EVALUATION OF PAPAYA
(Carica papaya.L)
VARIETIES FOR DESSERT PURPOSE

BY
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DECLARATION

I here by declare that this thesis entitled "**Evaluation of Papaya varieties (*Carica papaya.L*) for dessert purpose**" 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, associateship, fellowship or other similar titles of any other university or society.

Lakshmi Unnithan

Vellayani
18-11-2000

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CERTIFICATE

Certified that this thesis entitled **"Evaluation of Papaya varieties (*Carica papaya* L.) for dessert purpose"** is a bonafide record of research work done independently by **Ms.Lakshmi Unnithan** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship, or associateship to her.

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LAKSHMI UNNITHAN

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INTRODUCTION

INTRODUCTION

India is uniquely placed to produce horticultural crops and has a wide range of agroclimatic conditions. Our country occupies a prominent position among the horticulturally rich countries of the world due abounds in a variety of fruit crops which could cater to our needs of taste.

Papaya (*Carica papaya* L.) is an important fruit crop of our country. The major papaya growing areas in India are Kerala, Tamilnadu, Karnataka, Maharashtra and Bihar India is rated as the largest producer of papaya in the world since it accounts for about 7.03 per cent of the world production . Within the country papaya contributes for 3.09 per cent of the total fruit production (FAO,1991).

Papaya is considered as one of the most important and nutritious fruits that has gained commercial importance over the years because of its varied uses. It is a wholesome fruit, being a good source of carbohydrates, minerals, vitamin A, vitamin C, pectin and alkaloids. Apart from being highly nutritious, papaya yield latex which is the source for the proteolytic enzyme papain. Papain is widely used in pharmaceutical preparations and has variety of other industrial uses.

Although papaya is a common component of the homestead farming systems in Kerala,it needs further popularisation . It is the ideal fruit for the processing sector due to year round production and availability of fruits at cheaper rates . Unfortunately there is much wastage of this nutritious fruit in our country . The fresh papaya fruit does not fetch good price as other table fruits . It has not caught the fancy of our people as much as it deserves,mainly because the odour of papaya is not appealing (Malathi *et al.* 1986) .

There are not many distinctly superior cultivars of papaya barring a few well-known ones like Coorg Honeydew, Coimbatore varieties, Washington and of late Pusa varieties. The

characteristics, composition and adaptability of each variety vary widely. The varieties ideal for the limited space in the homesteads of Kerala should be dwarf, bearing at lower height and producing large number of medium sized fruits having good organoleptic qualities. Tolerance to pests and diseases will be an added advantage.

With the above mentioned objectives, an experiment was laid out to evaluate the performance of different papaya varieties to assess their suitability for homestead cultivation and for dessert purposes. Assessment of the relationship between biometric characters with yield potentiality is also aimed in the present experiment to fix selection criteria while screening papaya germplasm for higher productivity.

MATERIALS AND METHODS

MATERIALS AND METHODS

The present investigations on "Evaluation of papaya (*Carica papaya* L.) varieties for dessert purpose " was conducted at the Department of Horticulture,College of Agriculture,Vellayani Thiruvananthapuram during 1997 – 1999. The location of the experiment is situated at 8 degree 5 minute North latitude and 77 degree 1 minute East longitude at an altitude of 29 metre above mean sea level. Predominant soil type of the experimental site is red loam belonging to Vellayani series, texturally classified as sandy clay loam.

The experiment was laid out in randomised block design with three replications and 12 varieties of papaya as the treatments. Every treatment in each replication contained six observational plants. The papaya varieties evaluated were given in Table 1

Table 1

Treatment	Varieties
T1	CO-2
T2	CO-3
T3	CO-4
T4	CO-5
T5	Coorg Honeydew
T6	Sunrise Solo
T7	9-1-D
T8	Thailand
T9	Tainung
T10	Pusa Dwarf
T11	Pusa Nanha
T12	Washington

Seeds of the parent material were obtained from germplasm collections maintained at the universities such as IIHR,Fruit Research Station,Chettali and TNAU.The plants were raised and grown as per package of practice reccomendation.

The following observations were recorded to evaluate the performance of the treatment plants.

3.1 Biometric characters

The biometric characters were recorded every month after transplanting in the main field . Of these the mean values for the critical growth periods, that is early vegetative growth stage (one month after transplanting),flower initiation stage (three months after transplanting), and yield stabilisation stage (six months after transplanting) were statistically analysed for assessing the performance of the varieties.

3.1.1 Height of plants

Height of plants was measured from soil level to the tip of growing plant and expressed in centimetres.

3.1.2 Girth of plants

Girth of plants were recorded at 10 centimetres above ground level in each plant and expressed in centimeters and average worked out.

3.1.3 Number of leaves

The number of fully developed leaves were recorded and average worked out.

3.1.4 Time of first flowering

The number of days from sowing till the opening of the first female flowers was recorded and average worked out.

3.1.5 Height at which first flower appears

The height at which the first flower appears was recorded in centimetres from the ground level and average worked out.

3.1.6 Time for harvest

Time taken for harvest was recorded as the number of days taken from sowing to the harvest of first formed fruit in each plant.

3.1.7 Number of flowers per cluster

One plant in each variety was marked in every replication. The total number of flowers in each cluster was recorded and the average values were worked out.

3.2 Yield characters

3.2.1 Percentage of fruit set

Percentage of fruit set was calculated by recording the number of female and hermaphrodite flowers and the average values were worked out.

$$\text{Percentage of fruit set} = \frac{\text{Number of fruits set}}{\text{Total number of flowers}} \times 100$$

3.2.2 Number of fruits per plant

The total number of fruits was counted from each plant and the average worked out for each replication.

3.2.3 Fruit weight

Four fruits selected from of each observational plants were taken and the average fruit weight was worked out and expressed in gram

3.2.4 Fruit length and girth

fruit and mean length was recorded in centimeters. Girth at the middle of the fruits was measured and the average was recorded in centimeters.

3.2.5 Fruit volume

A container filled with water was taken and placed inside another container. Then the fruits selected were taken individually and immersed without forcing. The volume of water displaced by the fruit was measured with the help of a measuring cylinder and the value was expressed in cubic centimeters.

3.2.6 Pulp percentage

Weight of the fruit was recorded before and after peeling and removing seeds.

$$\text{Pulp percentage} = \frac{\text{Weight of pulp(g)}}{\text{Weight of fruit(g)}} \times 100$$

3.2.7 Cavity index

Fruits were cut longitudinally and then the seeds were removed. Water was poured into both the halves so that it filled the cavity without spilling. Then the water was poured into the measuring cylinder and the volume was recorded. The fruit cavity index was calculated using the following formula:

$$\text{Fruit cavity index} = \frac{\text{Volume of fruit cavity (cc)}}{\text{Volume of fruit (cc)}} \times 100$$

3.2.8 Seed content

The net weight of seeds in individual fruits were taken and the average values were worked out and expressed in grams.

3.3 Quality Characters

3.3.1 Total soluble solids (TSS)

Total soluble solids of the pulp was measured using Erma hand refractometer(pocket type) and expressed in percentage.

3.3.2 Acidity

Titrable acidity of the fruit pulp was estimated following the method proposed by Ranganna (1977) and expressed as per cent anhydrous citric acid .

3.3.3 Ascorbic acid content

The estimation of ascorbic acid was done as per the method described by Sadasivam *et al.*(1992) and expressed as mg per 100 gram of pulp.

3.4 Total carotenoid

The estimation of total carotenoids was done as per the method described by Jensen (1978) and expressed in percentage.

3.3.5 Total sugars

The total sugars on fresh weight basis was estimated as per the method described by Ranganna (1977) and expressed in percentage.

3.3.6 Reducing sugars

The estimation of reducing sugars was also done as per the method described by Ranganna (1977) and expressed in percentage on fresh weight basis.

3.3.7 Non reducing sugars

The non reducing sugar content was arrived by deducting the value for reducing sugars from the value of total sugars (Ranganna,1977).

3.3.8 Fruit shape

Fruit shape was described based on visual appearance of the well matured whole fruit.

3.3.9 Colour of peel and pulp

Colour of peel was observed after the whole fruit surface changed to characteristic colour from green on ripening. Ripe fruits were cut open and the pulp colour was recorded.

3.3.10 Firmness of pulp

Firmness of the fully ripe fruit was assessed with the help of a panel of judges for organoleptic evaluation. Fully ripe fruits were utilised for the observation.

3.3.11 Organoleptic qualities

The panel members for sensory analysis at the laboratory level were selected from a group of teachers and students. Ten judges were selected through triangle test as suggested by Mahony (1985). The score chart is furnished in Appendix - 2.

The sensory analysis of panel members were done using the scoring method and scoring was done as suggested by Swaminathan (1974). The major quality attributes included in the score card were appearance, colour, texture, flavour and taste (Appendix - 1). Scores for overall acceptability was obtained by determining the average mean scores for each character.

3.4 Incidence of pests and diseases

3.4.1 Pests

The plants were regularly observed for incidence of pests like aphids, whiteflies etc.

3.4.2 Diseases

Incidence of diseases like damping off, collar rot, anthracnose, leaf curl and powdery mildew were observed regularly. Intensity of incidence of mosaic, ring spot, shoot string diseases were observed and was scored as per the method suggested by Lokhande and Moghe(1992).

3.5 Weather parameters

Information regarding the weather parameters such as maximum and minimum temperature (degree celsius), day length (hours), relative humidity (percentage) and rainfall(mm) were taken from the Metereology Department, College of Agriculture, Vellayani. The weather data are presented in Appendix -3.

3.6 Estimation of Variability components, heritabiity and genetic advance

3.6.1 Estimation of variability components

Analysis of variance (Anova) was conducted to test whether there was any significant difference among the different varieties with respect to the various characters under study (Panse and Sukhatme,1978).The components of variance were estimated as follows.

Environmental variance, $V(e) = MSE$

Genotype variance, $V(g) = (MST - MSE)/r$

Phenotypic variance, $V(p) = MSE + (MST-MSE)/r$

Where MST and MSE are the mean squares for treatment and error respec tively, from Anova.

Genotype coefficient of variation, $GCV = \frac{\sqrt{V(g)}}{\overline{X}} \times 100$

$$\text{Phenotypic coefficient of variation, PCV} = \frac{\sqrt{V(p)}}{\overline{X}} \times 100$$

$\overline{X}$ = Mean of the character

3.6.2 Heritability

Heritability in broad sense was estimated as by the method proposed by Lush (1949) and Allard (1960) as the fraction of genotype variance to the phenotypic variance, expressed as percentage.

$$h^2 = \frac{V(g)}{V(p)} \times 100$$

Where h^2 = Heritability expressed in percentage

V(p) = Phenotypic variance, V(g) = Genotypic variance

3.6.3 Genetic advance

Genetic advance was calculated according to Singh and Choudhary (1985).

$$\text{Genetic advance as percent of mean, G.A} = K.\, h^2.\, \frac{\sqrt{V(p)}}{\overline{X}} \times 100$$

Where,

G A = Genetic advance

h^2 = Heritiability in the broad sense

V(p) = Phenotypic variance

K = Selection differential expressed in phenotypic standard deviation=2.06 in the case of 5% selection of large samples

3.7 Selection Index

Selection indices were worked out through the application of discriminent function proposed by Smith (1936) With n characters, the selection index was defined as

$I = b_1x_1 + b_2x_2 = \ldots\ldots\ldots b_nx_n$

where $b_1, b_2 \ldots\ldots b_n$ are determined such that the correlation between the genotype worth and phenotypic performance was maximum.Based on this function index values were obtained for all the twelve treatments . Identification of superior genotypes was made based on this index.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Papaya is one of the important fruit crops of the tropics. The dietary and medicinal value of papaya is well accepted. Apart from being a table fruit, it is used in processing industry also. Papain, the proteolytic enzyme is a byproduct, which finds extensive application in leather and pharmaceutical industry.

Despite the well-established importance, papaya is not given the place of importance it deserves in Kerala. The ideal papaya variety for Kerala homesteads should be dwarf or medium tall, producing medium sized fruits of good edible qualities and resistant or tolerant to pests and diseases. The current experiment was laid out for screening the improved varieties of papaya for Kerala homesteads for dessert purpose. The main criteria for screening are biometric characters, yield, quality aspects and tolerance to pests and diseases. The review is presented under the following aspects:

Biometric characters

Yield characters

Quality characters

Incidence of pests and diseases

Association of vegetative characters with yield

Estimation of Variability components,Heritability and Genetic advance

2.1 Biometric characters

Effect of non-heritable factors such as planting season and environmental conditions on fruiting height of papaya was reported by Gandhi (1945) in India and by Agnew (1941) in Queensland. Plants set out early in the fall fruit lower on the stem than those planted in the spring.

According to Nakasone and Storey (1955) the seasonal variations have effect on

papayas grown in Hawaii. Rao *et al.* (1958) reported the height of commencement of bearing of fruits on the stem to be two feet six inches. Aiyappa and Nanjappa (1959) reported that the variety Coorg Honeydew attains a height of 25 to 30 feet.

Seemanthani (1968) studied six papaya selections and recorded the height of plants at which the first flower buds were formed. The data showed that the staminate plants have flowered at a lesser height than the pistillate plants in the papaya selections except in the case of Selection- 4. The maximum height noted in the pistillate plants ranged from 102 to 130 cm as against only 78 to 113 cm noted in the staminate plants. Pistillate plants registered an increase of 4.5 – 12.5 cm in the mean height at first flowering over the staminate plants. Hamilton and Ito (1968) noted that the variety Sunrise Solo attained a height of 3 feet in 9 months after transplanting. Singh and Sirohi (1977) reported 145cm height in cultivar Washington and 246cm height in cultivar Honeydew under Nainital condition of Uttar Pradesh. Ram (1983) reported the average height of the Pusa Nanha as 106cm. Bose and Mitra (1985) reported the plant heights of Washington, CO-2, CO-4, Coorg Honeydew and Pusa Dwarf. The heights were 145cm, 120cm, 250-300cm, 127cm and 130cm respectively. Ghanta and Mandal (1992) recorded 193cm height under West Bengal conditions for cultivar CO-2.

Singh and Sharma (1994) recorded plant height and growth characters. Pusa Dwarf (140.667cm) and CO-2 (155.667cm) were identified dwarfest compared to other varieties. Highest plant height was recorded for Honeydew (253.33cm). Pusa Nanha, Washington and Coorg Honeydew had a height of 170cm, 185.67cm, 204.67cm respectively. Dash *et al.* (1998) reported the plant height in varieties namely CO-2, CO-3, CO-5, Washington and Honeydew. There were significant differences among these characters. The plant height was 210.9cm, 116.1cm, 235.6cm, 220.2cm and 204.5cm respectively.

Subramanyam and Iyer (1981) reported the number of days taken for first flowering

in papaya varieties to range from 115.40 to 146.93 days. Selvaraj *et al.* (1982) observed that depending upon the variety the papaya fruits took 145–165 days to attain eating stage from the date of flowering. The varieties studied were Coorg Honeydew, Sunrise Solo, Thailand and Washington. The first two varieties took 145 to150days, while Thailand took 150-155 days, and Washington took 160-165 days to reach edible stage.

Ram (1982) reported that Pusa Dwarf starts flowering at a height of 40cm.It grows to a height of 130cm.Prasad (1982) reported that the variety Pusa Dwarf bear fruits at a height of 25-35 cm from ground level. Veeranah *et al.* (1985) reported that papaya variety CO-5 is medium tall and it flowers at 90cm height. Singh (1990) reported that Pusa Nanha starts flowering at 40cm height from ground level. Dash *et al.* (1998) reported the flowering height in varieties namely CO-2, CO-3, CO-5, Washington, and Honeydew to be 171cm, 108.8cm, 142.3cm, 141.1cm and 128.8cm respectively.

2.2 Yield characters

Selvaraj *et al.* (1982) recorded the fruitset data in an experiment conducted at IIHR. The varieties studied were Coorg Honeydew, Sunrise Solo, Thailand and Washington. The fruitsets was 32.3,57.1,53.3 and 50.8 percent respectively.

Ram (1981) reported the fruits per plant, in popular varieties of papaya namely Washington, CO-2 and Coorg Honeydew.The number of fruits per plant was 43,39 and 10 respectively. Bose and Mitra (1985) observed that the number of fruits per plant in varieties namely Washington, CO-2, CO-3,C0-4, Solo, Coorg Honeydew and Pusa Dwarf to be11, 30-40, 35-40, 40, 50-60, 20 and 40 respectively. Singh and Sharma (1994) evaluated papaya varieties Pusa Dwarf, Pusa Nanha, CO-2, Washington, Coorg Honeydew and CO-5 under Tripura conditions, for growth and yield. They recorded the number of fruits per plant to be 27.83,16.733,21.423,7.65,21.333,15.993 respectively.

Rao et al. (1958) reported the weight of an average papaya fruit to be 1–1.5 kg. Desikan (1972) studied the fruit characters of three papaya varieties (CO-1, Coorg

and 1.24kg respectively. Shah and Shanmugavelu (1975) reported that the hybrid of CO-1 x Coorg Honeydew recorded the greatest weight, diameter and circumference among the parents and hybrids evaluated. Similar increase in fruit size was noticed in the hybrid CO-1 x Washington over its parents. Ram (1981) observed that the average fruit weight of papaya varieties namely Washington, CO-2 and Coorg Honeydew was 395g, 692g and 400g respectively. Singh (1990) reported the fruit weight of Washington variety to range between 1.0-1.5kg,Coorg Honeydew to range between 1.25-2.5kg,CO-2 to range between 1.0-1.5kg and Sunrise Solo to range between 425-620g. Singh and Sharma (1994) evaluated papaya varieties namely Pusa Dwarf, Pusa Nanha, CO-2, Washington, Coorg Honeydew and CO-5 for growth and yield. They observed the fruit weight to be 1593.3g, 1830g, 1991.667g, 1725g, 1450g and 1283.333g respectively.

Desikan (1972) studied the lengths and girths of fruits of papaya varieties namely CO-1, Coorg Honeydew and Washington. The mean length was 17.50cm, 26.57cm and18.70cm respectively and the mean girths was 51.76cm, 54.20cm and 39.20 cm respectively. Wagh *et al.* (1992) assessed varieties of papaya namely CO-2,CO-3, CO-4, and CO-5, Sunrise Solo, Washington, Thailand, Honeydew and Pusa Dwarf for fruit length and girth. The length of fruits of CO-2, CO-3, CO-4, CO-5, Washington, Thailand and Pusa Dwarf ranged from 16.98-21.70cm.Sunrise Solo had a length of 9.83cm. The girth of fruits was 41.76cm, 33.66cm, 39.10cm, 39.789cm, 13.50cm, 36.82cm, 24.60cm, 40.55cm and 40.27cm respectively. Singh and Sharma(1994)recorded the fruit characters of varieties namely Pusa Dwarf, Pusa Nanha,CO-2,Washington,Coorg Honeydew and Co-5. The fruit length of the varieties varied from 16.057-20.457cm and width ranged from 11.547-15.420cm.

According to Hofmeyr (1936), small fruits have a higher unit volume weight than larger fruits due to their relatively smaller seed cavities. Shah and Shanmugavelu (1975) reported that the hybrid of CO-1 x Coorg Honeydew recorded the greatest volume among the parents and hybrids. taken were Coorg Honeydew,Sunrise Solo,Thailand and Washington. Selvaraj *et al.*(1982) reported the pulp percentage of papaya varieties Coorg

Honeydew, Sunrise Solo, Thailand and Washington. The pulp percentages was in the range of 89.4 to 83.4 percent.

With regard to fruit size and pollination in papaya, Agnew (1941) observed that the amount of seed indicates the degree of effective pollination and is correlated with both size and shape of the fruit.

Ram (1981)recorded the yield per plant of papaya varieties namely Washington,CO-2 and Coorg Honeydew. The yield was 17kg, 27kg and 4kg respectively. Wagh *et al.*(1992) assessed varieties of papaya for yield. The yield was 22.461, 4.883, 11.844, 8.541, 5.952, 21.712,7.812,7.765 and7.35kg respectively for CO-2, CO-3, CO-4, CO-5,Sunrise Solo, Washington, Thailand, Honeydew, and Pusa Dwarf. Singh and Sharma (1994) reported the fruit yield of varieties namely Pusa Dwarf, Pusa Nanha, CO-2,Washington,Coorg Honeydew and CO-5.The average fruit yield per plant was recorded as 44.43kg, 30.543kg, 42.74kg, 13.947kg, 30.903kg and 20.637kg respectively.

2. 3 Quality Characters

2.3.1 Total Soluble Solids (TSS)

Hamilton and Ito (1968) recorded the TSS of the variety Sunrise Solo to be in between 12-17 per cent. Shah and Shanmugavelu (1975) reported that the variety Coorg Honeydew recorded the highest TSS (12 per cent) followed by Pink Flesh Sweet (11.6 per cent) among the varieties studied.

Singh and Sirohi (1977) also reported TSS variation between different papaya varieties . They observed the TSS of Washington to be 10.1 per cent and Coorg Honey dew to be 9.8 per cent. Mehta and Tomar (1980) reported the TSS of the papaya fruits to be 10 percent in general. They also observed that the variety Coorg Honeydew had the highest TSS (12 per cent) followed by Pink Flesh Sweet (11.6 per cent) among the different varieties evaluated. Pal *et al.* (1980) recorded the TSS of some varieties of papaya fruits ripened on and off the plant The varieties were Coorg Honeydew, Sunrise Solo, Thailand

and Washington. The TSS varied from 11.5-11.6 per cent in Coorg Honeydew, 10.7-12.0 per cent in Sunrise, 9.8-10 per cent in Thailand and 11.8-12.4 per cent in Washington. Ram (1981) reported the TSS of seven popular varieties of papaya .It was seen that the TSS ranged from 6.00-13 per cent among the varieties observed. Bose and Mitra (1985) reported the TSS of Washington to be 10.1 per cent, CO-2 to be in between 11.5 per cent to 12.5 per cent, CO-3 to be in between 13.8 per cent-14.6 per cent, CO-4 to be in between 13.2 per cent-13.5 per cent, Sunrise Solo to be in between 13.5 per cent-15 per cent, Coorg Honeydew to be 9.8 per cent and Pusa Dwarf to be 6.5 per cent. Veeranah *et al.* (1985) reported that T.S.S of CO-5 variety to be in the range of 12-13 per cent.

Singh(1990) reported the TSS of Pusa Nanha to be in between 6.5-8 per cent. Singh and Sharma(1994) reported the TSS to be 8.56 per cent in Coorg Honeydew and 9.63 per cent in Washington .Auxicilia and Sathiamoorthy (1996) evaluated 20 gynodioceous lines of papaya. The TSS of these varieties in general varied from 9.12-14.50 per cent.

2.3.2 Acidity

Papaya is an almost an acidless fruit; the variation in what all little acidity that is present is of no significance with respect to maturity standards, (Akamine and Goo, 1971). Pal *et al.* (1980) noted that total titrable acidity was considerably low in papaya fruits .The open pollinated variety Solo Small had maximum acidity (0.11g citric acid /100g pulp) and Washington had minimum acidity (0.058 g). Mehta and Tomar (1980) reported the acidity of papaya to be 0.15 per cent. Pal *et al.* (1980) studied the acidity of papaya fruits ripened on and off the plants .The acidity ranged from 0.06 per cent-0.07 per cent in Coorg Honeydew, 0.04 -0.05 per cent in Sunrise Solo, 0.04 per cent -0.05 per cent in Thailand and 0.05 -0.06 per cent in Washington. Selvaraj *et al.* (1982) reported the total titrable acidity value to be very low (0.05 per cent) in papaya variety Thailand. Auxicilia and Sathiamoorthy (1996) reported that the titrable acidity of 20 lines of gynodioecious papayas to be negligible and ranged from (0.10 -0.2 per cent).

2.3.3 Ascorbic acid content

Chittiraichelvan and Shanmugavelu (1977) reported the ascorbic acid content of CO-2 papaya. It did not show any regular pattern but fluctuation .On the 120th day the ascorbic acid content was maximum (3.0 mg/g). Janabaigiri *et al.* (1980) noticed an upward trend for Vitamin C content from half-ripe to full ripe stage in five papaya varieties namely CO-1, CO-2, Solo, Washington and Coorg Honeydew. The variety Solo had the highest Vitamin C content in all ripening stages (half ripe- 0.725 +/- 0.0086mg/g, full ripe- 1.310+/ -0.0133mg/g, over ripe -1.070+/- 0.2880mg/g) and it was very much superior in Vitamin C content of Honeydew and Washington and slightly superior to CO-1. Varieties CO-2 and CO-1 came next to Solo in Vitamin C content (half ripe- 0.994+/- 0.0206mg/g, full ripe- 1.660+/-0.4113mg/g, over ripe-1.064+/-0.0873mg/g).

Pal *et al.* (1980) reported the Ascorbic acid content of five varieties of papaya viz., Coorg Honeydew, Sunrise Solo, Thailand and Washington. In Coorg Honeydew, the Vitamin C content ranged from 66.6 to 64.6 mg/100g,in Sunrise Solo from 46..3 to 75.5 mg/100g,in Thailand from 46.6 to 74.1 mg/100g and in Washington from 78.1 to 75.3 mg/ 100g respectively in fruits ripened on and off the plant. Mehta and Tomar (1980) reported the Ascorbic acid content to be 46mg/100g in papaya fruits in general. Selvaraj and Pal (1982) noticed considerable increase in the Ascorbic acid content as the fruit ripened, in the variety Thailand. The Ascorbic acid content was 46.6mg/100g. Auxicilia and Sathiamoorthy (1996) evaluated the Vitamin C content of 20 gynodioecious lines of papayas. They showed wide variation ranging from 27.65-65.57mg/100g.

2.3.4 Total Carotenoid content

Chittiraichelvan and Shanmugavelu (1979) reported that in CO-2 papaya, carotenoids were found to occur in the flesh only on the 120th day and increased remarkably at the eating ripe stage. On the 120th day it was found to be 1.5mg/100g and on the 140th day it was found to be nearly 5.0 mg/100g. Janabai giri et al. (1980) observed that there was a gradual increase in carotenoid content from half-ripe to full ripe stage in all varieties

observed namely CO-2, Solo, Washington and Honeydew. In CO-2, at full ripe stage the carotenoid content ranged from 1.8933+/- 0.2376mg/g in Washington from 1.0133+/- 0.4343mg/g and in Honeydew from 0.9657+/-0.0106mg/g. Auxicilia and Sathiamoorthy (1996) observed the total carotenoid content of twenty lines of gynodioecious papayas ranged from 3.35-7.67mg/100g.

2.3.5 Total Sugars

Papaya being a non starchy fruit, the formation of sugars in fruits after harvest may be from latex break down products and the pectic substances. As the ripening process sets in, there will be a rapid synthesis of sugars from the precursors such as starch, pectin, hemicellulose and organic acids already present in the fruit tissues. This change is largely dependent upon conditions of storage such as temperature, time and the physical status of the fruit (Jones and Kubota, 1940).

Desikan (1972) recorded the sugar content of the papaya varieties Washington and Coorg Honeydew and their crosses. The total sugar content of Washington was 9.81 per cent and Coorg Honeydew was 10.14 per cent. Chittiraichelvan and Shanmugavelu (1979) noticed that as the CO-2 fruit ripened, the total sugar content showed a steady upward trend till 60 days. Thereafter there was a slight increase until 135 days. At the eating ripe stage the total sugar content reached its peak spectacularly.

According to Harvey and Chan (1979) in papaya, the sugar content increased slowly during the first 110 days of fruit development to 3.4mg/100g, then rapidly to a peak of 9.8mg/100g about 135 days after anthesis. Mehta and Tomar (1980) reported the sugar content of the papaya fruits to be 8.09 percent. Selvaraj *et al.* (1982) recorded the sugar content of four cultivars of papaya that showed little variation until 110 to 130 days of fruit growth and increased two or five fold thereafter. Selvaraj and Pal (1982) observed that the total sugars increased progressively from anthesis upto 130 days and thereafter the increase was at a higher rate till the ripening of fruits of variety Thailand. They also found an exactly reverse trend wherein the predominant sugars before the harvest were glucose and

fructose, but after the initiation of ripening, sucrose dominated by 2-3 folds over the reducing sugars. The total sugar content recorded was 8.43 percent. Auxicilia and Sathiamoorthy (1996) reported the total sugar content of twenty gynodioecious lines of papaya to range from 7.86 to 12.75 per cent.

2.3.6 Reducing and Non-Reducing Sugar content

Mehta and Tomar (1980) reported the reducing sugar content of papaya varieties to be 8.0 per cent in general. In CO-2 papaya, Chittiraichelvan *et al.* (1977) observed the predominance of glucose and fructose among ripe fruits. Among the reducing sugars, fructose overwhelmed glucose content by nearly two folds. The contents of glucose, fructose as well as sucrose were registered alike during the ripening process.

Auxicilia and Sathiamoorthy (1996) recorded the reducing and non-reducing sugar content of twenty gynodioeci ous lines of papaya. The reducing sugar content ranged from 5.30 per cent to 11.79 per cent and non- reducing sugar content ranged from 0.18 per cent to 1.38 per cent.

2.3.7 Fruit Shape

When grown under similar agro ecological conditions, the weight, volume and shape of papaya fruits are found not to vary much among the fruits of a specific variety. Hofmeyr (1936) made some crosses using two different female parents and one male plant and studied the progenies for the of fruit shape. In one cross, the fruit shape was oblong and in the other cross it was round. He also reported that in papaya, the shape of the fruit is likely to be linked with sex. All hermaphrodite plants produce usually long shaped fruits while pistillate plants produce round or oblong shaped fruits.

Storey (1937) while studying the primary types of papaya flower reported that the fruit produced by each type of flower has a characteristic shape. The fruit shapes in papaya reported were spherical or slightly obovoid, obovoid and long cylindrical to ellipsoid with

a more or less bulbous apex. Rao *et al.* (1974) reported the CO-2 fruits to be medium to large and oblong in shape. Purohit (1981) observed the shape of Coorg Honeydew to be long to oval. Singh (1990) reported the shape of Washington to be round to ovate- oblong, CO-2 to be ridged at the apex and oblong, Solo to be pyriform and ribbed and Pusa Nanha to be ovate.

2.3.8 Colour of peel and pulp

Of all the maturity indices set in various fruits, the most relevant significant and easily recognisable index is the external colouration of the skin of fruit and this visual method of assessing maturity is generally employed in many climacteric fruits (Akamine and Goo,1971).

Akamine and Goo (1971) working on papayas have recommended to harvest fruits when there is at least 33 percent yellow coloration on skin to get maximum percentage of TSS in the ripe fruits. Rao *et al.* (1974)observed the colour of peel and pulp of CO-2 fruits at the time of harvest. The colour of peel was yellow and pulp was also yellow. Pal *et al.* (1980) reported the pulp of the papaya varieties to be varying from pure yellow to pink. Purohit (1981) reported the colour of pulp of two varieties namely Coorg Honeydew and CO-2.The pulp colour was orangish yellow for Coorg Honeydew and yellow for CO-2.Singh (1990) reported the pulp colour of Washington to be yellowish,Coorg Honeydew, CO-2 and Pusa Nanha to be orange colour.

2.3.9 Firmness of Pulp

The strength of fruit tissue is mainly due to the physical properties of the individual cell walls and the middle lamella which contain the cementing pectic materials and as the fruit approaches ripening, the tissues become soft due to degradation of cell wall and intercellular adhesive substances (Dilley,1970). Pal *et al.* (1980) recorded that the thickness of pulp of papaya varieties varied from soft to hard.

2.4 Incidence of pests and diseases

Sen et al. (1945) reported a serious disease of the papaya initiating with the symptoms of etiolation and curling of leaves, in advanced stages showing crippled leaves and fruits of various degrees and ultimately bringing about premature death of the plant. Sham Singh and Daljit Singh (1956) reported the incidences of diseases like damping off, collar rot or stem rot, anthracnose and pests like red spider mite in papaya.

Purohit (1981) reported the incidence of diseases like damping off, collar rot and pests like red spider mite. Prasad(1982) noticed three strains of papaya virus in the humid conditions. Ram (1982) observed no serious disease while assessing the eighteen cultivars of papaya. Viruses like mosaic, leaf curl and distortion ring spot were observed during the rainy season when the vectors were most active. Ram (1983) reported that no serious disease was noticed in Pusa Nanha. Taya and Singh (1995) observed the incidence of papaya mosaic virus disease, during a survey. They reported upto sixty five percent occurrence of disease in some cases and less incidence of disease was recorded in the dry belt of Haryana.

2.5 Association of vegetative characters with yield

Correlation studies between traits are of great help in selecting suitable plant type. It is therefore important to establish the genetic basis of correlation and hence are useful tools in indulging an efficient basis of phenotypic selection in population.

Nakasone and Storey (1955) reported that a significant correlation exists between height to first flowering, number of nodes to first flower and earliness of flowering in papaya. Singh and Singh (1997) reported the important interrelationships of fruit parameters in papaya. It was found that the significant correlation existed between fruit weight, pulp weight, fruit volume, fruit length and fruit circumference and the number of seeds per fruit and between the fruit length and the number of seeds per fruit.

Increment of plant height and girth after first flowering were also studied. Chittiraichelvan and Shanmugavelu (1978) found highly significant correlations

between seed weight, fruit weight and volume and with seed ber in CO-2 papaya.

Magdalita *et al.* (1984) observed that fruit weight was positively and highly correlated with fruit length, width, volume, flesh thickness and cavity volume in papaya.

Ram and Majumdar (1984) observed that fruit yield was highly correlated with fruit weight, leaf length and number of fruits per plant in papaya. Dinesh (1989) observed significant, positive phenotypic and genotypic correlation of yield with fruit length, fruit weight and number of fruits.

2.6 Estimation of Variability components, Heritability and Genetic advance

The improvement of any crop plant is proportional to the amount of genetic variability present among the genotypes in the population .It is therefore necessary to quantify the genetic variability with respect to each character, which would help in the improvement of the crop. In case of quantitative characters, the phenotypic expression is a combination of the genotype and environment and interaction between the two. Therefore nature and magnitude of variation conditions efficiency of selection in a population. Estimation of heritability along with genetic advance helps in drawing valuable conclusion for effective selection based on phenotypic performance (Lush,1949).

Vasquez and Galan (1973) obtained high heritability values for the number of fruits in papaya. Khadi and Singh (1980) found that genotypic variability and heritability (broad sense) were quite high for yield per plant and number of fruits per plant in papaya.Subramanyam and Iyer (1981) observed high heritability in broad sense for morphological characters and yield. They also reported high phenotypic and genotypic coefficients of variability for stem thickness and moderately high variability for fruit weight and volume in papaya. Ghanta and Mandal (1992) observed high and genetic advance

for plant height,number of leaves per plant and fruit yield per plant and number of leaves per plant showed high genotypic coefficient of variation.

RESULTS

RESULTS

The present experiments were conducted at the Department of Horticulture, College of Agriculture, Vellayani during 1997-1999 with an objective of selecting suitable varieties of papaya for dessert purpose. The results of the studies are presented below.

4.1 Biometric characters

4.1.1 Height of plants

The data on variation of height of plants in the twelve varieties of papaya included in the study are presented in the Table2. Statistical analysis of the data revealed that there was significant variation in the height of plants among the varieties at all the three stages of crop growth viz, one month after planting, three months after planting three months after planting and six months after planting.

The treatment T4 (17.01cm) recorded the lowest plant height one-month after planting followed by T2 (17.11cm) and T7 (17.80cm). These treatments were statistically on par with T5 (18.57cm), T12 (21.97cm), T11 (22.22cm) and T10 (23.53cm). The highest value for height of plants at this stage of growth was recorded in T8 (33.17cm) followed by T9 and T1 (29.67cm) and these treatments did not differ significantly from T3 (28.42cm) and T6 (28.05cm).

During the third month after planting, T7 (50.44cm) recorded the lowest plant height followed by T10 (67.75cm) and T11 (82.72cm); the three treatments being statistically on par. The highest values for plant height at this stage recorded in T3 statistically on par. The highest values for plant height at this stage recorded in T3(121.55cm) which did not differ significantly from T1, T8, T9, T12, T6, and T2 andT5.

Observations at sixth month after planting showed that the dwarfest plants were in

Table 2 Variation in plant height in papaya varieties

Treatments	Height of plant (cm). Stages after planting		
	1 month after planting	3 months after planting	6 months after planting
T1	29.67	116.56	230.3
T2	17.11	89.84	255.15
T3	28.42	121.55	265.86
T4	17.01	85.72	246.78
T5	18.57	87.17	207.55
T6	28.05	93.39	225.17
T7	17.80	50.44	168.75
T8	33.17	103.50	185.43
T9	29.69	95.60	205.83
T10	23.53	67.75	132.17
T11	22.22	82.72	145.78
T12	21.97	93.44	207.92
F	3.373**	2.637*	5.175**
CD(0.05)	9.087	34.749	54.299

**- significant at 1%level

*-significant at 5%level

Table 3 Variation in girth of stem in papaya varieties

Treatments	Girth of pseudostem		
	Stages after planting		
	I month after planting	3 months after planting	6 months after planting
T1	3.53	13.41	24.5
T2	2.21	8.94	27
T3	3.31	12.28	28.28
T4	2.34	8.43	20.53
T5	2.67	9.39	20.11
T6	3.02	9.57	23.53
T7	2.02	4.97	15.5
T8	3.58	10.89	19.9
T9	3.36	9.77	22.15
T10	3.22	7.40	17.25
T11	3.06	7.84	21.11
T12	2.53	9.61	19.92
F	2.395*	3.282**	1.869
CD	1.013	3.585	NS

**-significant at 1 % level

* -significant at 5 % level

T10 (132.17cm) followed by T11 (145.78cm), T7 (168.75cm) and T8 (185.43cm); these treatments being statistically on par. The highest values for plant height was recorded in T3 (265.86cm) which was statistically on par with T2, T4, T1 and T6 while the treatment T2 was statistically on par with T4, T1, T6, T12, T5 and T9.

The data on variation in plant height thus revealed in general that plant height was lower in varieties Pusa Dwarf (T10), Pusa Nanha (T11), 9-1-D (T7) and Thailand (T8) compared to the other varieties under evaluation at the different stages of plant growth, particularly during the later stages. The varieties CO-4 (T3), CO-2 (T1) and Sunrise Solo (T6) were taller than the other varieties on all stages of growth. During the later stages of growth, varieties CO-3 (T2), CO-5 (T4) and CO-2 (T1) also exhibited tall stature.

4.1.2 Girth of plants

The data on variation of plant girth of twelve varieties of papayas are presented in Table3. Girth of the plant varied in different months of planting. Mean girth was highest in T8 (3.58cm) in the first month of planting, followed by T1 (3.53cm) and T9 (3.36cm). These treatments were statistically on par with T3 (3.31cm), T10 (3.23cm), T11 (3.06cm), T6 (3.02cm) and T5 (2.68cm). The treatment T1 was statistically on par with T9, T3, T10, T11, and T6, T5and T12 (2.53cm). Mean girth was lowest in treatment T7 (2.02cm) followed by T2 (2.21cm) and T4 (2.34cm). All were on par except T7, T2 and T4.

During the third month, girth was higher in T1 (13.41cm) followed by T3 (12.28cm) and T8 (10.89cm). These treatments were statistically on par. The treatment T7 (4.97cm) was found to be having the lowest girth followed by T10, T11 and T4 and these four treatments did not differ significantly from one another.

In the sixth month, none of the varieties differed significantly with respect to girth of stem.

The data revealed that generally plant girth did not differ significantly in all the twelve varieties.

Table 4 Variation in number of leaves of papaya varieties

Treatments	Number of leaves		
	Stages after planting		
	1 month after planting	3 months after planting	6 months after planting
T1	11.16	16.08	24.67
T2	9.61	15.64	27.12
T3	12.28	17.89	27.41
T4	10.5	14.08	25.64
T5	11.77	14.33	15.17
T6	13.56	16.19	25.13
T7	5.77	8.28	16.44
T8	12.5	14.22	19.16
T9	11.89	15.07	21.08
T10	10.39	15.03	24.14
T11	10.56	14.69	27.41
T12	10.39	13.94	19.33
F	2.813*	1.969	3.062*
CD	3.413	NS	6.287

**- significant at 1%level

* - significant at 5%level

Table 5 Variation in time taken for flowering, height at first flowering, time for harvest & number of flowers per cluster

Treatments	Time of first flowering (days)	Height of first flowering (cm)	Time for harvest (days)	No of flowers per cluster
T1	183.72	95.61	159.33	2.00
T2	150.17	106.22	157.06	3.00
T3	178.73	78.77	135.16	2.00
T4	181.00	86.42	169.00	3.00
T5	171.22	83.50	149.78	2.30
T6	189.19	101.56	132.19	3.22
T7	140.33	94.39	145.72	4.17
T8	178.94	59.83	177.89	4.67
T9	177.42	69.83	146.08	3.57
T10	191.87	49.46	162.06	4.00
T11	186.08	47.22	154.97	4.00
T12	186.67	62.17	175.00	3.00
F	15.266**	12.777**	3.531**	14.522**
CD(0.05)	11.772	16.487	22.559	0.668

**- significant at 1 % level

*- significant at 5 % level

4.1.3 Number of leaves

Data on variation on number of leaves at three stages of the twelve varieties studied are presented in Table 4.

The lowest number of leaves was recorded in T7 (5.78), which was significantly different from all other treatments. All were on par except T7 and T2.

During the third month after planting, none of the varieties differed significantly.

During the sixth month after planting, T3 (27.41) recorded the maximum number of leaves followed by T11 (27.41) and T2 (27.11). These three treatments were statistically on par with T6 (25.14), T1 (24.67), T10 (24.14) and T4 (23.64). The treatment T7 recorded the lowest number of leaves followed by T8 and T5.

The data on the number of leaves thus revealed that the number of leaves was greatest in CO-4 (T3),Pusa Nanha (T11) and CO-3 (T2) compared to the other varieties, particularly during the later stages of growth. The variety 9-1-D (T7) had lesser number of leaves in all stages of growth.

4.1.4 Time of first flowering

The data on the time of first flowering are presented in Table 5. There was significant difference among various treatments. The shortest flowering time was observed in T7 (140.33days). It was followed by T2 (150.17 days) and they were found to be statistically on par and differed significantly from the rest of the varieties. The treatment T10 was the late flowering one (191.87 days)and was statistically on par with T1 and T4.

From the results it was evident that the shortest duration for flowering was in T7 (9-1-D) followed by T2 (CO-3) compared to all other treatments. The longest time was recorded in T10 (Pusa Dwarf) and T12 (Washington) and T11 (Pusa Nanha).

4.1.5 Height at first flowering

The data on the height at first flowering are presented in Table 5.The height of first flowering was the lowest in T11 (47.22cm) followed by T10 (49.46cm) and T8 (59.84cm). These were found to be statistically on par with T12 (62.17cm). The treatment T2 (106.22cm) was followed by T6 (101.56cm) and T1 (95.11cm) and were on par with T7.

From the results, it was evident that the shortest height of flowering was recorded for T11 (Pusa Nanha) followed by T10 (Pusa Dwarf), T8 (Thailand) and T12 (Washington) and T7 (9-1-D). The treatments T2 (CO-3), T6 (Sunrise Solo) and T1 (CO-2) recorded the greatest height at which first flowering occurred.

4.1.6 Time for harvest

The data on time for harvest of fruits are presented on Table 5.Harvest time was the early in T6 (132.19 days) followed by T3 (135.16 days) and T7 (145.72days). They were on par with T9 (146.08days) and T5 (149.78days). The harvesting time was greatest in T8 (177.89 days) followed by T12 (175 days) and T4 (169 days) and they were statistically on par with T10, T1 and T2.

The results thus indicated that the shortest duration for harvest was in T6 (Sunrise Solo) followed by T3 (CO-4), T7 (9-1-D), T9 (Tainung) and T5 (Coorg Honeydew) compared to other treatments. The longest duration for harvest was recorded in T8 (Thailand) followed by T12 (Washington) and T4 (CO-5). The varieties T10 (Pusa Dwarf), T1 (CO-2) and T2 (CO-3) also took longer duration for harvest of the fruit.

4.1.7 Number of flowers per cluster

The data on number of flowers per cluster are given in Table 5.Analysis of data on the number of flowers showed significant differences among the varieties. The treatment T8 had the highest number of flowers per cluster (4.67) followed by T7 (4.17), T10(4.0) and T11 (4.0), which were statistically on par. The lowest number of flowers per cluster

1. Varietal variation of papaya varieties

1. CO-2

2. CO-3

3. CO-4

4. CO-5


CO-2


CO-1


CO-4


CO-5

2. Varietal variation of papaya varieties

5.Coorg Honeydew

6.Sunrise Solo

7.9-1-D

8.Thailand


SUNRISE-SOLO
1·5m
1·4m
1·3m
1·2m
1·1m
1m


1·5m
1·4m
1·3m
1·2m
1·1m
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PUSA DWARF
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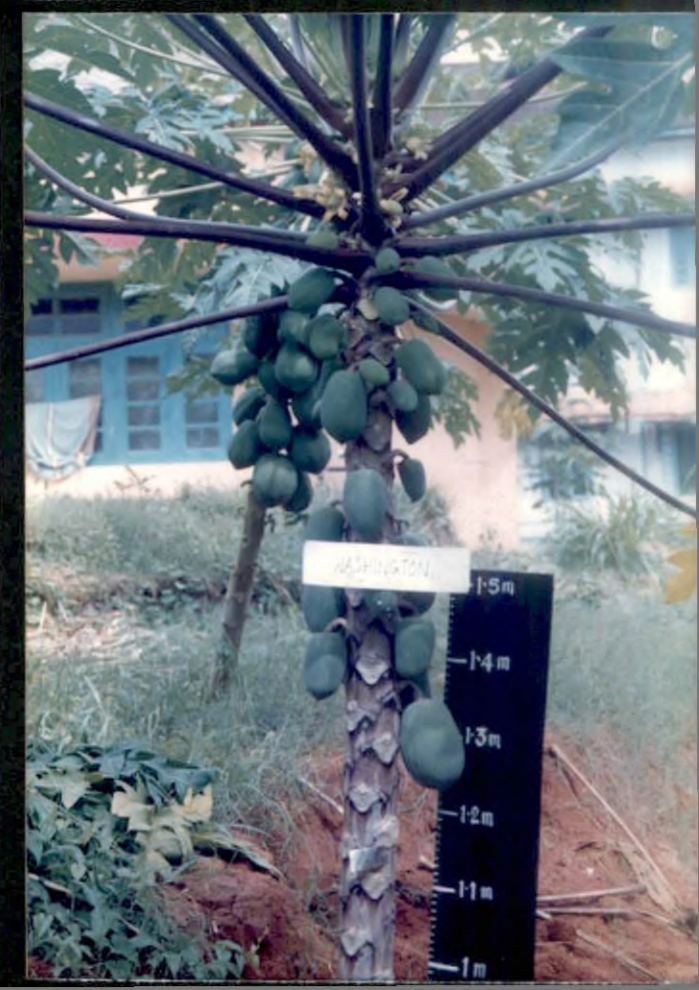

WASHINGTON
1·5m
1·4m
1·3m
1·2m
1·1m
1m

Table 6 Variation in yield characters in Papaya varieties

Treatment	% of fruit set.	No.of fruits per plant	Fruit wt. (g)	Fruit length (cm)	Fruit grith (cm)	Fruit volume (cc)
T1	50.00	37.50	1204.83	21.70	41.70	977.67
T2	66.66	57.31	294.97	15.18	24.64	213.61
T3	66.66	53.34	906.25	21.94	34.33	989.28
T4	33.33	27.72	814.25	21.22	35.53	685.00
T5	45.00	37.98	1181.33	16.02	16.52	968.12
T6	41.20	39.03	400.28	14.89	30.25	326.39
T7	36.47	18.25	823.05	24.00	31.78	731.00
T8	50.87	10.58	974.00	24.53	31.17	772.67
T9	28.00	22.61	829.83	21.93	32.26	633.53
T10	25.00	19.55	1213.75	23.54	42.94	1104.17
T11	25.00	18.67	1754.44	27.14	49.72	1537.22
T12	33.33	18.84	414.50	16.04	27.32	304.92
F	83.612**	19.940**	33.846**	34.147**	33.778**	44.739**
CD(0.05)	4.661	10.590	208.191	2.071	4.432	166.233

**- significant at 1 % level

*- significant at 5 % level

was found in T3 (2.0) and T1(2.0) followed by T5 (2.3). These treatments were found to be statistically on par.

Results indicated that the number of flowers per cluster was higher in T8 (Thailand), T7 (9-1-D), T10 (Pusa dwarf) and T11 (Pusa Nanha). Lower number of flowers per cluster among the varieties observed was recorded in T3 (CO-4), T1 (CO-2) and T5 (Coorg Honeydew).

4.2. Yield Characters

4.2.1 Percentage of fruitset

Analysis of data on the percentage of fruit set (Table 6) showed significant differences among the varieties. The treatments T2 and T3 (66.66 per cent) had the greatest percentage of fruit set which were statistically superior to all other varieties. Treatments T10 (25 per cent) and T11 (25 percent) recorded the lowest percentage of fruit set (25 per cent) followed by T9 (28 per cent) and were on par.

From the results it was evident that the percentage of fruit set was highest in T2 (CO-3) and T3 (CO-4). The lowest percentage of fruit set was found in T10 (Pusa Dwarf) and T11 (Pusa Nanha) and T9 (Tainung).

4.2.2 Number of fruits per plant

Analysis of data on the number of fruits per plant (Table 6) showed significant difference among the varieties. The treatment T2 (57.3) followed by T3 (53.34) produced the highest number of fruits per plant and these were on par and statistically superior to all other varieties. The lowest number of fruits per plant was observed in T8 (10.55), which was statistically on par with T7, T11, T12 and T10.

Results indicated that the number of fruits per plant was the highest in T2 (CO-3) followed by T3 (CO-4), while T8 (Thailand) recorded the least number of fruits followed by T7 (9-1-D), T11 (Pusa Nanha), T12 (Washington) and T10(Pusa Dwarf).

4.2.3 Fruit Weight

The data on the weight of fruits (Table 6) revealed significant difference among the 12 varieties studied. Weight of fruits was the highest in T11 (1754.44g), which was significantly superior to all other treatments. The treatment T10 (1213.75g), T1 (1204.83g) and T5 (1181.33g) that followed T11 were statistically on par. The lowest weight of fruits recorded in T2 (294.97g) did not differ significantly from that of T6 (400.28g) and T12 (414.50g), which followed T2.

The results thus indicated that fruit weight was higher in T11 (Pusa Nanha) followed by T10 (Pusa Dwarf), T1 (CO-2) and T5 (Coorg Honeydew). Fruit weight was low in T2 (CO-3) followed by T6 (Sunrise Solo) and T12 (Washington).

4.2.4 Fruit length

The data on the fruit length (Table 6) of different varieties of papaya showed significant differences. The highest length of fruits recorded in T11 (27.14cm) was superior to all other fruits. This was followed by T8 (24.53cm) and T7 (24.00cm) which were statistically on par The length of fruits was shortest in T6 (14.89cm) followed by T2 (15.18cm), T5 (16.02cm) and T12 (16.04cm); all these treatments being statistically on par.

From the results it was inferred that among the varieties studied T11 (Pusa Nanha) produced the longest fruits followed byT8 (Thailand) and T7 (9-1-D) while length of fruits was shortest in T6 (Sunrise Solo) followed by T2 (CO-3), T5 (Coorg Honeydew) and T12 (Washington).

4.2.5 Fruit girth

The data on the girth of fruits are presented in Table 6.Girth was significantly highest in T11 (49.72cm). This was followed by T10 (42.94cm) and T1 (41.70cm), which did not differ, significantly from one another. The lowest girth of fruits recorded in T5

Table 7 Variation in yield characters of Papaya varieties

Treatmerts	Pulp%	Cavity index	Seed content (g)	Yield per plant (kg)
T1	63.33(79.89)	32.36(28.6)	84.40	39.68
T2	50.29(59.22)	26.59(20.0)	39.42	18.80
T3	61.09(76.67)	29.00(23.5)	69.00	38.27
T4	64.38(81.33)	29.89(24.8)	25.50	23.00
T5	66.23(83.78)	23.50(15.9)	9.41	12.18
T6	59.61(74.45)	26.48(19.8)	50.16	7.09
T7	64.97(82.14)	29.55(24.3)	37.56	16.30
T8	65.29(82.57)	33.13(29.8)	8.50	9.49
T9	69.22(87.44)	26.18(19.4)	23.47	12.52
T10	58.15(72.19)	27.33(21.0)	60.29	28.40
T11	61.26(76.91)	27.14(20.8)	72.77	27.16
T12	55.01(67.15)	28.95(23.4)	46.83	5.61
F	26.568**	8.041	32.143**	13.564**
CD (.05)	2.985	NS	12.748	9.200

** -significant at 1% level

* -significant at 5 % level

values in brackets denote the means of transformed data)

(16.52cm) differed significantly from other treatments. The treatments T2 (24.64cm) and T12, which followed T5 (16.52), did not differ significantly from one another.

From the data, it becomes evident that fruit girth was the highest in T11 (Pusa Nanha) followed by T10 (Pusa Dwarf) and T1 (CO-2). At the same time, lowest girth was observed in T5 (Coorg Honeydew) followed by T2 (CO-3) and T12 (Washington).

4.2.6 Volume of fruit

The data presented in Table 6 indicated that T11 (1537.22cc) had significantly highest fruit volume compared to all other fruits. This was followed by T10 (1104.17cc), T3 (989.28cc), T1 (977.67cc) and T5 (968.12cc), which were statistically on par. Volume of fruits was the lowest in T2 (213.61cc) followed by T12 (304.92cc) and T6 (326.39cc), which were statistically on par.

From the above results it can be inferred that T11 (Pusa Nanha) had highest fruit volume followed by T10 (Pusa Dwarf), T3 (CO-4), T1 (CO-2) and T5 (Coorg Honeydew), while volume of fruits was low in T2 (CO-3), T12 (Washington) and T6 (Sunrise Solo).

4.2.7 Pulp per centage

Among the varieties observed (Table 7), T9 (69.22 per cent) had significantly highest pulp percentage and differed significantly from all other varieties. This was followed by T5 (66.23 per cent), T8 (65.29 per cent), T7 (64.97 per cent) and T4 (64.38 per cent), which were statistically on par. The lowest pulp percentage was recorded in T2 (50.29 per cent) followed by T12 (55 per cent) which differed significantly from one another and all other treatments.

Thus the data revealed that the highest pulp percentage was recorded by T9 (Tainung), while the lowest by T2 (CO-3).

4.2.8 Cavity index

The data presented in Table 7 showed no significant difference in the character among the treatments.

4.2.9 Seed Content

Seed content of the papaya varieties on fresh weight basis studied, varied significantly (Table 7). The highest seed content was in T1 (84.40g) followed by T11 (72.77g), which did not differ significantly from one another. These two varieties were superior to all other varieties. The lowest seed content was recorded T8 (8.5g) followed by T5 (9.41g), which were statistically on par.

The above results showed that seed content of the fruits is low in T8 (Thailand) and T5 (Coorg Honeydew) while highest in T1(CO-2) and T11 (Pusa Nanha).

4.2.10 Yield

The data on fruit yield per plant, presented in Table 7 showed significant differences among the varieties. The highest fruit yield was recorded in T1 (39.68kg) followed by T3 (38.27kg), which were statistically on par. The lowest yield recorded in T12 (5.61kg) was on par with T9 and T5.The lowest yield recorded in T12 was on par with T6 (7.09kg), T8 (9.49kg), T5 (12.18kg) and T9 (12.52kg).

From the results, it is evident that fruit yield was high in T1 (CO-2) and T3 (CO-4). The yield was low in T12 (Washington), T6 (Sunrise Solo),T8 (Thailand) T5 (Coorg Honeydew) and T9 (Tainung) compared to other varieties.

Table 8 Variation in quality characters of papaya varieties

Treatment	TSS (%)	Acidity (%)	Reducing. sugar(%)	Non-reducing sugar (%)	Total sugar(%)	As corbic acid content (mg/100g)	Total carote-noids (mg/100g)
T1	13.41	0.23	10.23	4.21	14.44	74.49	1.64
T2	13.45	0.14	10.22	0.71	10.93	131.26	1.95
T3	12.44	0.07	4.31	2.23	6.54	68.14	2.32
T4	12.18	0.14	10.79	1.99	12.77	62.01	1.86
T5	13.54	0.12	11.88	2.37	14.24	80.53	2.33
T6	14.78	0.15	8.81	10.84	19.66	93.14	2.48
T7	13.46	0.17	7.61	8.87	16.48	66.18	1.87
T8	13.95	0.11	9.53	3.11	12.64	86.15	1.92
T9	12.89	0.11	8.87	1.83	10.70	95.61	1.95
T10	11.60	0.18	5.34	1.32	6.72	104.30	1.73
T11	12.45	0.14	5.10	0.34	5.44	104.26	2.28
T12	13.40	0.13	7.08	4.34	11.42	87.60	2.38
F	25.586**	17.817**	30.822**	27.790**	47.042**	67.493**	169.870**
CD	0.499	0.027	1.287	1.795	1.796	7.036	0.063

**- significant at 1 % level

*- significant at 5 % level

4.3 Quality Characters

4.3.1 Total Soluble Solid (TSS)

There was significant difference among the varieties in the TSS content of the fruits (Table 8). Significantly higher TSS was recorded in T6 (14.78 per cent) which was significantly superior to all other treatments. This was followed by T8 (13.95 per cent), T5 (13.54 per cent) and T7 (13.46 per cent); they being statistically on par. The lowest TSS was recorded in T10 (11.60 per cent), which differed significantly from all other treatments. This was followed by T4 (12.18 per cent), T3(12.44), and T11(12.45) that were statistically on par.

From the data, it is evident that fruits of T6 (Sunrise Solo) had the highest TSS followed by, T8 (Thailand) and T5 (Coorg Honeydew) had higher TSS while it was lowest in T10 (Pusa Dwarf). The TSS of T4 (CO-5), T3 (CO-4) and T11 (Pusa Nanha) which followed T10 was also low compared to the other varieties under test.

4.3.2 Acidity

The twelve papaya varieties (Table 8) differed significantly in the acidity of the fruits. Significantly higher acidity compared to all other varieties was noted in T1 (0.23 per cent) followed by T10 (0.18 per cent) and T7 (0.17 per cent); the latter two being statistically on par. Acidity of the fruits was the lowest in T3(0.07per cent) which differed from all other treatments. This was followed by T9 (0.11 per cent), T8 (0.11 per cent), T5 (0.13 per cent) and T12(0.13 per cent), which did not differ, from one another.

The data thus revealed that acidity of fruits was lowest in T3 (CO-4). Fruits of T9 (Tainung), T8 (Thailand), T5 (Coorg Honeydew) and T12 (Washington) also had comparatively lower acidity. On the other hand fruits of T1 (CO-2) showed the highest acidity

4.3.3 Reducing sugars

As shown in Table 8, among the twelve varieties of papaya, treatments T5 (11.88

per cent) and T4 (10.79 per cent) showed the highest values for reducing sugars and these two treatments were on par. The lowest content of reducing sugars was recorded in T3 (4.31 per cent) followed by T11 (5.10 per cent) and T10 (5.33 per cent) which were on par.

The results thus shows that varieties T5 (Coorg Honeydew) and T4 (CO-5) had the highest reducing sugar content among the varieties studied. The least reducing sugar content of the fruits was in T3 (CO-4) followed by T11 (Pusa Nanha) and T10 (Pusa Dwarf).

4.3.4 Non reducing sugars

The data (Table 8) showed significant variation in the content of non- reducing sugars among the papaya varieties. The treatments, T6 (10.84 per cent) followed by T7 (8.87 per cent) showed the highest content of non- reducing sugars; the two treatments differing significantly from one another and also from all other treatments. The lowest content of non- reducing sugar observed in T11 (0.34 per cent) was on par with T2(0.71per cent), T10(1.32per cent), T9(1.83per cent) and T4 (1.99per cent). .

The above results showed that the varieties T6 (Sunrise Solo) had the highest non reducing sugar content followed by T7 (9-1-D) The lowest content of non -reducing sugars was in T11 (Pusa Nanha) followed by T2 (CO-3), T10 (Pusa Dwarf), T9 (Tainung) and T4 (CO-5).

4.3.5 Total sugars

Significant difference in the total sugar content (Table 8) of fruits of papaya varieties was observed.The treatment T6(19.66per cent) followed by T7 (16.48 per cent) had the highest total sugar content. These two treatments differed from one another and also from all other treatments The lowest total sugar content was recorded in T11 (5.44 per cent) followed by T3 (6.54 per cent) and T10 (6.72 per cent) and these treatments did not differ significantly from one another.

From the above results, it can be concluded that varieties T6 (Sunrise Solo) followed by T7 (9-1-D) had the highest total sugar content. The lowest total sugar content was observed in varieties T11 (Pusa Nanha) followed by T3 (CO-4) and T10 (Pusa Dwarf).

4.3.6 Ascorbic acid content

The data on the ascorbic acid content (Table 8) of fruits of different papaya varieties revealed that the treatment T2 (131.26 mg/100g) had significantly higher ascorbic acid content than all the varieties tested. This was followed by T10 (104.30 mg/100g) and T11 (104.26mg/100g) , which were statistically on par. The lowest values for ascorbic acid content of the fruits was recorded in T4 (62.01mg/100g), which did not statistically differ from T7 (66.18mg/100g) and T3 (68.14mg/100g).

The results, thus indicated that the highest ascorbic acid content was in the fruits of T4 (CO-5) followed by T7 (9-1-D) and T3 (CO-4).

4.3.7 Total carotenoids

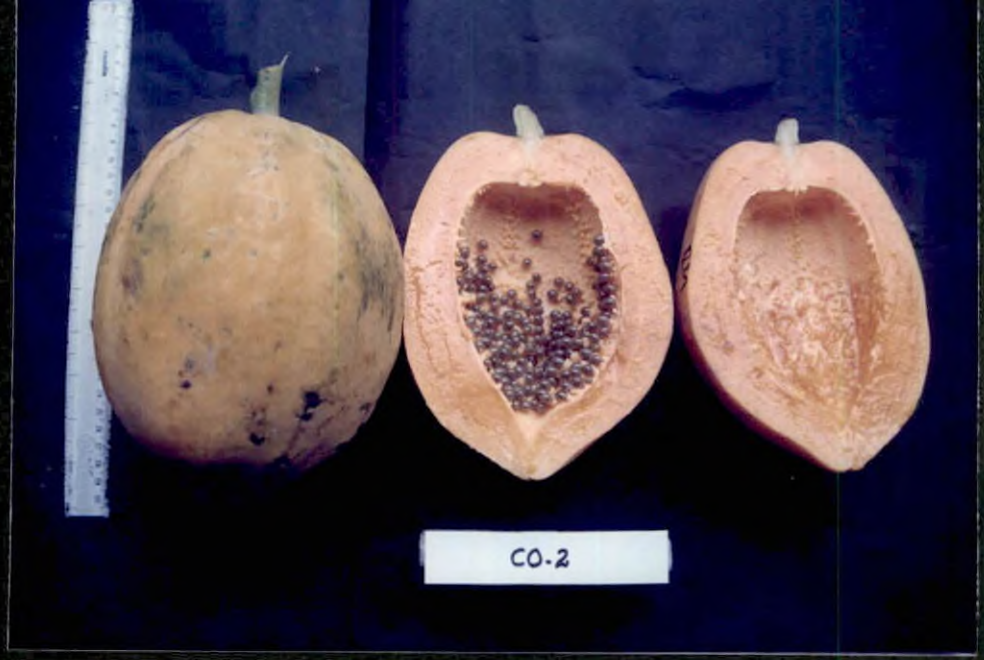
Significant variation in total carotenoid content (Table8) of the fruits was observed among the papaya varieties under study. The carotenoid content was the highest in T6 (2.48), which was superior to all other treatments. T12 (2.38) and T5 (2.33) followed this, which were statistically on par. The lowest carotenoid content of fruits was recorded in T1 (1.64) followed by T10 (1.73). These two treatments differed from one another and from all other treatments.

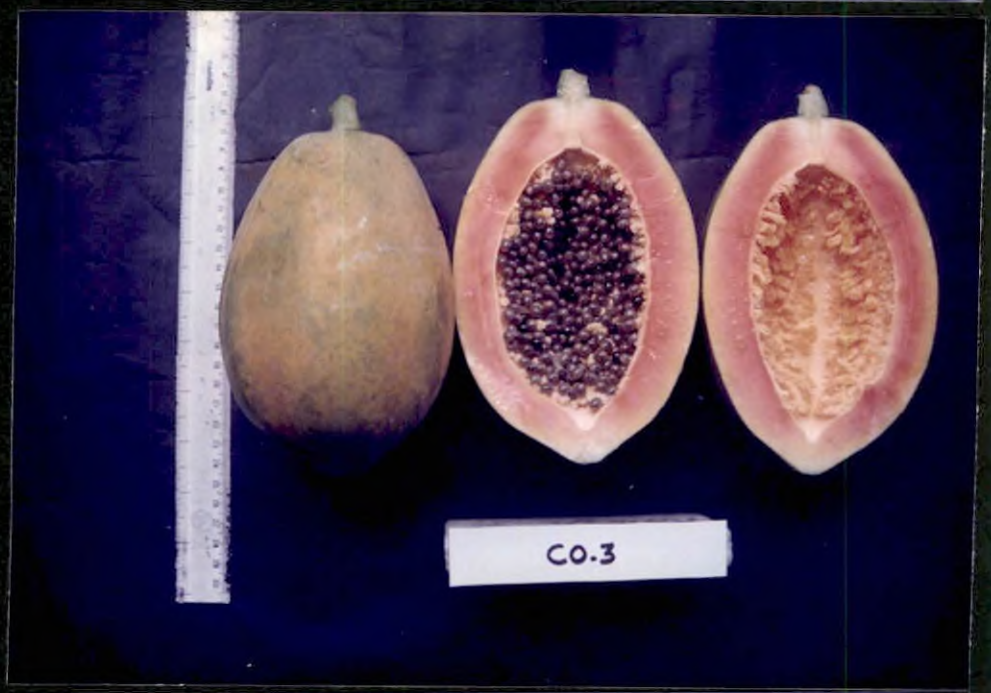
The results indicated that fruits of varieties T6 (Sunrise Solo) had the highest carotenoid content The lowest carotenoid content was inT1 (CO-2) followed by T10 (Pusa Dwarf).

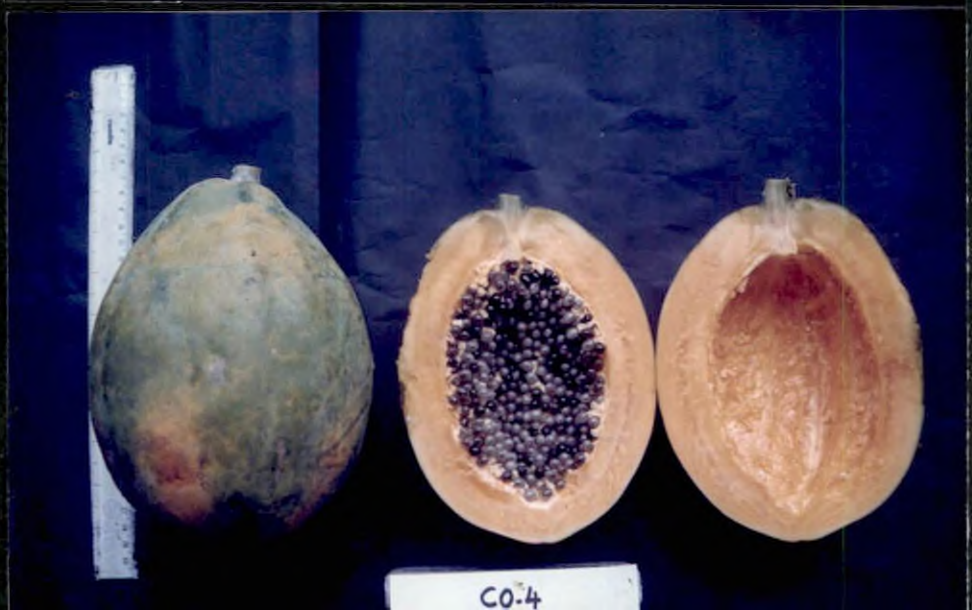
4.3.8 Fruit shape

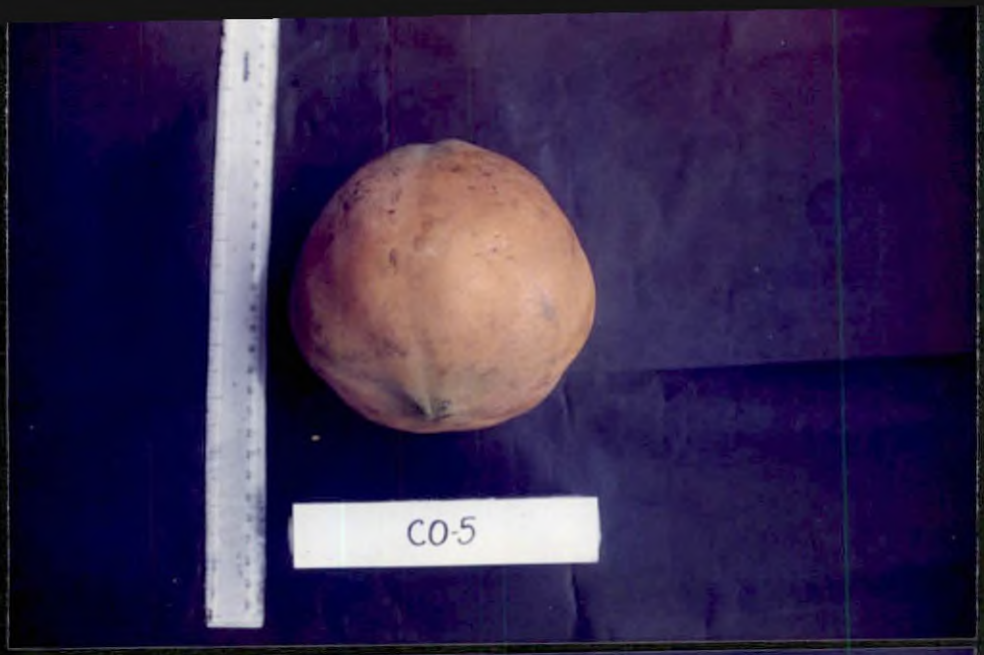
In the varieties studied (Table 9) five fruit shapes viz, obovoid, spherical, pyriform, cylindrical and ellipsoid were observed. The varieties T1 (CO-2), T2(CO-3), T3(CO-4),

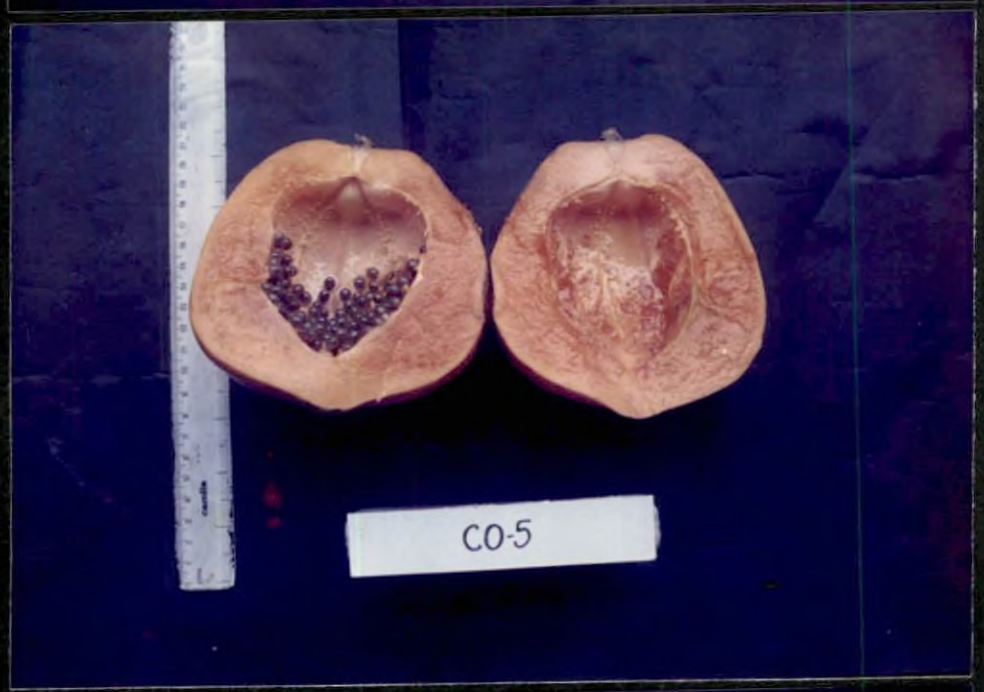
Fruit shape Variation of twelve varieties of Papaya


CO-2


CO-3


CO-4


CO-5


CO-5


COORG HONEY DEW


COORG HONEY DEW


SUNRISE SOLO


9-1-D


9-1-D


TAINUNG

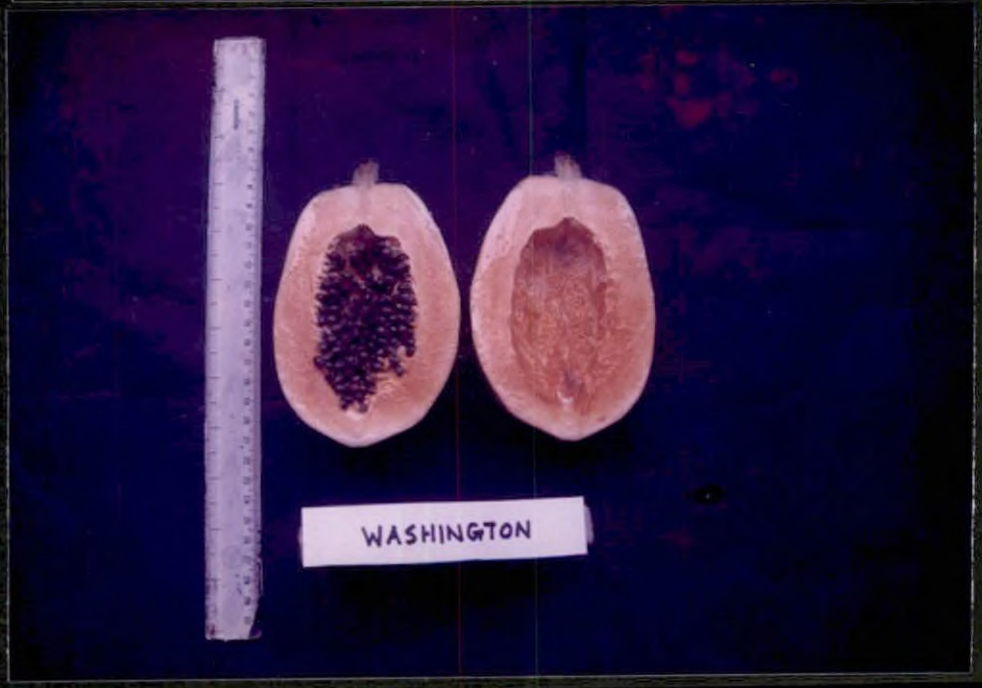

THAILAND


THAILAND


PUSA DWARF


PUSA NANHA


WASHINGTON


WASHINGTON

T7(9-1-D), T8(Thailand), T9(Tainung), T10(Pusa Dwarf), T11(Pusa Nanha), T12(Washington) produced obovoid or cylindrical to ellipsoid fruits. T4(CO-5) produced spherical fruits, T5(Coorg Honeydew) produced long to oval fruits. T6 (Sunrise Solo) produced pyriform fruits.

4.3.9 Colour of peel and pulp

Peel colour of the fruit (Table 9) at edible ripe stage ranged from greenish yellow to yellow and deep yellow. The varieties T2 (CO-3), T3 (CO-4), T6 (Sunrise Solo), T7 (Tainung) and T12 (Washington) produced greenish yellow peel colour, while T4 (CO-5), T5 (Coorg Honeydew), T8 (Thailand) and T9 (Tainung) had deep yellow and T10 (Pusa Dwarf) and T11 (Pusa Nanha) had yellow colour ,while T1 (CO-2) had light yellow peel colour.

Colour of pulp ranged from yellow, orange to pinkish red. T6 (Sunrise Solo), T8(Thailand) and T9 (Tainung) recorded orange to pinkish red pulp colour. Rest all the varieties had yellow flesh colour.

4.3.10 Firmness of pulp

Data in Table 9 showed that varieties T2 (CO-3), T3 (CO-4), T6 (Sunrise Solo), T8 (Thailand) and T9 (Tainung) had firm flesh, where as T4 (CO-5), T10 (Pusa Dwarf) had too soft flesh. In varieties T1 (CO-2), T5 (Coorg Honeydew), T7 (9-1-D), T11 (Pusa Nanha) and T12 (Washington), the flesh was fairly firm.

4.3.11 Organoleptic qualities

As indicated in Table 10, the mean score obtained for appearance ranged between 1.400 to 3.545. The variety T9 (Tainung) obtained high score followed by T8 (Thailand) and T1 (CO-2). The lowest score was obtained for T10 (Pusa Dwarf).

The evaluation of colour revealed that the variety T9 (Tainung) obtained the highest mean score followed by T7 (9-1-D), while the lowest score was seen for the variety T10

Table 9 Organoleptic qualities of papaya varieties

Treatment	Mean Score						
	Appearance	Colour	Flavour	Taste	Texture	Papain odour	Overall acceptability
T1	3.181	3.636	2.363	2.272	2.818	1.636	15.906
T2	2.181	3.272	2.727	2.727	2.545	2.454	15.906
T3	2.545	3.454	2.363	2.363	2.363	1.909	14.997
T4	2.090	2.727	2.272	1.727	2.545	2.636	13.997
T5	2.600	2.800	2.800	2.300	2.800	2.500	15.800
T6	2.750	3.040	3.200	3.290	2.900	2.863	20.770
T7	2.909	3.545	2.545	2.181	2.454	2.818	16.452
T8	3.300	3.300	2.900	2.300	3.100	2.500	17.400
T9	3.545	4.090	3.000	3.272	2.272	3.272	19.906
T10	1.400	1.900	2.000	1.800	1.700	2.600	11.400
T11	2.454	3.000	2.272	2.181	2.272	3.090	12.269
T12	2.363	3.000	2.545	2.545	2.727	2.727	15.907

(Pusa Dwarf) followed by T4 (CO-5) and T5 (Coorg Honeydew). The scores obtained for colour ranged from 1.9 to 4.09.

While considering the quality attribute flavour, it was noted that the highest score was obtained by the varieties T6 (Sunrise Solo) followed by T9 (Tainung) and T8 (Thailand). The lowest score was recorded in T10 (Pusa Dwarf) followed by T11 (Pusa Nanha) and T4 (CO-5).

The mean scores obtained for taste ranged between 1.727 to3.290. The treatment T6 (Sunrise Solo) recorded the highest score followed by T9 (Tainung), T2 (CO-3), T12 (Washington) and T3 (CO-4). T4 (CO-2), recorded the lowest score followed by T10 (Pusa Dwarf) and T11 (Pusa Nanha).

With regard to the texture of pulp, it was observed that the varieties T8 (Thailand) secured maximum score followed by T6 (Sunrise Solo) and T1 (CO-2), while the minimum score was recorded by T10 (Pusa Dwarf) followed by T11 (Pusa Nanha) and T9 (Tainung). The scores ranged between 1.7 to 3.1.

Freedom from papain odour is an important quality attribute with regard to papaya fruits. Among the varieties studied, T1 (CO-2) recorded the lowest score for presence of papain odour followed by T3 (CO-4) and T2 (CO-3). WhileT11 (Pusa Nanha) recorded the maximum amount of papain odour followed by T9 (Tainung). The scores ranged between 1.64 to 3.09.

A detailed assessment of the organoleptic quality of the different papaya varieties indicated that the varieties T6 (Sunrise Solo) was the most acceptable with a score of 20.77 followed by the variety T9 (Tainung), T8 (Thailand) and T7 (9-1-D). The least mean score 11.40 for overall acceptability was observed for the variety T10 (Pusa Dwarf), followed by T11 (Pusa Nanha).

Table 10 Variation in quality characters of papaya varieties

Treatment	Fruit shape	Colour of peel	Colour of pulp	Firmness of pulp
T1	Slightly obovoid	Light yellow	Yellow to orange	Fairly firm
T2	Obovoid	Greenish yellow	Pinkish orange	Firm
T3	Obovoid	Greenish yellow	Yellow	Firm
T4	Spherical	Deep yellow	Yellow	Too soft
T5	Long to oval	Deep yellow	yellowish orange	Fairly firm
T6	Pyriform ribbed	Yellowish green	Orange to pinkish red	Firm
T7	Cylindrical	Greenish yellow	Yellowish orange	Fairly firm
T8	Long- cylindrical to ellipsoid	Deep yellow	Orange to pinkish red	Firm
T9	Long - cylindrical to ellipsoid	Deep yellow	Orange to pinkish red	Firm
T10	Obovoid to slightly spherical	Yellow	Yellow	Too soft
T11	Obovoid to slightly spherical	Yellow	Yellow	Fairly firm
T12	Small , ellipsoid	Greenishyellow	Yellow	Fairly firm

Table 11 Incidence of major pests and diseases of papaya varieties

Treatments	Leaf grade	Stem grade	Fruit grade
T1	33.82(30.99)	0.67	3.17
T2	71.35(89.80)	1.44	3.67
T3	61.63(77.46)	1.50	4.67
T4	58.43(72.63)	1.00	2.50
T5	54.37(66.09)	1.83	2.58
T6	47.73(54.78)	0.89	3.11
T7	43.70(47.77)	1.00	0.77
T8	6.4(1.24)	0.11	0.00
T9	32.65(29.12)	0.19	0.83
T10	0(0)	0.28	0.00
T11	0(0)	0.67	0.44
T12	41.79(44.44)	0.83	3.08
F	18.573**	11.302**	11.202**
CD	16.453	0.467	1.384

** - significant at 1 % level

* - significant at 5 % level

4.4 Incidence of Pests and Diseases

The incidence of major diseases in various varieties of papaya are given in Table 11.

No major pests were recorded among the twelve varieties of papaya.

Incidence of diseases on leaf showed statistically significant difference among various treatments. The disease index score ranged from 0 in T10 to 89.80 in T2; the latter recorded the highest disease score followed by and T3 (77.46). The treatments T2 and T3 are on par and significantly different from all others. The lowest score was recorded in T10 (0.00) and T11 (0.00) and these treatments were on par with T8 (1.24).

From the results it was observed that incidence of leaf diseases like mosaic was the highest in T2 (CO-3) and T3 (CO-4). Varieties T10 (Pusa Dwarf), T11 (Pusa Nanha) and T8 (Thailand) recorded the lowest incidence of diseases.

The stem index score ranged from 1.833 for T5 to 0.11 for T8.The treatment T5 recorded higher disease index score on stem. Treatment T5 was found to be on par with T3 (1.50) and T2 (1.44). The lowest disease was scored in T8 (0.11) followed by T9 (0.19) and T10 (0.28). These three treatments were found to be on par.

None of the varieties differed significantly with respect to the disease incidence on stem. From the results it was observed that incidence of diseases on stem was the highest in T5 (Coorg Honeydew), followed by T3 (CO-4) and T2 (CO-3). The lowest incidence was noticed in T10 (Pusa Dwarf), followed by T1 (CO-2) and T11 (Pusa Nanha).

None of the varieties differed significantly with respect to the disease incidence on fruits. The treatment T3 (4.67) recorded the highest score on the fruits followed by T2 (3.37) and T1 (3.17)The lowest score was seen on treatment T8 (0.00) and T10 (0.00).

Results revealed that T3 (CO-4) and T2 (CO-3) had the highest degree of disease incidence on fruits and it was nil for T8 (Thailand), T10 (Pusa Dwarf), T11 (Pusa Nanha) and T7 (9-1-D).

Table 12. Phenotypic and Genotypic correlations of Papaya varieties

Phenotypic	1	2	3	4	5	6	7	8	9	10	11
1 Height at 6th month	1.0000										
2 Leaves "	0.4632	1.0000									
3 Girth "	0.7890	0.7322	1.0000								
4 Height at first flowering	0.6171	0.0981	0.3509	1.0000							
5 No.of flowers/cluster	-0.1102	-0.1569	-0.1521	-0.2726							
6 No.of fruits	0.7155	0.5036	0.6629	0.6219	-0.3002	1.0000					
7 Percent of fruit set	0.6045	0.2144	0.4936	0.5261	-0.1067	0.7198	1.0000				
8 Fruit weight	-0.5020	0.0575	-0.2196	-0.5106	0.0059	-0.3278	-0.3542	1.0000			
9 Fruit length	-0.4820	-0.0138	-0.2478	-0.5250	0.1045	-0.5128	-0.3363	0.7389	1.0000		
10 Fruit girth	-0.3606	0.3817	-0.0298	-0.4350	0.1010	-0.2853	-0.3887	0.5882	0.7371	1.0000	
11 Yield per plant	0.1698	0.4884	0.3255	0.0265	0.0175	0.4035	0.2281	0.4551	0.4135	0.58771	1.0000

Genotypic	1	2	3	4	5	6	7	8	9	10	11
1 Height at 6th month	1.0000										
2 Leaves "	0.1555	1.0000									
3 Girth "	0.8108	0.7255	1.0000								
4 Height at first flowering	0.7353	0.0320	0.5042	1.0000							
5 No.of flowers/cluster	-0.3240	-0.4261	-0.6952	-0.5489	1.0000						
6 No.of fruits	0.8103	0.6808	1.1186	0.7005	-0.7020	1.0000					
7 Percent of fruit set	0.8019	0.3591	0.0907	0.5775	-0.2637	0.7888	1.0000				
8 Fruit weight	-0.6203	0.1819	-0.3263	-0.6091	0.1102	-0.3649	-0.3607	1.0000			
9 Fruit length	-0.6263	0.0146	-0.4824	-0.6088	0.2085	-0.5880	-0.3572	0.7345	1.0000		
10 Fruit girth	-0.4884	0.5450	-0.1311	-0.4848	0.0633	-0.3503	-0.4232	0.6251	0.7664	1.0000	
11 Yield per plant	0.6887	0.7155	0.4738	-0.395	-0.3853	0.3083	0.2361	0.5376	0.47625	0.6395	1.0000

4.5 Association among vegetative characters and yield

The results are presented in Table 12.

Phenotypic correlation

Phenotypic correlation of height at sixth month with leaves at sixth month (0.4632), girth at sixth month (0.7890), height at first flowering (0.6171), number of fruits (0.7155) and percentage of fruit set (0.6045) was positive and significant. Phenotypic correlation of height with number of flowers/cluster (-0.1102), fruit length (-0.4820), girth (-0.3606) and that with fruit weight (-0.5020) was negative and not significant. Yield per plant(0.1698) recorded positive correlation with height at sixth month, but it was not significant.

Number of leaves at sixth month showed positive and significant association with plant girth (0.7322) and number of fruit (0.5036). Negative association was found in number of flowers per cluster (-0.1569) and fruit length (-0.0138). Leaves at sixth month and yield per plant showed positive correlation (0.4884),but it was not significant.

The plant girth at sixth month showed positive and significant association with number of fruits per plant (0.6629). Negative, though not significant correlation was recorded with number of flowers per cluster (-0.1521), fruit weight (-0.2196), fruit length (-0.2478) and fruit girth(-0.0298). Yield per plant had positive, but not significant correlation with plant girth (0.3255).

Height at first flowering had significant and positive correlation with number of fruits (0.6219) and percentage of fruit set (0.5261). Negative and significant correlation was recorded for fruit weight (-0.5106), fruit length (0.5250) and fruit girth (-0.4350).

The number of flowers per cluster had no correlation with fruit weight, fruit length, fruit girth and yield per plant.

Negative and significant correlation was found for number of fruits with length of fruits (- 0.5128). Correlation of number of fruits was positive with yield per plant

(0.4035), but not significant. Significant and positive correlation was recorded for number of fruits with percentage of fruitset (0.7198). Positive; though not significant correlation wasnoted for percentage of fruit set with yield per plant (0.2281). Negative correlation which was not statistically significant were found for fruit weight (-0.3542), fruit length (0.3363) and fruit girth (-0.3887).

Fruit weight had significant positive correlation with fruit length (0.7389), fruit girth (0.5882) and yield per plant (0.4551).

Fruit length had significant positive correlation with fruit girth (0.7371) with yield per plant (0.4135) it was not significant, but positive. Fruit girth had significant positive correlation with yield per plant (0.5877). No significant correlation was found for percentage of fruit set for any other character.

Genotypic Correlation

Genotypic correlations of height at sixth month with girth (0.8108), height of first flowering (0.7353), number of fruits (0.8103), percentage of fruit set (0.8019) and yield per plant (0.6887) were positive and significant. Negative and significant correlation was found for fruit weight (-0.6203) and fruit length (-0.6263).

Number of leaves at sixth month had positive and significant association with plant girth (0.7255), number of fruit (0.6808),fruit girth (0.5450) and yield per plant (0.7155).

Positive and significant correlation was found for plant girth with height at first flowering (0.5042). Girth at sixth month after planting had positive, though not significant correlation (0.4739) with yield per plant. Negative but significant correlation was found for girth with number of flowers per cluster (-0.69).

Height at first flowering had positive and significant correlation with number of fruits (0.7005) and percentage of fruit set (0.5775). Negative and significant correlations were found for number of flowers per cluster (-0.5489), fruit weight (-0.6091), fruit length (0.6088) and yield per plant (-0.3950).

Number of flowers per cluster had negative and significant correlation with the number of fruits (-0.7020). It had negative, though not significant correlation with yield per plant (-0.3853).

Number of fruits had positive and significant association with percentage of fruit set (0.7888) but with fruit length the association was but(-0.5880). The number of fruits had a positive, though not significant correlation with yield per plant (0.3083).

Yield per plant had positive correlation with percentage of fruit set (0.2361) but it was not significant. Fruit length (0.7345), fruit girth (0.6251), yield per plant (0.5376) had positive correlation with fruit weight.

Fruit length had positive correlation with the fruit girth (0.7664) and with yield per plant the correlation was (0.4762) positive though not significant. Girth had positive and significant correlation with yield per plant (0.6395).

4.6 Estimation of variability components , heritability and genetic advance

The variability components, viz., genotypic and phenotypic variability were assessed. The results of the variability analysis are presented in Table 13.

Results of the variability analysis revealed that the phenotypic coefficient of variation (PCV) was the highest for the character yield (62.268) followed by number of fruits (52.178) , volume of fruit (50.307), fruit weight (47.168),total sugars (36.262) , percentage of fruit set (35.020),number of flowers per cluster (28.546) , height at first flowering (27.733) and plant height (24.028).Moderate PCV values were recorded for cavity index (19.547), total carotenoids (13.712), and pulp percentage (10.385).However the character TSS (6.816) showed low PCV value.

The highest genotypic coefficient of variation (GCV) was observed for yield (55.946) and volume of fruit (48.724),followed by number of fruits (47.868) , fruit weight(45.152) , total sugars (35.135) and percentage of fruit set (34.388) Moderate GCV values were

Table 13 Genetic parameters of twelve varieties of papaya

Character	Heritability h^2 %	Genetic advance	GCV %	PCV %
Height at-6 th month	58.1	28.758	18.329	24.028
Ht at first flowering	79.6	45.475	24.7592	27.733
No of flowers/cluster	81.8	18.102	25.825	28.546
No.of fruits	84.1	90.396	47.868	52.178
% of fr. set	96.4	69.544	34.388	35.020
Fruit weight	91.6	89.004	45.152	42.168
Fruit volume	96.8	100.316	48.724	50.307
T.S.S	89.1	12.510	6.434	6.816
Total carotenoids	98.2	26.930	13.592	13.712
Total sugars	93.8	70.068	35.135	36.262
Pulp %	93.5	20.002	10.046	10.385
Cavity index	83.7	33.703	16.370	19.547
Yield	80.7	103.515	55.946	62.268

Table 14 Selection Indices of Papaya varieties in descending order

Sl No.	Varieties		Selection Indices
1	Pusa Nanha	(T11)	6664.134
2	CO 2	(T1)	5726.772
3	Pusa Dwarf	(T10)	5663.462
4	Coorg Honeydew	(T5)	5288.197
5	CO 4	(T3)	5080.925
6	Thailand	(T8)	4822.031
7	Tainung	(T9)	4546.98
8	CO 5	(T4)	4496.824
9	9-1-D	(T7)	4406.704
10	Sunrise Solo	(T6)	3393.503
11	Washington	(T12)	3256.974
12	CO 3	(T2)	3026.353

observed for number of flowers per cluster (25.825) and height at first flowering (24.759), height (18.329),cavity index (16.370) and total carotenoids (13.592).Low GCV values were recorded for TSS(6.434).

Heritability manifested wide variation in the thirteen characters studied. All the characters displayed relatively very high degree of heritability. Among the different characters studied , very high degree of heritability were recorded for total carotenoids(98.200),fruit volume(96.8) and percentage of fruit set (96.4).High heritability values were accounted for total sugars (93.800) , pulp percentage(93.500), fruit weight (91.600),TSS (89.100),number of fruits per plant (84.1) , cavity index (83.7) , number of flowers per cluster (81.800) , yield (80.7) and height at first flowering (79.600).Low values for heritability was recorded for plant by height at sixth month (58.1) followed by height at first flowering (79.6) and number of flowers per cluster (81.8).High heritability was not always accompanied by higher genetic advance.

Genetic advance was maximum for fruit volume (100.316), followed by yield (103.515) and number of fruits per plant (90.396). Genetic advance was minimum for TSS (12.510) followed by number of flowers per cluster (18.102) and pulp percentage (20.002).

4.7 Discriminent function analysis

Estimation of selection indices (discrimination indices) and ranking of the varieties based on indices are presented in Table 14.The characters used for selecting were height at sixth month, height at first flowering, number of flowers per cluster, number of fruits, percentage of fruit set, fruit weight, fruit volume, TSS, total carotenoids, total sugars, pulp percentage, cavity index and yield. The highest scoring four varieties were selected, namely T11 (Pusa Nanha), T1 (CO–2), T10 (Pusa Dwarf) and T5 (Coorg Honeydew). These varieties are in general are dwarf or medium in height , had large sized fruits, high yield , good fruit quality and less incidence of pest and diseases.

DISCUSSION

Papaya is one of the major tropical fruits suited for both nutrition gardens and for commercial orcharding. Due to year round availability of fruits, high nutritive value, reasonably high returns per unit area, easiness in management and scope for processing, this fruit has attained a place of prominence in tropical fruit orcharding. However, papaya has not attained the popularity it deserves in the cropping pattern of Kerala. Lack of varieties suited for homestead cultivation is one of the main drawbacks. Hence the present experiment was conducted with an objective of evaluating the performance of improved papaya varieties for homestead cultivation for dessert purpose. An ideal papaya variety for homesteads should be dwarf to medium in height, producing medium to large sized fruits and having good dessert qualities. Tolerance to pests and diseases and adaptability to the humid tropical climate are added advantages. The results of evaluation of twelve improved varieties of papaya with these objectives are discussed here under:

5.1 Biometric characters

5.1.1 Height of plants

The present study revealed that plant height was lower in papaya varieties Pusa Dwarf, Pusa Nanha, 9-1-D and Thailand compared to the other varieties evaluated. The varieties Tainung, Coorg Honeydew, Washington, Sunrise Solo were intermediate in the stature of plants. The varieties CO-4, CO-3, CO-2 and Sunrise Solo were comparatively taller.

Variation in plant height among papaya varieties was reported in earlier research works in similar lines. Aiyappa and Nanajappa (1959) observed that papaya variety Coorg Honeydew attains a height of 25 – 30 feet. Hamilton and Ito (1968) recorded three feet height in Sunrise Solo nine months after transplanting. According to Singh and Sirohi (1977), cultivar Washington grows to 145 cm and Coorg Honeydew to 246 cm. In the studies conducted by Ram (1983), the average plant height of Pusa Nanha was recorded to be

106 cm. According to Bose and Mitra (1985), the average height of Washington is 145 cm, CO-2 is 20 cm, Coorg Honeydew is 250 – 300 cm and Pusa Dwarf is 130 cm.

Ghanta and Mandal (1992) reported 193 cm height for CO-2. Singh and Sharma (1994) found Pusa Dwarf (140.7 cm) and CO-2 (155.7 cm) to be dwarfer compared to the other varieties evaluated. According to the reports of Dash *et al.* (1998) papaya varieties CO-2, CO-3, CO-5, Washington and Coorg Honeydew attained the height of 210.9 cm, 116.1 cm, 235.6 cm, 220.2 cm and 204.5 cm respectively.

The results of the present study in general are in confirmity with the above mentioned studies on varietal level variation in height of papaya plants. However some varieties like CO-2 and Washington recorded higher values for plant height in the present studies compared to the earlier reports. These variations may be due to the differences in the agro climatic conditions in which the experiments were conducted. The possibility of such variations in growth performance in papaya was reported by Gandhi (1945), Agnew (1951) and Nakasone and Storey (1955).

5.1.2 Girth of plants

The present studies revealed that none of the varieties differed significantly with respect to girth.

Research reports on varietal level variation on plant girth in papaya are very scanty. The results of the present studies are in agreement with the report of Purohit (1971).

5.1.3 Number of leaves

Results of present studies showed that the mean number of leaves produced per plant was more in varieties CO-4, Pusa Nanha and CO-3. The lowest number of leaves were recorded in 9-1-D. Only 9-1-D was the lowest in all stages. Sunrise Solo, CO-2, Pusa Dwarf and CO-5 were on par. No earlier reports on the number of leaves produced in papaya could be traced.

5.1.4 Time taken for first flowering and height of first flowering

In the present studies, it was observed that the shortest period for flowering was in papaya variety 9-1-D followed by CO-3. Time taken for flowering was the longest in Pusa Dwarf followed by Sunrise Solo, Washington, Pusa Nanha, CO-2 and CO-5. The other varieties were intermediate with respect to the time taken for flowering.

The results of the experiment also showed that papaya varieties Pusa Nanha, Pusa Dwarf, Thailand and Washington started flowering at the shortest height from ground level. Height of first flowering was the greatest among the varieties CO-3, Sunrise Solo, CO-2 and 9-1-D.

Varietal variation in the time taken for first flowering as observed in the present studies was reported by Subramanyam and Iyer (1981). They observed that papaya varieties take 115.40 to 146.93 days for flowering.

Selvaraj *et al.* (1982) also observed that depending upon the variety, papaya plants took 145–165 days to attain edible ripe stage. This report indirectly implies that the time for flowering in general corresponds to the earlier reports and the present studies.

According to Seemanthani (1968), staminate plants flowered at a lesser height than the pistillate plants. Studies conducted under different agro climatic conditions show variation in the height of first flowering in the same variety. In general these studies indicate that varieties Pusa Dwarf and Pusa Nanha are dwarf and bear at lower height as observed in the present studies. Studies conducted in similar lines by Ram (1982), Prasad (1982), Bose and Mitra (1985), Singh (1990), Singh and Sharma (1994) and Dash *et al.* (1998) agree with the inferences made from the present studies on the height of first flowering in different papaya varieties.

5.1.5 Time for Harvest

In the present experiment the average time taken for harvest in different varieties of papaya ranged from 132.19 days to 177.89 days. The shortest duration for harvest was recorded in Sunrise Solo followed by CO-4, 9-1-D, Tainung and Coorg Honeydew. The longest duration for harvest was in variety Thailand followed by Washington and CO-5, Pusa Dwarf, CO-2 and CO-3.

According to Subramanyam and Iyer (1981), the time for different varieties of papaya to flower varied from 115.4 to 146.93 days resulting in variation in the time taken for harvest also. Selvaraj *et al.* (1982) also reported variation in time taken for harvest of fruits in different varieties. They observed that the average duration for harvest of fruits was 145 days in Coorg Honeydew 150 days in Sunrise Solo it was 150 days, 150–155 days in Thailand and 160–165 days in Washington. Similar results were also obtained by Dash *et al.* (1998). These results in general agree with the findings of the present experiment.

5.1.6 Number of flowers per cluster

The present studies indicated that the number of flowers per cluster was higher in varieties like Thailand, 9-1-D, Pusa Dwarf and Pusa Nanha. The lowest number of flowers per cluster was recorded in CO-4, CO-2 and Coorg Honey dew. In different varieties observed, the average number of flowers per cluster ranged from 2 to 4.67. Earlier reports on the number of flowers per cluster in papaya varieties are very scanty.

Singh (1990) has reported that in papaya, the flowers in female plants are found sometimes solitary or in racemose or corymb types of inflorescence and in latter cases 5 – 6 flowers are seen per cluster.

5.2 Yield Characters

5.2.1 Percentage of fruitset and number of fruits per plant

The results of the present studies showed that the percentage of fruit set was the highest in CO-3 followed by CO-4, while the lowest was in Pusa Dwarf followed by Pusa Nanha and Tainung.

The average number of fruits per plant ranged from 10.55 to 57.31 in the varieties studied. The number of fruits per plant was the highest in CO-3 followed by CO-4. The number of fruits per plant was the lowest in Thailand followed by 9-1-D, Pusa Nanha, Washington and Pusa Dwarf.

Selvaraj *et al.* (1982) reported that the percentage of fruit set vary with varieties. They found that the percentage of fruit set in Coorg Honeydew Sunrise Solo, Thailand and Washington was 32.3, 57, 53.3 and 50.8 percent respectively. Generally in papaya, female flowers are borne either solitary or in racemose of 5 – 6. Of these, only one fruit develops and reaches harvest stage which gives satisfactory yield per plant. It is observed in the present study that in general, those varieties which produced lesser number of flowers had lower percentage of fruit set. Thus the number of flowers per cluster does not appear to adversely affect the production of satisfactory number of fruits per plant.

The earlier reports of Ram (1981), Bose and Mitra (1985) and Singh and Sharma (1994) clearly indicate that there is varietal level variation in the number of fruits per plant. According to these studies, the average number of fruits in different varieties under varied climatic conditions are 7 – 43 in Washington, 21 – 40 in CO-2, 10 – 21 in Coorg Honey dew, 35 – 40 in CO-3 and 40 in CO-4, 50 –60 in Sunrise Solo, 27 – 40 in Pusa Dwarf, 16 in Pusa Nanha and 15 in CO-5.

In the present studies also such variation in the average number of fruits per plant was observed. This may be due to the adaptability of the varieties tested to the climatic conditions of the locality. The studies also indicate that the percentage of fruit set has more relation with the number of fruits produced than the number of flowers per cluster. It may

be the increase in the number of flower producing leaf axils, which may be more, related to the total fruit production per plant. The present studies on the number of leaves produced per plant show possibilities of this sort of relationship between productive leaf axils and number of fruits per plant. It was seen that varieties such as CO-3 and CO-4, which had higher number of leaves had more number of fruits per plant also. The genotypic correlation studies in the present experiment also indicate that the number of leaves has significant and positive correlation with the number of fruits per plant.

5.2.2 Fruit Weight

In the varieties evaluated, the average fruit weight ranged from 0.29 kg to 1.75 kg. The results of the experiment indicate that fruit weight was the highest in Pusa Nanha followed by Pusa Dwarf, CO-2 and Coorg Honeydew, while the lowest weight of fruits was in CO-3, followed by Sunrise Solo and Washington.

Rao *et al.* (1958) reported that the weight of an average papaya is 1.0 to 1.5 kg. Varietal variation in fruit weight in papaya was reported by Desikan (1972), Shah and Shanmugavelu (1975), Ram (1981), Singh (1990) as well as Singh and Sharma (1994). From a compilation of these results, the fruit weights of important papaya varieties show variation under different agro climatic conditions. The average weight of Coorg Honey Dew varied from 0.400 kg – 1.93 kg, Washington from 0.395 kg – 2.9 kg, CO-2 from 0.692 kg – 1.991 kg, Sunrise Solo from 0.425 – 0.620 kg, Pusa Dwarf was 1.593 kg, Pusa Nanha was 1.830 kg and CO-5 was 1.283 kg and CO-1 was 1.24 kg.

The average fruit weights in different papaya varieties in the present experiment are in the range recorded in these earlier reports in similar lines.

5.2.3 Fruit length and girth

Fruit length among the varieties evaluated ranged from 14.887 cm to 27.143 cm. Length of fruits was the highest in Pusa Nanha followed by Thailand and 9-1-D. Varieties Pusa Dwarf, CO-4 and Tainung produced medium sized fruits. Lowest fruit length was

observed in varieties Sunrise Solo, CO-3, Coorg Honeydew and Washington.

The present studies indicate that among the varieties evaluated Pusa Nanha had the highest fruit girth. Pusa Dwarf and CO-2 produced medium thick fruits. Mean Fruit girth was the lowest in Coorg Honeydew. This was followed by CO-3, Washington and Sunrise Solo. The mean fruit girth ranged from 16.52 cm to 49.72 cm in the varieties observed.

Studies in the variation of fruit length and girth in different varieties of papaya were conducted by scientists like Desikan (1972), Wagh *et al.* (1992) and Singh and Sharma (1994). According to their reports, the fruit length of different varieties of papaya ranged from 9.83 cm in Sunrise Solo to 26.57 cm in Coorg Honeydew under varied climatic conditions. The girth of fruits ranged from 13.50 cm in Sunrise Solo to 54.20 cm in Coorg Honey Dew. In the present studies also, similar variations in the fruit length and girth were observed.

5.2.4 Volume of fruits

Among the different papaya varieties included in the present study, Pusa Nanha had the highest fruit volume. This was followed by Pusa Dwarf, CO-4, CO-2 and Coorg Honey dew. The volume of the fruits was the lowest in CO-3 followed by Washington and Sunrise Solo. The mean volume of fruits ranged from 213.61 cc to 1537.22 cc among the varieties evaluated.

Indications of variation in fruit volume in different varieties of papaya are available in the studies of Hofmeyer (1936), Shah and Shanmugavelu (1975) and Selvaraj *et al.* (1982).

5.2.5 Pulp percentage and Cavity Index.

The pulp content of different varieties of papaya evaluated in the present studies ranged from 59.21 to 87.44 percent. The highest pulp percentage was observed in Tainung. This was followed by Coorg Honeydew, Thailand, 9-1-D and CO-5. Pulp percentage was the lowest in CO-3.

The cavity index of the twelve varieties of papaya did not differ significantly. According to Hofmeyer (1936) small fruits have higher unit volume weight than larger fruits due to the relatively smaller seed cavities. Agnew (1951) has observed that effective pollination and consequent seed development will contribute to both size and shape of fruits. In general, it can be observed that varieties like Coorg Honey Dew, Tainung etc having lower cavity index had higher pulp percentage. This is due to the fact that edible portion per unit volume of fruit is higher when the cavity is shallow. This is in confirmity with the report of Hofmeyer (1936).

5.2.6 Seed content

The present studies revealed that papaya varieties Thailand, Coorg Honey dew, Tainung and CO-5 had low seed content while CO-2, Pusa Nanha, CO-4 and Pusa Dwarf had high seed content.

In general, the varieties having high seed content had higher fruit volume. Apart from this factor, the varietal variations in fertility, which was not studied in the present experiment, may also have contributed to the variation in seed content of the fruits. Agnew (1951) also has reported that the amount of seeds indicates the degree of effective pollination and is correlated with both size and shape of fruit.

5.2.7 Yield per plant

The current experiment revealed that yield in different varieties of papaya tested ranged from 5.61 to 39.68 kg per plant. Fruit yield was the highest in CO-2 and CO-4. Varieties Washington, Sunrise Solo, Thailand, Coorg Honeydew and Tainung recorded low average yield per plant on weight basis. Ram (1981) obtained an average yield of 17 kg per plant from Washington, 27 kg from CO-2 and 4.0 kg from Coorg Honey Dew. The mean yield in CO-2, CO-3, CO-4, CO-5, Sunrise Solo, Washington, Thailand, Coorg Honey Dew, and Pusa Dwarf was 22.46, 4.88, 11.84, 8.54, 5.92, 21.71, 7.81, 7.65 and 7.35 kg respectively in the evaluation of varietal performance done by Wagh *et al.* (1992).

The mean yield recorded in a similar experiment Singh and Sharma (1994) was 44.43 kg, 30.54 kg, 42.74 kg, 13.95 kg, 30.90 kg and 20.64 kg in papaya varieties Pusa Dwarf, Pusa Nanha, CO-2, Washington, Coorg Honey Dew and CO-5 respectively. The results of the above experiments show wide variation in yield of different varieties under varied climatic conditions. Such variations in the performance of papaya varieties were due to seasonal and environmental effects have been reported by Gandhi (1945), Agnew (1951) as well as Nakasone and Storey (1955). The yield of papaya varieties recorded in the present experiment in general fall in the yield range reported in the previous experiments in similar lines.

5.3 Quality characters

5.3.1 TSS (Total Soluble Solids)

Among the varieties tested in the current studies the highest TSS values were recorded in Sunrise Solo. This was followed by Thailand and Coorg Honey dew. The TSS content was lowest in Pusa Dwarf. In general, the TSS content of different varieties ranged from 11.6 percent to 14.78 percent.

According to Mehta and Tomar (1980), the TSS content of papaya varieties in general is 10.0 per cent. Ram (1981) opines that variation in TSS content of papaya varieties can range from 6 to 13 per cent. The experimental results in variation of TSS content of different papaya varieties show a range of 9.8 per cent to 11 per cent in Coorg Honey Dew, 10.7 per cent to 15 per cent in Sunrise Solo, 9.8 per cent to 10 per cent in Thailand, 11.8 per cent to 12.4 per cent in Washington, 11.5 per cent to 12.5 per cent in CO-2, 13.8 per cent to 14.6 per cent in CO-3, 13.2 per cent to 13.5 per cent in CO-4, 12 per cent to 13 per cent in CO-5, 6.5 per cent to 8 per cent in Pusa Nanha, 6.5 per cent in Pusa Dwarf.

Such variations are observed in the reports of Singh and Sirohi (1977), Mehta and Tomar (1980),Pal *et al* (1980) Bose and Mitra (1985), Veeranah *et al.* (1985) and Singh

(1990). Accomodating slight variations due to environmental effects, the TSS values recorded in the varieties included in the present studies are more or less in the same range recorded in the above mentioned works.

5.3.2 Acidity

The data revealed that acidity of the fruits was the lowest in CO-4 followed by Tainung and Thailand. Varieties Coorg Honeydew and Washington also had comparitively low acidity. Fruits of CO-2 showed the highest acidity followed by Pusa Dwarf and 9-1-D. In general, the acidity of fruits of the varieties evaluated ranged between 0.71 per cent to 0.10 per cent.

According to Akamine and Goo (1971) and Pal *et al* (1980) total titrable acidity is considerably low in papaya fruits. Mehta and Tomar (1980) reported that in general, acidity of papaya is around 0.14 per cent. Auxcilia and Sathiamoorthy (1996) observed an acidity range of 0.10 per cent to 0.19 per cent in different papaya varieties.

Observations of Pal *et al* (1980) and Selvaraj *et al.* (1982) show that the acidity of fruits of Washington is 0.05 per cent, 0.05 per cent to 0.07 per cent in Coorg Honey Dew, 0.04 per cent to 0.05 per cent in Sunrise Solo and 0.44 per cent to 0.05 per cent in Thailand under varied agro climatic situations. The results of the present study also agree with the above mentioned reports.

5.3.3 Ascorbic Acid

The ascorbic acid content of the papaya varieties evaluated in the present studies varied from 62.01 per cent to 131.25 per cent. The highest ascorbic acid content was recorded in CO-3, while the lowest was in the fruits of CO-5.

In general the ascorbic acid content of papaya varieties is around 46 mg per 100 gram (Mehta and Tomar, 1980). Studies on quality of papaya varieties conducted by Auxcilia and Sathiamoorthy (1996) showed a variation in ascorbic acid content ranging between 27.65 mg per 100 gram to 65.57 mg per 100 gram. The studies in similar lines

conducted by Chittiraichelvan and Shanmugavelu (1977), Janabaigiri *et al.* (1980), Selvaraj and Pal (1982) show that in Solo, ascorbic acid content varied from 1.310 mg per 100 gram to 1.660 mg per 100 gram, in Coorg Honey Dew 64.6 mg per 100 gram to 66 mg per 100 gram, Sunrise Solo 46.3 mg per 100 gram to 75.5 mg per 100 gram, in Thailand 46.6 mg per 100 gram to 74.1 mg per 100 g and in Washington 75.36 mg per 100 mg to 78.1 mg per 100 gram. Such variations in ascorbic acid content of the varieties were observed in the present experiment also. The higher values in ascorbic acid content of varieties observed in the present experiment may be due to the difference in varietal character and the environmental effects.

5.3.4 Total Carotenoids

Total carotenoid content in the papaya varieties evaluated in the present studies ranged from 1.64 per cent to 2.47 per cent. The highest carotenoid content was recorded in Sunrise Solo, Washington and Coorg Honeydew. The lowest values was recorded in CO-2.

Chittiraichelvan and Shanmugavelu (1979) observed that towards eating ripe stage, the carotenoid content of CO-2 papaya reached 5 mg/100gram. According to Janabaigiri *et al.* (1980), the carotenoid content of fruits of CO-2 was 1.89 mg per 100 gram, in Washington it was 1.01 mg per 100 gram and in Honey Dew it was 0.96 mg per 100 gram. A range of 3.35 mg per 100 gram to 7.6mg per100gram to 7.67 mg per 100 gram carotenoid content in different vareities of papaya was recorded by Auxcilia and Sathiamoorthy (1996). Similar variations in carotenoid content were observed in the present studies also. The slight variations in carotenoids observed in the same variety in different studies may be due to the effect of differences in climatic conditions and cultural practices.

5.3.5 Sugar Contents

Reducing sugar contents in the fruits of the varieties evaluated in the present studies ranged from 4.31 percent to 11.87 percent. Reducing sugar was the highest in the fruits of Coorg Honeydew and CO-5. Fairly high reducing sugar content was recorded in CO-2. The lowest content of reducing sugars was recorded in CO-4 followed by Pusa Nanha

and Pusa Dwarf.

Non reducing sugars in the papaya varieties studied showed a range of variation from 0.33 per cent to 10.84 per cent. The varieties Sunrise Solo and 9-1-D had the highest non reducing sugars while fairly high values were recorded in 9-1-D.The varieties Pusa Nanha followed by CO-3, Pusa Dwarf, Tainung and CO-5 had low non reducing sugar content.

Total sugar content in the varieties evaluated showed a range of 5.44 per cent to 19.655 per cent. The highest total sugar content was in Sunrise Solo and 9-1-D. Varieties CO-2, Coorg Honeydew and CO-5 also had comparitively high total sugars in the fruits. The lowest values for total sugars were recorded in Pusa Nanha, CO-4 and Pusa Dwarf.

According to Jones and Kubota (1940), papaya is a non-starchy fruit and the synthesis of sugars in ripening fruits from precursors like starch, pectin, hemicellulose and organic acids in the fruit tissues. These changes are largely influenced by factors like temperature, time and physical status of the fruit.

According to Harvey and Chan (1979), Mehta and Tomar (1980) and Auxcilia and Sathiamoorthy (1996), the reducing sugar content of papaya varieties is in the range of 5.3 per cent to 11.79 per cent, non reducing sugars in the range of 0.18 per cent to 1.38 per cent and total sugars in the range of 7.86 per cent to 12.75 per cent in the varieties evaluated by them. The experimental results of Desikan (1972), Selvaraj *et al.* (1982), Selvaraj and Pal (1982), the total sugar content of Washington is 9.81 per cent and Coorg Honeydew is 10.14 per cent. In the present studies also variation in sugar content of papaya fruits were observed as reported by earlier workers in the same field.

5.3.6 Fruit Shape

Variation in the shape of fruits on visual observation in different varieties of papaya was observed in the present study. Obovoid to ellipsoid fruit shape was observed in CO-2, CO-3, CO-4, 9-1-D, Thailand, Pusa Dwarf, Pusa Nanha and Washington. Spherical

fruit shape was observed in CO-5 oval shape in Coorg Honeydew and pyriform in Sunrise Solo.

Fruit shapes reported in different papaya varieties vary from spherical to slightly obovoid, obovoid and long cylindrical to ellipsoid with a more or less bulbous apex. Storey (1936) has reported that fruit shape may vary depending on the type of flower. Rao *et al.* (1974) reported CO-2 fruits to be oblong in shape. According to Purohit (1981), the shape of Coorg Honeydew fruits is long to oval. The fruits of Washington are ovate – oblong, CO-2 are oblong and Pusa Nanha are ovate according to Singh (1990). These reports in general agree with the results of the present experiment.

5.3.7 Colour of peel and pulp

The peel colour of the varieties included in the present study varied from greenish yellow to yellow and deep yellow at edible ripe stage. The varieties CO-3, CO-4, Sunrise Solo, Tainung and Washiongton had greenish yellow peel colour while CO-5, Coorg Honeydew, Thailand and Tainung had deep yellow colour. The peel colour of Pusa Dwarf and Pusa Nanha was yellow. Peel of CO-2 was light yellow at edible ripe stage.

Colour of pulp ranged from yellow and orange to pinkish red. Varieties Sunrise Solo, Thailand and Tainung had orange to pinkish red pulp colour while rest of varieties had yellow colour.

Akamine and Goo (1971) reported that papaya fruits develop yellow skin colour on nearly one-third portion at edible ripe stage. Pal *et al.* (1980) observed that pulp colour of papaya varieties vary from pure yellow to pink. Results from the experiments in similar lines by Rao *et al.* (1974),Purohit(1981)andSingh (1990) also agree with such colour variation in different papaya varieties as observed in the current studies.

Slight differences in the intensity of colour development especially in the pulp may be due to the differences in climatic conditions under which the crops were raised, since the temperature and such climatic factors play an important role in the development of colour

contributing plant pigments such as carotenoids, xanthophylls etc.

5.3.8 Firmness of pulp

Among the varieties observed, CO-3, CO-4, Sunrise Solo, Thailand and Tainung had firm flesh at edible ripe stage, while CO-5 and Pusa Dwarf had less firm flesh. Fairly firm flesh was noted in varieties CO-2, Coorg Honeydew, 9-1-D, Pusa Nanha and Washington.

Firmness of flesh of fruits is mainly due to the physico-chemical properties of the cell wall and middle lamella (Dilley, 1970). In papaya varieties, the flesh firmness varies from hard to soft (Pal *et al*, 1980). The difference in the firmness provides chance for choice of soft or hard fleshed varieties based on personal preferences and requirements for preparation of various products also.

5.3.9 Organoleptic Qualities

The organoleptic qualities of the papaya varieties included in the present study gave the following indications:

The variety Tainung obtained high score for appearance followed by Thailand and CO-2 while Pusa Dwarf obtained the low score followed by CO-5 and CO-3.

The score for pulp colour was high for CO-2 followed by 9-1-D and CO-3 while low for Pusa Dwarf, CO-5, Pusa Nanha and Washington.

High score for flavour was secured by Sunrise Solo followed by Tainung and Thailand and low scores by Pusa Dwarf, Pusa Nanha and CO-5.

The score for taste was high in Tainung, Sunrise Solo, CO-3, Washington and CO-4 while low in CO-5, Pusa Dwarf, 9-1-D and Pusa Nanha.

Maximum score for texture of pulp was secured by Thailand followed by Sunrise Solo and CO-2 while low score was obtained by Pusa Dwarf followed by Pusa Nanha

and Tainung.

Varieties CO-2 followed by CO-4 and CO-3 had less papain odour while Pusa Nanha followed by Tainung had high papain odour.

The results of the overall assessment of organoleptic qualities indicated that among the varieties tested, Sunrise Solo was the most acceptable followed by Tainung, Thailand and 9-1-D. In the order of preference, Pusa Dwarf and Pusa Nanha were the last.

In papaya, the personal preference and acceptability are largely decided by factors such as colour of pulp, firmness or softness of the pulp, taste, flavour, freedom from objectionable papain odour etc. Based on these characters the evaluation revealed that varieties Sunrise Solo, Thailand and 9-1-D were most acceptable. These varieties had appealing pinkish to orange red pulp colour, high TSS content, low acidity, fairly high carotenoid content, firm pulp and low papain odour compared to the other varieties under evaluation.

5.4 Incidence of Pests and Diseases

No major pests were recorded among the twelve varieties of papaya. Studies on the diseases showed varietal variation. Diseases of leaves was high in CO-3, and CO-4 while low in Pusa Dwarf, Pusa Nanha and Thailand . Damage to the stem was high in Coorg Honeydew, CO-4 and CO-3, while low in Pusa Dwarf, CO-2 and Pusa Nanha. Damage to the fruits was high in CO-4 and CO-3. It was observed that in general, papaya varieties Pusa Dwarf, Pusa Nanha, Thailand, Tainung had less damage to the plant and fruit during the course of the experiment.

Ram (1982) observed more virus diseases in papaya varieties during rainy season when the vectors were most active. According to Prasad (1982) three strains of virus attack papaya in the humid condition. A further study of Ram (1983) indicates no serious disease incidence in Pusa Nanha. Taya and Singh (1995) reported that in the dry belt of Haryana disease incidence in papaya was comparitively less.

These reports indicate of varietal level difference and influence of climatic factors in disease incidence as observed in the present experiment.

5.5 Association of vegetative characters with yield

The results of the present studies reveal that the fruit yield had highly significant positive phenotypic correlation with character like fruit girth. Positive but not significant correlation was found for yield with height at sixth month, leaves at sixth month, girth at sixth month, height at first flowering, number of flowers per cluster, percentage of fruit set, number of fruits, fruit weight and fruit length.

Yield had positive and significant genotypic correlation with height at sixth month, number of leaves, fruit weight and fruit girth. Results reveal that yield had positive and insignificant correlation with plant girth at sixth month, number of fruits, percentage of fruit set and fruit length. Negative correlation was found for characters like height at first flowering and number of flowers per cluster, but they were not significant.

Correlation provides information on the nature and extend of association between characters in a population. The component characters always show inter relationships. When selection pressure is applied on a trait, the population under selection is not only improved for that trait, but also for other characters asssociated with it. This facilitates simultaneous improvement for that trait and for other characters associated with it. Therefore analysis of yield in terms of phenotypic and environmental correlation coefficients of component characters leads to the understanding of characters that can form the basis of selection.

In papaya, Nakasone and Storey (1955), Purohit (1978), Chittiraichelvan and Shanmugavelu (1978) and Magdalita *et al.* (1984) conducted correlation studies. Ram et al. (1984) observed that fruit yield was highly correlated with fruit weight and number of fruits per plant in papaya. Highly positive phenotypic correlation of yield with fruit weight and number of fruits per plant were obtained in the present study. Positive and significant

genotypic correlation was found for fruit yield with fruit weight and positive correlation was found with number of fruits.

Highly positive phenotypic and genotypic association of yield was noticed in papaya with number of fruits, fruit weight and fruit length. Significant positive genotypic correlation was revealed for the character fruit weight. These were in confirmity with reports of Dinesh (1989).

5.6 Estimation of variability components, heritability and genetic advance

The results of present studies revealed that the phenotypic, genotypic coefficients were high for yield, number of fruits, volume of fruit, fruit weight, total sugars and percentage of fruit set. However the phenotypic and genotypic coefficients of variation were moderate for number of flowers per cluster, height at first flowering, height of plant at sixth month, cavity index, total carotenoids and pulp percentage.

Khadi and Singh (1980) observed high genotypic variability for yield per plant and number of fruits per plant in papaya. This was in accordance with the results obtained in this research work. Subramanyam and Iyer (1981) conducted similar experiments. They also obtained moderately high genotypic coefficient of variation for fruit weight and volume in papaya as obtained in the present studies. Ghanta and Mandal (1992) also obtained similar results. They got high genotypic coefficient of variation for fruit yield per plant.

Results of the present studies revealed that the heritability values were very high for the characters total carotenoids, followed by fruit volume and percentage of fruit set. Total sugars, pulp percentage, fruit weight, T.S.S, number of fruits, cavity index, number of flowers per cluster and yield had high heritability values. Minimum heritability was recorded by height of plant at sixth month, followed by height at first flowering and number of flowers per cluster.

The high heritability for number of fruits per plant obtained by Vasquez and Galan

(1973) are in agreement with the results obtained in the present studies. The high heritability values for yield per plant and number of fruits in papaya are in consonance with the findings of Khadi and Singh (1980). The high heritability for morphological characters andyield recorded by Subramanyam and Iyer(1981) are in accordance with the results obtained in the present studies.High heritability for fruit yield per plant obtained in the present study is in accordance with the findings of Ghanta and Mandal(1992) except for the plant height.

Genetic advance was maximum for fruit volume, followed by yield and number of fruits. High genetic advance obtained in the character yield is in accordance with that of Ghanta and Mandal(1992).

5.5 Discriminent Function Analysis

Based on the desirable horticultural traits the highest scoring varieties were Pusa Nanha and CO-2.The varieties Pusa Nanha had dwarf stature,medium to large fruit size while CO-2 had high yield,moderate organoleptic qualities and both were less susceptible to major pests and diseases.The varieties Pusa Dwarf and Coorg Honeydew were also found to perform well with respect to growth,yield quantity and hence can be grown for dessert purpose in the homesteads.

SUMMARY

SUMMARY

The present investigations entitled"Evaluation of Papaya variety (*Carica papaya* L.) for dessert purpose" were carried out to select elite types of papaya having superior horticultural traits for cultivation in Kerala. The experiment using twelve improved varieties of papaya was laid out in the Department of Horticulture, College of Agriculture, Vellayani, Thiruvananthapuram during 1997 to 1999. Major findings of the study are summarised below.

The present study revealed that plant height was lower in papaya varieties Pusa Dwarf, Pusa Nanha, 9-1-D and Thailand compared to the other varieties evaluated. The varieties Tainung, Coorg Honeydew, Washington, Sunrise Solo were intermediate in the stature of plants. The varieties CO-4, CO-3, CO-2 and Sunrise Solo were comparatively taller.

The present studies revealed that none of the varieties differed significantly with respect to girth. During the full-grown stage papaya varieties CO-4, CO-3 and CO-2 showed more plant girth compared to the other varieties under evaluation.

Results of present studies showed that the mean number of leaves produced per plant was more in varieties CO-4, Pusa Nanha and CO-3. The lowest number of leaves were recorded in 9-1-D.Only 9-1-D was the lowest in all stages. Sunrise Solo, CO-2, Pusa Dwarf and CO-5 were on par.

In the present studies, it was observed that the shortest period for flowering was in papaya variety 9-1-D followed by CO-3. Time taken for flowering was the longest in

Pusa Dwarf followed by Sunrise Solo, Washington, Pusa Nanha, CO-2 and CO-5. The other varieties were intermediate with respect to the time taken for flowering.

The experiment also showed that papaya varieties Pusa Nanha, Pusa Dwarf, Thailand and Washington started flowering at the shortest height from ground level. The shortest duration for harvest was recorded in Sunrise Solo followed by CO-1, 9-1-D, Tainung and Coorg Honeydew. The longest duration for harvest was in variety Thailand followed by Washington and CO-5, Pusa Dwarf, CO-2 and CO-3. The number of flowers per cluster was higher in varieties like Thailand, 9-1-D, Pusa Dwarf and Puss Nanha. The lowest number of flowers per cluster was recorded in CO-4, CO-2 and Coorg Honey dew. The results of the present studies showed that the percentage of fruit set was the highest in CO-3 followed by CO-1, while the lowest was in Pusa Dwarf followed by Pusa Nanha and Washington.

The average number of fruits per plant ranged from 10.58 to 57.31 in the varieties studied. The number of fruits per plant was the highest in CO-3 followed by CO-4. Fairly high number of fruits were harvested from Sunrise Solo, Coorg Honeydew and CO-2. In the varieties evaluated, the average fruit weight ranged from 0.29 kg to 1.75 kg. The results of the experiment indicate that fruit weight was the highest in Pusa Nanha followed by Pusa Dwarf, CO-2 and Coorg Honeydew, while the lowest weight of fruits was in CO-3, followed by Sunrise Solo and Washington. Length of fruits was the highest in Pusa Nanha followed by Thailand and 9-1-D. Varieties Pusa Dwarf, CO-4 and Tainung produced medium sized fruits. The present studies indicated that among the varieties evaluated Pusa Nanha had the highest fruit girth. Pusa Dwarf and CO-2 were intermediary in

thickness of fruits.

The pulp content of different varieties of papaya evaluated in the present studies ranged from 59.21 to 87.44 percent. The highest pulp percentage was observed in Tainung. This was followed by Coorg Honeydew, Thailand, 9-1-D and CO-5. The cavity index of the twelve varieties of papaya did not differ significantly. The present studies revealed that papaya varieties Thailand, Coorg Honeydew, Tainung and CO-5 had low seed content.

The current experiment revealed that yield in different varieties of papaya tested ranged from 5.61 to 39.68 kg per plant. Fruit yield was the highest in CO-2 and CO-4. Varieties Washington, Sunrise Solo, Thailand, Coorg Honeydew and Tainung recorded low average yield per plant on weight basis. Among the varieties tested in the current studies the highest TSS values were recorded in Sunrise Solo. This was followed by Thailand and Coorg Honeydew. The TSS content was lowest in Pusa Dwarf.

The data revealed that acidity of the fruits was the lowest in CO-4 followed by Tainung and Thailand. Fruits of CO-2 showed the highest acidity followed by Pusa Dwarf and 9-1-D. The highest ascorbic acid content was recorded in CO-3, while the lowest was in the fruits of CO-5.

The highest carotenoid content was recorded in Sunrise Solo, Washington and Coorg Honeydew. Reducing sugar was the highest in the fruits of Coorg Honeydew and CO-5. The varieties Sunrise Solo and 9-1-D had the highest non-reducing sugars. The varieties Pusa Nanha followed by CO-3, Pusa Dwarf, Tainung and CO-5 had low non-reducing sugar content.

Variation in the shape of fruits on visual observation in different was observed in the

present study. Obovoid to ellipsoid fruit shape was observed in CO-2, CO-3, CO-4, 9-1-D, Thailand, Pusa Dwarf, Pusa Nanha and Washington. Spherical varieties of papaya fruit shape was observed in CO-5, oval shape in Coorg Honeydew and pyriform in Sunrise Solo.

The varieties CO-3, CO-4, Sunrise Solo, Tainung had greenish yellow peel colour while CO-5, Coorg Honeydew, Thailand and Tainung had deep yellow colour. The peel colour of Pusa Dwarf and Pusa Nanha was yellow. Peel of CO-2 was light yellow at edible ripe stage.

Varieties Sunrise Solo, Thailand and Tainung had orange to pinkish red pulp colour while rest of varieties had yellow colour. Among the varieties observed, CO-3, CO-4, Sunrise Solo, Thailand and Tainung had firm flesh at edibile ripe stage, while CO-5 and Pusa Dwarf had less firm flesh.

The variety Tainung obtained high score for appearance followed by Thailand and CO-2. The score for pulp colour was high for CO-2 followed by 9-1-D and CO-3. High score for flavour was secured by Sunrise Solo followed by Tainung and Thailand. The score for taste was high in Tainung, Sunrise Solo, CO-3, Washington and CO-4.Maximum score for texture of pulp was secured by Thailand followed by Sunrise Solo and CO-2. Varieties CO-2 followed by CO-4 and CO-3 had less papain odour. The results of the overall assessment of organoleptic qualities indicated that among the varieties tested, Sunrise Solo was the most acceptable followed by Tainung, Thailand and 9-1-D. In the order of preference, Pusa Dwarf and Pusa Nanha were the last.

No major pests were recorded among the twelve varieties of papaya. Studies on the

diseases showed varietal variation in reaction. Diseases to leaves was low in Pusa Dwarf, Pusa Nanha, Thailand and Tainung.Damage to the stem was low in Pusa Dwarf, CO-2 and Pusa Nanha. No damage was observed in fruits of Pusa Nanha, 9-1-D and Tainung.

The fruit yield had highly significant positive phenotypic correlation with character like fruit girth. Yield had positive and significant genotypic correlation with height at sixth month, number of leaves, fruit weight and fruit girth.

The results of present studies revealed that the phenotypic, genotypic coefficients were high for yield, number of fruits, volume of fruit, fruit weight, total sugars and percentage of fruit set. The heritability values were very high for the characters total carotenoids, followed by fruit volume and percentage of fruit set. Total sugars, pulp percentage, fruit weight, T.S.S, number of fruits, cavity index, number of flowers per cluster and yield had high heritability values. Genetic advance was maximum for fruit volume, followed by yield and number of fruits.

Based on the desirable Horticultural traits the highest scoring varieties, were Pusa Nanha and CO-2. The variety Pusa Nanha had dwarf stature, medium to large fruit size while CO-2 had high yield, moderate organoleptic qualities and both were less susceptible to major pests and diseases. The varieties Pusa Dwarf and Coorg Honeydew were also found to perform well with respect to growth, yield and quantity and hence can be grown for dessert purpose in the homesteads.

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APPENDIX

APPENDIX- I

Score Card For Assessing Organoleptic Qualities of Papaya varieties

CRITERIA		VARIETIES											
		V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12
1. Appearance													
Very good	-4												
Good	-3												
Fair	-2												
Poor	-1												
2. Colour													
Most acceptable	-4												
Acceptable	-3												
Fairly acceptable	-2												
3. Flavour													
Most acceptable	-4												
Acceptable	-3												
Fairly acceptable	-2												
Not acceptable	-1												
4. Taste													
Very good	-4												
Good	-3												
Fair	-2												
Poor	-1												
5. Texture													
Firm,crisp & melting	-4												
Firm,crisp not melting	-3												
Fairlyfirm,crisp not melting	-2												
Too soft or too hard	-1												
6. Papain odour													
Not at all present	-4												
Not mildly present	-3												
Mildly present	-2												
Strongly present	-1												

Name and Signature

APPENDIX -2

Evaluation Card for Triangle Test

In the triangle test three sets of sugur solution of different concentration were used of the three sets, two solutions were of indentical concentrations and the members were asked to identity the thrid sample which was of differ ent concentration.

Name of the prroduct : Sugar Solution

Note : Two of the three samples are identical, identify the odd sample.

Sl No	Code No. of the samples	Code No. of the identical samples	Code No. of the odd samples
1	XYZ		
2	ABC		

APPENDIX-3

Weather data prevailed during the cropping period

Year and month		Temperature(°c) Mean Maximum	Mean Minimum	Relative humidity (%)	Evaporation rate	Total rainfall (mm)	Total day-length (hours)
1998	July	29.6	24.1	82.5	2.3	108.7	147.3
	August	29.9	24.3	84.0	3.4	139.3	154.4
	September	29.5	24.2	87.5	3.4	312.8	179.7
	October	29.7	23.6	85.0	3.0	424.6	160.4
	November	30.1	23.2	82.8	3.1	356.0	146.1
	December	30.6	22.8	86.0	2.4	142.4	140.1
1999	January	31.2	22.0	84.6	3.2	5.2	234.3
	February	31.4	22.8	81.9	3.9	78.6	249.1
	March	32.5	24.4	80.7	4.3	58.2	277.2
	April	31.4	24.9	82.2	3.9	147.2	190.4
	May	31.5	24.8	89.3	3.2	408.5	179.7
	June	29.5	23.9	85.2	2.9	297.4	199.2
	July	29.0	23.5	84.1	3.6	154.2	188.6

EVALUATION OF PAPAYA (*Carica papaya*.L) VARIETIES FOR DESSERT PURPOSE

BY
LAKSHMI UNNITHAN

ABSTRACT OF THE THESIS
SUBMITTED IN PARTIAL FULFILMENT OF
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COLLEGE OF AGRICULTURE
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ABSTRACT

The present investigations entitled "Evaluation of Papaya varieties (*Carica papaya* L.) for dessert purpose" were carried out to select elite types of papaya having superior horticultural traits for cultivation in Kerala. The experiment using twelve improved varieties of papaya was laid out in the Department of Horticulture, College of Agriculture, Vellayani, Thiruvananthapuram during 1997 to 1999. Major findings of the study are summarised below.

The present study revealed that plant height was lowest in papaya varieties Pusa Dwarf and Pusa Nanha. None of the varieties differed significantly with respect to girth. Results of present studies showed that the mean number of leaves produced per plant was more in variety CO-4.

In the present studies, it was observed that the shortest period for flowering was in papaya variety 9-1-D. The experiment also showed that papaya varieties Pusa Nanha and Pusa Dwarf started flowering at the shortest height from ground level. The shortest duration for harvest was recorded in Sunrise Solo. The longest duration for harvest was in variety Thailand. The number of flowers per cluster was higher in varieties like Thailand and lowest in CO-4. The results of the present studies showed that the percentage of fruit set was the highest in CO-3 and was the lowest in Pusa Dwarf.

The results of the experiment indicate that fruit weight was the highest in Pusa Nanha while the lowest weight of fruits was in CO-3, Length of fruits was the highest in Pusa

Nanha. The present studies indicate that among the varieties evaluated Pusa Nanha had the highest fruit girth. Pusa Nanha had the highest fruit volume and the lowest was recorded in CO-3.

The highest pulp percentage was observed in Tainung. The cavity index of the twelve varieties of papaya did not differ significantly. The present studies revealed that papaya variety Thailand had low seed content. Fruit yield was the highest in CO-2.

The highest TSS values were recorded in Sunrise Solo and lowest in Pusa Dwarf. The data revealed that acidity of the fruits was the lowest in CO-4 and fruits of CO-2 showed the lowest acidity. The highest ascorbic acid content was recorded in CO-3, while the lowest was in the fruits of CO-5. The highest carotenoid content was recorded in Sunrise Solo, Washington and Coorg Honeydew. Reducing sugar was the highest in the fruits of Coorg Honeydew and CO-5. The varieties Sunrise Solo had the highest non-reducing sugars and the varieties Pusa Nanha had low non-reducing sugar content.

Variation in the shape of fruits on visual observation in different was observed in the present study. Obovoid to ellipsoid fruit shape was observed in CO-2, CO-3, CO-4, 9-1-D, Thailand, Pusa Dwarf, Pusa Nanha and Washington. Spherical varieties of papaya fruit shape was observed in CO-5, oval shape in Coorg Honeydew and pyriform in Sunrise Solo.

The varieties CO-3, CO-4, Sunrise Solo, Tainung had greenish yellow peel colour while CO-5, Coorg Honeydew, Thailand and Tainung had deep yellow colour. The peel colour of Pusa Dwarf and Pusa Nanha was yellow. Peel of CO-2 was light yellow at edible ripe stage. Varieties Sunrise Solo, Thailand and Tainung had orange to pinkish red

pulp colour while rest of varieties had yellow colour. Among the varieties observed, CO-3, CO-4, Sunrise Solo, Thailand and Tainung had firm flesh at edibile ripe stage, while CO-5 and Pusa Dwarf had less firm flesh.

The variety Tainung obtained high score for appearance. The score for pulp colour was high for CO-2. High score for flavour was secured by Sunrise Solo. The score for taste was high in Tainung.Maximum score for texture of pulp was secured by Thailand. The variety CO-2 had less papain odour. The results of the overall assessment of organoleptic qualities indicated that among the varieties tested, Sunrise Solo was the most acceptable followed by Tainung, Thailand and 9-1-D.

No major pests were recorded among the twelve varieties of papaya. Studies on the diseases showed varietal variation in reaction. Diseases to leaves was low in Pusa Dwarf, Pusa Nanha, Thailand and Tainung.Damage to the stem was low in Pusa Dwarf, CO-2 and Pusa Nanha. No damage was observed in fruits of Pusa Nanha, 9-1-D and Tainung.

The results of the present studies reveal that the fruit yield had highly significant positive phenotypic correlation with character like fruit girth. Yield had positive and significant genotypic correlation with height at sixth month, number of leaves, fruit weight and fruit girth.

The results of present studies revealed that the phenotypic, genotypic coefficients were high for yield, number of fruits, volume of fruit, fruit weight, total sugars and percentage of fruit set. Results of the present studies revealed that the heritability values were very high for the characters total carotenoids, followed by fruit volume and percentage of fruit set. Total sugars, pulp percentage, fruit weight, T.S.S, number of fruits, cavity index, number

of flowers per cluster and yield had high heritability values. Genetic advance was maximum for fruit volume, followed by yield and number of fruits.

Based on the desirable Horticultural traits the highest scoring varieties, were Pusa Nanha and CO-2. The variety Pusa Nanha had dwarf stature, medium to large fruit size while CO-2 had high yield,moderate organoleptic qualities and both were less susceptible to major pests and diseases.The varieties Pusa Dwarf and Coorg Honeydew were also found to perform well with respect to growth, yield and quantity and hence can be grown for dessert purpose in the homesteads.