PERFORMANCE ANALYSIS OF SNAP MELON

(*Cucumis melo* L. var. *momordica* Duth. & Full.)

By

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THESIS

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DECLARATION

I, hereby declare that this thesis entitled **"Performance analysis of snap melon (*Cucumis melo* L. var. *momordica* Duth. & Full.)"** is a bonafide record of research done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, fellowship or other similar title, of any other University or Society.

Vellanikkara
14/08/2012

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CERTIFICATE

Certified that this thesis, entitled **"Performance analysis of snap melon (*Cucumis melo* L. var. *momordica* Duth. & Full.)"** is a record of research work done independently by **Ms. Priya T. Joseph (2010-12-106)** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

Dr. Salikutty Joseph
Chairperson
Advisory Committee

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Introduction

1. INTRODUCTION

Melons are important horticultural crops across the world. India, being one of the secondary centres of origin of *Cucumis melo*, is rich in its feral and cultivated forms which comprises nearly 40 species (Whitaker and Davis, 2008). *Cucumis melo* L. is a polymorphic species encompassing a large number of botanical and horticultural varieties or groups with great morphological variation in fruit characters such as size, colour and taste, reflecting rich diversity in cultivation, area and use. Due to development of large number of varieties and increasing degree of morphological similarities between them, it is necessary to distinguish newly bred cultivars from other cultivars of the same kind (Smith and Smith, 1992). The river bed farmers have been unconsciously maintaining a large reservoir of germplasm of the crop which has not been properly conserved, documented and utilized.

There are several local varieties of melon grown in different regions of India. A wide range of variability is met from Gujarat in the west to West Bengal in the east (Seshadri and More, 2002). The dessert form of *Cucumis melo* L. is a distinct group distributed and adapted well essentially under humid tropics of South India. Snap melon or *phoot* (*Cucumis melo* var. *momordica* Duth. and Full.) is a locally grown dessert melon in Kerala, known as *Pottuvellari* and cultivated in Thrissur, Ernakulam and Malappuram districts of the state. The large scale cultivation of *phoot* is confined to the states of UP, Rajasthan, Haryana, Punjab and Bihar in India. It is very popular in arid and semi arid regions (Hazra *et al*. 2011).

The use of melon is extremely diverse, depending on the type of fruit. Sweet types are consumed as dessert, while non sweet types are used as vegetable, i.e. the immature fruits are eaten raw, pickled or cooked. Some with odour are cultivated as ornamental plants also. They are good sources of vitamin C, sugars, minerals and

dietary fibre (Bates and Robinson, 1995). The fruit of snap melon contains 3 per cent carbohydrate, 0.3 per cent protein, 0.1 per cent fat, 95.7 per cent moisture, 265 IU Vitamin A $100g^{-1}$ and 10mg Vitamin C $100g^{-1}$ (Peter and Hazra, 2012). Seed contains 12.5 to 39.1 per cent edible oil. The fruit is a many seeded pepo. This nutritive and medicinal fruit is also used as a good summer drink since it reduces heat from the body.

Snap melon is a hardy and short duration indigenous crop with much resistance to biotic and abiotic stresses (Maurya *et al*., 2004). It is cultivated as a mixed crop along with maize, sorghum and pearl millet or as a sole crop in summer season (Seshadri and More, 2009). At CIAH, Bikaner snap melon accessions AHS10 and AHS82 with high yield and superior quality were developed (Samadia *et al*., 2005). Pareek *et al*. (1999) also collected open pollinated semi cultivated landraces of snap melon in the north western parts of Rajasthan and identified accessions with economic and nutritional potential for cultivation in the arid regions of India. Pandey *et al*. (2007) identified a snap melon genetic stock, B-159 with resistance to downy mildew. Pusa Shandar is another released variety of snap melon (Singh *et al*., 2009). The mature fruits of snap melon are peeled off, sun dried and preserved which is locally known as *khelra* (Pareek and Samadia, 2002).

India being secondary centre of origin, snap melon has accumulated wide range of genetic variability with respect to different quantitative and qualitative characters, even larger than that of South and tropical Africa, where the crop is supposed to have originated. The fruits are small to large and smooth, either oval or cylindrical in shape with a mealy, somewhat insipid or slightly sour flesh which burst on maturity. The productivity and quality are highly variable and sometimes results in low economic returns to the growers.

Though highly variable in fruit shape and size, skin characters, flesh colour, keeping quality, and reactions towards pests and diseases, no authentic reports are available on the characterization of these landraces. There is abundant scope to utilize the existing indigenous genetic variability because of their drought hardiness and ability to withstand many biotic stress conditions (Pareek *et al.*, 1999). Hence, it is necessary to identify and develop standard varieties of snap melon to enable its commercial production for different uses. Critical assessment of the nature and magnitude of variability is a prerequisite for any efficient breeding programme and provides an opportunity to identify superior lines with desirable yield and quality traits.

Information on genetic variability and components of variation is basic for any crop improvement programme. Being a cross pollinated crop, tremendous variation exists among the melons. Transfer of quantitatively inherited characters to commercially adopted cultivars from available germplasm can be an efficient way to obtain greater genetic variation and response to selection. No systematic work has been carried out in Kerala to characterize the genetic wealth on '*Pottuvellari*'. Many valuable genotypes may be lost forever if not saved. Hence, there is an urgent need to collect and conserve the genetic wealth in this crop.

The present study was attempted for collection and characterization of landraces of snap melon distributed in different parts of India and also to assess the variability existing in the germplasm for morphological characters, yield and quality attributes. An attempt was also made to assess the inter relationship between yield and other traits. Apart from this, path analysis and discriminant function analysis were also carried out to determine the extent of improvement that could be made in yield contributing characters.

Review of Literature

2. REVIEW OF LITERATURE

Despite its wide genetic variability, nutritional and economic importance, very little attention has been paid to snap melon. Crop improvement works appear scanty. However, available literature on melons relevant to the present investigations is reviewed here under.

2.1 VARIABILITY

The extent of variability is of paramount importance in the improvement of any crop. Knowledge of available variability within the species enables the breeder to determine the method of crop improvement. Selection of superior types will be effective only when major part of the variability of the trait is genetic.

Knavel (1991) observed genotypic differences among the musk melon cultivars with respect to canopy architecture. According to him, spacing had no effect on average fruit weight, but increasing plant density of short internode genotypes decreased the number of fruits per plant. Generally, doubling the density, reduced the leaf area and total plant dry weight, but had minimal effect on the amount of shaded leaf area. Genotype 'Main Dwarf' provided a greater percentage of plant leaf area exposed to sunlight.

In a study conducted on 51 genotypes of melon, including 4 snap melons genotypes Lal and Singh (1997) reported that the highest coefficient of variation was shown by the fruit yield per plant (17.98%) and number of fruits per vine(12.53) whereas, the lowest was days to first fruit maturity (1.60%) followed by days to first female flowering (3.79%). There were wide differences between the estimates of PCV and GCV for number of fruits per vine and fruit weight.

Kultur *et al*. (2001) also found genotypic differences among musk melon cultivars when grown at different spacing. The cultivars BN1 and BNV had higher mean fruit weight, yield per plant and fruit quality (fruit sugar concentration) than BN2. Spacing affected all traits, except primary branch number and fruit sugar concentration. Fruit number and yield per plant and average fruit weight were higher with wider spacing, but yield and fruit number per hectare were lower. Increased fruit weight at the lower plant density changed the fruit sugar concentration and had no effect on percentage of soluble solids in the melon juice.

Seventy indigenous germplasm lines of musk melon from different geographical pockets were collected, evaluated and characterized by Choudhary and Ram (2002). They reported a variation in fruit yield between 1.14 and 2.79 kg per plant. The flesh colour varied from light green to light orange**.**

Prasad *et al*. (2004) revealed that high and significant variation was found among 34 musk melon inbreds for all the characters studied except for the node at which first female flower appeared, as evidenced by very high value of variance ratio. The highest coefficient of variation was shown by the node at which male flower appeared, followed by yield per plot, number of fruits, days to male flower appearance and the node at which female flower appeared.

According to Kaur and Dhillon (2008) melons of South India expressed high variability for fruit shape, size, skin characters, flesh colour, keeping quality and reaction towards insect pest and disease incidence. Peduncle length showed the highest coefficient of variation(18.48) followed by rind thickness(17.27), fruit breadth(14.7) and number of fruits per plant(13.05). The position of the node at which the first male appeared was 2.02-6.06 and female flower appeared was 5.05-9.09. Petiole length varied from 5.66 to 23.00 cm. Days from sowing to first fruit harvest varied from 82.03 to 85.90. Days from sowing to last fruit harvest ranged

from 116.36 to 140.50. Fruit weight varied from 425g to 3500g. Number of fruits per plant also varied. Flesh thickness varied from 0.51cm to 3.45cm.

Tomar *et al*. (2008) studied genetic variability in 50 musk melon genotypes and found that genotypic variance contributed a major proportion of total variance in characters like fruit yield per plant, the node on which first flower appeared, days to first picking, fruit girth, flesh thickness, number of fruits per plant, total soluble solids, total soluble sugars and acidity percentage. Characters like fruit weight, fruit length and moisture percentage showed differences between genotypic and the phenotypic variance, indicating that environment played an important role in expression of these traits. Moderate genotypic and phenotypic coefficient of variation was observed for fruit yield per plant, followed by acidity percentage, number of fruits per plant, total soluble sugars, position of the node at which the first female flower appeared and fruit weight. Low estimates were observed for total soluble solids, flesh thickness, fruit girth, fruit length, days to first picking and moisture percentage.

In a study conducted by Nagre *et al*. (2009) high GCV as well as PCV was observed for percentage of fruit set, length of vine at harvest, weight of fruit, rind thickness and yield per plant in musk melon.

Samadia *et al*. (2009) reported that a wide range of variations were recorded in musk melon genotypes for days to first male flower appearance (32.7-57.2 days), days to first female flower appearance (40.3-62.2 days), days to first harvest (79.2-96.9 days), number of fruits per plant (5.5-17.1), fruit weight (0.26-3.14kg), fruit length (6.5-27.6cm), fruit diameter (9.1-17.4cm), fruit cavity (4.2-10.2cm), flesh thickness (1.3-3.5cm), number of seeds per fruit (96.1-632.5) and TSS (3.3-15.3^0 Brix).

In a genetic diversity conducted among 50 melon landraces Fergany *et al.* (2011) reported that the ascorbic acid content and titrable acidity of mature fresh fruits ranged between 1.4 and 9.0 mg/100 g and 0.12– 0.57% respectively. Their TSS ranged between 2.1 and 6.4^0B. In general, the number of primary branches per vine was varied from 2.0 to 7.5 and found that majority of the landraces possessed either elongated (42%) or oblate (40%) fruits, and elliptical or pyriform were represented by only 10 and 6% of the accessions respectively. Majority of the landraces (60%) had yellow primary skin colour, other accessions were orange (14%), light green (18%) or green (4%). Three patterns of secondary skin colour *viz.* speckled (54%), spotted (22%), and striped (14%) were also expressed. Yellow orange (44%) and orange (56%) flesh colour was observed amongst the accessions. The days to first harvest also varied from 50.1 to 77.2 days. The average number of fruits/vine ranged between 2.5 and 9.0 with an average weight of 0.175 and 1.735 kg. Average yield per plant varied between 0.87 and 5.33 kg.

Stability analysis among 50 genotypes of musk melon revealed that genetic variability among the genotypes and environments were effective in influencing the performance of the genotypes. Three genotypes showed wider stability for number of fruits per plant, fruit weight and yield per plant (Dhakare *et al.*, 2012b).

In the study conducted among 42 landraces of culinary melon collected from different melon growing tracts of Kerala, Rakhi and Rajamony (2003) found that there were significant differences in days to harvest (50.25-60.5) and number of fruits per plant. High values of PCV with corresponding GCV was obtained for yield per plant, average fruit weight, fruits per plant, keeping quality of fruits, 1000 seed weight, leaf area index and sex ratio.

Incalcaterra *et al.* (2006) studied several Sicilian landraces of Winter melon among which Giallo di Recattivo and Giallo di Sutera gave earlier productions, with high fruit weight and high soluble solid content. Among the ecotypes with green rind, good earliness and very good organoleptic traits were shown by Purceddu and Verde di San Giuseppe Jato.

While measuring the magnitude of variability in 13 lines of sweet melon (*Cucumis melo* var. *reticulatus*) high estimates of GCV for netting density (83.31%) and fruit weight (59.42%) were observed. Netting development (28.18%) and earliness (13.76%) exhibited moderate GCV, whereas other traits including netting appearance (9.23%), plant length (9.28%), netting callus weight (5.94%) and yield per vine(2.22%) had low GCV (Taha *et al*., 2007).

Jeeva and Pappiah (2002) reported that high genotypic coefficient of variation was recorded for first male and female flower node, weight of fruit, length of fruit and yield per plant in snap melon.

In studies conducted among 63 accessions of snap melon Pandey *et al*., 2003 reported that maximum range of mean values (6.38-44.58) was observed for fruit length, with an average of 22.61 $\pm$ 0.31. The minimum range of mean value (0.10-3.51) with an average of (1.19 $\pm$ 0.18) was recorded for average fruit weight. The GCV and PCV were highest for yield per plant (77.50 and 77.10) followed by fruit weight (76.55 and 74.13), node at which the first male flower appeared (37.46 and 36.86), fruit length (36.83 and 36.79) and node at which the first female flower appeared (35.89 and 34.94). The coefficient of variation were medium for fruit breadth (29.67 and 29.55) and number of fruits per plant (31.71 and 28.59).

In a study conducted for 19 important quantitative and biochemical characters in 30 genotypes of snap melon Reddy *et al.* (2005) reported that maximum variation, GCV and PCV was expressed by total carotenoids followed by average fruit weight and yield per plant. The GCV ranged from 5.81 percent to 65.55 percent. Characters like ascorbic acid, fruit length, non reducing sugars, flesh thickness, reducing sugars, length of fruit cavity and fruit diameter exhibited moderate values of GCV. Characters such as total carotenoids, non reducing sugars, reducing sugars, fruit length had narrow difference in PCV and GCV values which indicated least influence of the environment on their expression.

Joydip and Dhangrah (2006) observed that the genotypes were heterogeneous for various traits, indicating the possibility of isolating superior lines through breeding. Out of these genotpes, one land race (Srinikethan SM1) with superior yield (11t/ha) and quality attributes was highly suitable for severe summer conditions of West Bengal.

The diversity study among 36 snap melon land races conducted by Dhillon *et al.* (2007) revealed that there was seven types of fruit shapes *viz.* round, acorn, oblate, ovate, elongated, elliptical and pyriform. Majority of the accessions (81%) had light yellow to deep yellow fruits, whereas only one accession (IC 274014) had whitish fruit. The accessions were soft, crispy or intermediate in flesh texture. Fruit cracking was either longitudinal or random, starting in the middle of the fruit, whereas the round fruits always displayed blossom end cracking. In some cases, instead of fruit cracking, only skin peeling occurred. The average number of fruits per plant ranged from 1.0 to 3.5 and average fruit weight ranged from 0.239 kg to 1.4kg. Their total sugars ranged from 2.0 to 5.3^0B, with ascorbic acid and titrable acidity ranging between 1.6 and 34.1 mg/ 100 g of fresh weight and 0.08–0.61%

respectively. There was wide variation in their vegetative growth and the number of primary branches per plant ranged from 2.9 to 11.8.

In a study of genetic diversity among 42 snap melon landraces Dhillion *et al*. (2009) observed high level of genetic variability within snap melon germplasm. Differences between accessions were observed in a number of plant and fruit traits. Snap melon germplasm with high acidity, elevated carotenoid content and resistance to cucumber mosaic virus were identified in the collection. Comparison of the genetic variability between snap melons of eastern India and melons from north, south and central regions of India and reference accessions of melon from Spain, France, Japan, Korea, Maldives, Iraq, Zambia, Israel showed that Indian snap melon germplasm was not closely related to melon accessions from other parts of the world and that there are regional differences between Indian melon accessions. They have also reported that East Indian snap melon have unique traits that have to be preserved.

Pandey *et al*. (2009) observed high phenotypic (PCV) and genotypic (GCV) coefficient of variation among 74 accessions of snap melon (*Cucumis melo* var. *momordica*) for characters like fruit weight and yield per plant.

Highly significant differences among the fifty five genotypes of snap melon for all the characters studied was reported by Dhakare *et al*. (2012a) in all the environments as well as in pooled mean. Yield per plant varied from 0.68kg to 2.6kg. They have also reported that among the different environments, significantly highest number of fruits per plant, heavier fruit weight and maximum yield per plant was obtained in E_3 (21st February 2000) followed by E_1 (24th April 1999).

2.2 HERITABILITY AND GENETIC ADVANCE

Heritable variation can be found out with greater degree of accuracy when heritability in conjunction with genetic advance is studied (Dudley and Moll, 1969). Heritability along with genetic advance will be helpful in assessing the reliability of a character for selection.

Lal and Singh (1997) reported that very high estimates for heritability in the broad sense, were observed for the characters under study except number of fruits per vine. High values of heritability in the broad sense coupled with high genetic advance were recorded for fruit weight, marketable yield per vine and total yield per vine in musk melon.

In musk melon high heritability and medium genetic advance as per cent mean were exhibited by F:C ratio, P.D.I., yield per plant, number of fruits per plant and fruit weight which indicates that hybridization followed by selection will be effective for genetic improvement (Somkuwar *et al.*, 1997).

Taha *et al.* (2007) reported that high broad sense heritability (BSH) estimates were found for earliness (83.60), netting appearance (79.33), and fruit weight (77.25) in melon. The BSH for vine length (58.31), netting density (52.23), and number of fruits/vine (64.74) were considered as moderate, whereas netting callus weight was found to be low in BSH (39.81) in sweet melon (*Cucumis melo* var. *reticulatus*).

High heritability estimates were obtained for total soluble sugars, total soluble solids and fruit yield per plant and high acidity percentage in musk melon by Tomar *et al.* (2008). Number of days to first picking, moisture percentage, node at which the first female flower appeared, number of fruits per plant, fruit girth, flesh

thickness and fruit weight exhibited moderately high estimates of heritability. Fruit length recorded moderately low heritability, characters like moisture percentage and days to first picking showed moderately high estimates of heritability, but, genetic advance as per cent of mean was low because of lower values of GCV and PCV indicating presence of a lower amount of variability for these traits in the population studied.

Nagre *et al*. (2009) reported that in musk melon the highest estimates of heritability was recorded for length of vine at harvest and fruit weight. High genetic advance was also observed for these characters.

High heritability and moderate genetic advance were recorded by first female flower node, weight of fruit and length of fruit in snap melon. High heritability along with high genetic advance were recorded for first male flower node, number of fruits per plant and yield per plant indicating additive gene action. Low heritability and low genetic advance were recorded for days to first male flower appearance and girth of fruit indicating non additive gene action and these characters are highly influenced by environmental factors (Jeeva and Pappiah, 2002).

High estimate of heritability and genetic advance were obtained for average fruit weight and yield per plant in snap melon by Pandey *et al*. (2003). High heritability with moderate genetic advance was observed for node at which the first male and female flower appears, fruit breadth and fruit length which indicate that additive gene action also governs these traits.

Reddy *et al*. (2005) reported that heritability estimates ranged from 22.10 per cent for first female flower node number to 95.90 per cent for total carotenoids in snapmelon . Very high heritability estimates were observed for total carotenoids,

non reducing sugars, average fruit weight, reducing sugars, fruit length, total soluble solids, fruit diameter, yield per plant and length of fruit cavity indicating least influence of environment on these traits. Total carotenoids, average fruit weight, yield per plant exhibited the highest genetic advances.

High heritability along with high expected genetic advance for polar and equatorial circumference of fruit in snap melon was recorded by Pandey *et al*. (2009).

2.3 CORRELATION STUDIES

Yield is a complex character determined by several component characters. Improvement in yield is possible only through selection for the desirable characters. Correlation analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for genetic improvement in yield (Singh and Narayanan, 2009). Research work done to bring out the relationship of different traits with yield and yield contributing factors in snap melon and other melons are briefly reviewed.

Singh and Nandpuri(1978) reported that yield per plant had significant and positive correlation with number of fruits, fruit weight and length of main vine in musk melon.

According to Kalloo *et al*. (1983) reported that number of fruits, fruit weight, number of branches and vine length were positively correlated with fruit yield in musk melon.

Fruit yield was correlated positively with number of fruits, vine length and number of primary branches in musk melon (Swamy, 1986; Kitroongruang *et al.*,1992). Dhaliwal *et al.* (1996) reported that fruits per vine and TSS was positively correlated in musk melon.

Lal and Singh, (1997) reported that the total yield per vine showed highly significant and positive phenotypic correlations with flesh thickness (0.944), marketable fruit yield per vine (0.894), fruit weight (0.837), seed cavity size (0.714) and vine length (0.326) in musk melon. Days taken from transplanting to first female flower opening was found to be positively and significantly correlated with node at which the first female flower appeared (0.758). The number of fruits per vine exhibited negative correlation with fruit weight (-0.305) and flesh thickness (-0.373), while fruit weight showed positive correlation with flesh thickness (0.588), seed cavity size (0.690), vine length (0.351) and yield per vine (0.837) at phenotypic level.

According to Somkuwar *et al.* (1997) improvement in muskmelon would be possible by selecting genotypes for number of fruits per plant, fruit number, days to first harvest and T.S.S.

In musk melon, yield per plant had significant positive correlation with fruit weight, fruits per plant, number of vines per plant, harvest duration, rind thickness, shelf life and vine length. The magnitude of genotypic correlation coefficients for most of the character pairs were higher than their respective value of the phenotypic correlation coefficients, which may be ascribed to the low effect of environment on the character expression. Vine length showed positive correlation with fruit weight, yield per plant, rind thickness, shelf life and severity of downy and powdery mildew incidence. Days to first female flower exhibited significant positive correlation with days to first fruit harvest, size of seed cavity and severity of downy and powdery

mildew incidence and significant and negative correlation with vines per plant, harvest duration, rind thickness, flesh thickness and shelf life. Number of fruits per plant showed significant positive correlation with vines per plant, yield per plant, harvest duration, TSS and shelf life. Harvest duration exhibited significant positive association with vines per plant, fruit weight, fruits per plant, yield per plant, flesh thickness and TSS (Choudhary *et al*., 2004).

Tomar *et al*. (2008) reported that fruit weight showed positive and significant genotypic and phenotypic association with fruit yield per plant, fruit length, fruit girth, flesh thickness and moisture percentage, while negative and significant correlation was seen with total soluble solids in musk melon. Fruit yield was positively correlated with fruit weight, fruit girth, flesh thickness, number of fruits per plant and moisture percentage at both the genotypic and phenotypic level, while, it had significant and positive correlation with fruit length at the genotypic level only. On the other hand, it showed significant and negative correlation with total soluble solids at both the phenotypic and genotypic level.

According to Nagre *et al*. (2009) yield per vine had positive and significant correlation with characters like fruit weight, length of vine, length of fruit, diameter of fruit, rind thickness and TSS in musk melon.

Fergany *et al*. (2011) reported that there were highly significant positive correlations between the primary fruit skin colour, the secondary colour and the repartition of these colours and a highly significant negative correlation was observed between fruit weight and fruit number in melon. Positive correlation of fruit weight with flesh thickness, vine length, TSS and days to flowering in snap melon was reported by Vijay (1987).

Pandey *et al*. (2003) reported that fruit yield per plant in snap melon showed positive and significant association with fruit weight (0.901, 0.926), fruit length (0.608, 0.613), fruit breadth (0.328, 0.361), node number at which the first male flower appeared (0.257, 0.263), node number at which the first female flower appeared (0.253, 0.226) and number of fruits per plant (0.249, 0.268) at phenotypic and genotypic levels respectively. Node at which the first female flower appeared had positive correlations with node at which the first male flower appeared, fruit length, fruit weight and yield per plant. Fruit weight showed positive association with node number at which the first male flower appeared, fruit length, fruit breadth and the number of fruits per plant. Fruit breadth showed significant association with fruit length.

According to Pandit *et al*. (2003) accumulated Growing Degree Days (GDD) from first fruiting to first harvest and from first male flower to first harvest was positively and significantly correlated with fruit yield in snap melon.

Rakhi and Rajamony, (2003) reported that there were direct positive correlation between the number of secondary branches and the number of fruits per plant in culinary melon.

Studies conducted in 30 genotypes of snap melon by Reddy *et al*. (2007) reported that fruit weight(0.932), vine length (0.861), flesh thickness (0.737), fruit length (0.621), fruit diameter (0.612), first female flower node number (0.569), length of fruit cavity (0.484), ascorbic acid (0.410) and maturity period (0.235) were positively and significantly correlated with yield. The number of fruits per plant showed a highly significant positive correlation with TSS (0.578) and a highly significant negative correlation with fruit length (-0.428), fruit weight (-0.374), fruit diameter (-0.318), flesh thickness (-0.314), length of fruit cavity (-0.286) and total

carotenoids (-0.279). The number of fruits per plant exhibited a non significant negative correlation (-0.065) with yield.

Yestisir *et al*. (2004) reported that the genotypes with long cotyledons have longer and larger fruits and genotypes with short and round cotyledons have smaller and round fruits in cantaloupe melon. The correlation between cotyledon width and fruit diameter was low and cotyledon width was not as effective as cotyledon length in predicting fruit shape and size at early growth stages. Cotyledon index was highly correlated with fruit index.

Report from Kaur and Dhillon (2008) indicated that fruit weight and number of fruits per plant was negatively correlated in culinary melon (*Cucumis melo* var. *acidulus*).

Yield had positive and significant correlation with fruit weight, polar and equatorial circumference of fruit at both phenotypic and genotypic level and with days to first female flower anthesis at genotypic level in snap melon. Fruit weight, polar and equatorial circumference of fruit had positive correlation coefficient among themselves (Pandey *et al*., 2009).

2.4 PATH ANALYSIS

The path coefficient provides an effective means of finding out direct and indirect causes of association and allows a detailed examination of specific forces acting to produce a given correlation and measures the relative importance of each factor.

Kalloo *et al*. (1982b) reported that number of fruits per plant and fruit weight in musk melon had positive direct effect on fruit yield while, More *et al*. (1987) reported that flesh thickness had positive direct effect on yield in musk melon. According to Pandita *et al*., (1990) number of fruits and earliness had the highest positive direct effect on yield per plant in musk melon.

Lal and Singh, (1997) reported that the number of fruits per vine (2.1388) followed by fruit weight (1.6433) had the highest direct effect at phenotypic level on fruit yield per vine in musk melon. Positive phenotypic indirect effect on fruit yield per vinewas also observed via flesh thickness (1.3771), days from transplanting to first fruit maturity (1.1754) and node at which first female flower opened (0.1181). In musk melon, fruit weight and number of fruits per plant had positive direct effect on fruit yield as per the report of Somkuwar *et al*. (1997).

Path coefficient analysis in musk melon revealed that plant characters like fruit weight, number of fruits per plant, rind thickness, flesh thickness, shelf life, rind thickness, TSS, severity of downy mildew, severity of powdery mildew and incidence of fruit fly had direct positive effect on yield per plant. The characters like vine length, number of vines per plant, days to first female flower, harvest duration, and size of seed cavity had negative indirect effect on fruit yield per plant (Choudhary *et al*., 2004).

Tomar *et al*. (2008) found that fruit weight had a positive direct effect on fruit yield in musk melon. It showed negative indirect effect through total soluble solids and acidity percentage and positive indirect effects through moisture percentage, fruit girth, total soluble sugars and flesh thickness. Though fruit length had a positive correlation with yield, it showed negative direct effect and had maximum positive indirect effect through fruit weight. It had negative indirect effect through

total soluble solids, acidity percentage and number of fruits per plant. Fruit girth had a positive direct effect on fruit yield and positive indirect effect through moisture percentage and total soluble sugars, while, it had a negative indirect effect through total soluble solids and acidity percentage. Flesh thickness had a positive direct effect on yield and positive indirect effect through moisture percentage, total soluble sugars and fruit girth had a negative indirect effect through total soluble solids and acidity percentage. Number of fruits per plant had the maximum positive direct effect on fruit yield and negative indirect effect through moisture percentage and total soluble sugars. Moisture percentage had higher positive direct effect on yield. It had a positive indirect effect through total soluble sugars and fruit girth and a negative indirect effect through total soluble solids and acidity percentage.

Path coefficient analysis revealed the importance of characters *viz*., internodal length, number of fruits per vine, diameter of fruit and weight of fruit which showed high and positive direct effects for enhancing the yield of musk melon (Nagre *et al*., 2009). Number of fruits per plant, fruit weight, flesh thickness and incidence of fruit fly had positive direct effect and TSS, vine length, days to flowering and maturity had negative direct effect on fruit yield in snap melon (Vijay, 1987).

Pandey *et al*. (2003) reported that average fruit weight and fruit length had maximum direct effect on yield followed by number of fruits per plant and node number at which first male flower appears in snap melon. The node number at which first female flower appears and fruit breadth had negative direct effect but correlation with yield is positive owing to indirect effect through all characters, whereas fruit breadth had negative indirect effect on yield through node number of male and female flower appears, fruit length and number of fruits per plant.

Path coefficient analysis in snap melon conducted by Reddy *et al*. (2007) revealed that vine length (3.067), non reducing sugars (0.762) and total carotenoids (0.667 had high direct effect on yield per plant**.** The negative direct effect over yield was exhibited by fruit length (-1.226), fruit diameter (-0.703), first male flower node number (-0.502) and first female flower node number (-0.793).

In snap melon, Pandey *et al*. (2009) reported that high positive direct effect of the following characters on yield - number of fruits per plant, fruit weight, polar and equatorial circumference of fruit, days to first male flower anthesis and node at which first female flower appeared. Direct selection for fruit weight and indirect selection through polar and equatorial circumference of fruit could be considered for further improvement of yield.

2.5 GENETIC DIVERGENCE

A knowledge of genetic divergence among the different genotypes is very essential in selection of parents for hybridization programme. Divergence analysis is a potent tool in divulging the diversity among the genotypes based on multiple characters. According to Mahalanobis (1936) generalized distance estimated by D^2 statistics is an efficient tool in the estimation of genetic diversity for a rational choice of potential parent in a breeding programme. According to Singh and Gupta (1968), the more divergent the parents with a reasonable range, the more would be the chance of improving a character in question through hybridization programme.

Mathew *et al*. (1986) opined that among the subspecies of *Cucumis melo* the genetic distance was greatest between (*Cucumis melo* var. *inodorus*) and snake melon (*Cucumis melo* var. *flexuosus*), and least between long melon (*Cucumis melo*

var. *utilissimus*) and snap melon (*Cucumis melo* var. *momordica*). Fruit number per plant made major contribution to the total divergence.

Choudhary and Ram (2002) grouped seventy musk melon genotypes into 11 clusters using non-hierarchial Euclidean cluster analysis. These 10 superior lines were distributed into 4 different clusters exhibiting considerable variability.

Ninety eight musk melon genotypes were classified into 12 clusters based on the statistical significance by More and Seshadri (2002) and the study revealed that Indian sub-continent (including Pakistan) represents a distinct secondary centre of diversification probably different from central Asian region consisting of southern Russia, Afghanistan, Iran and Arabian peninsula. The distinct non-dessert types, consisting of different cooking, salad cucumer, and sour types are unique products of domestication, representing , one extreme end of polymorphism while world's sweetest melons evolved under ideal environmental conditions prevalent in Tashkent region of southern Russia point towards another extreme.

Prasad *et al.* (2004) studied genetic divergence among 34 musk melon inbreds and grouped them into eight clusters using Mahalanobis D^2 statistic. All the exotic collections fell in separate clusters. The results indicated that geographical isolation has contributed much towards divergence in exotic populations.

Genetic divergence studies undertaken by Reddy *et al.* (2005) among 30 indigenous genotypes of snap melon (*Cucumis melo* L. var. *momordica*) for 19 important quantitative and qualitative characters using D^2 statistics revealed that there was no association between geographical distance and genetic divergence. Maximum divergence was observed between clusters I and III followed by I and V.

Tomar *et al.* (2008) grouped 50 musk melon genotypes into seven clusters using Mahalanobis D^2 statistic. Genetic diversity observed among the genotypes might be due to factors like history of selection, heterogeneity, selection under diverse environments and genetic drift. Maximum genetic distance was observed between clusters II and V, while clusters III and VII displayed the lowest degree of divergence. Clusters II and V were composed of 12 and 8 genotypes, respectively, whereas, clusters III, IV and VI, VII were composed of two genotypes and a single genotype, respectively. Total soluble sugars followed by total soluble solids and fruit yield per plant contributed the most towards divergence.

2.6 SELECTION INDEX

To make effective selection for higher yield, it is necessary to determine the selection index.

Lal and Singh (1997) observed that the characters such as number of fruits per vine, fruit weight, flesh thickness, fruit yield per vine and vine length were used for selection index analysis in musk melon.

Materials and Methods

3. MATERIALS AND METHODS

Present investigation on "Performance analysis of snap melon (*Cucumis melo* L. var. *momordica* Duth. & Full.)" was carried out in the Department of Olericulture, College of Horticulture, Kerala Agricultural University, Vellanikkara, during February – April 2011. The site is located at 10^0 32' N latitude and 76^0 13' E longitude at an altitude of 22.5m above MSL and the experimental site has a sandy loam soil, which is acidic in reaction (pH 5.3). The area lies in tropical monsoon climate region, with more than 80 per cent of the rainfall getting distributed through southwest and northeast monsoon showers. Data on temperature, rainfall, relative humidity, number of rainy days and sunshine hours during the entire cropping period were collected from meteorological observatory of College of Horticulture, Vellanikkara (Appendix 1).

The project consisted of the following aspects

3.1. Genetic cataloguing of the snap melon (*Cucumis melo* L. var. *momordica* Duth. & Full.) germplasm.
3.2. Assessment of genetic variability and identification of promising genotypes.

3.1. GENETIC CATALOGUING OF THE SNAP MELON (*Cucumis melo* L. var. *momordica* Duth. & Full.) GERMPLASM

3.1.1. **Morphological Characterisation**

Twenty five accessions collected from different parts of India (Table 1) were genetically characterised based on the descriptor developed by NBPGR/ IPGRI.

Table 1. Passport data of *Cucumis melo* L. var. *momordica* Duth. & Full. accessions.

Sl. No	Collection number	Village	District	State
1	CMM-1	Peringanam	Thrissur	Kerala
2	CMM-2	Panagad	Thrissur	Kerala
3	CMM-3	Sakthipuram	Thrissur	Kerala
4	CMM-4	SN Puram	Thrissur	Kerala
5	CMM-5	Edavilangu	Thrissur	Kerala
6	CMM-6	Edavilangu	Thrissur	Kerala
7	CMM-7	Kodungalloor	Thrissur	Kerala
8	CMM-8	Paravoor	Ernakulum	Kerala
9	CMM-9	Mahewa	Allahabad	UP
10	CMM-10	Dudhpura	Samastipur	Bihar
11	CMM-11	Kodungalloor	Thrissur	Kerala
12	CMM-12	Thriprayar	Thrissur	Kerala
13	CMM-13	Bairahana	Allahabad	UP
14	CMM-14	Bairahana	Allahabad	UP
15	CMM-15	Bikaner	Bikaner	Rajasthan
16	CMM-16	Unhel	Jhalawar	Rajasthan
17	CMM-17	Pusa campus	New Delhi	New Delhi
18	CMM-18	Thrissur	Thrissur	Kerala
19	CMM-19	Samastipur	Samastipur	Bihar
20	CMM-20	Thrissur	Thrissur	Kerala
21	CMM-21	Ponda	North Goa	Goa
22	CMM-22	Canacona	South Goa	Goa
23	CMM-23	Cuncolim	North Goa	Goa
24	CMM-24	Hisar	Hisar	Haryana
25	CMM-25	Jodhpur	Jodhpur	Haryana

Plate 1. View of the experimental plot

3.1.2. **Botanical Description**

Since the crop is underexploited the botany of the crop was studied in detail and the botanical description of *Cucumis melo* L. var. *momordica* Duth. & Full. has been elucidated.

3.2. ASSESSMENT OF GENETIC VARIABILITY AND IDENTIFICATION OF PROMISING GENOTYPES.

3.2.1**. Experimental Materials**

The experimental materials consisted of 25 accessions collected from different parts of India. The source of the different accessions is given in Table 1.

3. 2. 2 **Experimental Methods**

The experiment was laid out in a randomized block design with two replications. Four pits were raised separately for each accessions at a spacing of 2m X 1.5m under each replication (Plate 1). Care was taken to see that the vines of one accession do not overlap with the space provided for the adjacent accession. The crop received timely management and care as per the Package of Practices Recommendations of Kerala Agricultural University (KAU, 2011).

3.2.3 **Observations**

Observations were taken from all the four plants separately for each genotype. The following observations were recorded for all accessions and average was worked out for further analysis.

a) ***Vine length (m)***

The length was measured from the collar region to the tip of the main vine at the 70th day after sowing and expressed in meter.

b) ***Nodes to first male flower appearance***

The node at which the first male flower appeared was counted and recorded.

c) ***Nodes to first female flower appearance***

The node at which the first female flower appeared was counted and recorded.

d) ***Days to first male flower appearance***

The number of days from the date of sowing to the date of opening of first male flower was counted.

e) ***Days to first female flower appearance***

The number of days from the date of sowing to the date of opening of first female flower was counted.

f) ***Days to first fruit set***

The number of days from the date of sowing to the date of first fruit set was counted.

g) ***Days to first harvest***

The number of days from the date of sowing to the date of first fruit harvest was counted.

h) ***Number of fruits per plant***

Total number of fruits per plant was counted.

i) ***Maturity period of fruits (days)***

The number of days from fruit set to fruit harvest was counted.

j) ***Duration of the crop***

The number of days from sowing to the date of last marketable fruit harvest was counted.

k) ***Number of harvests***

Total number of harvests from the first to the last harvest was noted.

l) ***Average fruit weight (kg)***

Weight of fruits per plant at each harvest was recorded and average fruit weight was worked out and expressed in kilogram.

m) ***Yield per plant (kg)***

Weight of fruits harvested periodically from each plant was recorded separately and the total was worked out and expressed in kilogram.

n) ***Fruit length (cm)***

Length of fruit from the stem end to the blossom end was measured and average was recorded in centimeter.

o) ***Fruit diameter (cm)***

Diameter at the middle of the fruit was measured and average was recorded in centimeter.

p) ***Number of seeds per fruit***

Number of seeds contained in each fruit was counted and average was recorded.

q) ***Flesh thickness (cm)***

Thickness of the flesh at the centre of the fruit was measured and average was recorded in centimeter.

r) ***Length of fruit cavity (cm)***

Fruit was cut longitudinally into two and the length of cavity from stalk end to blossom end was recorded in centimeter.

s) ***Pulp placenta ratio***

The ratio of the weight of the pulp to the weight of the placenta was noted.

t) ***Shelf life (days)***

Fruits were stored under open condition at room temperature after harvest and the shelf life was recorded by visual observation.

u) ***Rind firmness (kg/cm^2)***

Firmness of fruit was measured using the instrument Penetrometer and the average was expressed in kg.

t) ***Ascorbic acid (mg/100g)***

Ascorbic acid content of the fruit at maturity was estimated by titration with 2, 6-dichlorophenol indophenol dye (Sadasivam and Manikeam 1991).

One gram of the fresh sample was extracted in four per cent oxalic acid using a mortar and pestle and made up to 100ml. From this, 5ml of the extract was pipetted, 10ml of four per cent oxalic acid was added and titrated against the dye.

Ascorbic acid content of the fresh sample was calculated from the titre value and was expressed in mg $100g^{-1}$.

u) ***Reducing sugar (%)***

Reducing sugar was estimated by Fehling's method (Ranganna, 1997). Fruit juice (25ml) was taken, 50ml water was added and stirred well. To this, 2ml of 45 per cent lead acetate was added and left for 10 minutes. Then, 2ml of 22 per cent potassium oxalate was added and left again for another 10 minutes. The solution was neutralized with 1*N* NaOH, made upto 250ml and filtered. The filtrate was used for titration against Fehling's solution.

v) ***Non reducing sugar (%)***

Non reducing sugar was estimated by the substraction of reducing sugar from the total sugar. Total sugar was estimated by Fehling's method (Ranganna, 1997). Fruit juice (25ml) was taken, 2.5g citric acid was added, 50ml of water was poured and was boiled for 10 minutes. After cooling, it was neutralized with 5*N* NaOH and was made upto 250ml. It was used for titration against Fehling's solution.

w) ***Total soluble solids (TSS)***

The total soluble solids of the flesh at the equatorial region, was recorded with help of an Erma hand refractometer and was expressed as ^{0} Brix.

x) ***Organoleptic evaluation***

Organoleptic scores for sensory attributes such as colour, flavour, texture, appearance, taste and overall acceptability of the fruit were recorded over a five point hedonic scale (Amerine *et al.*, 1965) by a panel of ten evaluators and Kendall's coefficient of concordance (W) was used to assess the significance among them.

3.2.4. Statistical analysis

Data on different characters were subjected to statistical analysis, using Spar-1 package. The analysis of variance technique suggested by Fisher (1954) was employed for the estimation of various genetic parameters. The data thus obtained were processed for analysis of variance, genotypic and phenotypic coefficient of variations, correlation coefficient and path coefficients.

3.2.4.1. Phenotypic and genotypic variance

The variance components were estimated using the formula suggested by Burton (1952).

Phenotypic variance (Vp) = Vg + Ve

Where,

Vg- genotypic variance

Ve- environmental variance

Genotypic variance (Vg) = $(V_T - V_E)/R$

Where,

V_T - mean sum of squares due to treatments

V_E - mean sum of squares due to error

R - number of replications

Environmental variance (Ve)= V_E

3.2.4.2. Phenotypic and genotypic coefficient of variation

The phenotypic and genotypic coefficients of variation were calculated by the formula suggested by Burton and Devane (1953).

Phenotypic coefficient of variation (PCV) = $(Vp^{1/2}/X) \times 100$

Where,

Vp- Phenotypic variance

X- Mean of characters under study

Genotypic coefficient of variation (GCV) = $(Vg^{1/2}/X) \times 100$

Where,

Vg- Genotypic variance

X- Mean of characters under study

The PCV and GCV are classified as suggested by Sivasubramanian and Menon (1973) as

0-10 per cent	-low
11-20 per cent	-moderate
21 and above	-high

3.2.4.3. Heritability

Heritability in the broad sense was estimated by the formula suggested by Burton and Devane (1953).

$H^2 = (Vg/Vp) \times 100$

Where,

Vg- genotypic variance

Vp- phenotypic variance

The range of heritability was categorized as suggested by Robinson *et al.* (1949) as

0-30 per cent	- low
31-60 per cent	- moderate
61 per cent and above	- high

3.2.4.4. Expected genetic advance

The genetic advance expected for the genotypic variance was calculated using the formula by Lush (1949) and Johnson *et al.* (1955) with value of the constant K as 2.06 as given by Allard (1960).

Expected genetic advance $GA = (Vg/vp^{1/2}) \times K$

Where,

Vg- Genotypic variance

Vp- Phenotypic variance

3.2.4.5. Genetic gain (genetic advance as percentage of mean)

Genetic advance (GA) calculated by the above method was used for the estimation of genetic gain.

Genetic gain, $GG = (GA/X) \times 100$

Where,

GA- Genetic advance

X- Mean of characters under study

The genetic gain was classified according to Johnson *et al*. (1955) as follows;

1-10 per cent - Low
11-20 per cent - Moderate
21 and above - High

3.2.4.6. Phenotypic and genotypic correlation coefficients

The phenotypic and genotypic correlation coefficients were worked out to study the extent of association between the characters. The phenotypic and genotypic correlation coefficients among the various characters were worked out in all possible combinations according to the formula suggested by Johnson *et al*. (1955).

Phenotypic correlation coefficients between two characters 1 and 2 were calculated by the formula

$(rp12) = COVp12/ (Vp1. Vp2)1/2$

Where,

Vp1 = Phenotypic variance of character 1
Vp2 = Phenotypic variance of character 2

Genotypic correlation coefficients between two characters 1 and 2 were calculated by the formula

$(rg12) = COVg12/ (Vg1. Vg2)1/2$

Where,

Vg1 = Genotypic variance of character 1
Vg2 = Genotypic variance of character 2

3.2.4.7. Path coefficient analysis

In path coefficient analysis the correlation among cause and effect is partitioned into direct and indirect effects of casual factors on effect factor. The principles and techniques are suggested by Wright (1921) and Li (1955) for the analysis using the formula given by Dewey and Lu (1959).

The direct and indirect effects are rated by Lenka and Mishra (1973) as follows;

0.00-0.09	- Negligible
0.10-0.19	- Low
0.20-0.29	- Moderate
0.30-1.00	- High
More than 1.00	- Very high

3.2.4.8. Genetic divergence

The genetic divergence among 25 accessions was assessed based on different characters as given by Mahalanobis (1936). Clustering of genotypes using Mahalanobis D^2 value was carried out using the computer oriented iterative method as suggested by Suresh and Unnithan (1996).

3.2.4.9. Selection index

The statistical methods suggested by Smith (1936) and Robinson *et al.*, (1951) were used for constructing selection index. A series of selection indices were obtained by discriminant function analysis using different combination of component characters. These component characters were selected based on their significant

correlation with yield. This is desired to select plants, the merit (H) of which is linearly expressed as

$$H= a_1G_1 + a_2G_2 \ldots\ldots\ldots\ldots + a_n G_n$$

Where G_1, G_2…….G_n represents the genotypic values of characters and a_1, a_2….. a_n denote the weights to be assigned to each character.

Results

4. RESULTS

The studies on "Performance analysis of snap melon (*Cucumis melo* L. var. *momordica* Duth. & Full)" was carried out in the Department of Olericulture, College of Horticulture, Kerala Agricultural University, Vellanikkara during 2011. The results obtained from the experiments are presented below.

4.1. GENETIC CATALOGUING OF THE SNAP MELON (*Cucumis melo* L. var. *momordica* Duth. & Full.) GERMPLASM

Twenty five accessions of snap melon collected from different parts of India were genetically catalogued based on descriptor. Vegetative and reproductive characters were recorded and accessions were catalogued. (Tables 2,3 and 4, Plates 2, 3, 4, 5, 6,7, 8, 9, 10 and 11).

4.2. ASSESSMENT OF GENETIC VARIABILITY AND IDENTIFICATION OF PROMISING GENOTYPES.

4.2.1. **Genetic Variability**

The analysis of variance of 25 accessions of snap melon showed significant differences between them for all the characters (Tables 5, 6, 7 and Appendix II). The population mean, range, phenotypic and genotypic coefficient of variation are presented in Table 9. Variation in PCV and GCV for yield and its components is discussed in Figure 4.

a) ***Vine Length***

Significant differences among the genotypes were observed for vine length. It varied from 1.41m (CMM-25) to 3.18m (CMM-20) with a mean

Table 2 . Vegetative characters

Accession No	Early plant vigour	Plant growth habit	Stem pubescence	Stem shape	Tendril type	Tendril branching	Leaf margin	Leaf shape	Leaf size	Leaf pubescence density	Petiole length (cm)
CMM-1	Very good	Long viny	Present	Angular	Coiled	Unbranched	Unifid	Reniform	Large	Sparse	14.6
CMM-2	Very good	Long viny	Present	Angular	Coiled	Unbranched	Unifid	Reniform	Large	Sparse	16.8
CMM-3	Very good	Long viny	Present	Angular	Coiled	Unbranched	Unifid	Reniform	Large	Sparse	13.2
CMM-4	Good	Medium viny	Present	Angular	Coiled	Unbranched	Unifid	Reniform	Large	Sparse	14.6
CMM-5	Very good	Long viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Large	Sparse	15.0
CMM-6	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Large	Sparse	16.0
CMM-7	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Large	Sparse	10.5
CMM-8	Good	Medium viny	Present	Angular	Coiled	Unbranched	Unifid	Reniform	Large	Sparse	14.8
CMM-9	Poor	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Large	Sparse	14.0
CMM-10	Good	Medium viny	Present	Angular	Coiled	Unbranched	Unifid	Reniform	Large	Sparse	10.6
CMM-11	Very good	Long viny	Present	Angular	Coiled	Unbranched	Unifid	Reniform	Large	Sparse	14.8
CMM-12	Very good	Long viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Large	Sparse	15.4
CMM-13	Poor	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Large	Sparse	11.2
CMM-14	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Large	Sparse	16.0
CMM-15	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Medium	Intermediate	9.2
CMM-16	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Large	Sparse	12.6
CMM-17	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Large	Intermediate	10.3
CMM-18	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Large	Sparse	16.4
CMM-19	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Large	Sparse	16.0
CMM-20	Very good	Long viny	Present	Angular	Coiled	Unbranched	Unifid	Reniform	Large	No hairs	15.5
CMM-21	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Medium	Intermediate	10.0
CMM-22	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Medium	Intermediate	10.1
CMM-23	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Medium	Intermediate	10.4
CMM-24	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Medium	Intermediate	7.0
CMM-25	Good	Medium viny	Present	Angular	Coiled	Unbranched	Multifid	Reniform	Medium	Intermediate	6.0

Table 3. Flower and fruit characters

Accession No	Flower colour	Sex type	Stem end fruit shape	Blossom end fruit shape	Fruit skin lusture	Peduncle separation from fruit	Fruit skin texture	Fruit skin predominant primary colour	Fruit skin secondary colour	Design produced by secondary skin colour	Fruit shape
CMM-1	Yellow	Monoecious	Rounded	Rounded	Glossy	Easy	Plain	Green	Light yellow	No design	Elongate
CMM-2	Yellow	Monoecious	Flattened	Flattened	Intermediate	Easy	Plain	Green	Greenish yellow	No design	Oblong
CMM-3	Yellow	Monoecious	Rounded	Rounded	Glossy	Easy	Plain	Green	Light yellow	Striped	Elongate
CMM-4	Yellow	Monoecious	Flattened	Flattened	Glossy	Easy	Plain	Green	Greenish yellow	No design	Oblong
CMM-5	Yellow	Monoecious	Depressed	Depressed	Glossy	Easy	Plain	Green	Light yellow	No design	Elongate
CMM-6	Yellow	Monoecious	Flattened	Flattened	Glossy	Easy	Plain	Green	Light yellow	No design	Oblong
CMM-7	Yellow	Monoecious	Rounded	Rounded	Glossy	Easy	Plain	Green	Greenish yellow	Spotted	Elongate
CMM-8	Yellow	Monoecious	Rounded	Rounded	Glossy	Easy	Plain	Green	Light yellow	No design	Elongate
CMM-9	Yellow	Monoecious	Rounded	Rounded	Intermediate	Easy	Plain	Green	Dark green	No design	Oblong
CMM-10	Yellow	Monoecious	Rounded	Rounded	Intermediate	Easy	Plain	Green	Orange	Striped	Elongate
CMM-11	Yellow	Monoecious	Rounded	Rounded	Matt	Intermediate	Plain	Green	Yellow	Speckled	Elongate
CMM-12	Yellow	Monoecious	Flattened	Flattened	Matt	Easy	Plain	Green	Yellow	Speckled	Oblong
CMM-13	Yellow	Monoecious	Flattened	Flattened	Intermediate	Intermediate	Plain	Green	Orange	Spotted	Globular
CMM-14	Yellow	Monoecious	Rounded	Rounded	Intermediate	Easy	Plain	Green	Dark green	No design	Oblong
CMM-15	Yellow	Monoecious	Rounded	Rounded	Intermediate	Easy	Plain	Green	Orange	Spotted	Oblong
CMM-16	Yellow	Monoecious	Rounded	Rounded	Intermediate	Easy	Plain	Green	Orange	Spotted	Ovate
CMM-17	Yellow	Monoecious	Rounded	Rounded	Intermediate	Intermediate	Plain	Green	Yellow	Spotted	Oblong
CMM-18	Yellow	Monoecious	Rounded	Rounded	Intermediate	Easy	Plain	Green	Light yellow	No design	Elongate
CMM-19	Yellow	Monoecious	Rounded	Rounded	Intermediate	Easy	Plain	Green	Greenish yellow	No design	Oblong
CMM-20	Yellow	Monoecious	Rounded	Rounded	Matt	Easy	Plain	Green	Yellow	Speckled	Elongate
CMM-21	Yellow	Monoecious	Rounded	Rounded	Intermediate	Easy	Plain	Green	Orange	Striped	Oblong
CMM-22	Yellow	Monoecious	Rounded	Rounded	Intermediate	Easy	Plain	Green	Orange	Spotted	Oblong
CMM-23	Yellow	Monoecious	Rounded	Rounded	Intermediate	Easy	Plain	Green	Orange	Spotted	Oblong
CMM-24	Yellow	Monoecious	Rounded	Rounded	Matt	Easy	Plain	Green	Yellow	Speckled	Oblong
CMM-25	Yellow	Monoecious	Rounded	Rounded	Intermediate	Easy	Plain	Green	Yellow	No design	Globular

Table 4. Fruit and seed characters

Accession No	Skin hardness of fruit	Fruit ridge	Flesh texture	Flesh colour	Presence of placental cavity	Seed cavity length (cm)	Seed cavity breadth (cm)	Seed shape	100 seed weight (g)
CMM-1	Soft	Absent	Soft-spongy	White	Present	33.33	9.385	Oval	2.59
CMM-2	Soft	Absent	Soft-spongy	White	Present	19.71	13.75	Oval	2.61
CMM-3	Soft	Absent	Soft-spongy	White	Present	25.75	11.3	Oval	2.51
CMM-4	Soft	Absent	Soft-spongy	White	Present	26.00	12.05	Oval	1.38
CMM-5	Soft	Absent	Soft-spongy	White	Present	33.33	9.46	Oval	2.49
CMM-6	Soft	Absent	Soft-spongy	White	Present	24.50	10.4	Oval	1.90
CMM-7	Soft	Absent	Soft-spongy	White	Present	30.25	11.775	Oval	2.59
CMM-8	Soft	Absent	Soft-spongy	White	Present	37.75	8.25	Oval	2.27
CMM-9	Hard	Absent	Smooth-firm	Orange	Present	27.25	7	Oval	1.71
CMM-10	Hard	Absent	Smooth-firm	Orange	Present	39.75	5.4	Oval	1.94
CMM-11	Hard	Absent	Smooth-firm	White	Present	43.50	11.75	Oval	3.49
CMM-12	Hard	Absent	Smooth-firm	White	Present	43.00	10.15	Oval	2.55
CMM-13	Hard	Absent	Smooth-firm	Light orange	Present	19.10	5.375	Oval	2.09
CMM-14	Hard	Absent	Smooth-firm	Light orange	Present	28.20	8.25	Oval	1.11
CMM-15	Hard	Absent	Smooth-firm	Orange	Present	15.10	4.25	Oval	1.93
CMM-16	Hard	Absent	Smooth-firm	Orange	Present	20.20	7.5	Oval	1.24
CMM-17	Hard	Absent	Smooth-firm	Orange	Present	20.60	5.25	Oval	2.16
CMM-18	Soft	Absent	Soft-spongy	White	Present	29.33	6.625	Oval	1.77
CMM-19	Hard	Absent	Smooth-firm	Light orange	Present	23.50	9.125	Oval	0.44
CMM-20	Hard	Absent	Smooth-firm	Light orange	Present	40.20	9	Oval	3.31
CMM-21	Hard	Absent	Smooth-firm	Light orange	Present	16.80	5.75	Oval	1.83
CMM-22	Hard	Absent	Smooth-firm	Light orange	Present	18.50	4.375	Oval	0.75
CMM-23	Hard	Absent	Smooth-firm	Light orange	Present	16.75	3.375	Oval	1.84
CMM-24	Intermediate	Absent	Smooth-firm	Light orange	Present	13.25	4.375	Oval	1.5
CMM-25	Intermediate	Absent	Smooth-firm	Light orange	Present	8.75	5.25	Oval	1.41

Plate 2. Variability in leaf margin

(A) Unifid

(B) Multifid

Plate 3. Variability in flower

(A) Male flower without pubescence

(B) Male flower with pubescence

(C) Female flower without pubescence

(D) Female flower with pubescence

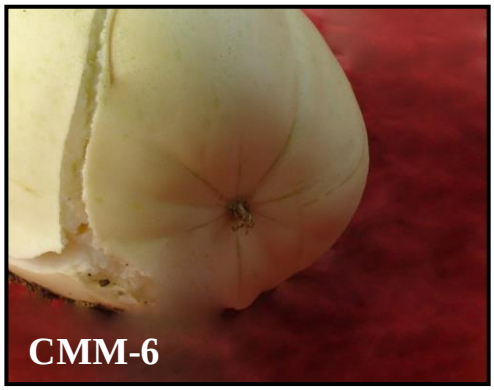
Plate 4. Variability in stem end fruit shape

(A) **Depressed**

(B) **Rounded**

(C) **Flattened**

Plate 5. Variability in blossom end fruit shape

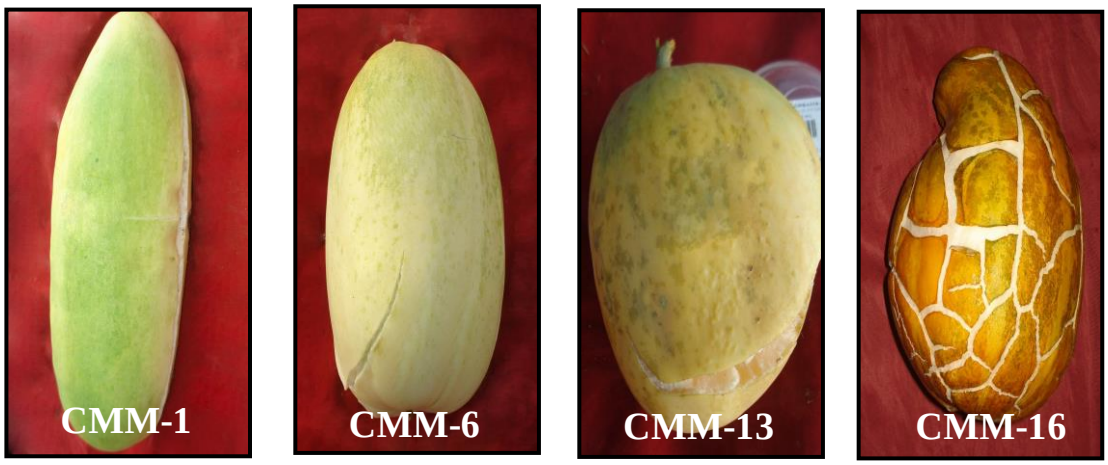


(A) Depressed

(B) Flattened

(C) Rounded

Plate 6. Fruit shape



(A) Elongated **(B) Oblong** **(C) Globular** **(D) Ovate**

Plate 7. Cracking pattern

(A) Cellular **(B) Longitudinal**

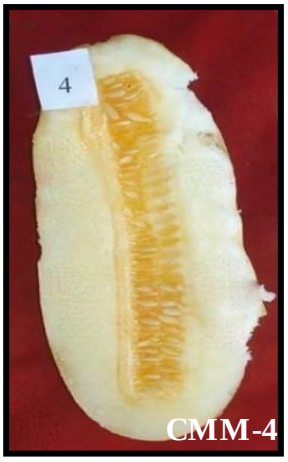
Plate 8. Fruit skin lustre

(A) Glossy

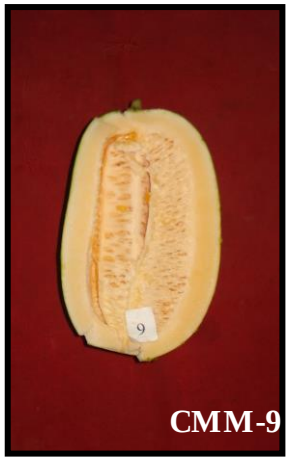
(B) Intermediate

(C) Matt

Plate 9. Flesh colour



(A) White



(B) Orange

Plate 10. Fruit skin secondary colour

(A) Yellow

(B) Greenish yellow

(C) Dark green

(D) Orange

Plate 11. Secondary skin colour design

No design

Spotted

Speckled

Striped

Table 5. Vegetative, flowering and maturity characters

Accessions	Vine length (m)	Nodes to first male flower appearance	Nodes to first female flower appearance	Days to first male flower appearance	Days to first female flower appearance	Days to first fruit set	Maturity period of fruits (days)	Days to first harvest	Number of harvests	Duration of crop
CMM-1	2.56	4.50	5.75	25.75	30.38	30.75	23.38	53.75	1.88	83.71
CMM-2	2.62	2.00	3.88	26.00	31.00	31.25	24.75	56.00	1.50	75.75
CMM-3	3.11	2.00	3.00	26.75	33.40	33.75	22.35	54.83	1.62	74.00
CMM-4	2.38	1.65	5.25	26.50	35.00	35.00	21.12	56.12	1.50	71.62
CMM-5	2.57	2.75	3.88	25.38	33.00	33.25	20.25	53.25	1.88	69.50
CMM-6	2.42	3.00	6.00	25.88	31.00	31.25	19.38	50.38	2.38	80.75
CMM-7	1.84	1.62	3.00	27.62	34.38	34.50	24.38	58.75	2.00	75.00
CMM-8	2.03	1.98	3.00	26.12	34.00	34.50	22.25	56.25	1.62	71.88
CMM-9	2.32	4.00	4.00	29.88	39.50	40.00	21.25	61.00	2.25	82.75
CMM-10	2.20	2.00	3.50	30.75	38.62	38.75	26.88	65.50	1.62	83.12
CMM-11	3.04	3.29	4.38	26.50	32.88	33.00	23.46	56.33	1.50	80.00
CMM-12	2.91	3.50	4.75	28.00	34.00	34.25	30.50	64.50	1.62	81.12
CMM-13	2.07	3.00	4.40	28.00	36.88	36.88	24.00	60.88	3.12	82.38
CMM-14	2.01	3.00	4.00	30.38	40.12	40.38	17.38	57.50	1.50	81.71
CMM-15	1.50	2.50	3.62	26.38	37.38	37.38	29.27	66.65	2.62	88.25
CMM-16	2.40	2.00	4.03	32.25	39.25	39.38	19.12	55.50	3.12	84.00
CMM-17	2.38	3.15	5.15	27.75	34.38	34.50	31.46	65.83	3.38	86.75
CMM-18	2.37	2.75	4.25	27.38	33.38	33.75	20.50	55.40	1.88	75.62
CMM-19	2.14	3.00	4.00	27.75	34.88	35.12	20.62	55.50	2.00	80.50
CMM-20	3.18	2.25	8.00	27.50	35.50	35.50	20.58	55.83	1.88	78.62
CMM-21	1.60	3.00	9.25	32.88	39.00	39.12	28.62	67.62	3.50	87.88
CMM-22	1.84	3.00	5.00	32.62	37.75	37.88	27.62	67.50	3.25	87.38
CMM-23	1.78	3.50	6.00	33.00	38.62	38.62	29.12	67.75	3.38	91.75
CMM-24	2.12	2.62	5.15	25.50	28.62	28.88	29.00	57.88	2.38	83.75
CMM-25	1.41	2.50	6.60	26.75	29.12	29.38	29.25	58.62	1.25	93.25
CD (P=0.05)	0.29	0.41	0.88	1.43	1.96	9.34	2.39	3.04	2.13	3.62

Table 6. Fruit characters

Accessions	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (kg)	Flesh thickness (cm)	Fruit cavity (cm)	Number of fruits/ plant	Number of seeds/ fruit	Yield/plant (kg)	Pulp placenta ratio
CMM-1	38.88	17.78	2.04	4.20	34.87	2.38	427.00	4.88	19.4:1
CMM-2	28.45	22.25	2.41	4.25	23.25	2.62	433.50	6.36	11.1:1
CMM-3	29.48	19.40	2.14	4.05	28.88	2.50	763.50	5.36	9.7:1
CMM-4	30.30	20.70	1.80	4.32	28.56	2.25	388.50	4.09	8:1
CMM-5	39.76	17.36	2.28	3.95	36.75	2.75	994.00	6.26	3.6:1
CMM-6	30.40	18.32	2.20	3.96	27.00	2.88	300.00	6.32	21:1
CMM-7	35.50	19.94	1.99	4.09	32.29	2.88	412.00	5.74	5.6:1
CMM-8	40.82	18.75	2.07	5.25	39.71	2.75	719.50	5.72	5.7:1
CMM-9	30.83	14.66	1.36	3.83	29.27	4.25	885.50	5.72	4.2:1
CMM-10	47.12	9.74	1.25	2.17	42.38	2.50	400.00	3.12	2.6:1
CMM-11	49.65	18.75	3.18	3.50	45.75	2.50	1074.50	7.97	6.6:1
CMM-12	46.71	16.15	3.05	3.00	44.50	2.50	1056.00	7.62	6.1:1
CMM-13	24.08	9.38	0.67	2.00	21.42	4.12	774.50	2.78	2.4:1
CMM-14	36.40	13.00	2.20	2.38	30.85	2.50	516.00	5.47	10:1
CMM-15	18.24	8.37	0.56	2.06	16.30	3.88	729.00	2.19	5.1:1
CMM-16	28.19	15.00	1.30	3.75	21.33	5.50	271.00	7.15	3.4:1
CMM-17	27.46	10.48	1.18	2.62	22.35	4.62	515.00	5.45	2.9:1
CMM-18	38.69	14.34	2.35	3.86	30.90	2.62	572.50	6.18	6.9:1
CMM-19	30.50	14.28	1.53	2.58	25.00	3.00	384.00	4.59	4.1:1
CMM-20	43.55	15.80	2.99	3.40	42.40	2.50	887.00	7.48	6.5:1
CMM-21	24.00	12.56	0.88	3.40	18.65	4.50	1234 .00	3.99	3.4:1
CMM-22	22.39	11.62	0.98	3.62	20.25	4.12	716.00	4.06	3.9:1
CMM-23	21.26	9.51	0.86	3.07	17.83	4.12	652.00	3.55	3.3:1
CMM-24	19.70	8.88	0.64	2.25	14.25	4.00	432.50	2.55	2.5:1
CMM-25	16.25	8.51	0.34	1.63	10.12	2.38	403.50	0.77	2.4:1
CD (P=0.05)	5.52	2.48	0.47	0.53	5.78	0.53	156.58	1.11	2.83

value of 2.27m. The PCV and GCV values were 22.41 and 19.73 respectively.

b) ***Nodes to First Male Flower Appearance***

There were significant differences between the accessions for nodes to first male flower appearance. The value ranged from 1.62 (CMM-7) to 4.50 (CMM-1) with a mean value of 2.74. The PCV and GCV values were 26.84 and 25.28 respectively.

c) ***Nodes to First Female Flower Appearance***

There were significant differences between the accessions for nodes to first female flower appearance. The value ranged from 3.00 (CMM-3,7& 8) to 9.25 (CMM-21) with a mean value of 4.79. The PCV and GCV values were 31.86 and 31.43 respectively.

d) ***Days to First Male Flower Appearance***

The accessions varied from 25.38 days (CMM-5) to 33.00 days (CMM-23) for first male flower appearance with a mean value of 28.13 days. The PCV and GCV values were 8.99 and 8.53 respectively.

e) ***Days to First Female Flower Appearance***

For the appearance first female flower CMM-24 took the minimum (28.62) and CMM-14 took the maximum (40.12) number of days with a mean value of 34.88 days. The PCV and GCV values were 9.72 and 9.46 respectively.

f) ***Days to First Fruit Set***

The first fruit was set after 28.88 days in CMM-24 and 40.38 days in CMM-14 with a mean value of 35.44 days. The PCV and GCV values were 9.52 and 9.30 respectively.

g) ***Days to First Harvest***

The first harvest was done 50.38 days after sowing in CMM-6 and 67.75 days in CMM-23 with a mean value of 59.17 days. The PCV and GCV values were 8.62 and 8.28 respectively.

h) ***Number of Fruits Per Plant***

Total number of fruits varied from 2.25 (CMM-4) to 5.50 (CMM-16) with a mean value of 3.24. The PCV and GCV values were 28.73 and 27.42 respectively.

i) ***Maturity Period of Fruits***

There were significant differences among the accessions for maturity period of fruits. The value ranged from 17.38 days (CMM-14) to 31.46 days (CMM-17) with a mean value of 24.26 days. The PCV and GCV values were 17.23 and 16.24 respectively.

j) ***Number of Harvests***

Number of harvests varied from 1.25 (CMM-25) to 3.5 (CMM-21) with a mean value of 2.23. The PCV and GCV values were 35.32 and 34.84 respectively.

k) ***Average Fruit weight***

The highest weight of fruit was obtained for the accession CMM-11 (3.18kg) and the lowest was recorded by CMM-25 (0.34kg) with a mean value of 1.69kg. Variation in average fruit weight is shown in Figure 1. The PCV and GCV values were 48.74 and 47.85 respectively.

l) ***Yield Per Plant***

The fruit yield per plant varied significantly among different accessions (Fig 2). The accession CMM-25 (0.77kg) had the lowest yield and CMM-11 (7.92kg) had the highest yield with a mean value of 5.06kg. The PCV and GCV estimates were 38.86 and 36.42 respectively.

m) ***Fruit Length***

Significant differences among the genotypes were observed for length of fruit (Fig 3). It varied from 16.25cm (CMM-25) to 49.65cm (CMM-11) with a mean of 31.94. The PCV and GCV values were 29.77 and 29.32 respectively.

n) ***Fruit Diameter***

The diameter of fruit ranged from 8.37cm (CMM-15) to 22.25cm (CMM-2) with a mean of 14.62cm. The PCV and GCV values were 21.20 and 20.90 respectively.

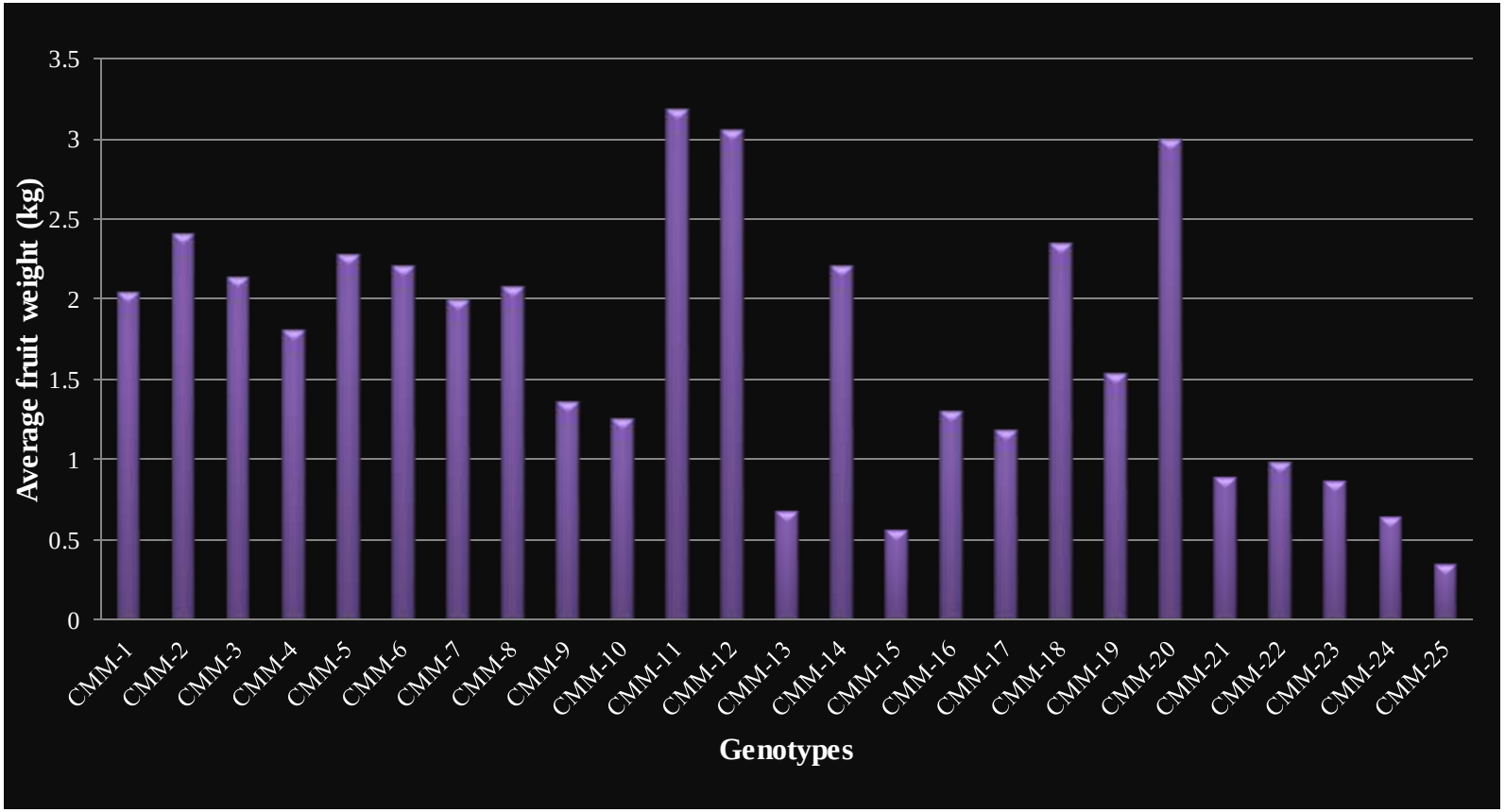


Fig 1. Comparison of average fruit weight in 25 accessions of snap melon

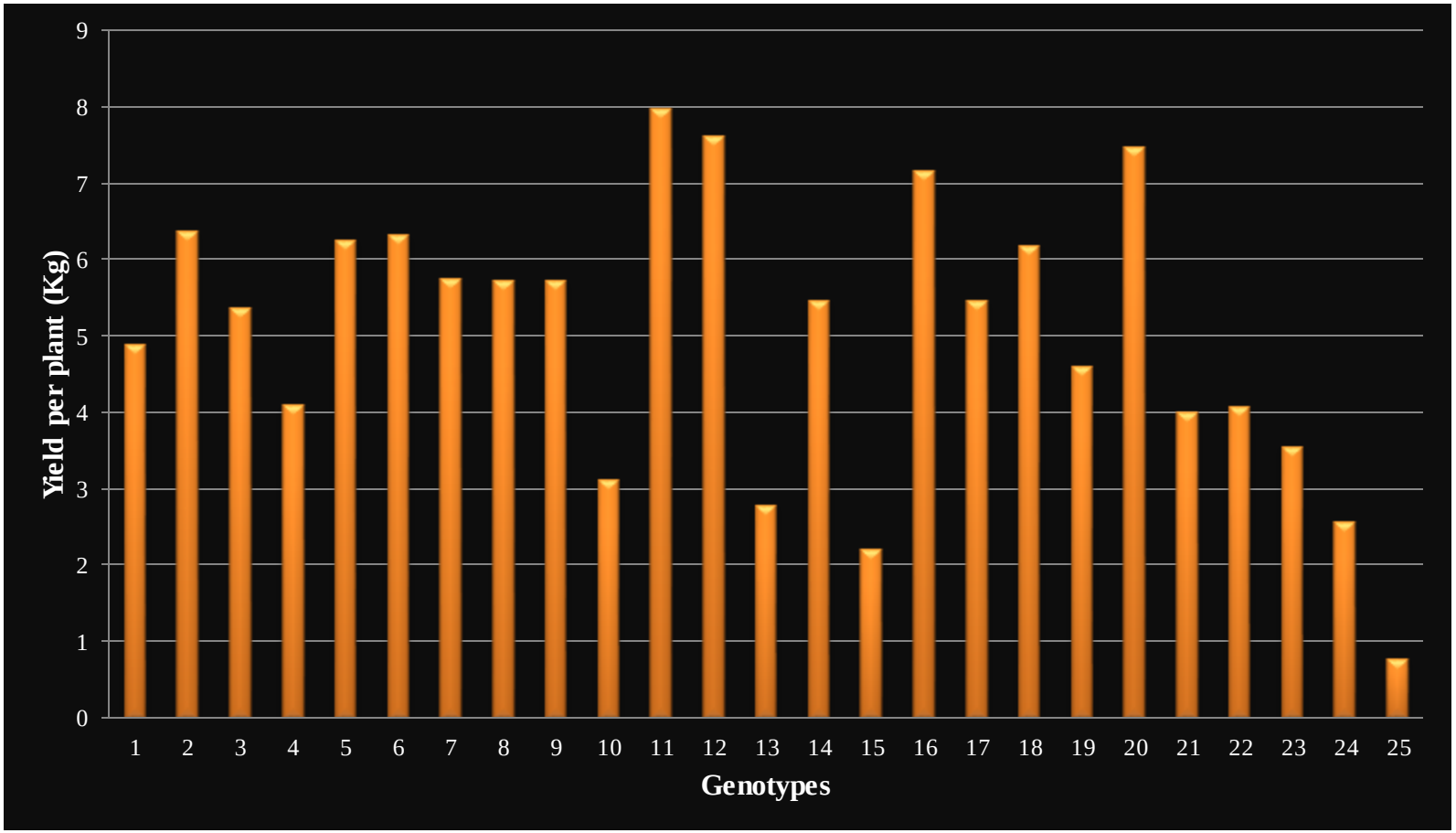


Fig 2. Variation in yield per plant in different accessions of snap melon

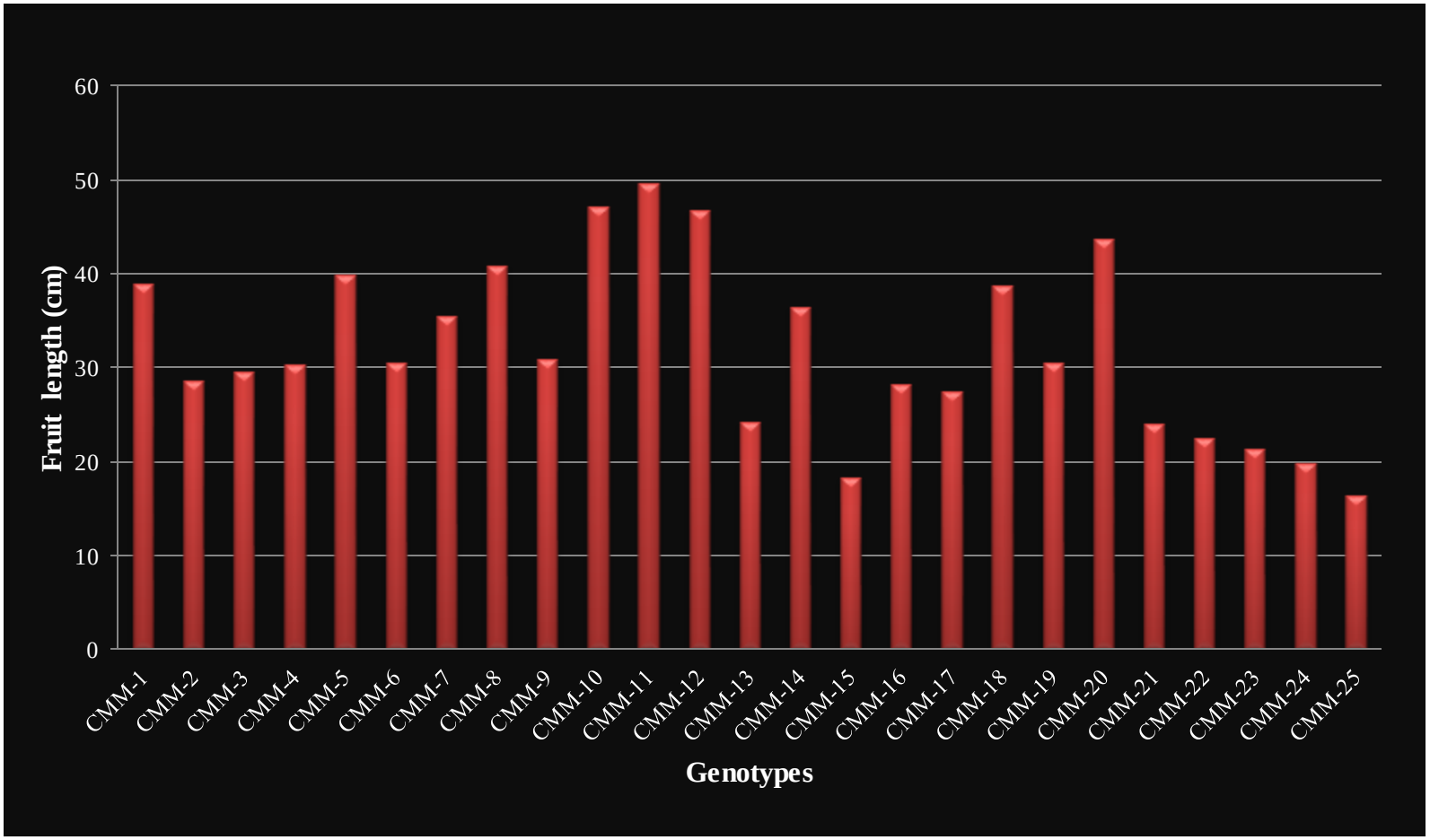


Fig. 3. Comparison of fruit length of 25 accessions of snap melon

o) ***Number of Seeds Per Fruit***

The highest number of seeds recorded in the fruits of the accession CMM-21 (1234) and the lowest was in CMM-16 (271) with a mean value of 637.64. The PCV and GCV values were 42.08 and 42.07 respectively.

p) ***Flesh thickness***

Flesh thickness ranged from 1.63cm (CMM-25) to 5.25cm (CMM-8) with a mean value of 3.33cm. The PCV and GCV values were 27.66 and 27.11 respectively.

q) ***Length of Fruit Cavity***

There was significant differences between the accessions for length of fruit cavity. The value ranged from 10.12cm (CMM-25) to 45.75cm (CMM-11) with a mean value of 28.19cm. The PCV and GCV values were 34.13 and 31.04 respectively.

r) ***Pulp Placenta Ratio***

Pulp placenta ratio varied from 2.4 (CMM-25) to 21.00 (CMM-6) with a mean value of 6.42. The PCV and GCV values were 32.21 and 32.11 respectively.

s) ***Shelf Life***

Shelf life ranged from 1 day to 3 days with a mean value of 2.16 days. The PCV and GCV values were 43.71.

t) ***Rind firmness***

Significant differences among the genotypes were observed for rind thickness. It varied from 0.1kg/cm^2 (CMM, 3-8, CMM-1, 11& 20) to 3.2 kg/cm^2 (CMM-10& 24) with a mean of 1.55 kg/cm^2. The PCV and GCV values were 39.81 and 39.03 respectively.

u) ***Ascorbic Acid***

The ascorbic acid content of fresh fruits ranged between 4.70 mg (CMM,1-8 & 20)and 13.95 mg (CMM, 21-23). The PCV and GCV was 37.34.

v) ***Reducing Sugar***

Reducing sugar ranged from 1.83 per cent (CMM-2) to 3.01 per cent (CMM-21) with a mean value of 2.52 per cent. The PCV and GCV values were 13.93.

w) ***Non reducing sugar***

Non reducing sugar ranged from 1.93 per cent (CMM-2) to 3.03 per cent (CMM-21) with a mean value of 2.45 per cent. The PCV and GCV values were 15.11 and 15.09 respectively.

x) ***Total Soluble Solids***

Total soluble solids was the highest in the fresh fruit of the accession CMM-21 (5.3^{0}Brix) and lowest in the accession CMM-6 (2^{0}Brix) with a mean value of 3.86^{0}Brix. The PCV and GCV values were 24.60 and 24.53 respectively.

Table 7. Quality parameters

Accessions	Ascorbic acid (mg/100g)	Reducing sugar (%)	Non reducing sugar (%)	Total soluble solids (^{0}Brix)	Shelf life (days)	Rind firmness (kg/cm^2)
CMM-1	4.70	2.11	2.01	3.9	1	0.10
CMM-2	4.70	1.83	1.93	4.0	1	0.20
CMM-3	4.70	2.05	2.01	2.3	1	0.10
CMM-4	4.70	2.09	2.05	3.2	1	0.10
CMM-5	4.70	2.44	2.15	3.0	1	0.10
CMM-6	4.70	1.90	1.97	2.0	1	0.10
CMM-7	4.70	2.23	2.23	3.8	1	0.10
CMM-8	4.70	2.14	2.06	3.7	1	0.10
CMM-9	9.30	2.74	2.92	5.0	3	2.65
CMM-10	9.30	2.16	2.18	4.9	3	3.20
CMM-11	9.30	2.57	2.37	3.2	2	1.10
CMM-12	9.30	2.66	2.26	3.5	2	1.20
CMM-13	9.30	2.73	2.89	5.0	3	1.75
CMM-14	9.30	2.70	2.79	4.2	3	1.65
CMM-15	9.30	2.76	2.94	3.1	3	1.55
CMM-16	9.30	2.78	2.76	4.9	3	2.75
CMM-17	9.30	2.97	2.71	4.9	3	2.75
CMM-18	9.30	2.49	2.06	3.6	1	0.15
CMM-19	9.30	2.72	2.33	4.1	3	3.10
CMM-20	4.70	2.66	2.10	2.9	2	1.10
CMM-21	13.95	3.01	3.03	5.3	3	3.05
CMM-22	13.95	2.96	2.78	5.1	3	2.85
CMM-23	13.95	2.93	2.74	5.0	3	2.85
CMM-24	9.30	2.64	2.55	3.2	3	3.20
CMM-25	9.30	2.66	2.53	3.0	3	3.05
CD (P=0.05)	1.78	0.20	1.02	0.55	1.59	0.53

y) ***Organoleptic evaluation***

Kendall's (W) value for appearance, colour, texture, flavor, taste and overall acceptability was significantly different among the accessions (Table 8). Accession CMM-9 had the highest mean score with high mean rank for appearance (8.3, 20.5), colour (8.6, 20.7), texture (7.8, 16.6) and flavour (7.5, 19.1). Accession CMM-21 had the highest mean score and mean rank for taste (8.8, 20.90) and over all acceptability (8.3, 19.38).

4.2.2. Heritability, Genetic advance and Genetic gain

The magnitude of heritable value is the most important aspect of genetic constitution of breeding material, which has close bearing on the response to selection (Panse, 1957). Heritability is a measure of efficiency of selection system in separating genotypes and indicates the effectiveness with which selection of genotypes could be done. Allard (1960) suggested that gain from selection for a particular character depends largely on the heritability of the character. Heritability, genetic advance and genetic gain for different characters are presented in Table 10 (Fig 5).

High heritability was expressed by all the characters under study- Shelf life, number of seeds per fruit and ascorbic acid (99.8%) followed by reducing sugar (99.7%), non reducing sugar (99.6), total soluble solids (99.5%), rind firmness (99.4), fruit diameter (99.1), nodes to first female flower appearance and length of fruit cavity (97.3%), fruit diameter (97.2%), fruit length (97%), average fruit weight (96.4%), flesh thickness (96.1%), days to first female flower appearance (94.8%),

Table 8. Mean score for the organoleptic qualities in snap melon

Sl No.	Accessions	Mean score					
		Appearance	Colour	Texture	Flavour	Taste	Overall acceptibility
1	CMM-1	6.9 (10)	6.6 (7.2)	7.5 (13.2)	5.9 (9.3)	7.2 (9.3)	7.1 (8.5)
2	CMM-2	7.3 (12.6)	6.7 (8.5)	7.7 (14.3)	6.0 (10.0)	7.0 (8.5)	7.0 (9.4)
3	CMM-3	7.1 (10.7)	6.8 (9.8)	7.7 (13.7)	6.2 (10.3)	7.1 (8.9)	7.3 (11.4)
4	CMM-4	6.4 (5.7)	6.5 (5.9)	7.3 (10.8)	5.9 (8.0)	6.5 (8.4)	6.9 (7.9)
5	CMM-5	7.1 (10.9)	6.9 (7.0)	7.6 (14.4)	5.8 (8.7)	7.8 (14.4)	7.3 (10.2)
6	CMM-6	6.9 (10.2)	6.9 (9.1)	7.8 (15.4)	6.3 (12.2)	7.2 (10.2)	7.2 (10.1)
7	CMM-7	6.7 (8.8)	6.2 (5.5)	7.5 (12.8)	5.7 (6.5)	6.2 (5.2)	6.5 (7.4)
8	CMM-8	6.8 (8.4)	6.8 (9.6)	7.5 (12.9)	6.5 (11.1)	7.4 (11.0)	7.3 (10.4)
9	CMM-9	8.3 (20.5)	8.6 (20.7)	7.8 (16.6)	7.5 (19.1)	8.1 (16.6)	8.2 (18.1)
10	CMM-10	7.7 (16.1)	8.1 (16.6)	7.6 (13.1)	7.0 (14.9)	8.1 (16.0)	8.2 (18.0)
11	CMM-11	7.2 (11.4)	7.2 (9.8)	7.6 (13.8)	6.2 (10.0)	7.6 (12.1)	7.5 (11.5)
12	CMM-12	7.1 (10.6)	7.2 (9.8)	7.6 (13.8)	6.1 (8.7)	7.7 (13.1)	7.6 (12.7)
13	CMM-13	7.9 (17.4)	8.5 (19.6)	7.4 (13.2)	7.0 (15.8)	8.2 (17.6)	8.3 (19.2)
14	CMM-14	7.9 (17.4)	8.4 (18.9)	7.4 (13.2)	7.0 (15.8)	8.1 (17.0)	8.1 (17.6)
15	CMM-15	7.7 (16.5)	8.3 (18.1)	7.3 (12.6)	7.4 (17.5)	8.0 (15.8)	8.0 (14.9)
16	CMM-16	8.0 (18.9)	8.5 (19.3)	7.4 (13.0)	7.7 (19.0)	8.4 (18.1)	8.1 (17.1)
17	CMM-17	7.9 (17.9)	8.4 (19.2)	7.8 (15.1)	7.6 (18.2)	8.5 (18.3)	8.0 (16.6)
18	CMM-18	7.1 (10.8)	7.2 (10.4)	6.7 (5.2)	5.9 (6.8)	7.1 (10.1)	7.6 (12.6)
19	CMM-19	7.7 (16.5)	7.9 (15.3)	7.5 (13.4)	7.4 (18.3)	8.0 (15.2)	7.7 (13.2)
20	CMM-20	7.1 (11.5)	7.1 (8.8)	7.4 (11.4)	6.1 (8.5)	7.2 (9.0)	7.5 (11.2)
21	CMM-21	7.7 (15.5)	7.9 (15.7)	7.8 (15.6)	7.5 (18.1)	8.8 (20.9)	8.3 (19.4)
22	CMM-22	7.4 (12.8)	7.8 (14.6)	7.9 (16.4)	7.5 (18.1)	8.7 (20.2)	8.2 (17.7)
23	CMM-23	7.4 (12.8)	7.9 (15.7)	7.7 (14.2)	7.5 (18.1)	8.6 (19.2)	8.1 (17.6)
24	CMM-24	7.2 (11.4)	7.9 (15.3)	6.9 (9.2)	6.6 (11.7)	6.2 (5.2)	6.8 (6.2)
25	CMM-25	7.0 (10.2)	7.8 (15.0)	6.8 (8.2)	6.5 (10.7)	6.6 (5.3)	6.8 (6.2)
Kendall's W[a]		0.331**	0.512**	0.147**	0.421**	0.507**	0.432**

(Figures in parenthesis indicate mean rank scores)

a-Kendall's coefficient of concordance

**- Significant at 1% level

Table 9. Range, mean, Phenotypic Coefficient of Variation (PCV) and Genotypic Coefficient of Variation (GCV) of different characters

SL. No.	Characters	Range	Mean+ SE	PCV	GCV
1	Vine length (m)	1.41-3.18	2.27+ 0.10	22.41	19.73
2	Nodes to first male flower appearance	1.62-4.50	2.74+0.14	26.84	25.28
3	Nodes to first female flower appearance	3.00-9.25	4.79+0.30	31.86	31.43
4	Days to first male flower appearance	25.38-33.00	28.13+0.49	8.99	8.53
5	Days to first female flower appearance	28.62-40.12	34.88+0.67	9.72	9.46
6	Days to first set	28.88-40.38	35.44+3.20	9.52	9.30
7	Days to first harvest	50.38-67.75	59.17+1.04	8.62	8.28
8	Number of fruits per plant	2.25-5.50	3.24+0.18	28.73	27.42
9	Maturity period of fruits (days)	17.38-31.46	24.26+0.82	17.23	16.24
10	Duration of crop	69.50-93.25	81.24+1.24	7.79	7.48
11	Number of harvests	1.25-3.50	2.23+0.73	35.32	34.84
12	Average fruit weight (kg)	0.34-3.18	1.69+0.16	48.74	47.85
13	Yield per plant (kg)	0.77-7.97	5.06+0.38	38.86	36.42
14	Fruit length (cm)	16.25-49.65	31.94+1.89	29.77	29.32
15	Fruit diameter (cm)	8.37-22.25	14.62+0.85	29.21	29.07
16	Number of seeds per fruit	271-1234	637.6+53.66	42.08	42.07
17	Flesh thickness (cm)	1.63-5.25	3.33+0.18	27.66	27.11
18	Length of fruit cavity (cm)	10.12-45.75	28.19+1.98	34.13	31.04
19	Pulp placenta ratio	2.40-21.00	6.42+0.97	32.21	32.11
20	Shelf life (days)	1.00-3.00	2.16+0.89	43.71	43.71
21	Rind firmness (kg/cm^2)	0.10-3.20	1.55+0.18	39.81	39.03
22	Ascorbic acid ($mg\ 100g^{-1}$)	4.70-13.95	8.20+0.61	37.34	37.34
23	Reducing sugar (%)	1.83-3.01	2.52+0.07	13.93	13.93
24	Non reducing sugar (%)	1.97-3.03	2.45+0.35	15.11	15.09
25	Total Soluble Solids (^{0}Brix)	2.00-5.30	3.86+0.19	24.60	24.53

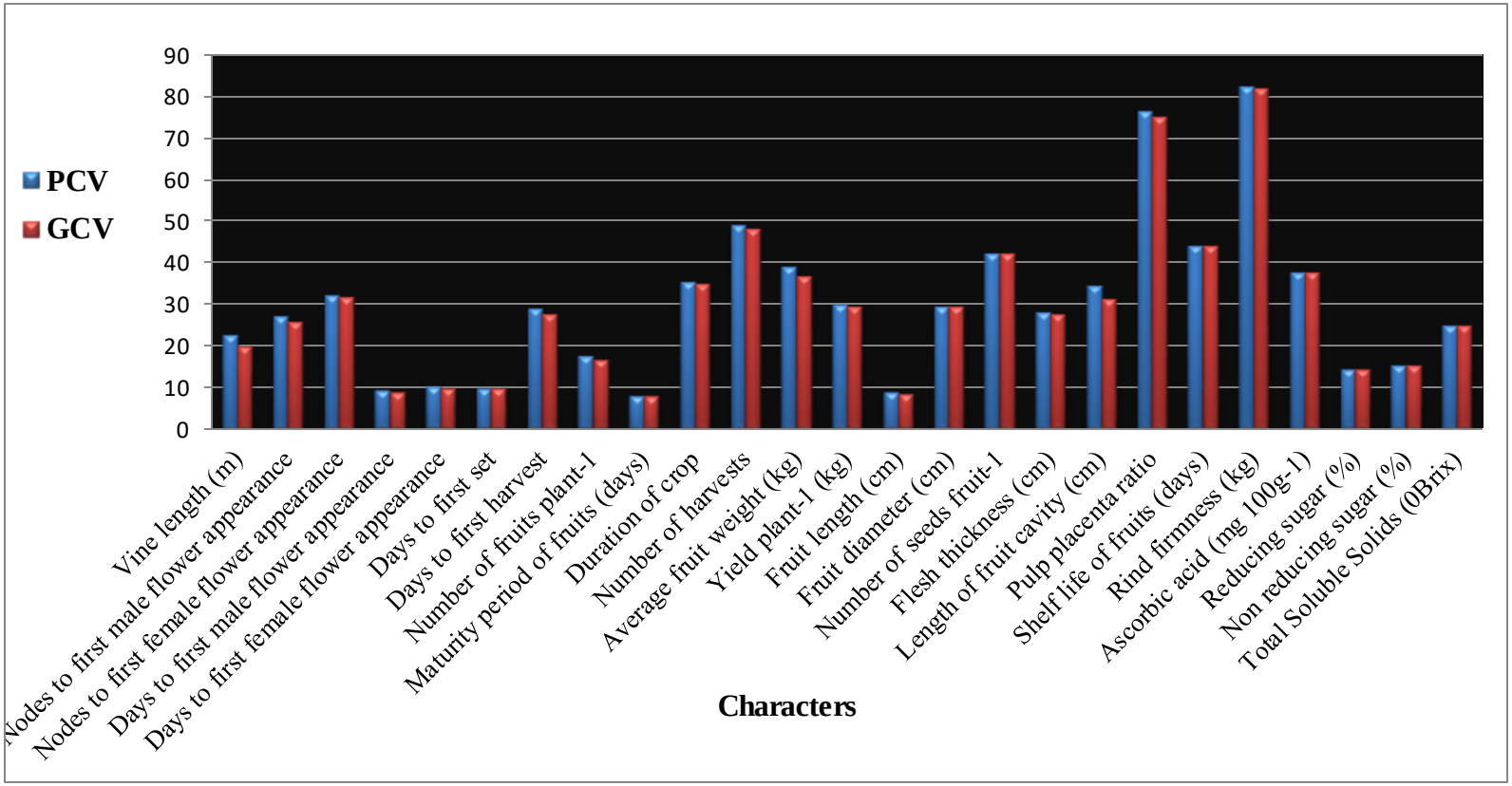


Fig.4. Variation in PCV and GCV for yield and its components

days to first harvest (92.5%), duration of crop (92.2%) and number of fruits per plant (91.1%). Genetic advance was the highest (552.49) for number of seeds per fruit and the lowest (0.72) for reducing sugar.

Highest magnitude of genetic gain (97.06%) was manifested by average fruit weight and the lowest (14.80%) by duration of crop. The characters like pulp placenta ratio (96.5), rind firmness (96.1), length of fruit cavity (70.79%), yield per plant (70.36), ascorbic acid (76.93%), number of seeds per fruit (86.65%), nodes to first female flower appearance (63.84%), fruit diameter (59.58%), fruit length (59.48%), flesh thickness (54.70%) and total soluble solids (50.47%) also had high genetic gain.

4.2.3. Correlation

Correlation provides the information about the nature and extent of relationship of yield and its component characters and is essential for the simultaneous improvement of yield components, and in turn yield. The genotypic correlation provides a reliable measure of genetic association between the characters and helps to differentiate the vital association useful in breeding from non vital ones (Falconer, 1981). The genotypic and phenotypic correlations between different pairs of characters were estimated and presented in Table 11.

It was observed that fruit yield had highly significant positive genotypic correlation with average fruit weight (0.884), vine length (0.842), fruit length (0.717), length of fruit cavity (0.705), fruit diameter (0.684) and flesh thickness (0.584)

Table 10. Heritability, genetic advance and genetic gain for different characters

SL.No	Characters	Heritability (%)	Genetic advance	Genetic gain (%)
1	Vine length (m)	77.5	0.81	35.66
2	Nodes to first male flower appearance	88.7	1.35	49.22
3	Nodes to first female flower appearance	97.3	3.06	63.84
4	Days to first male flower appearance	90.1	4.69	16.67
5	Days to first female flower appearance	94.8	6.62	18.98
6	Days to first fruit set	95.4	6.56	18.7
7	Days to first harvest	92.5	9.72	16.42
8	Number of fruits per plant	91.1	1.75	54.01
9	Maturity period of fruits (days)	88.8	7.66	31.57
10	Duration of crop	92.2	12.02	14.80
11	Number of harvests	82.7	1.27	58.12
12	Average fruit weight (g)	96.4	1.64	97.06
13	Yield per plant (kg)	87.9	3.56	70.36
14	Fruit length (cm)	97	19	59.48
15	Fruit diameter (cm)	99.1	8.71	59.58
16	Number of seeds per fruit	99.8	552.49	86.65
17	Flesh thickness (cm)	96.1	1.82	54.70
18	Length of fruit cavity (cm)	97.3	19.96	70.79
19	Pulp placenta ratio	96.0	9.65	96.5
20	Shelf life (days)	99.8	1.87	89.9
21	Rind firmness ($kg/cm^{2)}$	99.4	2.61	96.1
22	Ascorbic acid (mg $100g^{-1}$)	99.8	6.31	76.93
23	Reducing sugar (%)	99.7	0.72	28.60
24	Non reducing sugar (%)	99.6	0.75	31.07
25	Total Soluble Solids (^{0}Brix)	99.5	1.95	50.47

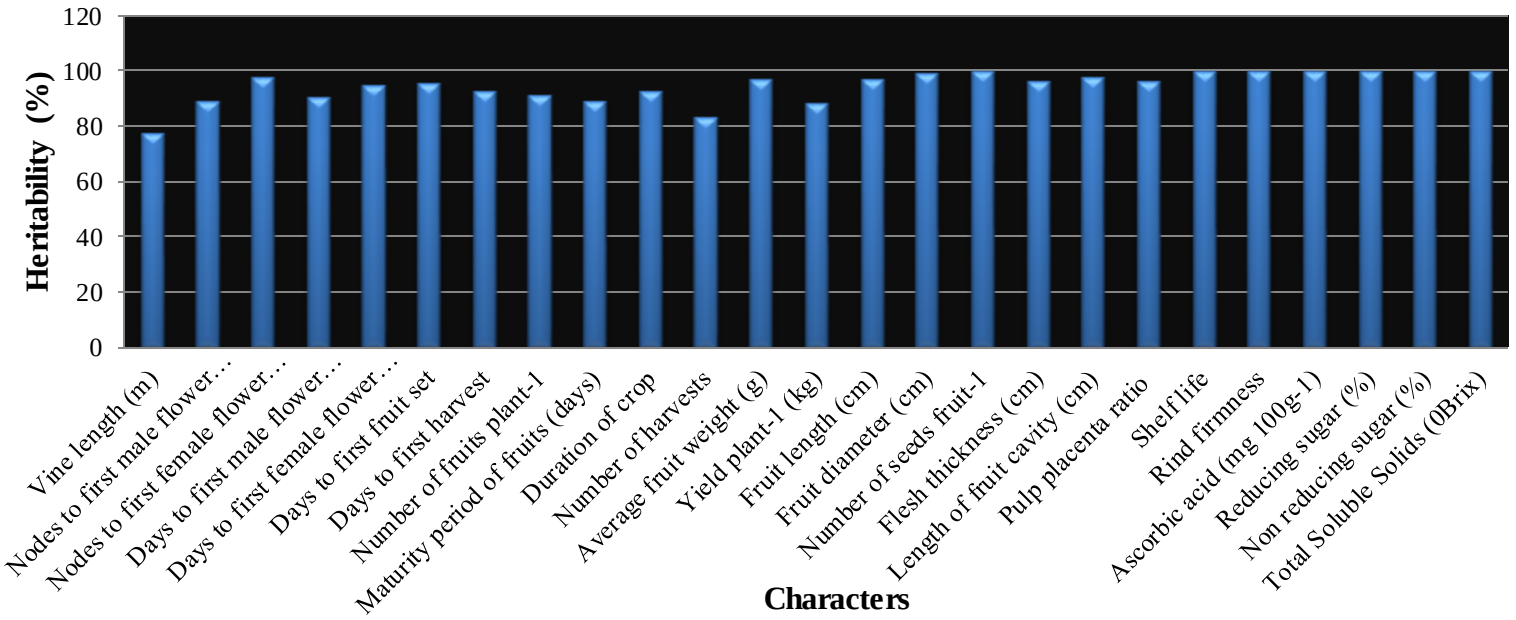


Fig. 5. Variation in heritability for yield and its components

and significant negative correlation with maturity period (-0.483), duration of crop (-0.539), days to first harvest (-0.377) and rind firmness (-0.486). Vine length (0.710), length of fruit cavity (0.675), fruit length (0.673), average fruit weight (0.864), fruit diameter (0.649) and flesh thickness (0.558) were found to have significant positive phenotypic correlation with yield.

Vine length showed highly significant positive genotypic correlation with length of fruit cavity (0.721). It recorded highly significant negative correlation with days to first harvest (-0.540) and duration of crop (-0.591), while it had significant negative correlation with days to first male flower appearance (-0.422) and maturity period (-0.409). Nodes to first male flower appearance showed significant positive genotypic correlation with duration of crop (0.443).

Days to first male flower appearance was found to have high significant positive genotypic correlation with days to first female flower appearance (0.805), days to first fruit set (0.807), days to first harvest (0.671), duration of crop (0.533), number of fruits per plant (0.613), number of harvest (0.650), T.S.S. (0.792), but negative significant correlation with average fruit weight (0.363).

The characters having highly significant positive genotypic correlation with days to first female flower appearance were days to first fruit set (1.001), days to first harvest (0.582), number of fruits per plant (0.501), number of harvests (0.490), T.S.S. (0.670) and ascorbic acid (0.514).

Table 11. Phenotypic and genotypic correlation coefficients between yield and its components

Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
X1- Vine length	1	0.056	-0.122	-0.422 *	-0.285	-0.281	-0.409 *	-0.540 **	-0.591 **	-0.361	0.721**	-0.393 *
X2- Nodes to first male flower appearance	0.030	1	0.274	0.139	0.023	0.037	0.165	0.158	0.443*	0.159	0.024	0.269
X3- Nodes to first female flower appearance	-0.089	0.271	1	0.256	-0.026	-0.042	0.258	0.195	0.473 **	0.174	-0.242	0.332
X4-Days to first male flower appearance	-0.289	0.127	0.232	1	0.805 **	0.807 **	0.152	0.671 **	0.533 **	0.613**	-0.220	0.650 **
X5- Days to first female flower appearance	-0.215	0.034	-0.037	0.803 *	1	1.001 **	-0.108	0.582 **	0.227	0.501 **	0.015	0.490**
X6- days to first fruit set	-0.211	0.044	-0.051	0.798*	0.997 *	1	-0.120	0.573**	0.217	0.491 **	0.024	0.475 **
X7- Maturity period	-0.334	0.125	0.231	0.134	-0.117	-0.132	1	0.746 **	0.623 **	0.290	-0.363 *	0.475 **
X8- Days to first harvest	-0.439	0.134	0.170	0.647 *	0.568*	0.554 *	0.748 *	1	0.673 **	0.581 **	-0.294	0.654 **
X9- Duration of crop	-0.495	0.420	0.442	0.491	0.214	0.203	0.574 *	0.624 *	1	0.531**	-0.601 **	0.577 **
X10- Number of fruits per plant	-0.312	0.140	0.178	0.528	0.455	0.453	0.225	0.499	0.478	1	-0.565 **	0.925 **
X11- length of fruit cavity	0.625 *	0.025	-0.228	-0.200	0.015	0.025	-0.352	-0.292	-0.565 *	-0.523	1	-0.569 **
X12- Number of harvests	-0.369	0.236	0.319	0.529 *	0.409	0.399	0.308	0.530 *	0.489	0.872 *	-0.488	1
X13- Fruit length	0.599 *	0.035	-0.219	-0.176	-0.007	0.002	-0.351	-0.303	-0.529	-0.525	0.977*	-0.508
X14- Number of seeds per fruit	0.193	0.294	0.253	0.131	0.236	0.238	0.177	0.293	-0.043	0.068	0.315	0.118
X15- Average fruit weight	0.749 *	0.002	-0.133	-0.336	-0.208	-0.199	-0.438	-0.514	-0.647 *	-0.570 *	0.819 *	-0.533 *
X16- Fruit diameter	0.573 *	0.052	-0.143	-0.184	-0.062	-0.047	-0.559 *	-0.514	-0.573 *	-0.238	0.567 *	-0.247
X17- flesh thickness	0.352	-0.138	-0.147	-0.168	-0.123	-0.104	-0.443	-0.452	-0.645 *	-0.176	0.402	-0.157
X18- yield per plant	0.710 *	0.043	-0.058	-0.096	0.006	0.016	-0.453	-0.380	-0.509	-0.104	0.675 *	-0.162
X19- Pulp placenta ratio	0.356	0.034	-0.128	-0.369	-0.192	-0.188	-0.381	-0.458	-0.399	-0.425	0.354	-0.326
X20- Total soluble solids	-0.362	0.256	0.048	0.751 *	0.653 *	0.655 *	0.237	0.646 *	0.425	0.598 *	-0.205	0.569 *
X21- Ascorbic acid	-0.477	0.358	0.300	0.741*	0.501	0.496	0.493	0.751*	0.731*	0.562*	-0.428	0.590*
X22-Shelf life	-0.344	0.360	0.347	0.574*	0.490	0.483	0.370	0.639*	0.630*	0.656*	-0.363	0.609*
X23- Rind firmness	-0.548*	0.299	0.200	0.602*	0.599*	0.593*	0.331	0.684*	0.678*	0.748*	-0.544	0.657*

Table 11 Continued…

Characters	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23
X1- Vine length	0.707 **	0.217	0.854**	0.632**	0.423 *	0.842 **	0.378 *	-0.410*	-0.539 **	-0.428 *	-0.495 **
X2- Nodes to first male flower appearance	0.035	0.311	-0.017	-0.243	-0.150	0.023	0.226	0.266	0.380*	0.291	0.210
X3- Nodes to first female flower appearance	-0.225	0.256	-0.152	-0.238	-0.159	-0.099	0.047	0.045	0.304	0.163	0.284
X4-Days to first male flower appearance	-0.193	0.137	-0.363 *	-0.407 *	-0.155	-0.081	-0.400 *	0.792**	0.779 **	0.724**	0.639 **
X5- Days to first male flower appearance	-0.009	0.243	-0.212	-0.292	-0.119	0.030	-0.377 *	0.670 **	0.514**	0.709 **	0.394 *
X6- days to first fruit set	0.002	0.245	-0.203	-0.282	-0.105	0.036	-0.370 *	0.670 **	0.507**	0.699 **	0.388 *
X7- Maturity period	-0.379*	0.186	-0.480 **	-0.553 **	-0.454 **	-0.483 **	-0.427 *	0.257	0.522**	0.311	0.467 **
X8- Days to first harvest	-0.320	0.304	-.541 **	-0.655 **	-0.457 **	-0.377*	-0.605 **	0.674**	0.780 **	0.738**	0.658 **
X9- Duration of crop	-0.570**	-0.045	-0.673 **	-0.792 **	-0.674 **	-0.539 **	-0.242	0.438**	0.760 **	0.725 **	0.788 **
X10- Number of fruits per plant	-0.553 **	0.071	-0.611**	-0.506 **	-0.209	-0.187	-0.469 **	0.626 **	0.587**	0.671**	0.621 **
X11- length of fruit cavity	0.985 **	0.318	0.832 **	0.535 **	0.400 *	0.705 **	0.228	-0.212	-0.434 **	-0.340	-0.490 **
X12- Number of harvest	-0.564**	0.127	-0.607 **	-0.522 **	-0.191	-0.248	-0.326	0.629 **	0.647 **	0.616 **	0.520**
X13- Fruit length	1	0.249	0.830**	0.503 **	0.352	0.717 **	0.222	-0.172	-0.388 *	-0.321	-0.440 **
X14- Number of seeds per fruit	0.246	1	0.240	0.003	0.071	0.266	-0.274	0.051	0.259	0.135	-0.022
X15- Average fruit weight	0.815 *	0.238	1	0.767 **	0.544 **	0.884 **	0.462**	-0.442 **	-0.548**	-0.559 **	-0.691 **
X16- Fruit diameter	0.555 *	0.148	0.753 *	1	0.619**	0.684 **	0.561**	-0.408 *	-0.721**	-0.749 **	-0.792 **
X17- flesh thickness	0.355	0.069	0.527	0.619 *	1	0.584**	0.444 **	-0.176	-0.514 **	-0.665 **	-0.686 **
X18- yield per plant	0.673 *	0.253	0.864 *	0.649 *	0.558 *	1	0.299	-0.187	-0.387 *	-0.321	-0.486 **
X19- Pulp placenta ratio	0.320	-0.042	0.628 *	0.493	0.512	0.477	1	-0.553 **	-0.543**	-0.559 **	-0.634 **
X20- Total soluble solids	-0.166	0.051	-0.432	-0.351	-0.169	-0.173	-0.487	1	0.655**	0.697**	0.605 **
X21- Ascorbic acid	-0.382	0.259	-0.538	-0.468	-0.504	-0.364	-0.502	0.653*	1	0.792**	0.793**
X22- Shelf life	-0.343	0.377	-0.445	-0.277	-0.526	-0.181	-0.520	0.539	0.814*	1	0.865 **
X23- Rind firmness	-0.543	0.256	-0.662*	-0.445	-0.532	-0.394	-0.477	0.621*	0.779*	0.846*	1

Days to first fruit set had highly significant positive genotypic correlation with days to first harvest (0.573), number of fruits per plant(0.491), number of harvests (0.475), T.S.S. (0.670) and ascorbic acid (0.507) whereas highly significant negative correlation with fruit length (-0.379), average fruit weight (-0.203), fruit diameter (-0.054) and flesh thickness (-0.105).

Highly significant and positive genotypic correlation was observed for maturity period with days to first harvest (0.746), duration of crop (0.623), number of harvests (0.475), ascorbic acid (0.522) and rind firmness (0.467).

Days to first harvest had highly significant positive genotypic correlation with duration of crop (0.673), number of fruits per plant(0.581), number of harvests (0.654), T.S.S. (0.674), ascorbic acid (0.780), shelf life (0.738) and rind firmness (0.658). Days to first harvest had highly significant negative correlation with average fruit weight (-0.541), fruit diameter (-0.655) and flesh thickness (-0.457).

Duration of crop was found to have highly significant and positive genotypic correlation with number of fruits per plant (0.531), number of harvests (0.577), T.S.S. (0.438), ascorbic acid (0.760), shelf life (0.725) and rind firmness (0.788). It was negatively correlated with length of fruit cavity (-0.601), fruit length (-0.570), average fruit weight (-0.673), fruit diameter (-0.596) and flesh thickness (-0.674).

Number of fruits per plant was highly significant and positively correlated with number of harvests (0.925), T.S.S. (0.626), ascorbic acid (0.587), shelf life (0.671) and rind firmness (0.621). It was negatively correlated with length of fruit cavity (-0.565), fruit length (-0.553) and average fruit weight (-0.611).

Highly significant and positive genotypic correlation was observed for length of fruit cavity with fruit length (0.985), average fruit weight (0.832), fruit diameter (0.570), and flesh thickness (0.400). But it was negatively correlated with number of harvests (-0.569), ascorbic acid (-0.434) and rind firmness (-0.490).

Fruit length was highly significant and positively correlated with average fruit weight (0.830) and fruit diameter (0.503). It was negatively correlated with ascorbic acid (-0.388) and rind firmness (-0.440).

Average fruit weight was highly significant and positively correlated with fruit diameter (0.767) and flesh thickness (0.544). Fruit diameter was also highly significant and positively correlated with flesh thickness (0.619). But it was negatively correlated with duration of crop (-0.647), number of fruits per plant (-0.570), length of fruit cavity (-0.819), number of harvests (-0.533), T.S.S. (-0.442), ascorbic acid (-0.548), shelf life (-0.559) and rind firmness (-0.691).

The characters having highly significant and positive genotypic correlation with T.S.S. were ascorbic acid (0.655), reducing sugar (0.540), non reducing sugar (0.624), shelf life (0.697) and rind firmness (0.605). Ascorbic acid had high significant positive correlation with reducing sugar (0.815) and non reducing sugar (0.780), shelf life (0.792) and rind firmness (0.793). Reducing sugar was highly significant and positively correlated with non reducing sugar (0.848). Shelf life of fruit had high significant correlation with rind firmness (0.865) (Fig. 6).

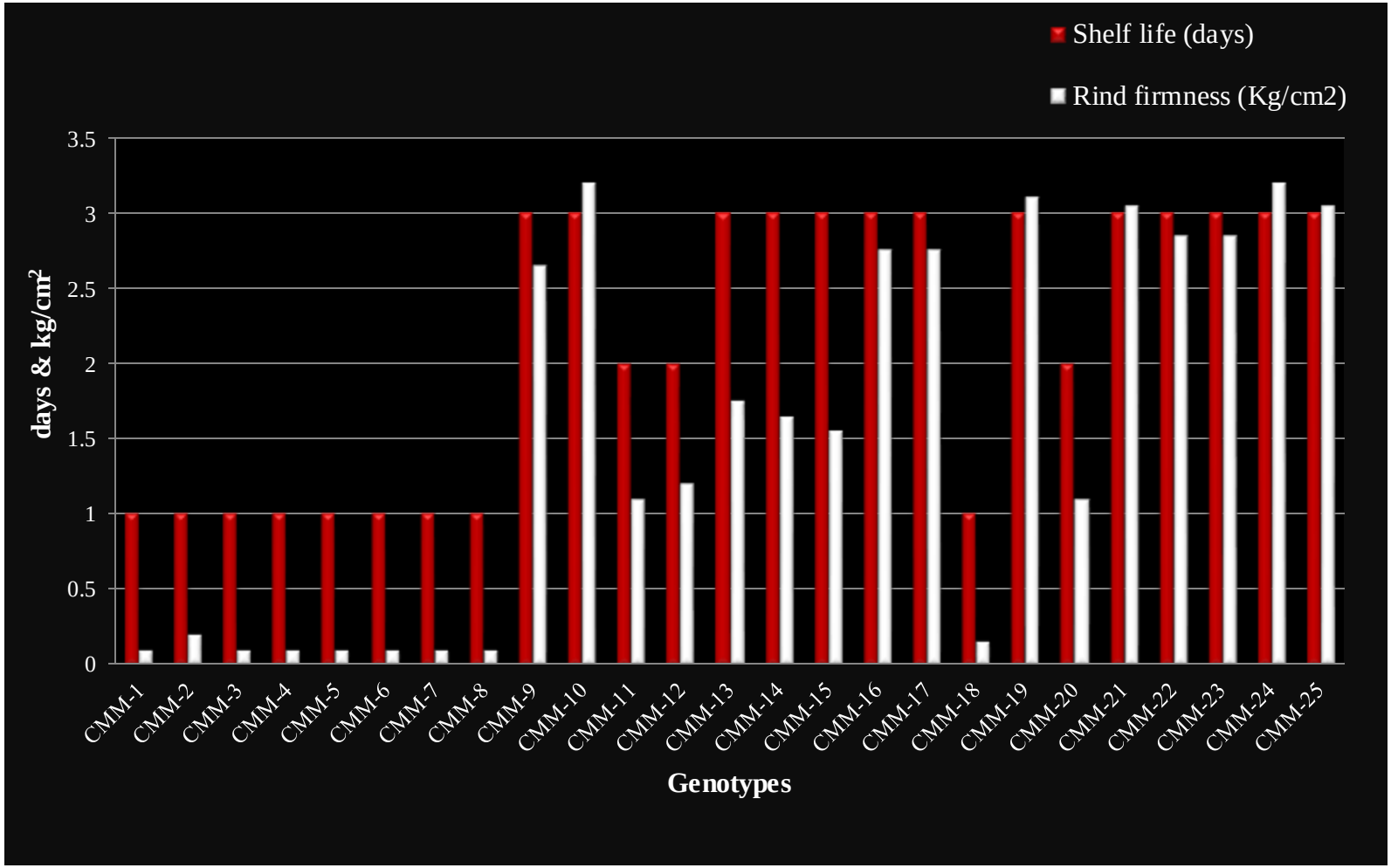


Fig. 6. Relationship between shelf life and rind firmness

4.2.4. Path coefficient analysis

By partitioning the correlation between yield and component characters into direct and indirect effects, contribution of the component characters towards yield can be found out. The result of the path coefficient analysis of 25 accessions of *Cucumis melo* var. *momordica* Duth. and Full. for different characters is furnished in table 12.

In path coefficient analysis, the highest positive direct effect on yield was exhibited by average fruit weight (1.121) followed by number of fruits per plant (0.591). Maturity period had low negative direct effect (-0.162) on fruit yield followed by non reducing sugar (-0.159).

Direct effect of vine length on yield was negative (-0.032) and its correlation with yield was found to be positive (0.708) due to high indirect effects of average fruit weight (0.837) and maturity period (0.054).

Days to first female flower appearance showed moderate positive indirect effect on fruit yield through number of fruits per plant (0.267), but moderate negative indirect effect through average fruit weight (-0.236). Maturity period also showed high negative indirect effect on yield through average fruit weight (-0.490).

Number of fruits per plant had high negative indirect effect on yield through average fruit weight (-0.635). Its genotypic correlation with yield was also found negative (-0.101). Days to first harvest had moderate indirect positive effect on yield via number of fruits per plant (0.294) and high negative indirect effect through average fruit weight (-0.577).

Table 12. Path coefficient analysis of yield and component characters

Characters	X1	X2	X3	X4	X5	X6	X7	X8
X1	**-0.032**	0.013	0.054	-0.051	-0.040	-0.184	-0.028	0.027
X2	0.007	**-0.061**	0.019	0.067	0.018	0.267	-0.001	-0.001
X3	0.011	0.007	**-0.162**	0.088	0.047	0.133	0.016	-0.016
X4	0.014	-0.035	-0.121	**0.118**	0.051	0.294	0.013	-0.014
X5	0.016	-0.013	-0.093	0.073	**0.082**	0.282	0.025	-0.024
X6	0.010	-0.028	-0.036	0.058	0.039	**0.591**	0.023	-0.023
X7	-0.020	-0.001	0.057	-0.035	-0.046	-0.308	**-0.044**	0.043
X8	-0.019	0.001	0.057	-0.036	-0.043	-0.310	-0.043	**0.045**
X9	-0.006	-0.014	-0.029	0.034	-0.004	0.040	-0.014	0.011
X10	-0.024	0.013	0.071	-0.060	-0.053	-0.335	-0.036	0.036
X11	-0.018	0.004	0.090	-0.061	-0.047	-0.140	-0.025	0.025
X12	-0.011	0.008	0.072	-0.053	-0.053	-0.103	-0.018	0.016
X13	0.011	-0.040	-0.038	0.076	0.035	0.353	0.009	-0.007
X14	0.015	-0.030	-0.080	0.088	0.060	0.332	0.019	-0.017
X15	0.011	-0.030	-0.060	0.075	0.051	0.388	0.016	-0.015
X16	0.017	-0.036	-0.054	0.080	0.055	0.441	0.024	-0.024

Residual effect=0.0190

X1-Vine length, X2- Days to first female flower appearance, X3- Maturity period, X4- Days to first harvest, X5- Duration of crop, X6- Number of fruits per plant, X7- length of fruit cavity, X8- Fruit length, X9- Number of seeds per fruit , X10- Average fruit weight, X11- Fruit diameter, X12- flesh thickness, X13- Total soluble solids, X14- Ascorbic acid, X15- Reducing sugar, X16-Non reducing sugar, rg- Genotypic correlation with yield.

Table 12. Continued.

Characters	X9	X10	X11	X12	X13	X14	X15	X16	rg
X1	-0.002	0.837	-0.009	0.002	-0.016	0.050	-0.032	0.087	0.676
X2	-0.002	-0.236	0.005	-0.001	0.028	-0.053	0.046	-0.095	0.007
X3	-0.002	-0.490	0.009	-0.002	0.01	-0.052	0.035	-0.052	-0.42
X4	-0.003	-0.577	0.010	-0.002	0.028	-0.079	0.060	-0.108	-0.351
X5	0.001	-0.725	0.124	-0.004	0.019	-0.077	0.059	-0.107	-0.362
X6	-0.001	-0.635	0.008	-0.001	0.026	-0.059	0.062	-0.118	-0.084
X7	-0.003	0.919	-0.009	0.002	-0.009	0.045	-0.034	0.086	0.643
X8	-0.002	0.913	-0.008	0.002	-0.007	0.041	-0.032	0.086	0.645
X9	**-0.009**	0.267	0.006	0.001	0.002	-0.027	0.036	-0.041	0.253
X10	-0.002	**1.121**	-0.012	0.003	-0.019	0.057	-0.042	0.105	0.823
X11	-0.001	0.843	**-0.016**	0.003	-0.015	0.049	-0.026	0.071	0.736
X12	-0.001	0.591	-0.014	**0.005**	-0.007	0.053	-0.050	0.084	0.519
X13	-0.001	-0.484	0.007	-0.001	**0.044**	-0.069	0.051	-0.099	-0.153
X14	-0.002	-0.602	0.012	-0.003	0.029	**-0.105**	0.077	-0.124	-0.331
X15	-0.003	-0.497	-0.011	-0.003	0.024	-0.086	**0.094**	-0.134	-0.18
X16	-0.002	-0.741	-0.018	-0.003	0.027	-0.082	0.080	**-0.159**	-0.395

Residual effect=0.0190

X1-Vine length, X2- Days to first female flower appearance, X3- Maturity period, X4- Days to first harvest, X5- Duration of crop, X6- Number of fruits per plant, X7- length of fruit cavity, X8- Fruit length, X9- Number of seeds per fruit , X10- Average fruit weight, X11- Fruit diameter, X12- flesh thickness, X13- Total soluble solids, X14- Ascorbic acid, X15- Reducing sugar, X16-Non reducing sugar, rg- Genotypic correlation with yield.

Fruit diameter showed a high positive indirect effect on yield through average fruit weight (0.843) and a low negative indirect effect via number of fruits per plant (-0.140). Hence, indirect selection for fruit diameter through average fruit weight would be effective for yield improvement.

Length of fruit cavity had high positive indirect effect on yield via average fruit weight (0.919). It had negative indirect effect through duration of crop (-0.046) but, its genotypic correlation with yield was positive (0.674).

Fruit length showed high positive indirect effect on fruit yield through average fruit weight (0.913), while it had a high negative indirect effect through number of fruits per plant (-0.310). Its genotypic correlation with yield was also positive (0.675).

Number of seeds per fruit showed moderate positive indirect effect on yield through average fruit weight (0.267) and negative indirect effect via maturity period (-0.029) and ascorbic acid (-0.027) but, its correlation with yield was positive (0.253). Average fruit weight exhibited a high negative indirect effect on yield via number of fruits per plant (-0.335).

Flesh thickness also showed a high positive indirect effect on yield through average fruit weight (0.591) and a low negative indirect effect via number of fruits per plant (-0.103).

Total soluble solids exhibited high positive indirect effect on yield via number of fruits per plant (0.353) and high negative indirect effect via average fruit weight (-0.484).

Ascorbic acid also showed high positive indirect effect on yield via number of fruits per plant (0.332) and high negative indirect effect via average fruit weight (-0.602). Reducing sugar and non reducing sugar also exhibited high positive indirect effect on yield (0.388,0.441respectively) via number of fruits per plant and high negative indirect effect (-0.497, -0.741 respectively) via average fruit weight.

The residual effect of 0.019 was low since all the characters in this study contributed 98.1% to the variability in fruit yield indicating the sufficiency of these independent characters in the regression.

4.2.5. Genetic divergence

Twenty five accessions of *Cucumis melo* var. *momordica* Duth. & Full. were grouped into 5 clusters using Mahalanobis D^2 statistics. It is a measure of group distance based on multiple characters. The clustering pattern and the variable means of clusters are presented in tables 13 and 14.

Accessions included in cluster I were CMM-9, CMM-10, CMM-13, CMM-14, CMM-16 and CMM-19. This cluster recorded the highest mean value for days to first female flower appearance (38.21 days) and the lowest mean value for nodes to first female flower appearance (3.99) and maturity period of fruits (21.54 days).

Cluster II included the accessions CMM,1-8 and CMM-18 and they had the highest mean value for fruit diameter (18.76cm), flesh thickness (4.21cm) and pulp placenta ratio (10.09). The lowest mean value for nodes to first male flower appearance (2.47), days to first harvest (54.97 days), duration of crop (75.31 days),

Table 13. Clustering pattern in 25 accessions of snap melon

Cluster Number	Number of accessions in each clusters	Accessions
I	6	CMM-9, CMM-10, CMM-13, CMM-14, CMM-16, CMM-19
II	9	CMM-1, CMM-2, CMM-3, CMM-4, CMM-5, CMM-6, CMM-7, CMM-8, CMM-18
III	4	CMM-17 , CMM-21, CMM-22, CMM-23
IV	3	CMM-11, CMM-12, CMM-20
V	3	CMM-15, CMM-24, CMM-25

number of fruits plant^{-} (2.62), ascorbic acid (5.21mg 100g^{-1}) and reducing sugar (2.14%) was also recorded in this cluster.

Accessions included in cluster III were CMM-17, CMM-21, CMM-22 and CMM-23. They had the highest mean value for nodes to first male flower appearance (3.16), nodes to first female flower appearance (6.35), days to first male flower appearance (31.56 days), days to first harvest (66.68 days), duration of crop (88.44 days), number of fruits plant^{-} (4.34), T.S.S. (5.07^{0} Brix), ascorbic acid (12.79mg 100g^{-1}) and reducing sugar (2.97%).

The accessions CMM-11, CMM-12 and CMM-20 were included in cluster IV which had the highest mean value for vine length (3.05m), length of fruit cavity (44.22cm), fruit length (46.64 cm), number of seeds per fruit (1005.83), average fruit weight (3.08kg) and yield per plant (8.06kg). Three accessions were in cluster V which included CMM-15, CMM-24 and CMM-25. They had the lowest mean value for vine length (1.68m), fruit cavity length (13.56cm), fruit length (18.07 cm), average fruit weight (0.52kg), fruit diameter (8.59cm), flesh thickness (1.98cm), yield per plant (1.84kg), number of seeds per fruit (521.67), pulp placenta ratio (3.31) and T.S.S. (3.31^{0} Brix). Inter and intra D^2 values among the 5 clusters are given in Table 15.

Cluster I had the maximum intra cluster value (2.95) and cluster IV had the minimum (2.16). The intra cluster distance for other clusters was 2.82 (cluster II), 2.27 (cluster III) and 2.24 (cluster V).

The maximum statistical distance was found between cluster IV and V (7.91) followed by cluster II and III (7.39). The distance between the cluster I and III displayed the lowest degree of divergence (4.01)

Table14. Means of variables for five clusters

Clusters	Vine length (m)	Nodes to first male flower appearance	Nodes to first female flower appearance	Days to first male flower appearance	Days to first female flower appearance	Maturity period of fruits (days)
I	2.19	2.83	3.99	29.83	38.21	21.54
II	2.43	2.47	4.22	26.38	32.84	22.21
III	1.90	3.16	6.35	31.56	37.44	29.21
IV	3.05	3.01	5.71	27.33	34.12	24.85
V	1.68	2.54	5.12	26.21	31.71	29.18

Clusters	Days to first harvest	Duration of crop	Number of fruits per plant	Length of fruit cavity (cm)	Fruit length (cm)	Number of seeds per fruit	Average fruit weight (kg)	Fruit diameter (cm)
I	59.81	82.41	3.65	28.38	32.86	538.50	1.38	12.68
II	54.97	75.31	2.62	31.36	34.70	556.72	2.14	18.76
III	66.68	88.44	4.34	19.77	23.78	779.25	0.98	11.04
IV	58.89	79.92	2.62	44.22	46.64	1005.83	3.08	16.90
V	61.05	88.42	3.42	13.56	18.07	521.67	0.52	8.59

Clusters	Flesh thickness (cm)	Yield per plant (kg)	Pulp placenta ratio	T.S.S. (^{0}Brix)	Ascorbic acid (mg $100g^{-1}$)	Reducing sugar (%)
I	2.78	4.81	4.43	4.68	9.30	2.64
II	4.21	5.66	10.09	3.26	5.21	2.14
III	3.18	4.26	3.38	5.07	12.79	2.97
IV	3.30	8.06	6.38	3.20	7.77	2.63
V	1.98	1.84	3.31	3.08	9.30	2.69

Table 15. Inter and intra cluster D^2 value among five clusters of snap melon

Clusters	I	II	III	IV	V
I	**2.946**				
II	4.658	**2.820**			
III	4.006	7.394	**2.269**		
IV	5.319	4.299	7.212	**2.162**	
V	5.025	6.693	4.855	7.908	**2.238**

The values printed in bold indicates intra cluster D^2 values

4.2.6. Selection Index

Selection index refers to a linear combination of characters associated with the dependent variable (Nadarajan and Gunasekaran, 2005). Based on reliable and effective characters, a selection index can help to select suitable genotypes from a mass population (Table 16).

Selection index involving the characters like nodes to first female flower appearance, days to first female flower appearance, number of fruits per plant, fruit length, average fruit weight, fruit diameter and flesh thickness was formulated for *Cucumis melo* var. *momordica* Duth. & Full. to identify superior genotypes.

Based on selection index, the accession CMM-11 was found to be the most superior one followed by accessions CMM-12, CMM-20, CMM-5 and CMM-8. Accession CMM-11 was the highest yielder with a mean yield of 7.97kg per plant and had the maximum fruit length (49.65cm), average fruit weight (3.18kg) and length of fruit cavity (45.75cm).

Table 16. Estimation of selection index

SL.No.	Accession No.	Selection index	Rank according to	
			Selection index	Yield
1	CMM-11	19.142	1	1
2	CMM-12	18.972	2	2
3	CMM-20	18.706	3	3
4	CMM-5	16.409	4	4
5	CMM-8	16.344	5	5
6	CMM-18	16.203	6	6
7	CMM-14	15.801	7	7
8	CMM-16	15.694	8	8
9	CMM-7	15.558	9	9
10	CMM-1	15.313	10	10
11	CMM-2	15.145	11	11
12	CMM-6	15.047	12	12
13	CMM-9	15.037	13	13
14	CMM-10	14.907	14	14
15	CMM-3	14.631	15	15
16	CMM-4	14.036	16	16
17	CMM-17	13.878	17	17
18	CMM-19	13.709	18	18
19	CMM-21	13.279	19	19
20	CMM-22	12.730	20	20
21	CMM-23	12.274	21	21
22	CMM-13	11.964	22	22
23	CMM-15	10.726	23	23
24	CMM-24	10.578	24	24
25	CMM-25	7.991	25	25

Discussion

5. Discussion

5.1 Variability

The success of any crop improvement programme depends upon the precise information available on the extent of genetic variation and diversity in a crop.

In the present study, significant differences existed among the genotypes for all the characters studied like vine length, nodes to first male flower appearance, nodes to first female flower appearance, days to first male flower appearance, days to first female flower appearance, days to first fruit set, maturity period, days to first harvest, duration of crop, fruit length, fruit diameter, fruit weight, flesh thickness, fruit cavity length, number of harvests, number of fruits per plant, number of seeds per fruit, yield per plant, pulp placenta ratio of fruits, total soluble solids, ascorbic acid, reducing sugar and non reducing sugar. The existence of considerable variation indicated enough scope for improvement.

Collections from the state of Kerala were higher yielders than the North Indian collections, but its T.S.S. and (2-4^0 Brix) shelf life (1 day) were comparatively low. North Indian collections exhibited more shelf life (3 days) and T.S.S (3.1-5.3^0 Brix). Rind firmness was also observed high in all North Indian collections. This may be the reason for their higher shelf life. Hence, it could be possible to combine high yield, T.S.S. and shelf life through hybridization between South Indian and North Indian collections followed by selection of these traits.

It is also possible to get a variety with sufficiently high T.S.S. and shelf life combined with high yield by continuous selection of the North Indian collection, CMM-16.

The study showed high estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for nodes to first male flower appearance, nodes to first female flower appearance, number of fruits per plant, number of harvests, length of fruit cavity, fruit length, number of seeds per fruit, average fruit weight, fruit diameter, flesh thickness, yield per plant, shelf life of fruits, total soluble solids, ascorbic acid and non reducing sugar. The above mentioned characters having higher range of variation have a better scope of improvement through selection. The studies conducted by Pandey *et al*. (2003, 2005 & 2009) in snap melon; Prasad *et al*. (2004) and Tomar *et al*. (2008) in musk melon also revealed a wide range of variability for most of the characters indicating a better scope of improvement through selection.

The characters like vine length, maturity period of fruits and reducing sugar exhibited moderate values of GCV and PCV, which is also considered sufficient to make an effective selection.

Low variability for days to first male flower appearance, days to first female flower appearance, days to first fruit set, days to first harvest and duration of crop reflecting little possibility of improvement of these characters through selection. Similar results were reported for days to first harvest by Deol *et al*. (1981) and Swamy *et al*. (1985) in musk melon.

High environmental effects on phenotype for vine length and number of harvest were evident from their higher PCV as compared to GCV.

GCV was very near to PCV for all the characters studied and hence effect of genotypes on phenotypic expression was also high. The closeness between GCV and

PCV in all quantitative and qualitative characters suggested low influence of environmental factors. These findings are in accordance with that of Pandey *et al*. (2005) for the characters like fruit length, reducing sugar and non reducing sugar. In such a situation, selection can be effective on the basis of PCV alone with equal possibility of success.

5.2 Heritability

Heritability is a good index of the transmission of characters from parents to their offspring (Singh and Narayanan, 2009). The estimates of heritability help the breeder in selection of elite genotypes from diverse genetic population. High heritability of a character indicates low influence of the environment and low heritability indicates high influence of the environment. If the effect of environment is high, genetic improvement through selection will be difficult due to masking effects of environment on genotype. Presence of additive genes is indicated by high genetic advance and genetic gain.

In the present investigation, heritability was high for all the characters and it ranged from 77.5% to 100%. This can be attributed to the fact that these characters are least influenced by environmental effects and there could be greater correspondence between phenotypes and breeding value while selecting individuals (Johnson *et al*., 1955).

High heritability noticed in this study is supported by similar results reported by Nandpuri *et al*. (1975) and Kalloo *et al*. (1983) for average fruit weight, length of fruit cavity, fruit length, and yield per plant in musk melon; Rakhi and Rajamony (2003) for fruit length, fruit diameter and fruit weight in culinary melon; Jeeva and Pappaiah (2002) for average fruit weight, fruit length, and yield per plant and

Pandey *et al*. (2009) for average fruit weight, number of fruits per plant, yield per plant in snap melon.

Value of genetic advance indicates the expected genetic progress for a particular trait under a suitable selection system. In the present study, the genetic gain that could be expected by selection for a character provides the estimates of genetic advance and expressed as per cent of mean. Higher values of genetic gain recorded in the present study for average fruit weight, pulp placenta ratio, rind firmness and shelf life of fruit.

Heritability with genetic gain is of more precise in predicting the effect of selection than the former alone. The heritability estimates were high and coupled with high genetic gain for shelf life (100%, 89.9%), rind firmness (100%, 86.65%), number of seeds per fruit (99.4%, 99%), average fruit weight (96.4%, 97.06%), length of fruit cavity (97.3%,70.79%) , fruit length (97%, 59.48%) and yield per plant (87.9%, 70.36%) which revealed the role of additive gene action in the expression of these characters and could be considered as reliable indices for selection. The results confirmed the earlier findings of Kalloo and Dixit (1983) and Pandey *et al*. (2009) for average fruit weight.

Though characters such as days to first male flower appearance, days to first female flower appearance, days to first fruit set and harvest, duration of crop and pulp placenta ratio of fruits had high heritability estimates, their GCV being low, resulted in moderate genetic gain which implied selection based on these characters to be less effective since they are controlled by non additive genes. These results are in agreement with the earlier findings of Pandey *et al*. (2003) in snap melon. This reflects that high heritability is not always associated with genetic advance (Swarup and Chaugale, 1962).

5.3 Correlation studies

Yield is a complex character contributed by many mutually related components. Hence information on the magnitude of the relationship of individual yield component to the final yield and interrelationships among themselves would play a pivotal role for the identification of characters which would influence the economic traits (Nadarajan and Gunasekaran, 2005). The results of correlation studies between yield and its twenty three yield components are discussed below.

In the present investigation yield was significantly and positively correlated with vine length (rg = 0.842, rp =0.710), length of fruit cavity (rg = 0.705, rp = 0.675), fruit length (rg = 0.717, rp = 0.675), average fruit weight (rg = 0.884, rp =0.864), fruit diameter (rg = 0.846, rp =0.793) and flesh thickness (rg = 0.584, rp = 0.558) at both phenotypic and genotypic levels. These results indicated the importance of above traits in determining the fruit yield since they had certain inherent relationship with yield.

The genotypic correlation coefficient of vine length, length of fruit cavity, fruit length, average fruit weight, fruit diameter and flesh thickness with yield was higher than the phenotypic correlation which indicated the presence of strong association between these characters and yield. Low phenotypic correlations can be attributed due to the smaller effect of environment.

Number of fruits per plant did not exhibit any significant correlation with yield. Unlike most other cucurbits, the fruits of snap melon are harvested after ripening. Hence, the supply of assimilates to the fruits for their development continued for a long duration, which would have otherwise been utilized for producing more fruits per plant. Because of this physiological balancing act, the

fruit growth of snap melon has compensated for the number of fruits and thus, did not have a significant influence on the yield per plant.

Negative correlation between fruit weight and number of fruits per plant recorded in the present study has also been reported earlier by Lal and Singh (1997) in musk melon, Kaur and Dhillon (2008) in culinary melon and Reddy *et al*. (2007) in snap melon. It is quite possible that with the increase in the number of fruits, the fruit weight starts decreasing.

5.4 Path coefficient analysis

Path coefficient analysis is simply a standardized partial regression coefficient which splits the correlation coefficient into the measures of direct and indirect effects. It measures the direct and indirect contribution of various independent characters on a dependent character (Singh and Narayanan, 2009).

On partitioning of the correlation into direct and indirect effects, it was observed that average fruit weight and number of fruits per plant had high direct positive effect on yield. It revealed a true relationship between these characters and yield and hence direct selection for these traits would be rewarding for yield improvement. The results are akin to those reported by Pandey *et al*. (2009) in snap melon and Singh and Nandpuri (1978), Chonkar *et al*. (1979), Dhaliwal *et al*. (1996), Lal and Singh, (1997), Pandey *et al*. (2003), Somkuwar *et al*. (1997) and Tomar *et al*. (2008) in musk melon.

Number of fruits per plant had high positive direct effect on yield, but its correlation was negative and in such situation, direct selection for the trait should be practised to reduce the undesirable indirect effect.

5.5 Genetic divergence

Mahalanobis D2 statistics is a valuable multivariate analytical tool used for obtaining quantitative estimates of divergence between biological populations. Genetically divergent parents are essential to generate new variability and desired recombinants.

In the present study, the 25 accessions of *Cucumis melo* var. *momordica* Duth. and Full. were grouped into five clusters, indicating considerable genetic diversity prevailing among them. Genotypes belonging to Kerala were distributed in two different clusters (cluster II & IV), ruling out the association between geographical distribution of genotypes and genetic divergence. The cluster divergence is proved by high inter cluster and low intra cluster distance values (Fig 7).

Analysis of inter cluster distance revealed that the genetic divergence was maximum between cluster IV and V (7.91) followed by cluster II and III (7.39) suggesting wider genetic divergence among them compared to other clusters. The inter cluster distance between cluster I and II was low (3.661) suggesting less genetic divergence among them compared to other clusters.

Hybridization between II and III and IV and V genotypes cluster is likely to give high heterosis for yield attributes due to high divergence between these clusters. Cluster IV exhibited highest yield per plant (8.06kg) followed by cluster II (5.66kg).

Cluster II recorded maximum flesh thickness (4.21cm), while cluster V had the minimum (1.98cm).

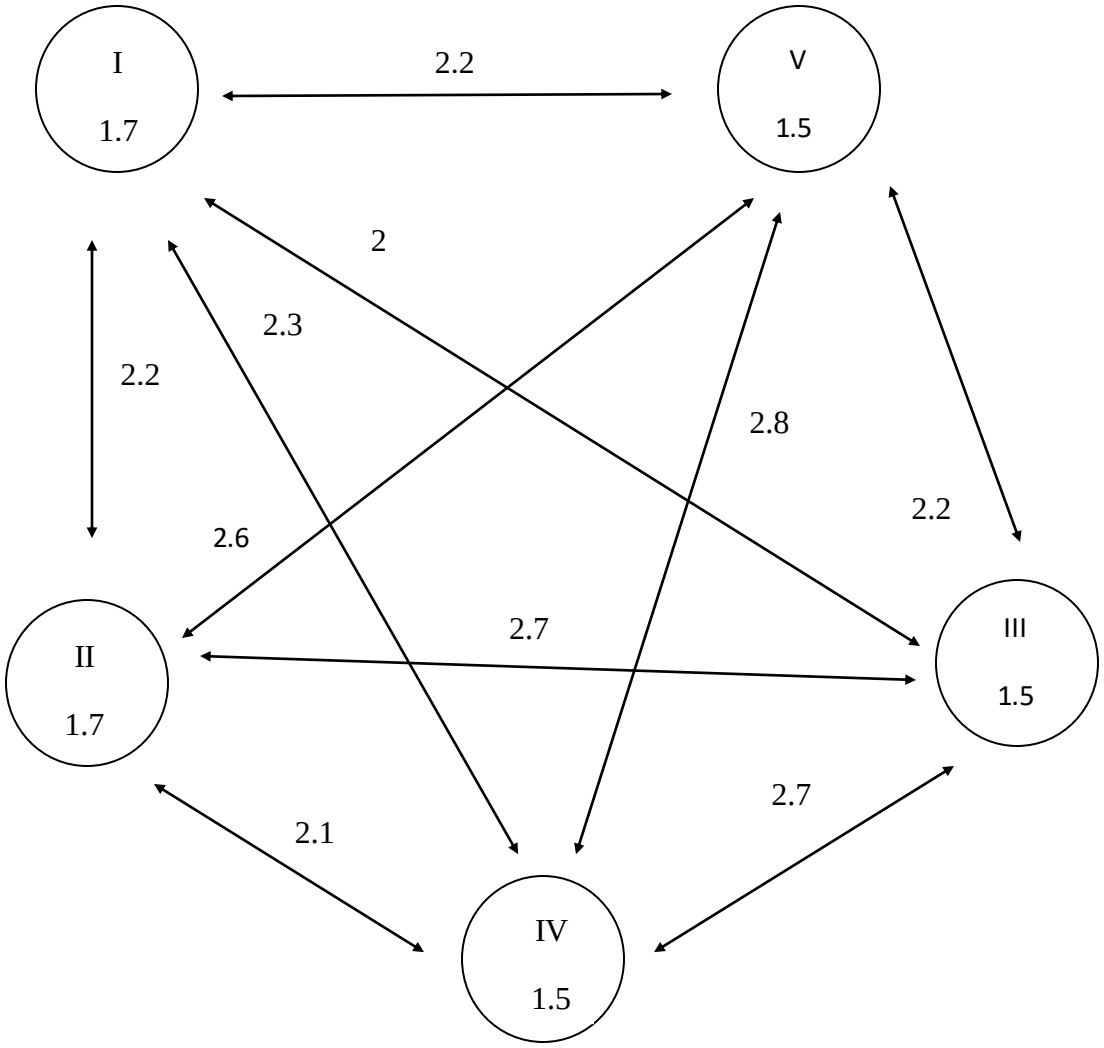


Fig. 7. Cluster diagram

Maximum fruit length (46.64cm), average fruit weight (3.08kg), fruit cavity length (44.22cm) and number of seeds per fruit (1005.83) were recorded by cluster IV, while minimum by cluster V.

Fruit characters were high in cluster IV whereas the quality parameters were high for accessions belonging to cluster III. Hence, in further breeding programme accessions from these clusters can be utilized for combining the yield and quality parameters.

Kalloo *et al.* (1982a), Singh and Lal (2000) , More and Seshadri (2002) and Tomar *et al.* (2008) studied 45, 51, 98 and 50 diverse genotypes respectively for yield and yield related traits in musk melon and grouped them into 14, 13, 12 and 7 clusters respectively. Reddy *et al.* (2005) also grouped 30 genotypes of snap melon into 5 clusters.

5.6 Selection index

Selection index helps to select the best suitable genotypes from germplasm based on minimum number of reliable and effective characters.

Selection index involving the characters namely nodes to first female flower appearance, days to first female flower appearance, number of fruits per plant, fruit length, average fruit weight, fruit diameter and flesh thickness were observed to have the maximum efficiency compared to direct selection based on yield alone. The model suggested by Smith (1936) was selected for ranking the genotypes.

Ranking based on selection index showed CMM-11 as the most superior one followed by CMM-12 and CMM-20. It indicated that superiority of these genotypes

was stable and reliable since the selection index value was calculated considering other yield contributing factors.

The accession CMM-11 identified as the best performer was found to have an average yield of 7.97kg per plant. It expressed the highest fruit length, length of fruit cavity, average fruit weight and yield per plant. Next in line was CMM-12 with an average yield of 7.62kg per plant followed by CMM-20 with an average yield of 7.48 kg per plant.

Thus the study revealed that the accessions CMM-11, CMM-12 and CMM-20 were the most promising ones with respect to yield and other important economic characters.

Summary

6. SUMMARY

The present study on "Performance analysis of snap melon (*Cucumis melo* L. var. *momordica* Duth. & Full.)" was carried out in the Department of Olericulture, College of Horticulture, Vellanikkara, during February- April, 2011.

The programme envisaged cataloguing of available germplasm; assessment of genetic variability and divergence; assessment of association of different traits with yield including the direct and indirect effects of traits on yield; analysis of nutritional profile and formulation of a selection index to identify superior genotypes. The experiment was laid out in RBD with two replications and the experimental materials consisted of 25 accessions collected from different parts of India.

The salient findings of the study are summarized below.

- Twenty five genotypes were catalogued based on the descriptor for snap melon (*Cucumis melo* L. var. *momordica* Duth. & Full.).

- The accessions showed significant differences for all the characters studied *viz*. vine length, nodes to first male flower appearance, nodes to first female flower appearance, days to first male flower appearance, days to first female flower appearance, days to first fruit set, maturity period, days to first harvest, duration of crop, fruit length, fruit diameter, fruit weight, flesh thickness, fruit cavity length, number of harvests, number of fruits per plant, number of seeds per fruit, yield per plant, pulp placenta ratio, total soluble solids, ascorbic acid, reducing sugar and non reducing sugar.

- In general, the South Indian collections of snap melon were high yielding than the North Indian collections. Accession CMM-11 was the highest yielder with 7.97kg/plant followed by CMM-12 (7.62kg/ plant).

- Fruit length varied from 16.25cm (CMM-25) to 49.65cm (CMM-11). The fruit diameter was highest in CMM-2 (22.25cm) and lowest in CMM-15 (8.37cm). Maximum flesh thickness was expressed by CMM-8 (5.25cm).

- North Indian collections exhibited more shelf life (3 days) due to high rind firmness than the South Indian types (1 day).

- The highest total soluble solid was recorded in accession CMM-21 (5.3^0Brix) followed by CMM-22 (5.1^0Brix), CMM-23 and CMM-9 (5^0Brix). In general, north Indian types recorded high T.S.S. than the South Indian types.

- The accessions CMM-21, CMM-22 & CMM-23 possessed high ascorbic acid content ($13.95 mg 100 g^{-1}$).

- Accession CMM-9 had the highest mean score with high mean rank for appearance (8.3, 20.5), colour (8.6, 20.7), texture (7.8, 16.6) and flavor (7.5, 19.1). Accession CMM-21 had the highest mean score and mean rank for taste (8.8, 20.90) and over all acceptability (8.3, 19.38) during the organoleptic evaluation.

- The genotypic (42.07) and phenotypic (42.08) coefficients of variation were maximum for average fruit weight.

- Heritability estimate was found to be the highest (99.8%) for number of seeds per fruit, shelf life and ascorbic acid.

- Correlation studies revealed that yield had strong association with average fruit weight, fruit diameter, flesh thickness, fruit length, length of fruit cavity and vine length.

- Results of path coefficient analysis brought out that average fruit weight had the highest positive direct effect on yield followed by the number of fruits per plant.

- The genotypes were grouped into five clusters based on genetic distance. There was parallelism between geographical distribution and genetic diversity. Intra cluster distances were much lower than inter cluster distances, suggesting homogeneity and heterogeneity of the strains within and between the clusters respectively. Therefore, it is possible to exploit heterosis in *Cucumis melo* L. var. *momordica* Duth. & Full.

- A selection model was formulated consisting of the characters, viz. nodes to first female flower appearance, days to first female flower appearance, number of fruits per plant, fruit length, average fruit weight, fruit diameter and flesh thickness with better efficiency over direct selection.

- Comparison of different genotypes based on the index value revealed the superiority genotypes CMM-11 followed by CMM-12 and CMM-20.

- The accession CMM-11 was superior in fruit length (49.65cm), length of fruit cavity (45.75cm) and average fruit weight (3.18kg). Invariably CMM-11 was the highest yielder (7.97kg per plant).

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Appendices

Appendix I. Meteorological data (mean fortnightly) during 2011.

Source: College of Horticulture, Vellanikkara

Month/ Fortnight	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	Morning	Evening	
January I	33.30	21.00	76	39	0.00
January II	32.10	22.20	80	42	0.00
February I	34.20	21.00	68	27	0.00
February II	33.50	22.70	90	52	11.60
March I	35.50	23.70	84	33	0.00
March II	34.10	25.00	89	58	0.00
April I	35.00	25.10	87	56	2.80
April II	33.80	24.60	89	65	145.55
May I	32.80	24.70	88	64	0.00
May II	33.70	25.60	91	61	118.8
June I	29.20	24.00	95	84	201.10
June II	30.00	23.40	96	76	122.55
July I	30.30	23.20	94	75	181.40
July II	28.30	22.40	96	83	152.35
August I	29.20	22.50	97	80	202.2
August II	29.60	22.80	94	73	142.25
September I	28.70	22.80	96	79	193.50
September II	31.50	23.10	91	63	24.10
October I	32.30	23.40	92	62	5.50
October II	31.90	23.30	89	71	153.60
November I	31.70	22.00	84	54	17.10
November II	31.50	23.90	63	54	7.70
December I	32.30	22.80	82	51	0.00
December II	31.00	23.50	61	44	1.20

Appendix II. Analysis of variance in 25 accessions of snap melon

Source of variation	Df	Mean squares											
1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Vine length (m)	Nodes to first male flower appearance	Nodes to first female flower appearance	Days to first male flower appearance	Days to first female flower appearance	Days to first fruit set	Maturity period of fruits	Days to first harvest	Duration of crop	Number of fruits/ plant	Number of harvests	Number of seeds/ fruit
Replication	1	0.006	0.084	0.151	0.504	1.82	1.125	0.262	2.09	1.97	0.02	0.911**	36
Treatment	24	0.46**	1.023**	4.601**	12.16**	22.38**	21.80**	33.92**	50.07**	76.94**	1.66**	1.016**	143944**
Error	24	0.058	0.061	0.062	0.633	0.602	0.518	1.9	1.96	3.12	0.077	0.961	27.25

(Contd…)

Appendix II. Continued…

Source of variation	Df	Mean squares										
		15	16	17	18	19	20	21	22	23	24	25
		Fruit weight (kg)	Fruit length (cm)	Fruit cavity (cm)	Fruit diameter (cm)	Flesh thickness (cm)	Yield/plant (kg)	Pulp placenta ratio of fruits	Total soluble solids (^{0}Brix)	Ascorbic acid (mg/100g)	Reducing sugar (%)	Non reducing sugar (%)
Replication	1	0.113*	1.15	7.9	0.009	0.098	0.627	1.76	0.031	0.0007**	0.0029**	0.0079
Treatment	24	1.33**	178.15**	195.6**	36.3**	1.66**	7.26**	46.61**	1.802**	18.76**	0.246**	0.2659**
Error	24	0.024	2.74	2.69	0.173	0.03	0.469	0.943	0.0049	-0.00002	0.00015	0.003

*P=0.05 **P=0.01

PERFORMANCE ANALYSIS OF SNAP MELON

(*Cucumis melo* L. var. *momordica* Duth. & Full.)

by

PRIYA T. JOSEPH

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THESIS

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ABSTRACT

An experiment was carried out in the Department of Olericulture, College of Horticulture, Kerala Agricultural University, Vellanikkara, during February- April 2011 to analyse the performance of different accessions of snap melon (*Cucumis melo* L. var. *momordica* Duth. & Full.). The major objective of the study was to identify superior snap melon genotypes with high yield and T.S.S. The other objectives were to genetically catalogue the germplasm and to assess the genetic variability, divergence, heritability, genetic gain and correlation of different traits with yield. Twenty five accessions collected from different parts of India were grown in randomized block design with two replications.

Cataloguing of the germplasm evidenced significant differences for all the characters studied *viz*., vine length, nodes to first male flower appearance, nodes to first female flower appearance, days to first male flower appearance, days to first female flower appearance, days to first fruit set, maturity period, days to first harvest, duration of crop, number of harvests, fruit length, fruit diameter, fruit weight, flesh thickness, fruit cavity length, number of fruits plant^{-1}, number of seeds fruit^{-1}, yield plant^{-1}, pulp placenta ratio, total soluble solids, ascorbic acid, reducing sugar and non reducing sugar.

Accession CMM-11 was the highest yielder with 7.97kg/plant followed by CMM-12 (7.62kg/ plant). Maximum fruit length was observed in CMM-11(49.65cm). The fruit diameter was highest in CMM-2 (22.25cm). It was observed that collections of snap melon from the state of Kerala were higher yielders than the North Indian collections. But, North Indian collections exhibited more shelf life (3days) due to their high rind firmness. Among quality attributes total soluble solids (5.3^{0}Brix), reducing sugar (3.01%) and non reducing sugar (3.03%) were found to be highest in CMM-21.

During organoleptic evaluation, accession CMM-9 had the highest mean score for appearance (8.3), colour (8.6), texture (7.8) and flavour (7.5). Accession CMM-21 had the highest mean score for taste (8.8) and over all acceptability (8.3).

The highest genotypic and phenotypic coefficients of variation were observed for average fruit weight, shelf life and number of seeds fruit^{-1}. High heritability coupled with high genetic gain was observed for most of the characters.

Yield had strong association with average fruit weight, fruit diameter, flesh thickness, fruit length, length of fruit cavity and vine length. Highest positive direct effect on yield was contributed by average fruit weight and number of fruits plant^{-1}.

The 25 accessions were grouped into five clusters based on genetic distance. Intra cluster distances were much lower than inter cluster distances, suggesting homogeneity and heterogeneity of the accessions within and between the clusters respectively. Based on selection index, the accession CMM-11 was identified as the best performer followed by the accessions CMM-12 and CMM-20.