GENETIC VARIABILITY AND CORRELATION STUDIES IN SNAKE GOURD

(*Trichosanthes anguina* L.)

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "GENETIC VARIABILITY AND CORRELATION STUDIES IN SNAKE GOURD (*Trichosanthes anguina* L.)" is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Vellanikkara,
4th, December, 1978.

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CERTIFICATE

Certified that this thesis is a record of research work done independently by Shri. Joseph. S. Pynadath under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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CONTENTS

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LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

INTRODUCTION

INTRODUCTION

Snake gourd (*Trichosanthes anguina* L.) occupies a pride of place among vegetables particularly in South India, where it is most commonly grown. It is found growing wild in India and Indian Archipelago is thought to be its place of origin. The fruits are harvested and cooked green and have fairly good nutritive value.

In spite of the economic importance of this vegetable in South India and particularly in Kerala, no attempt has so far been made in respect of improvement of this crop. The types that are under cultivation at present are non-descript ones. This necessitates a need-based crop improvement programme for developing high yielding varieties with superior quality fruits. Again, there is an imperative need for developing varieties suited to the agro-climatic conditions of Kerala. Hence, the present investigations were undertaken, utilising the high amount of diversity noticed among the snake gourd types in Kerala, which have been collected and maintained in the College of Horticulture, Kerala Agricultural University, Vellanikkara.

The preliminary step in all crop improvement programmes is the selection of desirable genotypes. For effective selection, information on the extent of variability present in the available population, for the different characters, is inevitable. In selecting a plant or a type, one should be reasonably sure that there is good chance of the superiority of selection being inherited by the progenies. This can be ascertained by partitioning the total variability into heritable and non-heritable components with the aid of suitable genetic parameters such as genotypic coefficient of variation, heritability and genetic advance.

The development of biometrical genetics has revealed that yield and most other economic characters are being controlled by polygenes. Therefore, direct selection for yield is often misleading and inappropriate. For rational improvement of yield and its components, association of component characters with yield and among the components themselves should be understood by estimating the correlation coefficients.

Association of characters determined by correlation coefficients, although useful, will not provide an exact picture of the relative importance of direct and indirect influence of each of the characters towards yield. Path analysis technique suggested by Wright (1921) and first adapted in plants by Dewey and Lu (1959) helps to study this cause and effect relationship by partitioning the correlation coefficient into direct and indirect effects.

In snake gourd, the information on genetic variability, association analysis, and path coefficient analysis is scanty. Therefore the present investigations were undertaken with the following objectives.

i) To identify gonotypes which are superior for yield and other economic characters by the analysis of variance technique.

ii) To find out the extent of genetic variability available for different characters by estimating genotypic coefficient of variation, heritability and genetic advance.

iii) To study the association between yield and its components and also among themselves by estimating phenotypic and genotypic correlation coefficients.

iv) To determine the direct and indirect effects of important yield components by utilising path coefficient analysis.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The important works carried out on the different aspects of variability, correlation studies and path coefficient analysis in various vegetable crops are presented below. The review is confined to the more recent works.

1. VARIABILITY STUDIES

Fisher (1918) partitioned genetic variance into its components as additive genetic variance, dominant components and epistatic components. According to him the additive genetic variance can be exploited for genetic advance through selection.

According to Panse (1957), if heritability is mainly due to genetic effects (dominance and epistasis) the genetic gain would be low while in cases where heritability is chiefly due to additive gene effects, a high genetic advance may be expected.

The extent of variability in various crops have been studied by many workers by estimating the parameters like phenotypic coefficient of variation, genotypic coefficient of variation, heritability, genetic advance and genetic gain.

Thakur and Nandpuri (1974) reported the highest estimates of genotypic coefficient of variation and expected genetic advance for number of seeds per kg of fruit weight and the lowest for days to first picking in watermelon. Heritability was maximum for 100-seed weight and was minimum for branches per plant.

In cucumber, Miller and Quisenberry (1976) reported that genetic variance was primarily additive for early flowering. They found that days to opening of first female flower was controlled by relatively few genes and its heritability was moderately high. Singh et al (1976) found that the additive component of variance was high for days for opening of the first female flower, maturity and fruit number per vine whereas dominance was evident for fruit weight, flesh thickness and total yield in muskmelon.

In bitter gourd, Srivastava and Srivastava (1976) obtained the highest genotypic coefficient of variation, heritability and genetic gain for number of fruits per plant. They opined that characters like weight of fruit, yield per plant and length of fruit might be controlled by additive genes whereas number of lateral branches per plant, number of female flowers per plant and days taken for the first female flower to appear might be controlled by non-additive gene effects. Work done by Ramachandran (1978) with 25 bitter gourd types revealed that there were highly significant differences between the types, for all the 21 characters studied. The estimates of variance components and coefficients of variation have indicated that the major portion of total variability in all characters, except number of seeds per fruit, was due to genetic causes. Heritability in the broad sense was found to be quite high for all characters except number of seeds per fruit. The estimate of expected genetic advance has shown that by selecting five per cent superior plants from the available population, yield could be improved by 4.08 kg per plant. Characters such as yield per plant, vitamin C content, number of fruits per plant, iron content and phosphorus content exhibited high estimates of heritability and genetic gain indicating the possibility of improvement through selection.

Thakur and Choudhury (1977) reported high estimates of heritability in girth of fruit, length of fruit and number of fruits per plant in ridge gourd. High expected genetic gain estimates were obtained for the latter two characters.

Srivastava and Sachan (1973) recorded the highest genotypic coefficient of variation for number of fruits per bunch in tomato. Heritability and expected genetic advance were high for weight per fruit. Parthasarathy _et al_. (1976) however recorded the highest heritability value for size of fruit. Expected genetic advance was low for yield and number of primary branches, while it was maximum for average fruit weight. However, the genetic gain was found to be quite high for yield, size of fruit and average fruit weight. Singh _et al_. (1977) noticed high values of heritability and genetic advance for yield per plant, fruit width and number of locules per plant in tomato.

Dixit and Mehrotra (1973) observed a wide range of phenotypic variability for yield per plant, fruit length and plant height in brinjal. They also obtained high estimates of heritability and genetic advance for number of branches per plant, plant height and bottom girth of fruit. Srivastava and Sachan (1973) reported maximum variability for fruits per plant and minimum for days to fruiting in 25 varieties of the crop studied. Genotypic coefficient of variation was found to be highest for fruits per plant and lowest for branches per plant. Fruits per plant had also high heritability and high genetic gain. Singh et al. (1974) investigated that the genotypic coefficient of variation and genetic gain were high for fruit weight, fruit length and yield per plant in brinjal. Days to flower, number of primary branches, plant height and number of secondary branches had low genetic gain coupled with high heritability which was suggested to be due to non-additive gene effects. The works of Mishra and Roy (1976) revealed that in brinjal, the genotypic coefficient of variation was high for average weight of fruit, number of fruits per plant and yield per plant. These characters had high heritability also. The highest genetic advance as percentage of mean was shown by yield per plant.

Nandpuri et al. (1971) reported high heritability for days to flowering, fruit number, days to maturity and single plant yield in chilli. Genetic advance was maximum for number of fruits per plant followed by number of branches, yield and plant height and they have inferred that high heritability need not be associated with high genetic gain.

Kirti Singh *et al.* (1972) recorded high phenotypic and genotypic coefficients of variation in primary and tertiary branches, fruit number, size, fresh weight and yield in chilli. Fruit size exhibited maximum heritability and had high expected genetic advance also.

Many workers have reported contrasting results with respect to variability in chillies. Arya and Saini (1976) observed high heritability and low genetic gain in the case of fruit yield per plant. But according to Awasthi *et al.* (1976), Arya and Saini (1977a), Arya and Saini (1977b) and Hiremath and Mathapato (1977), fruit yield had high genetic gain. Other characters which exhibited parallelism in the high estimates of heritability and genetic advance were number of fruits per plant, number of branches per plant, weight of fruit, size of fruit, rind thickness and number of seeds per fruit (Arya and Saini, 1977b; Hiremath and Mathapati, 1977; and Ramalingam and Murugarajendran, 1977).

In bhindi, Kirti Singh et al.(1974) found that phenotypic and genotypic coefficients of variation showed the maximum values for diameter of fruit, while heritability was maximum in vitamin C content. Yield exhibited low value for heritability. Genetic gain was highest for fruit diameter followed by crude fibre content, total sugars, vitamin C content and marketable fruit yield per plant. Variability studies carried out by different workers have shown that days to flower in bhindi had high heritability in the broad sense (Lal et al., 1977 and Rao et al., 1977). Lal et al.(1977) also recorded that the fruit length and fruit thickness had high heritability but the genetic gain was highest for number of branches per plant. Yield was found to have the lowest genotypic coefficient of variation and heritability. In contrast to this, Rao et al. (1977) opined that yield per plant had the highest values of heritability and genetic gain.

Singh and Mehndiratta (1969) found that in cowpea the number of pods per plant had the highest genotypic coefficient of variation while the heritability estimates showed high values for 100-seed weight, days to flowering, pod length and days to maturity. Expected genetic advance was appreciable for number of branches, 100-seed weight, pod number, pod length and yield. Borida *et al.* (1973) reported the highest value of heritability for 100-seed weight in cowpea followed by number of days for flowering and pod length. They also observed the highest genotypic coefficient of variation and genetic advance for pod number per plant. Lakshmi and Goud (1977) investigated that the genotypic coefficient of variation was higher for plant height, seed yield, number of pods per plant and 100-seed weight. They also obtained high heritability accompanied by high genetic advance as percentage of mean in the cases of plant height, seed yield, 100-seed weight and length of pod. Number of pods per plant and seed yield per plant also had high genetic advance as percentage of mean but the heritability was comparatively low.

In french bean, high genotypic coefficient of variation for average pod length and green pod yield per plant was reported by Seth *et al.* (1972). Number of primary branches and green pod yield per plant had high heritability and low genetic advance showing non-additive gene effect. Pande *et al.* (1975) revealed that in french bean, plant height, secondary branches and pod weight had high genetic variability and the genetic advance was appreciable for plant height, secondary branches and pod yield. Sharma et al. (1977) found that genetic gain was low for days taken to flowering and first picking.

Sohoo et al. (1971) reported high values of genotypic coefficient of variation, heritability and expected genetic advance in branches per plant, pods per plant and plant height in cluster bean. Tikka et al. (1974) noted a good amount of genetic variability in pods per plant, seed yield and days to flower in cluster bean. Tripathi and Lal (1975) observed high values of variance components and coefficients of variation for clusters per plant, pod length, pod width and yield per plant in cluster bean. All characters were highly heritable and pod length, pod width and yield per plant had high estimates of genetic advance also.

Teehan et al. (1969) found that the broad sense heritability and expected genetic advance were high for characters such as pods per node, length of pod, girth of pod and weight per pod in garden pea. Yield per plant showed moderate genetic gain. Srivastava et al. (1972) estimated high heritability values for days to flowering, pod length and pod width in peas. Genetic advance was highest for number of pods per plant. Srivastava and Sachan (1974) suggested that pods per plant in peas showed the maximum genotypic coefficient of variation whereas high heritability in conjunction with high genetic advance as percentage of mean was observed in the case of branches per plant and seed per pod. Saini et al. (1976) reported a good amount of phenotypic and genotypic variability for all characters studied in pea. Yield per plant and seed weight of fifteen pods exhibited high heritability estimates in conjunction with high genetic advance. Tikka and Asawa (1977) found that in peas, genotypic coefficient of variation and heritability were high for plant height, pods per plant and seed yield.

2. CORRELATION STUDIES

Galton's (1889) concept on correlations was elaborated by Fisher (1918).

The works done on the association of plant characters with yield and also on the intercorrelations, in the important vegetable crops, is discussed below.

Ramalao (1975) observed that the number of pistillate flowers was positively correlated phenotypically and genotypically with fruit number and negatively with fruit weight, length and set in cucumber. The occurrence of pistillate flowers on the main stem was also found to have negative correlation with number of fruits, fruit weight, fruit length and fruit yield.

Thamburaj (1973) found significant positive correlation for number of seeds per pod, pod weight and pod length, with yield per plant in ridge gourd.

In bitter gourd, Srivastava and Srivastava (1976) noted that the genotypic correlation coefficients were higher than phenotypic correlation coefficients, among the different pairs of characters studied. Yield per plant was positively correlated with number of female flowers, number of fruits and number of lateral branches. Number of female flowers and number of lateral branches were also found to exhibit positive association with number of fruits per plant. Days to first female flower showed negative correlations with number of fruits per plant and number of female flowers per plant but positive correlation with weight of fruit. Weight of fruit had negative genotypic association with number of fruits per plant. Ramachandran (1978) found that yield in bitter gourd was highly correlated with length of main vine, weight of fruit, length of fruit, number of fruits per plant, number of female flowers per plant and number of primary branches per plant. The correlation coefficients among these yield components were also highly significant.

Kalyanasunderam (1976) reported that fruit weight was positively and significantly correlated with diameter, size and flesh thickness of the fruits in muskmelon.

Srivastava and Sachan (1973) found that in tomato, the number of fruits per plant was correlated with yield per plant. Barooah and Mohan (1976) obtained significant negative association between fruit size and ascorbic acid content in tomato. Singh and Mital (1976) opined that fruit weight, locule number and fruit girth were the important characters in increasing the yield in tomato. Positive association was also observed between fruit length and fruit girth. Nandpuri et al. (1976) observed that yield per plant was negatively correlated with average fruit size and plant height. Plant height was also found to be negatively associated with number of fruits per plant.

Correlation studies in brinjal by Baha-Eldin *et al.* (1968) revealed that early flowering habit and positive association with yield, number of fruits per plant and long fruit shape. Neowah (1970) noticed that fruit number had negative correlation with average weight of first matured fruit; but positive correlation with total fruit weight.

Work done in chilli by Singh and Singh (1970) have shown that yield was positively correlated with number, length and width of berries and 100-seed weight. Kirti Singh *et al.* (1972) reported that yield per plant had positive association with plant height, number of branches, fruit number and fruit weight in chilli. Fruit number in turn was found to have positive association with fruit weight, branch number, plant height and days to flowering. Hiremath and Mathapati (1977) observed that in chilli yield was positively associated with number of branches. They also observed negative correlation between number of fruits per plant and length of fruit and between number of branches and seeds per fruit.

Kirti Singh *et al.* (1974) reported that in bhindi, yield had negative correlation with days to flowering. They also obtained positive correlations between yield per plant and flower number, number of branches, plant height and fruit number per plant, both at phenotypic and genotypic levels. Fruit number was also found to exhibit positive association with number of flowers, plant height and number of branches. Srivastava and Sachan (1975) obtained significant positive association between brancnes per plant and number of fruits and between plant height and length of fruit. Srivastava and Sachan (1975) and Roy and Chhonkar (1976) noted that yield per plant had strong positive correlations with number of fruits and number of branches per plant.

Kumar *et al.* (1976) found that the pod yield in cowpea was positively associated with branches per plant, pods per plant, pod length, thickness of pod, days to flowering and days taken to maturity.

Pande *et al.* (1975) reported that in french bean, the pod yield was strongly and positively correlated with plant height, primary branches, pod weight, pod length and number of pods per plant and was negatively correlated with days to flower. Sharma *et al.* (1977) opined that vegetable yield and earliness in french bean were mainly contributed by number of pod-bearing nodes, plant height and number of branches per plant.

In cluster bean, many workers have shown that yield per plant was strongly and positively correlated with pods per plant, cluster per plant, branches per plant and pod length (Sanghi and Sharma, 1964; Solanki *et al.*, 1975; and Tikka, 1975). Tikka (1975) also found that pod number was correlated with pod length.

Studies conducted by Teehan *et al.* (1969) revealed that pod yield in pea was highly and positively correlated with girth of pod, weight of pod and number of pods per plant. Singh and Singh (1970) found that yield per plant had positive correlation with branches per plant and number of pods per plant in pea. They also obtained positive correlation coefficients between days to flowering and days to maturity and between pod length and seeds per pod. Srivastava *et al.* (1975) and Tikka and Asawa (1977) have concluded that yield per plant in pea was significantly and positively associated with length of pod and number of pods per plant.

3. PATH COEFFICIENT ANALYSIS

Path coefficient analysis suggested by Wright (1921) is a means of untangling direct and indirect contributions of various factors in building up a complex correlation. This method is based on the premise that the degree of influence of one variable upon other can be defined in quantitative terms. After the construction of casual diagram, the values had to be assigned to each of the influencing paths. The values assigned to these paths is termed the path coefficients. It is defined as the portion of standard deviation of a dependent variable, if arising as a result of the variation in the independent variable. In order to have a coefficient independent of physical units, path coefficients are expressed in terms of standard deviation of Y on X. Therefore, path coefficients may also be considered as standardized partial regression coefficients.

The salient path coefficient analysis works employed in various vegetable crops are summarised below.

Srivastava and Srivastava (1976) reported that in bitter gourd, the number of female flowers per plant had the maximum direct effect on yield followed by number of fruits per plant and number of lateral branches per plant. The indirect effects of other characters towards yield were mainly through number of lateral branches, number of female flowers and number of fruits per plant. Number of fruits per plant also had high indirect contribution towards yield through weight of fruit. The analysis of path coefficients by Ramachandran (1978) has shown that the weight of fruit, number of fruits per plant and length of main vine had high direct positive effect on yield. Number of primary branches per plant, number of female flowers per plant and length of fruit exhibited low and negative direct effects on yield.

Nandpuri <u>et al</u>. (1976), on working out the path coefficient values in tomato observed that only the average number of fruits per plant had high direct positive effect and high indirect effect through plant height on the fruit yield. The direct effect of plant height and indirect effect through number of fruits per plant were also negative. Singh and Mital (1976) estimated that locule number, fruit girth, number of primary branches and fruit weight in early pickings had a high direct positive effect on yield in tomato. They also obtained negative direct effects in the case of fruit length, fruit shape index, number of fruits per plant and fruit weight towards early yields in tomato.

Singh and Singh (1974) reported maximum direct effect for number of branches in chilli. Days to flower and days to maturity, in addition to their direct effects, influenced the yield indirectly through number of branches. Plant height and fruit number also had indirect influence on yield through number of branches. Lee (1976) and Korla and Rastogi (1977) reported that the number of fruits per plant had high direct influence on yield. Korla and Rastogi also noted that the weight of fruit, plant height and length of fruit had considerable direct effects. Fruit length showed negative indirect effects through number of fruits and plant height.

In bhindi, Rao *et al*. (1977) observed maximum direct effect on yield for number of pods per plant.

Shettar *et al*. (1975) found that in french bean, the number of pods per plant had high direct effect on yield. Pod length had a moderate direct effect but its indirect effect through pod number was low.

Tikka (1975) has shown that in cluster bean, positive correlations of pod number and pod length on seed yield were due to their indirect effects through cluster per plant and seeds per pod. The direct effect of pod length was negative.

Path analysis in pea by Singh and Singh (1970) revealed that branch number, pods per plant, seeds per pod and 100-seed weight were the important yield contributing characters. Srivastava *et al*. (1975) reported that number of pods per plant, pod length and number of seeds per pod had high direct effects on yield in pea. According to Tikka and Asawa (1977), maximum weightage should be given to seed size and pods per plant in selecting high yielding genotypes in peas.

MATERIALS AND METHODS

MATERIALS AND METHODS

A field experiment for the analysis of genetic variability correlations and path coefficients in snake gourd (Trichosanthes anguina L.) was conducted during the summer season in 1977-78 (December-April). The experiment was conducted in the fields of the College of Horticulture, Vellanikkara.

MATERIALS

Twenty-five diverse snake gourd types, collected from different parts of Kerala State and maintained in the department of Olericulture, College of Horticulture, Vellanikkara were used for the study. These types were selfed for two generations when apparent homozygosity was achieved. Selection was based on visual morphological characters of fruit, given in Table 1.

METHODS

Layout of experiment

The experiment was laid out in randomised block design with three replications. Each replication consisted of 25 plots, one for each type. Three plants were raised in each plot and a spacing of 3 M was given between rows and between plants.

Table 1. Morphological fruit characters of the snake gourd types

Type	Colour	Length	Girth in the middle
T.A. 1	White	Short	Narrow
T.A. 2	Green	Short	Narrow
T.A. 3	Light green	Medium-long	Broad
T.A. 4	White	Short	Narrow
T.A. 5	Green	Medium-long	Narrow
T.A. 6	Greenish white	Very short	Broad
T.A. 7	White	Short	Narrow
T.A. 8	Greenish white	Short	Narrow
T.A. 9	White	Short	Broad
T.A.10	Green	Very long	Broad
T.A.11	Dark green	Very long	Broad
T.A.12	Greenish white	Short	Narrow
T.A.13	Green with white stripes	Long	Narrow
T.A.14	White with green stripes	Very long	Broad
T.A.15	Green	Very long	Narrow
T.A.16	Greenish	Short	Narrow
T.A.17	White	Long	Narrow
T.A.18	Green with white stripes	Medium-long	Broad
T.A.19	Bottle green	Long	Broad
T.A.20	Light green with white stripes	Short	Narrow
T.A.21	Light green	Very long	Narrow
T.A.22	Green	Short	Narrow
T.A.23	White with greenish stripes	Medium-long	Broad
T.A.24	Whitish green	Long	Narrow
T.A.25	White	Medium-long	Broad

Field culture

The seeds of the 25 types of snake gourd were sown at the rate of three seeds per pit, on 10.12.1977. After germination, only one seedling was retained per pit and the rest were removed.

Farm yard manure was basally applied at the rate of five tonnes per hectare. Inorganic fertilizers were applied at the rate of 56 kg N, 56 kg P and 56 kg K per hectare as ammonium sulphate, super phosphate and muriate of potash respectively, in three equal doses, one before sowing and later at 15 days interval after germination. Regular irrigations were given on all the days from sowing till harvesting was over. Pandal was erected for the plants to trail and care was given to see that the vines of one plant do not overlap with the space provided for the adjacent plants. During the cropping period, prophylactic plant protection measures were taken as per the recommendations. The harvest of the crop was completed on 5.4.1978. Information regarding the temperature, rainfall and humidity during the period of the experiment is given in Appendix I.

Characters studied

The following 21 characters were selected for the present studies.

1. Days for opening of first male flower.
2. Days for opening of first female flower.
3. Node at which first female flower appeared.
4. Number of female flowers.
5. Length of main vine (M).
6. Number of primary branches.
7. Number of fruits per plant.
8. Yield per plant.
9. Days for maturity.
10. Length of fruit (cm)
11. Girth of fruit (cm)
12. Weight of individual fruit (g).
13. Flesh - thickness (mm)
14. Number of seeds per fruit.
15. 400 - seed weight (g).
16. Vitamin C content (mg/100g edible fruit).
17. Crude fibre per cent.
18. Crude protein per cent.
19. Per cent ash content.
20. Percentage P.
21. Percentage K.

Table 2. Details of number of plants and/or fruits selected for taking the observations

Sl. No.	Observation	Details of number of plants and/or fruits selected for taking observation
1.	Days for opening of first male flower	All plants
2.	Days for opening of first female flower	-do-
3.	Node at which first female flower appeared	-do-
4.	Number of female flowers	Middle row
5.	Length of main vine	All plants
6.	Number of primary branches	-do-
7.	Number of fruits per plant	-do-
8.	Yield per plant	-do-
9.	Days for maturity	6 Fruits/plant from all plants
10.	Length of fruit	-do-
11.	Girth of fruit	-do-
12.	Weight of individual fruit	-do-
13.	Flesh - thickness	-do-
14.	Number of seeds per fruit	-do-
15.	100 - Seed weight	All plants
16.	Vitamin C content	One fruit/plant/plot
17.	Crude fibre per cent	-do-
18.	Crude protein per cent	-do-
19.	Per cent ash content	-do-
20.	Percentage P	-do-
21.	Percentage K	-do-

Observations

For taking the observations, plants and/or fruits were selected as detailed in Table 2. The average values of the characters per plant for every type were worked out for each block, which were used for further statistical analysis.

Detailed procedure followed

1. Days for opening of first male flower

The number of days were counted from the date of sowing to the date when the first male flower opened, in all the plants.

2. Days for opening of first female flower

The number of days were counted from the date of sowing to the date when the first female flower opened, in all the plants.

3. Node at which first female flower appeared

The nodes were counted from the lowest to the one at which the first female flower emerged, in all the plants.

4. Number of female flowers

The number of female flowers were counted every day as and when they open, starting from the day of opening of the first female flower, in the plants of the middle row.

5. Length of main vine

The plants were pulled out when the harvesting was over and the length was measured from the root initiation point to the tip of the main vine, in M, to the nearest cm.

6. Number of primary branches

The number of branches originating from the main vine were recorded, in all the plants, after the plants were pulled out.

7. Number of fruits per plant

The number of fruits in each plant was counted as and when the fruits were harvested.

8. Yield per plant

The weight of fruits harvested from each plant was recorded separately, in kg, to the nearest ten grams.

9. Days for maturity

The number of days from the day of opening of the female flower to the day of ripening and harvest of the fruit were counted, in six fruits per plant, from all the plants.

10. Length of fruit

The length of six fruits from each plant was recorded separately in cms., to the nearest one tenth of a cm., after they were harvested.

11. Girth of fruit

The girth at the middle of six fruits from each plant was recorded separately in cms., to the nearest one tenth of a cm., after they were harvested.

12. Weight of individual fruit

The weight of six fruits from each plant was recorded separately in grams to the nearest ten grams.

13. Flesh-thickness

The fruits were cut and the thickness of the flesh at the middle were measured with a micrometer, in six fruits each, from all plants, in mm., to the nearest one - tenth of a mm.

14. Number of seeds per fruit

The number of seeds per fruit were counted in six fruits each, from all the plants.

15. <u>100-seed weight</u>

The weight of 100 seeds from each plant was recorded in grams to the nearest one hundredth of a gram.

For estimating the following chemical constituents of fruit, one fruit per plant was harvested at random, on the 25th day of flower opening, from the middle row of each replication.

16. <u>Vitamin C content</u>

Samples were taken from the middle portion of the fruits and macerated in a pestle and mortar, adding two per cent metaphosphoric acid - acetic acid stabilising - extracting solution and vitamin C content was estimated by the 2, 6 - dischlorophenol - indophenol visual titration method (A.O.A.C., 1960). The value was expressed in mg of vitamin C per 100 g of fruit, on wet weight basis.

17. <u>Crude fibre per cent</u>

One gram of the dried and powdered flesh of the fruit was extracted with 1.25 per cent H_2SO_4 and then with 1.25 per cent NaOH. The residue was then washed with acetone to estimate the crude fibre content (A.O.A.C., 1960).

18. Crude protein per cent

0.1 g of the dried and powdered flesh material was weighed accurately and nitrogen content was estimated by macrokjeldahl method. The protein content was calculated by multiplying the value of nitrogen by 6.25 and the resulting value was expressed in grams per 100 g of fruit, on dry weight basis (A.O.A.C., 1960).

19. Per cent ash content

2 g of the ground fruit sample was weighed accurately and heated to 600°C in a muffle furnace for four hours. It was then cooled in a desiccator and weighed again. The percentage ash content was calculated on the basis of dry weight of the ground material (A.O.A.C., 1960).

The ash thus obtained was extracted with Hcl and this extract was used for the estimation of phosphorus and potassium.

20. Percentage Phosphorus

Phosphorus was estimated in a 10 ml aliquot of the Hcl extract using vanadomolybdophosphoric yellow colour method, in nitric acid system (Jackson, 1973).

2

21. Percentage potassium

Potassium present in an aliquot of the Hcl extract was estimated by flame photometric method (Jackson, 1973).

Statistical analysis

The mean values of the characters for every type in each replication was taken as the value of that particular replication for all the calculations. The data thus obtained were processed for analyses of variance, genotypic and phenotypic variances, heritability, genetic advance, genetic gain, genetic coefficient of variation, genotypic and phenotypic correlation coefficients and path coefficients.

Genetic variability

The analysis was done by the method suggested by Panse and Sukhatme (1961) for randomised block design. The variations among individuals caused by genetic reasons were measured by using the formula:

$$Vg = \frac{MSV - VE}{N}$$

Where Vg = Genetic variance

MSV = Mean sum of squares of types

VE = Error variance

N = Number of replications

<u>Phenotypic variability</u>

The actual visual variation among individuals is due to the genetic as well as environmental causes. This was calculated using the formula:

$$Vp = Vg + VE$$

where Vp = Phenotypic variance

Vg = Genotypic variance

VE = Environmental variance

<u>Heritability</u>

Heritability is the potentiality of an individual to inherit a particular character to its offspring. In broad sense, it is equivalent to the total genetic variance divided by the total phenotype variance and is expressed in percentage. The heritability in broad senso was calculated by the formula suggested by Burton and Devane (1953) and Johnson *et al.* (1955a) where it is given:

$$H = \frac{Vg \times 100}{Vp}$$

where H = Heritability

Vg = Genetic variance

Vp = Phenotypic variance

Expected genetic advance

At a certain level of selection pressure, the shift of a population towards the superior side of genetic action is meant by genetic advance. The genetic advance of the population under these studies was calculated by the formula given by Lush (1949) and Johnson et al. (1955 a) at five per cent selection pressure using the constant K as 2.06 given by Allard (1960).

$$GA = \frac{Vg}{Vp} \times \sqrt{Vp} \times K$$

$$= \frac{Vg}{\sqrt{Vp}} \times K$$

where GA = Genetic advance

Vg = Genetic variance

Vp = Phenotypic variance

K = Selection differential (constant)

Genetic gain

Genetic gain is the percentage of expected genetic advance based on the mean of the particular character under study. The method for the assessment of genetic gain suggested by Johnson et al. (1955a) was used, which is as follows:

$$\text{Genetic gain (G.G.)} = \frac{GA}{\bar{\bar{X}}} \times 100$$

where GA = Genetic advance

$\bar{\bar{X}}$ = Mean of character

Genetic coefficient of variation

To work out the magnitude of genetic variation in a character, genetic coefficient of variation was calculated by the formula suggested by Burton (1952) which is as follows:

$$\text{Genetic coefficient of variation (G.C.V.)} = \frac{\sqrt{Vg}}{\bar{\bar{X}}} \times 100$$

where Vg = Genetic variance

$\bar{\bar{X}}$ = Mean of character

Genotypic and phenotypic covariances and correlation coefficients

The genotypic and phenotypic covariances were worked out in the same way as the variances were calculated. Mean product of the expectation of covariance analysis is similar to the mean square expectation for analysis of variance. The phenotypic and genotypic correlation coefficients were worked out by substituting the genotypic and phenotypic covariances and variances in the formula suggested by Fisher (1954) and Aljbouri et al. (1958).

Genotypic correlation coefficient between two characters (1) and (2) $= r\,1.2 = \dfrac{g\ \mathrm{cov}\ 1.2}{\sqrt{(\sigma^2 g.1)(\sigma^2 g.2)}}$

Phenotypic correlation coefficient between two characters (1) and (2) $= r_p\,1.2 = \dfrac{p\ \mathrm{cov}\ 1.2}{\sqrt{(\sigma^2 p.1)(\sigma^2 p.2)}}$

where $g\ \mathrm{cov}\ 1.2$ = Genotypic covariances of characters in pairs

$p\ \mathrm{cov}\ 1.2$ = Phenotypic covariances of characters in pairs

$\sigma^2 g.1$ = Genotypic variance of the first character

$\sigma^2 g.2$ = Genotypic variance of the second character

$\sigma^2 p.1$ = Phenotypic variance of the first character

$\sigma^2 p.2$ = Phenotypic variance of the second character

Path coefficient analysis

The principles and techniques suggested by Wright (1921) and Li (1955) for the cause and effect system were adopted for the analysis, using the formula given by Dewey and Lu (1959). Since almost all the morphological traits were significantly correlated at one per cent level with yield, the following characters were selected for path coefficient analysis.

1. Number of fruits per plant.
2. Weight of individual fruit.
3. Length of main vine.
4. Number of female flowers.
5. Number of primary branches.
6. Days for maturity.
7. Node at which first female flower appeared.
8. Length of fruit.
9. Girth of fruit.
10. Flesh-thickness.
11. Number of seeds per fruit.
12. 100 - Seed weight.
13. Yield per plant.

The design adopted by Durate and Adams (1972) was chosen for further analysis of path coefficient.

Number of fruits per plant and weight of individual fruit were taken as first order components because these two characters were the major causes to influence the yield. The other characters were taken as second order components as their main effects were expressed through number of fruits per plant and weight of individual fruit, to bring about an ultimate change in yield. Among the second order components, length of main vine, number of female flowers, number of primary branches, days for maturity and node at which the first female flower appeared were taken as components of number of fruits per plant and the characters like length of fruit, girth of fruit, flesh-thickness, number of seeds per fruit and 100 - seed weight were considered as components influencing weight of individual fruit.

The following three sets of linear equations were employed for working out the path coefficients.

I First order components

$$r_{(1,8)} = P_{1.8} + r_{(1,2)} \; P_{2.8}$$

$$r_{(2,8)} = P_{2.8} + r_{(1,2)} \; P_{1.8}$$

$$\text{Residual effect } (P_{x.13}) = \sqrt{1 - R^2}$$

$$R^2 = P^2_{\;1.8} + P^2_{\;2.8} + 2\, r_{(1,2)} \, P_{(1.8)} \, P_{2.8}$$

II Second order components

(a) Number of fruits per plant and its components

$$r_{(3,1)} = P_{3.1} + r_{(3,4)} P_{4.1} + r_{(3,5)} P_{5.1} + r_{(3,6)} P_{6.1} + r_{(3,7)} P_{7.1}$$

$$r_{(4,1)} = r_{(4,3)} P_{3.1} + P_{4.1} + r_{(4,5)} P_{5.1} + r_{(4,6)} P_{6.1} + r_{(4,7)} P_{7.1}$$

$$r_{(5,1)} = r_{(5,3)} P_{3.1} + r_{(5,4)} P_{4.1} + P_{5.1} + r_{(5,6)} P_{6.1} + r_{(5,7)} P_{7\,1}$$

$$r_{(6,1)} = r_{(6,3)} P_{3.1} + r_{(6,4)} P_{4.1} + r_{(6,5)} P_{5.1} + P_{6.1} + r_{(6,7)} P_{7.1}$$

$$r_{(7,1)} = r_{(7,3)} P_{3.1} + r_{(7,4)} P_{4.1} + r_{(7,5)} P_{5.1} + r_{(7,6)} P_{6.1} + P_{7.1}$$

$$\text{Residual effect } (P_{x\,1}) = \sqrt{1 - R^2}$$

$$R^2 = \le P^2_{i.1} + 2 \underset{i \neq j}{\le} P_{i.1} \; P_{j.1} \; r_{i,j}$$

where

$P_{i.1}$ = Path coefficients

$r_{i,j.}$ = Genotypic correlation coefficients between all possible combinations of casual factors.

(b) Weight of individual fruit and its components

$$r_{(8,2)} = P_{8.2} + r_{(8,9)} P_{9.2} + r_{(8,10)} P_{10.2} + r_{(8,11)} P_{11.2} + r_{(8,12)} P_{12.2}$$

$$r_{(9,2)} = r_{(9,8)} P_{8.2} + P_{9.2} + r_{(9,10)} P_{10.2} + r_{(9,11)} P_{11.2} + r_{(9,12)} P_{12.2}$$

$$r_{(10,2)} = r_{(10,8)} P_{8.2} + r_{(10,9)} P_{9.2} + P_{10.2} + r_{(10,11)} P_{11.2} + r_{(10.12)} P_{12.2}$$

$$r_{(11,2)} = r_{(11,8)} P_{8.2} + r_{(11,9)} P_{9.2} + r_{(11,10)} P_{10.2} + P_{11.2} + r_{(11,12)} P_{12.2}$$

$$r_{(12,2)} = r_{(12,8)} P_{8.2} + r_{(12,9)} P_{9.2} + r_{(12,10)} P_{10.2} + r_{(12,11)} P_{11.2} + P_{12.2}$$

$$\text{Residual effect } (P_{x.2}) = \sqrt{1 - R^2}$$

$$R^2 = \leq P^2_{i.2} + 2 \leq P_{i.2} \quad P_{j.2} \quad r_{i,\,j}$$

$$i \neq j$$

where

$P_{i.2}$ = Path coefficients

$r_{i,j}$ = Genotypic correlation coefficients between all possible combinations of casual factors

RESULTS

RESULTS

1. VARIABILITY STUDIES

Mean, range and variation around the mean are the basic parameters of quantitative variability. The values of these parameters of the 25 snake gourd types in respect of 21 characters studied are furnished in Table 3 and Fig. 1, 2 and 3. The analysis of variance presented in Table 4 showed that the 25 types showed significant differences with respect to the characters studied. Table 5 includes the estimates of phenotypic, genotypic and environmental variances. The genotypic coefficient of variation, heritability, expected genetic advance and genetic gain are furnished in Table 6 and Fig.4 and 5.

1.1 Days for opening of first male flower

The mean number of days for the opening of first male flower ranged from 36.22 to 45.00 with a general mean of 39.17 days. Maximum number of days was recorded for the type T.A.23 and the minimum for T.A.20. The phenotypic variability present was low (4.97), the genetic component (2.92) being slightly higher than the environmental

Table 3. Mean, Range, Standard error and Overall mean of the characters studied

Sl. No.	Types	Days for opening of first male flower	Days for opening of first female flower	Node at which first female flower appeared	Number of female flowers	Length of main vine (metres)	Number of primary branches	Number of fruits per plant
1.	2.	3.	4.	5.	6.	7.	8.	9.
1.	T.A. 1	37.67	46.78	18.11	22.66	4.90	4.56	15.11
2.	T.A. 2	39.67	47.00	16.89	33.66	4.49	4.67	14.22
3.	T.A. 3	38.44	47.33	16.67	46.00	4.94	5.11	10.67
4.	T.A. 4	37.00	45.33	16.67	43.33	4.18	5.22	18.44
5.	T.A. 5	38.67	47.67	17.78	28.66	4.01	4.33	9.00
6.	T.A. 6	37.55	47.22	18.00	45.66	5.65	6.00	13.89
7.	T.A. 7	37.44	46.11	15.11	31.66	4.20	5.66	10.22
8.	T.A. 8	37.67	45.33	19.00	29.66	4.12	5.45	17.33
9.	T.A. 9	39.11	47.00	18.00	24.00	4.41	6.00	10.89
10.	T.A.10	38.67	49.11	18.67	31.33	5.44	5.56	15.00
11.	T.A.11	37.67	47.33	17.78	30.66	5.58	6.22	14.78
12.	T.A.12	40.00	47.57	16.78	44.33	5.11	5.33	13.55
13.	T.A.13	38.55	47.11	17.22	34.33	4.65	6.55	15.22
14.	T.A.14	41.44	51.22	20.11	25.66	4.57	6.45	13.00
15.	T.A.15	40.11	48.44	17.78	39.66	4.50	6.33	13.45
16.	T.A.16	39.88	46.89	17.67	34.33	5.19	5.22	12.22

(Contd.)

(Table 3 contd.)

1.	2.	3.	4.	5.	6.	7.	8.	9.
17.	T.A.17	39.22	48.33	17.67	16.66	4.74	5.67	8.11
18.	T.A.18	41.00	47.22	18.22	34.66	5.72	6.56	11.78
19.	T.A.19	40.89	50.45	19.67	53.33	4.58	6.33	18.89
20.	T.A.20	36.22	45.78	19.33	33.33	4.38	6.22	13.33
21.	T.A.21	36.67	45.56	15.78	35.00	5.21	5.33	15.56
22.	T.A.22	40.11	47.11	16.89	29.33	4.66	5.33	15.89
23.	T.A.23	45.00	51.33	22.11	22.33	4.49	6.67	11.67
24.	T.A.24	39.44	50.00	17.00	40.33	4.70	7.00	13.45
25.	T.A.25	41.22	51.00	23.44	29.66	6.17	5.67	8.34
Overall Mean ($\bar{\bar{x}}$)		39.173	47.769	18.093	33.213	4.825	5.702	13.361
Range		36.22-45.00	45.33-51.33	15.11-23.44	16.66-53.33	4.01-6.17	4.33-7.00	8.11-18.89
S.E.(d) $\pm$		1.431	1.712	1.554	4.244	0.531	0.864	3.454

component (2.05). The genotypic coefficient of variation was only 4.36 per cent. Heritability estimate was moderate (58.79 per dent) and the expected genetic advance (2.70) and genetic gain (6.89 per cent) exhibited low values.

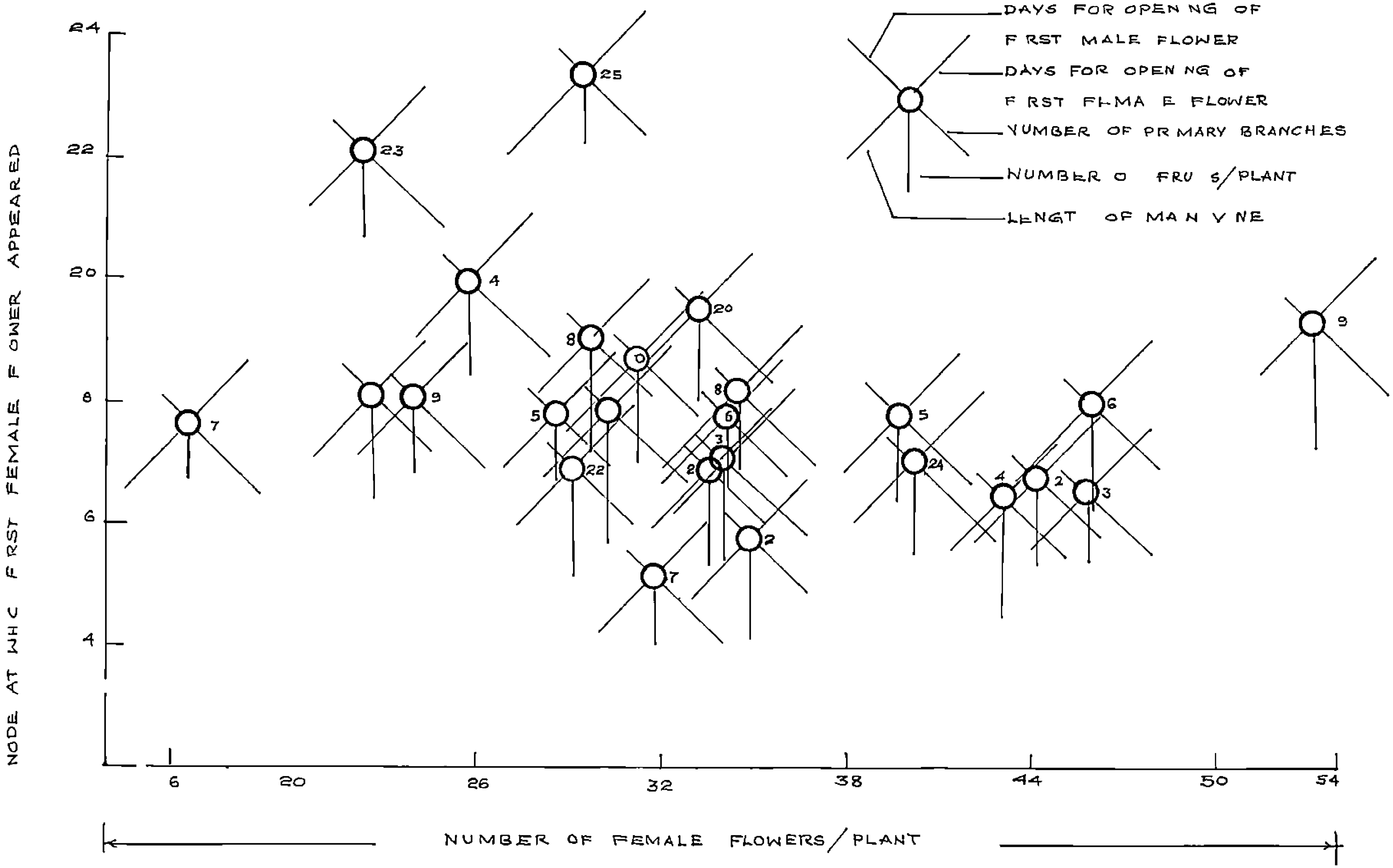
1.2. Days for opening of first female flower

The mean number of days for the opening of the first female flower ranged from 45.33 to 51.33 with a general mean of 47.77 days. Maximum number of days was recorded for the type T.A.23 and the minimum for T.A.4 and T.A.8. The total variability present was low (5.21) of which the error variance (2.93) was slightly higher than the genotypic variance (2.28). The genotypic coefficient of variation was only 3.16 per cent. The heritability (43.69 per cent) expected genetic advance (2.05) and genetic gain (4.30) exhibited low values.

1.3. Node at which first female flower appeared

The character exhibited a range of 15.11 to 23.44 and an overall mean of 18.09. The type T.A.25 showed maximum delay and T.A.7 the minimum, in terms of number of nodes, for appearance of the first female flower. The low phenotypic variability estimated (4.93) was shared almost

FIG 1 METROCLYPH SHOWING PLANT CHARACTERS IN DIFFERENT SNAKE GOURD TYPES



equally by the genetic (2.51)and environmental (2.42) components. The genetic coefficient of variation (8.76 per cent) heritability (50.99 per cent) and expected genetic advance (2.33) showed only comparatively low values. Tho genetic gain of the character was 12.88 per cent.

1.4. Number of female flowers per plant

This character exhibited a very wide range of 16.66 to 53.33 and the general mean was 33.21. The maximum number of female flowers was produced by the type T.A.19 and the minimum by T.A.17. The high phenotypic variance estimate of 91.42 was mainly contributed by the genetic component (73.41), the error variance being only 18.01. The genotypic coefficient of variation was fairly high (25.80 per cent). The expected genetic advance (15.82), heritability (80.30 per cent), and genetic gain (47.62 per cent) also exhibited fairly good values.

1.5. Length of main vine

The length of the main vine ranged from 4.01 to 6.17 metres with a general mean of 4.83 metres, the maximum being in the case of T.A.25 and the minimum in T.A.5. The variance estimates were very low (Vp = 0.52, Vg = 0.24 and Ve = 0.28). The genotypic coefficient of variation was 10.14 per cent. Heritability estimates recorded a low value of 47.82 per cent. The expected genetic advance and genetic gain also recorded low values (G A = 0.70, G.G. = 3.45 per cent).

1.6. Number of primary branches

The mean number of primary branches in the different snake gourd types ranged from 4.33 to 7.00 with a general mean of 5.70. T.A.24 had the maximum number of primary branches whereas T.A.5 had the minimum. The variance estimates (Vp = 0.93, Vg= 0.69, Ve = 0.24) were low but the heritability showed a high value of 73.68 per cent. The value of expected genetic advance (1.46) was low. The genetic coefficient of variation was 14.52 per cent. An improvement of 25.68 per cent was possible for the character as indicated by the estimate of genetic gain.

1.7. Number of fruits per plant

The range of this character was 8.11 to 18.89 the maximum number of fruits being in the type T.A.19 and the minimum in T.A.17. The types T.A.4 (18.44) and T.A.8 (17.33) closely followed T.A.19 in the number of fruits produced per plant. The general mean of the character was 13.36. The variability present in the types were not appreciable (Vp = 16.22, Vg = 4.21, Ve = 11.01). Heritability recorded a low value of 26.09 per cent. The values of expected genetic advance (2.17) and genetic gain (16.20 per cent) were also low. The genetic coefficient of variation (15.36 per cent) exhibited a moderate value.

1.8. <u>Yield per plant</u>

Yield per plant showed a general mean of 5.51 kg and a range of 3.02 to 8.92 kg. The highest yield was recorded by the type T.A.19 followed by T.A.13 (8.33 kg), T.A.14 (7.64 kg) and T.A.18 (7.09 kg). T.A.7 was the lowest yielder. The variance estimates were low (Vp = 4.23, Vg = 1.98, Ve = 2.25). The genotypic coefficient of variation exhibited a high value of 25.55 per cent. A moderate heritability of 45.90 per cent was noticed. The expected genetic advance was 1.97 and the value of genetic gain indicated the possibility of improvement by 35.66 per cent.

1.9. <u>Days for maturity</u>

The mean number of days taken for maturity ranged

Table 3 (contd.)

Sl. No.	Types	Yield per plant (kg)	Days for maturity	Length of fruit (cm)	Girth of fruit (cm)	Weight of individual fruit (g)	Flesh-thickness (mm)	Number of seeds per fruit
1.	2.	10.	11.	12.	13.	14.	15.	16.
1.	T.A. 1	4.52	37.08	56.42	14.59	306.05	5.59	42.39
2.	T.A. 2	3.93	36.19	50.84	13.64	281.42	4.81	35.34
3.	T.A. 3	3.95	37.70	62.47	17.15	377.37	5.29	29.48
4.	T.A. 4	6.04	36.76	59.95	15.04	327.50	5.15	44.13
5.	T.A. 5	3.19	36.01	64.81	13.08	353.40	5.19	30.31
6.	T.A. 6	4.31	35.74	45.08	16.21	302.81	5.20	39.28
7.	T.A. 7	3.02	37.47	51.54	15.56	302.97	5.49	44.31
8.	T.A. 8	4.95	38.32	59.42	13.15	285.94	6.02	48.21
9.	T.A. 9	4.97	36.83	53.66	16.47	455.00	6.12	39.13
10.	T.A.10	6.70	36.76	89.53	17.61	453.35	5.99	64.86
11.	T.A.11	6.71	38.36	80.24	16.31	476.73	5.75	62.69
12.	T.A.12	4.90	38.04	56.65	14.63	379.76	5.02	45.94
13.	T.A.13	8.33	37.29	73.54	15.09	548.95	4.81	47.74
14.	T.A.14	7.64	37.02	89.55	19.13	586.64	6.21	41.18
15.	T.A.15	6.83	37.41	87.52	15.37	523.28	5.09	46.53
16.	T.A.16	4.19	38.48	55.04	14.67	382.60	6.30	41.86

(Contd.)

(Table 3 contd.)

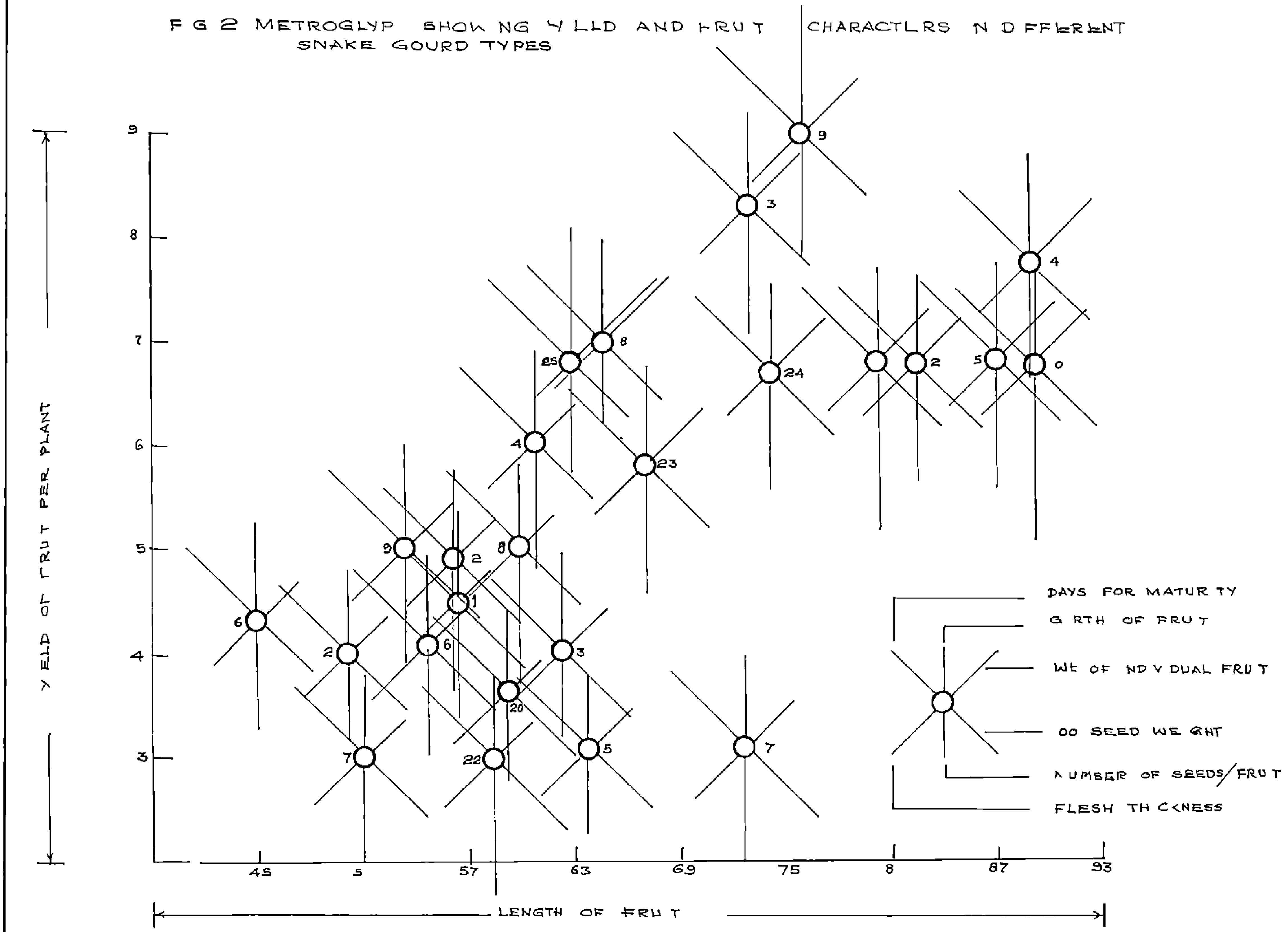
1.	2.	10.	11.	12	13.	14.	15.	16.
17.	T.A.17	3.11	38.39	72.91	15.45	404.53	6.19	47.77
18.	T A.18	7.09	36.86	64.57	17.40	610.56	5.44	35.02
19.	T.A.19	8.92	42.75	75.92	23.62	495.63	5.40	46.40
20.	T.A.20	3.60	37.82	58.76	14.04	267.70	6.12	34.21
21.	T.A.21	6.61	37.90	82.81	14.82	419.67	6.06	44.52
22.	T.A.22	3.03	37.60	57.74	14.96	321.37	5.79	51.40
23.	T.A.23	5.73	36.29	67.22	17.34	515.89	5.26	46.66
24.	T.A.24	6.66	38 70	74.94	16.01	506.90	4.43	43.61
25.	T.A.25	6.81	40.09	62.91	24.14	858.03	6.57	39.13
Overall Mean ($\bar{x}$)		5.511	37.767	66.161	16.219	429.762	5.572	43.684
Range		3.02-8.92	35.74-42.75	45.08-89.55	13.08-24.14	267.70-858.03	4.43-6.57	29.48-64.86
S.E.(d) ±		1.500	0.742	1.151	0.323	95.258	0.253	2.506

from 35.74 to 42.75 with a general mean of 37.77 days. The longest period for maturity was taken by the type T.A.19 and the shortest by T.A.6. The variability observed for the character as shown by different variance estimates (Vp = 2.43, Vg = 1.88, Ve = 0.55) was not appreciable. The genotypic coefficient of variation was only 6.34 per cent. However, heritability estimate showed a high value of 77.70 per cent. The expected genetic advance (2.50) and genetic gain (6.61 per cent) were also low.

1.10. Length of fruit

The length of fruit exhibited a range of 45.08 to 89.55 cm among the different types with a general mean of 66.16 cm. The longest fruits were produced by the type T.A.14 and the shortest by T.A.6. Other types which produced appreciably long fruits were T.A.10 (89.53 cm), T.A.15 (87.52 cm), T.A.21 (82.81 cm) and T.A.11 (80.24 cm). The variance estimates have shown that the major contribution was made by the genetic component (Vp = 163.13, Vg = 161.81, Ve = 1.32). The genotypic coefficient of variation was 19.23 per cent. Heritability recorded the

F G 2 METROGLYP SHOW NG Y LLD AND FRU T CHARACTLRS N D FFERENT SNAKE GOURD TYPES



highest value of 99.19 per cent among the different characters studied. Expected genetic advance (26.10) and genetic gain (39.45 per cent) also exhibited fairly promising values.

1.11. Girth of fruit

Mean girth of fruit ranged from 13.08 to 24.14 cm the maximum being recorded in T.A.25 and the minimum in the type T.A.5. The overall mean for the character was 16.22 cm. The variance estimates exhibited low values, of which the error variance was negligible (Vp = 7.48, Vg = 7.38, Ve = 0.10). The genotypic coefficient of variation was 16.75 per cent. The heritability estimate recorded high value (98.60 per cent) while the expected genetic advance (5.56) and genetic gain (34.25 per cent) were of moderate magnitude.

1.12. Weight of individual fruit

Mean weight of fruit ranged from 267.70g to 858.03 g, the highest value being recorded for the type T.A.25 and the lowest for T.A.20. Other snake gourd types like T.A.18 (610.56 g), T.A.14 (586.64 g), T.A.13 (548.95g) and T.A.19 (515.89 g) also had appreciably high average fruit weight. The phenotypic, genotypic and environmental variances were 24276.78, 15202.72 and 9074.06 respectively. The genetic coefficient of variation (28.69 per cent) indicated that the variation due to genetic causes was appreciable. The heritability (62.62 per cent) and genetic gain (46.77 per cent) showed moderate values. The expected genetic advance was as high as 201.00.

1.13. Flesh - thickness

Flesh-thickness showed a narrow range of 4.43 to 6.57 mm. The thickest flesh was observed in the type T.A.25 while the type T.A.24 had the least flesh-thickness. Variance estimates have shown that the greater part of variation was contributed by the genetic component. The genotypic coefficient of variation was found to be low (9.72 per cent). High heritability (84.40 per cent) coupled with low genetic gain (18.40 per cent) was recorded.

1.14. Number of seeds per fruit

Mean number of seeds per fruit was found to range from 29.48 to 64.86 with a general mean of 43.68. T.A.10 contained the maximum number of seeds in the fruit while the minimum was in T.A.3. The values of variance estimated were high ($Vp = 72.72$, $Vg = 66.17$, $Ve = 6.55$). The genetic coefficient of variation was 18.62 per cent. The heritability (90.99 per cent), expected genetic advance (15.99) and genetic gain 36.59 per cent) estimates were appreciable.

1.15. <u>100 - Seed weight</u>

The range of variation for 100-seed weight was from 27.31 to 34.46 g with a general mean of 30.29 g. The highest and the lowest values were recorded by the types T.A.17 and T.A.4 respectively. The various variance components and genetic coefficient of variation were found to have low estimates. The heritability percentage was moderate (63.69 per cent) and the genetic gain was only to the extent of 10.47 per cent.

1.16. <u>Vitamin C content</u>

The vitamin C content in the fruits ranged from 8.75 to 19.39 mg per 100 g of fruit and the general mean was 12.68 mg. T.A.10 had the maximum vitamin C content whereas the minimum was recorded in the type T.A.21. Other snake gourd types which contained comparatively higher quantities of vitamin C in their fruits were T.A.12,

Table 3 (contd.)

Sl. No.	Type	100-seed weight (g)	Vitamin C content (mg/100g edibile fruit)	Crude fibre per cent	Crude protein per cent	Per cent ash content	Percentage P	Percentage K
1.	2.	17.	18.	19.	20.	21.	22.	23.
1.	T.A. 1	32.57	12.06	21.04	14.28	7.87	0.22	2.30
2.	T.A. 2	28.77	9.83	19.45	11.20	13.77	0.27	3.02
3.	T.A. 3	32.74	15.40	15.01	7.00	5.66	0.18	1.93
4.	T.A. 4	27.31	12.75	11.98	15.41	8.62	0.32	2.88
5.	T.A. 5	28.27	13.41	15.21	10.79	7.82	0.28	3.10
6.	T.A. 6	27.77	12.06	18.79	9 .96	8.08	0.18	2.48
7.	T.A. 7	28.81	11.15	15.93	8.54	5.21	0.14	2.38
8.	T.A. 8	27.87	14.71	14.59	7.83	6.76	0.25	2.04
9.	T.A. 9	32.04	15.21	15.96	5.25	13.16	0.40	2.81
10.	T.A.10	30.18	19.39	16.65	8.36	11.45	0.27	2.76
11.	T.A.11	30.53	11.36	18.10	8.84	9.14	0.13	2.69
12.	T.A.12	30.03	16.40	18.01	10.30	7.74	0.11	2.39
13.	T.A.13	29.52	12.38	15.25	8.44	5.82	0.20	2.36
14.	T.A.14	28.76	14.28	18.08	7.02	6.60	0.29	2.36
15.	T.A.15	28.45	9.83	18.99	6.17	6.79	0.20	3.10
16.	T.A.16	33.82	9.88	14.38	4.73	6.81	0.15	2.54

(Contd.)

(Table 3 contd.)

1.	2.	17.	18.	19.	20.	21.	22.	23.
17.	T.A.17	34.46	12.50	11.98	6.52	6.67	0.28	2.44
18.	T.A.18	29.93	10.11	20.91	9.28	8.62	0.15	2.69
19.	T.A.19	29.12	9.62	20.27	11.62	5.92	0.33	2.44
20.	T.A.20	31.54	11.29	11.17	8.62	6.51	0.19	2.47
21.	T.A.21	31.56	8.75	14.28	7.10	8.71	0.19	2.64
22.	T.A.22	34.37	10.44	13.68	10.80	11.10	0.21	3.18
23.	T.A.23	30.03	14.91	16.64	9.60	6.95	2.27	2.84
24.	T A.24	30.62	13.80	16.59	10.98	6.34	0.27	3.21
25.	T.A.25	28.14	15.39	20.02	7.58	5.93	0.24	2.69
Overall Mean ($\bar{x}$)		30.289	12.675	16.518	9.049	7.922	0.229	2.630
Range		27.31-	8.75-	11.17-	4.73-	5.21-	0.11-	1.93-
		34.46	19.39	21.04	15.41	13.77	0.40	3.21
S.E.(d) $\pm$		1.456	0.405	0.716	0.676	0.489	0.026	0.105

FG 3 METROGLYPH SHOW NG B OCHEM CAL CHARACTERS OF FRU T

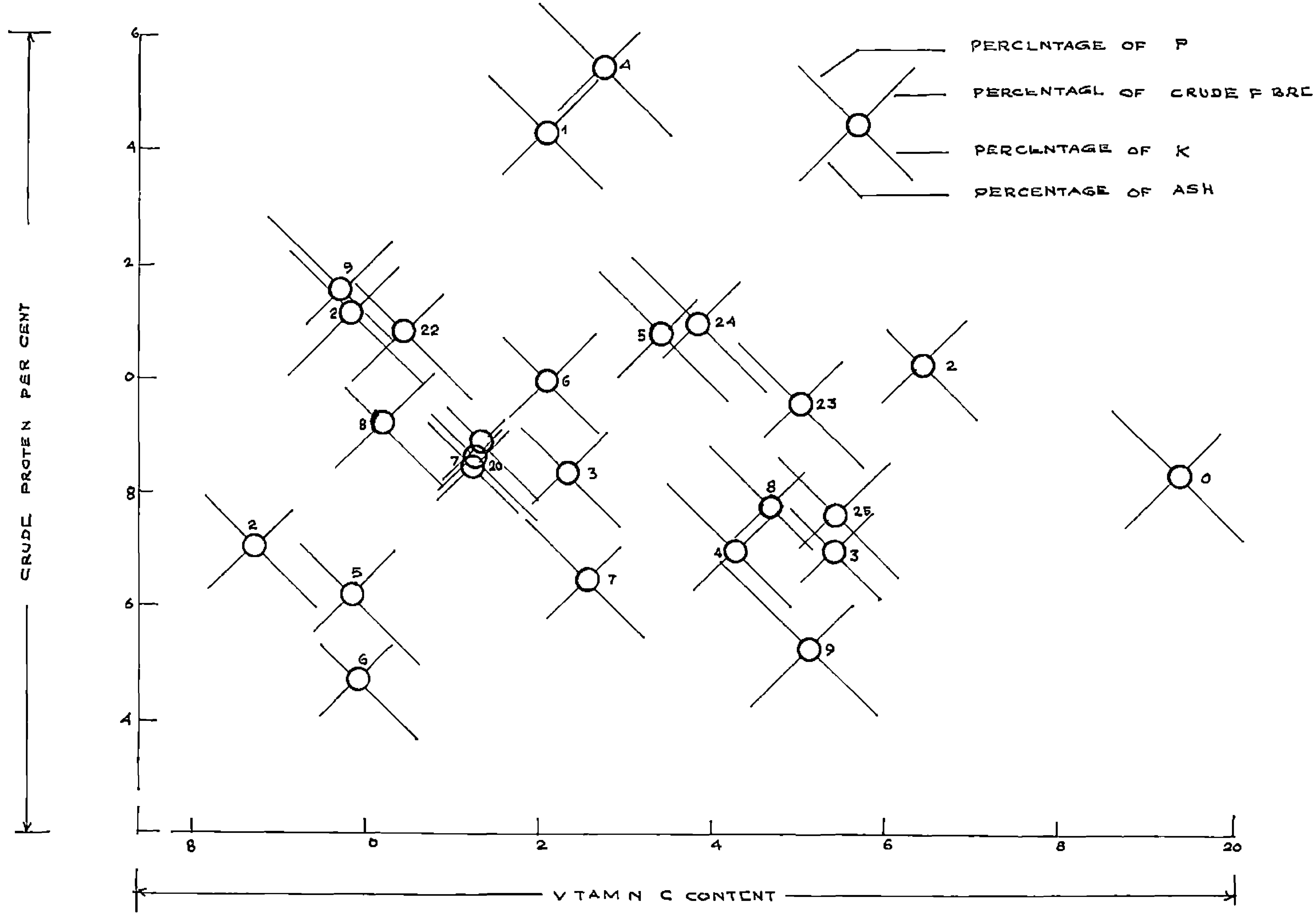


Table 4. Analysis of variance for 21 characters in 25 snake gourd types (mean square values)

	Character	Replication (d.f.=2)	Types (d.f=24)	Error (d.f.=48)	F values for types	C.D. P=0.05
1.	Days for opening of first male flower	23.06	10.80	2.05	5.28**	2.38
2.	Days for opening of first female flower	27.41	9.76	2.93	3.33**	2.81
3.	Node at which first female flower appeared	3.34	9.95	2.41	4.12**	2.55
4.	Number of female flowers	1.01	238.25	18.01	13.23**	6.97
5.	Length of main vine (metres)	0.58	0.94	0.28	3.32**	0.37
6.	Number of primary branches	5.81	1.45	0.75	1.94 *	1.42
7.	Number of fruits per plant	62.78	24.69	11.98	2.06 *	5.68
8.	Yield per plant (kg)	8.07	8.49	2.25	3.77**	2.46
9.	Days for maturity	0.23	6.21	0.55	11.29**	1.22
10.	Length of fruit (cm)	11.64	486.76	1.32	367.67**	1.89
11.	Girth of fruit (cm)	0.73	22.23	0.10	214.14**	0.53
12.	Weight of individual fruit (g)	14096.35	54682.22	9074.06	6.03**	156.33
13.	Flesh-thickness (mm)	0.46	0.92	0.06	14.36**	0.41
14.	Number of seeds per fruit	26.19	205.07	6.28	32.65**	4.11
15.	100-Seed weight (g)	4.72	13.29	2.12	6.26**	2.39
16.	Vitamin C content (mg per 100 g)	0.76	20.10	0.16	122.32**	0.67
17.	Crude fibre per cent	0.03	23.82	0.51	46.45**	1.18
18.	Crude protein per cent	0.31	19.56	0.46	42.83**	1.11
19.	Per cent ash content	0.20	15.60	0.24	65.21**	0.80
20.	Percentage P	0.0005	0.01	0.0007	21.49**	0.04
21.	Percentage K	0.06	0.34	0.01	32.32**	0.17

* Significant at 5 per cent level

** Significant at 1 per cent level

T.A.3, T.A.25 and T.A.9. The variance estimates were low and the environmental component was negligible. The genetic coefficient of variation was high (20.34 per cent). The heritability (97.59 per cent) and genetic gain (41.39 per cent) also showed fairly high values.

1.17. <u>Crude fibre per cent</u>

The crude fibre percentage ranged from 11.17 to 21.04 with a general mean of 16.52. The crude fibre was minimum in the type T.A.20. The variance estimates were low and the genetic coefficient of variation was 16.28 per cent. The estimates of heritability (93.81 per cent) and genetic gain (33.67 per cent) were high.

1.18. <u>Crude protein per cent</u>

The protein content in the different snake gourd types ranged from 4.73 to 15.41 with a general mean of 9.05. The maximum protein content was observed in the type T.A.4 followed by T.A.1 (14.28), T.A.4 (11.62) and T.A.2 (11.20). The minimum protein content was recorded in T.A.16. The variance estimates have shown that a good percentage of variation was contributed by genetic factors. The genetic coefficient of variation was 27.89 per cent.

Table 5. Genotypic, phenotypic and error variances of characters studied

Sl. No.	Character	Genotypic variance (Vg)	Phenotypic variance (Vp)	Error variance (Ve)
1.	Days for opening of first male flower	2.92	4.97	2.05
2.	Days for opening of first female flower	2.28	5.21	2.93
3.	Node at which first female flower appeared	2.51	4.93	2.41
4.	Number of female flower per plant	73.41	91.42	18.01
5.	Length of main vine	0.24	0.52	0.28
6.	Number of primary branches	0.69	0.93	0.24
7.	Number of fruits per plant	4.21	16.22	11.01
8.	Yield per plant	1.98	4.23	2.25
9.	Days for maturity	1.88	2.43	0.55
10.	Length of fruit	161.81	163.13	1.32
11.	Girth of fruit	7.38	7.48	0.10
12.	Weight of individual fruit	15202.72	24276.78	9074.06
13.	Flesh-thickness	0.29	0.35	0.06
14.	Number of seeds per fruit	66.17	72.72	6.55
15.	100 - Seed weight	3.72	5.84	2.12
16.	Vitamin C content	6.64	6.80	0.16
17.	Crude fibre per cent	7.77	8.28	0.51
18.	Crude protein per cent	6.37	6.82	0.45
19.	Per cent ash content	5.09	5.41	0.32
20.	Percentage P	0.004	0.01	0.001
21.	Percentage K	0.11	0.12	0.01

Table 6. Heritability, expected genetic advance, genetic gain and genetic coefficient of variation of characters studied

Sl. No.	Characters	Herita-bility	Expected genetic advance (GA)	Genetic gain (G.G.)	G.C.V.
1.	Days for opening of first male flower	58.79	2.70	6.89	4.36
2.	Days for opening of first female flower	43.69	2.05	4.30	3.16
3.	Node at which first female flower appeared	50.99	2.33	12.88	8.76
4.	Number of female flowers per plant	80.30	15.82	47.62	25.80
5.	Length of main vine	47.82	0.70	14.45	10.14
6.	Number of primary branches	73.68	1.46	25.68	14.52
7.	Number of fruits per plant	26.09	2.17	16.20	15.36
8.	Yield per plant	45.90	1.97	35.66	25.55
9.	Days for maturity	77.[illegible]	2.50	6.61	3.64
10.	Length of fruit	99.19	26.10	39.45	19.23
11.	Girth of fruit	98.60	5.56	34.25	16.75
12.	Weight of individual fruit	62.62	200.10	46.77	28.69
13.	Flesh-thickness	84.40	1.03	18.40	9.72
14.	Number of seeds per fruit	90.99	15.99	36.59	18.62
15.	100-Seed weight	63.69	3.17	10.47	6.37
16.	Vitamin C content	97.59	5.25	41.39	20.34
17.	Crude fibre per cent	93.81	5.56	33.67	16.88
18.	Crude protein per cent	93.40	5.02	55.52	27.89
19.	Per cent ash content	94.09	4.51	56.92	28.49
20.	Percentage P	81.89	0.13	55.12	29.55
21.	Percentage K	86.48	0.63	23.92	12.49

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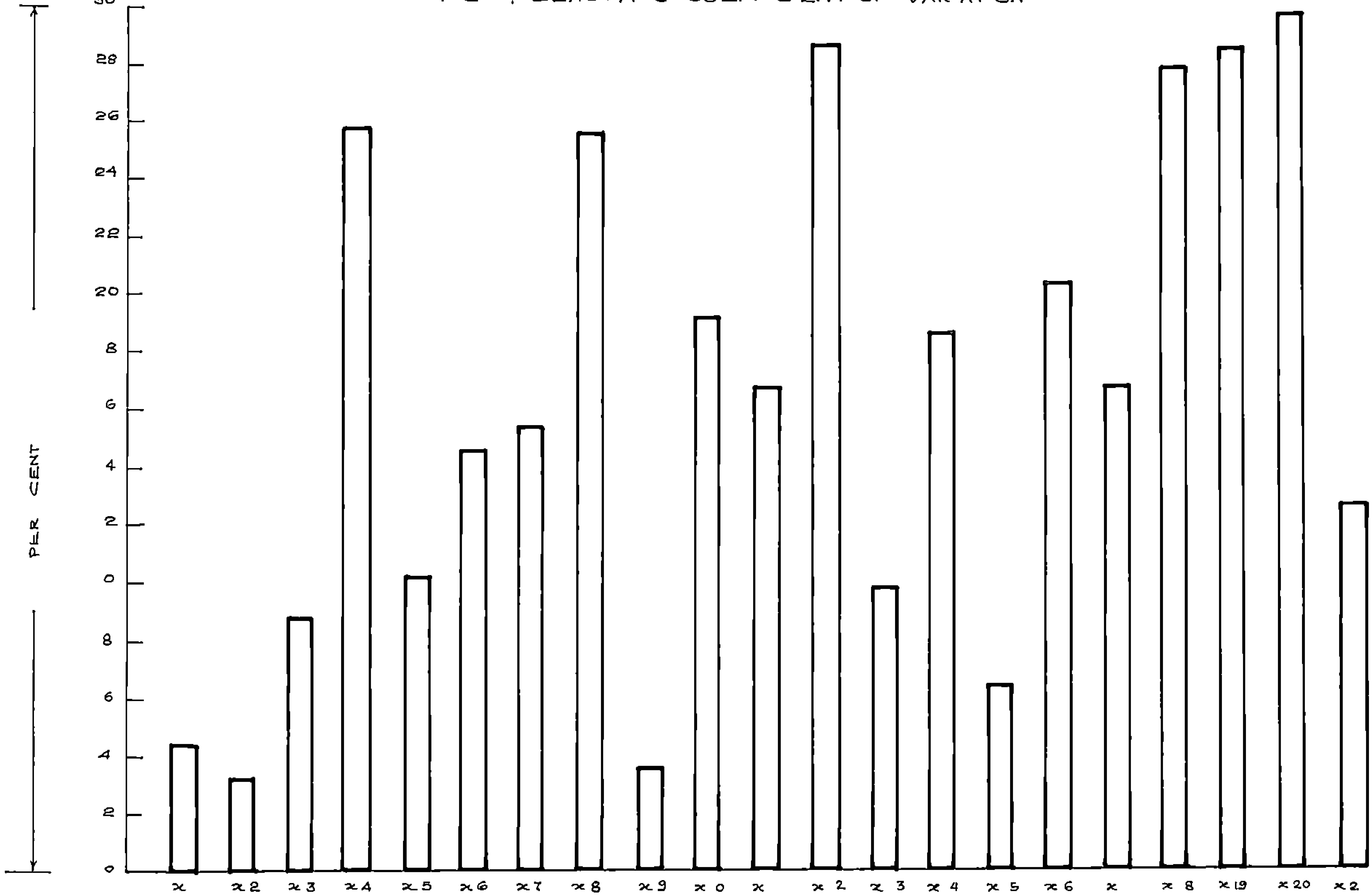

The genetic gain was as high as 55.52 per cent.

1.19. Per cent ash content

The mean value of per cent ash content ranged from 5.21 in T.A. 7 to 13.77 in T.A. 2 with a general mean of 7.92. The variance estimates showed predominance of genetic component. The genetic coefficient of variation was 28.49 per cent. The heritability (94.09 per cent) and genetic gain (56.92 per cent) exhibited fairly high values.

1.20. Percentage P.

The percentage of phosphorus in the fruits ranged from 0.11 to 0.40 with a general mean of 0.23. Maximum phosphorus was estimated in T.A.9 and the minimum in T.A.12. The variance estimates were very low. The heritability (81.89 per cent), genetic gain (55.12 per cent) and genetic coefficient of variation (29.55 per cent) had comparatively very high values.

1.21. Percentage K

The potassium percentage of the fruits ranged from 1.93 in T.A.3 to 3.21 in T.A.24. The overall mean of the character was 2.63. The estimates of variance were

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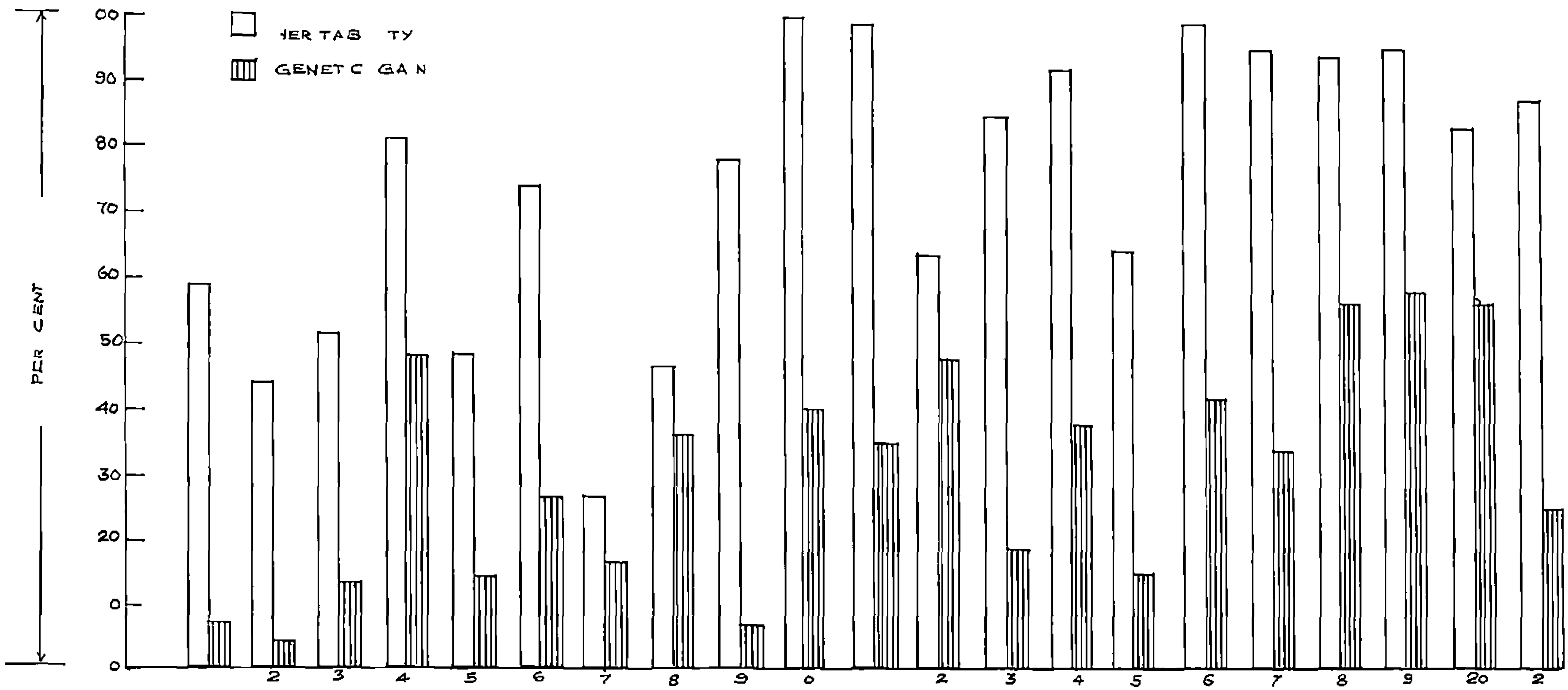


low and the genetic coefficient of variation was 12.49 per cent. The heritability and genetic gain exhibited values of 86.48 per cent and 23.92 per cent respectively.

2. CORRELATION STUDIES

In order to understand the various components of fruit and their extend of association with yield and among themselves, the phenotypic and genotypic correlation coefficients were worked out. The results are presented in Tables 7, 8, 9, 10 and 11. In Fig.6 the correlation coefficients between yield and all other characters are given.

2.1. Correlation between yield and yield components

The values of genotypic correlation of all characters were almost similar to that of phenotypic values, although slightly on to the higher side, indicating their strong inherent association with yield. The highest positive association with yield per plant was observed of number of primary branches (r_g= 0.82289, r_p = +0.33338) followed by weight of individual fruit (r_g = +0.77204, r_p = +0.57624), length of fruit (r_g = +0.76378, r_p = +0.51863), days for opening of first

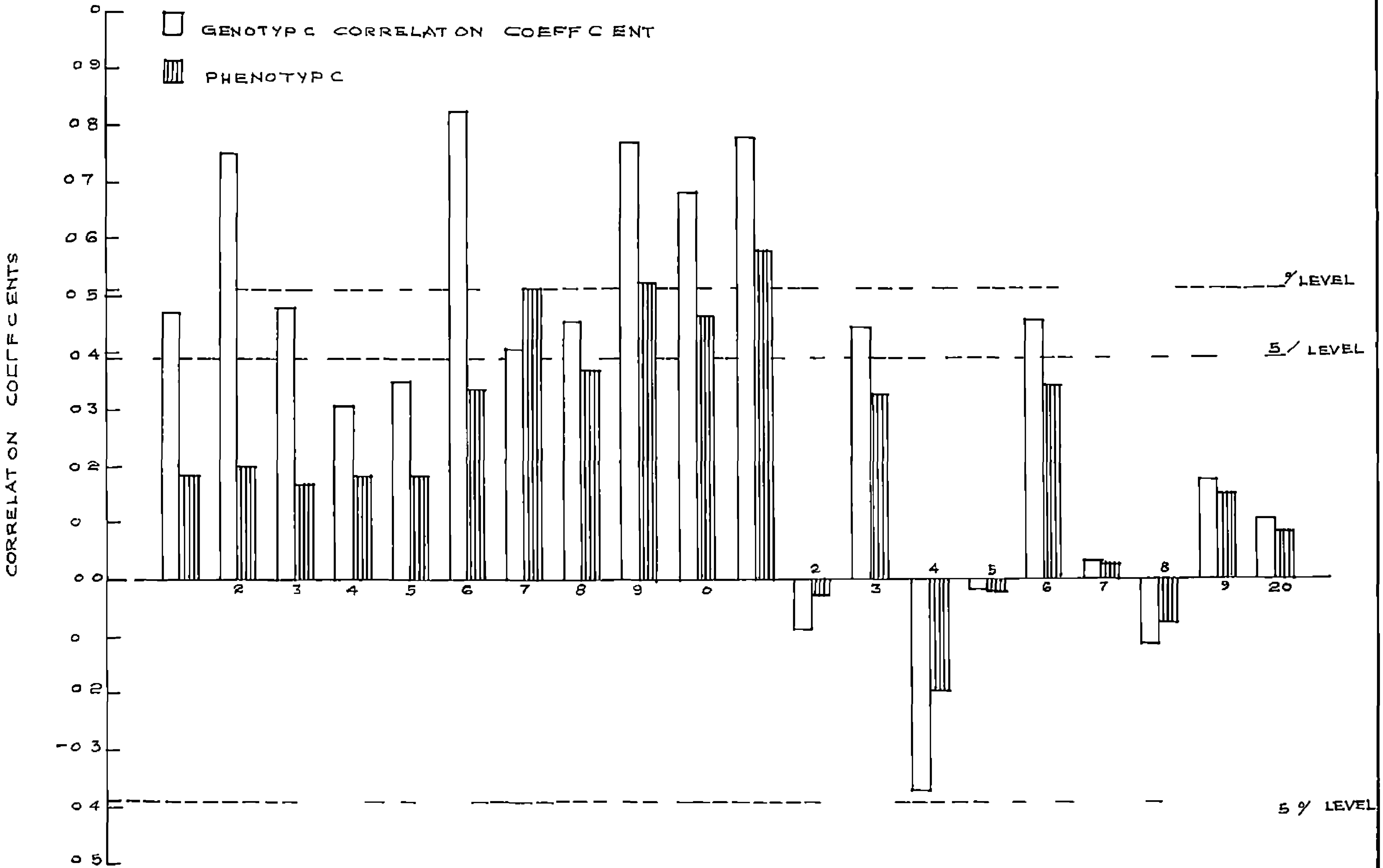
Table 7. Genotypic and phenotypic correlation coefficients of all the characters with yield

Sl. No.	Character	Yield per plant	
		Genotypic correlation coefficient	Phenotypic correlation coefficient
1.	Days for opening of first male flower	+ 0.47550*	+ 0.18178
2.	Days for opening of first female flower	+ 0.75100**	+ 0.19629
3.	Node at which first female flower appeared	+ 0.47170*	+ 0.16581
4.	Number of female flowers per plant	+ 0.30471	+ 0.17918
5.	Length of main vine	+ 0.34961	+ 0.17853
6.	Number of primary branches	+ 0.82289**	+ 0.33338
7.	Number of fruits per plant	+ 0.40599*	+ 0.50824*
8.	Days for maturity	+ 0.45204*	+ 0.36781
9.	Length of fruit	+ 0.76378**	+ 0.51863**
10.	Girth of fruit	+ 0.67971**	+ 0.46479*
11.	Weight of individual fruit	+ 0.77204**	+ 0.57624**
12.	Flesh - thickness	- 0.09015	- 0.03513
13.	Number of seeds per fruit	+ 0.43803*	+ 0.31901
14.	100 - Seed weight	- 0.37457	- 0.20292
15.	Vitamin C content	- 0.02279	- 0.02550
16.	Crude fibre per cent	+ 0.45395*	+ 0.33773
17.	Crude protein per cent	+ 0.02995	+ 0.02775
18.	Per cent ash content	- 0.12024	- 0.08228
19.	Percentage P	+ 0.17200	+ 0.14746
20.	Percentage K	+ 0.00551	+ 0.08299

* Significant at 5 per cent level

** Significant at 1 per cent level

FIG 6 CORRELAT ON COEF C ENTS BETWEEN YIELD AND OTHER CHARACTERS



female flower (r_g = +0.75100, r_p = +0.19629), girth of fruit (r_g = +0.67971, r_p = +0.46479), days for opening of first male flower (r_g = +0.47550, r_p = +0.18178), node at which first female flower appeared (r_g = +0.16581), crude fibre per cent (r_g = +0.45395, r_p = +0.33773), days for maturity (r_g = +0.45204, r_p = +0.36781, number of seeds per fruit (r_g = +0.43803, r_p =+0.31901) and number of fruits per plant (r_g = +0.40599, r_p = +0.50824). Positive correlations significant only at five per cent level were observed with length of main vine (r_g = +0.34961, r_p = +0.17853) and number of female flowers per plant (r_g = +0.30471, r_p = +0.17918). 100 - Seed weight (r_g = -0.37457, r_p = -0.20292) had significant negative correlation with yield. The relationships of flesh - thickness (r_g = -0.09015, r_p = -0.03513), Vitamin C content (r_g = -0.12024, r_p = - 0.08228) were negative and non-significant while those of percentage P (r_g = +0.17200, r_p= +0.14746), percentage K (r_g= +0.10551, r_p = +0.08299) and crude protein per cent (r_g= +0.02995, r_p = +0.02775) were positive and non significant.

2.2. Intercorrelation among yield components

Highly significant positive phenotypic correlations were observed between days for opening of first

Table 8. Phenotypic correlation coefficient (r_p) for different pairs of morphological characters

Character	X_2	X_3	X_4	X_5	X_6
X_1 Days for opening of first male flower	+0.6646**	+0.45689*	-0.01372	+0.02662	+0.16255
X_2 Days for opening of first female flower		+0.50501*	-0.05536	+0.09693	+0.33570
X_3 Node at which first female flower appeared			-0.14004	+0.18290	+0.10759
X_4 Number of female flowers				+0.04719	+0.04368
X_5 Length of main vine					+0.13046
X_6 Number of primary branches					
X_7 Number of fruits per plant					
X_8 Days for maturity					
X_9 Length of fruit					
X_{10} Girth of fruit					
X_{11} Weight of individual fruit					
X_{12} Flesh - thickness					
X_{13} Number of seeds per fruit					
X_{14} 100 - Seed weight					

* Significant at 5 per centlevel

** Significant at 1 per cent level

(Contd.)

Table 8 (Contd.)

	Character	X_7	X_8	X_9	X_{10}
X_1	Days for opening of first male flower	-0.21645	-0.16492	+0.14739	+0.41053*
X_2	Days for opening of first female flower	-0.19601	+0.22443	+0.36881	+0.56306**
X_3	Node at which first female flower appeared	+0.04016	+0.23293	+0.11385	+0.52178**
X_4	Number of female flowers	+0.33130	+0.26821	-0.12808	+0.15760
X_5	Length of main vine	-0.01852	+0.13590	+0.07337	+0.35086
X_6	Number of primary branches	+0.02269	+0.16506	+0.29960	+0.28308
X_7	Number of fruits per plant		+0.17155	+0.10828	-0.05819
X_8	Days for maturity			+0.20720	+0.57687**
X_9	Length of fruit				+0.28764
X_{10}	Girth of fruit				
X_{11}	Weight of individual fruit				
X_{12}	Flesh - thickness				
X_{13}	Number of seeds per fruit				
X_{14}	100 - Seed weight				

* Significant at 5 per cent level

** Significant at 1 per cent level

(Contd.)

Table 8 (Contd.)

	Character	X_{11}	X_{12}	X_{13}	X_{14}
X_1	Days for opening of first male flower	+0.43216*	-0.03361	+0.01632	-0.01372
X_2	Days for opening of first female flower	+0.43492*	+0 01405	+0.27851	-0.08735
X_3	Node at which first female flower appeared	+0.28320	+0.27144	+0.02127	-0.23888
X_4	Number of female flowers	-0.10981	-0.47954*	-0.22265	-0.26097
X5	Length of main vine	+0.28753	+0.17763	+0.10430	+0.06449
X6	Number of primary branches	+0.25920	-0.08029	+0.16906	-0.11306
X7	Number of fruits per plant	-0.34071	-0.18072	+0.29489	-0.19544
X8	Days for maturity	+0.29420	-0.21736	+0.16671	+0.06388
X9	Length of fruit	+0.40760*	+0.07954	+0.47217*	-0.04122
X10	Girth of fruit	+0.63570**	+0.24787	+0.07317	-0.16579
X11	Weight of individual fruit		+0.17598	+0.05371	+0.17835
X12	Flesh - thickness			+0.11389	+0.26178
X13	Number of seeds per fruit				+0.04849
X14	100 - Seed weight				

* Significant at 5 per cent level

** Significant at 1 per cent level

Table 9. Phenotypic correlation coefficients (r_p) for different pairs of biochemical characters

	Character	X_2	X_3	X_4	X_5	X_6
X_1	Vitamin C content	-0.03236	-0.07813	+0.03321	+0.23877**	-0.16607
X_2	Crude fibre per cent		+0.15885	+0.07464	-0.08000	+0.03858
X_3	Crude Protein per cent			+0.09977	+0.10746	+0.21368
X_4	Per cent ash content				+0.28098	+0.45654*
X_5	Percentage P					+0.24024
X_6	Percentage K					

* Significant at 5 per cent level

male flower and days for opening of first female flower (r_p = +0.6646) followed by girth of fruit and weight of individual fruit (r_p = +0.6357). The phenotypic correlations between days for maturity and girth of fruit (r_p = +0.57687), between girth of fruit and days for opening of first female flower (r_p = +0.56306) and between girth of fruit and node at which first female flower appeared (r_p= +0.52178) were also significant at one per cent level.

The phenotypic correlations were positive and significant at five per cent level between days for opening of first female flower and node at which first female flower appeared, between weight of individual fruit and days for opening of first female flower, between weight of individual fruit and days for opening of first male flower, between days for opening of first male flower and node at which first female flower appeared, between girth of fruit and days for opening of first male flower and between length of fruit and weight of individual fruit. The phenotypic correlation between flesh - thickness and number of female flowers was negative and significant at five per cent level.

However, highly significant positive genotypic correlations were obtained between (i) days for opening of first male flower and days for opening of first female flower (ii) days for opening of first male flower and node at which first female flower appeared (iii) days for opening of first female flower and node at which female flower appeared (iv) number of primary branches and days for opening of first male flower (v) number of primary branches and days for opening of first female flower (vi) number of female flowers and number of fruits per plant (vii) days for opening of first female flower and length of fruit (viii) number of primary branches and length of fruit and (ix) number of seeds per fruit and number of fruits per plant. The correlation between number of female flowers and flesh - thickness was negative and significant at one per cent level. The genotypic correlations of days for opening of first male flower, days for opening of first female flower, node at which first female flower appeared and length of main vine, with girth of fruit and with weight of individual fruit were also positive and significant at one per cent level. Girth of fruit, length of fruit and number of primary branches also exhibited highly significant positive genotypic correlation with weight of individual fruit.

Table 10. Genotypic correlation coefficients (r_g) for different pairs of morphologica

	Character	X_2	X_3	X_4	X_5
X_1	Days for opening of first male flower	+0.91293**	+0.71940**	-0.19785	+0.
X_2	Days for opening of first female flower		+0.85835**	-0.15161	+0.
X_3	Node at which first female flower appeared			-0.35529	+0.
X_4	Number of female flowers				+0.
X_5	Length of main vine				
X_6	Number of primary branches				
X_7	Number of fruits per plant				
X_8	Days for maturity				
X_9	Length of fruit				
X_{10}	Girth of fruit				
X_{11}	Weight of individual fruit				
X_{12}	Flesh - thickness				
X_{13}	Number of seeds per fruit				
X_{14}	100 - Seed weight				

(Contd.

* Significant at 5 per cent level

** Significant at 1 per cent level

Table 10. (Contd.)

	Character	X_7	X_8	X_9	X_{10}
X_1	Days for opening of first male flower	-0.30419	-0.06378	+0.19796	+0.53766**
X_2	Days for opening of first female flower	-0.34879	+0.38283	+0.54868**	+0.86216**
X_3	Node at which first female flower appeared	-0.49112*	+0.28465	+0.17103	+0.72928**
X_4	Number of female flowers	+0.52013**	+0.39613*	-0.13727	+0.17645
X_5	Length of main vine	-0.35982	+0.16406	+0.05376	+0.55582**
X_6	Number of primary branches	+0.03768	+0.14812	+0.69534**	+0.46232*
X_7	Number of fruits per plant		+0.21770	+0.18240	-0.10854
X_8	Days for maturity			+0.23452	+0.63954
X_9	Length of fruit				+0.28963
X_{10}	Girth of fruit				
X_{11}	Weight of individual fruit				
X_{12}	Flesh - thickness				
X_{13}	Number of seeds per fruit				
X_{14}	100 - Seed weight				

* Significant at 5 per cent level

** Significant at 1 per cent level

(Contd.)

Table 10. (Contd.)

	Character	X_{11}	X_{12}	X_{13}	X_{14}
X1	Days for opening of first male flower	+0.68468**	-0.04031	-0.01399	-0.03339
X2	Days for opening of first female flower	+0.94797**	+0.00587	+0.39321*	-0.16079
X3	Node at which first female flower appeared	+0.89745**	+0.48229*	-0.02789	-0.20828
X4	Number of female flowers	-0.05279	-0.53734**	-0.26735	-0.36221
X5	Length of main vine	+0.69543**	+0.42319*	+0.20746	+0.08464
X6	Number of primary branches	+0.70373**	+0.16344	+0.17615	-0.11858
X7	Number of fruits per plant	-0.25410	-0.28807	+0.57083**	-0.22036
X8	Days for maturity	+0.38583	+0.13459	+0.17021	+0.10097
X9	Length of fruit	+0.53257**	+0.13222	+0.48563*	-0.04965
X10	Girth of fruit	+0.81900**	+0.26307	+0.06358	-0.19811
X11	Weight of individual fruit		+0.20351	+0.09238	+0.19844
X12	Flesh - thickness			+0.15473	+0.40197*
X13	Number of seeds per fruit				+0.08442
X14	100 - Seed weight				

* Significant at 5 per cent level

** Significant at 1 per cent level

Table 11. Genotypic correlation coefficients (r_g) for different pairs of bio chemical characters

	Character	X_2	X_3	X_4	X_5	X_6
X_1	Vitamin C content	-0.03393	-0.07294	+0.04075	+0.25578	-0.11598
X_2	Crude fibre per cent		+0.17143	+0.07578	-0.08837	+0.03864
X_3	Crude protein per cent			+0.11629	+0.16392	+0.27076
X_4	Per cent ash content				+0.31682	+0.49007*
X_5	Percentage P					+0.24873
X_6	Percentage K					

* Significant at 5 per cent level

The genotypic correlations between length of main vine and node at which first female flower appeared, between number of primary branches and node at which first female flower appeared, between number of female flowers and days for maturity, between number of primary branches and girth of fruit, between flesh-thickness and node at which first female flower appeared, between flesh - thickness and length of main vine, between number of seeds per fruit and days for opening of first female flower, between number of seeds per fruit and length of fruit and between flesh - thickness and 100 - seed weight were positive but significant only at five per cent level. All other intercorrelations between the morphological traits were non-significant.

The biochemical characters studied did not show significant intercorrelations except for the correlation significant at five per cent level exhibited between per cent ash content and percentage K (r_p = +0.45654, r_g = +0.49007).

3. PATH COEFFICIENT ANALYSIS

3.1. First order components (Table 12 and Fig.7).

3.1.1. Yield per plant v/s number of fruits per plant

Path analysis revealed that number of fruits per plant had considerable positive direct effect (+0.64372) on the yield per plant. However, its indirect effect on yield via weight of individual fruit was negative (-0.23773). Thus the total correlation coefficient (r_g = 0.40599) was only a part reflection of its direct effect as partly it was nullified by the indirect effect through weight of individual fruit.

3.1.2. Yield per plant v/s weight of individual fruit

The simple genotypic correlation coefficient of weight of individual fruit with yield per plant was +0.77204. The direct effect was estimated to be very high and positive (+0.93560). Here also the high positive direct effect was partly nullified by its negative indirect effect through number of fruits per plant (-0.16356).

3.2. Second order components

3.2.1. Number of fruits per plant and its components (Table 13 and Fig.7)

3.2.1.1. Number of fruits per plant v/s length of main vine

The negative correlation coefficient of -0.35982

Table 12. Pata coefficient analysis - Direct (underlined) and indirect effects of first order components of yield

Character	Number of fruits per plant	Weight of individual fruit (g)	Genotypic correlation with yield per plant
Number of fruits per plant	$\underline{+0.64372}$	-0.23773	+0.40599
Weight of individual fruit	-0.16356	$\underline{+0.93560}$	+0.77204

Residual effect = 0.12786

between number of fruits per plant and length of main vine was mainly due to negative direct effect of length of main vine itself (-0.19295) and the rest was due to indirect effects via number of primary branches (-0.00607) and node at which first female flower appeared (-0.21176). However, the indirect effects of length of main vine via number of female flowers (+0.00899) and days for maturity (+0.04197) were positive. Thus the overall negative association of length of main vine with number of fruits per plant was mainly due to its direct negative effect and the negative indirect effect via node at which first female flower appeared.

3.2.1.2. Number of fruits per plant v/s. number of female flowers per plant

The manifestation of simple correlation (+0.52013) between number of fruits per plant and number of female flowers per plant were the direct effect of number of female flowers per plant (+0.25665) accompanied by indirect effects via node of emergence of first female flower (+0.18055) and days for maturity (+0.10135). Practically there was no effect via length of main vine (-0.00676) and number of primary branches (-0.01168).

Table 13. Path coefficient analysis - Direct (underlined) and indirect effects of second order components of yield (number of fruits per plant and its components)

Character	Length of main vine	Number of female flowers	Number of primary branches	Days for maturity	Node at which first female flower appeared	Genotypic correlation with number of fruits
Length of main vine	-0.19295	+0.00899	-0.00607	+0.04197	-0.21176	-0.35982
Number of female flowers	-0.00676	+0.25665	-0.01168	+0.10135	+0.18055	+0.52013
Number of primary branches	-0.01217	+0.00476	+0.24625	+0.03789	-0.23905	+0.03768
Days for maturity	+0.10166	-0.03165	+0.03647	+0.25587	-0.14465	+0.21770
Node at which first female flower appeared	-0.09118	-0.08040	+0.11583	+0.07283	-0.50820	-0.49112

Residual effect = 0.39463

3.2.1.3. <u>Number of fruits per plant v/s number of primary branches</u>

When compared to the other components, number of primary branches had only a very low correlation coefficient (+0.03768) but the direct effect was comparatively high (+0.24625). This positive direct effect was nullified mainly by the negative indirect effects through node of emergence of first female flower (-0.23905). The indirect effects via length of main vine (-0.01217), days for maturity (+0.03789) and via number of female flowers per plant (+0.00476) were negligible.

3.2.1.4. <u>Number of fruits per plant v/s days for maturity</u>

The correlation exhibited by days for maturity was comparatively low (+0.21770), but its direct effect was slightly higher (+0.25587). The indirect effect via length of main vine (+0.10166) was positive, but the indirect effect via node at which first female flower appeared (-0.14465) was negative. The indirect effects via number of primary branches (+0.03647) and via number of female flowers per plant (-0.03165) were low and negligible. The net effect of this system was therefore primarily due to the direct effect.

3.2.1.5. Number of fruits per plant v/s node at which first female flower appeared

The node at which first female flower appeared exhibited moderate negative correlation with number of fruits per plant (-0.49112). Its direct effect was infact negative and slightly higher (-0.50820). The influence of indirect effects via number of primary branches (+0.11583) and via days for maturity (+0.07283), which were positive were nullified by the indirect effects via length of main vine (-0.09118) and via number of female flowers per plant (-0.08040) which were negative. The net effect of node at which first female flower appeared on number of fruits per plant therefore is due to the direct effect.

3.2.2. Weight of individual fruit and its components (Table 14 and Fig. 7).

3.2.2.1. Weight of individual fruit v/s length of fruit

The simple correlation between length of fruit and weight of individual fruit (+0.53257) was the net result of the indirect effect via girth of fruit (+0.35388) and the direct effect itself (+0.27427). The indirect effects via flesh thickness (-0.02668), number of seeds per fruit (-0.04808) and 100 - Seed weight (-0.02081) were negative and negligible.

Table 14. Path coefficient analysis - Direct (underlined) and indirect effects of second order components of yield (weight of individual fruit and its components)

Character	Length of fruit	Girth of fruit	Flesh-thickness	Number of seeds per fruit	100 - Seed weight	Genotypic correlation with weight of individual fruit
Length of fruit	+0.27427	+0.35388	-0.02668	-0.04808	-0.02081	+0.53257
Girth of fruit	+0.07943	+0.88591	-0.05673	-0.00629	-0.08307	+0.81900
Flesh - thickness	+0.03379	+0.23305	-0.21657	-0.01532	+0.16855	+0.20351
Number of seeds per fruit	+0.13319	+0.05632	-0.03350	-0.09902	+0.03539	+0.09238
100 - Seed weight	-0.01361	-0.17550	-0.02343	-0.00835	+0.41933	+0.19844

Residual effect = 0.38951

3.2.2.2. Weight of individual fruit v/s girth of fruit

The highest correlation coefficient among the characters of this group was exhibited between girth of fruit and weight of individual fruit (+0.81900). This was mainly the manifestation of its high direct effect (+0.88591), slightly nullified by the combined effects of the negative indirect effects via 100 - seed weight (-0.08307), flesh - thickness (-0.05673) and number of seeds per fruit (-0.00629). The indirect effect via length of fruit (+0.07943) was positive but very small.

3.2.2.3. Weight of individual fruit v/s flesh - thickness

Flesh thickness exhibited only a low correlation coefficient with weight of individual fruit (+0.20351). The direct effect however worked out to be low but negative (-0.21657). This low negative value was marked by the positive indirect effects via girth of fruit (+0.23305), 100 - Seed weight (+0.16855) and length of fruit (+0.03379). The indirect effect via number of seeds per fruit (-0.01532) was negative and negligible.

3.2.2.4. Weight of individual fruit v/s number of seeds per fruit

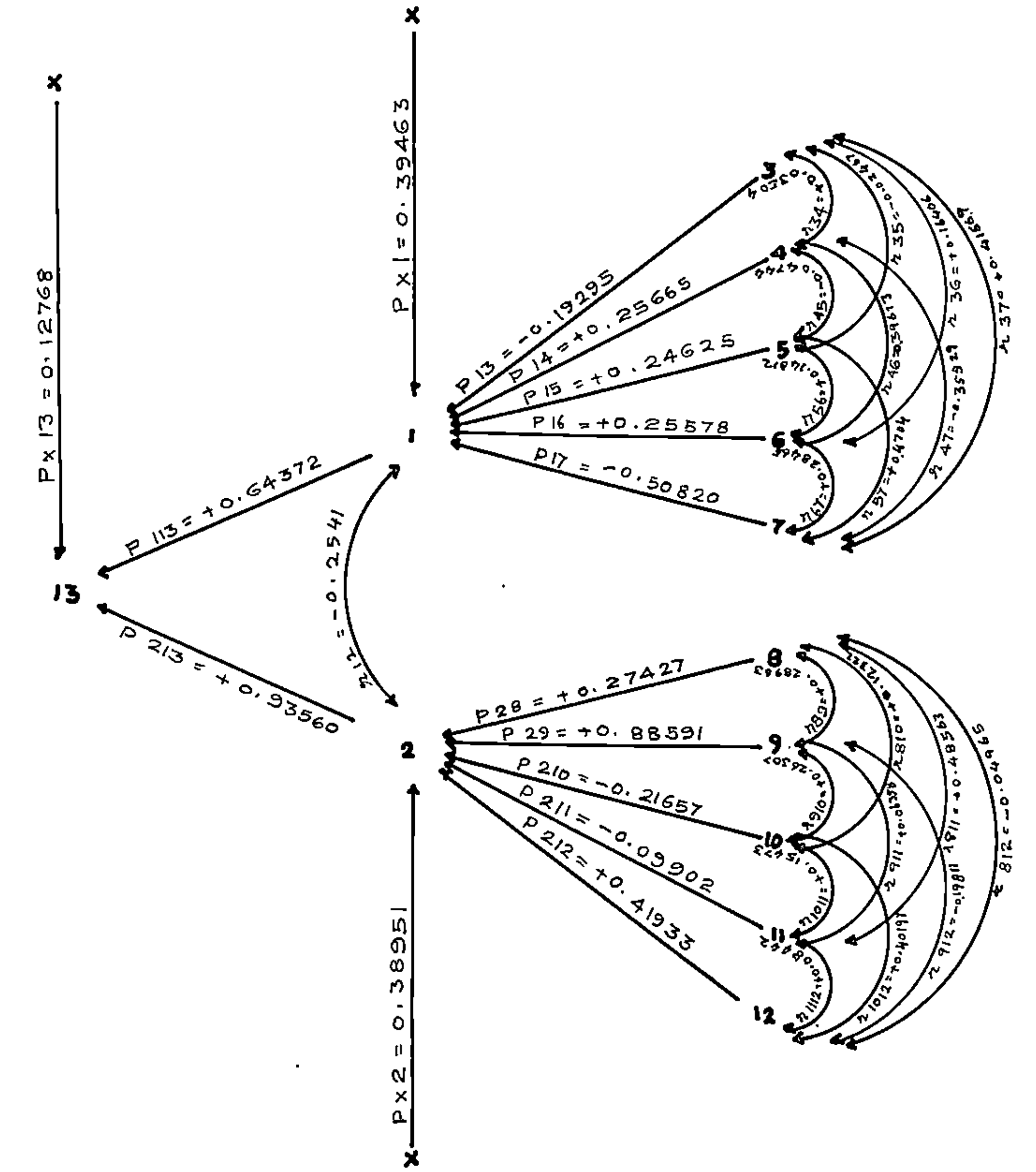
The positive indirect effects of number of seeds per fruit via length of fruit (+0.13319), girth of fruit (+0.05632) and 100 - seed weight (+0.03539) were nullified by the negative direct effect (-0.09902) and the indirect effect via flesh thickness (-0.03350) to give ultimate expression to the positive but negligible value of correlation coefficient (+0.09238).

3.2.2.5. <u>Weight of individual fruit v/s 100 - seed weight</u>

The moderate direct effect of 100 - seed weight on weight of individual fruit (+0.41933) was nullified by the combined negative indirect effects via girth of fruit (-0.17550), flesh thickness (-0.02343), length of fruit (-0.01361) and number of seeds per fruit (-0.00835) resulting in the expression of a low value of correlation coefficient (+0.19844).

The coefficient of determination is another index which is the fraction of complete determination of one variable for which the cause of another variable is directly responsible in a given system of related variables i.e., the sum of the coefficients of all such causes must be equal to unity. Due to the complexity of the characters, correlation studies as well as path

FIG: 7. PATH DIAGRAM



PATH COEFFICIENTS

CORRELATION ,,

1 - NUMBER OF FRUITS PER PLANT
2 - Wt. OF INDIVIDUAL FRUIT
3 - LENGTH OF MAIN VINE
4 - NUMBER OF FEMALE FLOWERS
5 - NUMBER OF PRIMARY BRANCHES
6 - DAYS FOR MATURITY
7 - NODE AT WHICH FIRST FEMALE FLOWER APPEARED
8 - LENGTH OF FRUIT
9 - GIRTH OF FRUIT
10 - FLESH THICKNESS
11 - NUMBER OF SEEDS
12 - 100 SEED WEIGHT
13 - YIELD PER PLANT
X - RESIDUAL FACTORS

coefficient analysis may be misleading in finding out the major components, unless the volume of the effect is not determined. The residual factor analysis gives the magnitude of the effect of the causes under study and the effect of external factors, which could not be taken into consideration.

The residual factor analysis of the three sets, viz., first order components and the two sets of second order components, exhibited the value +0.12786, +0.39463 and +0.38951.

DISCUSSION

DISCUSSION

Selection of desirable genotypes is a basic necessity in any plant breeding programme. But a genotype is expressed only through its phenotype and so the measurement and break up of phenotypic variation becomes inevitable for selection.

Of the various estimates of quantitative variability, mean, range and variation around the mean are the very basic ones. Success in genetic improvement of a crop depends upon the extent of genetic variability present. In the present study, the range of variation for almost all characters is large, especially for node at which first female flower appeared, number of female flowers, length of main vine, number of primary branches, number of fruits per plant, length of fruit, girth of fruit, weight of individual fruit, number of seeds, vitamin C content, crude protein per cent, percentage P and per cent ash content. The range of variation observed in yield per plant is also appreciable (Table 3). This means that there is scope for selection within the available population for most of the characters studied. The works carried out by Mehrotra and Dixit (1973) in brinjal, Kirti Singh et al. (1974) in bhindi and Thakur and Nandpuri (1974) in watermelon have shown that a wide range of variation was present for most of the characters considered, in these crops.

The break up of the phenotypic variation gives the environmental variance and the genotypic variance. Estimates of variance components obtained for the 21 characters in the present study have shown that very high phenotypic and genotypic variances are present for vitamin C content, crude fibre per cent, crude protein per cent, per cent ash content, percentage P, percentage K, length of fruit, girth of fruit, weight of individual fruit and number of seeds per fruit (Table 5). In bhindi, Kirti Singh et al. (1974) reported high estimates of phenotypic and genotypic variance for the chemical constituents and other characters of fruit.

Variance estimates have also shown that variations observed in most of the characters are mainly due to genetic causes, because of the predominance of genotypic variance over the environmental variance. Similar findings were made by Rao et al. (1977) in bhindi and Arya and Saini (1977 a) in chilli.

In order to get a clear picture of the genetic variability, the genetic coefficient of variation has to be estimated. The values of genetic coefficient of variation (vide Table 6 and Fig.4) have revealed that yield per plant, weight of individual fruit, number of female flowers per plant, vitamin C content, crude protein per cent percentage P and per cent ash content had high estimates (above 20 per cent). This intimates the possibility of these characters being utilised in the crop improvement programmes. Reports by Kirti Singh et al. (1974) in bhindi, Pande et al. (1975) in cluster bean, Parthasarathy et al. (1976) in tomato, Mishra and Roy (1976) in brinjal, Arya and Saini (1977 a) in chilli and Lakshmi and Goud (1977) in cowpea can be cited in support of the above findings.

Characters having moderate estimates of genotypic coefficient of variation (10-20 per cent) were length of main vine, number of primary branches, number of fruits per plant, length of fruit, girth of fruit, number of seeds per fruit, crude fibre per cent and percentage K. The other characters like days for opening of first male flower, days for opening of first female flower, node at which first female flower appeared, days for maturity, flesh-thickness and 100-seed weight have only low values of genotypic coefficient of variation and therefore offer little scope for selection.

According to Gandhi *et al.* (1964), the amount of variation that is heritable cannot be ascertained with the help of genotypic coefficient of variation alone. Burton (1952) had suggested that genotypic coefficient of variation together with heritability estimates would give the best picture of the amount of progress to be expected by selection. In the present investigation, most of the characters had high heritability. The characters like number of female flowers per plant, vitamin C content, crude protein per cent, percentage P and per cent ash content had given high genetic coefficient of variation coupled with high heritability estimates. Similar results have been reported by Nandpuri and Kumar (1973) in Chilli, Srivastava and Sachan (1973) in brinjal, Srivastava and Srivastava (1976) in bitter gourd and Arya and Saini (1977 b) in capsicum.

Yield per plant had a low heritability of 45.90 per cent. Kirti Singh *et al.* (1974) also observed a low heritability value of 33.06 per cent for yield in bhindi. The lowest estimate of heritability was noted for number of fruits per plant (26.09 per cent). Lakshmi and Goud (1977) reported similar finding in cowpea.

Johnson *et al.* (1955 a) in their studies with soybean have suggested that heritability estimates along with genetic gain (genetic advance in percentage of mean) is more useful than the heritability alone in predicting the resultant effect for selecting the best individuals.

The estimates of expected genetic advance in absolute values have made it clear that by selecting five per cent superior plants from the available population, it would be possible to improve the yield by 1.97 kg per plant, number of female flowers per plant by 15.82, length of main vine by 0.70 metres, number of primary branches by 1.46, length of fruit by 26.10 cm, girth of fruit by 5.56 cm, weight of individual fruit by 201 g, flesh-thickness by 1.03 mm and number of seeds by 15.99 per fruit. The values of expected genetic advance of other morphological characters were not appreciable. Among the chemical constituents of fruits, vitamin C content showed an improvement of 5.25 mg, crude protein by 5.02 per cent, phosphorus content by 0.13 per cent, potassium content by 0.63 per cent and ash content by 4.51 per cent.

The biochemical characters like per cent ash content (56.92 per cent), crude protein per cent (55.52 per cent) percentage P (55.12 per cent) and vitamin C content (41.39 per cent) had high values of genetic gain. Among the morphological characters, the highest value was exhibited by number of female flowers per plant (47.62 per cent) followed by weight of individual fruit (46.77 per cent). These characters were observed to have high heritability values also, which may be attributed to the additive gene effects (Panse, 1957) and as such, these traits can be improved through straight selection. By selecting five per cent superior plants from the available material, it is possible to improve the various characters to that percentage as indicated by the genetic gain estimates. The reports by Nandpuri et al. (1971) in chilli, Kirti Singh et al. (1974) in bhindi and Srivastava and

Srivastava (1976) in bitter gourd are in line with the present result.

Length of fruit, number of seeds per fruit, yield per plant, girth of fruit and crude fibre per cent also had promising values of genetic gain (30 to 40 per cent) and therefore, selection can be effectively practiced for these traits also. However, characters such as 100-seed weight, flesh-thickness and days for maturity which had high heritability and low genetic gain may be attributed to the action of non-additive genes (Panse, 1957) and selection has only limited scope for improving these traits. Johnson _et al._ (1955 a) while working in soybean had pointed out that high heritability need not be accompanied by high genetic gain estimates.

The comparison of available population for different economic characters has revealed that the type T.A.19 was the highest yielder, followed by T.A.13, T.A.14 and T.A.18. For early fruiting, the types T.A.4, T.A.8, T.A.21 and T.A.20 can be recommended whereas for early maturity of the fruits, T.A.6, T.A.5, T.A.2 and T.A.23 were found to be good. The types T.A.3, T.A.5, T.A.18 and T.A.2 had comparatively fewer number of seeds and the types T.A.20, T.A.17, T.A.4 and T.A.22 were low in the crude fibre content of the fruits. The fruits of T.A.10, T.A.12, T.A.3 and T.A.25 were richer in vitamin C content while the protein content was higher in the types, T.A.4, T.A.1, T.A.19 and T.A.2.

Thus it is evident that different types carry superiority with respect to different characters. So there is possibility of bringing together the high expression of the desirable traits into a variety which is high yielding, by effective hybridization of the desirable genotypes. The high variability in yield observed in the different types offers scope of exploiting hybrid vigour by crossing the distantly related individuals.

In the case of a complex character like yield which is influenced by many other traits, it is necessary to have simultaneous progress in as many contributary characters as possible, while breeding is attempted. Therefore, the knowledge of the association between yield and its attributes becomes a necessity. The simple correlation study is inadequate to measure the association, as different genotypes are susceptible to environment to varying degrees. Robinson et al. (1951) pointed out that the estimations of genotypic and phenotypic correlations are useful in crop improvement programmes. Genotypic correlation coefficients provide a measure of the genotypic association between the characters and reveal the characters that may be useful.

The phenotypic and genotypic correlations of most of the traits with yield worked out to be significant in the present study. The genotypic correlation coefficients were in general higher than the phenotypic values. This means that there is a strong inherrent relationship between yield and the characters under study; but their expression is impeded by the influence of environmental factors. The observations of Srivastava and Srivastava (1976) in bitter gourd corroborates with this finding.

Yield is the end product of interaction of many factors. The association analysis in the present study has revealed that yield was highly associated with number of primary branches, days for opening of first female flower, weight of individual fruit, length of fruit and girth of fruit. The high association of weight of individual fruit, length of fruit and girth of fruit with yield was logical. But the contributions of number of primary branches and days for opening of first female flower need physiological explanation. Perhaps, these traits may be enhancing the number of leaves and as such, the photosynthetic efficiency. Increased photosynthetic efficiency will result in increased dry matter accumulation and finally the economic yield. The reports of Thamburaj (1973) in ridge gourd, Kumar et al. (1976) in cowpea and Ramachandran (1978) in bitter gourd are in line with this observation.

Association of yield and its components alone is not adequate in selection programmes. A knowledge of the interrelationship among the yield components is also important. Doku (1970) with reference to his work in cowpea had suggested that intercorrelations among the yield components should be estimated because in a breeding programme, rate of improvement of one component does not hinder the improvement in other components.

The intercorrelations estimated for the yield components in the present study have indicated that the correlations of (i) days for opening of first male flower with days for opening of first female flower and node at which first female flower appeared (ii) days for opening of first female flower with node at which first female flower appeared (iii) number of female flowers with number of fruits per plant (iv) number of primary branches with length of fruit and weight of individual fruit (v) length of main vine with girth of fruit and weight of individual fruit and (vi) weight of individual fruit with girth of fruit and length of fruit were positive and highly significant. Therefore simultaneous improvement of the traits in these different sets is possible through selection. The high values of correlation of (i) days for opening of first male flower with number of primary branches (ii) days for opening of first female flower with number of primary branches and length of fruit and (iii) node at which first female flower appeared with girth of fruit and weight of individual fruit, indicate that improvement in number of primary branches, length of fruit, girth of fruit and weight of individual fruit will be accompanied by a proportionate delay in flowering and fruiting. The correlation coefficient between number of female flowers per plant and flesh - thickness was high and negative which shows that improvement in one of the characters is likely to be at the cost of the other. Similar results were reported by Molokojodova (1971) in cucumber, Khurana and Sadhu (1972) in soybean, Kirti Singh _et al_. (1972) in chilli, Kirta Singh _et al_. (1972) in bhindi and Srivastava and Srivastava (1976) and Ramachandran(1978) in bitter gourd.

The association analysis among the biochemical traits has revealed that they did not show significant intercorrelations, indicating that improvement of these traits has to be attempted individually.

Association of characters determined by correlation coefficients will not provide an exact picture of the relative importance of the direct and indirect influence of each of the characters towards yield. Path coefficient analysis provides a means of splitting the correlation coefficient into direct and indirect components. From the results of the path analysis given in Table 12, 13 and 14 and Fig.7 it is obvious that the direct effect of weight of individual fruit (+0.93560) on yield was higher than that of number of fruits per plant (+0.64372). The indirect effects of both these characters on yield were high and negative and therefore the total correlation coefficients of these characters with yield was only a part reflection of their direct effects as they were partly nullified by the indirect effects.

The path coefficient analysis of number of fruits per plant and its components has revealed that number of female flowers, days for maturity and number of primary branches exerted moderate positive direct effects on number of fruits and thereby on yield. The direct effect of node at which first female flower appeared (-0.50820) was negative and of the highest magnitude. The direct effect of length of main vine (-0.19295) was low and negative. Length of main vine, number of primary branches and days for maturity exhibited high negative indirect effects on number of fruits through node at which first female flower appeared.

However the indirect effects of number of female flowers through node at which first female flower appeared and node at which first female flower appeared through number of primary branches were high and positive.

Among the different components of weight of individual fruit, girth of fruit exerted the maximum direct effect (+0.88591) followed by 100-seed weight (+0.41933). The direct effects of length of fruit was low and positive whereas those of flesh-thickness and number of seeds per fruit were low and negative. The indirect effects of length of fruit via girth of fruit, flesh-thickness via girth of fruit, flesh-thickness via 100-seed weight and number of seeds per fruit via length of fruit were comparatively high and positive. 100-seed weight had fairly good negative indirect effect through girth of fruit.

From the foregoing discussion it is very evident that in snake gourd, weight of individual fruit, girth of fruit, number of fruits per plant and node at which first female flower appeared are the more important characters contributing to yield. The characters like length of main vine, number of primary branches, days for maturity, number of female flowers per plant, length of fruit, flesh-thickness and 100-seed weight are also important, as these traits indirectly influence the yield. But the estimates of heritability and genetic gain have revealed that characters like length of main vine, number of primary branches, days for maturity, flesh-thickness and 100-seed weight may not show improvement in selection. The results of path analysis studies by Tikka and Aswa (1975) in pea, singh and Mital (1976) in tomato, Korla and Rastogi (1977) in chilli and Ramachandran (1978) in bitter gourd corroborates with the findings of the present investigation.

The residual effects of the three sets viz., first order components and two sets of second order components exhibited the values +0.12786, +0.39463 and +0.38951, indicating that about 87, 60 and 61 per cent of yield, number of fruits and weight of individual fruit respectively were contributed by the characters considered for path analysis. Sengupta and Kataria (1971) obtained high residual effect (0.541) in their investigation on soybean and this was suggested to be due to sampling errors and other characters which were not considered.

On the whole, within the scope of the path analysis carried out in the present study, it can be concluded that greater emphasis has to be laid for improving weight of individual fruit, girth of fruit and number of fruits per plant which exerted positive and high direct effects. A reduction in the number of the node at which the first female flower appeared is also desirable as this trait is having a high negative direct effect. The importance of characters like number of female flowers per plant and length of fruit, cannot be ruled out as their direct effects are moderate and indirect effects are substantial. Therefore due consideration should be given for these characters also in selection programmes, for realising maximum yield.

SUMMARY

SUMMARY

Studies were undertaken with 25 diverse snake gourd types in the Department of Horticulture (Olericulture), College of Horticulture, Vellanikkara, during 1977-78 (December - April). The objectives were, to determine the extent of variability by estimating the various genetic parameters, to compute the extent of association of different characters with yield and among themselves by working out the correlation coefficients and to assess the direct and indirect effects of characters towards yield by analysing the path coefficients. The findings are summarised below.

1. The snake gourd types showed highly significant differences for all the 21 characters studied. A wide range of variation was also observed in most of the characters.

2. The estimates of phenotypic, genotypic and environmental variances have revealed that a large portion of the variation in all characters except number of fruits per plant was due to genetic factors.

3. The genotypic coefficient of variation estimated for different characters have shown that the major portion of total variation in most of the characters except days for opening of first male flower, days for opening of first female flower, node at which first female flower appeared, days for maturity, flesh-thickness and 100-seed weight, was due to genetic causes. Yield per plant had high estimate of genotypic coefficient of variation. Other characters which exhibited hign values of genotypic coefficient of variation were weight of individual fruit, number of female flowers per plant, vitamin C content, crude protein per cent, percentage P and per cent ash content.

4. Heritability in the broad sense was found to be quite high for most of the characters. Length of fruit had the highest heritability of 99.19 per cent, which was closely followed by girth of fruit (98.60 per cent) and vitamin C content (97.59 per cent). Yield per plant had comparatively low heritability of 45.90 per cent and the lowest estimate of heritability was noted for number of fruits per plant (26.09 per cent).

5. Genetic advance estimated in absolute values was found to be promising in number of female flowers per plant

(15.82), yield per plant (1.97 kg), length of main vine (0.70 metres), number of primary branches (1.46), length of fruit (26.10 cm), girth of fruit (5.56 cm), weight of individual fruit (201 g), number of seeds per fruit (15.99), flesh-thickness (1.03 mm), vitamin C content (5.25 mg/100g of fruit), crude protein per cent (5.02) and per cent ash content (4.51).

6. Estimate of genetic gain was highest for per cent ash content (56.92 per cent) followed by crude protein per cent (55.52 per cent), percentage P (55.12 per cent), number of female flowers per plant (47.62 per cent), weight of individual fruit (46.77 per cent) and vitamin C content (41.39 per cent). The genetic gain estimate of yield was 35.66 per cent.

7. Characters such as per cent ash content, crude protein per cent, percentage P, number of female flowers per plant, weight of individual fruit and vitamin C content which exhibited parallelism in the high estimates of heritability and genetic gain may be suggested to be due to the action of additive genes. Hence those characters can be improved straight away through selection. 100-seed weight, flesh-thickness and days for maturity were found to have high heritability and

low genetic gain which may be attributed to the action of non-additive genes. Therefore straight selection has only limited scope for improving these traits.

8. Comparison of the different snake gourd types has revealed that the type T.A.19 is the highest yielder followed by T.A.13, T.A.14 and T.A.18.

9. Correlation studies have shown that the phenotypic and genotypic correlations of most of the traits with yield were significant. The genotypic correlation coefficients were in general higher than the phenotypic values. Yield was highly associated with number of primary branches, days for opening of first female flower, weight of individual fruit, length of fruit and girth of fruit

10. Intercorrelations worked out in the present study have shown that the characters exhibiting significant association with yield per plant were also highly intercorrelated. Hence these characters can be simultaneously improved. The biochemical traits did not show significant intercorrelations, indicating that improvement of these traits has to be attempted individually.

11. Path coefficient analysis employed in the present investigations has revealed that weight of individual fruit, girth of fruit, number of fruits per plant and node at which first female flower appeared were the more important characters contributing to yield, on account of their high direct effects.

12. Length of main vine, number of primary branches, days for maturity, number of female flowers per plant, length of fruit, flesh-thickness and 100-seed weight were the characters having high indirect effects on yield. But the estimates of heritability and genetic gain point out that among these characters, only number of female flowers per plant and length of fruit can be improved through selection. These two characters have moderate direct effects also on yield.

13. The residual effects of the three sets viz. first order components and two sets of second order components exhibited the values +0.12786, +0.39463 and +0.38951, indicating that about 87, 60 and 61 per cent of yield, number of fruits and weight of individual fruit respectively were contributed by the characters considered for path analysis.

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* Originals not seen

APPENDIX - I

Meteorological data for the period from December 1977 to April 1978, when the crop was in the field (week wise)

Weeks			Temperature °C		Humidity (Maximum)	Rainfall (mm)
			Maximum	Minimum		
10.12.77	-	16.12.77	30.0	22.2	69	-
17.12.77	-	23.12.77	30.5	23.0	70.	-
24.12.77	-	31.12.77	31.2	20.3	80	-
1.1. 78	-	7. 1.78	32.0	21.9	79	-
8.1. 78	-	14. 1.78	31.4	20.9	80	-
15.1. 78	-	21. 1.78	31.4	19.1	76	-
22.1. 78	-	28. 1.78	32.6	21.9	77	-
29.1. 78	-	4. 2.78	33.3	21.5	78	-
5.2. 78	-	11. 2.78	34.1	22.4	83	-
12.2. 78	-	18. 2.78	34.9	22.2	83	-
19.2. 78	-	25. 2.78	34.4	22.1	87	5.8
26.2. 78	-	4. 3.78	34.8	22.5	74	-
5.3. 78	-	11. 3.78	36.0	24.0	84	-
12.3. 78	-	18.3. 78	35.2	23.4	89	-
19.3. 78	-	25. 3.78	35.8	24.1	90	-
26.3. 78	-	1. 4. 78	35.4	24.4	89	6.9
2.4. 78	-	8. 4.78	36.1	24.9	89	-
9.4. 78	-	15.4. 78	33.5	25.4	90	2.1

Source: Meterological observatory, District Agricultural Farm, Mannuthy.

Plate I. A general view of the experimental field, showing the method of training

Plate II. Field performance of the snake gourd type T.A. 19 (Highest yielder)


TA19

Plate III. Field performance of snake gourd type T.A.13

Plate IV. Field performance of snake gourd type T.A.14


TA13

Plate V. Field performance of snake gourd type T.A.21

Plate VI. Field performance of snake gourd type T.A.22


TA21


TA21

GENETIC VARIABILITY AND CORRELATION STUDIES IN SNAKE GOURD

(*Trichosanthes anguina* L.)

By

JOSEPH S PYNADATH

ABSTRACT OF A THESIS

Submitted in partial fulfilment of the

requirement for the degree of

MASTER OF SCIENCE IN HORTICULTURE

Faculty of Agriculture

Kerala Agricultural University

Department of Horticulture (Olericulture)

COLLEGE OF HORTICULTURE

VELLANIKKARA TRICHUR

1978

Studies were undertaken with 25 diverse snake gourd types in the Department of Horticulture (Olericulture), College of Horticulture, Vellanikkara, to estimate the genetic variability, correlation coefficients and path coefficients in the crop, during 1977-78.

The results have shown that the differences between the types were highly significant for all the 21 characters studied.

The estimates of variance components and coefficients of variation have indicated that the major portion of total variability in most of the characters was due to genetic causes. Heritability in the broad sense was found to be quite high for most of the characters but the heritability estimate of yield was only 45.90 per cent. The estimate of genetic gain has shown that by selecting five per cent superior plants from the available population, yield can be improved upto 35.66 per cent over the mean.

Characters such as per cent ash content, crude protein per cent, percentage P, number of female flowers per plant, weight of individual fruit and vitamin C content which exhibited parallelism in the high estimates of heritability and genetic gain may be suggested to be due to the action of additive genes and can be straightly improved through selection. The type T.A.19 was found to be the highest yielder.

Yield per plant was found to be highly associated with number of primary branches, days for opening of first female flower, weight of individual fruit, length of fruit and girth of fruit. The correlation coefficients among these yield components were also significant.

Path coefficient analysis has shown that weight of individual fruit, girth of fruit, number of fruits per plant and node at which first female flower appeared are the more important characters contributing to yield, on account of their high direct effects. Number of female flowers per plant and length of fruit are also important characters as their direct effects were moderate and indirect effects substantial.