BIOMETRICAL STUDIES IN ASH GOURD

(*Benincasa hispida* (Thumb.) Cogn.)

BY

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THESIS

Submitted in partial fulfilment of the requirement for the degree of

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Department of Olericulture

COLLEGE OF HORTICULTURE

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DECLARATION

I hereby declare that this thesis entitled 'BIOMETRICAL STUDIES IN ASH GOURD (*Benincasa hispida* (Thumb.) Cogn.)' 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,
6th, April, 1981.

(George, T.E.)

CERTIFICATE

Certified that this thesis is a record of research work done independently by Shri.George, T.E. 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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Introduction

INTRODUCTION

Ash gourd (Benincasa hispida (Thumb.) Cogn.) occupies a pride of place among fruit vegetables particularly in South India. Introduced to our country from Japan and Java by foreign navigators and emissaries, ash gourd is grown throughout the length and breadth of India. (Yawalkar, 1980). It is an important cucurbitaceous vegetable grown for its fruits which are used in confectionary and in ayurvedic medicinal preparations. The immature fruit is cooked as a vegetable, but when ripe it is used for preparing sweet meats known as 'petha' and 'pethamash cakes'. The 'kushmandarasayanam' an ayurvedic nerval tonic is prepared from the immature fruits of small types of ash gourd.

In spite of the economic importance of this vegetable in our country, very little attempt has so far been made to improve this crop. The genotypes that are under cultivation at present are non-descript ones. Yield in ash gourd remains low due to conglomeration of reasons, both genetic and environmental. Poor genetic stocks, inadequate and improper management practices and incidence of many parasitic and non parasitic diseases are the main causes for low yield. Formulation of an appropriate and effective breeding strategy is the need of the present time.

The success of any breeding programme aimed at evolving high yielding ash gourd varieties with superior quality fruits, depends mainly on the extent of available genetic variability. In selecting one elite genotype one should be reasonably sure that there is a good chance of superiority of selection being inherited by the progenies. This can be ascertained by partitioning the total variability into heritable and non heritable with the aid of appropriate statistical methods. The choice of breeding method either selection or hybridization depends on the type of gene action governing the polygenic character(s) under improvement. Information on heritability of polygenic characters, relation among yield and yield contributing characters and estimates of efficiency of straight selection over selection through discriminant function, if any, and vice-versa are all pre-requisites to formulate such a successful breeding strategy.

In ash gourd only a meagre work has been so far attempted in these directions. Therefore the present investigations were undertaken with the following objectives.

To catalogue the available ash gourd genotypes

To find out the extent of genetic variability with respect to yield, length of main vine, weight of first mature fruit and their possible components

To estimate heritability and genetic advance in the next generation of selection for different quantitative characters

To study the extent of association among yield, length of main vine, weight of first mature fruit and their possible components, by estimating phenotypic and genotypic correlation coefficients

To determine the direct and indirect effects of component characters on yield, length of main vine and weight of first mature fruit by utilizing path coefficient analysis

To find out the efficiency of selection through discriminant function over straight selection or vice-versa.

Review Of Literature

REVIEW OF LITERATURE

Eventhough the information on variability studies are abundant in many of the vegetable crops, the amount of work done on cucurbits particularly ash gourd is very limited and scanty. The available literature on variability studies in cucurbits are reviewed under the following heads

A Genetic variability

B Heritability and genetic advance

C Correlations among polygenic characters

D Path coefficient analysis

E Discriminant function analysis

A Genetic variability

Thakur and Nandpuri (1974) studied on variability in 25 varieties of water melon (Citrullus lanatus (Thumb.) Mansf.). They reported significant differences among the varieties for yield/plant, fruit weight, fruits/plant, fruits free from blossom end rot, days taken to first picking, length of vine, branches/plant, sex ratio, total soluble solids, seeds/kg of fruit weight and 100-seed weight. Both phenotypic coefficient of variation and genotypic coefficient of variation were maximum for seeds/kg of fruit weight.(g.c.v. = 41.31) and minimum for days to first picking,(g.c.v. = 16.46). Vashista *et al.*, (1975) recorded variability in seed characters of watermelon. Data on seed length, seed width, 100-seed weight and seed colour indicated considerable variability for all the above characters. Sidhu *et al.*, (1977) reported that both additive and dominant genetic variances were important for nodes produced before the appearance of first female flower, days to maturity of first fruit, fruit yield/plant, fruits/plant, weight of flesh/fruit, average fruit weight,total soluble solids, seed numbers/kg of flesh and 100-seed weight with dominant variance predominating for the first two characters in watermelon.

In cucumber (*Cucumis sativus* L.), Miller and Quisenberry (1976) reported that variance was primarily due to additive gene action for early flowering. Partial dominance type of gene action was reported for early flowering and low nodal position of the first female flower. Smith *et al.*, (1978) observed that the variance components for fruits/plant, fruit weight, fruit size, length to diameter ratio, fruit firmness and carpel wall thickness were additive in cucumber. Genotype x environment interaction variances were high for fruits/plant, length to diameter ratio and fruit firmness. Solanky and Seth (1980) working on 24 varieties of cucumber, reported considerable amount of phenotypic and genotypic variability for characters like plant height, leaves/plant, male flowers/plant, days to maturity and female flowers/plant.

Kalyanasundaram (1976) observed significant differences among three varieties of muskmelon (Cucumis melo), Annamali, Hara Madhu and Arka Rajhans for branches/plant, hermophrodite flowers/vine, percentage of hermophrodite flowers, fruit weight, fruits/plant, fruit cavity diameter, flesh thickness and seeds/fruit. The variance for days to maturity and total soluble solids were not significantly different among the three varieties. Singh et al., (1976) reported that the additive component of total genetic variance was high for days to opening of the first female flower, picking maturity, fruits/vine and total soluble solids in muskmelon. Dominance component of genetic variance was high for fruit weight, flesh thickness and total yield.

Kubiaki and Walezak (1976) reported large differences within and between varieties with respect to β carotene content in 19 varieties belonging to Cucurbita pepo, Cucurbita maxima and Cucurbita moschata. The variety Golden Delicious of Cucurbita maxima recorded the highest carotene content. Mangal et al.,

(1979) studied on the variability of 20 cultivars and selections of pumpkin (Cucurbita moschata Poir.) with respect to four characters - plant height, days from flower opening to maturity, fruits/plant and yield. The highest yield was obtained from Rajasthan local. Gopalakrishnan (1979) worked on 18 pumpkin types. The 18 types differed significantly with respect to all the 32 characters studied, days to first female flower anthesis, days to first male flower anthesis, node at which first female flower appeared, node at which first fruit is retained, length of main vine, primary branches/plant, thick branches/plant, internodal length, internodal circumference, leaves/plant, leaf area/plant, male flowers/plant, female flowers/plant, percentage of female flowers, average fruit weight, weight of first mature fruit, fruits/plant, percentage of fruit set, circumference of fruit, length of fruit, fruit shape index, flesh thickness, seeds/fruit, 100-seed weight, fruit yield/plant, protein content, phosphorus content, potassium content, calcium content, total soluble solids and carotene content. The range for fruit yield/plant varied from 5.45 kg to 16.10 kg. The maximum value of genotypic coefficient of variation was observed for male flowers/plant (56.23) followed by fruits/plant (50.32).

Srivastava and Srivastava (1976) studied variability in 10 lines of bitter gourd (Mormordica charantia L.) and obtained significant differences for all the characters except for male flowers/plant. The highest genotypic coefficient of variation (37.45) was observed for fruits/plant followed by yield/plant (32.13) and weight of fruit (30.02). Singh et al., (1977) reported among 20 bitter gourd varieties, high genotypic coefficient of variation was for fruit yield followed by fruits/plant and fruit length. Ramachandran (1978) studied 25 bitter gourd types for 21 characters, primary branches/plant, length of main vine, node at which first female flower appeared, days to opening of the first female flower, female flowers/plant, percent of female flowers, days to picking maturity, yield/plant, fruits/plant, fruit weight, length of fruit, girth of fruit, flesh thickness, seeds/fruit, 100-seed weight, T.S.S. vitamin C content, protein content, phosphorus content, potassium content and iron content. The 25 bittergourd gourd types differed significantly for all the 21 characters studied. The highest estimates of genotypic and phenotypic coefficients of variation were observed for yield/plant (39.88 and 39.82 respectively). Vitamin C content, and fruits/plant had high phenotypic and genotypic coefficients of variation well above 30%. The lowest estimate of variability was observed for girth of fruit (p.c.v. = 7.77; g.c.v. = 7.07)

Joseph (1978) worked on 25 snake gourd (Trichosanthes anguina L.) types. The 25 types he studied were significantly different for all the 21 characters studied, days to male flower anthesis, days to female flower anthesis, node at which first female flower appeared, female flowers/plant, length of main vine, primary branches/plant, fruits/plant, yield/plant, days to maturity, length of fruit, girth of fruit/average fruit weight flesh thickness, seeds/fruit, 100-seed weight, vitamin C content, crude fibre, crude protein, ash content, phosphorus and potassium contents. The genotypic coefficient of variation was maximum for phosphorus content (29.55) followed by weight of individual fruit (28.69) and minimum for days to opening of first male flower (3.16).

3 Heritability and Genetic advance

In watermelon Suzuki (1938) reported high estimates of heritability for seed size, T.S.S. content and fruit weight, and intermediate values for leaves/plant, days to first male flower anthesis and rind thickness. Thakur and Nandpuri (1974) reported a heritability estimate of 92.92% for 100-seed weight and

84.97% for seeds/kg of fruit in watermelon. The minimum heritability estimate of 25.95% was observed for branches/plant. The maximum genetic advance was observed for seeds/kg of fruit weight (83.75%) resulting from the highest variability estimate associated with higher estimate of heritability. The lowest estimate of genetic advance was observed for days to first picking (5.78%) resulting from lower estimates of heritability and variability. Brar and Nandpuri (1978) found that heritability in broad sense was medium (48.92%) and in narrow sense quite low (23.64%) for yield in watermelon. This indicated that in watermelon, yield is a complex character more influenced by environment. The heritability in broad sense was higher (72.29%) and in narrow sense was medium (66.90%) for fruit number, indicating the major role of genotypic and additive genetic variance in the inheritance of fruit number. Sidhu et al., (1977) recorded highest estimate of heritability (96.3%) for seeds/kg of flesh followed by 100-seed weight (76%), flesh weight (38%) and nodes produced before the appearance of the first female flower (35.6%).

In cucumber, Miller and Quisenberry (1976) reported that days to opening of the first female flower was controlled by relatively a few genes and heritability for this trait was moderately high. Mc Creight (1977) studied heritability estimates of fruit sugar concentration in a population of 501 cucumber types. Estimate of heritability in narrow sense calculated through half sib family variance method was observed to be 0.03. The heritability estimate, calculated through parent offspring regression analysis was found to be 0.04. The expected genetic gain in altering sugar concentration per cycle of half sib progeny testing was observed 0.21 mg. reducing sugar per gram fresh weight. Smith and Lower (1977) estimated heritability for commercial value and fruit number from full sib families of cucumber grown in two replicates and environments to be 0.14% and 0.02% respectively. Imam *et al.*, (1977) studied the inheritance of certain cotyledonory leaf characters and fruit characters in cucumber. They reported that the heritability ranged from 56.4% for leaf width to 61.36% for leaf surface area in the case of leaf characters. With respect to fruit characters, heritability ranged from 15.34% for fruit diameter to 59.22% for fruit shape index. Solanky and Seth (1980) after studying the genetic variability and heritability of 24 varieties of cucumber reported that a large portion of phenotypic variability was genetic and highly heritable in many of the characters studied. Association of high heritability with high genetic advance for plant height, leaves/plant, male flowers/plant, female flowers/plant, internodal distance, days to maturity and fruit yield suggested additive effects.

Kubiaki and Walezak (1976) studied variability and heritability of carotene content in a few Cucurbita spp. The β carotene content and T.S.S. recorded high heritability estimates. The inbred lines developed through selfing and selection, recorded 70%, 50% and 20% more β carotene when the parental populations were Melonowa Zolta, Golden Delicious and Nagydobos Sutolok respectively. Gopalakrishnan (1979) studied in detail the heritability and expected genetic advance for 32 characters in pumpkin. Among the yield and its component characters the highest estimate of heritability was obtained for male flowers/plant (99.14%) followed by per cent of female flowers (97.77%) and female flowers/plant (97.45%). The lowest heritability estimate was noted for per cent of fruit set (76.97%). Fruit yield/plant has moderate estimate of heritability (88.84%). The highest value of genetic advance as per cent of mean was observed for male flowers/plant (115.33) followed by fruits/plant (98.82). Days to first female flower anthesis recorded the lowest estimate of genetic advance (12.19). Among the component characters of length of main vine, leaves/plant had the highest estimate of heritability (98.26%) and thick branches/plant, the lowest (57.9%). Leaf area/plant recorded the highest value of expected genetic advance (70.71%) and internodal circumference recorded the lowest expected genetic advance (14.03). Among the weight of first mature fruit and its component characters, carotene content had the maximum value of expected genetic advance as per cent of mean (93.75) resulting from the highest heritability estimate (99.76%). The lowest value of genetic advance was for flesh thickness (24.00). Among the chemical constituents, phosphorus content recorded the highest estimate of heritability (98.61%) and calcium content, the lowest (88.16%). Potassium content recorded the highest value of expected genetic advance (62.11) and calcium content recorded the lowest expected genetic advance (17.38).

Prasad and Prasad (1979) worked on 40 genetically diverse lines of bottle gourd. They recorded high estimates of heritability for vine length (98.4%), fruit length (98.03%) and fruit diameter (96.27%). Maximum value of genetic advance was found for fruit thickness (78.99%) and fruit length (78.2%).

Panwar _et al._, (1977) studied 40 varieties of sponge gourd (_Luffa cylindrica_ Roem.) to estimate heritability and expected genetic advance. Fruit length and days to flower had higher estimates of heritability and expected genetic advance.

In bitter gourd, Srivastava and Srivastava (1976) reported that fruits/plant had the highest estimate of genetic advance (71.73%) resulting from the highest estimate of variability (g.c.v = 37.45%) and heritability (99.31%). High heritability associated with moderate variability resulting in high genetic gain was observed for fruit weight, yield/plant and length of fruit. Singh et al., (1977) observed high estimate of heritability and expected genetic advance for fruit yield, fruits/plant and fruit length in bitter gourd. Ramachandran (1978) reported that fruits/plant had the highest heritability of 99.80% which was closely followed by yield/plant (99.74%). The lowest heritability was for seeds/plant (99.6%). Genetic advance estimated as per cent of mean was found to be the highest for yield/plant (81.92%) followed by Vitamin C content (70.72%), fruits/plant (64.30%) and female flowers/plant (53.8%). High variability associated with high heritability resulting in high expected genetic advance was observed for fruit yield, vitamin C content, fruits/plant, female flowers/plant, iorn content and phosphorus content. The heritability estimates were observed to be higher for days to opening of the first female flowers (98.5%), per cent of female flowers (96.17%), girth of fruit (82.7%) and 100-seed weight (70.79%), but the genetic gain was observed low due to low estimate of variability for the above characters.

Joseph (1978) reported that the heritability in broad sense was quite high for many of the characters he studied in snake gourd. Length of the fruit had the highest heritability of 99.19% which was closely followed by girth of fruit (98.60%) and vitamin C content (97.59%). The lowest estimate of heritability was for fruits/plant (21.20%). The highest genetic advance as per cent of mean was observed for ash content (56.92%) followed by crude protein content (55.52%), phosphorus content (55.12%) female flowers/plant (47.62%) and fruit weight (46.77%). The expected genetic advance as per cent of mean was 435.66 for fruit yield.

C Correlations among polygenic characters

In watermelon, Khanna et al., (1969) found positive and significant correlation between T.S.S. and vitamin C content ($r = 0.84$). Tikka et al., (1974) reported that yield was positively correlated with main shoot length, number of primary laterals, days to first female flower anthesis, and average fruit weight in 10 varieties of watermelon.

Bohn and Andrews (1939) reported that fruit diameter was positively correlated with flesh thickness and cavity size in muskmelon. Selection for small cavity size alone would lead to reduced fruit size and flesh thickness. Lucille _et al_., (1939) observed high positive correlation between refractice index, a measure of total soluble solids, and vitamin C content in 16 American Varieties of muskmelon. Khanana _et al_., (1969) also found significant positive correlation between total soluble solids and vitamin C content in muskmelon varieties. Kalyanasundaram (1976) reported that fruit weight had positive significant correlation with fruit diameter, fruit size and flesh thickness in muskmelon. Size of fruit cavity had positive association with fruit diameter but had no relation with flesh thickness. Soluble solid content was negatively correlated with fruit weight and seeds/fruit. Singh and Nandpuri (1978) reported that days to fruit maturity was positively correlated with days to opening of first female flower, total soluble solids, fruit weight and total yield/plant in muskmelon. Fruits/vine was positively correlated with total soluble solids and total yield both phenotypically and genotypically. Phenotypically TSS showed positive correlation with fruit weight and total yield/vine, genotypically it has significant association only with total yield/vine. The fruit weight was positively correlated with flesh thickness and total yield/plant.

Flesh thickness was positively correlated with total yield both at genotypic and phenotypic levels.

In cucumber, Carlson (1962) observed that length of fruit was positively correlated with average fruit weight. Molocojedova (1962) reported that the correlation between fruit yield and the proportion of marketable fruits were positive and significant in cucumber. Ramaloa (1975) reported that the pistillate flowers/plant was positively correlated with fruit number, but negatively with fruit weight, length and fruit set in cucumber. The occurrence of pistillate flowers on the main stem was also found to be negatively correlated with total yield, number of fruits, fruit weight and fruit length. Imam <u>et al</u>., (1977) observed positive and significant correlation between fruit length and fruit diameter and between fruit diameter and diameter of seed cavity in cucumber. In pickling cucumber, Mc Creight <u>et al</u>., (1978) reported highly significant correlation between total carbohydrate concentration and reducing sugar content (r = 0.97). Smith <u>et al</u>., (1978) reported that fruit number was positively correlated, both genotypically and phenotypically with yield indicating that selection for more number of fruits would increase the yield of cucumber.

Gopalakrishnan (1979) in a detailed study on pumpkin found that fruit yield was significantly and positively correlated with length of main vine (r_g= 0.54), average fruit weight (r_g = 0.80) and weight of first mature fruit (0.73). Length of main vine was positively correlated with female flowers/plant (r_g = 0.54), nodes on main vine (r_g = 0.63) primary branches/plant (r_g = 0.6) leaves/plant (r_g = 0.93) and leaf area/plant (r_g = 0.86). Node at which the first female flower appeared had high positive correlation with node at which first fruit was retained (r_g = 0.76). Average fruit weight was positively correlated with weight of first mature fruit (r_g = 0.97) and negatively correlated with fruits/plant (r_g = - 0.77). Weight of first mature fruit was positively correlated with circumference of fruit (r_g = 0.75), length of fruit (r_g = 0.57), flesh thickness (r_g = 0.94) and seeds/fruit (r_g = 0.67). The correlations among carotene, phosphorus, calcium and T.S.S. content were not significant. A positive correlation was observed between potassium and carotene contents (r_g = 0.74).

In ridge gourd (Luffa acutangula Roxb.), Thamburaj (1973) reported seeds/pod, pod weight and pod length were significantly and positively correlated with yield/plant. Panwar et al., (1977) observed significant positive correlation between yield and fruits/plant.

Srivastava and Srivastava (1976) reported in bitter gourd that fruit yield/plant had positive association with female flowers/plant (r_g = 0.87), fruits/plant

(r_g = 0.86) and lateral branches/plant (r_g = 0.59). Female flowers/plant and lateral branches/plant were found positively associated with fruits/plant. Days to first female flower opening was observed negatively correlated with fruits/plant and female flowers/plant, but positively with fruit weight. Fruit weight has negative genotypic correlation with fruits/plant. A detailed correlation study by Ramachandran (1978) in bitter gourd revealed that phenotypic and genotypic correlations for any pair of characters were of comparable magnitude. Yield/plant was highly correlated with length of main vine, weight of fruit, length of fruit, fruits/plant, female flowers/plant and primary branches/plant. Characters exhibiting significant correlation with yield/plant, had showed high genotypic and phenotypic intercorrelation among themselves, which indicated that primary branches/plant, length of main vine, female flowers/plant, fruits/plant, fruit weight and fruit length could be simultaneously improved in bitter gourd.

Work done in snake gourd by Joseph (1978) has shown that fruit yield was highly associated with primary branches/plant (r_g = 0.82), days to opening of the first female flower (r_g = 0.75), average weight of fruit, (r_g = 0.77), length of fruit (r_g = 0.75) and girth of fruit (r_g = 0.68).

He also found that there was no intercorrelation among the biochemical traits, vitamin C content, crude fibre content, crude protein content, ash content, phosphorus content and potassium content. Thamburaj et al. (1978) obtained significant positive correlation between fruit length and weight of fruit (r_g = 0.67) in snake gourd. The association between length of fruit and girth of fruit was negative and significant (r_g = -0.63). Negative but non significant correlations existed between girth and weight of fruit (r_g = -0.14).

D Path coefficient analysis

In watermelon, Tikka et al. (1974) employed path coefficient analysis to find out the direct and indirect effects of yield components on fruit yield/plant. Days to first female flower anthesis and average fruit weight were observed to have the highest direct effects on yield.

Gopalakrishnan (1979) utilized path coefficient analysis to find out direct and indirect effects of components of fruit yield, length of main vine, weight of first mature fruit and carotene content. Length of main vine had the maximum direct effect (1.46) on fruit yield/plant followed by average fruit weight (1.33). Male flowers/plant and days to first male flower anthesis had high negative direct effects on yield (- 1.09 and - 1.21

respectively). Leaves/plant had the maximum positive direct effect on length of main vine (2.34) followed by internodal length (0.77). Primary branches/plant, thick branches/plant, internodal circumference and leaf area/plant had negative direct effects on length of main vine though they are positively correlated with length of main vine. Flesh thickness had the maximum value of positive direct effect on weight of first mature fruit (0.84). Seeds/fruit had a negative direct effect on weight of first mature fruit (-0.21). The potassium content had the maximum direct effect on carotene content (0.96). The other chemical constituents, protein, phosphorus, calcium and T.S.S. had negative direct effects on carotene content.

In bitter gourd, Srivastava and Srivastava (1976) reported that female flowers/plant had the maximum direct effect on yield (2.75) followed by fruits/plant (0.90) and lateral branches/plant (0.89). The indirect effects of other characters towards yield were mainly through lateral branches/plant, fruits/plant and female flowers/plant. Fruits/plant also had high indirect contribution towards yield through weight of fruit. Ramachandran (1978) found that fruit weight, fruits/plant and length of main vine had high positive direct effects on yield (0.55, 0.40, 0.30 respectively). Primary branches/plant, female flowers/plant and fruit length were found to have negative direct effects on fruit yield.

In snake gourd, path coefficient analysis was employed by Joseph (1978) to find out direct and indirect effects of components on fruit yield. Weight of individual fruit, fruit girth, fruits/plant and node at which first female flower appeared had high direct effects on fruit yield (0.94, 0.89, 0.64, 0.51 respectively). The path analysis of fruits/plant and its components indicated that female flowers/plant exerted moderate positive direct effects on fruits/plant and thereby on yield (0.26). Among the many components of weight of individual fruit, girth of fruit exerted the maximum direct effect followed by 100-seed weight (0.88, 0.42 respectively).

E. Discriminant function analysis

Gopalakrishnan (1979) utilized discriminant function analysis to estimate the efficiency of selection through discriminant function over straight selection of fruit yield/plant *per se*. Genetic advance through straight selection for yield/plant *per se* was higher than that calculated by discriminant function considering all combinations of component characters days to female flower anthesis, length of main vine, thick branches/plant, leaf area/plant, average fruit weight and flesh thickness.

Materials and Methods

MATERIALS AND METHODS

A field experiment for the estimation of genetic variability, correlations, path-coefficients and selection indices in ash gourd (Benincasa hispida (Thumb.) Cogn.) was conducted during 1979-80 (November-March) at the Instructional Farm of the College of Horticulture, Kerala Agricultural University, Vellanikkara. This station is located at an altitude of 23 meters above mean sea level and is situated between 10'32" N. latitude and 76'16" E. longitude. Geographically it falls in the humid tropical climatic zone. The meteorological data for the season under experimentation are appended (Appendix-1).

A. Materials

Thirty two ash gourd genotypes collected from different parts of Kerala and Tamil Nadu maintained in the department of Olericulture, College of Horticulture, Kerala Agricultural University were used for the study. The genotypes were diverse in their genetic make up. (Table 1).

B. Methods

The experiment was laid out in a randomised block design with three replications. There were three plants/ genotype/replication. The spacing adopted was 1.5 m between plants and width of each block was kept at 6m. In each pit, three seeds were sown, and only one plant was retained after thinning. During crop cultivation various cultural operations and prophylatic plant protection measures were done as recommended by Choudhary (1967).

C. Characters studied

Observations were recorded from the entire population and the average of each type in each replication was taken for further analysis. The following characters were studied in this experiment.

1. Earliness

   a Days to first female flower anthesis
   b Days to first male flower anthesis
   c Node at which the first female flower appeared
   d Node at which the first fruit is retained

2. Vegetative characters

   a Length of main vine (m)
   b Nodes on main vine
   c Primary branches/plant
   d Thick branches/plant. Branches having a diameter of 10 mm. or more were arbitarily fixed as thick branches

e Internodal length (cm). Length of 6th, 7th, 8th, 9th and 10th internodes were measured and average was taken

f Internodal circumference (cm). Circumference of 6th, 7th, 8th, 9th and 10th internodes were measured and average was taken

g Leaves/plant

3 Flower and Fruit characters

a Male flowers/plant

b Female flowers/plant

c Per cent of female flowers

d Average fruit weight (kg)

e Weight of first mature fruit (kg)

f Fruits/plant

g Percent of fruit set

h Circumference of fruit (cm)

i Length of fruit (cm)

j Fruit shape index. This was calculated as the ratio of fruit length to fruit diameter

k Flesh thickness (cm)

l Seeds/Fruit

m 100 - seed weight (g)

n Fruit yield/plant (kg)

4 Nutritive characters of fruit

a Protein content - The nitrogen content of the dried fruit flesh was estimated using the Micro-kjeldahl method (A.O. A.C., 1960). The protein content was obtained by multiplying the nitrogen content by 6.25 (Jackson, 1973) and expressed as per cent of dry weight

b Phosphorus content - This was estimated colorimetrically using the Vanadomolybdo phosphoric yellow colour method in nitric acid system (Jackson, 1973) and expressed as per cent of dry weight

c Potassium content - Potassium in an aliquote of the triple acid extract of the sample was determined using flame photometer (Jackson, 1973) and expressed as per cent of dry weight

Fruit characters, length of fruit, circumference of fruit, fruit shape index, flesh thickness, seeds/fruit, 100 - seed weight and the nutritive characters protein, phosphorus and potassium contents were recorded/estimated from the first mature fruit

D Statistical Analysis

The details of the statistical analysis followed in the present experiment are given below:

1 Analysis of variance

The data were first analysed for the analysis of variance as described by Ostle (1966) for a randomised block design. (Table 2). The model utilised in the analysis of this design is

$$Yij = \mu + bi + tj + eij,$$

$$i = 1, \ldots\ldots\ldots\ldots\ldots 3$$

$$j = 1, \ldots\ldots\ldots\ldots\ldots 32$$

Where, Yij = Performance of jth genotype in ith block

μ = general mean

bi = true effect of 'i'th block

tj = true effect of 'j'th genotype and

eij = error component of the ijth observation

2 Estimation of variability, heritability, genetic advance and genetic gain

Variability existing in the fruit yield and yield contributing characters, length of main vine and its contributing components and weight of first mature fruit and its possible components were estimated as suggested by Burton (1952). The formulae used in the estimation of variability at genotypic and phenotypic levels are as follows

Table 2. Analysis of variance of the design

Sources of variation	d.f.	Mean squares	
		Observed	Expected
Total	95		
Between replications	2	M_1	
Between genotypes	31	M_2	Error variance + number of replications x genotypic variance
Experimental error	62	M_3	Error variance

a Genotypic coefficient of variation

$$(g.cv.) = \frac{\text{Genotypic standard deviation}}{\text{Mean}} \times 100$$

b Phenotypic coefficient of variation

$$(p.c.v.) = \frac{\text{Phenotypic standard deviation}}{\text{Mean}} \times 100$$

The above two estimates - genotypic and phenotypic standard deviations - were obtained by solving the following equations from the respective analysis of variance table for different characters.

$$\text{Genotypic variance} = \frac{M2 - M3}{\text{Number of replications}}$$

$$\text{Phenotypic variance} = \text{Genotypic variance} + \text{Error variance}$$

C Heritability

Heritability is the potentiality of an individual to inherit a particular character to its offspring. In broad sense, it is equivalent to the total genotypic variance divided by the total phenotypic variance and is expressed in percentage. The heritability in the broad sense was estimated as suggested by Burton and Devane (1953)

$$h^2\ (b) = \frac{\text{Genotypic variance}}{\text{Phenotypic variance}} \times 100$$

D 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 expected genetic advance of the available germplasm at 5% intensity of selection was calculated as suggested by Lush (1949) and Johnson et al., (1955) using the constant (i) as 2.06 as given by Allard (1960).

GA = $h^2 \times \sigma p \times$ 'i' where σp refers to phenotypic standard deviation and 'i' to intensity of selection.

E 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., (1955) was used

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

Where G.A. = Genetic advance

$\bar{X}$ = Mean of character

3 Estimation of correlations

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.

Correlations between yield and its components, length of main vine and its components and weight of first mature fruit and its compenents were calculated at genotypic and phenotypic levels by substituting the genotypic and phenotypic covariances and variances in the formulae suggested by Searle (1961).

a Genotypic correlation between characters x and y

$$r_{xy}(g) = \frac{Cov_{xy}(g)}{[Var._x(g).\ Var._y(g)]^{\frac{1}{2}}}$$

b Phenotypic correlation between characters x and y

$$r_{xy}(p) = \frac{Cov_{xy}(p)}{[Var._x(p).\ Var._y(p)]^{\frac{1}{2}}}$$

Where, $COV_{xy}(g)$ = Genotypic covariance between characters x and y

$COV_{xy}(p)$ = Phenotypic covariance between characters x and y

$Var._x(g)$ = Genotypic variance for character x

$Var._x(p)$ = Phenotypic variance for character x

$Var._y(g)$ = Genotypic variance for character y

$Var._y(p)$ = Phenotypic variance for character y

4 . Path coefficient analysis

In a closed system of "cause and effect" variables, fruit yield was considered as the effect factor and casual variables were length of main vine, female flowers/plant, average fruit weight and weight of first mature fruit.

The length of main vine was considered as the effect factor in a similar closed system of "cause and effect" variables, the causal variables being the node at which first female flower appeared, nodes on main vine, internodal circumference and leaves/plant.

The weight of first mature fruit was also considered in a similar closed system of "cause and effect" variables, the causal variables being the circumference of fruit, length of fruit, flesh thickness, seeds/fruit, 100-seed weight, and potassium content.

The estimates of direct and indirect effects in such a closed system of variables were calculated by the path coefficient analysis as suggested by Dewey and Lu (1959). The following set of simultaneous equations were formed and solved for estimating the various direct and indirect effects.

$$r_{iy} = P_{iy} + r_{12}P_{2y} + r_{13}P_{3y} + r_{14}P_{4y} + \ldots r_{ik}P_{ky}$$

$$r_{2y}=P_{2y}+r_{21}P_{1y}+r_{23}P_{3y}+r_{24}P_{4y}+\ldots\ldots+r_{2k}P_{ky}$$

$$r_{3y}=P_{3y}+r_{31}P_{1y}+r_{33}P_{2y}+r_{34}P_{4y}+\ldots\ldots+r_{3k}P_{ky}$$

$$r_{4y}=P_{4y}+r_{41}P_{1y}+r_{42}P_{2y}+r_{43}P_{3y}+\ldots\ldots+r_{4k}P_{ky}$$

$$\vdots$$

$$r_{ky}=P_{ky}+r_{k1}P_{1y}+r_{k2}P_{2y}+r_{k3}P_{3y}+\ldots\ldots r_{k(k-1)}P_{(k-1)y}$$

Where, r_{1y} to r_{ky} denote coefficient of correlation between independent characters 1 to k and dependent character y. r_{12} to $r_{k(k-1)}$ denote co-efficient of correlation among all possible combinations of independent characters; and P_{1y} to P_{ky} denote direct effects of characters 1 to k on character y.

The above equations can be written in a matrix form as given below.

$$\begin{pmatrix} r_{1y} \\ r_{2y} \\ r_{3y} \\ r_{4y} \\ \vdots \\ \vdots \\ \vdots \\ r_{ky} \end{pmatrix} = \begin{pmatrix} 1 & r_{12} & r_{13} & r_{14}\ldots\ldots r_{1k} \\ & 1 & r_{23} & r_{24}\ldots\ldots r_{2k} \\ & & 1 & r_{34}\ldots\ldots r_{3k} \\ & & & 1 \quad \ldots\ldots r_{4k} \\ & & & \vdots \\ & & & \vdots \\ & & & \vdots \\ & & & 1 \end{pmatrix} \begin{pmatrix} P_{1y} \\ P_{2y} \\ P_{3y} \\ P_{4y} \\ \vdots \\ \vdots \\ \vdots \\ P_{ky} \end{pmatrix}$$

Path coefficients were obtained by replacing the corresponding elements in A and B matrices by phenotypic correlation coefficients.

Residual factor (P_{xy}) which measures the contribution of rest of the characters not considered in the causal scheme was obtained as follows:

$$\text{Residual factor } (X),\ P_{xy} = (I-R^2)^{\frac{1}{2}}$$

$$\text{Where } R^2 = \sum_{i=1}^{k} P_{iy}^2 + 2 \sum_{\substack{i,\ j=1 \\ i \neq j \\ i<j}}^{k} P_{iy}\, P_{jy} r_{ij}$$

7 Estimation of selection indices

The statistical methods suggested by Smith (1936) and Robinson et al., (1951) were used for constructing selection indices and computing genetic advance. A series of selection indices were obtained by discriminant function analysis using different combination of component characters. The component characters were length of main vine, female flowers/plant, average fruit weight and weight of first mature fruit. These characters were selected based on the relative magnitude of positive direct effects on fruit yield/plant.

In the method suggested by Smith (1936), the following set of simultaneous equations were solved to obtain weights in the selection index based on the component characters of yield.

$$b_1t_{11}+b_2t_{12}+b_3t_{13}+\ldots+b_kt_{1k} = a_1G_{11}+a_2G_{12}+a_3G_{13} + \ldots\ldots\ldots\ldots a_kG_{1k}$$

$$b_1t_{21}+b_2t_{22}+b_3t_{23}+\ldots+b_kt_{2k} = a_1G_{21}+a_2G_{22}+a_3G_{23} + \ldots\ldots\ldots\ldots a_kG_{2k}$$

$$b_1t_{31}+g_2t_{32}+b_3t_{33}+\ldots+b_kt_{3k} = a_1G_{31}+a_2G_{32}+a_3G_{33} + \ldots\ldots\ldots\ldots a_kG_{3k}$$

$$b_1t_{k1}+b_2t_{k2}+b_3t_{k3}+\ldots+b_kt_{kk} = a_1G_{k1}+a_2G_{k2}+a_3G_{k3} + \ldots\ldots\ldots\ldots a_kG_{kk}$$

Where t_{ii} represent phenotypic variances and covariances G_{ii} represent genotypic variances and co-variances; a_i represent economic values and b_i represent the unknown weights.

Genetic advance by discriminant function

$$G.A.(D) = \frac{(i)\Sigma\Sigma ai\ bj\ Gij}{(\Sigma\Sigma bi\ bj\ tij)^{\frac{1}{2}}}$$

where 'i' denotes the intensity of selection when top 5% of the population is selected.

In the method suggested by Robinson et al., (1951) the following set of simultaneous equations were solved to obtain weights in the selection index based on yield and the independent component characters

$$b_1t_{11} + b_2t_{12} + b_3t_{13} + \ldots\ldots b_kt_{1k} + b_yt_{1y} = g_{1y}$$

$$b_1t_{21} + b_2t_{22} + b_3t_{23} + \ldots\ldots b_kt_{2k} + b_yt_{2y} = g_{2y}$$

$$b_1t_{31} + b_2t_{32} + b_3t_{33} + \ldots\ldots b_kt_{3k} + b_yt_{3y} = g_{3y}$$

$$\vdots$$

$$b_1t_{k1} + b_2t_{k2} + b_3t_{k3} + \ldots\ldots b_kt_{kk} + b_yt_{ky} = g_{ky}$$

Where t_{kk} and t_{ky} represent phenotypic variance and covariance respectively and b_k is the unknown weight and g_{ky} and g_{kk} are genotypic covariance and variance respectively.

Genetic advance by discriminant function,

$$G.A.(D) = i\ (\Sigma\ b_k\ g_{ky})^{\frac{1}{2}}$$

Where, 'i' denotes the intensity of selection when top 5% of the population is selected.

Genetic advance by straight selection for yield

$$GA(S) = i.\ \frac{g_{yy}}{(t_{yy})^{\frac{1}{2}}}$$

The relative efficiency of selection through descriminant function over straight selection was calculated by the formula suggested by Paroda and Joshi (1976).

Relative efficiency over straight selection=

$$\frac{GA(D) - GA(S)}{GA(S)} \times 100$$

Results

RESULTS

The mean values of the quantitative characters recorded from genotypes in each replication were taken for further statistical analysis. The results are presented under the following heads

1 Analysis of variance, estimation of variability, heritability, genetic advance, correlation and, path coefficient analysis for yield and its components

2 Analysis of variance, estimation of variability, heritability, genetic advance, correlation and path coefficient analysis for length of main vine and its components

3 Analysis of variance, estimation of variability, heritability, genetic advance, correlation and path coefficient analysis for weight of first mature fruit and its components

4 Relative efficiency of selection through discriminant function over straight selection or vice-versa

1 Analysis of variance, estimation of variability, heritability, genetic advance, correlation and path coefficient analysis for yield and its components.

a Analysis of variance

The analysis of variance showed that the 32 ash gourd

Table 3. Mean performance of 32 ash gourd genotypes with respect to 28 characters

Acc.No.	Days to first female flower anthesis	Days to first male flower anthesis	Length of main vine(m)	Male flowers/ plant	Female flowers/ plant	Per-cent of female flowers	Average fruit weight (kg)
B.H. 1	56.22	53.89	5.03	64.22	10.00	13.10	7.86
B.H. 2	61.00	60.33	4.76	68.22	10.22	13.57	1.48
B.H. 3	57.56	56.66	5.87	64.44	10.22	12.67	4.35
B.H. 4	57.11	56.44	5.90	57.00	11.22	17.41	8.06
B.H. 5	59.00	58.90	4.60	69.00	9.44	12.30	3.99
B.H. 6	63.33	62.22	4.20	50.56	9.22	15.43	4.33
B.H. 7	60.33	69.00	5.77	106.22	9.78	7.82	1.81
B.H. 8	64.67	63.33	5.78	44.78	10.44	20.24	5.39
B.H. 9	65.00	64.67	4.29	44.22	8.89	16.59	5.67
B.H.10	60.45	57.45	5.22	75.33	9.33	10.93	5.17
B.H.11	59.33	58.67	5.85	69.22	9.56	12.15	2.38
B.H.12	59.44	59.00	4.39	56.33	9.00	14.23	4.26
B.H.13	62.89	61.67	6.05	42.00	8.78	16.55	5.76
B.H.14	61.67	60.33	5.45	78.89	9.45	11.04	28.11
B.H.15	64.89	63.67	4.75	77.22	8.56	9.87	5.56
B.H.16	60.00	59.78	3.89	68.33	8.56	11.43	7.23
B.H.17	66.11	64.67	5.75	67.00	7.89	10.24	5.00
B.H.18	60.33	59.67	4.79	76.11	8.89	9.40	7.17
B.H.19	68.67	67.33	4.22	69.00	11.33	12.21	4.90
B.H.20	60.33	60.33	5.76	93.78	11.00	11.47	4.07
B.H.21	57.00	56.33	5.56	42.33	8.89	20.15	9.00
B.H.22	62.11	61.56	4.42	60.67	11.78	12.11	5.37
B.H.23	65.33	64.67	4.42	55.11	11.11	19.44	5.61
B.H.24	60.33	68.67	5.51	77.67	9.22	11.70	4.41
B.H.25	60.33	59.33	5.90	41.33	40.00	17.21	3.46
B.H.26	63.00	63.00	5.33	52.89	9.44	16.68	3.18
B.H.27	69.33	67.00	5.25	60.00	8.56	12.92	6.55
B.H.28	62.45	62.33	4.38	55.67	10.44	13.21	5.20
B.H.29	62.45	61.00	5.96	90.78	9.00	11.13	3.67
B.H.30	65.89	64.33	5.37	90.22	9.44	8.28	20.65
B.H.31	59.22	58.33	5.81	55.33	10.22	15.32	6.15
B.H.32	58.89	58.67	4.56	53.22	10.33	16.98	5.16
C.D. p = 0.05	6.13	5.66	0.90	7.77	1.78	1.32	1.46

Table 3 (contd..)

Acc.No.	Weight of first mature fruit (kg)	Fruits /plant	Fruit set (%)	Fruit yield/ plant (kg)	Node at which first female flower appeared	Node at which first fruit is retained	Nodes on main vine
B.H. 1	8.87	1.67	17.18	12.69	12.67	12.82	46.67
B.H. 2	1.78	5.11	47.91	7.61	13.44	15.89	48.67
B.H. 3	7.90	3.33	35.66	14.36	15.44	16.74	42.33
B.H. 4	9.60	3.00	24.96	23.57	17.33	19.44	54.00
B.H. 5	4.68	4.56	47.13	18.20	10.56	11.56	34.33
B.H. 6	7.16	2.11	22.88	9.10	13.89	15.44	45.11
B.H. 7	2.72	4.33	48.10	7.84	15.89	16.78	45.89
B.H. 8	6.08	3.56	31.37	19.17	15.33	16.06	40.67
B.H. 9	7.26	2.44	27.81	13.83	10.11	12.33	34.89
B.H.10	5.52	2.56	27.70	13.21	13.45	14.22	48.67
B.H.11	3.93	3.22	33.57	8.05	13.33	15.78	45.33
B.H.12	4.43	4.44	47.60	19.30	15.33	16.22	46.00
B.H.13	6.22	2.22	27.04	12.76	12.33	15.33	48.33
B.H.14	29.68	1.11	11.34	30.82	17.56	18.00	44.45
B.H.15	5.67	3.44	40.76	19.14	12.67	13.44	42.33
B.H.16	8.12	3.44	39.20	24.87	14.78	15.00	44.89
B.H.17	5.80	3.11	38.70	15.56	10.78	15.11	39.67
B.H.18	7.73	2.11	26.73	15.34	12.67	13.33	43.33
B.H.19	5.50	1.89	19.76	9.24	10.67	13.00	32.67
B.H.20	8.46	2.44	20.07	9.94	16.33	14.44	48.00
B.H.21	11.60	3.56	43.39	32.01	9.67	11.45	49.67
B.H.22	5.63	2.56	30.71	13.73	9.33	18.78	38.56
B.H.23	6.60	4.56	34.46	26.08	14.33	15.89	46.56
B.H.24	7.74	3.56	35.19	19.68	16.67	15.44	48.00
B.H.25	4.09	2.44	27.81	8.46	12.00	14.33	43.56
B.H.26	4.45	4.44	41.85	13.51	14.33	13.78	38.67
B.H.27	7.17	3.89	43.79	25.46	13.33	15.89	45.56
B.H.28	7.32	3.44	40.76	17.87	10.67	18.22	38.33
B.H.29	6.02	4.22	37.23	15.47	17.89	22.11	51.11
B.H.30	21.02	1.33	16.64	27.45	17.00	16.33	46.67
B.H.31	7.47	2.22	22.22	13.64	13.78	14.00	40.00
B.H.32	7.89	3.33	31.89	17.26	13.00	13.67	39.67
C.D. p = 0.05	3.64	0.26	2.39	2.72	2.83	4.76	8.35

Table 3 (contd..)

Acc.No.	Primary branches/ plant	Thick branches/ plant	Inter-nodal length (cm)	Inter-nodal circumference (cm)	Leaves/ plant	Circumference of fruit (cm)	Length of fruit (cm)
B.H. 1	3.22	2.11	12.29	3.62	168.22	64.85	40.50
B.H. 2	4.78	5.67	13.61	2.60	172.78	41.55	27.27
B.H. 3	4.00	1.44	14.32	3.52	196.00	74.86	48.02
B.H. 4	4.00	2.00	12.93	3.52	168.00	78.33	50.00
B.H. 5	3.78	1.67	14.49	2.79	164.22	51.72	35.19
B.H. 6	4.11	2.11	15.03	3.35	130.00	60.49	46.40
B.H. 7	3.89	3.78	11.98	3.09	286.66	48.25	31.56
B.H. 8	4.78	3.22	13.78	2.99	180.56	56.30	39.54
B.H. 9	4.45	1.56	12.37	2.92	102.33	67.38	42.62
B.H.10	3.33	1.44	12.19	3.26	147.00	58.82	36.44
B.H.11	5.22	2.89	14.03	3.11	152.33	49.39	38.44
B.H. 12	3.56	2.45	13.29	2.69	198.33	58.50	33.77
B.H.13	4.22	2.00	12.85	3.61	169.67	63.24	40.60
B.H.14	4.67	3.11	14.15	3.81	190.33	113.78	62.04
B.H.15	4.67	2.00	10.43	3.31	197.34	60.67	38.55
B.H.16	3.33	2.45	12.02	3.39	150.00	74.32	42.93
B.H.17	5.11	1.33	14.91	2.90	159.33	60.92	33.28
B.H.18	4.51	1.67	15.07	3.07	150.67	59.07	50.17
B.H.19	4.45	2.00	12.53	2.32	207.00	55.04	42.17
B.H.20	4.33	2.00	12.15	3.15	222.67	67.89	45.46
B.H.21	2.78	1.33	14.68	3.67	226.00	73.85	54.32
B.H.22	5.11	1.33	11.73	2.90	133.67	54.57	39.85
B.H.23	5.33	3.89	12.87	3.26	234.33	62.33	40.09
B.H.24	4.44	2.33	12.43	3.00	209.67	63.09	42.83
B.H.25	4.89	4.33	14.82	3.23	160.67	63.37	36.01
B.H.26	3.89	1.89	13.66	3.11	119.17	57.70	40.02
B.H.27	4.00	1.89	11.20	3.46	191.67	56.29	38.87
B.H.28	4.00	1.44	12.96	3.33	177.00	64.37	47.00
B.H.29	4.44	4.56	10.67	3.46	257.67	59.95	45.52
B.H.30	4.44	2.44	12.55	3.30	234.67	90.41	55.26
B.H.31	4.00	3.11	10.64	3.19	164.00	64.33	44.47
B.H.32	4.33	1.78	13.54	3.00	160.33	66.11	48.72
C.D. $p = 0.05$	0.98	1.82	0.85	0.13	17.81	6.93	3.87

Table 3 (contd...)

Acc.No.	Fruit shape index	Flesh thickness (cm)	Seeds/fruit	100-seed weight	Protein (%)	Phosphorus (%)	Potassium (%)
B.H. 1	2.26	4.57	239.92	8.40	7.41	0.31	3.09
B.H. 2	2.07	4.09	372.58	5.24	8.04	0.41	2.37
B.H. 3	1.81	3.56	376.78	7.87	5.75	0.30	2.65
B.H. 4	2.01	5.00	1192.67	9.42	6.27	0.28	2.79
B.H. 5	2.13	3.55	313.33	6.24	7.08	0.29	2.12
B.H. 6	2.41	4.80	374.83	5.97	5.07	0.13	3.09
B.H. 7	2.06	4.27	445.67	6.45	5.44	0.21	2.49
B.H. 8	2.21	5.25	676.67	5.86	4.41	0.35	3.09
B.H. 9	1.99	5.09	515.67	9.98	7.78	0.40	2.88
B.H.10	1.95	5.44	646.00	8.60	8.54	0.42	2.56
B.H. 11	2.46	4.89	494.33	6.03	4.76	0.16	3.08
B.H.12	1.82	3.94	368.67	6.89	6.62	0.25	2.28
B.H.13	2.01	5.93	623.83	7.63	5.93	0.38	2.45
B.H.14	1.71	6.12	1036.33	10.99	6.16	0.21	3.17
B.H.15	2.03	5.21	1255.33	7.46	7.34	0.30	3.09
B.H.16	1.86	5.95	792.89	9.09	8.04	0.50	3.48
B.H.17	1.72	4.34	1158.11	8.12	4.94	0.12	2.85
B.H.18	2.69	5.22	386.33	7.84	6.66	0.40	2.61
B.H.19	2.40	5.41	476.50	8.28	5.67	0.36	2.78
B.H.20	2.16	5.09	1083.33	8.70	6.27	0.20	3.19
B.H.21	2.31	6.16	1262.67	9.33	8.12	0.49	3.29
B.H.22	2.29	5.86	640.67	6.32	6.95	0.21	2.93
B.H.23	2.03	5.03	374.33	7.45	7.05	0.27	2.08
B.H.24	2.13	5.87	1493.89	9.89	8.70	0.35	2.67
B.H.25	2.17	4.81	223.33	8.49	7.42	0.37	3.41
B.H.26	2.17	3.97	594.67	6.07	6.96	0.20	2.71
B.H.27	2.17	4.56	642.89	9.82	6.60	0.29	2.58
B.H.28	2.29	5.07	764.56	7.40	7.26	0.36	2.57
B.H.29	2.45	5.17	973.17	5.76	5.47	0.32	3.13
B.H.30	1.91	5.38	624.00	10.25	4.27	0.18	3.38
B.H.31	2.16	5.49	447.00	8.32	5.44	0.32	3.18
B.H.32	2.30	5.34	232.44	9.11	5.28	0.29	3.08
C.D. $p = 0.05$	0.21	0.32	18.97	1.73	0.16	0.06	0.24

genotypes were significantly different for yield and its ten component characters, days to first female flower anthesis, days to first male flower anthesis, length of main vine, male flowers/plant, female flowers/plant, percent of female flowers, average fruit weight, weight of first mature fruit, fruits / plant and percent of fruit set. (Table 4). The results showed that there was inherent and statistically significant differences among the genotypes for all the above 11 characters.

b Estimation of variability, heritability and genetic advance

The extent of variability present in the 32 ash gourd genotypes for yield and its 10 component characters was measured in terms of range, mean and its standard error and coefficients of variation at genotypic and phenotypic levels (Table 5). There was considerable amount of variation for all the characters under study. Days to first female flower anthesis ranged from 56.22 days after sowing in 'B.H.1' to 69.33 days in 'B.H.27'. The range of days to first male flower anthesis varied from 53.89 days in 'B.H.1' to 67.33 days in 'B.H.19'. The length of main vine ranged from 3.89 m. in B.H. 16 to 6.05 m. in 'B.H.13'. The range of male flowers/plant varied from 41.33 in 'B.H.25' to 106.22 in 'B.H.7'. Female flowers/plant ranged from 7.89 in B.H. 17 to 11.78 in 'B.H.22'. Percent of female flowers ranged from 7.82 in 'B.H.7' to 20.24 in 'B.H.8'. The range of average fruit weight varied from 1.48 kg. in 'B.H.2' to 28.11 kg in 'B.H.15'. Weight of first mature

Table 4. General analysis of variance for yield and its components

Sources of variation	d.f.	M.S.										
		Days to first female flower anthesis	Days to first male flower anthesis	Length of main vine (m)	Male flowers/ plant	Female flowers/ plant	Per cent of female flowers	Average fruit weight (kg)	Weight of first mature fruit (kg)	Fruits/ plant	Per cent of fruit set	Fruit yield/ plant (kg)
Replications	2	107.54	87.85	9.29	27.06	1.26	5.02	9.89	2.47	0.86	40.43	3.51
Genotypes	31	28.11**	27.24**	1.22**	777.68**	2.65**	32.97**	78.99**	48.04**	3.32**	305.97**	170.27**
Error	62	14.11	12.05	0.31	22.65	1.19	0.66	0.80	4.99	0.03	2.14	2.79

** p = 0.01

Table 5. Range, mean, genotypic (g.c.v.) and phenotypic (p.c.v.) coefficients of variation, heritability, expected genetic advance and genetic gain for yield and its components.

Characters	Range	Mean ± SEm	g.c.v.	p.c.v.	Heritability (%)	Expected genetic advance	Genetic gain
Days to first female flower anthesis	56.22 - 69.33	62.96 ± 1.44	3.62	7.26	24.85	2.22	3.72
Days to first male flower anthesis	53.89 - 67.33	60.33 ± 1.23	3.65	6.72	29.58	2.52	4.09
Length of main vine (m)	3.89 - 6.05	5.15 ± 0.03	10.70	15.17	49.73	0.80	15.54
Male flowers/ plant	41.33 -106.22	64.91 ± 2.31	24.44	25.52	91.74	31.30	48.22
Female flowers/ plant	7.89 - 11.78	9.69 ± 0.12	7.19	13.35	29.14	0.77	7.97
Percent of female flowers	7.82 - 20.24	13.56 ± 0.07	24.21	24.94	94.24	6.56	48.43
Average fruit weight (kg)	1.46 - 28.11	6.28 ± 0.08	81.29	82.53	97.01	10.36	164.95
Weight of first mature fruit(kg)	1.78 - 29.68	7.60 ± 0.51	54.10	62.80	74.22	6.72	96.01
Fruits/plant	1.11 - 5.11	3.12 ± 0.003	33.30	33.68	97.74	2.13	67.81
Per cent of fruit set	11.34 - 48.10	32.57 ± 0.21	30.90	31.22	97.93	20.52	62.99
Fruit yield/ plant (kg)	7.61 - 32.01	16.28 ± 0.28	44.27	45.36	95.25	15.02	88.99

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fruit ranged from 1.78 kg in 'B.H.2' to 29.68 kg in 'B.H.14'. Fruits/plants ranged from 1.11 in 'B.H.14' to 5.11 in 'B.H.2'. Tha range for fruit yield/plant varied from 7.61 kg in 'B.H.2' to 32.01 kg in 'B.H.21'. The genotype 'B.H.14' closely followed 'B.H.21' in yield with 30.82 kg/plant.

Maximum variability was observed for average fruit weight (g.c.v. = 81.29) followed by weight of first mature fruit (g.c.v. = 54.10) and fruit yield/plant (g.c.v. = 44.27). The lowest value of genotypic coefficient of variation was observed for days to first female flower anthesis (3.62). For all the characters studied phenotypic coefficients of variation were higher than the corresponding genotypic coefficients of variation.

The highest heritability estimate of 97.93% was obtained for percent of fruit set followed by fruits/plant (97.74%) and average fruit weight (97.01). (Fig.1.). Fruit yield/plant also had moderately high estimate of heritability (95.25%). The lowest heritability estimate of 24.85% was noted for days to first female flower anthesis. Average fruit weight recorded the highest value of expected genetic advance in the next generation of selection (164.95%). Days to first female flower anthesis recorded the lowest estimate of genetic advance as per cent of mean (3.72). Fruit yield/plant had an expected genetic advance of 88.99% in the next generation of selection when the intensity of selection was 5%.

Fig. 1 Heritability and expected genetic advance as per cent of mean.

1 Days to first female flower anthesis.
2 Days to first male flower anthesis
3 Length of main vine
4 Male flowers/plant
5 Female flowers/plant
6 Per cent of female flowers
7 Average fruit weight
8 Weight of first mature fruit
9 Fruits/plant
10 Per cent of fruit set
11 Fruit yield/plant
12 Node at which first female flower appeared
13 Node at which first fruit is retained
14 Nodes on main vine
15 Primary branches/plant
16 Thick branches/plant
17 Internodal length
18 Internodal circumference
19 Leaves/plant
20 Circumference of fruit
21 Length of fruit
22 Fruit shape index
23 Flesh thickness
24 Seeds/fruit
25 100-seed weight
26 Protein (%)
27 Phosphorus (%)
28 Potassium (%)

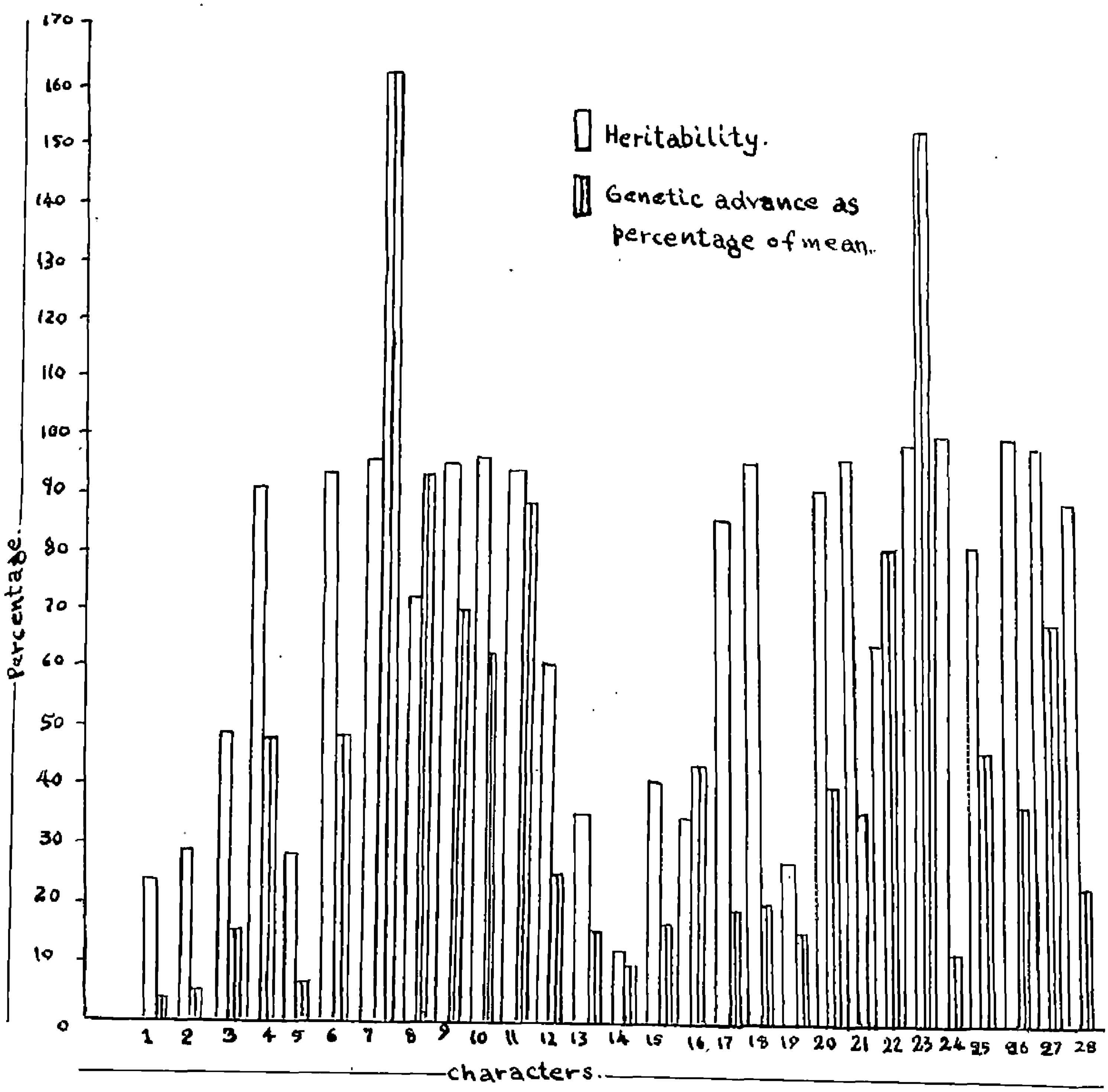


Fig: 1. Heritability and expected genetic advance as Percentage of mean.

c Correlation among yield and its components

Fruit yield/plant was significantly and positively correlated with length of main vine (r_g = 0.48), female flowers/plant (r_g = 0.70), average fruit weight (r_g = 0.76) and weight of first mature fruit (r_g = 0.59). Fruits/plant was not significantly correlated with yield (r_g = 0.13) (Table.6.). Days to first female flowef anthesis, days to first male flower anthesis and male flowers/plant had negative association with fruit yield/plant, though the estimates of correlation were not significant. (r_g = -0.10, -0.10 and -0.14 respectively). Days to first female flower anthesis was positively correlated with days to male flower anthesis (r_g = 0.95). Both, average fruit weight and weight of first mature fruit were negatively correlated with number of fruits/plant (r_g = -0.55 and -0.59 respectively).

d Path coefficient analysis

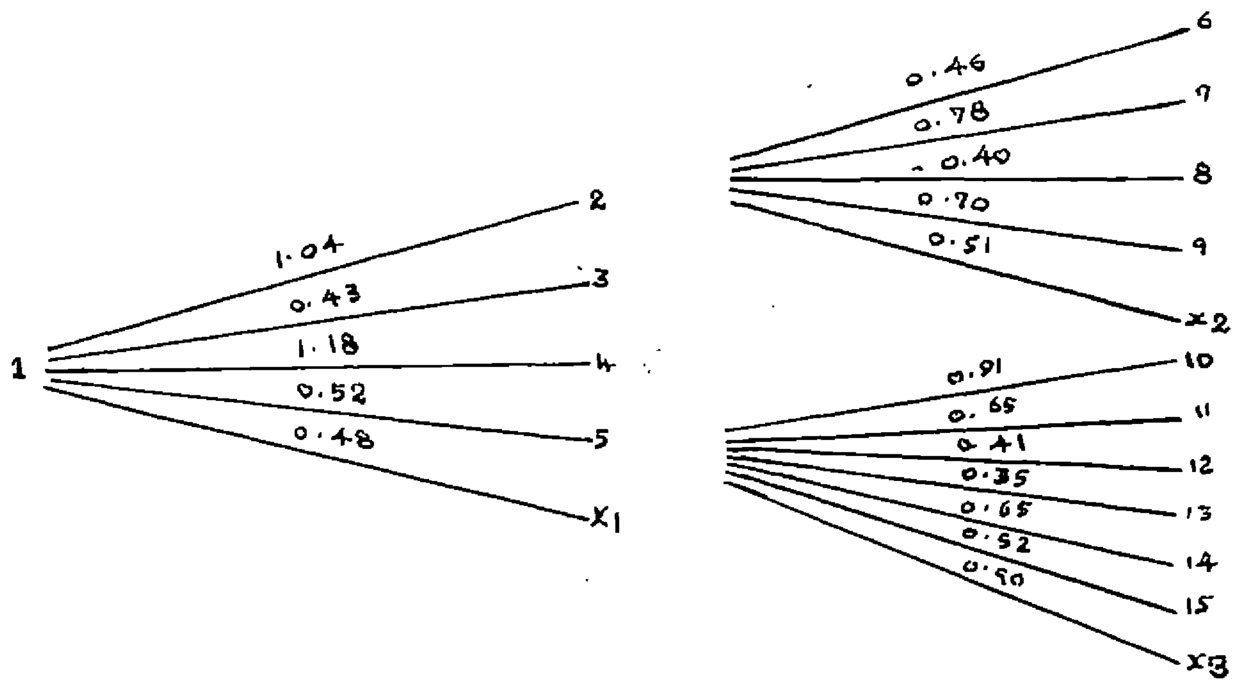
The direct effects of the component characters on fruit yield/plant, length of main vine and weight of first mature fruit are presented in Fig. 2.

Average fruit weight had the maximum direct effect (1.18) on fruit yield/plant followed by length of main vine (1.04) (Table 7) (Fig. 3). The significant positive correlation between female flowers/plant and fruit yield resulted

Table 6. Genotypic (r_g) and phenotypic (r_p) correlations among fruit yield and its components

Characters	Days to first female flower anthesis	Days to first male flower anthesis	Length of main vine	Female flowers/plant	Male flowers /plant	Average fruit weight	Weight of first mature fruit	Fruits/plant
Fruit yield/plant	- 0.10 (- 0.05)	- 0.10 (- 0.07)	0.48** (0.42)	0.70** (0.67)	-0.14 (-0.15)	0.76** (0.72)	0.59** (0.55)	0.13 (0.13)
Days to first female flower anthesis		0.95** (0.85)	-0.32 (-0.21)	-0.30 (-021)	0.07 (0.03)	0.17 (0.08)	-0.07 (-0.04)	-0.05 (-0.04)
Days to first male flower anthesis			-0.34 (-0.27)	-0.27 (-0.16)	-0.05 (-0.01)	-0.01 (-0.01)	-0.30 (-0.10)	-0.04 (-0.01)
Length of main vine				-0.02 (-0.01)	0.22 (0.16)	-0.49** (-0.44)	-0.27 (-0.20)	-0.02 (-0.02)
Female flowers/plant					-0.04 (-0.02)	-0.06 (-0.04)	0.62** (0.59)	-0.06 (-0.05)
Male flowers/plant						0.17 (0.15)	0.18 (0.15)	-0.06 (-0.05)
Average fruit weight							0.07 (0.04)	-0.55** (-0.54)
Weight of first mature fruit								-0.59** (-0.51)

** p= 0.01 Figures within paranthesis indicate phenotypic correlation coefficients.



1. Fruit yield / Plant.
2. Length of main vine.
3. Female flowers/plant
4. Average fruit weight.
5. Weight of first mature fruit.
6. Node at which first female flower appeared.
7. Nodes on main vine.
8. Internodal circumference.
9. Leaves / Plant.
10. Circumference of fruit.
11. Length of fruit.
12. Flesh thickness
13. Seeds / fruit.
14. 100- Seed weight.
15. Potassium content.

Fig: 2. Direct effects of polygenic characters on fruit yield / plant, length of main vine and weight of first mature fruit in ash gourd.

Table 7. Direct and indirect genotypic effects of four component characters on fruit yield

Characters	r_p*	Direct effect (Piy)	Indirect effect via. character			
			Length of main vine	Female flowers/plant	Average fruit weight	Weight of first mature fruit.
Length of main vine	0.42	1.04	-	- 0.004	- 0.52	- 0.10
Female flowers/ plant	0.67	0.43	- 0.01	-	- 0.05	0.30
Average fruit weight	0.72	1.18	- 0.46	- 0.02	-	0.02
Weight of first mature fruit	0.55	0.52	- 0.27	0.25	0.05	-

r_p* = Phenotypic correlation coefficients between fruit yield and its components

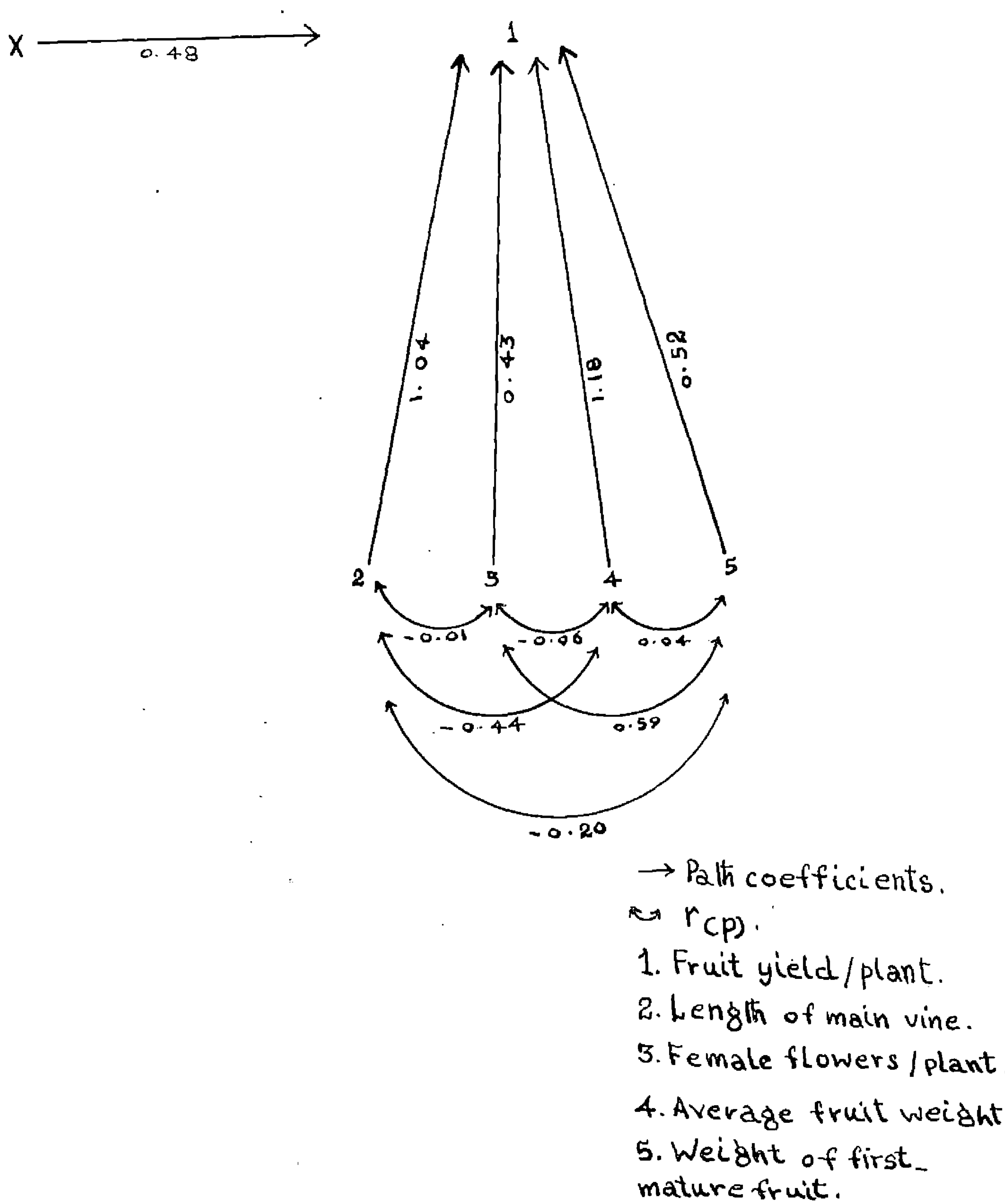


Fig: 3. Path diagram indicating direct and indirect effects of the possible components of fruit yield/plant.

not only from the positive direct effect (0.43) but from the positive indirect effect through weight of first mature fruit (0.30) also. Weight of first mature fruit had a direct effect of 0.52 on fruit yield.

2 Analysis of variance, estimation of variability, heritability, genetic advance, correlation and path coefficient analysis for length of main vine and its components

a Analysis of variance

Length of main vine was considered as a function of node at which first female flower appeared, node at which first fruit is retained, nodes on main vine, primary branches/plant, thick branches/plant, internodal length, internodal circumference, and leaves/plant. The 32 genotypes were significantly different among themselves for the above characters (Table 8). The differences were significant at 1% level of probability.

b Estimation of variability, heritability and genetic advance

The range for node at which the first female flower appeared varied from 9.33 in 'B.H.22' to 17.89 in 'B.H.29' (Table 9). Node at which the first fruit was retained ranged from 11.45 in 'B.H.21' to 22.11 in 'B.H.29'. The range for nodes on main vine varied from 32.67 in 'B.H.19' to 54 in 'B.H.4'. Primary branches/plant ranged from 2.78 in 'B.H. 21' to 5.33 in 'B.H.23'. The range for thick branches/plant varied

Table 8. General analysis of variance for length of main vine and its components

Sources of variation	d.f.	M.S.								
		Node at which first female flower appeared	Node at which first male flower appeared	Nodes on main vine	Primary branches/ plant	Thick branches/ plant	Inter-nodal length (cm)	Inter-nodal circum-ference (cm)	Leaves/ plant	Length of main vine (m)
Replication	2	27.06	26.70	436.38	4.17	6.78	0.78	0.02	6922.80	9.29
Genotypes	31	17.54**	18.66**	75.06**	1.10**	3.38**	5.2**	0.33**	4853.62**	1.22**
Error	62	3.01	6.90	26.18	0.36	1.24	0.27	0.01	2272.38	0.31

** p = 0.01

Table 9. Range, mean, genotypic (g.c.v.) and phenotypic (pc.v.) coefficient of variation, heritability, expected genetic advance and genetic gain for length of main vine and its components

Characters	Range	Mean ± SEm	g.c.v.	p.c.v.	Heritability (%)	Expected genetic advance	Genetic gain
Node at which the first female flower appeared	9.33 - 17.89	13.64 ± 0.31	16.13	20.54	61.67	3.56	26.10
Node at which the first fruit is retained	11.45 - 22.11	15.18 ± 0.70	13.15	21.84	36.25	2.46	16.31
Nodes on main vine	32.67 - 54.00	43.83 ± 2.67	9.21	14.86	13.84	5.15	11.75
Primary branches/ plant	2.78 - 5.33	4.24 ± 0.03	11.75	18.35	41.01	0.66	15.50
Thick branches/ plant	1.33 - 5.67	2.38 ± 0.13	35.45	58.68	36.50	1.05	44.11
Internodal length (cm)	10.43 - 15.07	13.01 ± 0.03	9.86	10.64	85.94	2.45	18.84
Internodal circumference(cm)	2.32 - 3.8	3.18 ± 0.0007	10.24	10.54	94.25	0.65	20.47
Leaves/plant	102.33 -286.66	180.70 ±23.19	16.23	30.98	27.46	31.67	17.53
Length of main vine (m)	3.89 - 6.05	5.15 ± 0.03	10.70	15.17	49.73	0.80	15.54

from 1.33 in genotypes 'B.H.17', 'B.H.21' and 'B.H.22' to 5.67 in 'B.H.2'. The range for internodal length varied from 10.43 cm in 'B.H.15' to 15.07 cm in 'B.H. 18'. Internodal circumference ranged from 2.32cm in 'B.H.19' to 3.81 cm in 'B.H.14'. Leaves/plant ranged from 102.33 in 'B.H.9' to 286.66 in 'B.H.7'.

The maximum value of genotypic coefficient of variation was observed for thick branches/plant (35.45) followed by leaves/plant (16.23) and node at which the first female flower appeared (16.13). The lowest value of genotypic coefficient of variation was recorded for nodes on main vine (9.21). Internodal circumference had the highest value of heritability (94.25%) followed by internodal length (85.94%). The lowest heritability value of 13.84 was observed for nodes on main vine. Thick branches/plant recorded the highest value of expected genetic advance as per cent of mean (44.11). Nodes on main vine recorded the lowest estimate of genetic advance as per cent of mean (11.75). Length of main vine had only a low expected genetic advance (15.54) resulting from low variability (g.c.v. = 10.70) and low estimate of heritability (49.73%).

C Correlation among length of main vine and its components

Node at which first female flower appeared, nodes on main vine and leaves/plant were positively correlated with the length of main vine (r_g = 0.61, 0.50 and 0.78 respectively) (Table 10). Internodal circumference was

Table 10. Genotypic (r_g) and phenotypic (r_p) correlation among length of main vine and its components

Characters	Node at which first female flower appeared	Node at which first fruit is retained	Nodes on main vine	Primary branches/plant	Thick branches/plant	Internodal length	Internodal circumference	Leaves/plant
Length of main vine	0.61** (0.58)	0.21 (0.09)	0.50** (0.44)	-0.27 (-0.15)	-0.04 (-0.04)	0.04 (0.04)	-0.42* (-0.40)	0.78** (0.74)
Node at which first female flower appeared		0.59** (0.50)	0.18 (0.14)	-0.39* (-0.31)	0.40* (0.37)	0.27 (0.21)	0.09 (0.10)	0.14 (0.05)
Node at which first fruit is retained			0.25 (0.18)	0.21 (0.20)	0.39* (0.32)	0.22 (0.16)	-0.33 (-0.22)	0.30 (0.24)
Nodes on main vine				-0.32 (-0.30)	0.41* (0.40)	-0.19 (-0.10)	-0.31 (-0.29)	-0.39 (-0.37)
Primary branches/plant					0.44** (0.38)	-0.19 (-0.10)	-0.31 (-0.29)	-0.39* (-0.37)
Thick branches/plant						0.33* (0.29)	-0.26 (-0.26)	-0.16 (-0.15)
Internodal length							-0.71** (-0.58)	-0.17 (-0.13)
Internodal circumference								-0.03 (-0.02)

*p = 0.05   **p = 0.01   Figures within paranthesis indicate phenotypic correlation coefficients.

negatively correlated with length of main vine (r_g= -0.42) and internodal length (r_g = -0.71). Node at which the first female flower appeared had positive correlation with node at which the first fruit was retained (r_g = 0.59). There was positive correlation between primary branches/plant and thick branches/plant (r_g = 0.44).

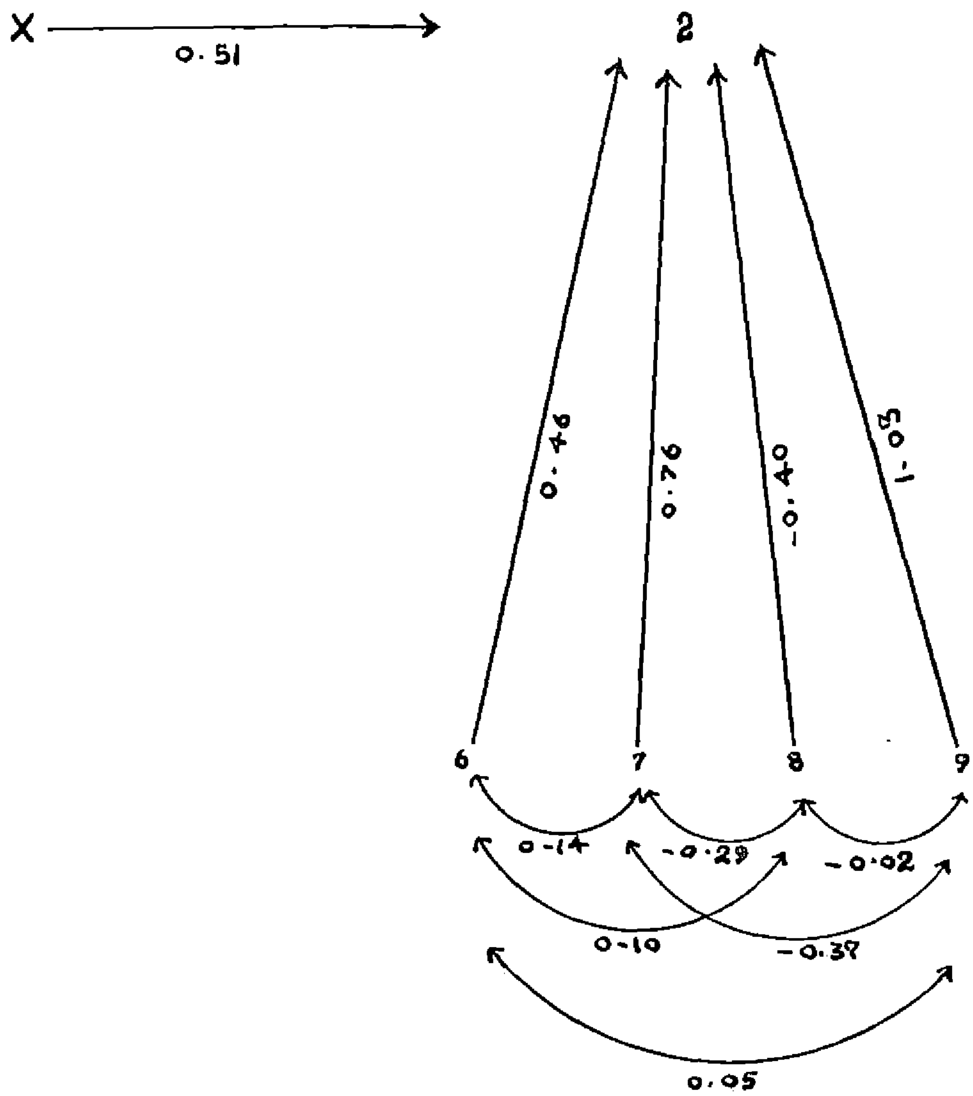
D Path coefficient analysis

Leaves/plant had the maximum direct effect on length of main vine (1.03) followed by nodes on main vine (0.78) and node at which first female flower appeared (0.46) (Table 11).(Fig.4). The high positive correlation of node at which first female flower appeared and length of main vine (r_g = 0.61) was due to the direct effect of node at which first female flower appeared and indirect effect through nodes on main vine (0.11). The negative correlation between internodal circumference and length of main vine (r_g = -0.42) resulted from the negative direct effect (-0.40) as the positive indirect effect through node at which first female flower appeared (0.05) was nullified by the negative indirect effects through nodes on main vine (-0.03) and leaves/plant (-0.02).

Table 11. Direct and indirect effects of four component characters on length of main vine

Characters	r_p*	Direct effect (P_{iy})	Indirect effect via. character			
			Node at which first female flower appeared	Nodes on main vine	Internodal circumference	Leaves/ plant
Node at which first female flower appeared	0.58	0.46	-	0.11	- 0.04	0.05
Nodes on main vine	0.44	0.78	0.06	-	0.02	- 0.042
Internodal circumference	-0.40	- 0.40	0.05	-0.03	-	- 0.02
Leaves/plant	0.74	1.03	0.02	-0.32	0.008	-

r_p* = Phenotypic correlation coefficients between length of main vine and its components.



→ Path coefficients.

↔ $r_{(p)}$.

2. Length of main vine.

6. Node at which first female flower appeared.

7. Nodes on main vine

8. Internodal circumference.

9. Leaves/plant.

Fig: 4. Path diagram indicating direct and indirect effects on the possible components of length of main vine.

3 Analysis of variance, estimation of variability, heritability, genetic advance, correlation and path coefficient analysis for weight of first mature fruit and its components.

a Analysis of variance

Observations on weight of first mature fruit and its component characters, circumference of fruit, length of fruit, fruit shape index, flesh thickness, seeds/fruit, 100-seed weight, protein content, phosphorus content and potassium content were subjected to analysis of variance to test the significance of differences among the genotypes in respect to these polygenic characters. Highly significant differences were observed among the 32 ash gourd genotypes for all the characters studied (Table 12).

b Estimation of variability, heritability and genetic advance

The circumference of fruit ranged from 41.55 cm in 'B.H.2' to 113.78 cm in 'B.H.14' (Table 13). Length of fruit varied from 27.27 cm in 'B.H.2' to 62.04 cm in 'B.H.14'. The range of fruit shape index varied from 1.71 in 'B.H.14' to 2.69 in 'B.H.18'. Flesh thickness ranged from 3.55 cm in 'B.H.5' to 6.16 cm in 'B.H.21'. The range of seeds/plant varied from 223.33 in 'B.H. 25' to 1493.89 in 'B.H.24'. The range of 100-seed weight varied from 5.24 g in 'B.H.2' to 10.99 g in 'B.H.14'. The protein content on dry weight basis ranged from 4.27 per cent in

Table 12. General analysis of variance for weight of first mature fruit and its components

Sources of variation	d.f.	M.S.									
		Circumference of fruit (cm)	Length of fruit (cm)	Fruit shape index	Flesh thickness	Seeds/fruit	100-seed weight (g)	Protein (%)	Phosphorus (%)	Potassium (%)	Weight of first mature fruit (kg)
Replications	2	6.95	1.97	1.56	12.30	29.01	0.17	0.01	0.0001	0.01	2.47
Genotypes	31	524.28**	161.16**	3.93**	44.79**	361308.8**	12.41**	4.40**	0.03**	0.39**	48.04**
Error	62	18.02	1.28	0.59	0.29	135.15	0.94	0.95	0.0001	0.02	4.99

** p = 0.01

Table 13. Range, mean, genotypic (g.c.v.) and phenotypic (p.c.v.) coefficient of variation, heritability, expected genetic advance and genetic gain for weight of first mature fruit and its components

Characters	Range	Mean ± SEm	g.c.v.	p.c.v.	Heritability (%)	Expected genetic advance	Genetic gain
Circumference of fruit (cm)	41.55 - 113.78	63.48 ± 1.84	20.46	21.52	90.35	24.44	40.07
Length of fruit (cm)	27.27 - 62.04	42.51 ± 0.13	17.17	17.38	97.65	14.86	34.96
Fruit shape index	1.71 - 2.69	2.12 ± 0.06	49.57	61.37	65.24	1.76	82.48
Flesh thickness (cm)	3.55 - 6.16	5.03 ± 0.03	76.83	77.57	98.10	7.86	156.77
Seeds/fruit	223.33 -1493.89	659.64 ± 13.79	52.60	52.63	99.89	114.37	10.83
100-seed weight (g)	5.24 - 10.99	7.59 ± 0.10	25.08	27.98	80.36	3.61	46.31
Protein (%)	4.27 - 8.70	6.51 ± 0.01	18.59	18.65	99.35	2.49	38.18
Phosphorus (%)	0.13 - 0.50	0.30 ± 0.00001	32.17	32.33	98.98	0.19	65.93
Potassium (%)	2.12 - 3.48	2.84 ± 0.002	12.40	13.45	85.08	0.67	23.57
Weight of first mature fruit(kg)	1.78 - 29.68	7.00 & 0.51	54.10	62.80	74.22	6.72	96.01

'B.H.30' to 8.7 per cent in 'B.H.24'. The range of phosphorus content varied from 0.13 per cent in 'B.H.6' to 0.50 per cent in 'B.H.16'. The potassium content ranged from 2.12 per cent in 'B.H.5' to 3.48 per cent in 'B.H.16'.

Maximum variability was observed for flesh thickness (g.c.v. = 76.83) followed by weight of first mature fruit (g.c.v. = 54.10) and seeds/fruit (g.c.v. = 52.60). The lowest value of genotypic coefficient of variation was observed for length of fruit (17.17). The highest heritability estimate of 99.89% was obtained for seeds/fruit followed by protein content (99.35%) and phosphorus content (98.98%). Fruit shape index had the lowest value of heritability (65.24%). Flesh thickness recorded the highest value of expected genetic advance (156.77%). Seeds/fruit recorded the lowest estimate of genetic advance (10.83%). Weight of first mature fruit had moderate values for genotypic coefficient of variation (54.10), heritability (74.22%) and genetic advance (96.01%).

c Correlation among weight of first mature fruit and its components

Circumference of fruit, length of fruit, flesh thickness, seeds/fruit, 100-seed weight and potassium content were positively and significantly correlated with the weight of first mature fruit (r_g = 0.98; 0.69; 0.51; 0.38; 0.72 and 0.59 respectively) (Table 14). Weight of

Table 14. Genotypic (r_g) and phenotypic (r_p) correlation among weight of first mature fruit and its components

Characters	Circumference of fruit	Length of fruit	Flesh thickness	Seeds/fruit	100-seed weight	Protein (%)	Phosphorus (%)	Potassium (%)
Weight of first mature fruit	0.98** (0.91)	0.69** (0.65)	0.51** (0.41)	0.38* (0.35)	0.72** (0.65)	-0.12 (-0.10)	-0.10 (-0.09)	0.59** (0.52)
Circumference of fruit		0.34* (0.32)	0.43* (0.38)	0.38* (0.36)	0.42* (0.38)	-0.11 (-0.10)	-0.09 (-0.09)	0.44** (0.36)
Length of fruit			0.58** (0.50)	0.29 (0.27)	0.61** (0.54)	-0.15 (-0.13)	0.008 (-0.001)	0.56** (0.49)
Flesh thickness				0.04 (0.03)	0.46** (0.45)	0.08 (0.08)	0.27 (0.27)	0.52** (0.47)
Seeds/fruit					0.36* (0.36)	0.19 (0.19)	0.02 (0.02)	0.26 (0.24)
100-seed weight						0.18 (0.18)	0.17 (0.17)	0.36* (0.31)
Protein %							0.63** (0.62)	-0.22 (-0.20)
Phosphorus %								-0.01 (-0.01)

* p = 0.05   **p = 0.01   Figures within paranthesis indicates phenotypic correlation coefficients.

first mature fruit had negative associations with protein content and phosphorus content though the correlations were nonsignificant (r_g = -0.12 and -0.10 respectively). Length of fruit had positive correlations with flesh thickness, 100-seed weight and potassium content (r_g=0.58 0.61 and 0.56 respectively). Flesh thickness and 100-seed weight were positively correlated (r_g = 0.46). There was a significant correlation between phosphorus content and protein content (r_g = 0.63).

d Path coefficient analysis

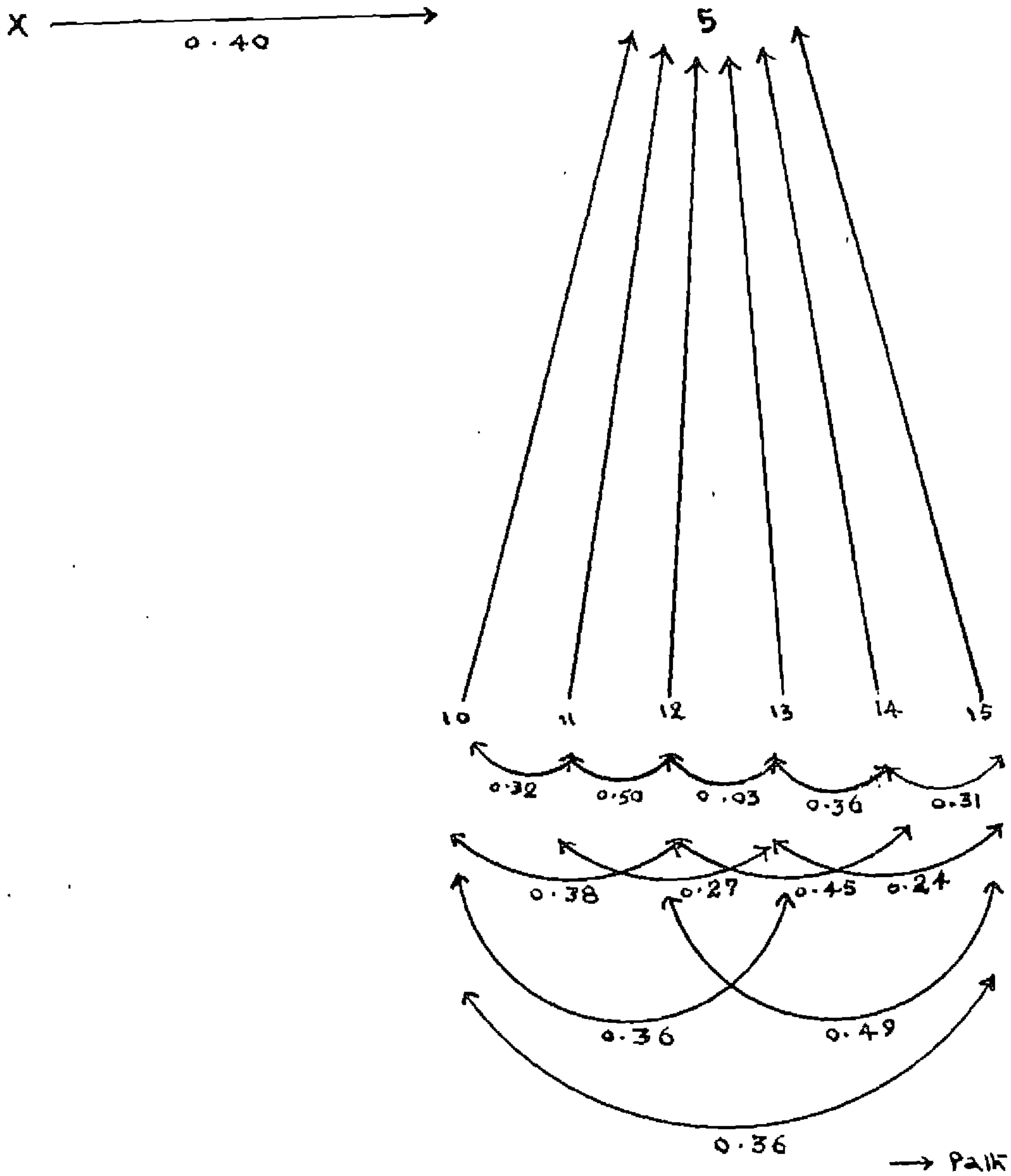
Circumference of fruit had the maximum direct effect on weight of first mature fruit (0.82), followed by length of fruit (0.36), and 100-seed weight (0.30) (Table 15) (Fig 5). Potassium content though having a correlation of 0.59 with weight of first mature fruit, had only marginal value of 0.12 as direct effect. Flesh thickness and seeds/ fruit had negative direct effects on weight of first mature fruit, (-0.28 and -0.18 respectively) eventhough they had positive correlations.

e Discriminant functions were worked out to find out component character combinations whose selection along with and without yield could result in maximum genetic response for fruit yield (Tables 16 and 17). The component characters for fitting the discriminant functions were chosen

Table 15. Direct and indirect effects of six component characters on weight of first mature fruit

Characters	r_p*	Direct effect (P_{1y})	Indirect effect via. character					
			Circumference of fruit	Length of fruit	Flesh thickness	Seeds/fruit	100-seed weight	Potassium content
Circumference of fruit	0.91	0.82	-	0.12	-0.11	-0.07	0.04	0.04
Length of fruit	0.65	0.36	0.26	-	-0.14	-0.05	0.16	0.06
Flesh thickness	0.41	-0.28	0.31	0.18	-	-0.005	0.14	0.06
Seeds/fruit	0.35	-0.18	0.30	0.10	-0.01	-	0.11	0.03
100-seed weight	0.65	0.30	0.31	0.19	-0.13	-0.06	-	0.04
Potassium content	0.52	0.12	0.30	0.18	-0.13	-0.04	0.09	-

r_p* = Phenotypic correlation coefficient between weight of first mature fruit and its components



→ Path coefficients.

↔ $r_{(p)}$.

5. Weight of first mature fruit.

10. Circumference of fruit.

11. Length of fruit.

12. Flesh thickness.

13. Seeds / fruit.

14. 100-Seed weight.

15. Potassium content.

Fig: 5. Path diagram indicating direct and indirect effects of the possible components of weight of first mature fruit.

Table 16. Selection indices and the relative efficiency of selection indices through discriminant function (Smith's method) over straight selection.

Discriminant functions	Genetic advance through straight selection	Genetic advance through discriminant function	Relative efficiency
Straight selection for yield/plant	15.02	15.02	0.00
$Y = 0.50\ X_1$	15.02	0.88	-94.68
$Y = 0.30\ X_2$	15.02	0.77	-94.85
$Y = 0.97\ X_3$	15.02	10.36	-31.04
$Y = 0.75\ X_4$	15.02	6.72	-55.23
$Y = 0.49\ X_1 + 0.27\ X_2$	15.02	1.09	-92.73
$Y = 0.77\ X_1 + 0.97\ X_3$	15.02	9.93	-33.86
$Y = 0.40\ X_1 + 0.73\ X_4$	15.02	6.49	-56.80
$Y = 0.32\ X_2 + 0.97\ X_3$	15.02	10.31	-31.37
$Y = 0.32\ X_2 + 0.74\ X_4$	15.02	6.70	-55.37
$Y = 0.99\ X_3 + 0.77\ X_4$	15.02	12.91	-14.04
$Y = -0.75\ X_1 + 0.26\ X_2 + 0.64\ X_3$	15.02	9.42	-37.30
$Y = 0.38\ X_1 + 0.33\ X_2 + 0.73\ X_4$	15.02	6.47	-56.94
$Y = 0.80\ X_1 + 0.90\ X_3 + 0.77\ X_4$	15.02	12.40	-17.42
$Y = 0.34\ X_2 + 0.99\ X_3 + 0.62\ X_4$	15.02	12.79	-14.85
$Y = 1.16\ X_1 + 0.37\ X_2 + 1.02\ X_3 + 0.78\ X_4$	15.02	12.36	-17.71

X_1 = Length of main vine X_3 = Average fruit weight

X_2 = Female flowers/plant X_4 = Weight of first mature fruit

Table 17. Selection indices and relative efficiency of selection indices, through discriminant function (Robinson's method) over straight selection

Discriminant functions	Genetic advance through straight selection	Genetic advance through discriminant function	Relative efficiency
$Y = 3.23\ X_1$	15.02	5.21	- 65.33
$Y = 2.17\ X_2$	15.02	5.80	- 61.40
$Y = 1.08\ X_3$	15.02	11.52	- 23.29
$Y = 0.86\ X_4$	15.02	7.82	- 47.92
$Y = 0.95\ X_5$	15.02	15.02	0.00
$Y = 3.27\ X_1 + 2.16\ X_2$	15.02	7.80	- 48.06
$Y = 7.91\ X_1 + 1.60\ X_3$	15.02	16.24	8.11
$Y = -\ 0.83\ X_1 + 0.99\ X_5$	15.02	15.07	3.33
$Y = 2.35\ X_2 + 1.10\ X_3$	15.02	13.12	- 12.68
$Y = 2.38\ X_2 + 0.90\ X_4$	15.02	9.98	- 33.57
$Y = -\ 2.90\ X_2 + 1.28\ X_5$	15.02	16.08	7.08
$Y = 1.05\ X_3 + 0.81\ X_4$	15.02	13.68	- 8.95
$Y = 0.13\ X_3 + 0.89\ X_5$	15.02	15.07	3.13
$Y = 0.07\ X_4 + 0.97\ X_5$	15.02	15.03	0.07
$Y = 7.83\ X_1 + 2.47\ X_2 + 1.59\ X_3$	15.02	17.29	15.17
$Y = 4.12\ X_1 + 2.28\ X_2 + 0.75\ X_4$	15.02	11.09	- 26.18
$Y = 0.65\ X_1 - 0.31\ X_2 + 0.47\ X_5$	15.02	12.42	- 17.34

Table 17 (contd...)

Discriminant functions	Genetic advance through straight selection	Genetic advance through discriminant function	Relative efficiency
$Y = 9.33\ X_1 + 1.66\ X_3 + 1.11\ X_4$	15.02	19.01	26.57
$Y = 0.02\ X_1 + 0.14\ X_3 + 0.88\ X_4$	15.02	15.06	0.25
$Y = 2.07\ X_2 + 0.26\ X_3 + 0.85\ X_4$	15.02	11.13	- 25.89
$Y = 3.23X_2 + 1.34\ X_3 + 0.21\ X_5$	15.02	12.81	- 14.91
$Y = 0.20\ X_1 + 0.13\ X_4 + 0.77\ X_5$	15.02	13.93	- 7.27
$Y = -5.78\ X_2 + 1.07\ X_4 + 1.96\ X_5$	15.02	17.26	14.91
$Y = 0.15\ X_3 + 0.22\ X_4 + 0.87\ X_5$	15.02	15.06	0.24
$Y = 10.37\ X_1 + 2.47\ X_2 + 1.73\ X_3 + 1.82X_4$	15.02	21.61	43.88
$Y = 2.00\ X_1 - 0.34\ X_2 + 0.50\ X_3 + 0.66\ X_5$	15.02	15.16	0.93
$Y = 13.34\ X_1 + 9.10\ X_2 + 3.00X_4 - 1.61\ X_5$	15.02	9.30	- 38.09
$Y = 0.57\ X_1 + 0.23\ X_3 + 0.10\ X_4 + 0.83\ X_5$	15.02	15.40	2.52
$Y = 0.83X_2 + 0.66X_3 + 0.48X_4 + 0.38X_5$	15.02	14.81	- 1.41
$Y = 1.34X_1 - 0.73X_2 + 0.35X_3 + 0.16X_4 + 0.75\ X_5$	15.02	15.28	1.74

X_1 = Length of main vine
X_2 = Female flowers/plant
X_3 = Average fruit weight
X_4 = Weight of first mature fruit.
X_5 = Fruit yield/plant.

from a set of characters based on the relative magnitude of contributions made by the selected characters to yield based on path coefficient analysis. The selected characters are length of main vine, female flowers/plant, average fruit weight and weight of first mature fruit. When discriminant functions were fitted as per Smith's method, the straight selection for yield per se was found to be more efficient than selection through component characters or character combinations. The discriminant functions fitted as per Robinson's method indicated that selection based on component characters, length of main vine, female flowers/plant, average fruit weight and weight of first mature fruit gave a genetic advance of 21.61% explaining an efficiency of 43.88 per cent over straight selection. The genetic gain through discriminant function considering length of main vine, average fruit weight and weight of first mature fruit was estimated 19.01%. This was 26.57% more efficient than straight selection.

Discussion

D I S C U S S I O N

Information on variability and heritability of polygenic characters and on the association among yield and its component characters are of vital importance in any plant breeding programme. This is more so in a crop like ash gourd where a little work has only been done to improve the genetic potential

Fruit yield in ash gourd is appropriately a function of 10 component characters, days to first female flower anthesis, days to first male flower anthesis, length of main vine, male flowers/plant, female flowers/plant, percent of female flowers, average fruit weight, weight of first mature fruit, fruits/plant, and per cent of fruit set. The 32 genotypes differed significantly among themselves for yield and 10 component characters indicating conclusively the genetic difference existing in the materials under study. The existence of considerable variability indicated enough scope for improving the population. The 32 genotypes of ash gourd exhibited the highest estimate of genetic advance as per cent of mean for average fruit weight (164.95) followed by weight of first mature fruit (96.01) and fruit yield/plant (88.99). The highest estimate of genetic advance for average fruit weight resulted from a higher value of heritability (97.01%) associated with a high variability estimate (p.c.v. = 82.53). The lowest estimate of genetic advance as per cent of mean was observed for days to first female flower anthesis (3.72). The reason being low estimate of heritability (24.85) associated with low estimate of variability (p.c.v. = 7.26). The above findings imply that there is enough scope to improve the genotypes through mass selection for the characters average fruit weight and weight of first mature fruit. The limited variability for earliness is a matter of concern since earliness is one of the most important economic characters of ash gourd. There is need for further exploration and collection of genotypes for earliness. Alternatively transgressive segregants which are early have to be synthesised through disruptive selection and hybridization after considering the type of gene action governing earliness.

The observation that selection for more fruits/plant gives a genetic gain of 67.81 as compared to an estimate of 7.97 when female flowers/plant were selected is intriguing. The low fruit set and high female flower fall resulting from environmental, pathogenic and non-pathogenic reasons might make the selection for more female flowers/plant less effective and less efficient. Selection for more fruits/plant appeared to be more desirable. This calls for further research for verification.

Selection for yield *per se* may not be effective since implicitely or explicitely "there may not be genes for yield *per se* but rather for the various components, the multiplicative interaction of which results in the artifact, of yield (Grafius, 1956). This necessitates identification of appropriate compoent character(s) whose selection would result in the selection of complex characters like yield. Fruit yield/plant was observed highly correlated with length of main vine (r_g=0.48), female flowers/plant (r_g=0.70), average fruit weight (r_g=0.76) and weight of first mature fruit (r_g=0.59). The correlations between fruits/plant and fruit yield/plant was not significant, (r_g=0.13). The path coefficient analysis indicated that the average fruit weight has the maximum direct effect on fruit yield/plant (1.18) followed by length of main vine (1.04) and weight of first mature fruit. Female flowers/plant had the lowest estimate of direct effect.

The discriminant function equations fitted as per Robinson (1951) indicated maximum selection response for yield (relative efficiency = 43.88) when the 4 components, length of main vine (x_1), female flowers/plant (x_2), average fruit weight (x_3) and weight of first mature fruit (x_4) were involved in selection, the equation being.

$$Y = 10.37\ x_1 + 2.47\ x_2 + 1.73\ x_3 + 1.82\ x_4.$$

Using this equation yield could be predicted for known values of x_1, x_2, x_3 and x_4.

Length of main vine was identified as an important component character of fruit yield in pumpkin (Gopalakrishnan, 1979). This character determines spread of plant, vegetative and canopy growth and ultimately the optimum plant population that can be accommodated in a unit of land. Length of main vine was considered appropriately as a function of node at which first female flower appeared, node at which first fruit is retained, nodes on main vine, primary branches/plant, thick branches/plant, internodal length, internodal circumference and leaves/plant. The existence of a significant negative correlation between length of main vine and internodal circumference ($r_g = -0.42$) is a worthwhile information which could be made use of in the selection of 'bushy' type(s) of ash gourd. As expected, positive and significant correlations were observed between length of main vine and nodes at which first female flower appeared (r_g=0.61), nodes on main vine (r_g=0.50) and leaves/plant (r_g=0.78). The leaves/plant per se followed by nodes on main vine has contributed the maximum direct effect on length of main vine (1.03 and 0.78 respectively) These observations are in agreement with those observed in pumpkin by Gopalakrishnan, (1979).

The weight of first mature fruit was considered as a function of circumference of fruit, length of fruit, fruit shape index, flesh thickness, seeds/fruit, 100-seed weight, protein conent, phosphorus content and potassium content. The 32 genotypes were highly significant for all the 9 characters implying significant genetic differences, which could be made use of in the crop improvement. The prospects of breeding for high protein lines in ash gourd is a feasible possibility due to the presence of considerable variability. The character protein percentage is quantitative having a heritability estimate of 99.35%. The genetic gain estimated was 38.18 indicating the effectiveness of mass selection to improve ash gourd for high protein content. Flesh thickness, another important character of ash gourd has a heritability estimate of 98.10%. The expected genetic gain was 156.77% indicating scope for improvement of ash gourd for more flesh thickness through simple mass selection. Fruit shape index is another important character of the fruit which could be manipulated as per consumer's demand. This is possible because of the presence of considerable variability (p.c.v. = 61.37), heritability (65.24) and expected genetic gain (82.48).

The weight of first mature fruit was positively and significantly correlated with circumference of fruit (r_g = 0.98), length of fruit (r_g = 0.69), flesh thickness, (r_g = 0.51), seeds/fruit (r_g = 0.38) and 100-seed weight (r_g = 0.72). The potassium percentage had also a significant correlation with weight of first mature fruit (r_g = 0.59). Circumference of fruit had the maximum direct effect on weight of first mature fruit (0.82). Flesh thickness has got negative direct effect (-0.28). In pumpkin, Gopalakrishnan (1979) observed that flesh thickness contributed more to weight of first mature fruit. This is quite apparent from the mesocarp arrangement observed in ash gourd that is distinct and different from that in pumpkin.

The genotypic correlation coefficients among fruit yield/plant, length of main vine and weight of first mature fruit and their respective possible components were observed to be greater than the corresponding phenotypic correlation coefficients except in few cases. This is in agreement with the reports of Thakur and Nandpuri (1974) in watermelon, Srivastava and Srivastava (1976) and Ramachandran (1978) in bitter gourd and Gopalakrishnan (1979) in pumpkin.

A relationship between phenotypic, genotypic and environmental correlations was worked out by Falconer (1960). He proposed the equation:

$$r_{xy}(p) = \sqrt{h^2 x \; h^2 y} . \; r_{xy}(g) + \sqrt{e^2 y \, e^2 x} \, r_{xy}(e)$$

where, $h^2 x$ and $h^2 y$ refer to heritability estimates of characters x and y respectively, $e^2 x = \sqrt{1-h^2 x}$ and $e^2 y = \sqrt{1-h^2 y}$ and $r_{xy}(p)$, $r_{xy}(g)$ and $r_{xy}(e)$ stand for phenotypic, genotypic and environmental correlation coefficients respectively between characters x and y. In the present study heritability estimate in broad sense was found high for most of the polygenic characters. This resulted in higher estimates of genotypic correlation coefficients than the phenotypic correlation coefficients.

The present study could identify promising lines for higher yield, flesh thickness, protein content and average fruit weight (Fig.6). The genotype 'B.H.21' has highest yield (32.01 kg), higher flesh thickness (6.61 cm) and higher protein content (8.12%). The average fruit weight of this genotype was 9.00 kg. An ash gourd variety suited for homestead nutrition garden should be one with fruit weight ranging from 3 to 5 kg with higher protein content and flesh thickness. The genotype 'B.H.24' has an average fruit weight of 4.41 kg, flesh thickness of 5.87 cm and protein content of 8.7%, the fruit yield/plant being medium (15.68 kg). The study indicated the genotype 'B.H.24', if improved for high yield potential, could be utilized for homestead gardening.

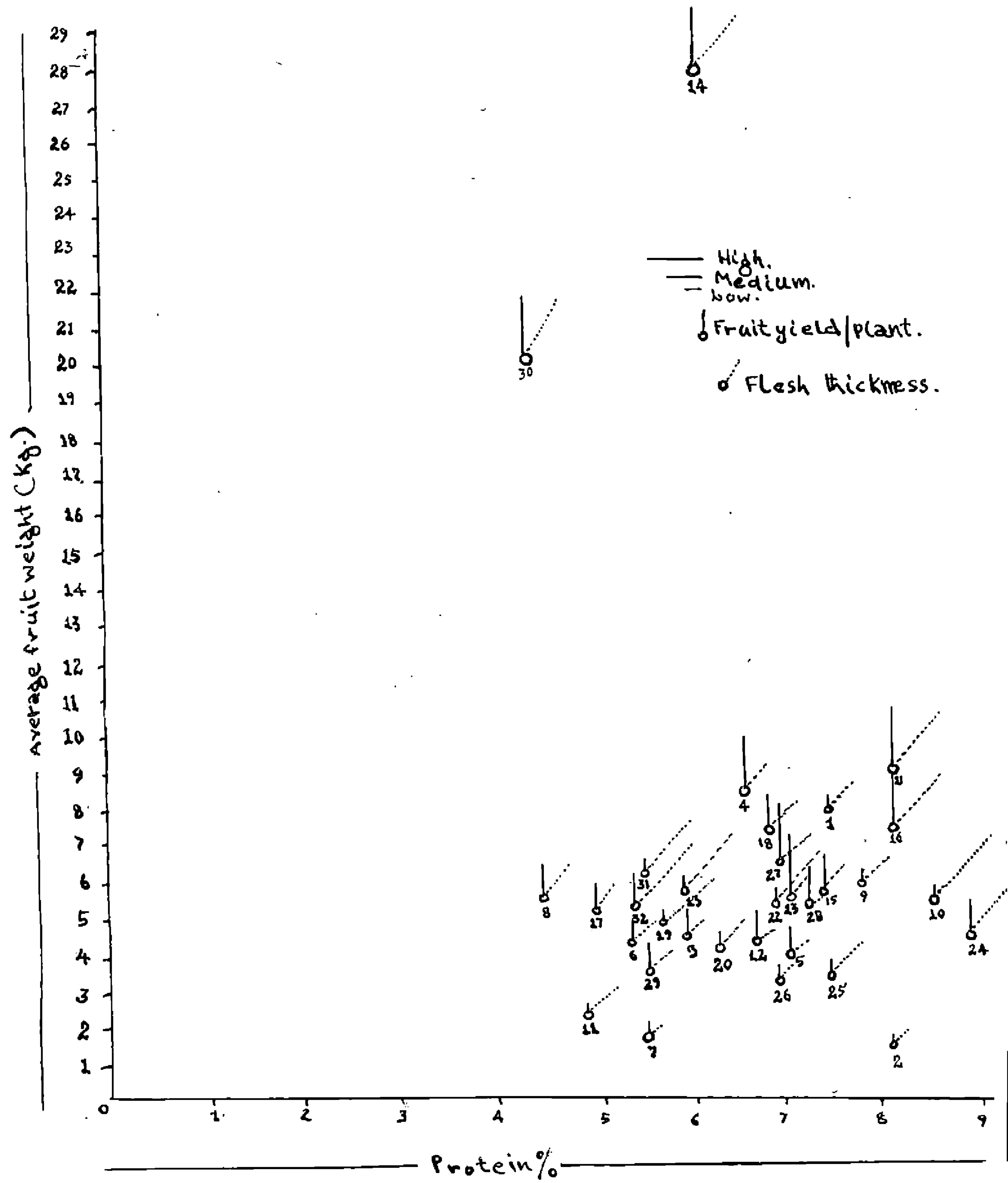


Fig: 6. Performance of 32 ash gourd genotypes with respect to 4 important economic characters.

Summary

Summary

SUMMARY

A field experiment was laid out during 1979-80 at the Instructional Farm, College of Horticulture, Kerala Agricultural University, Vellanikkara to estimate genetic variability, correlations, path coefficients and selection indices in ash gourd (Benincasa hispida (Thumb.) Cogn.).

2. The experimental materials consisted of 32 ash gourd genotypes collected from different parts of Kerala and Tamilnadu.

3. The 32 ash gourd genotypes were significantly different for fruit yield and its ten component characters, length of main vine and its eight component characters and weight of first mature fruit and its nine component characters.

4. Variability was limited for days to first female flower anthesis and as such there is need to generate variability through further collection, disruptive selection and hybridization.

5. Average fruit weight was observed to have the highest value of genetic advance in the next cycle of selection followed by weight of first mature fruit

and fruit yield/plant. The per cent of fruit set exhibited the highest estimate of heritability followed by fruits/plant and average fruit weight.

6. Fruit yield/plant was significantly and positively correlated with length of main vine, female flowers/plant, average fruit weight and weight of first mature fruit. The average fruit weight had the maximum direct effect on fruit yield/plant followed by length of main vine.

7. The discriminant functions indicate maximum selection response for yield when the four components, length of main vine, female flowers/plant, average fruit weight and weight of first mature fruit were used together as component characters in selection with equal weightage. Higher genetic response for yield could be expected through such a selection programme considering the above four characters together at a time.

8. The existence of a significant negative correlation between length of main vine and internodal circumference is a worthwhile information which could be made use of in the selection of bushy types of ash gourd. The breeding for bushy types is a distinct possibility

in ash gourd which could be achieved through further collection of germplasm and studying inheritance of the component characters of length of main vine.

9. The prospects of breeding for high protein lines in ash gourd is a feasible possibility due to the presence of considerable amount of variability in the material studied. The character protein percentage appears quantitative with a heritability estimate of 99.35%.

10. In ash gourd, circumference of fruit had the maximum direct effect on weight of first mature fruit unlike in pumpkin where flesh thickness contributed more to weight of first mature fruit. This is quite apparent from the mesocarp arrangement observed in ash gourd that is distinct and different from that in pumpkin.

11. The present study could identify 'B.H. 21' as the promising line with highest yield (32.01 kg), higher flesh thickness (6.61 cm) and protein content (8.12%) whose average fruit weight was 9 kg. An ash gourd variety suited for homestead nutrition garden should be one with average fruit weight ranging from 3 to 5 kg with higher protein content and flesh thickness.

The genotype 'B.H. 24' which had an average fruit weight of 4.41 kg, protein content of 8.7%, flesh thickness of 5.87 cm and fruit yield of 15.68 kg, if improved for high yield potential could be utilized for homestead gardening.

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* Originals not seen.

Appendix 1. Meteorological data during the cropping period

Days			Temperature (°C) Maximum	Temperature (°C) Minimum	Humidity (%) Morning	Humidity (%) Evening	Total rainfall (mm)
29-10-79	to	4-11-79	32.1	23.9	93	70	0.5
5-11-79	to	11-11-79	31.5	24.3	80	61	10.2
12-11-79	to	18-11-79	30.4	23.7	91	80	95.6
19-11-79	to	25-11-79	29.8	23.0	93	71	135.2
26-11-79	to	2-12-79	31.3	23.8	90	69	64.0
3-12-79	to	9-12-79	31.2	23.6	84	64	0.0
10-12-79	to	16-12-79	31.1	23.6	80	61	0.0
17-12-79	to	23-12-79	31.2	21.8	80	54	0.0
24-12-79	to	31-12-79	30.5	22.3	74	52	0.0
1-1-80	to	7-1--80	31.2	20.8	74	50	0.0
8-1-80	to	14-1--80	30.7	21.7	69	45	0.0
15-1-80	to	21-1--80	31.0	21.3	75	48	0.0
22-1-80	to	28-1--80	31.8	19.4	78	37	0.0
29-1-80	to	4-2--80	33.0	21.3	77	43	0.0
5-2-80	to	11-2-80	34.0	21.1	79	36	0.4
12-2-80	to	18-2-80	34.0	21.6	81	34	0.0
19-2-80	to	25-2--80	36.4	21.9	82	27	0.0
26-2-80	to	4-3--80	35.6	23.1	93	51	0.0
5-3-80	to	11-3--80	35.7	23.5	93	53	0.0
12-3-80	to	18-3--80	36.0	23.0	83	42	0.0
19-3-80	to	25-3--80	36.8	23.0	92	42	0.0
26-3-80	to	31-3--80	35.9	24.5	80	54	1.8

Source : Meteorological observatory, District Agricultural Farm, Mannuthy.

Plate I	Field performance of ash gourd genotype 'B.H. 21'

Plate II	Field performance of ash gourd genotype 'B.H. 24'


B.H.-21


BH-24

Plate III Field performance of ash gourd genotype 'B.H. 14'

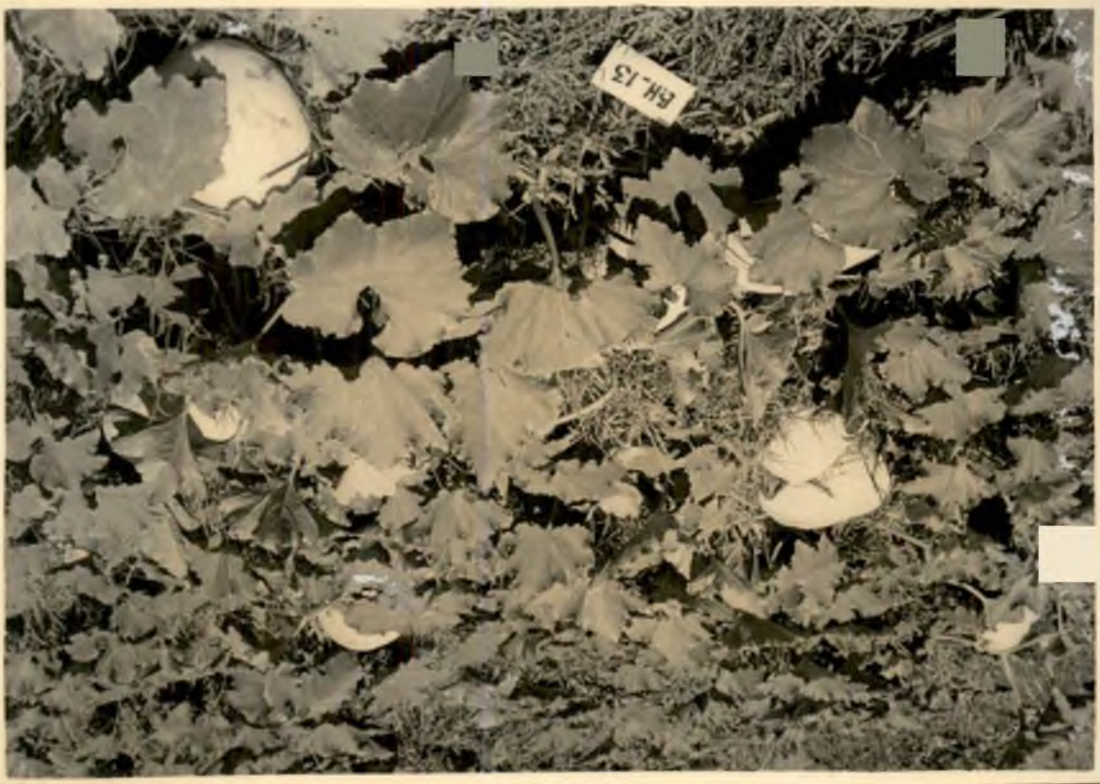
Plate IV Field performance of ash gourd genotype 'B.H. 4'


BH.14


BH-4

Plate V Field performance of ash gourd genotype 'B.H. 9'

Plate VI Field performance of ash gourd genotype 'B.H. 13'


BH.13


BH-9

Plate VII Fruit characters of different ash gourd genotypes ('B.H.1', 'B.H.2' and 'B.H.3')

Plate VIII Fruit characters of different ash gourd genotypes ('B.H.4', 'B.H.5' and 'B.H.6')


BH-1
B.H-2
B.H-3


BH-4
B.H-5
B.H-6

Plate IX Fruit characters of different ash gourd genotypes ('B.H.7', 'B.H.8' and 'B.H.9')

Plate X Fruit characters of different ash gourd genotypes ('B.H.10', 'B.H.11' and 'B.H.12')

Plate XI Fruit characters of different ash gourd genotypes ('B.H.13', 'B.H.14' and 'B.H.15')

Plate XII Fruit characters of different ash gourd genotypes ('B.H.16', 'B.H.17', and 'B.H.18')


B.H. 13
B.H. 14
B.H. 15

Plate XIII Fruit characters of different ash gourd genotypes ('B.H.19', 'B.H.20' and 'B.H.21')

Plate XIV Fruit characters of different ash gourd genotypes ('B.H.22', 'B.H.23' and 'B.H.24')


B.H. 19
B.H. 20
B.H. 21

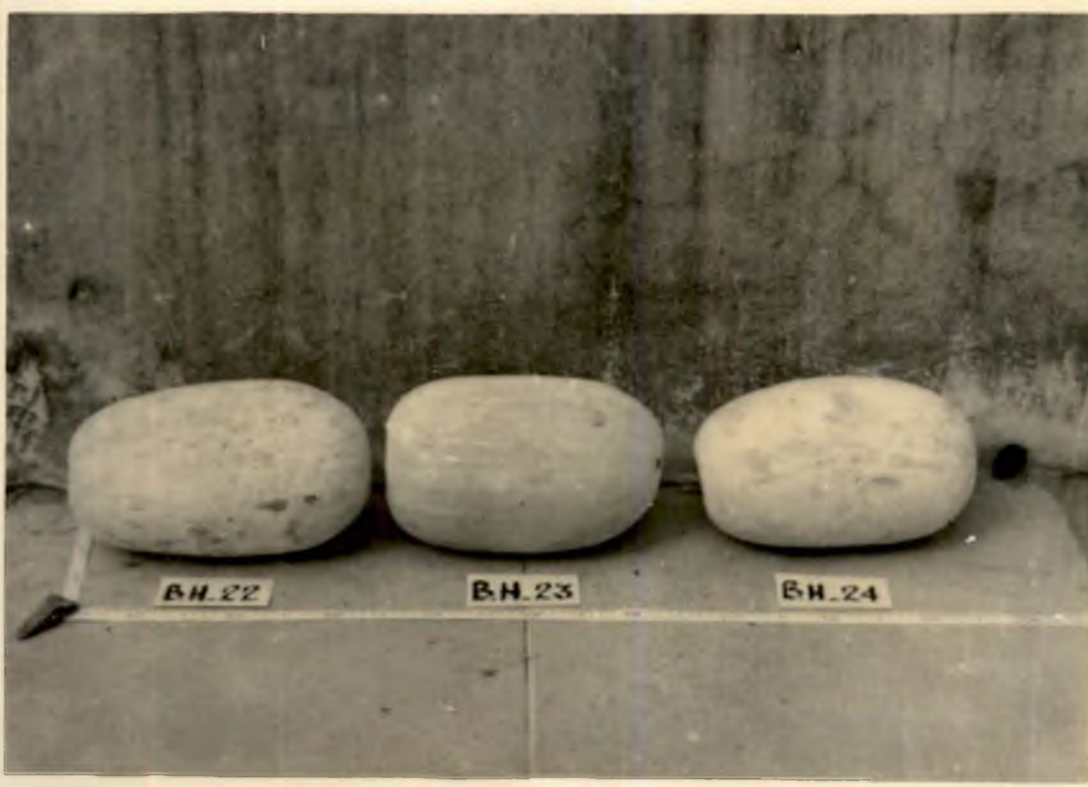

B.H. 22
B.H. 23
B.H. 24

Plate XV Fruit characters of different ash gourd genotypes ('B.H.25', 'B.H.26' & 'B.H.27')

Plate XVI Fruit characters of different ash gourd genotypes ('B.H.28', 'B.H.29' & 'B.H.30')


B.H_25
B.H_26
B.H_27


B.H_28
B.H_29
B.H_30

Plate XVII Fruit characters of different ash gourd genotypes ('B.H.31' and 'B.H. 32'


B.H_31
B.H_32

BIOMETRICAL STUDIES IN ASH GOURD

(*Benincasa hispida* (Thumb.) Cogn.)

BY

GEORGE, T. E.

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 Olericulture

COLLEGE OF HORTICULTURE

Vellanikkara, Trichur.

1981

A B S T R A C T

A field experiment was laid out during 1979-80 at the Instructional Farm, College of Horticulture, Kerala Agricultural University, Vellanikkara to estimate genetic variability, correlations, path coefficients and selection indices in ash gourd (Benincasa hispida (Thumb.) Cogn.).

The experimental materials consisted of 32 ash gourd genotypes collected from different parts of Kerala and Tamil Nadu.

The 32 ash gourd genotypes were significantly different for the 28 polygenic characters studied. Average fruit weight was observed to have the highest value of genetic advance in the next cycle of selection followed by weight of first mature fruit and fruit yield/plant.

Fruit yield/plant was positively correlated with length of main vine, female flowers/plant, average fruit weight and weight of first mature fruit. The average fruit weight had the maximum direct effect on fruit yield/plant followed by length of main vine. Length of main vine was positively correlated with node at which first female flower appeared, nodes on main vine and leaves/plant. Circumference of fruit had the maximum

direct effect on weight of first mature fruit followed by length of fruit.

The discriminant functions indicated maximum selection response for yield when the four components, length of main vine, female flowers/plant, average fruit weight and weight of first mature fruit were used together in selection with equal weightage.

The present study, could identify the genotypes 'B.H.21' and 'B.H.14' as high yielders, (32.01 and 30.82 kg respectively). The genotype 'B.H. 24' which had an average fruit weight of 4.41 kg, protein content of 8.7%, flesh thickness of 5.87 cm and fruit yield of 15.68 kg, if improved for high yield potential could be utilised for homestead gardening.