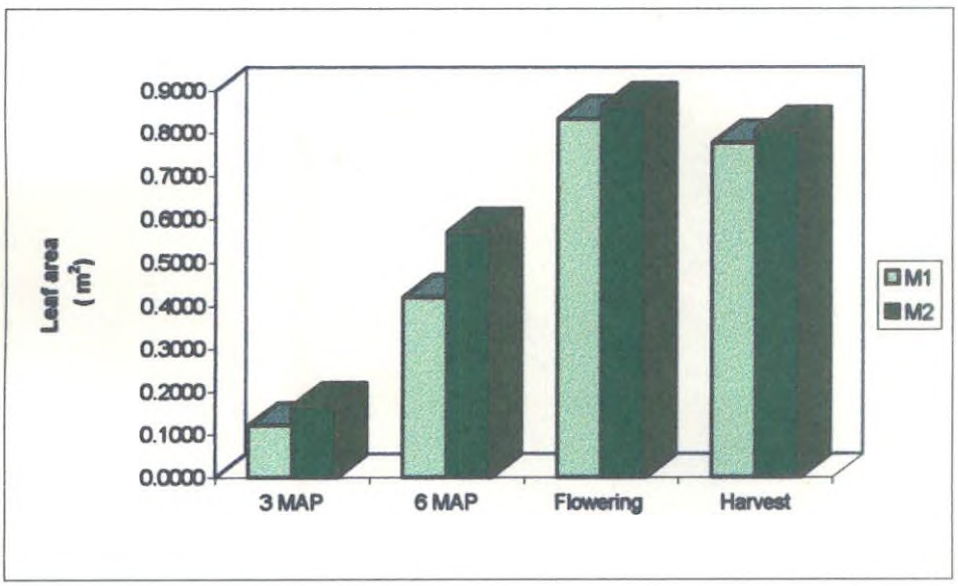


Fig. 2b Effect of fertilizer doses on total leaf area at critical stages of growth.



4.1.8 Fresh weight

Among the treatments, T_7 was found to be superior at all growth stages except during flowering with fresh weight ranging from 344.8 to 3395.3 g from 1 MAP to harvest (Table 8). At flowering T_1 had the maximum fresh weight (1618.3 g), while at harvest T_7 had the maximum value and other treatments were on par with T_7 expect T_6 which recorded the least value (2320.0g).

The effect of two levels of fertilizer doses showed significant positive relationship with respect to fresh weight. As for other parameters, M_2 was superior with respect to total plant fresh weight ranging from 249.8 to 3158.86 g from 1 MAP to harvest.

Treatment combinations differed significantly with respect to fresh weight. T_7M_1 had the highest value during 1 MAP and 2 MAP (356.6 and 408.6 g respectively). At 3 MAP, T_3M_2 was superior (514.8 g), while T_4M_2 was superior at 4, 5 and 6 MAP. During ethrel application and flowering stages, T_1M_2 had the maximum fresh weight (1346.6 and 1649.2 g respectively), whereas during harvest T_7M_2 recorded the maximum value (3497.2 g) and T_6M_2 had the least value (2300.0 g).

4.1.9 Total chlorophyll content

The data presented in Table 9 revealed that total chlorophyll content (mg/g of leaf) did not differ much among the treatments at 5 MAP except for T_6. The maximum total chlorophyll content was shown by T_7 (0.4755). At flowering T_4 had the highest chlorophyll content (0.5148) while T_6 (0.3501) had the least value. T_7 (0.2988) and T_2 (0.2826) recorded the maximum and minimum chlorophyll values during harvest.

Table 8: Effect of treatments on total plant fresh weight (g) in pineapple cv. Mauritius

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP	Ethrel appln.	Flowering	Harvest
T_1	202.30 ^{D}	250.00 ^{D}	403.40 ^{E}	568.60 ^{C}	711.40 ^{D}	840.50 ^{D}	1318.80 ^{A}	1618.30 ^{A}	3253.40 ^{B}
T_2	222.00 ^{C}	275.50 ^{C}	429.40 ^{D}	574.10 ^{C}	728.70 ^{C}	846.10 ^{D}	1268.40 ^{B}	1563.30 ^{B}	3163.60 ^{C}
T_3	244.40 ^{B}	290.50 ^{B}	462.00 ^{B}	643.50 ^{B}	778.40 ^{B}	873.60 ^{C}	1279.20 ^{AB}	1539.50 ^{B}	3367.10 ^{A}
T_4	242.00 ^{B}	294.10 ^{B}	451.90 ^{C}	643.90 ^{B}	774.50 ^{B}	886.00 ^{B}	1212.30 ^{C}	1512.30 ^{B}	3167.30 ^{C}
T_5	226.20 ^{C}	286.60 ^{B}	399.80 ^{E}	552.30 ^{D}	703.70 ^{D}	850.50 ^{D}	1267.50 ^{B}	1516.10 ^{B}	3241.80 ^{B}
T_6	203.80 ^{D}	255.40 ^{D}	327.80 ^{F}	459.90 ^{E}	550.70 ^{E}	705.60 ^{E}	875.70 ^{D}	1107.50 ^{C}	2320.00 ^{D}
T_7	344.80 ^{A}	397.50 ^{A}	487.80 ^{A}	659.90 ^{A}	814.70 ^{A}	910.70 ^{A}	1318.20 ^{A}	1536.40 ^{B}	3395.30 ^{A}
M_1	231.70	276.60	386.40	522.40	628.90	743.00	1206.40	1461.60	3100.14
M_2	249.80	309.07	459.90	649.60	818.40	946.40	1233.50	1506.90	3158.86
F Test (5%)	S	S	S	S	S	S	S	S	NS
T_1M_1	202.60 ^{E}	234.90 ^{G}	361.00 ^{I}	488.90 ^{J}	612.90 ^{H}	731.50 ^{FG}	1291.90 ^{ABCD}	1586.30 ^{AB}	3218.10 ^{BCD}
T_1M_2	201.90 ^{E}	265.10 ^{EF}	445.90 ^{D}	648.20 ^{D}	809.90 ^{D}	949.40 ^{C}	1346.60 ^{A}	1649.20 ^{A}	3289.30 ^{BC}
T_2M_1	223.60 ^{DE}	275.70 ^{E}	393.60 ^{G}	517.30 ^{I}	617.70 ^{H}	727.10 ^{G}	1264.20 ^{BCDE}	1566.20 ^{BC}	3192.30 ^{CD}
T_2M_2	220.40 ^{DE}	275.40 ^{E}	465.10 ^{C}	630.90 ^{E}	839.60 ^{C}	965.10 ^{C}	1273.60 ^{BCDE}	1559.40 ^{BC}	3134.30 ^{D}
T_3M_1	207.90 ^{E}	255.70 ^{F}	409.30 ^{F}	566.40 ^{G}	640.30 ^{G}	729.80 ^{FG}	1229.10 ^{DE}	1476.10 ^{D}	3313.00 ^{B}
T_3M_2	281.00 ^{C}	325.40 ^{C}	514.80 ^{A}	720.70 ^{B}	916.40 ^{A}	1017.00 ^{A}	1330.30 ^{AB}	1602.80 ^{AB}	3420.10 ^{A}
T_4M_1	215.10 ^{E}	256.20 ^{F}	390.30 ^{G}	544.40 ^{H}	623.90 ^{H}	752.10 ^{E}	1219.30 ^{DE}	1494.00 ^{CD}	3140.20 ^{D}
T_4M_2	268.90 ^{C}	331.90 ^{C}	513.40 ^{A}	743.30 ^{A}	925.20 ^{A}	1020.00 ^{A}	1205.40 ^{E}	1529.60 ^{BCD}	3194.40 ^{CD}
T_5M_1	209.40 ^{E}	265.30 ^{EF}	371.20 ^{H}	493.50 ^{J}	611.60 ^{H}	745.50 ^{EF}	1247.30 ^{CDE}	1475.10 ^{D}	3249.90 ^{BC}
T_5M_2	243.00 ^{D}	308.00 ^{D}	428.40 ^{E}	611.10 ^{F}	795.70 ^{E}	955.60 ^{C}	1287.70 ^{ABCD}	1557.00 ^{BC}	3234.80 ^{BCD}
T_6M_1	206.80 ^{E}	239.40 ^{G}	307.00 ^{K}	432.10 ^{K}	524.80 ^{J}	685.60 ^{H}	873.90 ^{F}	1105.30 ^{E}	2300.00 ^{E}
T_6M_2	200.70 ^{E}	271.40 ^{E}	348.70 ^{J}	487.80 ^{J}	576.60 ^{I}	725.60 ^{G}	877.50 ^{F}	1108.60 ^{E}	2340.00 ^{E}
T_7M_1	356.60 ^{A}	408.60 ^{A}	472.30 ^{C}	614.40 ^{F}	763.80 ^{F}	829.80 ^{D}	1320.20 ^{AB}	1529.40 ^{BCD}	3292.40 ^{BC}
T_7M_2	332.90 ^{B}	386.30 ^{B}	503.30 ^{B}	705.40 ^{C}	865.60 ^{B}	991.60 ^{B}	1317.10 ^{ABC}	1543.40 ^{BCD}	3497.20 ^{A}

S = Significant, NS = Non Significant ; Treatment means having similar alphabets in superscript do not differ significantly

Table 9: Effect of treatments on total chlorophyll content of leaves (mg/g) in pineapple cv. Mauritius

Treatments	5 MAP	Flowering	Harvest
T_1	0.4179 ^{B}	0.4342 ^{B}	0.2901 ^{B}
T_2	0.4124 ^{B}	0.4406 ^{B}	0.2826 ^{E}
T_3	0.4466 ^{AB}	0.4894 ^{AB}	0.2905 ^{B}
T_4	0.4874 ^{A}	0.5148 ^{A}	0.2863 ^{D}
T_5	0.4874 ^{A}	0.4974 ^{A}	0.2882 ^{C}
T_6	0.3106 ^{C}	0.3501 ^{C}	0.2694 ^{F}
T_7	0.4755 ^{A}	0.5079 ^{A}	0.2988 ^{A}
M_1	0.3910	0.4460	0.2840
M_2	0.4770	0.4780	0.2890
F test (5%)	S	S	NS
T_1M_1	0.3855 ^{EFG}	0.4198 ^{CD}	0.2918 ^{CD}
T_1M_2	0.4503 ^{BCDEF}	0.4487 ^{BC}	0.2884 ^{E}
T_2M_1	0.3670 ^{FG}	0.4244 ^{CD}	0.2746 ^{H}
T_2M_2	0.4578 ^{BCDE}	0.4568 ^{BC}	0.2907 ^{CD}
T_3M_1	0.3855 ^{EFG}	0.4726 ^{ABC}	0.2865 ^{F}
T_3M_2	0.5078 ^{ABCD}	0.5063 ^{ABC}	0.2944 ^{B}
T_4M_1	0.4198 ^{EF}	0.4763 ^{ABC}	0.2817 ^{G}
T_4M_2	0.5551 ^{A}	0.5533 ^{A}	0.2909 ^{CD}
T_5M_1	0.4420 ^{CDEF}	0.4642 ^{BC}	0.2900 ^{DE}
T_5M_2	0.5328 ^{AB}	0.5305 ^{AB}	0.2863 ^{F}
T_6M_1	0.3048 ^{G}	0.3660 ^{DE}	0.2691 ^{I}
T_6M_2	0.3163 ^{G}	0.3342 ^{E}	0.2696 ^{I}
T_7M_1	0.4300 ^{DEF}	0.4976 ^{ABC}	0.2919 ^{C}
T_7M_2	0.5210 ^{ABC}	0.5182 ^{AB}	0.3058 ^{A}

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

The fertilizer doses had significant effect on chlorophyll content at 5 MAP and flowering with M_2 having the highest chlorophyll content (0.4770 and 0.4780 respectively). At harvest, the chlorophyll content did not differ significantly among the doses.

The interaction effect on total chlorophyll content was high for treatment T_4M_2 at 5 MAP and flowering with values 0.5551 and 0.5533 respectively. During harvest T_7M_2 recorded the highest value of 0.3058. In general a trend was followed in which the chlorophyll content increased gradually from 5 MAP to flowering after which there was a gradual decline in the values at the time of harvest in all the treatments.

4.2 Dry matter production and partitioning

4.2.1 Total dry matter production (TDM) per plant

Data on total dry matter production (TDM) per plant at different stages of growth are presented in Table 10. Total dry matter increased steadily during the various stages of growth and the maximum increase was noticed between flowering and harvest.

Among the treatments, T_7 (sucker) recorded the maximum dry weight during the vegetative phase. However, at 4 MAP the tissue culture plants viz., T_3 and T_4 also recorded the maximum dry weight, whereas during ethrel application stage the trend differed in which, T_1 recorded the maximum dry weight (188.4) followed by T_7 (184.0). At the time of flowering also T_1 recorded the maximum dry weight followed by T_7, T_2 and T_3. Again the trend changed at the time of harvest wherein, T_7 recorded the maximum dry weight (444.2) followed by T_1 (432.9) and T_3 (431.1). Throughout the growth stages the tissue culture plants of unselected bulk (T_6) recorded the least dry weight (Fig.3a).

Table 10: Effect of treatments on total plant dry weight (g) in pineapple cv. Mauritius

Treatments	1MAP	2MAP		3MAP		4MAP		5MAP		6MAP		Ethrel appln.		Flowering		Harvest	
T_1	29.72 ^{D}	36.95 ^{D}	*24.30*	59.05 ^{E}	*98.60*	82.82 ^{B}	*178.60*	104.60 ^{C}	*251.90*	121.40 ^{E}	*308.40*	188.40 ^{A}	*533.90*	223.30 ^{A}	*651.30*	432.90 ^{B}	*1356.50*
T_2	32.89 ^{C}	40.60 ^{C}	*23.40*	62.80 ^{D}	*90.90*	83.55 ^{B}	*154.00*	105.90 ^{C}	*221.90*	122.00 ^{DE}	*270.90*	180.10 ^{B}	*447.50*	218.50 ^{ABC}	*564.30*	413.90 ^{C}	*1158.40*
T_3	35.82 ^{B}	42.70 ^{B}	*19.20*	67.59 ^{B}	*88.60*	93.35 ^{A}	*160.60*	113.30 ^{B}	*216.30*	125.80 ^{C}	*251.20*	183.20 ^{AB}	*411.40*	216.90 ^{ABC}	*505.50*	431.10 ^{B}	*1103.50*
T_4	35.93 ^{B}	43.40 ^{B}	*20.70*	66.02 ^{C}	*83.70*	93.60 ^{A}	*160.50*	112.90 ^{B}	*214.20*	128.30 ^{B}	*257.00*	172.80 ^{C}	*380.90*	213.90 ^{BC}	*495.30*	418.80 ^{C}	*1065.60*
T_5	33.09 ^{C}	42.12 ^{B}	*27.20*	58.23 ^{E}	*75.90*	80.40 ^{C}	*142.90*	102.80 ^{D}	*210.60*	123.50 ^{DE}	*273.20*	181.50 ^{B}	*448.50*	211.90 ^{C}	*540.30*	419.00 ^{C}	*1166.20*
T_6	30.23 ^{D}	37.37 ^{D}	*23.60*	47.85 ^{F}	*58.20*	67.00 ^{D}	*121.60*	80.12 ^{E}	*165.00*	101.80 ^{F}	*236.70*	125.40 ^{D}	*301.50*	151.50 ^{D}	*401.10*	300.80 ^{D}	*895.00*
T_7	50.73 ^{A}	58.35 ^{A}	*15.00*	71.28 ^{A}	*40.50*	95.08 ^{A}	*87.40*	118.80 ^{A}	*134.10*	130.40 ^{A}	*157.00*	184.00 ^{AB}	*262.70*	219.20 ^{AB}	*332.00*	444.20 ^{A}	*775.60*
M_1	34.12	40.62	*19.10*	56.47	*65.50*	75.88	*122.30*	91.48	*168.10*	107.49	*215.00*	171.04	*401.20*	204.39	*499.00*	405.41	*1088.10*
M_2	36.86	45.51	*23.40*	67.22	*82.30*	94.35	*155.90*	119.50	*224.10*	136.30	*269.70*	176.26	*378.10*	211.36	*473.40*	413.37	*1021.40*
F Test (5%)	S	S		S		S		S		S		S		S		S	
T_1M_1	29.67 ^{D}	34.73 ^{G}	*17.10*	52.90 ^{H}	*78.20*	71.23 ^{I}	*140.00*	89.67 ^{H}	*202.20*	105.40 ^{F}	*255.20*	184.50 ^{ABC}	*521.80*	221.50 ^{AB}	*646.50*	429.10 ^{BCD}	*1346.20*
T_1M_2	29.77 ^{D}	39.17 ^{EF}	*31.50*	65.20 ^{D}	*119.0*	94.40 ^{D}	*217.00*	119.40 ^{D}	*301.00*	137.30 ^{C}	*361.20*	192.30 ^{A}	*545.90*	225.10 ^{A}	*656.10*	436.70 ^{B}	*1366.90*
T_2M_1	33.00 ^{CD}	40.50 ^{EF}	*22.70*	57.43 ^{G}	*74.00*	75.13 ^{H}	*127.60*	89.73 ^{H}	*171.90*	104.60 ^{F}	*216.90*	178.80 ^{BCD}	*441.80*	219.50 ^{ABC}	*565.10*	413.40 ^{E}	*1152.70*
T_2M_2	32.78 ^{CD}	40.70 ^{E}	*24.10*	68.17 ^{C}	*107.9*	91.97 ^{D}	*180.50*	122.00 ^{C}	*272.10*	139.40 ^{BC}	*325.20*	181.50 ^{ABCD}	*453.60*	217.50 ^{ABC}	*563.50*	414.50 ^{E}	*1164.40*
T_3M_1	30.63 ^{D}	37.50 ^{E}	*22.40*	59.93 ^{F}	*95.60*	81.83 ^{F}	*167.10*	93.20 ^{G}	*204.20*	105.10 ^{F}	*243.10*	177.00 ^{CD}	*477.80*	209.60 ^{CD}	*584.30*	422.90 ^{DE}	*1280.60*
T_3M_2	41.00 ^{B}	47.90 ^{C}	*16.80*	75.25 ^{A}	*83.50*	104.90 ^{B}	*155.80*	133.50 ^{A}	*225.60*	146.60 ^{A}	*255.50*	189.50 ^{AB}	*362.10*	224.20 ^{A}	*446.80*	439.40 ^{B}	*971.70*
T_4M_1	31.97 ^{D}	37.70 ^{F}	*17.90*	56.97 ^{G}	*78.10*	79.17 ^{G}	*147.60*	90.80 ^{H}	*184.00*	110.20 ^{E}	*244.60*	176.40 ^{D}	*451.70*	209.40 ^{CD}	*554.90*	422.30 ^{DE}	*1220.90*
T_4M_2	39.90 ^{B}	49.10 ^{C}	*23.10*	75.07 ^{A}	*88.10*	108.00 ^{A}	*170.60*	135.00 ^{A}	*238.30*	146.50 ^{A}	*267.10*	175.20 ^{CD}	*339.00*	218.40 ^{ABC}	*447.30*	425.20 ^{CDE}	*965.60*
T_5M_1	30.88 ^{D}	39.10 ^{EF}	*26.60*	54.17 ^{H}	*75.40*	71.90 ^{I}	*132.80*	89.30 ^{H}	*189.10*	107.90 ^{E}	*249.40*	179.20 ^{BCD}	*480.30*	207.00 ^{D}	*570.30*	415.70 ^{E}	*1246.10*
T_5M_2	35.30 ^{C}	45.13 ^{D}	*27.80*	62.50 ^{E}	*77.00*	88.90 ^{E}	*151.80*	116.40 ^{E}	*229.70*	139.00 ^{BC}	*293.70*	183.90 ^{ABC}	*420.90*	216.90 ^{ABCD}	*514.40*	422.40 ^{DE}	*1096.60*
T_6M_1	30.67 ^{D}	35.03 ^{G}	*14.50*	44.80 ^{J}	*46.00*	62.80 ^{J}	*104.70*	76.30 ^{J}	*148.70*	99.20 ^{G}	*223.40*	125.90 ^{E}	*310.40*	150.20 ^{E}	*389.70*	299.10 ^{F}	*875.20*
T_6M_2	29.87 ^{D}	39.70 ^{EF}	*32.90*	50.90 ^{I}	*70.40*	71.20 ^{I}	*138.30*	83.93 ^{I}	*180.90*	104.40 ^{F}	*249.50*	125.00 ^{E}	*318.40*	152.70 ^{E}	*411.20*	302.50 ^{F}	*912.70*
T_7M_1	52.03 ^{A}	59.80 ^{A}	*14.90*	69.10 ^{C}	*32.80*	89.10 ^{E}	*71.20*	111.40 ^{F}	*114.10*	120.00 ^{D}	*130.60*	181.60 ^{ABCD}	*249.00*	213.60 ^{BCD}	*310.50*	435.40 ^{BC}	*736.80*
T_7M_2	49.43 ^{A}	56.90 ^{B}	*15.10*	73.47 ^{B}	*48.60*	101.10 ^{C}	*104.50*	126.20 ^{B}	*155.30*	140.90 ^{B}	*185.00*	186.50 ^{ABC}	*277.30*	224.80 ^{A}	*354.70*	452.90 ^{A}	*816.20*

S = Significant, NS = Non Significant ; Treatment means having similar alphabets in superscript do not differ significantly

Figures in bold italics indicate the percentage incremental increase in total dry matter

Fig. 3a Total dry matter content of different treatments at critical stages of growth.

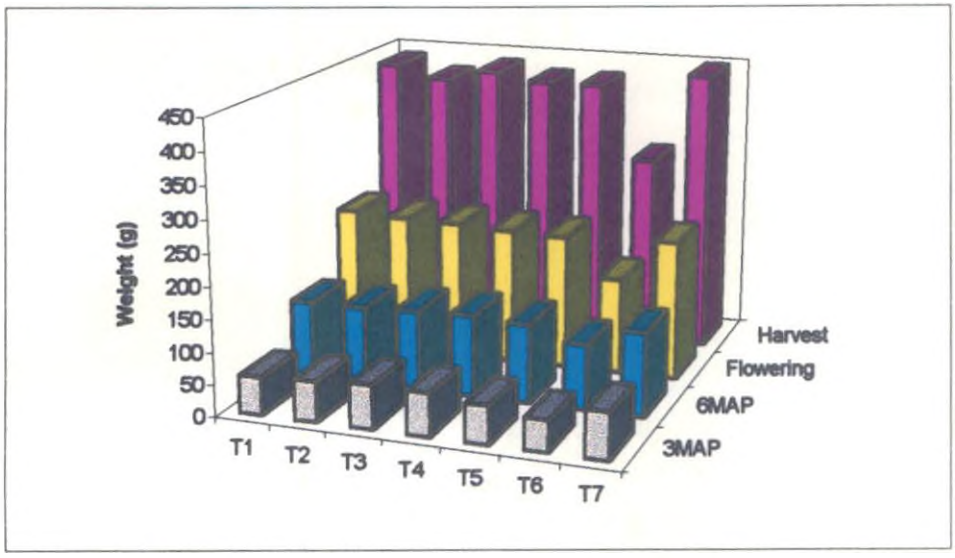


Fig. 3b Effect of fertilizer doses on total dry matter content at critical stages of growth.

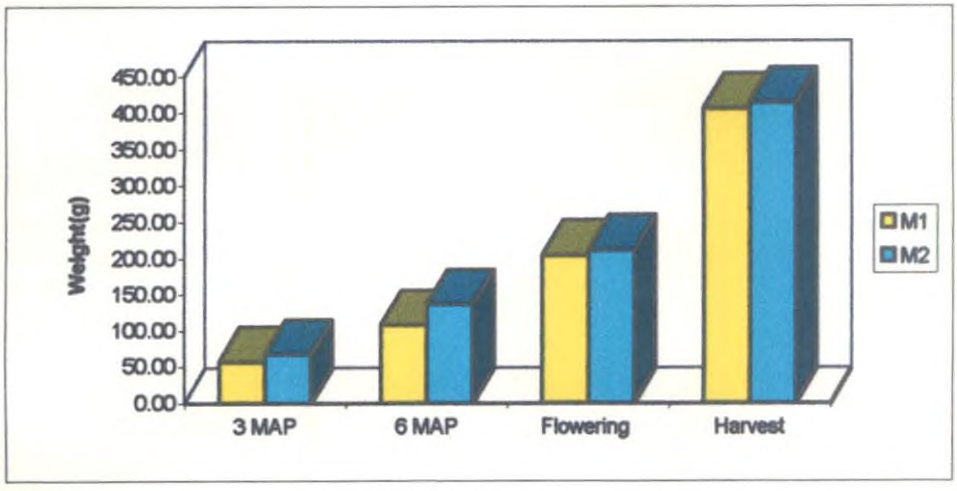
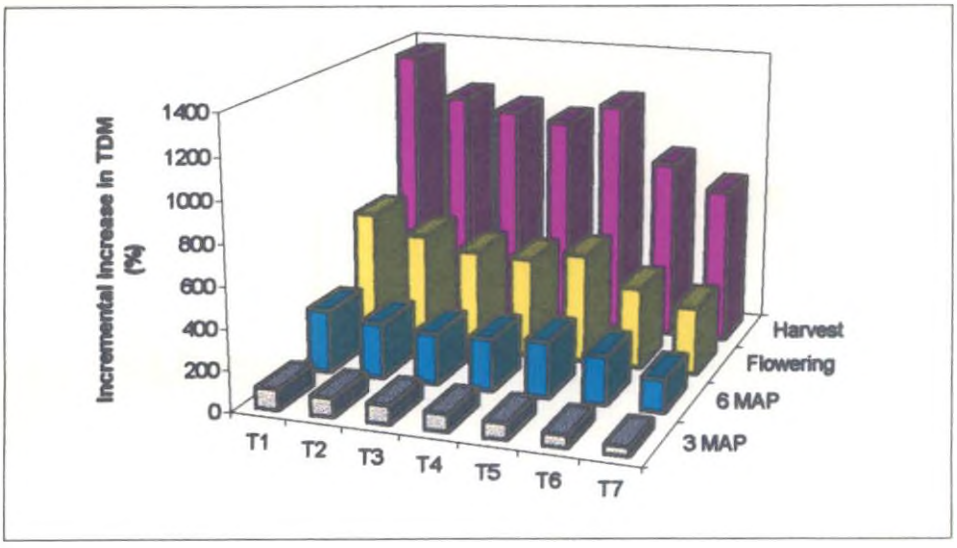


Fig. 3c Incremental increase in total dry matter content (%) of different treatments at critical stages of growth.



With respect to effect of two fertilizer doses there existed a significant difference between M_1 and M_2 at all growth stages (Fig.3b). M_2 was found to be superior at all stages of growth. Application of 50 per cent increment in fertilizer dose augmented the tissue culture plants to increase the dry matter content. This helped M_2 in attaining the physiological maturity (39-42 leaf stage) one month earlier when compared to M_1. Even though significant difference existed between M_1 and M_2 during flowering and harvest, the difference was meager and was not much pronounced.

The interaction effect differed significantly but did not follow a consistent pattern throughout the growth stages. However, in all treatment combinations application of 50 per cent increment in fertilizer dose (M_2) was found to be superior at all sampling periods.

Percentage increment in TDM was computed from second month onwards and given in bold italics of Table 10. Among the treatments, T_1 recorded the maximum increment in TDM (1356.6%) followed by T_5 (1166.2%), at the time of harvest. T_2, T_3 and T_4 were on par with T_5. T_7 recorded the least value (775.6%) followed by T_6 (895.0%). Increased fertilizer application (M_2) showed superiority over M_1 with respect to this parameter during vegetative stage and subsequent stages the differences became minimal.

4.2.2 Dry matter partitioning(DMP) to different plant parts.

Data on dry matter partitioning (DMP) to different plant parts at different stages of growth are presented in Table 11 to 19.

Table11: Effect of treatments on dry matter partitioning (g/plant) of different plant parts in pineapple cv. Mauritius at 1 MAP

Treatments	Leaf	%	Stem	%	D Leaf	%	Root	%
T_1	23.50 ^{D}	*79.12*	2.15 ^{D}	*7.24*	0.65 ^{D}	*2.19*	3.37 ^{C}	*11.35*
T_2	25.30 ^{CD}	*76.89*	2.38 ^{BC}	*7.23*	0.75 ^{CD}	*2.28*	4.51 ^{BC}	*11.71*
T_3	28.40 ^{B}	*79.32*	2.35 ^{BCD}	*6.56*	0.88 ^{AB}	*2.46*	5.32 ^{AB}	*14.86*
T_4	26.70 ^{BC}	*74.37*	2.40 ^{B}	*6.69*	0.95 ^{A}	*2.65*	5.90 ^{A}	*16.43*
T_5	25.60 ^{CD}	*77.34*	2.23 ^{BCD}	*6.74*	0.78 ^{BC}	*2.36*	4.51 ^{BC}	*13.63*
T_6	24.10 ^{D}	*79.80*	2.17 ^{CD}	*7.19*	0.68 ^{CD}	*2.25*	3.43 ^{C}	*11.36*
T_7	42.20 ^{A}	*83.23*	7.47 ^{A}	*14.73*	0.73 ^{CD}	*1.44*	0.34 ^{D}	*0.65*
M_1	26.70	*78.30*	3.03	*8.88*	0.72	*2.11*	4.05	*11.88*
M_2	29.30	*79.40*	3.01	*8.16*	0.83	*2.25*	3.78	*10.22*
F Test (5%)	S		S		S		S	
T_1M_1	23.10 ^{E}	*77.78*	2.20 ^{DE}	*7.41*	0.63 ^{CD}	*2.12*	3.70 ^{CD}	*12.46*
T_1M_2	24.00 ^{E}	*80.53*	2.10 ^{E}	*7.05*	0.67 ^{CD}	*2.25*	3.03 ^{D}	*10.17*
T_2M_1	25.60 ^{DE}	*77.58*	2.33 ^{CDE}	*7.06*	0.73 ^{BCD}	*2.21*	4.30 ^{ABCD}	*13.03*
T_2M_2	24.90 ^{DE}	*75.91*	2.43 ^{CD}	*7.41*	0.77 ^{BC}	*2.35*	4.72 ^{ABCD}	*14.39*
T_3M_1	25.10 ^{DE}	*82.03*	2.10 ^{E}	*6.86*	0.67 ^{CD}	*2.19*	5.07 ^{ABC}	*16.57*
T_3M_2	31.70 ^{B}	*77.32*	2.60 ^{C}	*6.34*	1.10 ^{A}	*2.68*	5.57 ^{AB}	*13.59*
T_4M_1	22.90 ^{E}	*71.57*	2.20 ^{DE}	*6.88*	0.77 ^{BC}	*2.41*	6.10 ^{A}	*19.07*
T_4M_2	30.50 ^{BC}	*76.44*	2.60 ^{C}	*6.52*	1.13 ^{A}	*2.83*	5.70 ^{AB}	*14.29*
T_5M_1	23.10 ^{E}	*74.76*	2.17 ^{DE}	*7.02*	0.67 ^{CD}	*2.17*	4.95 ^{ABC}	*16.02*
T_5M_2	28.20 ^{CD}	*79.89*	2.30 ^{CDE}	*6.52*	0.90 ^{B}	*2.55*	4.07 ^{BCD}	*11.53*
T_6M_1	24.00 ^{E}	*78.18*	2.20 ^{DE}	*7.17*	0.70 ^{CD}	*2.28*	3.73 ^{CD}	*12.15*
T_6M_2	24.10 ^{E}	*80.87*	2.13 ^{DE}	*7.15*	0.67 ^{CD}	*2.25*	3.13 ^{D}	*10.50*
T_7M_1	42.60 ^{A}	*81.92*	8.03 ^{A}	*15.44*	0.90 ^{B}	*1.73*	0.47 ^{E}	*0.91*
T_7M_2	41.80 ^{A}	*84.62*	6.90 ^{B}	*13.97*	0.57 ^{D}	*1.15*	0.20 ^{E}	*0.41*

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

Table 12: Effect of treatments on dry matter partitioning (g/plant) of different plant parts in pineapple cv. Mauritius at 2 MAP

Treatments	Leaf	%	Stem	%	D Leaf	%	Root	%
T_1	30.22 ^{C}	*81.62*	2.27 ^{D}	*6.14*	0.87 ^{B}	*2.36*	3.57 ^{C}	*9.65*
T_2	32.12 ^{B}	*79.06*	2.57 ^{BC}	*6.34*	0.93 ^{B}	*2.30*	4.98 ^{B}	*12.27*
T_3	33.47 ^{B}	*78.45*	2.42 ^{CD}	*5.67*	1.07 ^{A}	*2.51*	5.75 ^{AB}	*13.47*
T_4	35.57 ^{B}	*77.41*	2.65 ^{B}	*6.10*	1.17 ^{A}	*2.69*	6.02 ^{AB}	*13.88*
T_5	33.97 ^{B}	*40.76*	2.43 ^{CD}	*5.78*	0.87 ^{B}	*2.07*	4.90 ^{B}	*11.64*
T_6	30.20 ^{C}	*80.74*	2.40 ^{CD}	*6.42*	0.87 ^{B}	*2.33*	3.90 ^{C}	*9.43*
T_7	47.62 ^{A}	*81.64*	7.93 ^{A}	*13.60*	0.92 ^{B}	*1.58*	1.89 ^{D}	*3.23*
M_1	31.96	*78.82*	3.27	*8.05*	0.90	*2.22*	4.51	*11.09*
M_2	36.94	*81.09*	3.21	*7.05*	1.01	*2.22*	4.35	*9.57*
F Test (5%)	S		NS		S		S	
T_1M_1	27.57 ^{E}	*79.53*	2.30 ^{EFG}	*6.63*	0.87 ^{BCD}	*2.51*	4.00 ^{DEF}	*11.53*
T_1M_2	32.87 ^{C}	*83.93*	2.23 ^{FG}	*5.69*	0.87 ^{CD}	*2.22*	3.13 ^{F}	*7.99*
T_2M_1	32.33 ^{C}	*79.76*	2.57 ^{DE}	*6.35*	0.87 ^{BCD}	*2.15*	4.73 ^{BCDE}	*11.68*
T_2M_2	31.90 ^{C}	*78.38*	2.57 ^{CDE}	*6.31*	1.00 ^{BC}	*2.46*	5.23 ^{ABCD}	*12.86*
T_3M_1	28.93 ^{DE}	*77.07*	2.17 ^{G}	*5.79*	0.87 ^{BCD}	*2.32*	5.53 ^{ABC}	*14.75*
T_3M_2	38.00 ^{B}	*79.34*	2.67 ^{CD}	*5.58*	1.27 ^{A}	*2.66*	5.97 ^{AB}	*12.47*
T_4M_1	28.13 ^{E}	*74.53*	2.43 ^{DEFG}	*6.45*	1.00 ^{BC}	*2.66*	6.13 ^{A}	*16.26*
T_4M_2	39.00 ^{B}	*79.43*	2.87 ^{C}	*5.85*	1.33 ^{A}	*2.71*	5.90 ^{ABC}	*12.02*
T_5M_1	30.77 ^{CD}	*78.78*	2.33 ^{EFG}	*5.96*	0.77 ^{D}	*1.97*	5.23 ^{ABCD}	*13.38*
T_5M_2	37.17 ^{B}	*82.49*	2.53 ^{DEF}	*5.61*	0.97 ^{BCD}	*2.16*	4.57 ^{CDE}	*10.14*
T_6M_1	27.80 ^{E}	*79.43*	2.40 ^{DEFG}	*6.86*	0.84 ^{CD}	*2.38*	4.00 ^{DEF}	*11.43*
T_6M_2	32.60 ^{C}	*82.12*	2.40 ^{DEFG}	*6.05*	0.90 ^{BCD}	*2.27*	3.80 ^{EF}	*9.58*
T_7M_1	48.17 ^{A}	*80.61*	8.67 ^{A}	*14.50*	1.07 ^{B}	*1.79*	1.90 ^{G}	*3.18*
T_7M_2	47.07 ^{A}	*82.78*	7.20 ^{B}	*12.66*	0.77 ^{D}	*1.36*	1.87 ^{G}	*3.29*

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

Table 13: Effect of treatments on dry matter partitioning (g/plant) of different plant parts in pineapple cv. Mauritius at 3 MAP

Treatments	Leaf	%	Stem	%	D Leaf	%	Root	%
T_1	44.95 ^{D}	*76.28*	6.22 ^{B}	*10.55*	1.22 ^{BC}	*2.07*	6.67 ^{B}	*11.31*
T_2	48.18 ^{C}	*76.76*	6.18 ^{B}	*9.85*	1.40 ^{AB}	*2.23*	7.03 ^{AB}	*11.20*
T_3	52.59 ^{A}	*77.82*	5.95 ^{B}	*3.81*	1.53 ^{A}	*2.27*	7.52 ^{A}	*11.13*
T_4	50.70 ^{B}	*76.82*	6.25 ^{B}	*9.47*	1.52 ^{A}	*2.31*	7.55 ^{A}	*11.44*
T_5	44.18 ^{D}	*75.82*	6.07 ^{B}	*10.42*	1.35 ^{AB}	*2.32*	6.72 ^{B}	*11.53*
T_6	35.93 ^{E}	*75.10*	5.30 ^{C}	*11.09*	1.12 ^{C}	*2.35*	5.50 ^{C}	*11.51*
T_7	53.78 ^{A}	*75.46*	10.53 ^{A}	*14.77*	1.32 ^{B}	*1.86*	5.73 ^{C}	*8.05*
M_1	43.10	*76.79*	6.21	*10.99*	1.13	*2.00*	6.05	*10.71*
M_2	51.30	*76.34*	7.07	*10.53*	1.57	*2.33*	7.30	*10.87*
F Test (5%)	S		S		S		S	
T_1M_1	40.13 ^{GH}	*75.81*	5.90 ^{C}	*11.16*	0.93 ^{F}	*1.76*	5.93 ^{CDE}	*11.21*
T_1M_2	49.77 ^{D}	*76.39*	6.53 ^{B}	*10.02*	1.50 ^{BCD}	*2.31*	7.40 ^{B}	*11.35*
T_2M_1	44.10 ^{F}	*76.83*	5.87 ^{C}	*10.23*	1.13 ^{EF}	*1.97*	6.33 ^{CD}	*11.03*
T_2M_2	52.27 ^{C}	*76.69*	6.50 ^{B}	*9.54*	1.67 ^{AB}	*2.41*	7.73 ^{B}	*11.34*
T_3M_1	47.07 ^{E}	*78.64*	5.20 ^{DE}	*8.69*	1.23 ^{DE}	*2.06*	6.43 ^{CD}	*10.74*
T_3M_2	58.12 ^{A}	*77.16*	6.70 ^{B}	*8.90*	1.83 ^{A}	*2.44*	8.60 ^{A}	*11.43*
T_4M_1	43.47 ^{F}	*76.32*	5.63 ^{CD}	*9.88*	1.27 ^{DE}	*2.23*	6.60 ^{C}	*11.57*
T_4M_2	57.93 ^{A}	*77.10*	6.87 ^{B}	*9.15*	1.77 ^{AB}	*2.36*	8.50 ^{A}	*11.32*
T_5M_1	41.40 ^{G}	*76.39*	5.60 ^{CD}	*10.34*	1.33 ^{EF}	*2.09*	6.00 ^{CDE}	*11.08*
T_5M_2	46.97 ^{E}	*75.20*	6.53 ^{B}	*10.45*	1.57 ^{ABC}	*2.52*	7.40 ^{B}	*11.89*
T_6M_1	33.60 ^{I}	*75.00*	4.90 ^{E}	*10.94*	0.93 ^{F}	*2.08*	5.30 ^{E}	*11.99*
T_6M_2	38.27 ^{H}	*75.25*	5.70 ^{CD}	*11.20*	1.30 ^{CDE}	*2.56*	5.60 ^{DE}	*11.07*
T_7M_1	51.93 ^{C}	*75.11*	10.40 ^{A}	*15.16*	1.26 ^{DE}	*1.84*	5.60 ^{DE}	*8.21*
T_7M_2	55.63 ^{B}	*75.65*	10.67 ^{A}	*14.52*	1.36 ^{CDE}	*1.87*	5.80 ^{CDE}	*7.90*

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

Table 14: Effect of treatments on dry matter partitioning (g/plant) of different plant parts in pineapple cv. Mauritius at 4 MAP

Treatments	Leaf	%	Stem	%	D Leaf	%	Root	%
T_1	59.68 ^{BC}	*72.11*	11.07 ^{BC}	*13.37*	1.80 ^{B}	*2.17*	10.27 ^{AB}	*12.41*
T_2	60.33 ^{B}	*72.13*	10.78 ^{C}	*12.90*	1.85 ^{AB}	*2.21*	10.62 ^{A}	*12.71*
T_3	70.03 ^{A}	*75.03*	10.78 ^{BC}	*11.56*	1.93 ^{AB}	*2.07*	10.60 ^{A}	*11.37*
T_4	69.82 ^{A}	*74.58*	11.32 ^{B}	*12.10*	2.02 ^{A}	*2.16*	10.45 ^{AB}	*11.17*
T_5	58.13 ^{C}	*72.27*	10.70 ^{C}	*13.31*	1.87 ^{AB}	*2.32*	10.03 ^{AB}	*12.48*
T_6	47.20 ^{D}	*70.45*	9.45 ^{D}	*14.11*	1.50 ^{C}	*2.24*	8.85 ^{C}	*13.21*
T_7	68.25 ^{A}	*71.82*	14.92 ^{A}	*15.69*	1.95 ^{AB}	*2.06*	9.97 ^{B}	*10.19*
M_1	54.80	*72.21*	10.43	*13.75*	1.59	*2.10*	9.08	*11.97*
M_2	69.04	*73.18*	12.15	*12.89*	2.11	*2.23*	11.15	*11.83*
F Test (5%)	S		S		S		S	
T_1M_1	50.60 ^{H}	*71.07*	9.93 ^{E}	*13.95*	1.37 ^{G}	*1.93*	9.33 ^{D}	*13.11*
T_1M_2	68.77 ^{C}	*72.89*	12.20 ^{CD}	*12.92*	2.23 ^{AB}	*2.37*	11.20 ^{ABC}	*11.87*
T_2M_1	54.57 ^{G}	*72.71*	9.80 ^{EF}	*13.05*	1.53 ^{FG}	*2.04*	9.30 ^{D}	*12.39*
T_2M_2	66.10 ^{D}	*71.85*	11.77 ^{CD}	*12.80*	2.17 ^{AB}	*2.36*	11.93 ^{A}	*12.97*
T_3M_1	61.13 ^{E}	*74.70*	9.63 ^{EF}	*11.78*	1.53 ^{FG}	*1.88*	9.53 ^{D}	*11.66*
T_3M_2	78.93 ^{A}	*75.36*	11.93 ^{CD}	*11.34*	2.33 ^{A}	*2.26*	11.67 ^{AB}	*11.07*
T_4M_1	58.27 ^{F}	*73.61*	10.23 ^{E}	*12.92*	1.77 ^{DEF}	*2.24*	8.90 ^{D}	*11.24*
T_4M_2	81.37 ^{A}	*74.46*	12.40 ^{C}	*11.28*	2.27 ^{AB}	*2.08*	12.00 ^{A}	*11.09*
T_5M_1	51.27 ^{H}	*71.35*	9.80 ^{EF}	*13.64*	1.67 ^{EF}	*2.32*	9.17 ^{D}	*12.76*
T_5M_2	65.00 ^{D}	*73.12*	11.60 ^{D}	*13.05*	2.07 ^{ABC}	*2.33*	10.90 ^{BC}	*12.27*
T_6M_1	44.33 ^{I}	*70.55*	9.07 ^{F}	*14.45*	1.37 ^{G}	*2.19*	8.03 ^{E}	*12.79*
T_6M_2	50.07 ^{H}	*70.37*	9.83 ^{EF}	*13.81*	1.63 ^{EFG}	*2.29*	9.67 ^{D}	*13.59*
T_7M_1	63.43 ^{DE}	*71.16*	14.53 ^{B}	*16.31*	1.87 ^{CDE}	*2.10*	9.27 ^{D}	*10.41*
T_7M_2	73.07 ^{B}	*72.31*	15.30 ^{A}	*15.14*	2.03 ^{BCD}	*2.00*	10.67 ^{C}	*10.56*

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

Table 15: Effect of treatments on dry matter partitioning (g/plant) of different plant parts in pineapple cv. Mauritius at 5 MAP

Treatments	Leaf	%	Stem	%	D Leaf	%	Root	%
T_1	75.12 ^{C}	*71.80*	15.30 ^{B}	*14.63*	2.08 ^{A}	*1.99*	12.05 ^{B}	*11.53*
T_2	76.22 ^{C}	*71.96*	15.50 ^{B}	*14.64*	2.12 ^{A}	*2.01*	12.03 ^{B}	*11.36*
T_3	83.25 ^{B}	*73.53*	15.63 ^{B}	*13.80*	2.22 ^{A}	*1.96*	12.25 ^{AB}	*10.82*
T_4	82.83 ^{B}	*73.34*	15.50 ^{B}	*13.73*	2.18 ^{A}	*1.94*	12.40 ^{AB}	*10.99*
T_5	74.80 ^{C}	*72.77*	14.53 ^{C}	*14.14*	2.10 ^{A}	*2.05*	11.38 ^{C}	*11.08*
T_6	57.02 ^{D}	*71.15*	12.05 ^{D}	*15.04*	1.72 ^{B}	*2.17*	9.33 ^{D}	*11.65*
T_7	85.90 ^{A}	*72.31*	17.85 ^{A}	*15.03*	2.15 ^{A}	*1.81*	12.72 ^{A}	*10.71*
M_1	65.59	*71.70*	13.53	*14.79*	1.83	*2.01*	10.48	*11.46*
M_2	87.31	*73.05*	16.86	*14.11*	2.33	*1.95*	13.00	*10.88*
F Test (5%)	S		S		S		S	
T_1M_1	63.87 ^{G}	*71.24*	13.40 ^{CD}	*14.94*	1.67 ^{EF}	*1.87*	10.73 ^{D}	*11.97*
T_1M_2	86.37 ^{D}	*72.37*	17.20 ^{B}	*14.41*	2.50 ^{AB}	*2.10*	13.37 ^{AB}	*11.20*
T_2M_1	63.30 ^{G}	*70.57*	13.97 ^{C}	*15.58*	1.80 ^{DEF}	*2.01*	10.67 ^{D}	*11.90*
T_2M_2	89.13 ^{C}	*73.04*	17.03 ^{B}	*13.96*	2.43 ^{AB}	*2.00*	13.40 ^{AB}	*10.99*
T_3M_1	66.63 ^{F}	*71.46*	13.90 ^{C}	*14.92*	1.83 ^{DEF}	*1.97*	10.83 ^{D}	*11.63*
T_3M_2	99.87 ^{A}	*74.83*	17.37 ^{B}	*13.02*	2.60 ^{A}	*1.95*	13.67 ^{AB}	*10.24*
T_4M_1	64.87 ^{FG}	*71.48*	13.30 ^{CD}	*14.65*	1.93 ^{DE}	*2.13*	10.70 ^{D}	*11.79*
T_4M_2	100.80 ^{A}	*74.67*	17.70 ^{B}	*13.12*	2.43 ^{AB}	*1.80*	14.10 ^{A}	*10.45*
T_5M_1	65.37 ^{FG}	*73.24*	12.37 ^{D}	*13.86*	1.90 ^{DEF}	*2.13*	9.63 ^{E}	*10.79*
T_5M_2	84.23 ^{D}	*72.34*	16.70 ^{B}	*14.35*	2.30 ^{BC}	*1.98*	13.13 ^{B}	*11.29*
T_6M_1	55.17 ^{I}	*72.35*	10.97 ^{E}	*14.38*	1.63 ^{F}	*2.14*	8.53 ^{F}	*11.18*
T_6M_2	58.87 ^{H}	*70.21*	13.13 ^{CD}	*15.65*	1.80 ^{DEF}	*2.15*	10.13 ^{DE}	*11.08*
T_7M_1	79.90 ^{E}	*69.85*	16.83 ^{B}	*14.72*	2.07 ^{CD}	*1.81*	12.23 ^{C}	*10.70*
T_7M_2	91.90 ^{B}	*72.83*	18.87 ^{A}	*14.96*	2.23 ^{BC}	*1.77*	13.20 ^{B}	*10.46*

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

Table 16: Effect of treatments on dry matter partitioning (g/plant) of different plant parts in pineapple cv. Mauritius at 6 MAP

Treatments	Leaf	%	Stem	%	D Leaf	%	Root	%
T_1	85.90 ^{E}	*70.58*	20.28 ^{BC}	*16.71*	2.43 ^{B}	*2.01*	12.75 ^{AB}	*10.51*
T_2	86.70 ^{DE}	*71.07*	20.20 ^{BC}	*16.56*	2.48 ^{AB}	*2.04*	12.62 ^{AB}	*10.35*
T_3	89.32 ^{BC}	*70.99*	21.22 ^{B}	*18.87*	2.58 ^{AB}	*2.06*	12.70 ^{AB}	*10.10*
T_4	92.28 ^{A}	*71.95*	20.57 ^{BC}	*16.03*	2.53 ^{AB}	*1.98*	12.95 ^{AB}	*10.10*
T_5	88.67 ^{CD}	*71.83*	19.92 ^{C}	*16.13*	2.53 ^{AB}	*2.05*	12.30 ^{B}	*9.96*
T_6	72.42 ^{F}	*71.12*	17.05 ^{D}	*16.75*	1.98 ^{C}	*1.95*	10.37 ^{C}	*9.19*
T_7	91.10 ^{AB}	*69.87*	23.47 ^{A}	*17.99*	2.65 ^{A}	*2.04*	13.23 ^{A}	*10.15*
M_1	76.10	*70.80*	17.82	*16.58*	2.17	*2.02*	11.41	*10.61*
M_2	97.16	*71.32*	22.95	*16.84*	2.75	*2.02*	13.43	*9.86*
F Test (5%)	S		S		S		S	
T_1M_1	74.17 ^{EF}	*70.40*	71.57 ^{EF}	*16.67*	2.03 ^{CD}	*1.93*	11.67 ^{C}	*11.08*
T_1M_2	97.63 ^{B}	*71.09*	23.00 ^{BCD}	*16.76*	2.83 ^{A}	*2.07*	13.83 ^{A}	*10.08*
T_2M_1	73.87 ^{EF}	*70.66*	16.93 ^{EF}	*16.19*	2.17 ^{C}	*2.08*	11.63 ^{C}	*11.12*
T_2M_2	99.53 ^{B}	*71.38*	23.47 ^{BC}	*16.84*	2.80 ^{A}	*2.01*	13.60 ^{A}	*9.76*
T_3M_1	73.30 ^{F}	*69.75*	18.03 ^{E}	*17.16*	2.17 ^{C}	*2.07*	11.57 ^{C}	*11.01*
T_3M_2	105.30 ^{A}	*71.83*	24.40 ^{AB}	*16.65*	3.00 ^{A}	*2.05*	13.83 ^{A}	*9.44*
T_4M_1	78.90 ^{D}	*71.60*	17.40 ^{EF}	*15.78*	2.20 ^{BC}	*2.00*	11.67 ^{C}	*10.59*
T_4M_2	105.70 ^{A}	*72.16*	23.73 ^{BC}	*16.20*	2.87 ^{A}	*1.96*	14.23 ^{A}	*9.72*
T_5M_1	77.10 ^{DE}	*71.46*	17.27 ^{EF}	*16.01*	2.27 ^{BC}	*2.11*	11.27 ^{C}	*10.45*
T_5M_2	100.20 ^{B}	*72.09*	22.57 ^{CD}	*16.24*	2.80 ^{A}	*2.02*	13.33 ^{AB}	*9.59*
T_6M_1	71.87 ^{F}	*72.48*	16.00 ^{F}	*16.13*	1.90 ^{D}	*1.92*	9.43 ^{D}	*9.51*
T_6M_2	72.97 ^{F}	*69.93*	18.10 ^{E}	*17.34*	2.07 ^{CD}	*1.99*	11.30 ^{C}	*10.83*
T_7M_1	83.47 ^{C}	*68.59*	21.53 ^{D}	*17.95*	2.43 ^{B}	*2.03*	12.60 ^{B}	*10.51*
T_7M_2	98.73 ^{B}	*70.05*	25.40 ^{A}	*18.03*	2.87 ^{A}	*2.04*	13.87 ^{A}	*9.85*

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

Table 17: Effect of treatments on dry matter partitioning (g/plant) of different plant parts in pineapple cv. Mauritius at ethrel application

Treatments	Leaf	%	Stem	%	D Leaf	%	Root	%
T_1	141.70 ^{A}	*75.22*	29.70 ^{A}	15.77	3.23 ^{ABC}	*1.69*	13.76 ^{A}	*7.32*
T_2	135.80 ^{A}	*75.40*	27.58 ^{B}	15.31	3.32 ^{AB}	*1.84*	13.48 ^{AB}	*7.49*
T_3	136.80 ^{A}	*74.71*	29.30 ^{A}	16.01	3.44 ^{A}	*1.87*	13.67 ^{AB}	*7.47*
T_4	128.70 ^{B}	*74.48*	27.25 ^{B}	15.77	3.19 ^{BC}	*1.87*	13.66 ^{A}	*7.93*
T_5	138.80 ^{A}	*76.48*	26.65 ^{B}	15.69	3.06 ^{C}	*1.70*	13.02 ^{B}	*7.18*
T_6	90.90 ^{C}	*72.48*	20.58 ^{C}	16.42	2.44 ^{D}	*1.93*	11.53 ^{C}	*9.20*
T_7	137.70 ^{A}	*74.84*	29.57 ^{A}	16.08	3.19 ^{BC}	*1.73*	13.62 ^{B}	*9.41*
M_1	128.39	*75.08*	26.70	*15.61*	3.07	*1.81*	12.89	*7.54*
M_2	131.70	*74.72*	27.78	*15.77*	3.17	*1.80*	13.62	*7.73*
F Test (5%)	NS		S		NS		S	
T_1M_1	138.40 ^{ABC}	*75.01*	29.67 ^{A}	*16.09*	3.13 ^{A}	*1.69*	13.53 ^{AB}	*7.21*
T_1M_2	145.10 ^{A}	*75.46*	29.73 ^{A}	*15.47*	3.33 ^{A}	*1.68*	13.99 ^{AB}	*7.43*
T_2M_1	134.90 ^{ABC}	*75.45*	27.33 ^{AB}	*15.29*	3.33 ^{A}	*1.87*	13.23 ^{ABC}	*7.40*
T_2M_2	136.60 ^{ABC}	*75.27*	27.83 ^{AB}	*15.33*	3.30 ^{A}	*1.82*	13.73 ^{AB}	*7.57*
T_3M_1	131.30 ^{BC}	*74.19*	28.83 ^{AB}	*16.29*	3.43 ^{A}	*1.94*	13.40 ^{ABC}	*7.57*
T_3M_2	142.30 ^{AB}	*75.10*	29.77 ^{A}	*15.71*	3.43 ^{A}	*1.82*	13.93 ^{AB}	*7.36*
T_4M_1	128.10 ^{C}	*75.18*	25.77 ^{B}	*15.13*	3.13 ^{A}	*1.84*	13.14 ^{ABC}	*7.89*
T_4M_2	129.30 ^{BC}	*73.81*	28.73 ^{AB}	*16.40*	3.23 ^{A}	*1.91*	14.18 ^{A}	*7.98*
T_5M_1	137.90 ^{ABC}	*76.95*	25.77 ^{B}	*14.39*	2.97 ^{A}	*1.66*	12.57 ^{CD}	*7.02*
T_5M_2	139.60 ^{ABC}	*75.91*	27.53 ^{AB}	*14.98*	3.17 ^{A}	*1.73*	13.47 ^{ABC}	*7.33*
T_6M_1	91.81 ^{D}	*72.91*	20.40 ^{C}	*16.21*	4.47 ^{B}	*1.97*	11.23 ^{E}	*8.92*
T_6M_2	90.00 ^{D}	*72.00*	20.77 ^{C}	*16.62*	2.40 ^{B}	*1.93*	11.83 ^{DE}	*9.47*
T_7M_1	136.40 ^{ABC}	*75.12*	29.03 ^{AB}	*15.99*	3.07 ^{A}	*1.70*	13.07 ^{BC}	*7.20*
T_7M_2	139.00 ^{ABC}	*74.54*	30.10 ^{A}	*16.14*	3.30 ^{A}	*1.77*	14.17 ^{A}	*7.60*

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

Table 18: Effect of treatments on dry matter partitioning (g/plant) of different plant parts in pineapple cv. Mauritius at flowering

Treatments	Leaf	%	Stem	%	D Leaf	%	Root	%	Peduncle	%	Inflorescence	%
T_1	168.54 ^{A}	*74.92*	28.68 ^{AB}	*13.40*	3.37 ^{B}	*1.58*	13.98 ^{A}	*6.54*	3.15 ^{AB}	*1.47*	5.58 ^{A}	*2.61*
T_2	163.90 ^{A}	*75.01*	28.53 ^{AB}	*13.05*	3.47 ^{AB}	*1.59*	13.77 ^{A}	*6.30*	3.32 ^{A}	*1.51*	5.45 ^{A}	*2.50*
T_3	160.90 ^{A}	*74.18*	29.90 ^{AB}	*13.74*	3.67 ^{A}	*1.69*	13.93 ^{A}	*6.42*	3.13 ^{AB}	*1.44*	5.52 ^{A}	*2.54*
T_4	157.90 ^{A}	*74.38*	29.95 ^{AB}	*13.41*	3.35 ^{B}	*1.50*	14.05 ^{A}	*6.29*	3.20 ^{AB}	*1.43*	5.42 ^{A}	*2.43*
T_5	158.30 ^{A}	*74.70*	28.37 ^{B}	*13.39*	3.43 ^{AB}	*1.62*	13.40 ^{A}	*6.32*	3.07 ^{B}	*1.45*	5.35 ^{A}	*2.52*
T_6	114.90 ^{B}	*75.84*	22.47 ^{C}	*14.83*	2.73 ^{C}	*1.80*	11.90 ^{B}	*7.85*	2.72 ^{C}	*1.80*	4.20 ^{B}	*2.77*
T_7	162.90 ^{A}	*74.32*	30.47 ^{A}	*13.90*	3.40 ^{B}	*1.55*	13.90 ^{A}	*6.34*	3.02 ^{B}	*1.38*	5.48 ^{A}	*2.50*
M_1	152.18	*74.47*	27.58	*13.49*	3.25	*1.59*	13.29	*6.50*	3.01	*1.47*	5.14	*2.51*
M_2	158.53	*74.99*	29.07	*13.75*	3.44	*1.63*	13.83	*6.54*	3.17	*1.50*	5.44	*2.57*
F Test (5%)	S		S		S		NS		S		S	
T_1M_1	168.40 ^{A}	*75.39*	27.83 ^{BC}	*13.29*	3.20 ^{B}	*1.53*	13.87 ^{AB}	*6.23*	3.07 ^{BC}	*1.47*	5.47 ^{ABC}	*2.61*
T_1M_2	168.70 ^{A}	*75.45*	29.53 ^{ABC}	*13.52*	3.53 ^{AB}	*1.62*	14.10 ^{AB}	*6.46*	3.23 ^{AB}	*1.48*	5.70 ^{A}	*2.61*
T_2M_1	166.00 ^{A}	*75.62*	28.17 ^{ABC}	*12.83*	3.43 ^{AB}	*1.57*	13.57 ^{AB}	*6.18*	3.13 ^{B}	*1.43*	5.20 ^{C}	*2.37*
T_2M_2	161.90 ^{A}	*74.44*	28.90 ^{ABC}	*13.29*	3.50 ^{AB}	*1.61*	13.97 ^{AB}	*6.42*	3.50 ^{A}	*1.61*	5.70 ^{A}	*2.62*
T_3M_1	154.80 ^{A}	*73.85*	29.00 ^{ABC}	*13.84*	3.57 ^{AB}	*1.70*	13.73 ^{AB}	*6.55*	3.10 ^{BC}	*1.48*	5.37 ^{ABC}	*2.56*
T_3M_2	167.00 ^{A}	*74.49*	30.60 ^{AB}	*13.65*	3.77 ^{A}	*1.68*	14.13 ^{AB}	*6.30*	3.17 ^{B}	*1.41*	5.67 ^{AB}	*2.53*
T_4M_1	154.90 ^{A}	*74.45*	29.07 ^{ABC}	*13.12*	3.23 ^{B}	*1.46*	13.70 ^{AB}	*6.19*	3.13 ^{B}	*1.41*	5.37 ^{ABC}	*2.42*
T_4M_2	160.90 ^{A}	*74.31*	30.83 ^{A}	*13.70*	3.47 ^{AB}	*1.54*	14.40 ^{A}	*6.40*	3.27 ^{AB}	*1.45*	5.47 ^{ABC}	*2.43*
T_5M_1	155.30 ^{A}	*75.02*	27.00 ^{C}	*13.04*	3.40 ^{AB}	*1.64*	13.03 ^{BC}	*6.29*	3.03 ^{BC}	*1.46*	5.20 ^{C}	*2.51*
T_5M_2	161.30 ^{A}	*74.37*	29.73 ^{ABC}	*13.71*	3.47 ^{AB}	*1.60*	13.77 ^{AB}	*6.35*	3.10 ^{BC}	*1.43*	5.30 ^{ABC}	*2.44*
T_6M_1	107.30 ^{C}	*71.44*	21.97 ^{D}	*14.63*	2.67 ^{C}	*1.78*	11.63 ^{D}	*7.74*	2.63 ^{D}	*1.75*	4.07 ^{D}	*2.71*
T_6M_2	122.60 ^{B}	*80.29*	22.97 ^{D}	*15.04*	2.80 ^{C}	*1.83*	12.17 ^{CD}	*7.97*	2.80 ^{CD}	*1.83*	4.30 ^{D}	*2.84*
T_7M_1	159.00 ^{A}	*74.44*	30.00 ^{AB}	*14.04*	3.23 ^{B}	*1.51*	13.50 ^{AB}	*6.32*	2.93 ^{BCD}	*1.37*	5.26 ^{BC}	*2.47*
T_7M_2	166.90 ^{A}	*74.24*	30.93 ^{A}	*13.76*	3.57 ^{AB}	*1.59*	14.30 ^{A}	*6.36*	3.10 ^{BC}	*1.38*	5.70 ^{A}	*2.54*

S= Significant, NS = Non Significant (5 % Level) ;Treatment means having similar alphabets in superscript do not differ significantly

Table 19: Effect of treatments on dry matter partitioning (g/plant) of different plant parts in pineapple cv. Mauritius at harvest

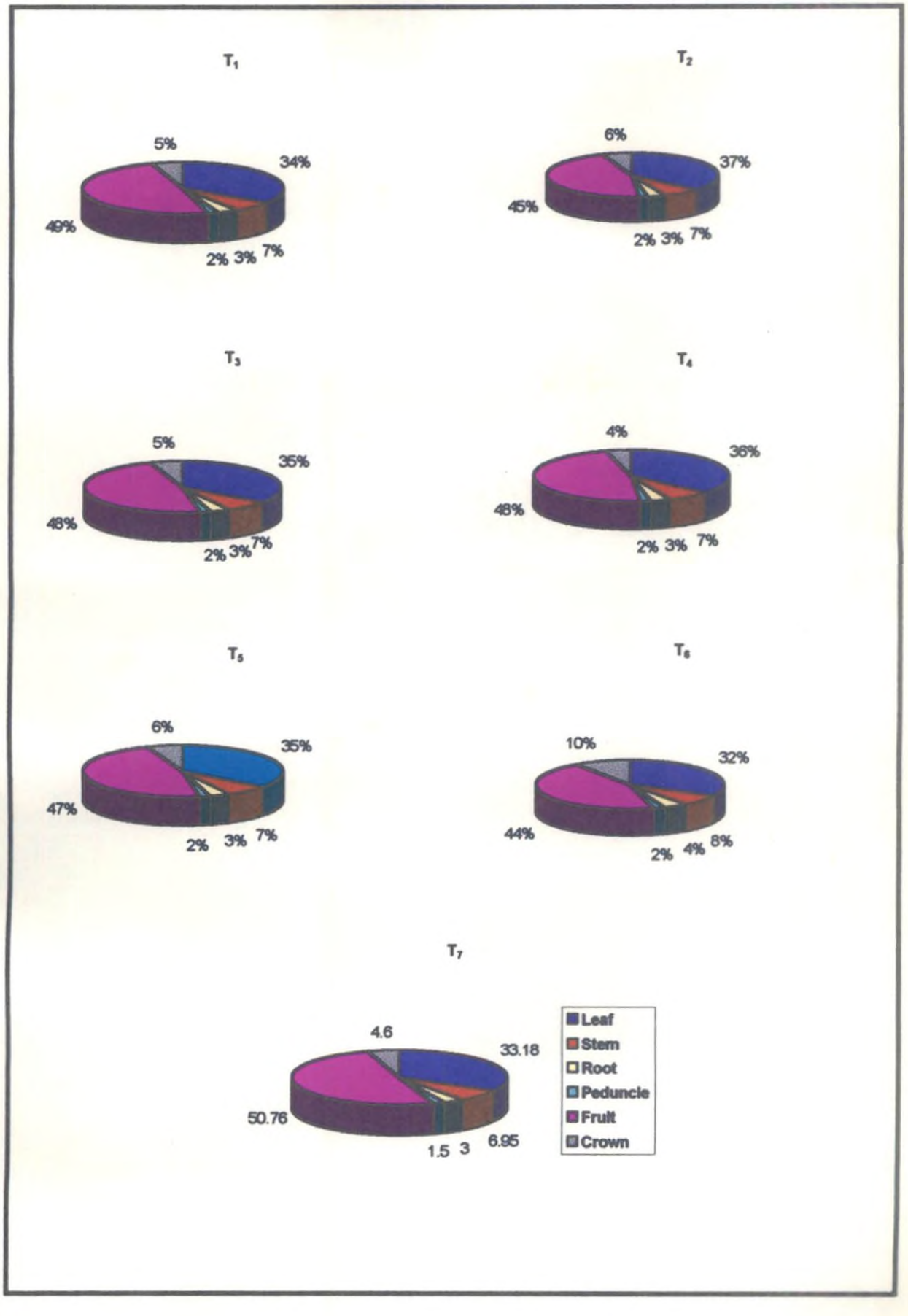
Treatments	Leaf	%	Stem	%	Root	%	Peduncle	%	Fruit	%	Crown	%
T_1	148.30 ^{B}	*34.25*	28.47 ^{B}	*6.58*	13.98 ^{A}	*3.23*	7.22 ^{AB}	*1.67*	213.30 ^{B}	*49.27*	21.60 ^{C}	*4.99*
T_2	152.10 ^{AB}	*36.74*	28.43 ^{B}	*6.87*	13.75 ^{A}	*3.22*	6.97 ^{BC}	*1.68*	189.42 ^{D}	*45.76*	23.28 ^{B}	*5.63*
T_3	151.00 ^{AB}	*35.02*	30.03 ^{AB}	*6.97*	14.05 ^{A}	*3.26*	7.42 ^{A}	*1.72*	205.40 ^{BC}	*47.64*	23.25 ^{B}	*5.40*
T_4	155.60 ^{A}	*36.28*	30.30 ^{AB}	*7.07*	14.25 ^{A}	*3.33*	7.00 ^{BC}	*1.63*	193.40 ^{D}	*47.44*	18.18 ^{D}	*4.24*
T_5	147.90 ^{B}	*35.29*	29.35 ^{AB}	*7.01*	13.45 ^{A}	*3.22*	6.97 ^{BC}	*1.67*	197.40 ^{CD}	*47.13*	23.90 ^{B}	*5.71*
T_6	96.60 ^{C}	*32.11*	23.23 ^{C}	*7.73*	12.10 ^{B}	*4.02*	5.57 ^{D}	*1.85*	134.40 ^{E}	*44.64*	28.95 ^{A}	*9.62*
T_7	147.40 ^{B}	*33.18*	30.88 ^{A}	*6.95*	13.32 ^{A}	*3.00*	6.68 ^{C}	*1.50*	225.50 ^{A}	*50.76*	20.43 ^{C}	*4.60*
M_1	141.41	*34.82*	27.98	*6.89*	13.27	*3.27*	6.71	*1.65*	193.59	*47.67*	23.17	*5.71*
M_2	143.99	*34.78*	29.36	*7.09*	13.84	*3.34*	6.95	*1.68*	197.50	*47.70*	22.43	*5.42*
F Test (5%)	NS		S		S		S		NS		NS	
T_1M_1	147.00 ^{AB}	*34.26*	27.70 ^{C}	*6.46*	13.70 ^{AB}	*3.19*	7.17 ^{ABC}	*1.67*	211.80 ^{BC}	*49.35*	21.83 ^{BCD}	*5.09*
T_1M_2	149.60 ^{AB}	*34.26*	29.23 ^{ABC}	*6.69*	14.27 ^{AB}	*3.27*	7.27 ^{ABC}	*1.66*	214.90 ^{B}	*49.20*	21.37 ^{CDE}	*4.89*
T_2M_1	151.50 ^{AB}	*36.65*	27.87 ^{BC}	*6.74*	13.53 ^{ABC}	*3.28*	7.00 ^{ABC}	*1.69*	189.60 ^{E}	*45.87*	23.93 ^{B}	*5.79*
T_2M_2	152.70 ^{AB}	*36.84*	29.00 ^{ABC}	*6.99*	13.97 ^{AB}	*3.37*	6.93 ^{BC}	*1.67*	189.20 ^{E}	*45.65*	22.63 ^{BC}	*5.46*
T_3M_1	145.40 ^{B}	*34.39*	29.53 ^{ABC}	*6.98*	13.63 ^{ABC}	*3.22*	7.33 ^{ABC}	*1.73*	203.30 ^{BCDE}	*48.07*	23.67 ^{B}	*5.60*
T_3M_2	156.60 ^{A}	*35.64*	30.53 ^{AB}	*6.94*	14.47 ^{A}	*3.30*	7.50 ^{A}	*1.71*	207.40 ^{BCD}	*47.21*	22.83 ^{BC}	*5.19*
T_4M_1	155.40 ^{A}	*36.37*	29.53 ^{ABC}	*6.91*	13.97 ^{AB}	*3.27*	7.00 ^{ABC}	*1.64*	191.80 ^{E}	*47.23*	19.57 ^{E}	*4.58*
T_4M_2	155.80 ^{A}	*36.22*	31.07 ^{A}	*7.22*	14.53 ^{A}	*3.38*	7.00 ^{ABC}	*1.63*	195.00 ^{DE}	*47.65*	16.80 ^{F}	*3.91*
T_5M_1	145.30 ^{B}	*34.95*	28.17 ^{BC}	*6.78*	13.00 ^{BCD}	*3.13*	7.10 ^{ABC}	*1.71*	198.20 ^{CDE}	*47.69*	23.93 ^{B}	*5.76*
T_5M_2	150.60 ^{AB}	*35.65*	30.53 ^{AB}	*7.23*	13.90 ^{AB}	*3.29*	6.83 ^{C}	*1.62*	196.70 ^{CDE}	*46.56*	23.87 ^{B}	*5.65*
T_6M_1	95.90 ^{C}	*32.07*	22.77 ^{D}	*7.61*	11.87 ^{D}	*3.97*	5.40 ^{E}	*1.81*	134.60 ^{F}	*44.59*	28.60 ^{A}	*9.56*
T_6M_2	97.30 ^{C}	*32.17*	23.70 ^{D}	*7.83*	12.33 ^{CD}	*4.08*	5.73 ^{DE}	*1.90*	134.10 ^{F}	*44.35*	29.30 ^{A}	*9.68*
T_7M_1	149.50 ^{AB}	*34.34*	30.30 ^{ABC}	*6.96*	13.20 ^{ABC}	*3.03*	5.97 ^{D}	*1.37*	215.80 ^{B}	*49.57*	20.63 ^{CDE}	*4.74*
T_7M_2	145.30 ^{B}	*32.08*	31.47 ^{A}	*6.95*	13.43 ^{ABC}	*2.97*	7.40 ^{AB}	*1.63*	235.10 ^{A}	*51.92*	20.23 ^{DE}	*4.46*

S= Significant, NS = Non Significant (5 % Level); Treatment means having similar alphabets in superscript do not differ significantly

DMP was found to be the maximum to leaves throughout the vegetative and flowering phase. At the time of harvest DMP was maximum towards fruit while leaves became secondary in this respect. For the first two samplings DMP to leaves was around 80% and during subsequent sampling, this showed a declining trend (80-74%) till flowering, followed by a drastic drop at the time of harvest (32-36%) which was due to more dry matter accumulation in fruits (45-50%). DMP to stem increased gradually (6-16%) and showed a considerable drop during flowering and harvest (16-13%). DMP to root and 'D' leaf showed an increasing trend for the first two sampling and gradually declined till flowering. DMP to peduncle and inflorescence was relatively low.

DMP to leaves differed significantly among treatments during the vegetative phase. T_7 recorded the maximum DMP to leaves for the first two samplings (83 and 81% respectively). During the subsequent sampling, percentage DMP to leaves was the maximum in treatment T_3 followed by T_4 and T_1. At the time of ethrel application and flowering stages there was no significant difference among the treatments. DMP to stem was maximum in T_7 for the first four samplings and during subsequent sampling there was not much variation among the treatments. With respect to DMP to 'D' leaf, tissue culture plants recorded the maximum value when compared to suckers till 4 MAP and during subsequent sampling much variation was not found among treatments. Similarly DMP to root was the maximum to tissue culture plants (11-16%) when compared to sucker (0.65%) at 1 MAP. Similar trend was observed till 3 MAP and later much variation was not found. At the time of flowering, tissue culture plants recorded the maximum DMP to peduncle and inflorescence while sucker was on par with tissue culture plants. At the time of harvest, T_7 (50.76) and T_1 (49.27) recorded the maximum DMP to fruit (Fig.4) and T_6 recorded the least value (44.66). With respect to DMP to crown, T_6 recorded the maximum value followed by T_5 and T_2. T_1 and T_7 recorded the least value.

Fig. 4 Dry matter partitioning of different treatments at harvest.



Among the two fertilizer doses M_2 was found to be superior in DMP to different plant parts. Eventhough the percentage DMP did not show difference between M_1 and M_2, the absolute values were found to be superior in M_2 when compared to M_1 during the vegetative phase. At the time of flowering and harvest there was not much variation with respect to this aspect between M_1 and M_2.

The interaction effect with respect to DMP to different plant parts was not consistent over the growth period. However, during the vegetative phase treatment combination with M_2 recorded the highest DMP to all plant parts. Hence, treatment combination with M_2 came to floral induction one month in advance when compared to treatment combination with M_1. However, during flowering and harvest interaction effect did not differ significantly with respect to DMP to different plant parts. At harvest T_7M_2 recorded the maximum DMP to fruit (51.91%) followed by T_1M_2 and T_3M_2. T_6M_1 and T_6M_2 recorded the minimum value.

4.3 Growth components

4.3.1 Leaf Area Index (LAI)

Data on LAI computed at different stages of growth are furnished in Table 20. LAI values showed an increasing trend till flowering followed by a steady drop (Fig.5.). T_7 recorded the maximum LAI during the vegetative stage. However, T_1 and T_2 recorded the maximum LAI value during flowering and harvest (4.62, 4.33 and 4.59, 4.29 respectively). Invariably T_6 recorded the least value at all growth stages.

The effect of two fertilizer doses were found to be significant at all growth stages. M_2 showed superiority with LAI and the values varied from 0.52 to 3.99 from 1 MAP to harvest.

Table 20: Effect of treatments on leaf area index in pineapple cv. Mauritius

Treatments	2 MAP	4 MAP	6 MAP	Flowering	Harvest
T_1	0.54 ^{B}	1.30 ^{B}	2.65 ^{AB}	4.62 ^{A}	4.33 ^{A}
T_2	0.43 ^{D}	1.12 ^{C}	2.54 ^{AB}	4.59 ^{A}	4.29 ^{A}
T_3	0.43 ^{D}	1.14 ^{C}	2.56 ^{AB}	4.38 ^{B}	4.11 ^{B}
T_4	0.40 ^{D}	1.13 ^{C}	2.34 ^{B}	4.27 ^{BC}	3.93 ^{C}
T_5	0.49 ^{C}	1.32 ^{B}	2.28 ^{B}	4.40 ^{AB}	4.11 ^{B}
T_6	0.26 ^{E}	0.79 ^{D}	1.65 ^{C}	2.87 ^{D}	2.71 ^{D}
T_7	0.66 ^{A}	1.48 ^{A}	2.75 ^{A}	4.13 ^{C}	3.88 ^{C}
M_1	0.39	1.01	2.06	4.13	3.83
M_2	0.52	1.35	2.72	4.24	3.99
F Test (5%)	S	S	S	S	S
T_1M_1	0.47 ^{EF}	1.04 ^{DE}	2.08 ^{DEFG}	4.57 ^{ABC}	4.23 ^{ABC}
T_1M_2	0.61 ^{B}	1.55 ^{B}	3.21 ^{A}	4.67 ^{A}	4.42 ^{A}
T_2M_1	0.37 ^{G}	0.96 ^{E}	1.97 ^{EFG}	4.62 ^{AB}	4.25 ^{ABC}
T_2M_2	0.49 ^{E}	1.27 ^{C}	3.11 ^{AB}	4.57 ^{ABC}	4.32 ^{AB}
T_3M_1	0.35 ^{GH}	0.98 ^{DE}	2.15 ^{DEF}	4.30 ^{CDE}	4.04 ^{CDE}
T_3M_2	0.51 ^{DE}	1.30 ^{C}	2.98 ^{ABC}	4.46 ^{ABCD}	4.19 ^{ABCD}
T_4M_1	0.32 ^{GH}	0.99 ^{DE}	2.05 ^{DEFG}	4.20 ^{DE}	3.89 ^{EF}
T_4M_2	0.48 ^{EF}	1.26 ^{C}	2.62 ^{BCD}	4.33 ^{BCDE}	3.97 ^{DE}
T_5M_1	0.43 ^{F}	1.07 ^{D}	2.12 ^{DEF}	4.41 ^{ABCD}	4.06 ^{CDE}
T_5M_2	0.55 ^{CD}	1.57 ^{AB}	2.43 ^{CDE}	4.47 ^{ABCD}	4.16 ^{BCD}
T_6M_1	0.23 ^{I}	0.74 ^{G}	1.53 ^{G}	2.77 ^{F}	2.58 ^{H}
T_6M_2	0.30 ^{H}	0.83 ^{F}	1.76 ^{FG}	2.97 ^{F}	2.85 ^{G}
T_7M_1	0.60 ^{BC}	1.31 ^{C}	2.54 ^{CDE}	4.06 ^{E}	3.74 ^{F}
T_7M_2	0.72 ^{A}	1.65 ^{A}	2.96 ^{ABC}	4.21 ^{DE}	4.02 ^{CDE}

S = Significant, NS = Non Significant

Treatment means having similar alphabets in superscript do not differ significantly

Among the interaction effect, T_7M_2 showed superiority during 2 MAP and 4 MAP while T_1M_2 recorded the maximum LAI value during rest of the stages. The maximum value of LAI recorded was 4.67 (T_1M_2) and the minimum was 2.77 (T_6M_1) at flowering.

4.3.2 Leaf Area Ratio (LAR)

Table 21 shows the LAR values, which indicate the superiority of T_1 at all growth stages. The maximum values were recorded at flowering in all treatments (Fig.5.), in which T_1 recorded the highest value (44.51 cm^2/g) and T_7 was the least (39.74 cm^2/g). LAR showed a declining trend at harvest.

There existed a significant difference among the effect of two fertilizer doses during vegetative phase and later on during flowering and harvest M_1 and M_2 did not differ significantly. M_2 value varied from 20.51 to 42.56 cm^2/g from 1 MAP to flowering and declined to 26.62 cm^2/g at the time of harvest.

The interaction effect showed that T_1M_2 had the maximum LAR value till flowering stage. The value varied from 27.81 to 45.00 cm^2/g from 1 MAP to flowering and declined to 27.53 cm^2/g during harvest. T_6M_1 recorded the least LAR value at all growth stages.

4.3.3 Relative Growth Rate (RGR)

RGR (g/g/day) differed significantly till vegetative phase and thereafter no significant difference was observed among the treatments. T_5 had the maximum RGR at 2 MAP (0.0081) and T_6 recorded higher value during 4 MAP (0.0112) and 6 MAP (0.0080). T_7 recorded the least value during vegetative stage which varied from 0.0047 at 2 MAP to 0.0031 at 6 MAP (Table 22).

Table 21: Effect of treatments on leaf area ratio (cm^2/g) in pineapple cv. Mauritius

Treatments	2 MAP	4 MAP	6 MAP	Flowering	Harvest
T_1	25.58 ^{A}	29.75 ^{A}	40.85 ^{A}	44.51 ^{A}	27.49 ^{ABC}
T_2	19.34 ^{BC}	24.69 ^{B}	36.84 ^{C}	44.09 ^{A}	28.13 ^{A}
T_3	18.34 ^{C}	22.82 ^{C}	36.14 ^{C}	42.65 ^{BC}	26.60 ^{BC}
T_4	16.35 ^{D}	22.69 ^{CD}	33.81 ^{D}	42.47 ^{C}	26.26 ^{CD}
T_5	20.69 ^{B}	30.68 ^{A}	40.22 ^{AB}	43.94 ^{AB}	27.40 ^{ABC}
T_6	13.26 ^{E}	21.45 ^{D}	31.44 ^{E}	39.99 ^{D}	25.07 ^{DE}
T_7	19.59 ^{BC}	29.64 ^{A}	39.07 ^{B}	39.74 ^{D}	24.52 ^{E}
M_1	17.53	24.56	35.93	42.31	26.31
M_2	20.51	27.36	37.88	42.56	26.62
F Test (5%)	S	S	S	NS	NS
T_1M_1	23.34 ^{B}	27.44 ^{B}	37.58 ^{CD}	44.01 ^{AB}	27.43 ^{A}
T_1M_2	27.81 ^{A}	32.06 ^{A}	44.12 ^{A}	45.00 ^{A}	27.53 ^{AB}
T_2M_1	16.45 ^{EFG}	23.36 ^{CD}	34.49 ^{FG}	43.67 ^{AB}	27.94 ^{AB}
T_2M_2	22.22 ^{B}	26.01 ^{B}	39.18 ^{C}	44.50 ^{A}	28.33 ^{AB}
T_3M_1	18.32 ^{DEF}	21.71 ^{DE}	36.80 ^{DE}	43.75 ^{AB}	26.73 ^{AB}
T_3M_2	18.36 ^{DE}	23.92 ^{C}	35.48 ^{EF}	41.54 ^{CD}	26.47 ^{AB}
T_4M_1	15.86 ^{FG}	22.83 ^{CDE}	35.34 ^{EF}	42.09 ^{BCD}	25.27 ^{ABC}
T_4M_2	16.84 ^{EFG}	22.56 ^{CDE}	32.28 ^{H}	42.20 ^{BCD}	25.81 ^{ABC}
T_5M_1	19.71 ^{CD}	27.91 ^{B}	38.35 ^{CD}	44.44 ^{A}	27.61 ^{BCD}
T_5M_2	21.67 ^{BC}	33.45 ^{A}	42.09 ^{B}	43.43 ^{ABC}	27.19 ^{BCD}
T_6M_1	11.84 ^{H}	21.10 ^{E}	30.26 ^{I}	38.88 ^{F}	24.17 ^{BCD}
T_6M_2	14.68 ^{G}	21.80 ^{DE}	32.61 ^{GH}	41.10 ^{DE}	25.96 ^{CD}
T_7M_1	17.18 ^{EF}	27.59 ^{B}	38.70 ^{CD}	39.31 ^{EF}	24.35 ^{D}
T_7M_2	22.00 ^{BC}	31.70 ^{A}	39.43 ^{C}	40.16 ^{DEF}	24.69 ^{D}

S = Significant, NS = Non Significant

Treatment means having similar alphabets in superscript do not differ significantly

Table 22: Effect of treatments on relative growth rate (g/g/day) in pineapple cv. Mauritius

Treatments	2 MAP	4 MAP	6 MAP	Flowering	Harvest
T_1	0.0073 ^{AB}	0.0110 ^{A}	0.0050 ^{BC}	0.0057 ^{B}	0.0074 ^{A}
T_2	0.0071 ^{AB}	0.0095 ^{B}	0.0048 ^{CD}	0.0064 ^{AB}	0.0071 ^{A}
T_3	0.0060 ^{B}	0.0107 ^{AB}	0.0035 ^{DE}	0.0056 ^{B}	0.0076 ^{A}
T_4	0.0062 ^{B}	0.0116 ^{A}	0.0046 ^{CD}	0.0071 ^{A}	0.0075 ^{A}
T_5	0.0081 ^{A}	0.0105 ^{AB}	0.0061 ^{B}	0.0052 ^{B}	0.0074 ^{A}
T_6	0.0070 ^{AB}	0.0112 ^{A}	0.0080 ^{A}	0.0063 ^{AB}	0.0076 ^{A}
T_7	0.0047 ^{C}	0.0095 ^{B}	0.0031 ^{E}	0.0057 ^{B}	0.0079 ^{A}
M_1	0.0060	0.0100	0.0050	0.0060	0.0080
M_2	0.0070	0.0110	0.0060	0.0060	0.0070
F Test (5%)	S	S	S	NS	NS
T_1M_1	0.0053 ^{DE}	0.0099 ^{CDEF}	0.0054 ^{CDE}	0.0061 ^{ABCD}	0.0074 ^{A}
T_1M_2	0.0092 ^{A}	0.0123 ^{A}	0.0046 ^{CDEF}	0.0053 ^{BCD}	0.0074 ^{A}
T_2M_1	0.0069 ^{BCD}	0.0089 ^{EF}	0.0051 ^{CDE}	0.0068 ^{AB}	0.0070 ^{A}
T_2M_2	0.0073 ^{BC}	0.0099 ^{CDEF}	0.0044 ^{DEFG}	0.0060 ^{ABCD}	0.0072 ^{A}
T_3M_1	0.0068 ^{BCD}	0.0104 ^{BCDE}	0.0039 ^{EFGH}	0.0056 ^{ABCD}	0.0078 ^{A}
T_3M_2	0.0052 ^{DE}	0.0111 ^{ABCD}	0.0031 ^{FGH}	0.0056 ^{ABCD}	0.0075 ^{A}
T_4M_1	0.0055 ^{CDE}	0.0110 ^{ABCD}	0.0064 ^{BC}	0.0057 ^{ABCD}	0.0078 ^{A}
T_4M_2	0.0069 ^{BCD}	0.0121 ^{AB}	0.0027 ^{GH}	0.0074 ^{A}	0.0074 ^{A}
T_5M_1	0.0079 ^{AB}	0.0094 ^{DEF}	0.0063 ^{BCD}	0.0048 ^{CD}	0.0078 ^{A}
T_5M_2	0.0083 ^{AB}	0.0116 ^{ABC}	0.0059 ^{BCD}	0.0055 ^{ABCD}	0.0070 ^{A}
T_6M_1	0.0044 ^{E}	0.0113 ^{ABCD}	0.0089 ^{A}	0.0059 ^{ABCD}	0.0077 ^{A}
T_6M_2	0.0096 ^{A}	0.0112 ^{ABCD}	0.0073 ^{AB}	0.0067 ^{ABC}	0.0076 ^{A}
T_7M_1	0.0046 ^{E}	0.0085 ^{F}	0.0025 ^{H}	0.0068 ^{ABC}	0.0079 ^{A}
T_7M_2	0.0047 ^{E}	0.0106 ^{ABCDE}	0.0037 ^{EFGH}	0.0047 ^{D}	0.0078 ^{A}

S = Significant, NS = Non Significant

Treatment means having similar alphabets in superscript do not differ significantly

The effect of two fertilizer doses exhibited significant difference during vegetative stage, M_2 being superior to M_1 in terms of RGR. M_1 and M_2 recorded the maximum RGR at 4 MAP (0.011 and 0.010 respectively).

The interaction effect of all the treatments differed significantly during vegetative stage. T_6M_2 recorded the maximum RGR at 2 MAP (0.0096), while T_1M_2 and T_6M_1 recorded the maximum RGR at 4 MAP (0.0123) and 6 MAP (0.0089) respectively. During flowering and harvest, there was no significant difference due to interaction effect with respect to RGR values.

4.3.4 Net Assimilation Rate (NAR)

Data on NAR (mg.sq.cm/day) are given in Table 23. There was no significant difference between treatments throughout the growth stages in terms of NAR. The maximum value of NAR was recorded at 4 MAP by T_6 (0.533) followed by T_4 and T_3 (0.521 and 0.481 respectively).

The effect of two fertilizer doses did not show significant difference in NAR values throughout the entire period of growth.

No specific trend was noticed in NAR due to the interaction between different treatments. T_6M_1 (0.546) recorded the maximum value followed by T_4M_1 (0.545), T_4M_2 (0.545), T_6M_1 (0.520) and T_3M_1 (0.491) at 4 MAP.

4.3.5 Crop Growth Rate (CGR)

CGR (g/sq/m/day) showed an increasing trend at all growth stages except at 6 MAP (Table. 24). T_7 recorded the highest CGR (12.44) followed by T_1

Table 23: Effect of treatments on net assimilatien ratio (mg/cm^2/day) in pineapple cv. Mauritius

Treatments	2 MAP	4 MAP	6 MAP	Flowering	Harvest
T_1	0.277 ^{BC}	0.378 ^{B}	0.127 ^{B}	0.127 ^{D}	0.255 ^{AB}
T_2	0.377 ^{B}	0.391 ^{B}	0.132 ^{B}	0.155 ^{A}	0.219 ^{B}
T_3	0.324 ^{BC}	0.481 ^{A}	0.097 ^{B}	0.132 ^{C}	0.249 ^{AB}
T_4	0.387 ^{B}	0.521 ^{A}	0.166 ^{AB}	0.155 ^{A}	0.281 ^{A}
T_5	0.394 ^{B}	0.327 ^{B}	0.195 ^{AB}	0.116 ^{E}	0.239 ^{AB}
T_6	0.508 ^{A}	0.533 ^{A}	0.260 ^{A}	0.154 ^{A}	0.243 ^{AB}
T_7	0.244 ^{C}	0.328 ^{B}	0.133 ^{B}	0.146 ^{B}	0.278 ^{A}
M_1	0.341	0.423	0.170	0.136	0.260
M_2	0.376	0.422	0.148	0.145	0.244
F Test (5%)	NS	NS	NS	NS	NS
T_1M_1	0.215 ^{C}	0.370 ^{BC}	0.145 ^{ABCD}	0.138 ^{F}	0.259 ^{ABCD}
T_1M_2	0.339 ^{BC}	0.386 ^{BC}	0.109 ^{BCD}	0.116 ^{K}	0.252 ^{ABCD}
T_2M_1	0.421 ^{B}	0.392 ^{BC}	0.149 ^{ABCD}	0.156 ^{C}	0.219 ^{BCD}
T_2M_2	0.332 ^{BC}	0.389 ^{BC}	0.115 ^{BCD}	0.154 ^{D}	0.219 ^{CD}
T_3M_1	0.358 ^{BC}	0.491 ^{A}	0.106 ^{BCD}	0.129 ^{I}	0.253 ^{ABCD}
T_3M_2	0.291 ^{BC}	0.471 ^{AB}	0.089 ^{CD}	0.135 ^{H}	0.245 ^{ABCD}
T_4M_1	0.352 ^{BC}	0.497 ^{A}	0.177 ^{ABCD}	0.136 ^{GH}	0.289 ^{A}
T_4M_2	0.422 ^{B}	0.545 ^{A}	0.154 ^{ABCD}	0.174 ^{A}	0.273 ^{ABC}
T_5M_1	0.404 ^{B}	0.359 ^{C}	0.250 ^{AB}	0.108 ^{L}	0.243 ^{ABCD}
T_5M_2	0.384 ^{BC}	0.295 ^{C}	0.141 ^{BCD}	0.124 ^{J}	0.235 ^{ABCD}
T_6M_1	0.369 ^{BC}	0.546 ^{A}	0.294 ^{A}	0.150 ^{E}	0.275 ^{ABC}
T_6M_2	0.646 ^{A}	0.520 ^{A}	0.226 ^{ABC}	0.158 ^{B}	0.211 ^{D}
T_7M_1	0.272 ^{BC}	0.308 ^{C}	0.066 ^{D}	0.137 ^{FG}	0.281 ^{AB}
T_7M_2	0.217 ^{C}	0.349 ^{C}	0.200 ^{ABCD}	0.155 ^{CD}	0.274 ^{ABC}

S = Significant, NS = Non Significant

Treatment means having similar alphabets in superscript do not differ significantly

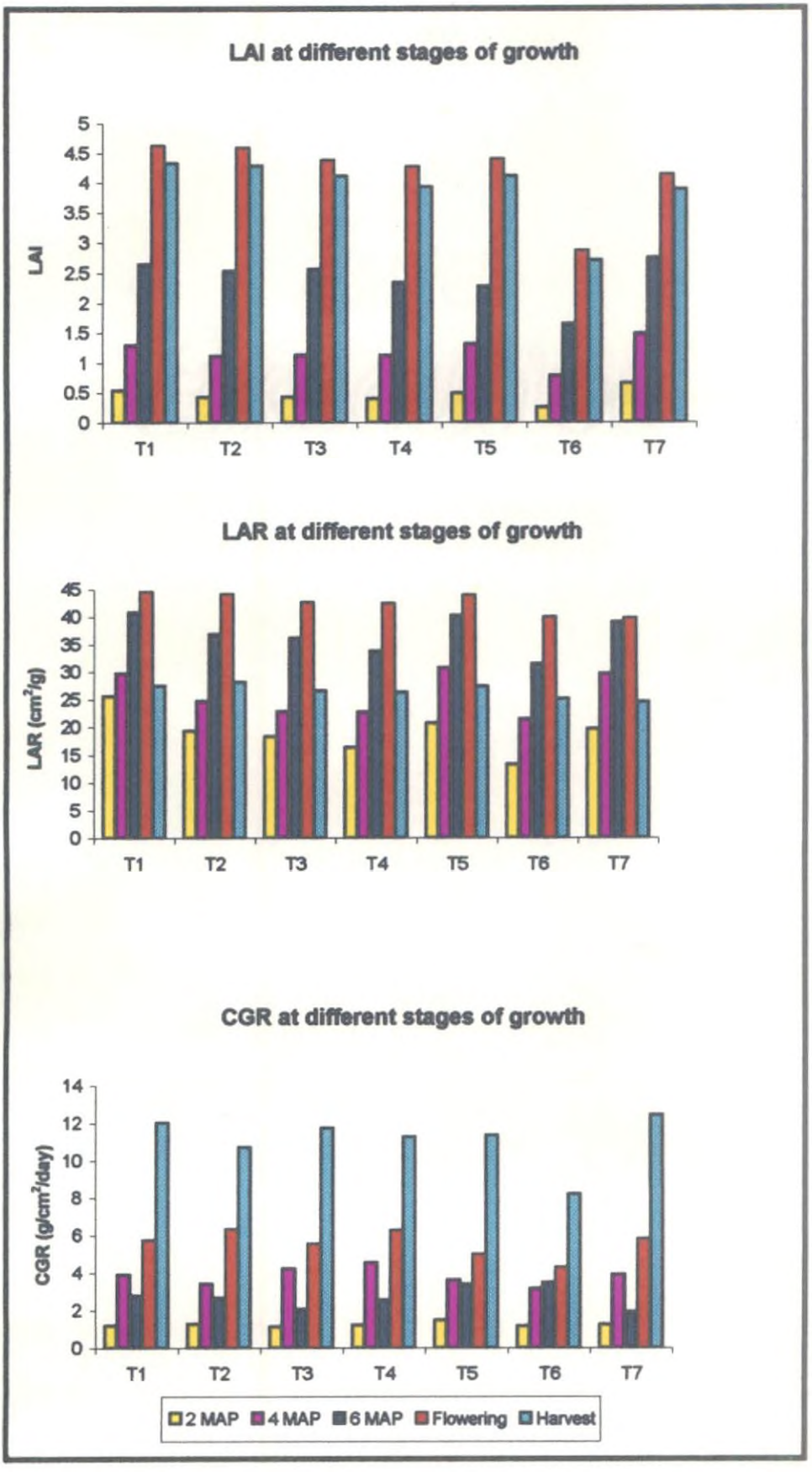
Table 24: Effect of treatments on crop growth rate (g/cm^2/day) in pineapple cv. Mauritius

Treatments	2 MAP	4 MAP	6 MAP	Flowering	Harvest
T_1	1.19 ^{A}	3.91 ^{BC}	2.77 ^{B}	5.75 ^{AB}	12.02 ^{AB}
T_2	1.27 ^{A}	3.42 ^{DE}	2.66 ^{B}	6.31 ^{A}	10.72 ^{D}
T_3	1.13 ^{A}	4.24 ^{AB}	2.05 ^{C}	5.54 ^{AB}	11.75 ^{BC}
T_4	1.23 ^{A}	4.54 ^{A}	2.54 ^{B}	6.26 ^{A}	11.27 ^{CD}
T_5	1.49 ^{A}	3.63 ^{CD}	3.40 ^{A}	5.00 ^{BC}	11.36 ^{C}
T_6	1.17 ^{A}	3.15 ^{E}	3.49 ^{A}	4.28 ^{C}	8.20 ^{E}
T_7	1.25 ^{A}	3.92 ^{BC}	1.92 ^{C}	5.80 ^{AB}	12.44 ^{A}
M_1	1.07	3.20	2.63	5.35	11.09
M_2	1.43	4.47	2.74	5.77	11.12
F Test (5%)	S	S	NS	S	NS
T_1M_1	0.82 ^{C}	3.02 ^{G}	2.60 ^{DEF}	6.09 ^{ABC}	12.06 ^{ABC}
T_1M_2	1.55 ^{AB}	4.81 ^{BC}	2.94 ^{CDE}	5.40 ^{CD}	11.98 ^{ABC}
T_2M_1	1.23 ^{ABC}	2.91 ^{G}	2.45 ^{EFG}	6.69 ^{AB}	10.65 ^{E}
T_2M_2	1.30 ^{ABC}	3.92 ^{DE}	2.86 ^{CDE}	5.93 ^{ABC}	10.81 ^{DE}
T_3M_1	1.13 ^{ABC}	3.60 ^{EF}	1.95 ^{GH}	5.36 ^{CD}	11.71 ^{ABCD}
T_3M_2	1.14 ^{ABC}	4.88 ^{B}	2.15 ^{FG}	5.72 ^{CD}	11.80 ^{ABC}
T_4M_1	0.94 ^{BC}	3.65 ^{EF}	3.19 ^{BC}	5.43 ^{CD}	11.29 ^{CDE}
T_4M_2	1.51 ^{AB}	5.43 ^{A}	1.89 ^{GH}	7.10 ^{A}	11.25 ^{CDE}
T_5M_1	1.35 ^{ABC}	2.91 ^{G}	3.06 ^{CD}	4.50 ^{DE}	11.45 ^{BCDE}
T_5M_2	1.63 ^{A}	4.35 ^{CD}	3.73 ^{AB}	5.43 ^{CD}	11.27 ^{CDE}
T_6M_1	0.72 ^{C}	2.96 ^{G}	3.77 ^{A}	4.01 ^{E}	8.17 ^{F}
T_6M_2	1.63 ^{A}	3.34 ^{FG}	3.21 ^{BC}	4.56 ^{DE}	8.22 ^{F}
T_7M_1	1.28 ^{ABC}	3.30 ^{FG}	1.43 ^{H}	5.30 ^{CD}	12.37 ^{AB}
T_7M_2	1.23 ^{ABC}	4.54 ^{BC}	2.41 ^{EFG}	6.30 ^{ABC}	12.52 ^{A}

S = Significant, NS = Non Significant

Treatment means having similar alphabets in superscript do not differ significantly

Fig. 5 Physiological growth components of different treatments at critical stages of growth.



(12.02) and T_3 (11.75) and T_5 (11.36) at harvest while T_6 (8.20) recorded the lowest CGR value (Fig.5).

In general CGR increased as the dose of applied fertilizers increased. But M_2 differed significantly with M_1 only during 2 MAP and 4 MAP and later the differences were not significant.

Though significance was observed in interaction between various treatments, the pattern was not specific. At the time of flowering T_4M_2 (7.10) recorded the maximum CGR while at harvest T_7M_2 (12.52) recorded the maximum value.

4.4 Flowering characters

4.4.1 Days for flower initiation

The mean number of days for flower initiation is presented in Table 25. It revealed that there existed a significant difference between the treatments. T_7 took maximum number of days for flower initiation (34.50 days) followed by T_5 (31.17 days) and T_1 (30.17 days). Among the treatments, T_2 exhibited earliest flowering (30.00 days).

Among the effect of two fertilizer doses, higher doses of fertilizers (M_2) resulted in early flower initiation (30.38 days) when compared to M_1 (32.10 days).

Due to the interaction effect T_2M_2 recorded the minimum time for initiation of flowering (28.67 days) and T_7M_1 recorded the maximum time for initiation of flowering (34.67 days).

4.4.2 Days for 50 per cent flowering

Data on the effect of various treatments on the days for 50 per cent of flowering of the plants are presented in Table 25.

Among the treatments tissue culture plants took lesser number of days for 50 per cent flowering whereas sucker progenies (T_7) took more number of days for 50 per cent flowering (39.0 days).

With respect to the effect of two fertilizer doses, 50 per cent higher dose of N, P, K (M_2) resulted in lesser number of days for 50 per cent flowering (35.86 days).

The interaction effect of various treatments on 50 per cent flowering showed that T_2M_2 took the least value (34.0 days) whereas, T_7M_1 and T_7M_2 took the maximum number of days (37.0 days).

4.4.3 Flowering phase

Data on flowering phase (Table 25) indicated that there was no significant difference among the treatments. T_6 had the shortest flowering phase (15.00 days), while T_7 recorded the longest flowering phase (17.83 days).

Among the effect of two fertilizer doses, M_1 resulted in shorter flowering phase (16.29 days) when compared to M_2 (17.76 days). In the interaction effect of treatments with respect to flowering phase, T_6M_1 and T_6M_2 had the shortest flowering phase (14.67 and 15.33 days respectively), while T_1M_2 had the longest flowering phase (19.00 days). The other interaction effects were on par with each other.

Table 25 : Effect of treatments on flowering characters in pineapple cv. Mauritius

Treatments	Flower Initiation (days)	50 % Flowering (days)	Flowering Phase (days)
T_1	30.17 ^{D}	35.50 ^{C}	17.67 ^{AB}
T_2	30.00 ^{D}	35.33 ^{C}	17.00 ^{AB}
T_3	30.67 ^{CD}	37.00 ^{B}	17.50 ^{AB}
T_4	31.17 ^{C}	37.17 ^{B}	16.83 ^{B}
T_5	30.17 ^{D}	35.83 ^{C}	17.33 ^{AB}
T_6	32.00 ^{B}	37.33 ^{B}	15.00 ^{C}
T_7	34.50 ^{A}	39.00 ^{A}	17.83 ^{A}
M_1	32.10	37.62	16.29
M_2	30.38	35.86	17.76
F test (5%)	S	S	S
T_1M_1	31.00 ^{DE}	36.33 ^{CD}	16.33 ^{CD}
T_1M_2	29.33 ^{FG}	34.67 ^{EF}	19.00 ^{A}
T_2M_1	31.33 ^{CD}	36.67 ^{BC}	16.33 ^{CD}
T_2M_2	28.67 ^{G}	34.00 ^{F}	17.67 ^{ABC}
T_3M_1	31.66 ^{BCD}	38.00 ^{AB}	16.67 ^{CD}
T_3M_2	29.66 ^{FG}	36.00 ^{CDE}	18.33 ^{AB}
T_4M_1	32.33 ^{BC}	38.67 ^{A}	16.33 ^{CD}
T_4M_2	30.00 ^{EF}	35.67 ^{CDE}	17.33 ^{BC}
T_5M_1	31.00 ^{DE}	36.67 ^{BC}	16.33 ^{CD}
T_5M_2	29.33 ^{FG}	35.00 ^{DEF}	18.33 ^{AB}
T_6M_1	32.67 ^{B}	38.00 ^{AB}	14.67 ^{E}
T_6M_2	31.33 ^{CD}	36.67 ^{BC}	15.33 ^{DE}
T_7M_1	34.67 ^{A}	39.00 ^{A}	17.33 ^{BC}
T_7M_2	34.33 ^{A}	39.00 ^{A}	18.33 ^{AB}

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

4.5 Yield attributes

4.5.1 Fruit characters

Table 26 shows the effect of treatments on the various fruit characters of pineapple.

4.5.1.1 Fruit length

Fruit length differed significantly between the treatments. T_7 recorded the maximum value (21.78 cm), while T_6 recorded the minimum value (13.02 cm). The treatments T_1 (19.50 cm) and T_3 (19.60 cm) were on par with T_7.

Higher fertilizer dose (M_2) showed superiority with respect to fruit length (18.46 cm) but the difference was not much significant when compared to M_1 (18.29 cm).

Due to the interaction effect T_7M_1 produced longer fruits (22.00 cm) while T_6M_1 gave shorter ones (12.97 cm). The other treatments viz., T_7M_2, T_3M_2 and T_1M_2 were on par with T_7M_1 with respect to this parameter.

4.5.1.2 Fruit breadth

Among the treatments, the maximum fruit breadth was recorded by T_1 (12.35 cm) followed by T_3 (12.25 cm). T_6 recorded the least value(10.03 cm).

The effect of two fertilizer doses did not differ significantly with respect to fruit breadth. M_2 recorded the maximum value (11.85 cm) while M_1 recorded the minimum value (11.72 cm).

Significant variation was noticed between the treatment combinations with respect to fruit breadth. The maximum value was 12.43 cm (T_1M_2) while the minimum value was 10.00 cm (T_6M_2). The other interaction effects viz., T_3M_2, T_1M_1, T_7M_2 and T_3M_1 were on par with T_1M_2.

4.5.1.3 Length/breadth ratio (L/B ratio)

All treatments differed significantly with respect to length:breadth ratio. T_7 had the maximum L/B ratio (1.80) while T_6 had the minimum value (1.30). L/B ratio of other treatments were on par with each other and value varied from 1.47 to 1.60.

The effect of fertilizer doses did not differ significantly with respect to L/B ratio.

Eventhough significant interaction was observed between all the treatment combinations, the interaction effect of two fertilizer doses on each treatment did not differ significantly. The maximum L/B ratio was recorded by T_7M_1 (1.84), while the minimum by T_6M_1 (1.29). L/B ratio of other treatments were in the range of 1.47 to 1.61.

4.5.1.4 Taper ratio

Taper ratio was the highest for T_4 (0.947) and least for T_7 (0.830). The other treatments were on par with T_4.

Superiority of M_2 with respect to taper ratio was observed with a value of 0.925 when compared to 0.911 in M_1.

The interaction effect showed significant difference between various treatments. The interaction effect of T_4 with both M_1 and M_2 recorded the maximum taper ratio (0.947), while T_7M_1 recorded the least value (0.807) followed by T_7M_2 (0.853).

4.5.1.5 Peel:pulp ratio

The peel:pulp ratio was the lowest in T_3 (0.327) and the highest in T_6 (0.429).

Peel:pulp ratio did not differ significantly with respect to effect of two fertilizer doses.

The interaction effect of treatment combination differed significantly with respect to this parameter. The least value was recorded by T_5M_2 (0.319) and the highest by T_6M_1 (0.426).

4.5.1.6 Juice content

Juice content of fruits differed significantly between the treatments. T_4 recorded the maximum juice percentage (67.24%) and T_5 had the minimum juice percentage (60.76%).

No significant difference was observed for juice content among the two levels of fertilizer doses.

Among the interaction effects, the treatment combination T_4M_2 had the highest juice per cent (68.62%) while T_5M_2 recorded the lowest value (60.10%).

Table 26 : Effect of treatments on fruit characters in pineapple cv. Mauritius

Treatments	Fruit length (cm)	Fruit breadth (cm)	L/B ratio	Taper ratio	Peel/Pulp ratio	Juice content (%)	Fruit wt.+ crown(kg)	Fruit wt.- crown(kg)	Crown wt. (g)	Crown:Fruit ratio	Est. yield (t/ha)	Harvest index	Duration (days)
T_1	19.50 ^{B}	12.35 ^{A}	1.58 ^{BC}	0.928 ^{D}	0.333 ^{E}	65.14 ^{AB}	1.91 ^{B}	1.75 ^{B}	159.30 ^{D}	0.083 ^{E}	77.24 ^{B}	49.27 ^{AB}	345.80 ^{BC}
T_2	17.70 ^{E}	12.03 ^{C}	1.47 ^{D}	0.925 ^{E}	0.344 ^{D}	61.63 ^{DE}	1.65 ^{D}	1.49 ^{D}	190.90 ^{B}	0.116 ^{B}	66.71 ^{D}	46.08 ^{CD}	341.80 ^{D}
T_3	19.60 ^{B}	12.25 ^{AB}	1.60 ^{BC}	0.932 ^{C}	0.377 ^{B}	63.93 ^{BC}	1.91 ^{B}	1.72 ^{B}	189.30 ^{B}	0.099 ^{C}	76.79 ^{B}	47.60 ^{BC}	348.80 ^{A}
T_4	18.95 ^{C}	11.98 ^{C}	1.58 ^{BC}	0.947 ^{A}	0.364 ^{C}	67.24 ^{A}	1.80 ^{C}	1.67 ^{C}	130.20 ^{E}	0.072 ^{G}	72.71 ^{C}	45.94 ^{CD}	347.20 ^{AB}
T_5	18.07 ^{D}	11.73 ^{D}	1.54 ^{C}	0.925 ^{E}	0.327 ^{F}	60.76 ^{E}	1.80 ^{C}	1.64 ^{C}	166.70 ^{C}	0.093 ^{D}	72.80 ^{C}	47.12 ^{C}	346.20 ^{BC}
T_6	13.02 ^{F}	10.03 ^{E}	1.30 ^{E}	0.940 ^{B}	0.429 ^{A}	62.80 ^{CD}	1.23 ^{E}	1.01 ^{E}	216.90 ^{A}	0.176 ^{A}	49.66 ^{E}	44.65 ^{D}	335.80 ^{E}
T_7	21.78 ^{A}	12.12 ^{BC}	1.80 ^{A}	0.830 ^{F}	0.365 ^{C}	64.50 ^{B}	2.13 ^{A}	1.96 ^{A}	169.50 ^{C}	0.080 ^{F}	86.21 ^{A}	50.73 ^{A}	343.80 ^{CD}
M_1	18.29	11.72	1.55	0.911	0.365	65.40	1.76	1.58	173.89	0.099	70.93	47.35	359.30
M_2	18.46	11.85	1.55	0.925	0.359	63.88	1.80	1.63	175.51	0.102	72.54	47.34	329.10
F Test (5%)	S	S	NS	S	NS	NS	S	S	NS	NS	S	NS	S
T_1M_1	19.33 ^{D}	12.27 ^{ABC}	1.58 ^{CD}	0.930 ^{E}	0.326 ^{L}	65.09 ^{BCD}	1.86 ^{DE}	1.71 ^{DE}	155.10 ^{E}	0.083 ^{J}	75.31 ^{DE}	49.34 ^{ABC}	360.70 ^{BC}
T_1M_2	19.67 ^{C}	12.43 ^{A}	1.58 ^{CD}	0.927 ^{F}	0.341 ^{I}	65.19 ^{BC}	1.96 ^{C}	1.80 ^{C}	163.40 ^{E}	0.083 ^{J}	79.18 ^{C}	49.20 ^{ABC}	331.00 ^{F}
T_2M_1	17.67 ^{H}	12.00 ^{DE}	1.47 ^{E}	0.907 ^{H}	0.307 ^{H}	61.41 ^{FG}	1.63 ^{G}	1.44 ^{G}	192.70 ^{C}	0.119 ^{C}	65.92 ^{G}	45.85 ^{DE}	358.00 ^{C}
T_2M_2	17.73 ^{GH}	12.07 ^{CD}	1.47 ^{E}	0.943 ^{B}	0.337 ^{J}	61.85 ^{EFG}	1.67 ^{G}	1.55 ^{F}	189.20 ^{C}	0.113 ^{D}	67.49 ^{G}	46.32 ^{CDE}	325.70 ^{G}
T_3M_1	19.33 ^{D}	12.13 ^{BCD}	1.59 ^{CD}	0.930 ^{E}	0.368 ^{F}	63.24 ^{CDEF}	1.91 ^{CD}	1.72 ^{CD}	191.00 ^{C}	0.099 ^{E}	77.27 ^{CD}	48.03 ^{BCD}	367.00 ^{A}
T_3M_2	19.87 ^{C}	12.37 ^{AB}	1.61 ^{C}	0.933 ^{D}	0.386 ^{D}	64.62 ^{BCD}	1.91 ^{CD}	1.73 ^{CD}	187.70 ^{C}	0.098 ^{F}	76.31 ^{D}	47.18 ^{BCDE}	330.70 ^{F}
T_4M_1	18.77 ^{E}	11.90 ^{DEF}	1.57 ^{CD}	0.947 ^{A}	0.356 ^{G}	65.86 ^{B}	1.80 ^{F}	1.66 ^{DE}	138.60 ^{F}	0.077 ^{K}	72.61 ^{F}	46.00 ^{DE}	364.00 ^{AB}
T_4M_2	19.13 ^{D}	12.07 ^{CD}	1.59 ^{CD}	0.947 ^{A}	0.372 ^{E}	68.62 ^{A}	1.80 ^{F}	1.68 ^{DE}	121.90 ^{G}	0.068 ^{M}	72.80 ^{EF}	45.87 ^{DE}	330.30 ^{F}
T_5M_1	17.97 ^{FG}	11.70 ^{F}	1.54 ^{D}	0.923 ^{G}	0.335 ^{K}	61.42 ^{FG}	1.79 ^{F}	1.63 ^{E}	157.60 ^{E}	0.088 ^{H}	72.36 ^{F}	47.69 ^{BCD}	364.00 ^{AB}
T_5M_2	18.17 ^{F}	11.77 ^{EF}	1.54 ^{D}	0.927 ^{F}	0.319 ^{M}	60.10 ^{G}	1.81 ^{EF}	1.64 ^{E}	175.80 ^{D}	0.097 ^{G}	73.25 ^{EF}	46.55 ^{BCDE}	328.30 ^{FG}
T_6M_1	12.97 ^{I}	10.07 ^{G}	1.29 ^{F}	0.937 ^{C}	0.426 ^{A}	62.53 ^{EF}	1.21 ^{H}	1.01 ^{H}	206.40 ^{B}	0.170 ^{B}	48.99 ^{H}	44.97 ^{DE}	352.30 ^{D}
T_6M_2	13.07 ^{I}	10.00 ^{G}	1.31 ^{F}	0.943 ^{B}	0.424 ^{B}	63.07 ^{DEF}	1.25 ^{H}	1.02 ^{H}	227.50 ^{A}	0.183 ^{A}	50.34 ^{H}	44.32 ^{E}	319.30 ^{H}
T_7M_1	22.00 ^{A}	11.97 ^{DE}	1.84 ^{A}	0.807 ^{J}	0.393 ^{C}	65.25 ^{BC}	2.08 ^{B}	1.91 ^{B}	175.80 ^{D}	0.084 ^{I}	84.11 ^{B}	49.56 ^{AB}	349.00 ^{D}
T_7M_2	21.57 ^{B}	12.27 ^{ABC}	1.76 ^{B}	0.853 ^{I}	0.337 ^{J}	63.76 ^{CDE}	2.19 ^{A}	2.02 ^{A}	163.10 ^{E}	0.075 ^{L}	88.30 ^{A}	51.91 ^{A}	338.70 ^{E}

S = Significant, NS = Non Significant ; Treatment means having similar alphabets in superscript do not differ significantly

4.5.1.7 Fruit weight with crown

Plate 3 shows the fruit weight with crown of different treatments. Among the treatments, T_7 was found to be superior (2.13 kg) followed by T_1 (1.91 kg) and T_3 (1.91 kg). T_6 recorded the least fruit weight with crown (1.23 kg).

Eventhough, significant difference was observed between M_1 and M_2 with respect to fruit weight with crown, the difference in absolute value was not much pronounced.

Among the interaction effects, T_7M_2 had the highest fruit weight with crown (2.19 kg) followed by T_7M_1 (2.08 kg). With respect to tissue culture plants, T_1M_2 recorded the maximum fruit weight with crown (1.96 kg) followed by T_3M_2 (1.91 kg). The interaction effect of T_6 with both the fertilizer doses recorded the least fruit weight with crown.

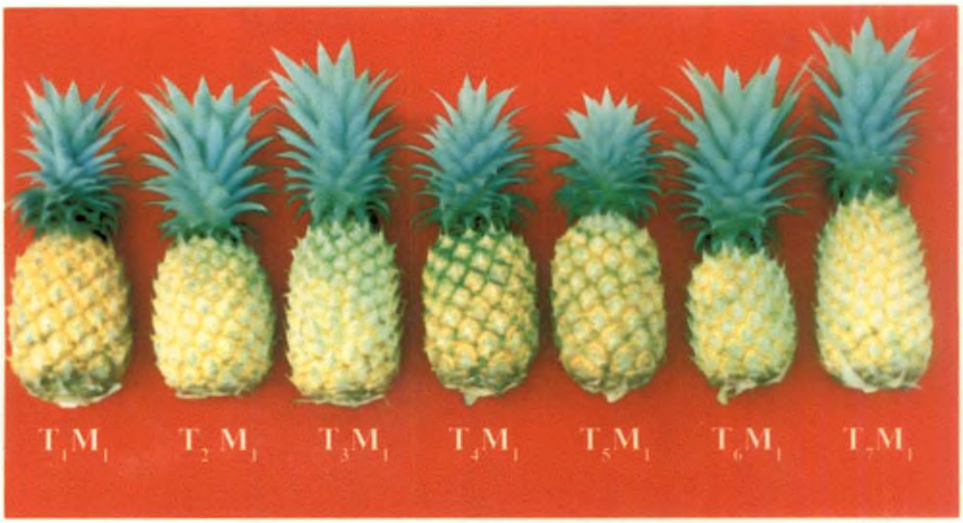
4.5.1.8 Fruit weight without crown

Treatment T_7 recorded the highest fruit weight without crown (1.96 kg) followed by T_1 (1.75 kg) and T_3 (1.72 kg) whereas T_6 recorded the least fruit weight without crown (1.01 kg).

Among the effect of two fertilizer doses, M_2 recorded higher fruit weight without crown (1.66 kg) than M_1 (1.60 kg).

The interaction effect of treatment combination followed the same pattern as that of fruit weight with crown. T_7M_2 recorded the highest value (2.02 kg) and T_6M_1 (1.01 kg) and T_6M_2 (1.02 kg) had the least value.

Plate 3. Fruits with crown under different treatments.



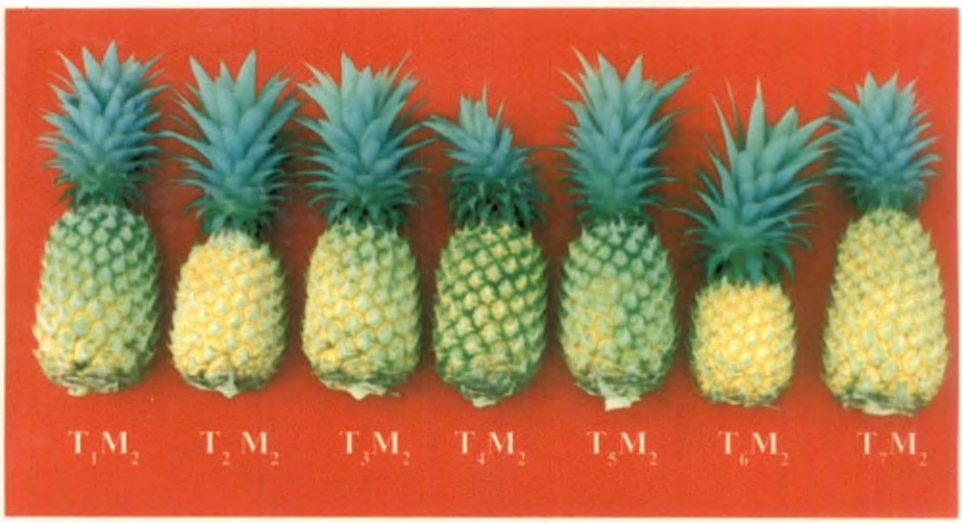
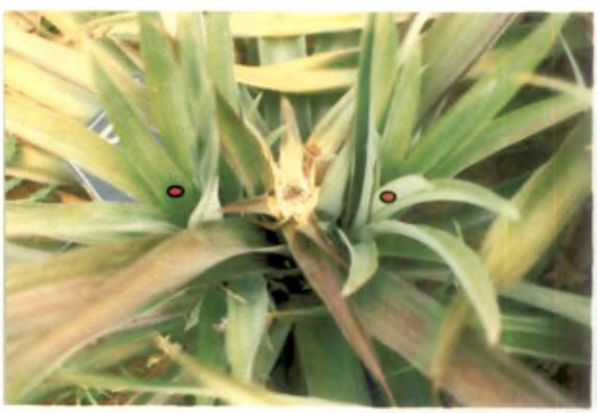


Plate 4. Sucker production in tissue culture and sucker derived plants.

Tissue culture plants

Suckers



4.5.1.9 Weight of the crown

The treatments differed significantly with respect to crown weight. The maximum and minimum values were recorded by T_6 (216.9 g) and T_4 (130.2 g) respectively.

There was no significant difference between the effect of two fertilizer doses with respect to crown weight.

Among the treatment combinations, T_4M_2 produced the smallest crowns (121.9 g) and T_6M_2 gave larger ones (227.5 g) followed by T_6M_1 (206.4 g). All other treatment combination were in the range of 157.6 to 192.7 g of crown weight.

4.5.1.10 Crown:fruit ratio

Among the treatments, T_4 showed the least crown: fruit ratio (0.072) followed by T_7 (0.080) and T_1 (0.083) whereas T_6 recorded the highest value (0.176).

No significant difference was observed among the effect of two fertilizer doses with respect to this parameter.

Interaction effect on crown:fruit ratio differed significantly with the maximum and minimum values ranging from 0.183 (T_6M_2) to 0.064 (T_4M_2).

4.5.1.11 Estimated yield with crown

Estimated yield of fruits with crown differed significantly between the treatments (Fig.6). T_7 recorded the maximum estimated yield (86.2 t/ha.) and T_6

recorded the minimum value (49.7 t/ha.). Among the tissue culture plants, T_1 recorded the maximum estimated yield (77.24 t/ha.) followed by T_3 (76.79 t/ha.).

Higher dose of fertilizers significantly increased the estimated yield of fruits to 73.5 t/ha. (M_2) when compared to general recommendation of fertilizers (M_1) followed for pineapple (71.7 t/ha.).

Among the treatment combinations, T_7M_2 proved to be superior (88.3 t/ha.) followed by T_7M_1 (84.1 t/ha) and T_6M_1 recorded the least estimated yield of fruits (49.0 t/ha).

4.5.1.12 Harvest Index

Data on Harvest Index of fruits showed that T_7 had the minimum value (50.73) followed by T_1 (49.27) and T_3 (47.60). Other treatments did not differ significantly (Fig.6).

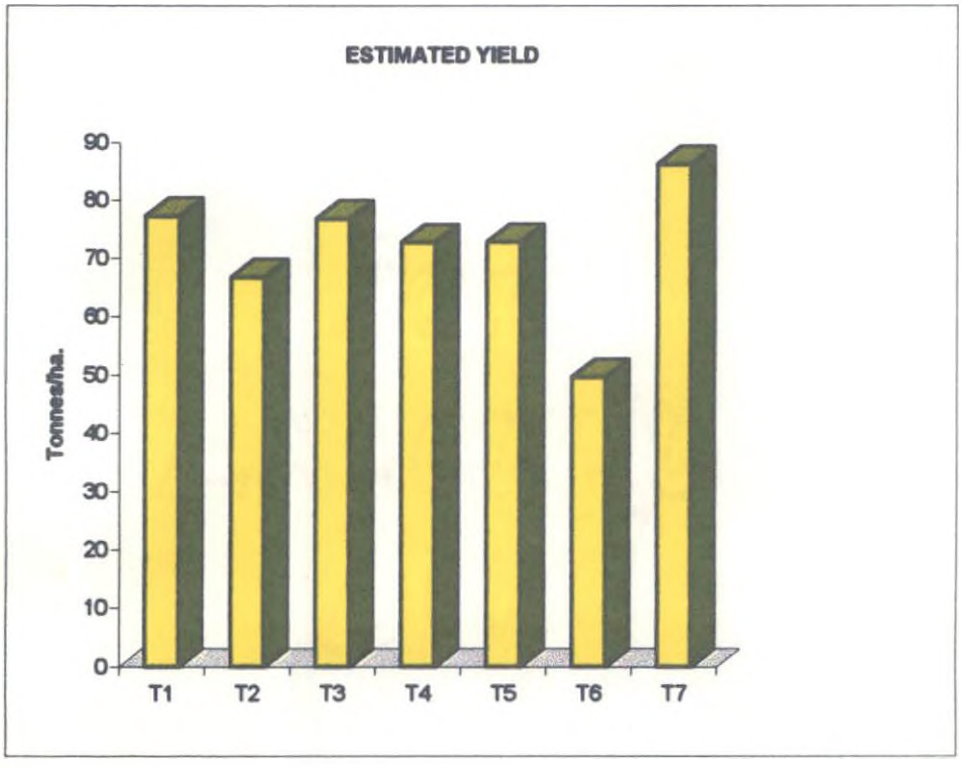
There was no significant difference among the fertilizer doses with respect to harvest index.

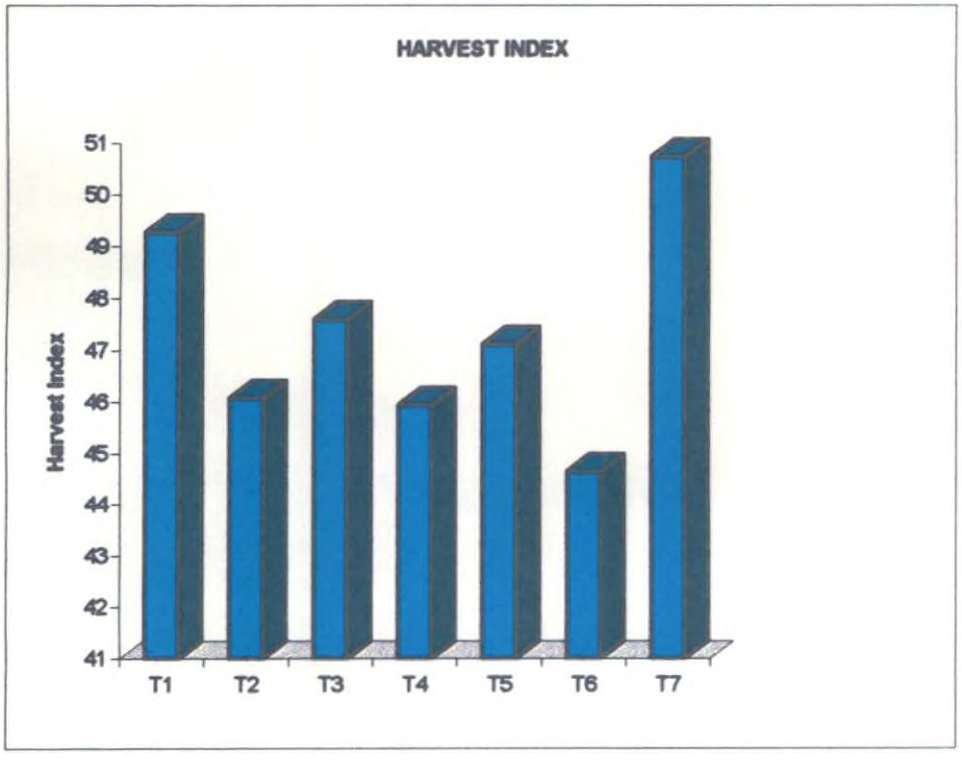
In the interaction effect, T_7M_1 and T_7M_2 showed higher harvest index (49.56 and 51.91 respectively), whereas T_2M_1 recorded the least value (44.32). There was not much variation among other treatment combinations.

4.5.1.13 Total duration of crop

Among the treatments, T_6 recorded the minimum crop duration (335.8 days) whereas T_3 recorded the maximum crop duration (348.8 days). Other treatments did not differ significantly.

Fig. 6 Estimated yield and Harvest Index for different treatments





The effect of two fertilizer doses differed significantly with respect to total duration of the crop. Fifty per cent increment in fertilizer dose resulted in early induction of plant for ethrel application and consequently led to lesser crop duration (329.1 days). (M_1) took 359.3 days to complete the crop cycle.

Interaction effect of the treatments with fertilizer doses showed that all treatment combination with M_2 took lesser number of days when compared to the treatment combination with M_1.

4.5.2 Fruit quality

The results of the various treatments on the fruit quality are presented in Table 27.

4.5.2.1 Total soluble solids (TSS)

Data pertaining to TSS (°Brix) showed that the treatment T_3 had the highest TSS content (16.61) followed by the treatments T_7 (16.37), T_6 (16.27), T_5 (16.27) and T_1 (16.16). T_2 had the least value (14.63) among the treatments.

The effect of two fertilizer doses differed significantly with respect to the TSS content, with M_1 recording higher value (16.17) compared to M_2 (15.89).

The interaction effect of two fertilizer doses on each treatment did not differ much with respect to TSS content. The maximum TSS value was recorded by the treatment combination T_3M_1 (16.78) while T_2M_2 (14.37) and T_2M_1 (14.89) had the minimum value. Other interaction effects were on par with T_3M_1.

4.5.2.2 Acidity

The treatment T_2 recorded the maximum acidity (0.793%) while T_3 had the least value (0.681%).

With respect to the effect of two fertilizer doses, 50 per cent increase in fertilizers (M_2) significantly reduced the acid content (0.654%) when compared to M_1 (0.830%).

The interaction effect of all treatment combination showed significance with respect to two fertilizer doses. The maximum acid per cent was recorded by the treatment T_2M_1 (0.886%), while T_3M_2 recorded the least value (0.593%).

4.5.2.3 TSS:Acid ratio

The treatments differed significantly with respect to TSS:Acid ratio. T_3 recorded the highest value (24.76) followed by T_5 (24.56), while T_2 recorded the least value (18.67).

The effect of two fertilizer doses also differed significantly with respect to TSS:Acid ratio. M_2 recorded the maximum TSS:Acid ratio (24.41) when compared to M_1 (20.17).

The interaction effect of all treatment combinations showed a similar pattern as acidity. T_3M_2 had the highest TSS:Acid ratio (27.72) and T_2M_1 recorded the least value (16.81).

4.5.2.4 Reducing sugars

Table 27: Effect of treatments on qualitative characters of fruit in pineapple cv. Mauritius

Treatments	TSS (° Brix)	Acidity (%)	TSS/Acid ratio	Reducing sugars (%)	Non Reducing sugars (%)	Total sugars (%)
T_1	16.16 ^{B}	0.746 ^{C}	21.79 ^{CD}	3.62 ^{C}	8.90 ^{A}	12.51 ^{B}
T_2	14.63 ^{D}	0.793 ^{A}	18.67 ^{E}	3.43 ^{D}	8.64 ^{B}	12.07 ^{C}
T_3	16.61 ^{A}	0.689 ^{F}	24.76 ^{A}	3.68 ^{C}	8.77 ^{AB}	12.45 ^{B}
T_4	15.92 ^{C}	0.771 ^{B}	20.85 ^{D}	4.07 ^{A}	8.92 ^{A}	12.98 ^{A}
T_5	16.27 ^{B}	0.741 ^{D}	24.56 ^{A}	3.94 ^{B}	8.67 ^{B}	12.60 ^{B}
T_6	16.27 ^{B}	0.743 ^{D}	22.24 ^{BC}	3.67 ^{C}	8.89 ^{A}	12.56 ^{B}
T_7	16.37 ^{B}	0.721 ^{E}	23.17 ^{B}	3.90 ^{B}	8.73 ^{AB}	12.63 ^{B}
M_1	16.18	0.830	20.17	3.64	8.36	12.00
M_2	15.89	0.654	24.41	3.88	9.21	13.08
F Test (5%)	S	S	S	S	S	S
T_1M_1	16.29 ^{BC}	0.805 ^{F}	20.23 ^{EF}	3.51 ^{E}	8.50 ^{C}	12.01 ^{E}
T_1M_2	16.02 ^{C}	0.687 ^{I}	23.35 ^{CD}	3.72 ^{CD}	9.29 ^{AB}	13.01 ^{BC}
T_2M_1	14.89 ^{E}	0.886 ^{A}	16.81 ^{G}	3.34 ^{F}	8.17 ^{D}	11.51 ^{F}
T_2M_2	14.37 ^{F}	0.700 ^{H}	20.53 ^{EF}	3.52 ^{E}	9.10 ^{B}	12.62 ^{D}
T_3M_1	16.78 ^{A}	0.770 ^{G}	21.81 ^{DE}	3.59 ^{DE}	8.39 ^{CD}	11.99 ^{E}
T_3M_2	16.44 ^{BC}	0.593 ^{M}	27.72 ^{A}	3.76 ^{C}	9.15 ^{AB}	12.91 ^{C}
T_4M_1	16.22 ^{BC}	0.853 ^{B}	19.01 ^{F}	3.86 ^{C}	8.41 ^{CD}	12.27 ^{E}
T_4M_2	15.62 ^{D}	0.688 ^{I}	22.69 ^{D}	4.27 ^{A}	9.42 ^{A}	13.69 ^{A}
T_5M_1	16.24 ^{BC}	0.893 ^{C}	23.77 ^{CD}	3.85 ^{C}	8.31 ^{CD}	12.17 ^{E}
T_5M_2	16.29 ^{BC}	0.644 ^{K}	25.35 ^{BC}	4.02 ^{B}	9.02 ^{B}	13.04 ^{BC}
T_6M_1	16.33 ^{BC}	0.834 ^{D}	19.58 ^{F}	3.53 ^{E}	8.53 ^{C}	12.06 ^{E}
T_6M_2	16.21 ^{BC}	0.651 ^{J}	24.90 ^{BC}	3.82 ^{C}	9.25 ^{AB}	13.07 ^{BC}
T_7M_1	16.48 ^{B}	0.824 ^{E}	20.00 ^{EF}	3.79 ^{C}	8.23 ^{CD}	12.02 ^{E}
T_7M_2	16.27 ^{BC}	0.618 ^{L}	26.33 ^{AB}	4.02 ^{B}	9.23 ^{AB}	13.23 ^{B}

S = Significant, NS = Non Significant

Treatment means having similar alphabets in superscript do not differ significantly

All treatments followed a similar trend as TSS:Acid ratio with respect to reducing sugars. The maximum and minimum values were recorded by T_4 (4.07%) and T_2 (3.43%) respectively.

The effect of two fertilizer doses also differed significantly with M_2 having higher reducing sugar (3.88%) compared to M_1 (3.64%).

Treatment combinations also followed the similar trend as that of TSS:Acid ratio. T_4M_2 recorded the maximum reducing sugar (4.27%) whereas T_2M_1 recorded the minimum (8.17%).

4.5.2.5 Non reducing sugars (%)

There was not much variation among the different treatments for non reducing sugar content. The fertilizer dose M_2 resulted in higher non reducing sugars (9.21%) compared to M_1 (8.36%).

The interaction effect revealed that the differences were minimal among the treatments for non reducing sugar content. T_4M_2 recorded the maximum value (9.42%), while T_2M_1 had the least (8.17%).

4.5.2.6 Total sugars

The treatments did not differ significantly with respect to total sugars. The effect of two fertilizer dose differed significantly with M_2 having higher total sugar content (13.08%) compared to M_1 (12.00%).

The interaction effect followed the same trend as that of non reducing sugars with T_4M_2 giving higher value (13.69%) and T_2M_1 recording the least value (11.51%).

4.6 Sucker and slip production

Data pertaining to mean number of suckers and slips produced by various treatments are furnished in Table 28. It indicated that all the tissue culture progenies produced more number of suckers (Plate 4) and slips, when compared to sucker derived progenies (T_7). T_4 produced the maximum number of suckers (4.68) and T_2 produced the maximum number of slips (5.27). T_7 had the lowest number of suckers and slips (1.98 and 4.60 respectively).

Among the effect of two fertilizer doses, (M_2) resulted in more number of suckers and slips (4.32 and 5.40), compared to M_1 (3.85 and 4.54).

Among the interaction effects, T_1M_2 recorded maximum number of suckers and slips (5.13 and 5.73 respectively). The treatments T_5M_2 (5.03) and T_6M_2 (4.80) were on par with T_1M_2 in sucker production, while T_5M_2 (5.63), T_2M_2 (5.60), T_3M_2 and T_4M_2 (5.40) were on par with T_1M_2 with respect to slip production. T_7M_1 recorded the least value in terms of sucker and slip number (1.93 and 4.30 respectively).

4.7 Plant nutrient concentration

4.7.1 Nitrogen content of 'D' leaf

The nitrogen content of 'D' leaf at 3 MAP, 6 MAP, flowering and harvest stages are presented in Table 29.

Table 28 : Effect of treatments on sucker and slip production in pineapple cv. Mauritius

Treatments	No. of suckers	No. of slips
T_1	4.67 ^{AB}	5.13 ^{AB}
T_2	4.50 ^{B}	5.27 ^{A}
T_3	4.25 ^{C}	4.67 ^{C}
T_4	4.68 ^{A}	5.05 ^{AB}
T_5	4.50 ^{B}	5.20 ^{AB}
T_6	4.00 ^{D}	4.87 ^{BC}
T_7	1.98 ^{E}	4.60 ^{C}
M_1	3.85	4.54
M_2	4.32	5.40
F test (5%)	S	S
T_1M_1	4.20 ^{DE}	4.53 ^{DE}
T_1M_2	5.13 ^{A}	5.73 ^{A}
T_2M_1	4.23 ^{DE}	4.93 ^{BCD}
T_2M_2	4.78 ^{C}	5.60 ^{A}
T_3M_1	4.07 ^{E}	3.93 ^{F}
T_3M_2	4.43 ^{D}	5.40 ^{AB}
T_4M_1	4.33 ^{D}	4.70 ^{CDE}
T_4M_2	5.03 ^{AB}	5.40 ^{AB}
T_5M_1	4.20 ^{DE}	4.77 ^{CDE}
T_5M_2	4.80 ^{BC}	5.63 ^{A}
T_6M_1	3.97 ^{E}	4.63 ^{CDE}
T_6M_2	4.03 ^{E}	5.10 ^{BC}
T_7M_1	1.93 ^{F}	4.30 ^{EF}
T_7M_2	2.03 ^{F}	4.90 ^{CD}

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

Nitrogen content of 'D' leaf showed an increasing trend from 3 MAP to 6 MAP and thereafter from flowering to harvest it declined steadily. The maximum nitrogen content was recorded by T_7 (1.63%) at 6 MAP. The other treatments were on par with T_7 except T_6 which recorded the least value(1.53%).

The effect of two fertilizer doses differed significantly throughout the growth stages. The maximum nitrogen content was recorded for M_2 (1.52%) at 6 MAP and the minimum value (0.77%) was recorded at the time of harvest.

The interaction effect of various treatment on nitrogen content of 'D' leaf showed superiority of T_7M_2 till flowering. T_7M_2 recorded the maximum value of 0.71 per cent at the time of flowering, followed by T_1M_2, T_2M_2, T_3M_2, T_4M_2 and T_5M_2. T_6M_1 recorded the least value (0.83%) at the time of flowering.

4.7.2 Phosphorus content of 'D' leaf

Phosphorus content of 'D' leaf did not differ significantly among the treatments at all the growth stages. The maximum per cent of phosphorus was noticed for all the treatments at 6 MAP and thereafter during flowering and harvesting stages it declined gradually (Table 30). T_7 recorded the maximum phosphorus content (0.110%) at 6 MAP followed by T_4 (0.109%) and T_5 (0.108%), while T_6 recorded the lowest value (0.103) at 6 MAP.

The effect of two fertilizer doses M_1 and M_2 did not differ much during the growth stages with respect to phosphorus content. The maximum value was recorded during 6 MAP in which M_2 had higher phosphorus content (0.108%) than M_1 (0.106%).

Table 29: Effect of treatments on nitrogen content (%) of D leaf in pineapple cv. Mauritius

Treatments	3 MAP	6 MAP	Flowering	Harvest
T_1	1.27 ^{B}	1.57 ^{B}	0.91 ^{A}	0.73 ^{BC}
T_2	1.28 ^{B}	1.60 ^{AB}	0.90 ^{A}	0.72 ^{C}
T_3	1.27 ^{B}	1.61 ^{AB}	0.90 ^{A}	0.75 ^{ABC}
T_4	1.27 ^{B}	1.59 ^{B}	0.90 ^{A}	0.73 ^{BC}
T_5	1.27 ^{B}	1.57 ^{B}	0.89 ^{A}	0.77 ^{AB}
T_6	1.21 ^{C}	1.53 ^{C}	0.84 ^{B}	0.66 ^{D}
T_7	1.33 ^{A}	1.63 ^{A}	0.91 ^{A}	0.78 ^{A}
M_1	1.23	1.52	0.87	0.70
M_2	1.32	1.65	0.91	0.77
F Test (5%)	S	S	S	S
T_1M_1	1.23 ^{CD}	1.50 ^{EF}	0.90 ^{ABC}	0.69 ^{EF}
T_1M_2	1.31 ^{AB}	1.64 ^{AB}	0.92 ^{AB}	0.77 ^{ABC}
T_2M_1	1.23 ^{CD}	1.55 ^{DE}	0.88 ^{BC}	0.69 ^{EF}
T_2M_2	1.33 ^{AB}	1.65 ^{AB}	0.91 ^{ABC}	0.76 ^{BCD}
T_3M_1	1.22 ^{D}	1.53 ^{E}	0.87 ^{BC}	0.70 ^{DEF}
T_3M_2	1.33 ^{AB}	1.69 ^{A}	0.92 ^{AB}	0.80 ^{AB}
T_4M_1	1.21 ^{D}	1.52 ^{E}	0.89 ^{ABC}	0.69 ^{EF}
T_4M_2	1.33 ^{AB}	1.65 ^{AB}	0.92 ^{ABC}	0.78 ^{AB}
T_5M_1	1.24 ^{CD}	1.49 ^{EF}	0.88 ^{BC}	0.71 ^{CDEF}
T_5M_2	1.31 ^{AB}	1.65 ^{AB}	0.91 ^{ABC}	0.82 ^{A}
T_6M_1	1.16 ^{E}	1.46 ^{F}	0.83 ^{C}	0.65 ^{F}
T_6M_2	1.27 ^{BCD}	1.61 ^{BC}	0.84 ^{BC}	0.66 ^{F}
T_7M_1	1.29 ^{BC}	1.59 ^{CD}	0.86 ^{BC}	0.75 ^{BCDE}
T_7M_2	1.36 ^{A}	1.67 ^{A}	0.97 ^{A}	0.80 ^{AB}

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

Table 30: Effect of treatments on phosphorus content (%) of D leaf in pineapple cv. Mauritius

Treatments	3 MAP	6 MAP	Flowering	Harvest
T_1	0.076 ^{A}	0.107 ^{C}	0.092 ^{A}	0.062 ^{AB}
T_2	0.075 ^{BC}	0.104 ^{D}	0.090 ^{C}	0.062 ^{BC}
T_3	0.074 ^{C}	0.106 ^{C}	0.090 ^{C}	0.062 ^{A}
T_4	0.075 ^{D}	0.109 ^{A}	0.091 ^{B}	0.062 ^{ABC}
T_5	0.075 ^{B}	0.109 ^{B}	0.087 ^{D}	0.062 ^{AB}
T_6	0.069 ^{D}	0.103 ^{E}	0.085 ^{E}	0.061 ^{D}
T_7	0.076 ^{A}	0.110 ^{A}	0.091 ^{D}	0.062 ^{C}
M_1	0.073	0.106	0.088	0.062
M_2	0.074	0.108	0.090	0.062
F Test (5%)	NS	S	S	NS
T_1M_1	0.075 ^{BCD}	0.105 ^{F}	0.090 ^{CD}	0.062 ^{AB}
T_1M_2	0.078 ^{A}	0.109 ^{BCD}	0.094 ^{A}	0.063 ^{AB}
T_2M_1	0.074 ^{CD}	0.106 ^{EF}	0.089 ^{CD}	0.062 ^{AB}
T_2M_2	0.076 ^{BC}	0.101 ^{G}	0.091 ^{BC}	0.062 ^{AB}
T_3M_1	0.074 ^{CD}	0.105 ^{F}	0.089 ^{CD}	0.062 ^{AB}
T_3M_2	0.073 ^{D}	0.109 ^{BCD}	0.091 ^{BCD}	0.063 ^{A}
T_4M_1	0.071 ^{E}	0.109 ^{BC}	0.090 ^{CD}	0.062 ^{AB}
T_4M_2	0.070 ^{E}	0.110 ^{B}	0.092 ^{AB}	0.063 ^{AB}
T_5M_1	0.074 ^{CD}	0.107 ^{CDE}	0.086 ^{EF}	0.062 ^{AB}
T_5M_2	0.076 ^{B}	0.110 ^{B}	0.087 ^{E}	0.063 ^{A}
T_6M_1	0.070 ^{E}	0.101 ^{G}	0.085 ^{F}	0.061 ^{B}
T_6M_2	0.069 ^{E}	0.104 ^{F}	0.086 ^{EF}	0.061 ^{AB}
T_7M_1	0.075 ^{BCD}	0.107 ^{DE}	0.089 ^{D}	0.061 ^{AB}
T_7M_2	0.078 ^{A}	0.112 ^{A}	0.093 ^{A}	0.062 ^{AB}

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

Among the treatment combinations, T_1M_2 and T_7M_2 recorded the maximum value at 3 MAP (0.078%). The other treatment combinations did not differ significantly except T_6M_1 (0.069%), which recorded the least value. Similar trend was observed till flowering and there was no significant difference among the treatment combinations with respect to phosphorus content of 'D' leaf at the time of harvest.

4.7.3 Potassium content of 'D' leaf

The potassium content of 'D' leaf did not differ significantly among the treatments at all the growth stages (Table 31). This parameter followed a similar pattern as that of nitrogen content. The maximum potassium content was found in T_7 (4.75%) at 6 MAP which was on par with all other treatments. The minimum was recorded by treatment T_3 (3.08%) at the time of harvest.

Eventhough the effect of two fertilizer doses differed significantly with respect to potassium content of 'D' leaf, the difference was not much pronounced. M_2 recorded higher values throughout the growth stages, the maximum value recorded was 4.73 per cent at 6 MAP.

The interaction effect of various treatments on potassium content of 'D' leaf did not follow a unique pattern during different growth stages. But the superiority of T_7M_2 with respect to potassium content was noticed throughout the period of growth.

Table 31: Effect of treatments on potassium content (%) of D leaf in pineapple cv. Mauritius

Treatments	3 MAP	6 MAP	Flowering	Harvest
T_1	3.82 ^{A}	4.67 ^{AB}	3.98 ^{C}	3.14 ^{A}
T_2	3.81 ^{A}	4.63 ^{B}	4.02 ^{BC}	3.17 ^{A}
T_3	3.78 ^{A}	4.64 ^{AB}	3.99 ^{BC}	3.08 ^{A}
T_4	3.75 ^{A}	4.66 ^{AB}	4.01 ^{BC}	3.23 ^{A}
T_5	3.76 ^{A}	4.65 ^{AB}	4.03 ^{B}	3.23 ^{A}
T_6	3.61 ^{B}	4.60 ^{B}	3.84 ^{D}	3.18 ^{A}
T_7	3.78 ^{A}	4.75 ^{A}	4.18 ^{A}	3.27 ^{A}
M_1	3.68	4.58	3.94	3.16
M_2	3.84	4.73	4.07	3.22
F Test (5%)	S	S	S	NS
T_1M_1	3.68 ^{D}	4.60 ^{CDE}	3.83 ^{DE}	3.05 ^{A}
T_1M_2	3.95 ^{A}	4.73 ^{ABC}	4.12 ^{ABC}	3.23 ^{A}
T_2M_1	3.73 ^{CD}	4.55 ^{E}	4.03 ^{ABCD}	3.08 ^{A}
T_2M_2	3.88 ^{AB}	4.72 ^{ABCD}	4.00 ^{ABCD}	3.25 ^{A}
T_3M_1	3.68 ^{D}	4.55 ^{E}	4.03 ^{ABCD}	3.05 ^{A}
T_3M_2	3.87 ^{AB}	4.73 ^{ABC}	3.95 ^{BCDE}	3.12 ^{A}
T_4M_1	3.70 ^{D}	4.55 ^{E}	3.85 ^{DE}	3.30 ^{A}
T_4M_2	3.80 ^{BC}	4.77 ^{AB}	4.17 ^{AB}	3.17 ^{A}
T_5M_1	3.63 ^{D}	4.57 ^{DE}	3.90 ^{CDE}	3.10 ^{A}
T_5M_2	3.88 ^{AB}	4.73 ^{ABC}	4.15 ^{AB}	3.37 ^{A}
T_6M_1	3.68 ^{D}	4.57 ^{DE}	3.77 ^{E}	3.30 ^{A}
T_6M_2	3.53 ^{E}	4.63 ^{BCDE}	3.92 ^{CDE}	3.05 ^{A}
T_7M_1	3.63 ^{D}	4.68 ^{ABCDE}	4.15 ^{AB}	3.20 ^{A}
T_7M_2	3.93 ^{A}	4.82 ^{A}	4.20 ^{A}	3.33 ^{A}

S= Significant, NS = Non Significant (5 % Level)

Treatment means having similar alphabets in superscript do not differ significantly

Discussion

5. DISCUSSION

'Mauritius' is one of the most important commercial cultivars of pineapple grown in Kerala. At present, more than 60 per cent of the area under pineapple is occupied by this cultivar. But practically no research work pertaining to the crop improvement of this cultivar, has been carried out. A study was conducted in Kerala Agricultural University to survey the major Mauritius growing areas of Kerala with the main objective of exploiting the clonal variation in order to identify the elite clones, and as a result five elite accessions were selected and mass multiplied through *in vitro* technique and the plantlets were maintained (Jose, 1996). In the present investigations, field performance of these *in vitro* multiplied elite accessions were compared with *in vitro* multiplied unselected bulk and also with conventional suckers. The results obtained are discussed hereunder.

5.1 Field performance of *in vitro* plants of selected accessions of pineapple in comparison with *in vitro* plants of unselected bulk and conventional suckers.

5.1.1 Vegetative characters

Vegetative vigour of the plant can be considered as a reasonable index of its physiological growth and resultant yield potential. Leaf number is the most important vegetative parameter which measures the photosynthetic ability and physiological maturity of the plants. In the present investigation plants derived from suckers (T_7) recorded more leaf number throughout the vegetative phase. This character was persistent right from the planting of suckers. However, the tissue culture (TC) plants of all the selected accessions were on par with T_7 during vegetative stage. During ethrel application and flowering stages, TK 3 (T_1) recorded higher values than the other accession and even suckers. TC plants of unselected

bulk (T_6) recorded the least number of leaves throughout the growth stages, indicating the superiority in vigour of the plants of selected accessions. This also indicated that TC plants of selected accessions even though recorded slow growth initially were able to cope up with suckers and showed superiority during ethrel application and flowering stages. Similar case of slow growth rate of TC plants in the initial growth stage were reported by Pradeep *et al.*, 1992 in banana and Radha and Aravindakshan, 1998 in pineapple.

In pineapple 'D' leaf is considered important which is described as the photosynthetically active and physiologically mature whorl. In the present study, 'D' leaf area showed an increasing trend as the advancement in growth, recording the peak values at flowering. Increased values of 'D' leaf measurements exhibited by suckers (T_7), during the initial vegetative phase resulted in higher 'D' leaf area in this treatment. TC plants of selected accessions were on par with suckers during the vegetative stage and recorded superior values during ethrel application and flowering. Among the selected accessions, TK 3 (T_1) recorded the maximum 'D' leaf area at flowering. The production of broader leaves by TK 3 (T_1) during the course of growth in turn resulted in augmented 'D' leaf area. TC plants of unselected bulk (T_6) recorded the least value which might be due to the production of narrow 'D' leaf. This result was in accordance with the report of Sudhadevi *et al.*, 1996 who stated that TC plants of pineapple recorded reduced 'D' leaf area than conventional suckers. Because of the superior mother plant, TC plants of selected accession recorded higher value than unselected bulk and suckers.

The increased 'D' leaf area and maximum number of leaves of the TC plants of selected accessions especially TK 3 (T_1) and KT 5 (T_2) attributed to the maximum total leaf area per plant at the time of flowering when compared to TC plants of unselected bulk (T_6) and suckers (T_7).

The total fresh weight per plant expressed a linear positive relationship throughout the growth period. At the time of planting there was a net difference of 100g in fresh weight between TC plants and suckers, TC weighing less. Due to this initial advantage, sucker recorded more fresh weight throughout the vegetative phase. TC plants of selected accessions receiving increased dose of fertilizers were able to catch up with suckers by 6 MAP showing their better genetic potential. TC plants of unselected bulk recorded the lowest value at all growth stages. The inherent vigour of the elite accessions enabled them to record more fresh weight than plants of unselected bulk.

Total chlorophyll content of leaves portrays the photosynthetic efficiency of crop plants. In the present study, total chlorophyll content of leaves reached the maximum value at the time of flowering. Sucker (T_7) recorded higher value whereas TC plants of unselected bulk recorded the least value. Not much variation was observed among the TC plants of selected accessions but was superior to unselected bulk and comparable with suckers.

5.1.2 Dry matter production and partitioning

Total dry matter production (TDM) increased throughout the growth stages and maximum partitioning of dry matter was recorded during harvest. Dry matter partitioning (DMP) was maximum to leaves till flowering when compared to other plant parts. DMP to leaves varied between 80 and 74 per cent from 1 MAP to flowering and expressed a drastic decline (32-36%) at the time of harvest. During the vegetative phase, gradual increase of DMP to stem (7-15%) from 1 MAP to the stage of ethrel application was noticed, which in turn resulted in slight reduction of dry matter partitioning to leaves as the growth advanced. At the time of harvest, the mobilization of photosynthates from leaves and stems to the developing fruit, which might have acted as strong sink could offer a possible explanation for the maximum

DMP to fruit and drastic decline in the same to leaves. The results were in conformity with those of Radha (1989) in pineapple.

Among the treatments, since sucker (T_7) had the initial advantage of more dry weight than TC plants, it showed superiority throughout the vegetative stages. Due to the inherent vigour and also due to influence of increased fertilizer application, increasing values of TDM were recorded by the selected accessions and they were able to cope up with suckers during peak vegetative stage. During ethrel application and flowering stages, TK 3 (T_1) recorded the maximum TDM followed by KT 2 (T_3). This might be attributed to the increased number of leaves with more leaf area shown by these plants. Similar behavior of TC plants of banana was reported by Eckstein and Robinson (1995). Throughout the growth period, TC plants of unselected bulk (T_6) recorded the least value. The inherent genetic character of unselected bulk attributed to the poor response towards applied fertilizers resulted in lower leaf area might be the reason for the lowest TDM value recorded by T_6. Higher TDM production, which in turn influenced the yield potential of the selected accessions, indicating their superiority over the unselected bulk.

Percentage increment in TDM was high for all TC plants of selected accessions. Among them, TK3 (T_1) recorded the maximum value at the time of harvest and other selected accessions were on par with this. Sucker (T_7) recorded the least value followed by TC plant of unselected bulk (T_6). The inherent advantage of superior mother plant coupled with better response to the applied fertilizers may be attributed to the significant increase in incremental values of TDM, for all the selected accessions. Enhanced growth and assimilation potential of selected accessions over the unselected bulk (T_6) and suckers (T_7) was clearly evident in the present study.

In all treatments, DMP to leaves the was maximum during the vegetative stage. Besides leaves, TC plants recorded higher DMP to roots and 'D' leaf while sucker recorded higher DMP to stem during early vegetative stage. During peak vegetative stage DMP towards 'D' leaf was higher in TC plants of selected accessions, showing the increased assimilation potential of the plants over that of unselected bulk and suckers. Further, better response of former towards applied fertilizer may be because of the presence of well developed root system during early vegetative phase, as evidenced from the maximum DMP to roots in TC plants of selected accessions than suckers. These results are in accordance with that of Eckstein and Robinson (1995) and Mavelil (1997) in tissue culture banana.

Sucker showed superiority in partitioning of dry matter towards fruit (50%) and TC plants of selected accessions especially, TK 3 (T_1) and KT 2 (T_3) were on par with suckers (48-49%), whereas TC plants of unselected bulk (T_6) registered the least DMP value towards fruit (44%). Absolute TDM value at the time of harvest showed a similar trend. Since higher percentage of DMP from higher TDM value was observed in the case of sucker, TK 3 (T_1) and KT 2 (T_3) resulted in higher fruit dry weight value and lower percentage of DMP from lower TDM value was observed in TC plants of unselected bulk (T_6) caused least fruit dry weight value. This indicated the significant superiority of all selected accessions over unselected bulk (T_6), particularly with that of TK 3 (T_1) and KT 2 (T_3).

5.1.3 Growth components

Growth analysis is considered as a useful tool for assessing crop productivity. In the present study some of the important growth components viz., Leaf Area Index, Leaf Area Ratio, Relative Growth Rate, Net Assimilation Rate and Crop Growth Rate were worked out to evaluate the growth of all treatments under varied fertilizer doses.

LAI, which gives an idea about the photosynthetic surface per unit area increased till flowering and showed a slight drop at the time of harvest in all treatments. The increased number of leaves as well as higher total leaf area during flowering had contributed to the peak LAI value during flowering. Similar result in pineapple was reported by Onaha *et al.*, 1986. Sucker (T_7) recorded higher LAI value during vegetative phase. However, during flowering and harvest TC plants of selected accessions recorded the maximum LAI value than suckers. Similar results have already been reported by Eckstein and Robinson, 1995 in tissue culture banana. Even though variation was less among the TC plants of selected accessions, TK 3 (T_1) followed by KT 5 (T_2) recorded the maximum LAI during flowering. TC plants of unselected bulk recorded the least LAI throughout the growth. The maximum and minimum total leaf area values registered by TK 3 (T_1), KT (T_2); and T_6 respectively directly influenced the LAI values.

LAR followed a similar trend as LAI. TC plants of selected accessions viz. TK 3 (T_1) and KT 5 (T_2) recorded the maximum values while sucker (T_7) and TC plants of unselected bulk (T_6) recorded the minimum value at flowering. The drop in LAR during harvest could be explained as due to the partitioning of large amount of dry matter and mobilization of photosynthates to the developing fruit from leaves. Radha (1989) has reported similar results.

RGR and NAR are the functions of radiant energy absorbed by the photosynthetic surfaces. Similarity in the trends of these two components observed in the present study elucidated the relationship between them. This is in agreement with the report of Tay and Tan, 1971 and Onaha *et al.*, 1986 in pineapple. The peak value of RGR and NAR were recorded at 4 MAP in all treatments. This might be attributed to the maximum accumulation of dry matter and increased rate of leaf area development. The reduction in RGR and NAR during 6 MAP and flowering stage coincided with the peak summer, with high temperature and low RH at

Vellanikkara, might have created a non congenial climatic situation for the plants to carry out the photosynthesis effectively. This might have resulted in lower values of RGR and NAR recorded during the above stages. Higher values of RGR and NAR recorded in all treatments at harvest, indicated the accumulation of large amount of dry matter to the developing fruits. The results were in conformity with Radha (1989). There was not much difference observed between the treatments with respect to RGR and NAR values at all growth stages. Even then both tissue culture plants of selected accessions and unselected bulk recorded higher values than suckers.

CGR showed a linear trend during the growth stages recording the peak value at harvest in all the treatments. The development of fruits resulted in maximum accumulation of dry matter in fruits, which in turn increased the TDM content of plant could offer a possible explanation for the peak CGR value registered at harvest. Sucker recorded the maximum CGR value followed by TC plants of selected accessions viz., TK 3 (T_1) and KT 2 (T_3), while TC plants of unselected bulk recorded the least value. The maximum and minimum CGR value exhibited by the treatments as mentioned above, might be due to maximum and minimum TDM values recorded at harvest.

5.1.4 Flowering characters

Days for flower initiation and 50 per cent flowering indicated that there was not much variation among the treatments. Even then tissue culture plants recorded less number of days for flower initiation than suckers, indicating a sign of earliness in flowering by three to four days. With respect to flowering phase, both sucker (T_7) and TC plants of selected accessions viz., TK 3 (T_1) and KT 2 (T_3) recorded the maximum value (17-18 days), whereas TC plants of unselected bulk (T_6) recorded the least value (15 days). Flowering phase is a direct indicative of the

number of flowers produced which ultimately decides the size of the fruit (Chadha *et al.*, 1974). The increased fruit weight as recorded by suckers (T_7) followed by TK 3 (T_1) and KT 2 (T_3) could be attributed to the increased number of flowers as indicated by the prolonged flowering phase, whereas the reduced fruit weight recorded by TC plants of unselected bulk (T_6) might be due to less number of flowers indicated by the shorter flowering phase.

5.1.5 Fruit characters

5.1.5.1 Yield parameters

The prime objective of any improvement programme in fruit crops is ultimately concerned with the improvement of fruit and yield parameters. In pineapple fruit size, shape and total yield per hectare are the most important characters for consideration.

Fruit weight with crown and without crown differed significantly in all the treatments studied. Sucker (T_7) recorded the maximum value (2.13 and 1.96 kg respectively) followed by TC plants of selected accessions. Among the selected accessions, TK 3 (T_1) and KT 2 (T_3) recorded the maximum fruit weight and TC plants of unselected bulk (T_6) recorded the least value (1.23 and 1.01 kg). The selection of elite mother plant based on yield would have contributed to the increased fruit weight values of TC plants of selected accessions over TC plants of unselected bulk. The lower fruit weight values recorded by the first crop of pineapple propagated through tissue culture material as compared to that of suckers, has already been reported by Sudhadevi *et al.* (1996). In the present study also, the accessions multiplied through *in vitro* technique recorded lesser yield than that of their parent material propagated through suckers.

Weight of the crown did not show much variation between TC plants of selected accessions and suckers. Among the treatments, KV 17 (T_4) recorded the least crown weight whereas TC plants of unselected bulk (T_6) recorded the maximum value. The maximum partitioning of dry matter to crown in T_6, might have contributed to the increased crown weight value. On the other hand, selection criteria with higher fruit weight and lesser crown weight employed to select the elite accessions, might be the reason for the lesser crown weight as recorded by TC plants of selected accessions.

Estimated yield is a useful index to assess the economic viability of the crop. In the present study sucker (T_7) recorded the maximum value (86.21 t/ha) followed by TK 3 (T_1) and KT 2 (T_3) with values of 77.24 and 76.79 t/ha respectively. The increased fruit weight value recorded in these selected accession in turn resulted in higher estimated yield. Tissue culture plants of unselected bulk (T_6) recorded the least value (49.66 t/ha) indicating the superiority of selected accessions over unselected bulk (T_6).

Harvest index is an important tool to compare the crop efficiency as it highlights the net return per unit input incurred. It indicates the percentage of total biological yield partitioned to the economic part of the plant viz., the fruit in terms of dry matter. In the present study sucker (T_7) had the maximum harvest index followed by TC plants of selected accessions viz., TK 3 (T_1) and KT 2 (T_3) and TC plants of unselected bulk (T_6) recorded the least value. These results clearly indicated the higher crop efficiency of suckers and TC plants of selected accessions than TC plants of unselected bulk.

Length:Breadth ratio is an important fruit parameter which measures the size of the fruit. In the present study length of the fruit varied from 12.97 to 22.00 cm and breadth from 10.07 to 12.43 cm. An ideal L/B ratio of pineapple fruit for

commercial canning purpose is 1.5 as reported by Chadha *et al.*(1972) in Kew pineapple. The present investigation clearly revealed that TC plants of selected accessions recorded an average L/B ratio of 1.55 which indicated the shape of kew fruits (Plate 3) and suitability of the same for canning purpose. Due to longer fruits sucker recorded higher value (1.80) and lower value recorded by TC plants of unselected bulk (1.30) was due to shorter fruits, indicated that these two treatments were not ideal for canning purpose. The mean L/B ratio of source material of selected five accession is 1.83 which is similar to the L/B ratio of sucker (T_7) recorded in the present study.

Taper ratio portrays the shape of the fruit. Ideal ratio for canning purpose as stated by Chadha *et al.*, 1972 in Kew pineapple is 0.96. In the present study TC plants of selected accessions recorded an average taper ratio of 0.931 which is near to the ideal value and hence these accessions may be well suited for canning purpose. The source material (sucker derived plants of selected five accessions) recorded an average value of 0.83 and in the present study also sucker (T_7) recorded the same value. The increased taper ratio as recorded by TC plants of selected accessions than its source material might be due to the combined effect of better genetic material receiving optimum management. Similar report of TC plants recording taper ratio near to one was reported by Sudhadevi *et al.*, (1996). Even then, tissue culture plants of unselected bulk recorded an ideal taper ratio value (0.94), its reduced L/B ratio and smaller sized fruits indicated its unsuitability for canning.

Juice content is an important parameter particularly when the fruits are used for juice extraction. There was not much variation observed among the treatments. Even then TC plants of selected accession viz., KV 17 (T_4) followed by TK 3 (T_1) recorded the superior values than TC plants of unselected bulk and suckers.

Peel pulp ratio also did not differ much between the suckers and TC plants of selected accessions. TC plants of unselected bulk recorded the maximum value indicating more wastage of fruits in terms of peel over other treatments. TC plants of selected accessions recorded similar values to that of the source material.

Considerable variation was observed between the treatments with respect to the total duration of the crop. All treatments receiving higher dose of fertilizers came to harvest one month earlier than those receiving lesser dose. TC plants of unselected bulk (T_6) receiving this amount of fertilizers came to harvest ten and twenty days in advance than TC plants of selected accessions and suckers respectively. This is attributed to shorter flowering phase and fruit maturation period as evidenced from the size of the fruit (Plate 3). TC plants of selected accessions receiving higher level of fertilizers came to harvest on an average of ten days in advance (329 days) than suckers receiving the same dose of fertilizers (345 days). The cumulative effect of better genetic material of selected accessions and increased fertilizer application resulted in lesser crop duration with comparable fruit values than suckers indicating the earliness and superiority of the former over the later.

5.1.5.2 Quality attributes

Qualitative fruit characters viz., TSS, acidity, TSS:Acid ratio, reducing, nonreducing and total sugars were recorded for the treatments to elucidate the influence of various treatments on fruit quality. Much variation was not observed between the treatments with respect to quality attributes except for TSS:Acid ratio. TC plants of selected accessions viz., KT 2 (T_3) and TK 18 (T_5) recorded higher TSS:Acid ratio than sucker (T_7) and TC plants of unselected bulk (T_6), indicating more sweetness of the selected accessions over control. Maximum TSS:Acid ratio of the accessions KT 2 (T_3) and TK 18 (T_5) was attributed to less acidity and more TSS value recorded by them. In general, TC plants of selected accessions exhibited

similar values for TSS and sugar content whereas, acidity percentage has increased over the source material. Increase in acidity might be attributed to the influence of environment and cultural management conditions.

5.1.6 Sucker and slip production

Suckers and slips are the planting material widely used in pineapple. Lack of propagule is one of the major constraints in pineapple cultivation. In general, sucker derived plants of Mauritius pineapple produce on an average of two suckers and 3-4 slips. In the present study number of suckers varied from 1.98 to 4.67 and slips from 4.60 to 5.27. TC plants of selected accessions and unselected bulk (T_6) recorded more number of suckers and slips (four to five suckers and slips per plant) than sucker derived plants. The TC plants having higher cytokinin content than sucker progenies would have suppressed the apical dominance and resulting in acceleration of axillary buds to develop into suckers. This might have contributed to the increased sucker / slip production. This finding is in conformity with Mavelil (1997) who observed more number of suckers in TC banana than that of sucker derived progenies.

5.1.7 Nutrient concentration

'D' leaf was analysed for nitrogen, phosphorus and potassium content to monitor the critical levels of N, P and K at various growth stages. The nitrogen content showed variation at different growth stages. The peak value was registered at 6 MAP and minimum value at the time of harvest. There was not much variation observed between the treatments with respect to nitrogen content. Similar trend was followed for P and K.

5.2 Effect of fertilizer doses on various treatments

The effect of fertilizer doses differed significantly for almost all the vegetative characters, M_2 being superior to M_1 in all the accessions. The superiority of M_2 for all the vegetative characters (number of leaves, plant height, 'D' leaf area, fresh weight, chlorophyll content and dry weight) was observed from 2 MAP and continued till the stage of ethrel application (39-42 leaf stage). Better response of plants to the increased fertilizer dose as indicated by augmented vegetative growth could offer a satisfactory explanation for the superiority of M_2 when compared to M_1, during the vegetative phase. Similar results on effect of increased fertilizer dose on vegetative characters were reported in pineapple (Morales *et al.*, 1977 and Singh *et al.*, 1977).

Tissue culture plants of selected accessions responded well to increased fertilizer dose when compared unselected bulk. Biometric characters of suckers were higher at the time of planting and hence it showed superiority over TC plants of selected accessions during vegetative phase. M_2 with split application in the early vegetative phase (1, 2 and 3 MAP) significantly boosted the vegetative growth of TC plants and they were on par with suckers at 4 MAP, except in unselected bulk (T_6). The same trend was maintained throughout the vegetative phase. The present study is in conformity with the works of Natesh *et al.*, 1993; Sheela, 1995 and Mavelil, 1997 in tissue culture banana.

The salient outcome of the present investigation is that TC plants which received higher dose of fertilizers (M_2) attained the physiological maturity for flower induction (39-42 leaf stage) one month prior to those supplied with lower dose (M_1). The variation between M_1 and M_2 was not much pronounced in the case of suckers and hence the treatment combination (T_7M_1 and T_7M_2) were induced for flowering at the same time. This result indicates the necessity of applying higher dose of

fertilizers especially during initial growth stage to TC plants to enable them to cope up with the growth rate of suckers and to attain optimum vegetative growth for flower induction in a shorter time.

The augmented vegetative growth due to increased fertilizer application resulted in superiority of M_2 in all the physiological growth parameters studied except for NAR, where there was no significant difference between the two doses. The proportionate increment in dry weight as well as total leaf area at all growth stages showed a uniform pattern which may be the reason for non significant difference in NAR between M_1 and M_2. Similar trend in the pattern of growth parameters was reported by Eckstein and Robinson, 1995 in banana.

The increased fertilizer dose (M_2) differed significantly with M_1 with respect to flowering characters. M_2 took less number of days for flower initiation and 50 per cent flowering. However, longer flowering phase was noticed in M_2 than M_1. It might be due to the fact that increased fertilizer application resulted in more number of flowers which led to longer flowering phase (17.76) for M_2 compared to M_1 (16.29). All the treatment combinations with M_2 exhibited the same effect. Similar results have been reported by Mavelil (1997) in tissue culture banana.

Increased fertilizer application showed significant difference in some of the fruit characters studied. But the difference is not much pronounced except for the total duration of the crop. Treatment combination with M_2 matured one month earlier compared to M_1. This could be attributed to the earlier floral induction possible in plants supplied with M_2 dose as they attain physiological maturity earlier when compared with those received M_1 dose.

The effect of fertilizer doses differed significantly with respect to all the quality parameters studied. Increased fertilizer application resulted in reduction in

TSS and acidity. Eventhough TSS content of fruits was low for M_2, TSS/acid ratio was high for this treatment due to reduction in acidity, which is a desirable result. M_2 also showed superiority with respect to other quality parameters like reducing, non-reducing and total sugars over M_1. This result is in accordance with the report of Obiefuna *et al.* (1987) in pineapple.

Increased fertilizer dose also resulted in production of more number of suckers and slips. Tissue culture plants gave better results than suckers with respect to propagule production. This finding is in conformity with the report of Daniells, 1988; Epsino *et al.*, 1992 and Anil, 1994 in tissue culture banana. M_2 showed superiority for nitrogen content at all stages of growth. This may be one of the reasons for increased vigour of plants receiving higher dose. With respect to phosphorus and potassium also, M_2 exhibited superiority during peak vegetative and flowering phase, resulting in an overall increased vigour of the plants.

The findings of the present investigation discussed so far revealed that sucker derived plants in general performed well in terms of vegetative and yield characters. The performance of TC plants is expected to be poor when compared to suckers as reported by several authors in different crops. In the present study TC plants of selected accession were on par with suckers with respect to many important parameters. Higher dose of fertilizers in split application during early vegetative phase is a must for TC plants to boost up the initial vegetative growth to obtain better performance of the plants. The poor performance of the TC plants of unselected bulk indicated the need for clonal selection for crop improvement in Mauritius. The superiority of the selected accessions was more clear in two of them viz., TK 3 (T_1) and KT 2 (T_3) which exhibited desirable characters throughout the growth period, especially in terms of total estimated yield. Hence it will be quite meaningful to select these two accessions for further evaluation trials. It is expected that the suckers derived from these two selected accessions will perform well in

terms of yield and there is a better scope for improvement of the two most superior accessions (TK 3 and KT 2). Therefore further evaluation trials are needed to ascertain the superiority of these two accessions over the bulk.

Summary

6. SUMMARY

The investigation on "Evaluation of *in vitro* multiplied accessions of pineapple (*Ananas comosus* [L.] Merr.) cv. Mauritius" was undertaken in the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara during 1997-1999. The findings of the experiments are summarised hereunder.

Among the treatments, sucker derived plants (T_7) recorded the maximum number of leaves during the vegetative stage. During ethrel application and flowering stages, TK 3 (T_1) recorded the maximum value.

Sucker (T_7) recorded the maximum plant height at all growth stages. Among the TC plants of elite accessions, TK 18 (T_5) had the maximum plant height followed by TK 3 (T_1).

KT 5 (T_2) recorded the maximum 'D' leaf length whereas TK 18 (T_5) had the broadest 'D' leaf at flowering. TK 3 (T_1) and KT 5 (T_2) registered the maximum 'D' leaf area and total leaf area at flowering.

Sucker had the maximum fresh weight throughout the growth stages except during flowering. Among the TC plants of elite accessions, TK 3 (T_1) and KT 2 (T_3) recorded the maximum fresh weight from the stage of ethrel application to harvest.

Total chlorophyll content of leaves in all treatments recorded its peak value during flowering. KV 17 (T_4) had the maximum total chlorophyll content followed by sucker (T_7).

Sucker (T_7) recorded the maximum dry weight during vegetative phase. TC plant of elite accessions were on par with suckers from 6 MAP onwards. Among them, TK 3 (T_1) followed by KT 2 (T_3) recorded the maximum dry weight at harvest.

During vegetative phase, the major proportion of dry matter was partitioned to leaves while during harvest partitioning was the maximum towards fruit. Besides leaves, TC plants recorded the maximum DMP value towards root and 'D' leaf than suckers, while sucker recorded the maximum DMP value towards stem than all TC plants. At harvest, the maximum DMP towards fruits was recorded by sucker (T_7) followed by TK 3 (T_1) and KT 2 (T_3).

LAI and LAR showed an increasing trend till flowering followed by a steady drop during harvest. TK 3 (T_1) and KT 5 (T_2) recorded the maximum LAI and LAR value during flowering. All treatments recorded the maximum RGR value at 4 MAP. KV 17 (T_4) followed by TC plants of unselected bulk (T_6) recorded the maximum RGR value. Similar trend of RGR was observed for NAR also. All the treatments recorded the maximum CGR value at the time of harvest. Sucker (T_7) followed by TK 3 (T_1) recorded the maximum CGR value.

With respect to flowering characters, sucker (T_7) took the maximum number of days for flower initiation and 50 per cent flowering, while all TC plants of selected accessions took relatively less number of days for flowering. Sucker (T_7) followed by TK 3 (T_1) recorded the longer flowering phase than TC plants of unselected bulk.

Sucker recorded the maximum fruit weight with and without crown. Among the TC plants of elite accessions, TK 3 (T_1) and KT 2 (T_3) registered higher values. Similar trend was observed for estimated yield and harvest index.

Sucker (T_7) recorded the maximum L/B ratio followed by KT 2 (T_3). TC plants of selected accessions recorded ideal taper ratio than suckers (T_7), indicating the suitability of fruits for canning. Peel pulp ratio and juice content of TC plants of elite accessions did not differ significantly with suckers.

KT 2 (T_3) recorded the maximum TSS:Acid ratio whereas KT 5 (T_2) recorded the minimum value. KV 17 (T_4) had the maximum value for reducing, non reducing and total sugars.

TC plants of selected accessions and unselected bulk produced more number of suckers and slips than sucker derived plants.

The maximum nutrient content viz., nitrogen, phosphorus and potassium was recorded by suckers (T_7) at 6 MAP. Among the TC plants of elite accessions, KT 2 (T_3), KV 17 (T_4) and TK 3 (T_1) recorded the maximum content of these elements respectively.

The TC plants of unselected bulk (T_6) recorded the least value for all the vegetative and desirable fruit parameters studied.

The effect of two fertilizer doses significantly influenced all the vegetative parameters studied. Higher fertilizer dose (M_2) was superior and attained physiological maturity one month earlier than M_1. No significant difference was observed between M_1 and M_2 during flowering and harvest.

The effect of two fertilizer doses significantly contributed to all the flowering parameters also. Early initiation and longer flowering phase were exhibited by higher level of fertilizers (M_2).

The effect of two fertilizer doses did not differ much for the fruit parameters studied. But, for the total duration of the crop M_2 had lesser duration than M_1 with a difference of 30 days in all the treatments except in suckers where the difference was ten days only. Higher dose of fertilizers (M_2) was superior to lower dose (M_1) for all the quality parameters with an exception to TSS.

M_2 also produced more number of propagules than M_1. The effect of two fertilizer doses also differed significantly in contributing to nutrient content, with M_2 being superior to M_1.

References

REFERENCES

*Abutiate, W.S. and Eyeson, K.K. 1973. The response of pineapple (*Ananas comosus* [L.] Merr.) var. Smooth cayenne to nitrogen, phosphorus and potassium in the forest zone of Ghana. *Ghana J. agric. Sci.* **6**:155-159

Anil, B.K. 1994. Standardisation of spacing for tissue culture banana cv. Nendran (*Musa* AAB group). M.Sc. Hort.) thesis, Kerala Agricultural University, Thrissur, p.192

A.O.A.C. 1980. *Official and Tentative Methods of Analysis.* 13th ed. Association of Official Agricultural Chemists, Washington, D.C., USA

*Arderi, H.P. 1986. Effect of NPK fertilization on nutrient extraction and yield of pineapple (*Ananas comosus*[L.] Merr.) cv. Red Spanish. *Centro Agricola* **13**:69-75

*Arias, E., Nieves, N., Perez, G., Isidron, M. and Benega, R. 1997. Isoenzymatic variability in pineapple somaclones. *Ananas comosus* (L.) Merr. *Cultivors-Tropicales* **18**:56-59

Balakrishnan, S., Nair, P.S., Nair, K.K.R. and Nambiar, I.P.S. 1978. Estimation of leaf area in pineapple. *Agric. Res. J. Kerala* **16**(2):247-248

Blackman, V.H. 1919. The compound interest law and plant growth. *Ann. Bot.* **33**:353-60

*Brown, F.B. 1953. Pineapple varieties selection in Malaya. *Malayan agric. J.* **36**:237-246

Chadha, K.L., Melanta, K.R., Lodh, S.B. and Selvaraj,Y. 1972. Biochemical changes associated with growth and development of pineapple var. Kew. I. Changes in physio-chemical constituents. *Indian J. Hort.* **29**:54-57

Chadha, K.L., Melanta, K.R. and Shikhamany, S.D. 1974. Effect of the type and size of planting material on the vigour of the subsequent plants, Yield and quality in Kew pineapple (*Ananas comosus* [L.] Merr.). *Indian J. Hort.* **31**:9-15

Chadha, K.L., Shikhamani, S.D. and Melanta, K.R. 1977. Correlations of growth characters with yield and quality in Kew pineapple (*Ananas comosus* [L.] Merr.) *Indian J. Hort.* **34**:107-112

*Chen, T.C. and Chi, C.Y. 1963. Study on the effect of harvesting leaves on different dates and in different amounts on fibre production and fruit yield of pineapple (*Ananas comosus* [L.] Merr.) *J. agric. Ass. China* **13**:57-65

Collins, J.L. 1960. *The Pineapple*. Leonard Hill, London, p. 294

Daniells, J.W. 1988. Comparison of growth and yield of banana derived from tissue culture and conventional planting material. *Banana Newsl.* p.2

Das, B.C., Sadhu, M.K. and Sen, S.K. 1999. Effect of plant density and nutrition on growth and yield of pineapple cv. Giant Kew. *The Hort. J.* **12**(1):1-11

*Dewald, M.G., Moore, G.A. and Sherman, W.B. 1992. Isozymes in *Ananas* (pineapple):genetics and usefulness in taxonomy. *J. Am. Soc. Hort. Sci.* **117**:491-496

*Donald, C.M. 1962. In search of yield. *J. Aust. Inst. Agric. Sci.* **28**:171-178

*Drew, R.A. and Smith, M.K. 1990. Field evaluation of tissue cultured banana in south Eastern Queensland. *Aust. J. exp. Agric.* **30**:569-574

Duval, M.F., Eeckenbrugge, G.C., Bartholomew, D.P. and Rohnbach, K.G. 1993. Genetic variability in the genus *Ananas*. *Acta Horticulturae*, **334**:27-32

Eckstein,K. and Robinson, J.C. 1995. Physiological responses of banana (*Musa*

AAA: Cavendish sub group) in the sub tropics. IV. Comparison between tissue culture and conventional planting material during the first months of development. *J. hort. Sci.* **70**:549-559

Eckstein, K., Robinson, J.C. and Davie, S.J. 1995. Physiological responses of banana (*Musa* AAA: Cavendish sub group) in sub tropics. III. Gas exchange, growth analysis and source-sink interaction over a complete crop cycle. *J. hort. Sci.* **70**:169-180

*Eeckenbrugge, G.C.D. and Duval, M.F. 1995. Genetic basis for defining a strategy for pineapple breeding. Revista-de-la-Facultad-de-Agronomica, Universidad-central-de-venezuela, **21**:95-118

Epsino, R.R.C., Pascua, O.C., Magnaye, L.V. and Loguias, L. 1992. Performance of tissue cultured and sucker derived planting materials of banana cv. Cardasa, Latundan and Lakatan. *Acta Horticulturae* **1**:321

FIB. 1999. *Farm Guide*. Farm Information Bureau, Government of Kerala, p.9

*Gadelha, R.S.D.S., Vieira, A. and Libeck, L.T. 1986. Effect of split application of NPK fertilizer on productivity of the pineapple cultivar Perola. EMBRAPA, Brazil, No.169, p.2

Gregory, F.G. 1926. The effect of climatic conditions on the growth of barley. *Ann. Bot.* **40**:1-26

*Hiscox, J.D. and Israelstam, G.F. 1979. A method for the extraction of chlorophyll from leaf tissue without maceration. *Can. J. Bot.* **57**:1332-1335

Hwang, S.C., Chen, C.L., Lin, J.C. and Lin, H.L. 1984. Cultivation of banana using plantlets from meristem culture. *HortScience* **19**:231-233

Jackson, M.L. 1973. *Soil Chemical Analysis*. 2nd ed. Prentice Hall of Indian Pvt. Limited. New Delhi, p.498-508

Johnson, C.M. and Ulrich, A. 1959. Analytical methods for use in plant analysis. *Calif. agric. Expt Sta. Bull.* **766**:26-76

Jose, C.J. 1996. Refinement of *in vitro* propagation technique in pineapple var. Mauritius and mass multiplication of elite clones. M.Sc.(Hort.) thesis, Kerala Agricicultural University, Thrissur, p.25-45

KAU. 1987. *Research Report*, Kerala Agricultural University, Thrissur, p.27

KAU, 1996. *Package of Practices Recommendations.* Kerala Agricultural University, Thrissur, p.196

*Kwa, M. and Ganry, J. 1990. Agronomic use of banana *in vitro* plants. *Fruits*-Paris p.107-111

*Lacoeuilhe, J.J. 1991. Research on pineapple at IRFA. The use of variability. *Fruits-paris* **46**:Numero Special Ananas, 311-314

Marr, G.S. 1965. Select planting material very carefully for better pineapple. *Fmg S. Africa* **41**:21-29

Mathew, V., Lyla, K.R., Nayar, N.R. and Mathew, V. 1979. Estimation of genetic variability in pineapple for quantitative and qualitative traits. *Indian J. agric. Sci.* **49**:855-857

Mavelil, D.J. 1997. Physiology, growth pattern and flowering of tissue culture banana Musa (AAB) 'Nendran'. M.Sc. (Hort.) thesis, Kerala Agricultural University, Vellanikkara, Thrissur, p.111-125

*Mitchell, A.R. 1962. Plant development and yield in the pineapple as affected by size and type of planting material and time of planting and forcing. *Qd J. Agric. Anim. Sci.* **19**:453-66

Mitra, S.K., Roy, R. and Biswas, B. 1994. Effect of split application of NPK fertilizers on flowering, yield and fruit quality of pineapple. *Ann. agric. Res.*

15:92-94

Morales, E.A.M., Costa, R.A. and Anderson, O. 1977. Response of pineapple (*Ananas comosus* Merr.) growing in savanna soil of Brasilia to levels of N,P and K. *Proc. of the Florida state horti. soc.* **90**:273-275

Nagatomi, S., Degi, K. and Ikemiya, H. 1997. Development of polyploid induction and discrimination methods in pineapple. *Technical News-Institute of Radiation Breeding*. No.59, p.2

Natesh, B.B., Aravindakshan, M. and Valsalakumari, P.K. 1993. Effect of split application of fertilizers in banana *Musa*, AAB " Nendran" *S. Indian Hort.* **41**:67-73

*Navarro, H.T., Saldana, H.L. and Avila, D.U. 1989. Clonal selection of pineapple, *Ananas comosus* L. Merr., with resistance to 'marchitez roja' virus and characteristics of commercial value. *Revista chapingo* **13-16**:156-160

Nayar, N.K. and Lyla, K.R. 1981. Varietal variations on pollen size and fertility in pineapple (*Ananas comosus* [L.] Merr.) *Progressive Hort.* **13**:85-87

Nayar, N.K., Mathew, V. and Aravindakshan, M. 1981. Studies on varietal variations in pineapple (*Ananas comosus* [L.] Merr.) for various morphological and nutritive characters. *S. Indian Hort.* **29**:81-86

Obiefuna, J.C., Majumder, P.K. and Ucheagwu, A.C. 1987. Fertilizer rates for increased pineapple production in the tropical ferrallitic soils of south western Nigeria. *Fertil. Res.* **12**:99-105

Onaha, A., Hidekazu, I., and Nakasone, F. 1986. Studies on dry matter production of pineapple. Relationships between dry matter production and an establishing processor yield. *J. Japan Soc. Hort. Sci.* **54**(4):438-449

Panse, V.G. and Sukhatme, P.V. 1985. *Statistical Methods for Agricultural Workers.* Indian Council of Agricultural Research, New Delhi, p.97-164

Pantastico, B. 1975. *Post harvest physiology, handling and utilisation of tropical and sub tropical fruits and vegetables.* West Port Connectient. AVI Publishing Co. Inc. p.491

Prabhakaran, P.V. and Balakrishnan, S. 1978. Relationship of some quantiative traits with the yield of pineapple. *Agric. Res. J. Kerala* **16**:133-137

Pradeep, K.P., Zachariah, G., Estellita, S. and Suma, A. 1992. Field performance of banana tissue culture plants of variety Nendran (*Musa* AAB). *S. Indian Hort.* **40**:1-4

*Py, C. and Lossois, P. 1962. Forecasting pineapple yields. Correlation studies part 2. *Fruits d' Outre Mer.* **17**:75-87

Radha, T. 1989. Growth analysis in Kew pineapple under varying levels of plant densities and applied nitrogen. Ph.D (Hort.) thesis, University of Agricultural Sciences, Bangalore, p.120-139

Radha, T and Aravindakshan, K. 1998. Field performance of tissue culture vis-a-vis sucker planted pineappple var. Kew. *Proc. of National Seminar on Plant Bio technology for Sustainable Hill Agriculture held at DARI, Pithorgarh,* p.24

Rao, M.H., Subramanian, T.R., Murthy, H.K.S., Singh, H.P., Dan, H.C. and Ganapathy, K.M. 1977. Leaf nitrogen status as influenced by varying levels of nitrogen application and its relationship with yield in 'Kew' pineapple. *Scientia Horticulturae* 7:137-142

*Robinson, J.C. 1989. Vegetative morphology and phenology of tissue cultured banana plants. *Info. Bull. Citrus and Subtropical Fruit Res. Institute,* South Africa **204**:3

Robinson, J.C. 1990. A field comparison of conventional suckers with *in vitro* derived banana planting material in the first crop cycle. *Acta Horticulturae* **275**:181-187

Robinson, J.C. 1992. Advantages of tissue cultured banana in the plant crop confirmed. *Banana Newsl.* p.14-15

*Robinson, J.C. and Fraser, C. 1992. Comparison of tissue culture with sucker planting material of Grand Nain banana at monthly planting dates. *Inlingtins Bull.* **224**:8-9

Sheela, V.L. 1995. Growth pattern, flowering and yield potential of tissue culture plants of *Musa* (AAB) 'Nendran' and standardisation of fertilizer schedule. Ph.D.(Hort.) thesis, Kerala Agricultural University, Thrissur, p.190

Singh, H.P., Das, H.C., Ganapathy, K.M. and Subramanian, T.R. 1977. Nitrogen requirement of pineapple under irrigated and rainfed conditions. *Indian J. Hort.* **34**:377-384

Singh, R., Singh, H.P. and Iyer, C.P.A. 1976. Occurrence of sectorial chimera and somatic mutants in Kew pineapple (*Ananas comosus*). *Indian J. Hort.* **33**:44-46

*Su, N.R. 1958. Influence of soil fertility and plant nutrition on the yield and properties of pineapple fruits. *J. Agric. Ass. China* **13**:57-65

Subramanian, T.R., Murthy, H.K.S., Chadha, K.L. and Melanta, K.R. 1977. Leaf N, P, K status and yield as influenced by sources of nitrogen and potassium and their interrelationship in pineapple. *Indian J. Hort.* **34**:335-341

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

Tan, K.M. and Wee, Y.C. 1973. Influence of size of pineapple slips on plant growth, fruit weight and quality in graded and mixed plantings. *Trop. Agric.* **50**:130-142

*Tay, T.H. 1975. Effects of nitrogen and potassium on the growth, mean fruit

weight and fruit quality of pineapple. *MARDI Res. Bull.* **3**:1-14

Tay, T.H. and Tan, K.M. 1971. Leaf area and growth studies of pineapple . *Malays pineapple* **1:** 11-21

*Verawudh, J., Rojanaridpiched, C. and Cheopan, W. 1988. The effect of nitrogen levels on growth, yield and fruit weight to plant weight ratio of pineapple. *Kasetsart J. Natural Sci.* **22**:177-184

Wakasa, K. 1979. Variation in the plants differentiated from the tissue culture of pineapple. *Japanese J. Breed. Ikushugaku Zasshi* **29**:13-22

Watson, D.J. 1952. The physiological basis of variation in yield. *Adv. Agron.* **4**:101-145

*Wee, Y.C. 1974. World Crops. **26**:64-67

Wee, Y.C., Tay, T.H. and Chiew, K.S. 1979. Correlation studies of leaf characters with fruit size in the Singapore Spanish pineapple. *Malaysian Agric. J.* **52**:39-42

Whitehead, F.H. and Mycersough, P.J. 1962. Growth analysis of plants. Ratio of mean relative growth rate to mean growth rate of increase of leaf area. *New Phytologist* **61**:314-21

Wu, Y.C. and Su, N.R. 1965. Response of pineapple growing on a latosol to phosphorus, magnesium and variously applied potassium. *J. Agric. Ass. China* **49**:48-64

*Zamora, A.B., Damasco, O.P., Estano, E.S., Barba, R.C. and Patena, L.F. 1989. Growth and yield of micropropagated and sucker-derived banana plants (*Musa* spp. cvs. Lacatan, Bungulan and Saba). *Philipp. Agriest* **72**:458-465.

* Originals not seen.

Appendix

APPENDIX 1

Meteorological data during the cropping period from Ocober 1998 - October - 1999

Month	Temperature ^{0} C		Rainfall	Rainy	Relative humidity %		Mean	Wind speed
	Maximum	Minimum	(mm)	days	Morning	Evening	sunshine (hrs)	km/h
October-98	28.0	22.8	452.8	18.0	94.0	76.0	4.8	1.7
November-98	31.5	23.1	109.4	9.0	92.0	64.0	7.2	1.8
December-98	30.1	22.9	33.0	4.0	79.0	58.0	6.6	5.7
January-99	32.4	21.5	0.0	0.0	76.0	40.0	9.3	-
February-99	34.5	23.3	22.8	1.0	77.0	35.0	9.1	-
March-99	35.5	24.5	0.0	0.0	88.0	48.0	8.8	-
April-99	33.4	25.6	39.0	4.0	88.0	58.0	10.3	-
May-99	30.7	24.7	430.5	18.0	92.0	72.0	4.9	-
June-99	29.4	23.0	500.2	28.0	94.0	75.0	5.0	-
July-99	28.4	23.0	823.3	28.0	96.0	82.0	2.4	-
August-99	29.8	22.9	260.1	12.0	94.0	73.0	5.5	-
September-99	31.6	23.4	28.4	3.0	89.0	63.0	7.1	2.1
October-99	30.5	23.2	506.2	15.0	94.0	75.0	4.8	1.6

EVALUATION OF *IN VITRO* MULTIPLIED ACCESSIONS OF PINEAPPLE (*Ananas comosus* [L.] Merr.) CV. MAURITIUS

By

S. PATTABI RAMAN

ABSTRACT OF THE THESIS

Submitted in partial fulfilment of the requirement for the degree of

Master of Science in Horticulture

Faculty of Agriculture

Kerala Agricultural University

Department of Pomology and Floriculture

COLLEGE OF HORTICULTURE

VELLANIKKARA, THRISSUR - 680 656

KERALA, INDIA

1999

ABSTRACT

Investigations on "Evaluation of *in vitro* multiplied accessions of pineapple (*Ananas comosus* [L.] Merr.) cv. Mauritius" were carried out in the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara during 1997-1999. The major objective of the study was to evaluate the field performance of tissue culture plants of elite accessions against the tissue culture plants of unselected bulk and conventional suckers under varied fertilizer doses, to ascertain the superiority of the former over the later two and to isolate the elite accessions.

During the early stage of crop growth, sucker derived plants recorded higher values for almost all the vegetative characters studied, whereas from six months after planting tissue culture plants of elite accessions were on par with sucker and showed significant superiority over the unselected bulk.

Total dry matter production as well as dry matter partitioning were higher for tissue culture plants of elite accessions than tissue culture plants of unselected bulk. The former also showed early flowering with longer flowering phase than the later. The fruit and yield parameters also showed superiority of tissue culture plants of elite accessions over that of unselected bulk and the values were on par with suckers. Among the elite accessions, TK 3 (T_1) and KT 5 (T_2) performed well and recorded the maximum estimated yield (77.0 tonnes), whereas tissue culture plants of unselected bulk recorded an estimated yield of 49 tonnes only. There was not much variation among the treatments in all the quality parameters studied, except for TSS:Acid ratio

All the tissue culture plants including unselected bulk produced more number of suckers and slips than sucker derived plants.

The salient outcome of the present investigation with respect to two fertilizer doses was that, M_2 showed significant superiority and recorded a lesser crop duration of one month than M_1 in all TC plants when compared to that of suckers.

The results of the present investigation undoubtedly proved the superiority of elite accessions over that of unselected bulk, indicating the importance of clonal selection for crop improvement. Results also proved the requirement of higher dose of fertilizers and split application of the same during early vegetative stage to boost up the growth of plants and to reduce the total duration of the crop. Among the elite accessions KT 3 and TK 2 performed well than others and hence can be recommended for further evaluation and yield trials.