STUDIES
ON
THE FORMULATION OF SELECTION INDEX
FOR
YIELD IN CHILLIES (*Capsicum annuum*, L.)

BY

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THESIS

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C E R T I F I C A T E

This is to certify that the thesis herewith submitted contains the results of bonafide research work by Shri R.Sankaranarayana Pillai, under my supervision. No part of the work embodied in this thesis has been submitted earlier for the award of any degree.

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INTRODUCTION

INTRODUCTION

Chilli, also called red pepper, is an important condiment crop grown for its pungent fruits,which are used both in the green and dried forms to impart pungency to food. It is also used medicinally and in various other food preparations.

This crop was introduced to India from tropical South America, in the 17th century. Now it is grown in all parts of India covering annually about 1.5 million acres and producing 364 thousand tons of dry chillies. Andhra Pradesh, Maharashtra, Mysore and Madras account for about 75 per cent of the area under cultivation and annual production. In Kerala chillies are grown in some districts covering an area of 8136.18 acres producing an average of 2240 tons of dry chillies. The importance of this crop as a condiment,necessitates its large scale production, for which refinements are inevitable.

The motive of any crop breeding programme is to obtain high yielding superior varieties. However,yield of plants is a complex character decided and governed by a polygenic system acted upon by environment and other 'fluctuations'. These features stand on the way of direct selection for this character. For overcoming these difficulties so as to make selection more efficient, indirect methods like determination of the relationship existing between yield and other less variable characters of the plant, which would serve as suitable guides for choosing high yielders should to be adopted. The existance and intensity of the association are usually determined by the study of correlations existing between the different characeters and yield.

In correlation studies it is quite usual to evaluate the characters in a good number of varieties and to utilise such correlational status of different characters with yield, as an index in deciding the factor on which the selection pressure is to be exerted. Previous workers utilised mostly the phenotypic variation in different characters. But advanced knowledge in biometric has made possible the estimation of the phenotypic and genotypic components of variations and also the formulation of suitable selection indices based on Fisher 's concept of discriminant function, which serves as the best yard-stick for selection. Various investigators have established the usefulness of selection indices in the breeding programmes of different crops.

Since there is no profound knowledge regarding the contributor factors and their successful application in constructing suitable selection indices in capsicum, an attempt has been made in the present investigation for a detailed study of these aspects in a divergent collection of ten varieties.

The work appears to be the first of its kind in this crop; and the results of the studies contribute valid informations of practical importance in plant selection.

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REVIEW OF LITERATURE

REVIEW OF LITERATURE

The usefulness of correlation studies in plant improvement needs no emphasis. Estimates of correlation between various characters in a crop, especially when partitioned into genotypic and environmental components are of great value in planning and evaluating breeding programmes. A knowledge of correlation between multiplicative characters like yield and its components, which show less susceptibility to environmental conditions and are therefore capable of being measured with greater precision, can obviously be of considerable use in selection. Correlations between economically important and unimportant characters are also of interest in so far as some of the unimportant characters could be conveniently used as indicators of the former. Again where the economic networth of a crop is dependent upon a number of components, a knowledge of the correlation between such components is essential. Salient results of works done on this direction in various crop plants are reviewed here.

In rice(Oryza sativa) Vibar(1920) recorded that height, length of panicle and duration were positively correlated with yield, although increased straw-weight was not always associated with yield. Mendiola(1926) recorded intervarietal variation in correlation with many characters contributing towards yield. Bhide(1926) and Bhalerao(1927) found high positive correlations between yield and number of ear-bearing tillers, and a low value of correlation for length of the main panicle. Mahalanobis(1934) studying the various characters of 147 varieties of rice noted that mean yield was correlated with number of tillers per plant and length of leaf, but independent of characters like size of grain, height of plant and duration. Narasinga Rao(1937) observed that yield was highly correlated with number of tillers, length of panicle and number of grains per ear. Further he formulated a multiple regression function for yield with number of tillers, length of ear head and number of grains per ear and he concluded that tillering and yield are highly correlated. Chakravarthy(1940) showed that there is no significant relationship between characters like flag leaf diamensions, length, breadth and thickness of grains etc. to yield. Ganguli and Sen(1941) have recorded that yield was positively correlated with height of tillers, length of panicle and number of grains per panicle. Ramiah(1953) in the review of experimental results obtained at various rice research stations, stated that yield was positively correlated with mean yield and number of tillers per plant. He also presented the association of yield with height, ear-length and mean number of grains per ear as positive, but feeble. Eikichi(1954) obtained high positive correlation between yield and component characters as tillering, weight of ear, length of ear and number of grains per ear. Ghose et al.(1956) in their study of intervarietal correlations found that length and number of panicle were positively correlated with yield, while height had only a negligible contribution. Sayed and Krishnamoorthy(1956) in a biometrical study of rice under different spacings, reported that the contribution of length of ear head and number of tillers was positive and the number of ear bearing tiller the most potent yield component. Chandramohan(1964) studied seven component characters of yield in rice, namely plant height, number of ear-bearing tillers, length of ear, number of grains per primary ear, number of grains per plant, weight of 1000 grains and yield of straw and reported that the number of ear-bearing tillers, number of grains per plant and yield of straw have very high association with yield, while plant height and number of grains per primary ear showed moderate correlations with yield. All the other characters studied did not have high correlation with yield.

Love(1912) showed a positive correlation between height of plants and yield and average weight of kernels in wheat (Triticum sp.). Arny(1918) studying the correlation of characters with special reference to weight of seed sown, noted that increase in yield was in accordance with the number of kernels, number of clums and total length of spikes, and was less closely by an increased mean weight of kernels and mean height of clum. Smith(1925) from his studies on a series of varieties of wheat concluded that no uniform correlation existed between yield and number of ears per plant. Hayes et al.(1927) studied the association between yield and reaction to certain diseases on other characters of spring wheat and winter wheat, and showed significant positive correlation between yield and plant height. Bridgeford and Hayes(1931) working on red spring wheat, obtained positive correlation of yield with plumpness of grain, weight of 1000 kernels, date of heading and height. Among these characters plumpness of grains was positively correlated with weight of 1000 kernels, date of heading and number of heads per row, but it was negatively correlated with kernels per spike. Date of heading was positively correlated with heads per row. Correlation between height and kernels per spike was positive. Pal and Butany(1947) recorded dependence of yield to number of kernels per spike and average weight of grains per ear. Simlote(1947) reported high association of yield with 1000-grain weight and number of tillers in durum wheats. Weibel(1956) while studying the association of yield and its component characters noted phenotypic correlations with many heads, high grain yield, high kernel weight and high bushel weight. Sikka and Jain(1958) in the study of correlations in aestivum wheats, found high correlations between yield and some ancillary characters like number of grains per ear. Karamsingh and Nandapuri(1959) in studying the date of heading, plant height and tillering in three wheat crosses obtained correlations between date of heading, plant height and number of tillers. In some crosses correlation was significant but they tended to be low in magnitude. Sikka and Maini(1962) showed that the main contribution of yield was by the number of ear-bearing tillers and the average weight of ear. They observed that spike fertility and ear weight were more closely related to yield than tillering capacity in the 36 strains of newly evolved wheat varieties of Punjab. Bhide(1963) studied inheritance and correlation in vulgare wheat population and recorded positive correlations between tillers per plant, grains per ear and ear length, germination and stand at thinning and negative correlations in germination and number of days taken to flower. Gandhi <u>et al.</u>(1964) while studying the genotypic variability and correlation co-efficients relating to grain yield and a few other quantitative characters in Indian wheat, found that number of ears per plant and 1000-grain weight gave high estimates of heritability and genetic advance. These vere highly and positively correlated with grain yield.

Kottur and Chavan(1928) in a study with jowar(Sorghum Sp.) noted a close interrelationship between yield and other quantitative characters like plant height, number of internodes and thickness, length and weight of ear heads. Kohle(1951) observed that height of plants, number of internodes, girth of stem and length, thickness, and weight of ear-head, together contributed for yield of grain and fodder. Vishnuswarup and Chaugale(1962) studying on selection indices for grain yield and fodder yield in Sorghum vulgare observed that fodder yield was positively correlated with the number of days of panicle emergence, height, stalk diameter and number of leaves. Plant height was correlated with grain yield in all the varieties. They, in a review of studies on sorghum sp. stated that the various characters such as plant height, stem thickness, number of leaves, length, girth and weight of panicle, length of rachis and size of grain were correlated with either yield of grain or yield of fodder. Stickler and Pauli(1963) while studying yield and yield components in sorghum as influenced by date of planting showed that, of the three yield components evaluated, number of seeds per panicle was most consistantly and most highly correlated with yield.

In maize(<u>Zea</u> <u>mays</u>) Jenkins(1924) recorded that within the inbred lines, yield was significantly and positively correlated with plant height, number of ears per plant, ear length, ear diameter, and shelling percentage, and negative with date of silking and ear shape index. Robinson <u>et</u> <u>al</u>.(1949) recorded strong association of yield with ear weight. Murthy and Roy(1957) in their study of Indian collection of maize varieties with special reference to the relationship between yield and other characters calculated total, partial and multiple correlations between various characters including yield. Characters like weight of ear, length of ear, leaf area and 100-grain weight were significantly correlated with yield. Chase <u>et</u> <u>al</u>.(1965) in their study of the relation between leaf number and maturity in maize have shown significant positive correlation between the average number of leaves per plant and the average number of days to 50% anthesis of progenies. Hatfield <u>et</u> <u>al</u>.(1965) in their studies on the growth and yield of corn components of mature ears have recorded that the correlation of ear components with yield and with each other was found to be affected by factors associated with the season of growth and soil moisture. This suggested that ear component analysis is of little value for determining the genetical yield potential values.

Bonnet and Woodworth(1931) studying the

association between yield and other morphological characters in barley(Hordeum vulgare) found that number of tillers, number of ears and 1000-grain weight contributed appreciably to yield. Graphius et al.(1952) have shown similar results when they worked out the heretability of yield and the related characters. Fiuzat and Atkins(1953) recorded that heading date and maturity-date were significantly correlated with yield of grain.

In oats(Avena sativa), Stephens(1942) showed high correlations between yield and number of spikelets and spikelet-weight and size of grains. He did not get any association of tillering with yield. Graphius(1956) proposed that yield in oats could be represented as the volume 'W' of a rectangular Parallelepiped, whose sides, xy and z represented the average number of panicle per unit area, the average number of kernels per panicle and the average kernel weight respectively. Frey(1959) examined yield components in relation to response of nitrogen and noted that increase in yield was dependent on increase in the number of heads per plant and number of seeds per head.

Mahadevappa and Ponnaiya(1963) in a varietal study of ragi(Elusine sp.) for the formulation of selection index, could find that the number of ear-bearing tillers, weight of straw, and number of fingers were the main components of yield.

In pearl millet(Pennisetum typhoides) Ayyangar *et al.*(1936) have shown correlation of yield with weight and length of panicle, number of grains and number and thickness of tillers, in order of importance. Shankar *et al.*(1963) in the analysis of 1000 plants grown from a random sample which was drawn from the open pollinated bulk of improved Ghana variety, estimated the phenotypic correlations among plant height, yield and four of the yield components namely, spike-length, spike-girth, spike-density and seed size. All these characters were positively and significantly correlated with yield.

Ratnaswamy(1963) affirmed strong association of weight of panicle, number of productive tillers, yield of straw and the length of main panicle with grain yield in italian millet(*Setaria italica*).

In soybean(*Glycine max*)Stewart(1925) showed that height of plant was more nearely associated with yield in determinate types than in indeterminate types. Bian,Kou yuen(1930) worked out the correlation of characters and found that number of pods and height of plants were highly correlated with yield of seed. Woodworth(1932) in the analysis of yield into its components, showed that the only significant correlation existed was between yield and average weight of 100-seeds. Between components themselves negative significant correlation was recorded for number of nodes and average weight of 100 seeds. Whetherspoon and Wentz(1934) observed that the number of pods per plant, number of nodes, number of pods per node and height of plant were significantly and simply correlated with number of pods, number nodes and height. Shih(1947) recorded correlation between yield and plant height, number of branches, seed size, seed number, seed weight and pod number. Bartely and Webber(1952) recorded positive and significant correlation between maturity date, height and yield. Waddle(1952) from a study of the components, concluded that the yield was considered to be the product of the components, number of nodes with pods, number of pods per node, number of seeds per pod and the average weight of seed. Johnson <u>et al</u>.(1955) have observed significant and positive correlation between yield on one side and period of flowering, length of pods, number of pods and weight of pods on the other side. Yoshino <u>et al</u>.(1955) noted a marked positive correlation between specific gravity and weight of seeds per plant. Hanway(1956) has recorded high and significant correlation between number of days for first flowering and number of days to maturity. Similar high positive correlation was observed between number of days from first flowering to maturity and number of days to maturity and also between number of seeds and yield of seeds. Number of pods in the main stem had a strong association with number of seeds and yield. Brim *et al.*(1959) found strong association between yield and number of pods. Thampi(1961) studying the effect of sowing dates on yield and component characters observed high positive correlations between yield and number of pods per node and total number of pods in the July sowing. But in the August sowing positive significance was obtained between yield and 100-seed weight, yield and number of cluster-bearing nodes on the main stem, yield and number of branches and between yield and plant height in addition to the association found in the July sowing. He also studied partial correlation between yield and four of its components namely 100 seed weight, number of cluster-bearing nodes on main stem, number of podes per cluster and total number of pods per plant and showed that absolute correlation co-efficient between yield and any one of the components after eleminating the effect of other three were not significant though positive in the July sowing. Multiple correlations showed that in both July and August sowings, the components jointly contributed towards yield. The intensity of correlation was found to be more in the August - sown crop.

Venkataraman and Jagannatha Rao(1933) in their studies to determine characters indicative of yield in bengalgram(*Cicer arietinum*), observed that weight of pods, weight of shoot and seed weight formed a very closely related group of characters, the co-efficient of correlation exceeding 0.9 in all cases.

In mung bean(*Phaseolus aureus*) Balram Singh and Bhatnagar(1964) showed that the number of days from seedling to harvesting can be predicted fairely accurately from the number of days from seeding to initiation of flowering. The characters are positively and significantly correlated.

Stroman(1930) in the biometrical analysis of certain characters in cotton(*Gossypium* sp.) concluded that yield was highly and positively correlated with bolling potential. Brown(1935) reported significant correlation between boll contents and seed weight in Egyptian cotton. Correlation was however negative between ginning out turn and seed weight. Pnase and Kargonkar(1949) in their attempt to formulate a discriminant function for selection for yield in cotton, analysed yield into its components. They observed significant correlation of lint yield with number of bolls, weight of lint per boll and weight of lint per seed. Stroman(1949) showed negative significant correlation between height and number of fruiting branches and height and number of bolls. Smith(1956) from a study of some quantitative characters in a cross of two varieties of *Gossypium hirsutum* concluded that lint percentage was unfavourably associated with other fibre properties and selection for boll size would result in stronger, longer and finer fibers but low lint percentage. Manning(1956) observed that characters like number of bolls per plant, seeds per boll and lint per seed as the primary components of yield in cotton. Venkataraman(1960) showed significant correlation between lint yield and number of bolls and between lint index and ginning percentage. Joshi _et al._(1961) in the review of the studies on the component characters in cotton stated that the main components of lint production were boll number per plant and boll weight, number of locules per boll, number of seeds per locule, seed index(100 seed weight) and lint index(weight of lint per seed). Saxena(1963) in the study of correlation between some characters in cotton, found a positive correlation to exist between height and dry matter accumulation(D.M), between D.M and yield of seed cotton and between the latter and plant height and number of bolls respectively.

Ling(1954) in the analysis of yield and its related characters in ground nut(_Arachis hypogaea_)showed that number of pods per plant, weight of pods per plant and number of seeds per pod were found to have a marked influence on yield. Mishra(1958) noticed strong association between characters, yield, size of seed, number of pods and number of kernels per pod.

In a study of the association of yield and other characters Kumar and Ranga Rao(1949) and Sikka and Gupta(1949) have shown positive correlation between yield and number of branches, number of capsules and height of plant in gingelly(Sesamum indicum). Varisai et al.(1964) recorded correlation between yield and 1000 seed weight, capsule number and capsule size in 100 varieties. When all the varieties were taken together the three components showed significant positive correlation with yield.

In Linseed(Linum usitatissimum),Batcha(1959) recorded correlation between yield and ripening period and 1000 seed weight. Kedarnath et al.(1960)found significant positive correlation between yield and capsule number.

Sindagi(1965) in the study of genotypic variability and correlation co-efficients relating to yield and a few other quantitative characters in castor(Ricinus communi showed high co-efficients of genetic variation, heritability and genetic gain values for number of capsules on the main spike and length of the pistillate portion of the main spike. The correlation between these two characters towards yield was positive. A negative correlation between branch number and spike length indicated that branching was less frequent with increased length.

DISCRIMINANT FUNCTION AND SELECTION INDEX.

Discriminant function which is an index for selection, makes use of the statistical constants to evaluate genotypic worth of the yield components in building up the ultimate yield. The function is calculated on the basis of:-

1. The correlation existing between yeild and its component characters, which show less susceptibility to environmental factors and

2. The weights allotted to these characters depending on their relative importance.

In selecting plants for yield or for other desirable combinations of attributes, the breeder very often faces difficulty in isolating desirable types because of the fact that heritable differences with respect to such quantitative characters are to some extent masked by non heritable or environmental variations. The problem then arises as to what is the best indicator of the genotype of any individual plant or variety. The observed yield is, no doubt, a good measure. But if the factors influencing yield affect to some extent other observable characters of the plant, then these latter characters can be used in assessing the strength of factors responsible for yield.

This can also be looked upon as a problem of prediction as to how best the genotypic value with respect to some characteristics to be predicted, when measurements on a number of observable characters are available (Radhakrishna Rao,1952). And here the discriminant function technique serves as an aid to the breeder.

Hazel and Lush(1942) compared three methods of selection in animals and plants namely:-

1. Method of independent culling levels.
2. Tnadem selection.
3. Selection index method.

They advanced the view point that the selection index method was most efficient than the other two methods of selection. Robinson et al.(1949), Johnson et al.(1955), Manning(1956) and Brim et al.(1959) also stressed the importance of multiple selection criteria.

Discriminant function is considered to be the best among all the linear functions of selection. This for the first time was evolved by Fisher(1936) in connection with the anthropometric measurements. Smith(1936) was the first to apply this technique in selection for plant yield. Panse(1940) stressed the importance of heritable variability and genetic analysis of the characters for selection efficiency.

Simlote(1947) expressed his view that expected genetic advance for any selection intensity was found to be greater especially when selection was done with the help of discriminant function than when done directly on the observed characters.

Abraham _et al_.(1954) in the work on discriminant function for yield in rice, taking into consideration four components namely number of tillers per plant, number of panicles per plant, number grains per panicle and 1000 grain weight. They stated that for the practical consideration, species selection for yield might give some efficiency if adequate replications were given in conducting the trial. They were also of opinion that discriminant function formulae were likely to be of use mainly in selection of single plants or progenies from segregating material where the amount of available seed was a limiting factor.

Johnson _et al_.(1955) showed that an index computed on fruiting period and seed weight was 96 and 111 per cent respectively as effective in increasing yield as straight selection into two populations of soybeans.

Manning(1955) computed an index based on components, number of bolls per plant, number of seeds per boll, and lint per seed and could obtain genetic advance of the order of 35 per cent in upland cotton in Uganda.

Fryxell(1956) analysed yield into component traits in thirteen varieties of Gossypium hirsutum. Various characters were used to construct fourteen selection indices. The indices tended to be more efficient criterian for selection than yield itself having a mean efficiency of 250 per cent compared to direct selection for yield.

Panse(1957) stated that whereever individual characters involved were merely direct components of yield, the discriminant function showed no advantage. However the case was different when selection was made on several independent characters whose economic contribution to the complex genotype might be different or when in selecting the complex character, consideration was made on one or more extraneous characters.

Kempthorne(1957) expressed a note of caution against the uncritical use of selection index without consideration of the correlational status among characters.

Sikka and Jain(1958) constructed selection index in aestivum wheat to aid in breeding work. But the genetic advance obtained from the discriminant score based on ear number and 1000-grain weight was not greater than direct selection for yield.

Vishnu Swarup and Chaugale(1962) used discriminant function for constructing suitable selection indices for selection for grain and fodder yield in sorghum. The results showed that in the case of grain yield, none of the indices gave a higher efficiency than that obtained from selection for grain yield alone. In the case of fodder yield, plant height, stalk diameter, and leaf number, recorded an increased efficiency of 11.56 per cent over direct selection.

Ratna Swamy(1962) made an index for selection in Seteria italica taking number of productive tillers and weight of straw as ancillary characters.

Kamalanathan(1962) has shown in Gossypium arboreum that three characters namely number bolls per plant, number of seeds per boll and lint index were capable of influencing lint yield to the extent of 64.83 per cent.

Sankar *et al.*(1963) observed that selection index technique would serve a two-fold purpose in breeding programme, to bring out simultaneous genetic advance in several characters and to improve yield through selection for relatively more heritable auxiliary characters. He also reported that selection index based on length and girth of spike and yield was found to be most efficient in pearl millet(*Pennisetum typhoides*).

Mahadevappa(1965) working with ragi(*Elusine coracana*) suggested that number of ear-bearing tillers and weight of straw might successfully be utilised as selection indices for improvement of yield.

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MATERIALS AND METHODS

MATERIALS AND METHODS

The present study was carried out in the Division of Agricultural Botany, Agricultural College and Research Institute, Vellayani, Trivandrum, during 1966 - 1967.

A. MATERIALS

The material necessary for this investigation consisted of ten varieties of capsicum which were of different durations. The necessary seed materials were obtained from the collection maintained in the Agricultural College Farm Vellayani and also from M/S. Pestonjee Pocha and Sons, Poona. All the ten varieties exhibited considerable amount of variation with respect to growth habit, stature and also with respect to morphological characters of the different plant parts, especially leaves, fruits and seeds. The list of varieties and some of their characteristics are shown in the Table I.

B. METHODS

1. Design and lay-out of the experiment.

Plants were grown in randomised block design with ten varieties and three replications (Vide figure I).

TABLE.I

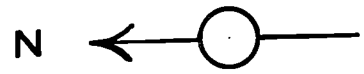
Description of varieties of capsicum used for the studies

Sl. No.	Name of variety	Source	Nature of branching	Colour of fruits	Size and shape of fruits
1	Purple Long	Agricultural College and Research Institute, Vellayani.	Profuse	Dark purple	Medium long.
2	Red long	-do-	Shy	Deep red	-do-
3	Large Red	-do-	Shy	Red	-do-
4	Hungarian Wax	M/S Pestonjee Pocha and Sons, Poona.	Profuse	Yellow	Long stout
5	Red Chilli	Agricultural College and Research Institute, Vellayani.	Profuse	Red	Medium long.
6	Long Chilli	-do-	Profuse	Red	-do-
7.	California Wonder	M/S Pestonjee Pocha and Sons, Poona.	Shy	Dark Red	Round big.
8.	Chinese Giant	-do-	Shy	-do-	-do-
9.	White Long	-do-	Medium	Light yellow	Medium long
10.	Oshkosh	-do-	Shy	Orange colour	Round big

Fig.1. Layout of the field experiment

LAY-OUT OF THE FIELD EXPERIMENT

R_1	V_3	V_2	V_1	V_5	V_{10}	V_8	V_9	V_7	V_6	V_4
R_3	V_8	V_5	V_4	V_3	V_9	V_7	V_{10}	V_6	V_2	V_1
R_2	V_1	V_3	V_8	V_2	V_7	V_4	V_5	V_9	V_{10}	V_6



DESIGN. 10 x 3. RANDOMISED BLOCK DESIGN

V_1, V_2, V_3 .... V_{10}. VARIETIES

SINGLE PLOT. 4.50 meters x 3.75 meters

FIG. 1

Plot size was 4.50 meters x 3.75 meters and the spacing given between plants and between rows was 75 cm.

2. Sowing and culture.

Seeds were sown in the nursery on raised and well prepared beds during November 1966. Date of sowing was adjusted depending upon the duration of different varieties. Seedlings were transplanted during December 1966 when the seedlings were about one month old; with two seedlings per pit. After the second week of transplanting the healthy seedlings were retained and the others were removed. Altogether a single plot contained five rows of six plants each.

3. Sampling.

Ten plants were randomly selected from the three central rows leaving the border plants. The ten plants selected were labelled for observations. Thus thirty plants from each variety and a total number of three hundred plants were individually studied.

4. Characters studied.

The following characters were studied individually for the three hundred plants.

(i) Yield of fruits.

The fruits at each harvest were gathered in separate paper bags and weight of fresh fruits was recorded. The total weight was calculated by adding the weight of fruits at each harvest.

(ii) Plant height.

Height was measured to the nearest c.m. from the base of the plant to the tip of the longest branch by holding all the branches together before the last harvest of fruits.

(iii) Number of branches.

All the branches were counted and recorded after the full maturity of the plant.

(iv) Number of flowers.

The total number of flowers was counted every day and after each counting flowers were marked to avoid repetition. At the end of the flowering phase, observation was taken once in two days.

(v) Number of fruits

All the fruits at each harvest were counted and recorded, for calculating the total number of fruits per plant

Percentage of fruit setting was determined by noting the total number of flowers and the total number of fruits per plant.

(vii) Duration of maturity.

For calculating the duration of maturity the date of first flowering and the date of first maturity of the fruit were recorded.

(viii) Weight of seeds per fruit.

From each plant a random sample of ten fruits, or all the fruits produced which ever was less, were used for extracting seeds. The weight, correct 0.01 gram was taken after uniform drying of seeds.

Studies on the number of leaves were also made but on preliminary examination of the data, it was found that number of leaves showed little correlation with yield. Hence a detailed analysis was not conducted.

5. Statistical procedure.

The whole data collected were processed and tabulated plot-wise(for ten plants), variety-wise(for thirty plants and for all the varieties taken together (for three hundred plants) in order to suit the following analytical works.

(1) Study of varietal differences.

Analysis of variance was worked out for all the eight characters to find out whether the varieties differed significantly or not for the characters studied.

Analysis of variance

Sources of variation	Degrees of freedom	Sum of squares	Mean squares	Variance ratio(F)
Replications	(r-1)	SS.R	S^2R	$\frac{S^2R}{S^2E}$
Varieties	(v-1)	SS.V	S^2V	$\frac{S^2V}{S^2E}$
Error	(r-1) (v-1)	SS.V.R.	SS.E	
Total	(rv-1)			

Where, 'r' is the number of replications and 'v', the number of varieties.

Variance ratios ie. F-ratios for varieties were calculated and compared with the critical value of 'F' for (v-1) and (r-1) (v-1) degrees of freedom at five per cent and one per cent levels of significance.

(2) Study of correlation.

Co-efficients of simple correlation were worked out between yield and other seven characters in all the varieties individually as well as combined.

Partial and multiple correlations were also calculated between the following five characters.

1. Yield of fruits
2. Plant height
3. Number of branbhes
4. Number of flowers
5. Number of fruits

Co-efficients of simple correlation were worked out by the formula given by Hays *et al.*(1955).

$$r = \frac{SP\ x\ Y}{\sqrt{SSx.SSy}},$$

where SP.xy denoted sum of products of the two variables x and y, SSx., the sum of squares of the variable x and SSy, the sum of squares of variable y.

For calculating the partial correlation the formulae suggested by Yule and Kendall(1950) were used.

$$r_{12.3} = \frac{r_{12}-(r_{13})\,(r_{23})}{\sqrt{(1-r_{13}^2)\,(1-r_{23}^2)}}$$

where r_{12}, r_{13} and r_{23} are simple correlation co-efficient between dependent variable x_1 and x_2, x_1 and x_3 and x_2 and x_3 respectively.

$$r_{12.34} = \frac{r_{12.3} -(r_{14.3})\,(r_{24.3})}{\sqrt{(1-r_{14.3}^2)\,(1-r_{24.3}^2)}}$$

$$r_{12.345} = \frac{r_{12.34} -(r_{15.34})\,(r_{25.34})}{\sqrt{(1-r_{15.34}^2)\,(1-r_{25.34}^2)}}$$

where $r_{12.3}$, $r_{12.34}$ etc. are partial correlation co-efficients for the different associations between the respective variables.

Multiple correlation co-efficient(R) was calculated by the formulae.

$$R_1(23) = \sqrt{1-(1-r_{12}^2)\,(1-r_{13.2}^2)}$$

$$R_1.(234) = \sqrt{1-(1-r_{12}^2)\,(1-r_{13.2}^2)(1-r_{14.23}^2)}$$

$$R_1.(2345) = \sqrt{1-(1-r_{12}^2)(1-r_{13.2}^2)(1-r_{14.23}^2)(1-r_{15.234}^2)}$$

where r_{12} is total correlation co-efficient between characters 1 and 2 and $r_{13.2}$, $r_{14.23}$, $r_{15.234}$ are partial correlation co-efficients.

The significance of simple, partial and multiple correlation co-efficients was tested by referring to the table of critical values of correlation co-efficients at five per cent and one per cent levels of significance given by Snedecor(1931) and reprinted in Appendix table V of Hayes *et al.*(1955).

3) Discriminant function.

The discriminant function which serves as the best yard-stick for selection of plants for yield was evolved by using the estimates of the genotypic components of yield(X_1) and four other characters namely height of plants(X_2), number of branches(X_3), number of flowers(X_4) and number of pods(X_5) which are expected to have correlated with yield.

The genotype of a given plant for yield can be represented by the following function.

$Y' = a_1x_1' + a_2\, x_2' + a_3\, x_3' \dots\dots + a_n\, x_n'$ where x_1', x_2', $x_3' \dots\dots x_n'$ are the genotypic values of the components x_1, x_2, $x_3 \dots\dots x_n$ and a_1, a_2, $a_3 \dots\dots a_n$ are the weights attached to them depending on the relative importance of the characters contributing towards yield.

The phenotype of a plant can be represented by the following relation.

$$Y = b_1 x_1 + b_2 x_2 + b_3 x_3 \ldots\ldots\ldots\ldots b_n x_n.$$

here the problem is the derivation of the value of $b_1, b_2, b_3 \ldots\ldots b_n$.

phenotype = genotype + environment. This states that phenotype is highly correlated with genotype and as a result Y and Y' are also correlated. Hence in the function, the weights $b_1, b_2, b_3 \ldots\ldots b_n$ should be studied in such a way that the correlation between Y and Y' is the maximum.

Thus the phenotype selection using Y as the discriminant function will make sure a maximum concentration of the desired genes in the plants selected.

The desired discriminant function for the present study was

$$Y = b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5$$

'b' values are calculated by solving the normal equations with a view to maximise the regression of Y and Y'.

$$b_1t_{11} + b_2t_{12} + b_3t_{13} + b_4t_{14} + b_5t_{15} = A_1$$

$$b_1t_{12} + b_2t_{22} + b_3t_{23} + b_4t_{24} + b_5t_{25} = A_2$$

$$b_1t_{13} + b_2t_{23} + b_3t_{33} + b_4t_{34} + b_5t_{35} = A_3$$

$$b_1t_{14} + b_2t_{24} + b_3t_{34} + b_4t_{44} + b_5t_{45} = A_4$$

$$b_1t_{15} + b_2t_{25} + b_3t_{35} + b_4t_{45} + b_5t_{55} = A_5$$

............(1)

Where,

$$A_1 = a_1g_{11} + a_2g_{12} + a_3g_{13} + a_4g_{14} + a_5g_{15}$$

$$A_2 = a_1g_{12} + a_2g_{22} + a_3g_{23} + a_4g_{24} + a_5g_{25}$$

$$A_3 = a_1g_{13} + a_2g_{23} + a_3g_{33} + a_4g_{34} + a_5g_{35}$$

$$A_4 = a_1g_{14} + a_2g_{34} + a_3g_{34} + a_4g_{44} + a_5g_{55}$$

$$A_5 = a_1g_{15} + a_2g_{35} + a_3g_{55} + a_4g_{45} + a_5g_{55}$$

............(2)

The phenotypic and genotypic variances and co-variances for the different characters were computed from the respective tables of analysis of variances and analysis of co-variances. The sum of squares and sum of products at error and varietal levels were taken as error and phontypic variances and co-variances(eij and tij) respectively.

For obtaining the genotypic variances and co-variances (g_{ij}), the sum of squares and sum of products at error level were deducted from their respective values at varietal level (Goulden 1959).

A's were calculated from the data by the substitution of the calculated values of g_{ij} and the assigned values of 'a'. The values for 'a' were arbitrarily assigned as

$$a_1 = 1, a_2 = 0, a_3 = 0, a_4 = 0 \text{ and } a_5 = 0$$

These values were inserted into the equation(1) and solved for values of b_1, b_2, b_3, b_4 and b_5.

The discriminant function was then set up by the equation.

$X = b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5$ where, b_1, b_2, b_3, b_4 and b_5 are economic weights and x_1, x_2, x_3, x_4 and x_5 the contributing factors.

Efficiency of selection was calculated by the formula suggested by Rao(1952).

$$\frac{\text{Genetic advance by discriminant function}}{\text{Genetic advance by straight selection}} = \sqrt{\frac{b_i A_i}{g_{ij}\sqrt{t_{ij}}}}$$ where,

b_i's represent the attached weights in the function and A_i's are compound genotypes as defined by equations(2). g_{ij} and t_{ij} denote genotypic and phenotypic variances respectively.

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EXPERIMENTAL RESULTS

EXPERIMENTAL RESULTS

The object of the present investigation was to study the association of yield with its contributory quantitative characters and to construct suitable selection indices for yield and to test their efficiency over direct selection.

A. RELATIONSHIP BETWEEN YIELD AND SOME OF ITS COMPONENT CHARACTERS

The characters studied are:-

1) Yield of fruits
2) Plant height
3) Number of branches
4) Number of flowers
5) Number of fruits
6) Percentage of fruit setting
7) Weight of seeds per fruit
8) Duration of maturity

a) Variability of characters

In a study of the correlation existing between yield and various other characters, variability is an important factor. If the variability of characters is narrow, such studies will be of little value in estimating the correlation between such characters. Hence a study of ten varieties in relation to the variability in these major attributes of yield was made. Mean values of yield and seven other related characters in these varieties are given in Table II.

The significance of variability in each of the characters selected for the study was tested by the the analysis of variance technique used for the randomised block design.

1) Yield of pods of individual plant

TABLE.III
Analysis of variance

Sources of variation	Degrees of freedom	Sum of squares	Mean squares	variance ratio(F)
Replications	2	11974.54	5987.27	1.74
Varieties	9	186870.09	20763.34	6.03**
Error	18	61982.32	3443.46	
Total	29	260826.95		

** Significant at 1% level.

The high values of the variance ratio indicates that there is significant difference in yield between the varieties. Graphical representation of the varietal variability is given in fig-2A.

Duplicate

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TABLE.II

Mean values of yield and other associated characters for the different varieties

Sl. No.	Varieties	Yield of fruits	Plant height	Number of branches	Number of flowers	Number of fruits	Percentage of fruit setting	Wt.of seeds per fruit	Duration of maturity
1	Purple Long	155.8	77.7	213.2	136.8	123.3	90.3	0.32	45.4
2	Red Long	117.5	46.8	81.0	51.4	16.2	36.6	0.55	57.1
3	Large Red	69.3	49.1	149.3	91.4	24.8	25.5	0.65	53.9
4	Hungarian Wax	252.0	40.5	26.5	38.2	15.7	39.6	0.91	42.8
5	Red Chilli	123.0	53.3	135.8	144.0	63.5	46.3	0.31	51.7
6	Long Chilli	115.6	52.0	147.2	140.8	56.4	37.0	0.32	52.5
7	California Wonder	319.3	40.0	26.4	24.9	8.4	35.3	1.70	44.8
8	Chinese Giant	241.6	36.6	27.6	26.8	6.5	27.2	1.53	45.7
9	White Long	270.7	45.2	71.2	100.8	45.9	41.3	0.26	38.0
10	Oshkosh	229.4	33.4	30.3	77.4	8.3	25.3	0.18	38.3

2) Plant height

TABLE.IV
Analysis of variance

Source of variation	Degrees of freedom	Sum of squares	Mean squares	Variance ratio(F)
Replications	2	37.87	18.93	1.10
Varieties	9	4182.30	464.70	26.94**
Error	18	310.44	17.25	
Total	29	4530.61		

** Significant at 1% level

All the varieties differ significantly in plants height as shown by the high value of the variance ratio. Graphical representation of the variability is given in fig:- 2.B.

3) Number of branches

The varieties differ significantly with regard to number of branches as shown by the increased value of the variance ratio(table.V). Graphical representation of the variability is given in fig:- 3.C.

Fig.2(A - B). Graphical representation of the varietal variation in two of the components studied.

Note. Varieties are given in the serial order given in table.1

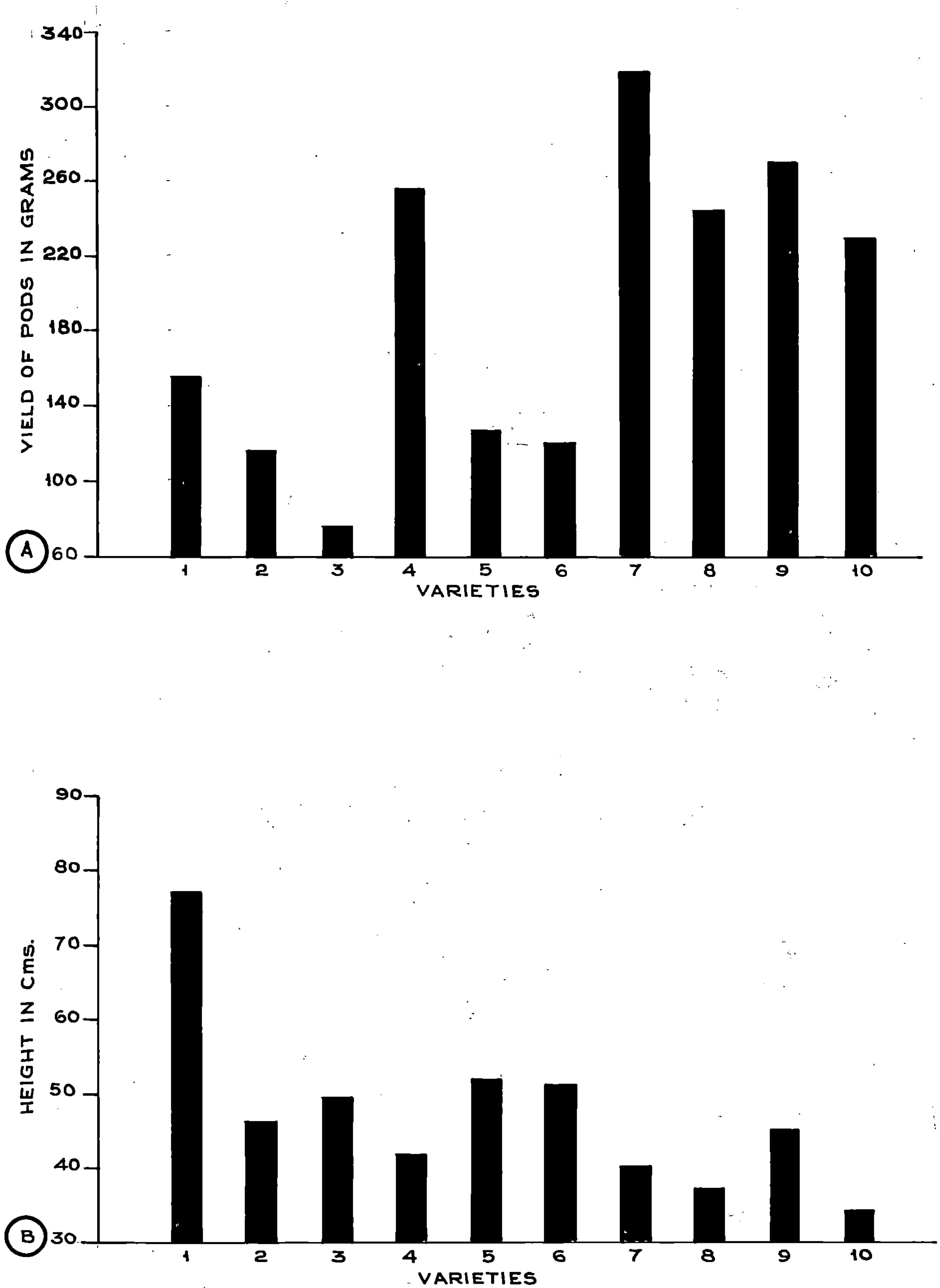
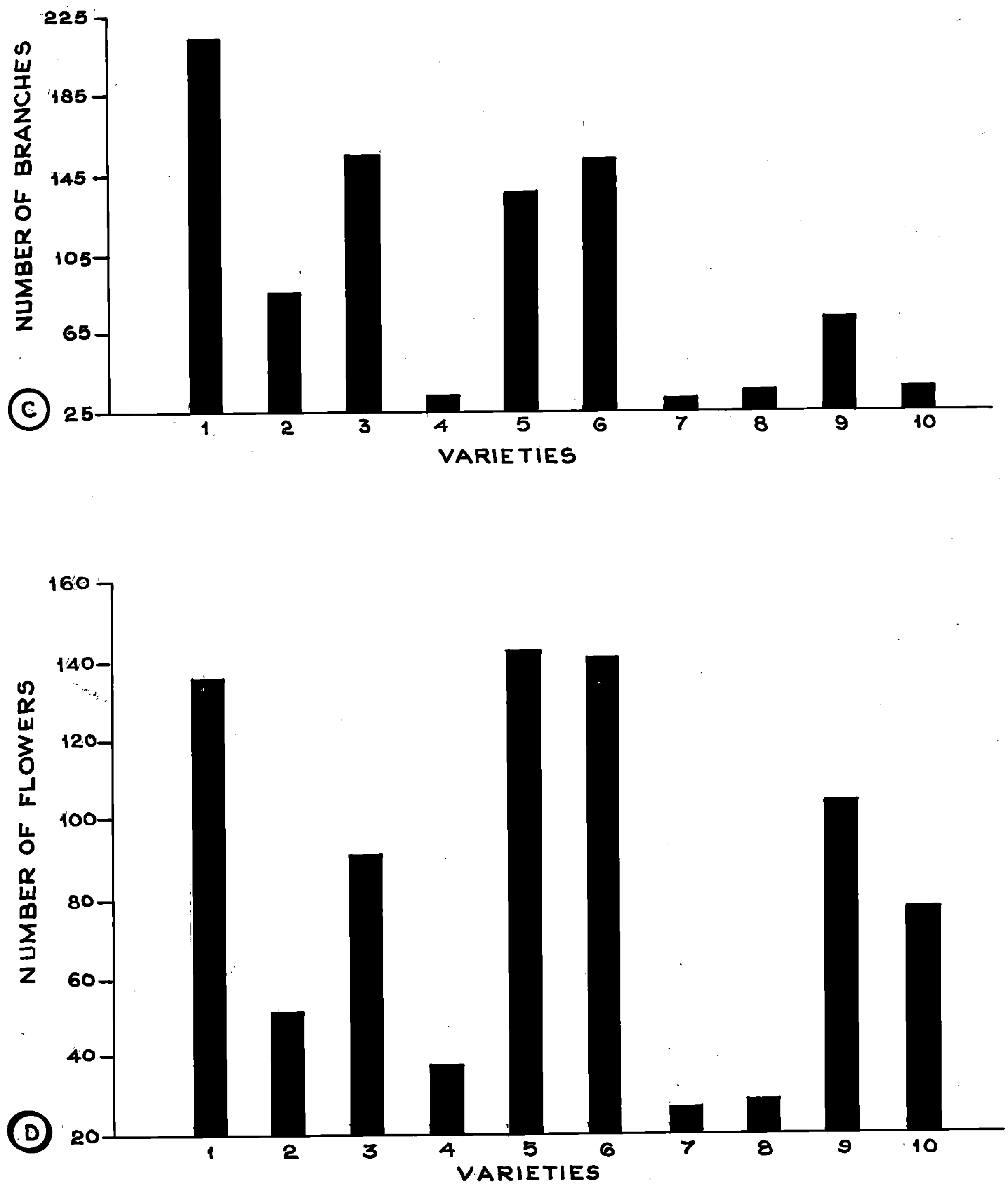

YIELD OF PODS IN GRAMS
340
300
260
220
180
140
100
60
A
1
2
3
4
5
6
7
8
9
10
VARIETIES
HEIGHT IN Cms.
90
80
70
60
50
40
30
B
1
2
3
4
5
6
7
8
9
10
VARIETIES

FIG. 2

Fig.3(C - D) Graphical representation of the varietal variations in two of the components studied.

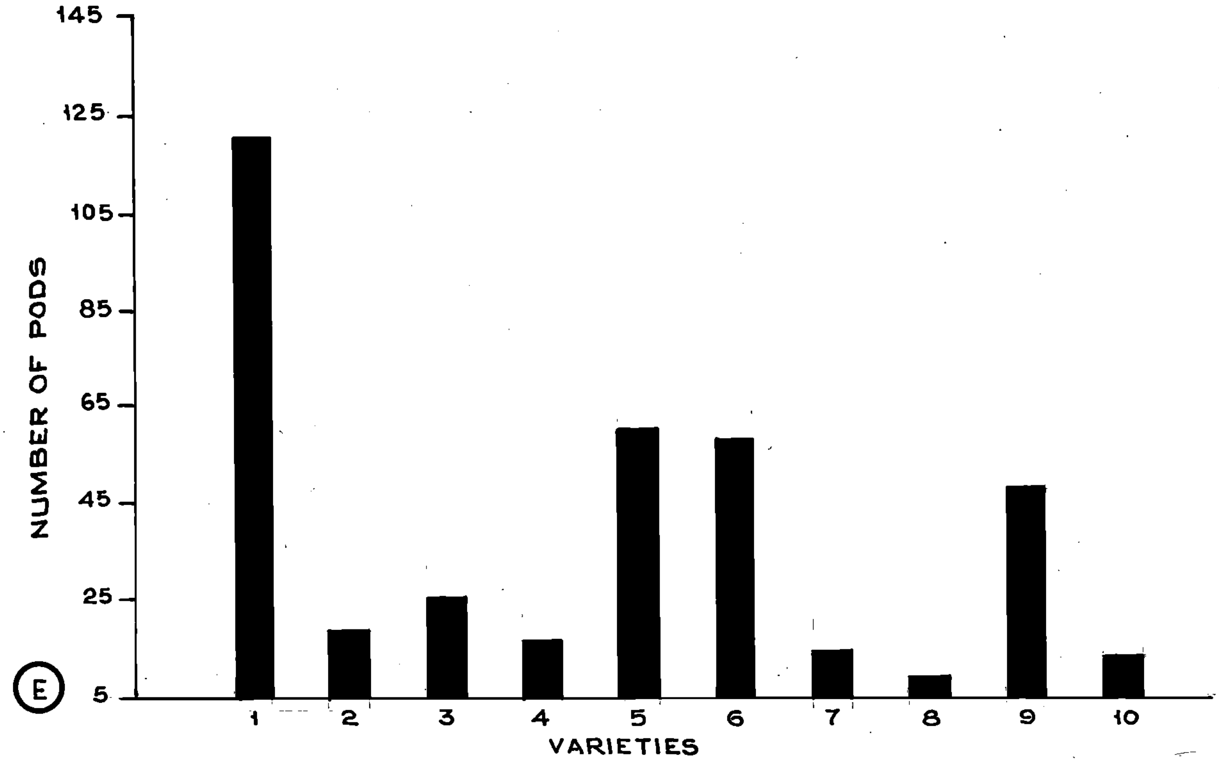
Note. Varieties are represented in the serial order given in table.1



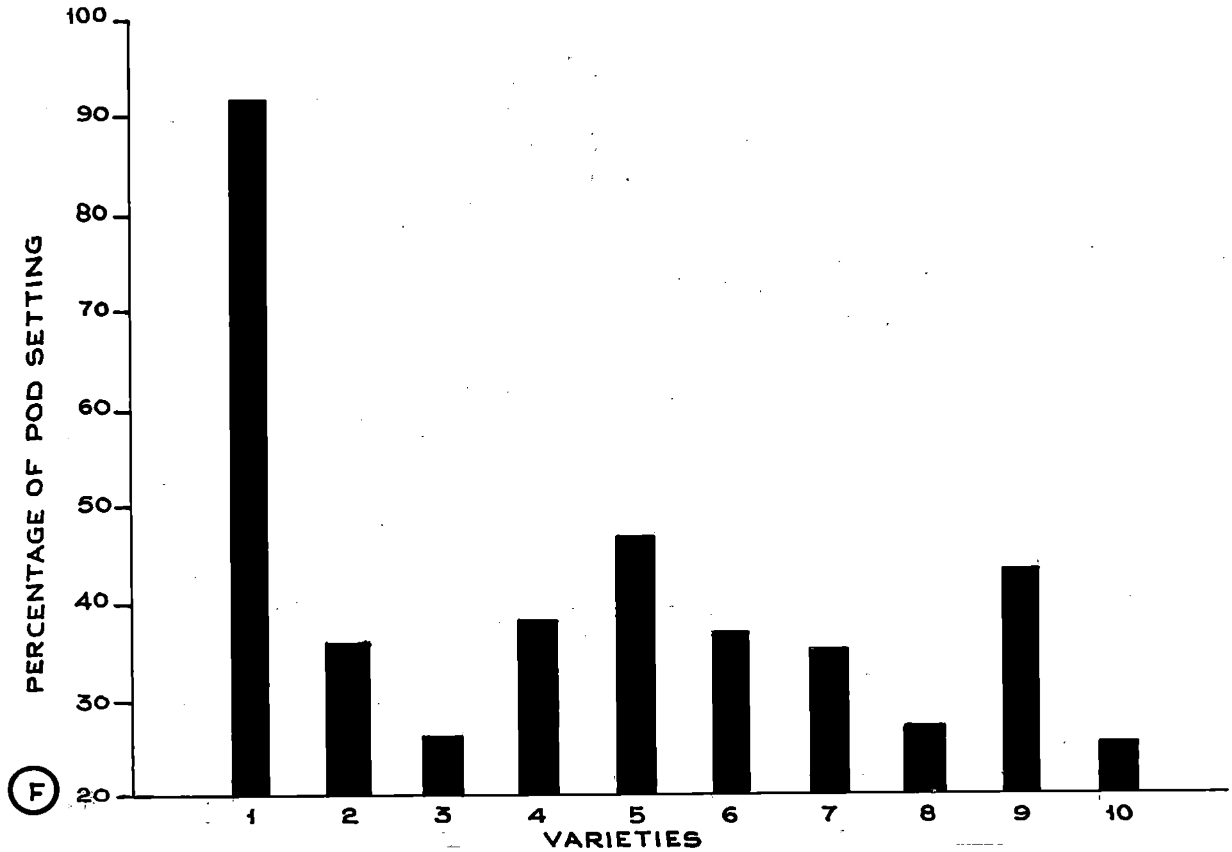
225
185
145
105
65
25
NUMBER OF BRANCHES
C
1
2
3
4
5
6
7
8
9
10
VARIETIES
160
140
120
100
80
60
40
20
NUMBER OF FLOWERS
D
1
2
3
4
5
6
7
8
9
10
VARIETIES

FIG. 3

Fig.4(E - F)	Graphical representation of the varietal variations in two of the components studied.
Note.	Varieties are represented in the serial order given in table.1



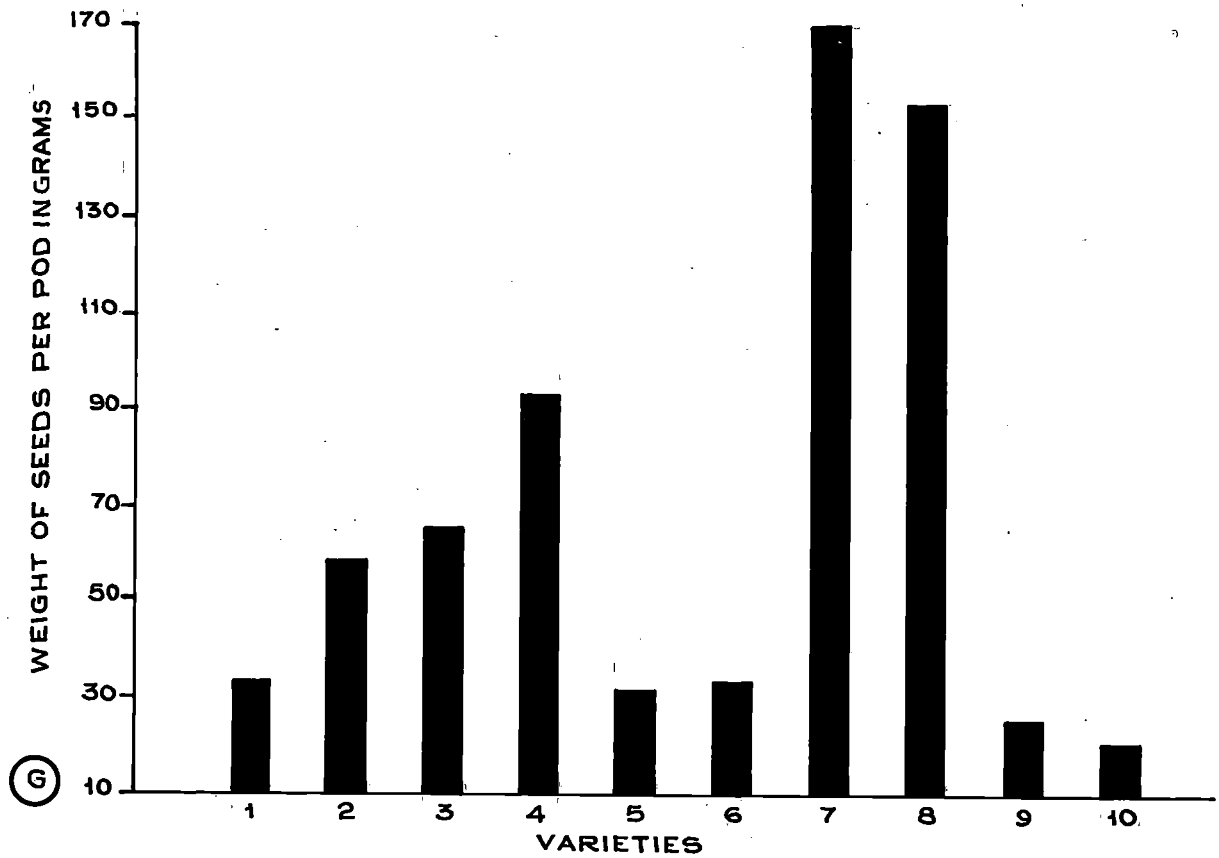
145
125
105
85
65
45
25
5
NUMBER OF PODS
E
1 2 3 4 5 6 7 8 9 10
VARIETIES



100
90
80
70
60
50
40
30
20
PERCENTAGE OF POD SETTING
F
1 2 3 4 5 6 7 8 9 10
VARIETIES

FIG. 4

Fig.5(G - H)	Graphical representation of the varietal variations in two of the components studied.
Note.	Varieties are represented in the serial order given in table.1


WEIGHT OF SEEDS PER POD INGRAMS
170
150
130
110
90
70
50
30
10
1 2 3 4 5 6 7 8 9 10
VARIETIES
G

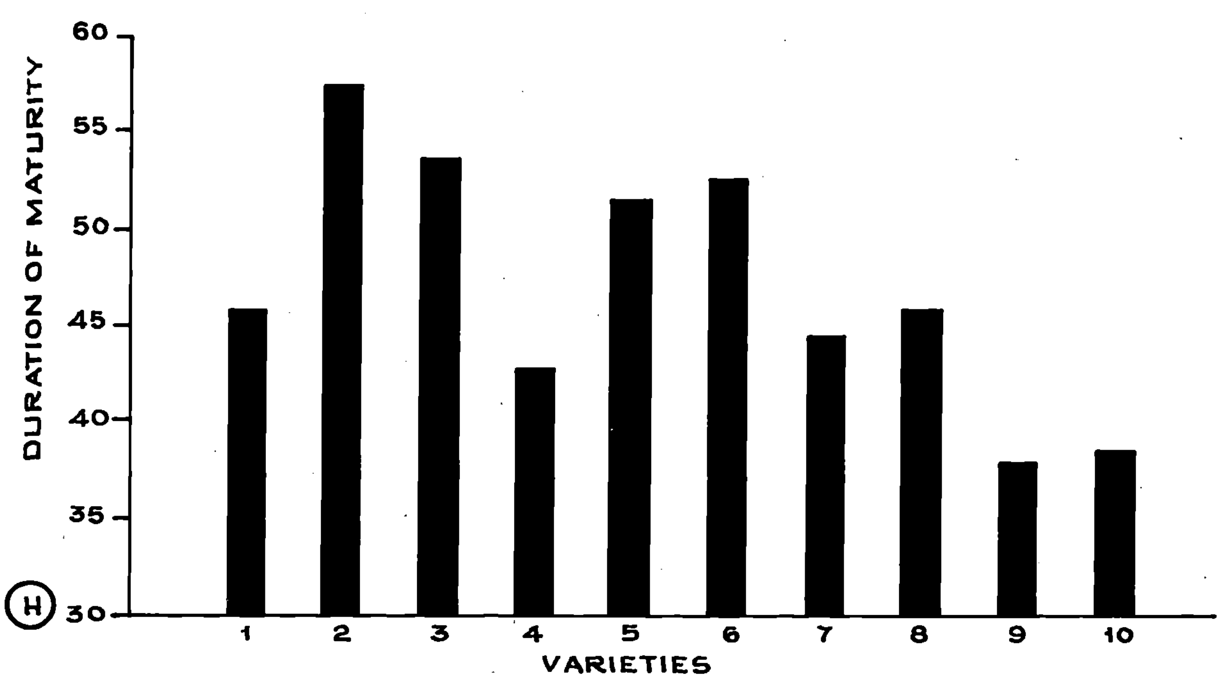

DURATION OF MATURITY
60
55
50
45
40
35
30
1 2 3 4 5 6 7 8 9 10
VARIETIES
H

FIG. 5

4) Number of flowers.

The analysis of variance table given below indicates that the difference between varieties with regard to this character is highly significant. The variability of this character is represented graphically in fig:-3.D.

TABLE.VI
Analysis of variance

Sources of variation	Degrees of freedom	Sum of squares	Mean squares	Variance ratio(F)
Replications	2	228.96	114.48	0.55
Varieties	9	68318.46	7590.94	36.55**
Error	18	3737.49	207.64	
Total	29	72284.41		

** Significant at 1% level.

5) Number of fruits of individual plant

TABLE.VII
Analysis of variance

Sources of variation	Degrees of freedom	Sum of squares	Mean squares	Variance ratio(F)
Replications	2	36.99	18.49	0.29
Varieties	9	36625.82	4069.54	63.85**
Error	18	1147.38	63.74	
Total	29	37810.19		

** Significant at 1% level

Table VII indicates that the variation with regard to the number of fruits of individual plants is highly significant as indicated by the F.ratio for varieties.

Graphical representation to show the variability of this character is given in fig:-4 E.

6) <u>Percentage of fruit setting.</u>

TABLE.VIII
Analysis of variance

Sources of variation	Degrees of freedom	sum of squares	Mean square	Variance ratio(F)
Replications	2	115.91	57.96	1.24
Varieties	9	9712.96	1079.22	23.02**
Error	18	843.88	46.88	
Total	29	10672.75		

** Significant at 1% level

The analysis of variance table shows significant difference between the ten varieties in respect of this character.

Graphical representation of the variability is given in fig:-4 F.

7) <u>Weight of seeds per fruit.</u>

The analysis of variance table given below indicat that the varieties differ significantly with respect to weight of seeds per fruit.

The variation is represented graphically in fig:-5.G.

TABLEIX

Analysis of variance

Sources of variation	Degrees of freedom	Sum of squares	Mean squares	Variance ratio(F)
Replications	2	0.0470	0.0235	1.61
Varieties	9	10.9465	1.2163	83.31**
Error	18	0.2619	0.0146	
Total	29	11.2554		

** Significant at 1% level

8) Duration of maturity

TABLE.X

Analysis of variance

Sources of variation	Degrees of freedom	Sum of squares	Mean squares	Variance ratio(F)
Replications	2	19.41	9.71	1.72
Varieties	9	1138.25	126.47	23.34**
Error	18	101.83	5.66	
Total	29	1259.49		

** Significant at 1% level

From the table X it is seen that the high value of F-ratio for varieties is indicative of the significant difference with respect to this character between all the varieties.

Graphical representation of the variability is given in fig:- 5H

b) Correlation studies

(1) Simple correlation coefficients in varieties.

Co-efficients of correlation between yield of fruits and seven other related characters worked out for each of the ten varieties are presented in table XI.

It can be seen from the table that there is highly significant positive correlation between yield and two other characters - number of flowers and number fruits in all the ten varieties.

The correlation co-efficients between yield and plant height are significant and positive at 1% level for 4 varieties, at 5 per cent level for 2 varieties and not significant for the reamining varieties.

Between yield and number of branches, the co-efficients of correlation are significant and positive at 1 per cent level for 3 varieties, at 5 per cent level for

TABLE.XI

Simple correlation co-efficients between yield and seven other associated characters in each of the ten varieties

Characters / Varieties	Plant height	No.of branches	No.of flowers	No.of fruits	Percentage of fruit setting	Weight of seeds per fruit	Duration of maturity
Purple Long	0.466**	0.417*	0.725**	0.650**	0.620**	0.251	-0.075
Red Long	0.638**	0.490**	0.542**	0.601**	0.315	0.210	-0.329
Large Red	0.358*	0.269	0.436*	0.847**	0.385*	0.116	-0.004
Hungarian Wax	0.560**	0.370*	0.535**	0.667**	0.320	0.065	0.259
Red Chilli	0.189	0.140	0.398*	0.658**	0.423	0.232	-0.206
Long Chilli	0.150	0.380*	0.402*	0.776**	0.382*	0.291	-0.014
California Wonder	0.212	0.415**	0.624**	0.858**	0.415*	-0.061	0.035
Chinese Giant	0.465**	0.482**	0.510**	0.845**	0.291	0.382	0.314
White Long	0.114	0.203	0.625**	0.729**	0.426*	0.055	0.359*
Oshkosh	0.397*	0.226	0.395*	0.724**	0.312	0.126	-0.209

* Significant at 5% level
** Significant at 1% level

3 varieties and not significant for the rest.

With regard to yield and percentage of fruit setting, one vareity possesss significant positive correlation at 1 per cent level and for 5 varieties at 5 per cent level. The correlation co-efficient is not significant in the case of the remaining varieties.

It is observed that correlation co-efficient between yield and weight of seeds per fruit are not significant for all the varieties and for one variety the correlation is negative and not significant.

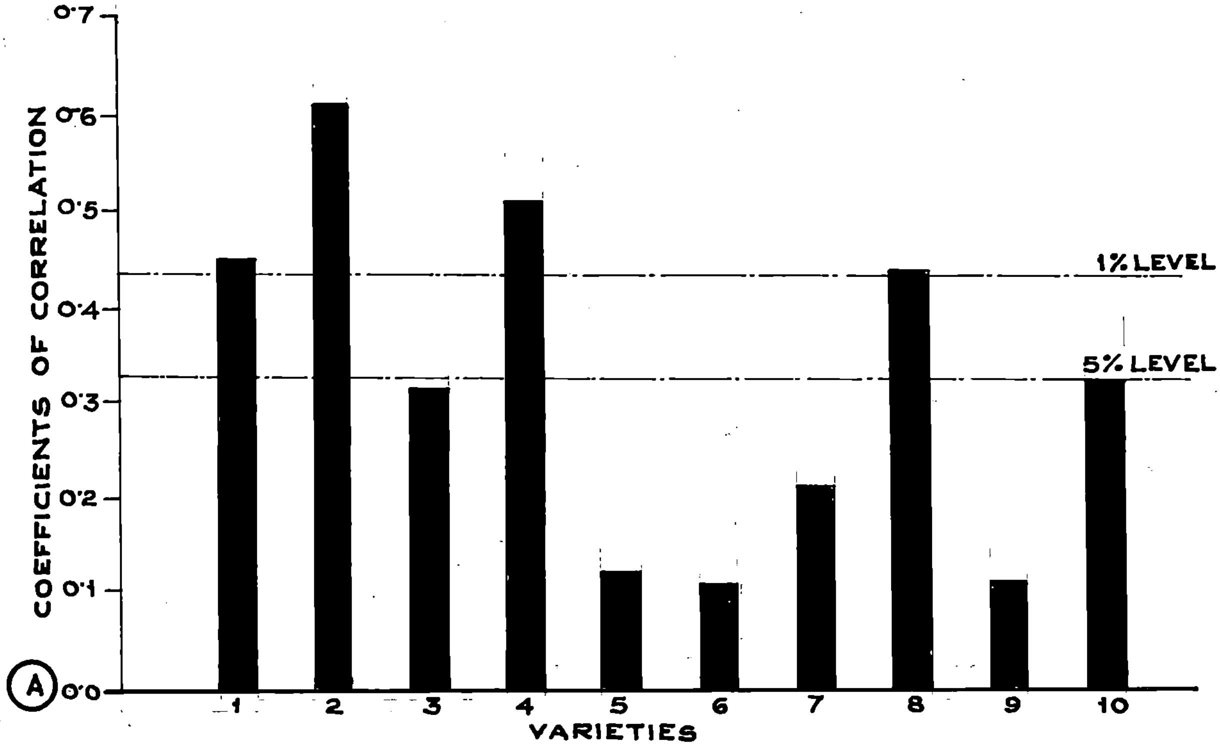
The correlation co-efficients between yield and duration of maturity are negative and not significant for 6 varieties. The rest of varieties have positive correlations which also are not significant.

Simple correlation co-efficients between yield and seven other characters are represented graphically in figures:- 6A to 8 G.

2) <u>Simple correlation co-efficient for all the varieties taken together.</u>

Co-efficients of correlation between yield and seven associated characters for all the ten varieties taken together are furnished in table XII.

Fig.6.	Bardiagrams showing coefficients of correlations for varieties.
A.	Between yield of fruits and plant height.
B.	Between yield of fruits and number of branches.
Note	Varieties are represented by numbers as given in table.1


0·7
0·6
0·5
0·4
0·3
0·2
0·1
0·0
COEFFICIENTS OF CORRELATION
1% LEVEL
5% LEVEL
A
1
2
3
4
5
6
7
8
9
10
VARIETIES

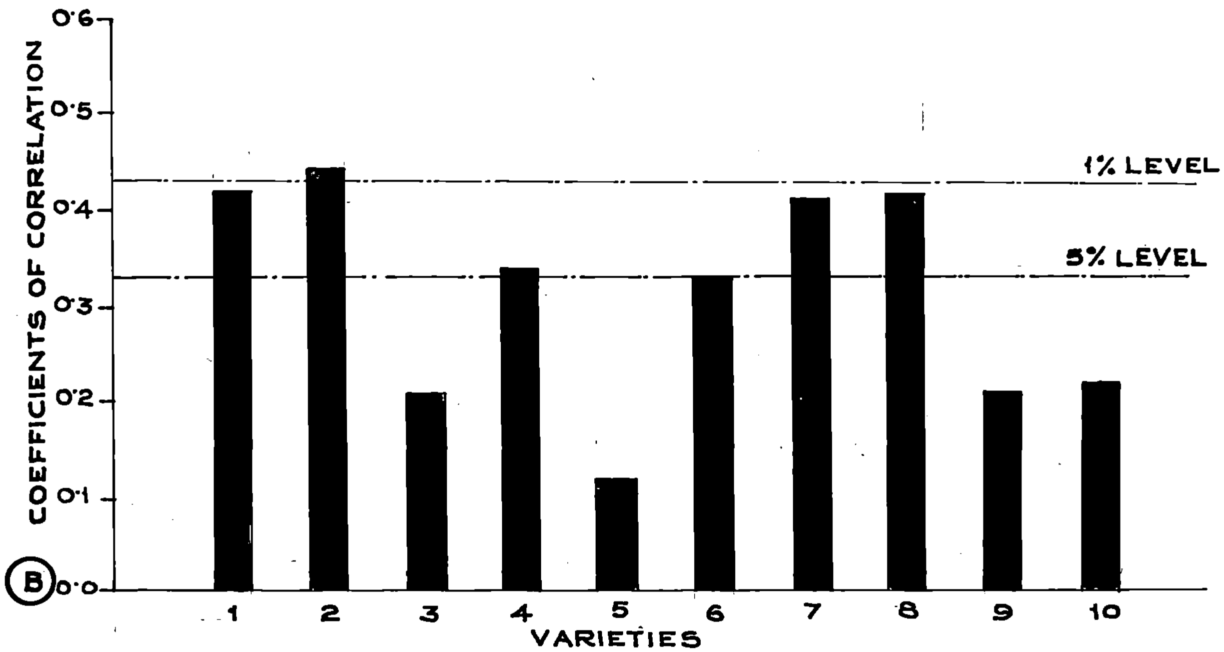
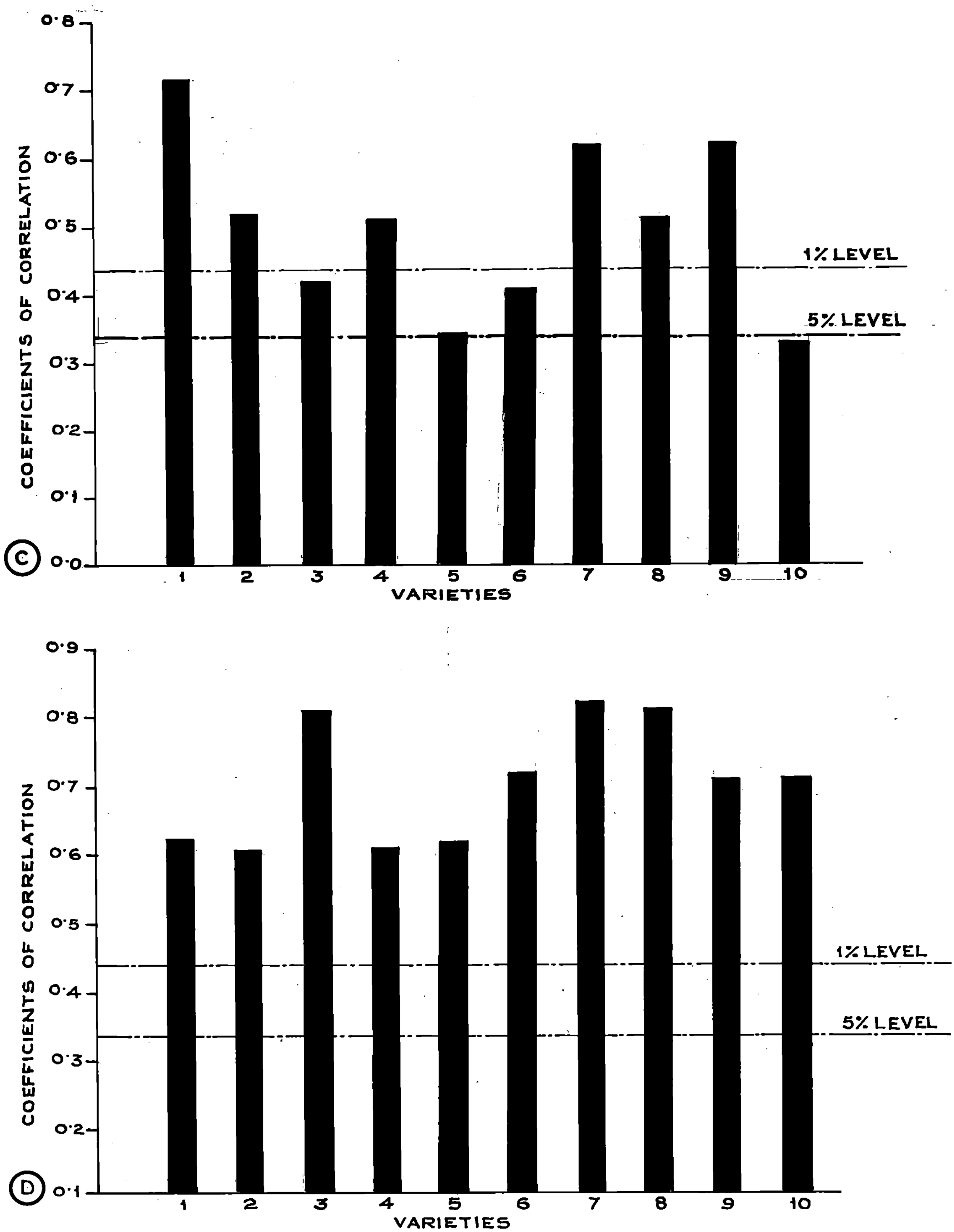

0·6
0·5
0·4
0·3
0·2
0·1
0·0
COEFFICIENTS OF CORRELATION
1% LEVEL
5% LEVEL
B
1
2
3
4
5
6
7
8
9
10
VARIETIES

FIG. 6

Fig.7	Bardiagrams showing coefficients of correlation for varieties.
C.	Between yield of fruits and number of flowers.
D.	Between yield of fruits and number of fruits.
Note	Varieøies are represented by numbers as given in table 1.



0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
0·0
COEFFICIENTS OF CORRELATION
1% LEVEL
5% LEVEL
C
1
2
3
4
5
6
7
8
9
10
VARIETIES
0·9
0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
COEFFICIENTS OF CORRELATION
1% LEVEL
5% LEVEL
D
1
2
3
4
5
6
7
8
9
10
VARIETIES

FIG. 7

Fig.8 Bardiagrams showing coefficients of correlation for varieties.

E. Between yield of fruits and percentage of fruit setting.

F. Between yield of fruits and weight of seeds per fruit.

G. Between yield of fruits and duration of maturity.

Note Varieties are represented by numbers as given in table.1

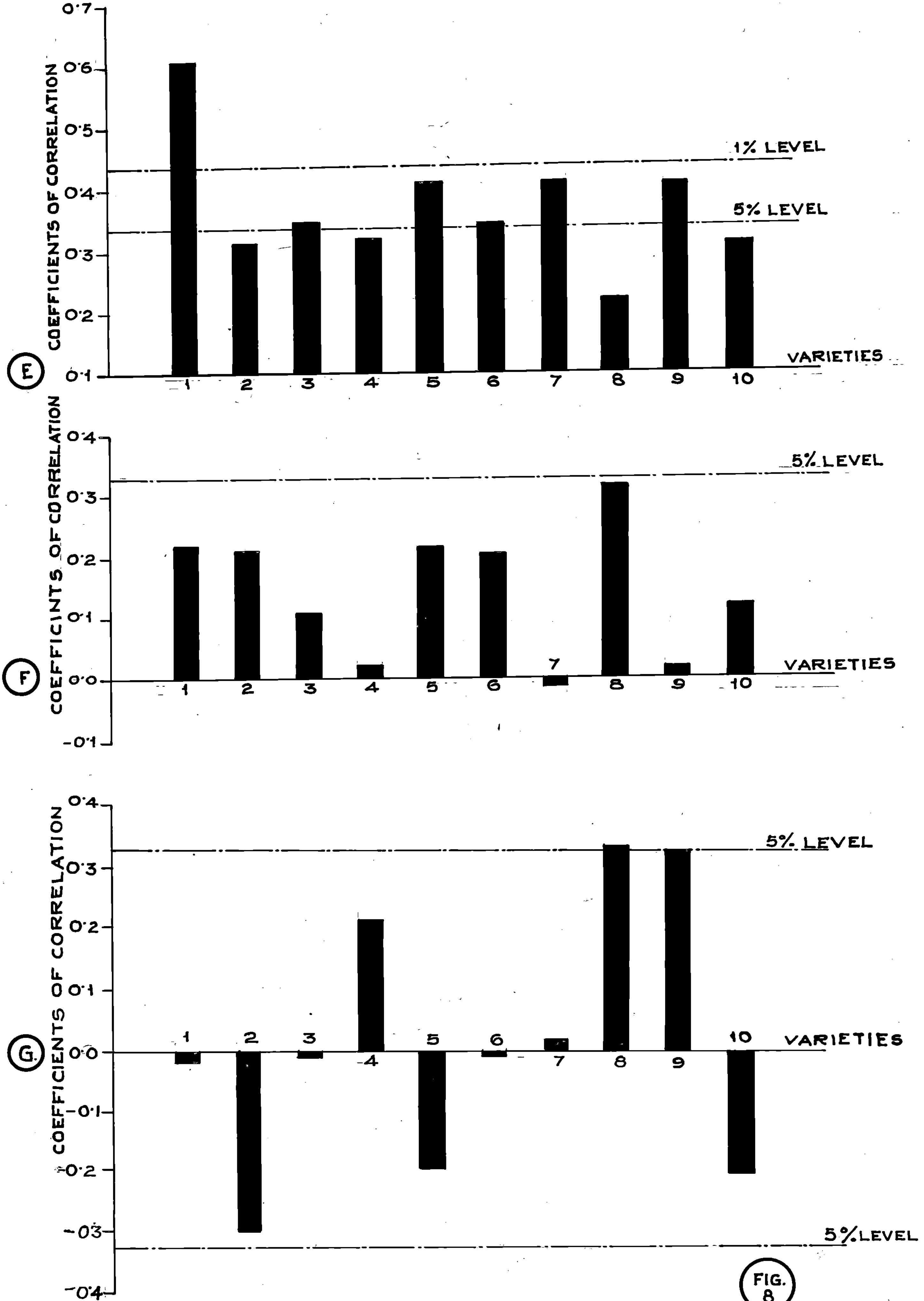

0·7
0·6
0·5
0·4
0·3
0·2
0·1
COEFFICIENTS OF CORRELATION
1% LEVEL
5% LEVEL
VARIETIES
E
1
2
3
4
5
6
7
8
9
10
0·4
0·3
0·2
0·1
0·0
-0·1
COEFFICINTS OF CORRELATION
5% LEVEL
VARIETIES
F
1
2
3
4
5
6
7
8
9
10
0·4
0·3
0·2
0·1
0·0
-0·1
-0·2
-0·3
-0·4
COEFFICIENTS OF CORRELATION
5% LEVEL
VARIETIES
5% LEVEL
G.
1
2
3
4
5
6
7
8
9
10

FIG. 8

The table below shows that yield is strongly associated with four of the characters namely, plant-height, number of branches, number of flowers and number of fruits. The association of yield and weight of seeds per fruit is positive but not significant. The correlation between yield and percentage of fruit setting is positive and significant at 5 per cent level. Duration of maturity is negatively correlated with yield, but the correlation co-efficient is not significant.

Co-efficients of correlation are represented graphically in figure:- 9A.

TABLE.XII

Co-efficients of correlation between yield and associated characters for all the varieties taken together

Sl. No.	Associations tested	Co-efficients of correlation(r)
1	Yield and plant height	0.638**
2	Yield and number of branches	0.560**
3	Yield and number of flowers	0.658**
4	Yield and number of fruits	0.846**
5	Yield and weight of seeds per fruit	0.268
6	Yield and percentage of fruit setting	0.365*
7	Yield and duration of maturity	-0.075

* Significant at 5% level
** Significant at 1% level

Fig.9. Bardiagrams showing

A. Correlation coefficients between yield of fruits and seven other characters associated with yield for the varieties as a whole.

B. Correlation coefficients between the components interse.

Note. r12 - Yield and plant height

r13 - ,, No.of branches

r14 - ,, No.of flowers

r15 - ,, No.of fruits

Fig. r16 - ,, Wt.of seeds per fruit

r17 - ,, percentage of fruit setting

r18 - ,, duration of maturity

r23 - Plant height and No.of branches

r24 - ,, No.of flowers

r25 - ,, No.of fruits

r34 - No.of branches and No.of flowers

r35 - ,, No.of fruits

r45 - No.of flowers and No.of fruits

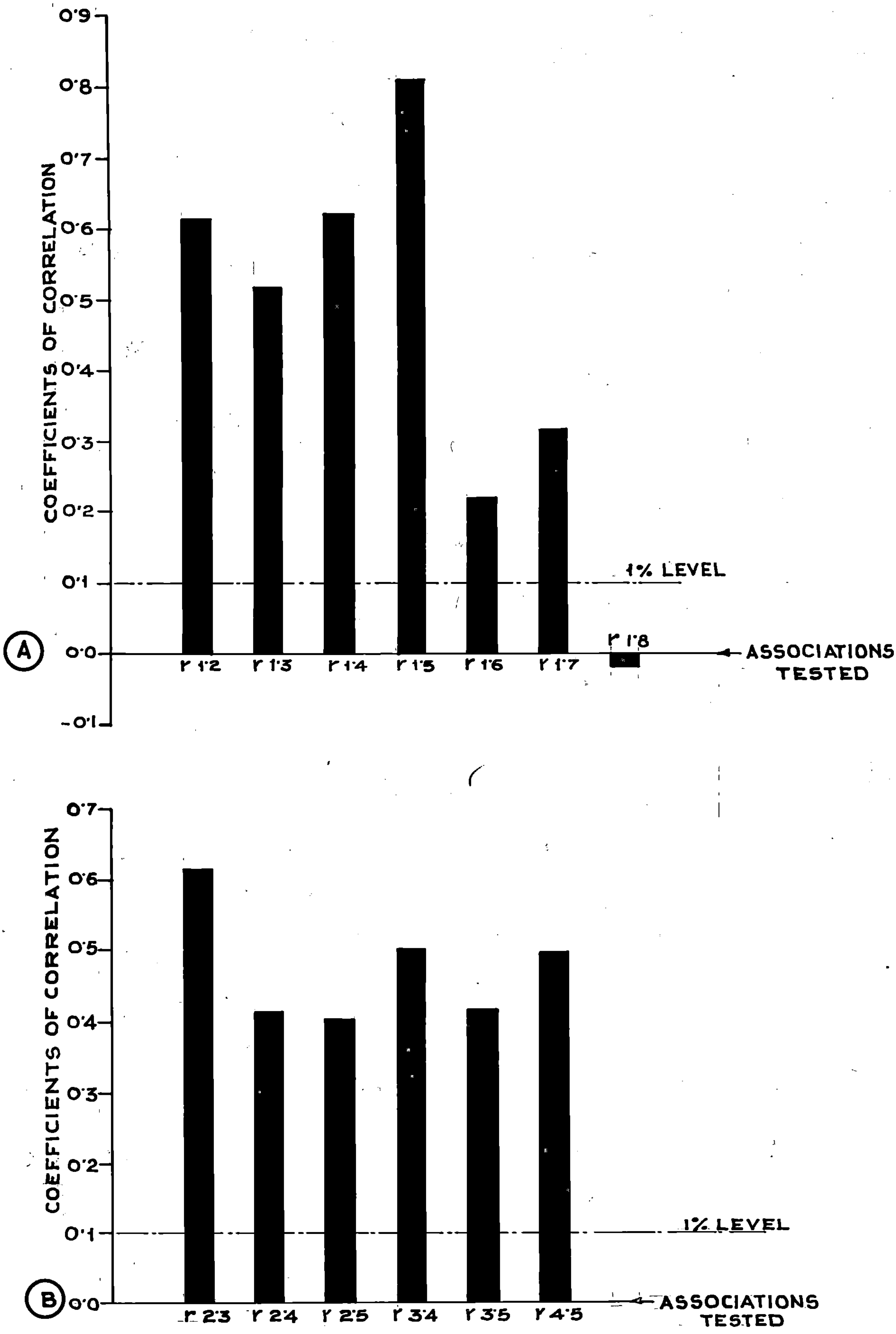

COEFFICIENTS OF CORRELATION
0·9
0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
0·0
-0·1
1% LEVEL
A
r 1·2
r 1·3
r 1·4
r 1·5
r 1·6
r 1·7
r 1·8
ASSOCIATIONS TESTED
COEFFICIENTS OF CORRELATION
0·7
0·6
0·5
0·4
0·3
0·2
0·1
0·0
1% LEVEL
B
r 2·3
r 2·4
r 2·5
r 3·4
r 3·5
r 4·5
ASSOCIATIONS TESTED

FIG. 9

(3) Mutual correlations between yield of fruits and related characters.

Mutual correlations between yield of fruits and the four strongly associated characters namely plant height, number of branches, number of flowers and number of fruits are given in table XIII.

TABLE.XIII

Mutual correlations between yield and the four strongly associated characters

Sl. No.	Characters	Plant height	No.of branches	No.of flowers	No.of fruits
		Correlation co-efficients(r).			
1	Yield of fruits	0.638**	0.560**	0.658**	0.846**
2	Plant height		0.669**	0.466**	0.435**
3	Number of branches			0.504**	0.495**
4	Number of flowers				0.501**

** Significant at 1% level.

The coefficients of correlation in all the cases are found to be positive and significant. Plant height and number of branches possess a strong association followed by the correlation between number of branches and number of flowers.

Mutual correlation co-efficients are represented graphically in fig:-9.B.

(4) Partial correlations

By the study of simple correlation alone, it is not possible to estimate the absolute correlation between any two characters because a character is influenced by the simultaneous variation of more than one character. Such situations necessitate the study of partial correlations. In the present investigation, partial correlation co-efficients were calculated for the following characters.

Yield of fruits	...	(1)
Plant height	...	(2)
Number of branches	...	(3)
Number of flowers	...	(4)
Number of fruits	...	(5)

The associations tested will be referred to hereafter by numerical figures as shown above, against each character.

i) Yield of fruits and plant height.

The partial correlations between yield of fruits and plant height eliminating the effects of number of branches($r12.3$), number of flowers($r12.4$) and number of fruits($r12.5$) singly and in combination namely, $r12.4$,$r12.45$ and $r12.345$ are presented in table - VIV.

It can be seen from the table(table-XIV) that partial correlation co-efficients for all the associations are positive and significant at 1 per cent level. Correlation of these two characters eliminating the other three variables namely number branches, number of flowers and number of fruits is significant at 1 per cent level which indicates that the effect of eliminated variables is not appreciable. In the same way the data as a whole indicate that the effect of the eliminated variables is not appreciable to render the absolute correlation between yield and plant height non-significant. The elimination of the effects of variables 3 and 5 (number of branches and number of fruits) have increased the strength of the association. Eliminating the effects of the variables 3 and 4 (number of branches and number of flowers) is found to weaken the relationship. This might suggest the comparatively greater influence which these variables have, on the relationship between yield and plant height.

TABLE.XIV

Partial correlation between yield of fruits and plant height

Sl. No.	Character association	Degrees of freedom	Correlation co-efficient(r)
1	r12	298	0.638**
2	r12.3	297	0.531**
3	r12.4	297	0.497**
4	r12.5	297	0.564**
5	r12.34	296	0.474**
6	r12.35	296	0.896**
7	r12.45	296	0.613**
8	r12.345	295	0.678

**Significant at 1% level

(ii) Yield of fruits and number of branches

TABLE.XV
Partial correlation between yield of fruits and number of branches

Sl. No.	Character association	Degrees of freedom	Correlation co-efficient(r)
1	r13	298	0.560**
2	r13.2	297	0.384**
3	r13.4	297	0.353**
4	r13.5	297	0.304**
5	r13.24	296	0.254**
6	r13.25	296	0.346**
7	r13.45	296	0.326**
8	r13.245	295	0.781**

** Significant at 1% level

Partial correlation co-efficients between yield of fruits and number of branches, keeping constant the other three variables singly and in combinations(r13.2,r13.4,r13.5, r13.24,r13.25,r13.45 and r13.245) are presented in table-XV.

The table indicates that the values of correlations for all associations are positive and significant at 1 per cent level. However, the different eliminates influence differently the relationship between the two tested characters. The elimination of the effects of variables 2,4 and 5(Plant height, number of flowers and number of fruits respectively) has resulted in an increase in the strength of the association between the two characters. By eliminating the variables 2 and 4(plant height and number of flowers) the value of correlation between the tested characters has decreased considerably. In general the elimination of three variables in combination has strengthened the correlation between yield of fruits and number of branches considerably.

iii) <u>Yield of fruits and number of flowers.</u>

Partial correlations between yield and number of flowers giving allowance for the effect of three other variables singly as well as jointly(r14.2, r14.3, r14.5,r14.23, r14.25,r14.35 and r14.235) are presented in table XVI.

The data shown in table XVI indicate that the elimination of three variables singly as well as combined, has not increased the strength of the association between yield and number of flowers. This might be due to the effects of the eliminated characters though not very high, on the association of the two characters. However, elimination of the variable 5 alone(number of fruits) has affected adversely on the strength of the association. The simultaneous elimination of variables 2,3 and 5(plant height, number of branches and number of fruits) has given a negative result and is highly significant. This is indicative of the strongest influence of the eliminated variables upon the realtionship of the tested characters.

TABLE.XVI

Partial correlations between yield and number of flowers

Sl. No.	Chracter association	Degrees of freedom	Correlation co-efficient(r)
1	r14	298	0.658**
2	r14.2	297	0.493**
3	r14.3	297	0.501**
4	r14.5	297	0.235**
5	r14.23	296	0.411**
6	r14.25	296	0.519**
7	r14.35	296	0.453**
8	r14,235	295	-0.521**

** Significant at 1% level

iv) Yield of fruits and number of fruits

Partial correlations between yield of fruits and number offruits, keeping constant the other three variables singly as well as jointly(r15.2,r15.3,r15.4,r15.23, r15.24,r15.34 and r15.234) are furnished in table XVII.

TABLE.XVII

Partial correlations between yield of fruits and number of fruits

Sl. No.	Chracter association	Degrees of freedom	Correlation co-efficient(r)
1	r15	298	0.846**
2	r15.2	297	0.818**
3	r15.3	297	0.792**
4	r15.4	297	0.724**
5	r15.23	296	0.272**
6	r15.24	296	0.896**
7	r15.34	296	0.799**
8	r15.234	295	-0.040

** Significant at 1% level

The table above reveals that the partial correlation of yield of fruits and number of fruits, eliminating the other three variables ie. plant height, number of branches, and number of flowers have not weakened the relationship of this tested association. However, the elimination of the variables 2 and 3 (plant height and number of branches) has decreased the value of correlation considerably which is suggestive of the appreciable amount of influence these variables have got upon the strength of the association. The joint elimination of three variables, 2,3 and 4(plant height, number of branches and number of flowers) has weakened the relationship to an appreciable extent, as indicated by the negative value of the association. This reveals the strength of influence of these eleminated variables in the relationship of the two characters.

v) Yield of fruits and any one of the components, keeping constant the other variables simultaneously.

The co-efficients of partial correlation between yield of fruits and any one of the components, keeping constant all other characters jointly at a time, are presented in table XVIII.

TABLE.XVIII

Partial correlation between yield of fruits and any one of four components, keeping constant the remaining factors at a time

Sl. No.	Character association	Degrees of freedom	Co-efficients of correlation(r)
1	r12.345	295	0.678**
2	r13.245	295	0.781**
3	r14.235	295	0.521**
4	r15.234	295	-0.040

** Significant at 1% level

The table shows that partial correlation co-efficients between yield of fruits and any one of the four components namely, plant height, number of branches, number of flowers and number of fruits, keeping the remaining variables constant are significant and positive in three cases($r_{12.345}$, $r_{12.245}$, and $r_{14.235}$) and the other($r_{15.234}$) is found to be negative, but not significant. With regard to the former three cases absolute correlations are found to be high, that is, between yield of fruits and plant height, between yield of fruits and number of branches and between yield of fruits and number of flowers. On the basis of the strength of absolute correlation existing between yield and its components, the characters can be ranked as follows.

1. Number of branches.
2. Plant height.
3. Number of flowers
4. Number of fruits.

5) Multiple correlation

Multiple correlations between yield of fruits and its components characters namely, plant height, number of branches number of flowers and number of fruits, computed in all combinations are presented in table XIX.

The co-efficients of multiple correlation are high and significant at 1% level as seen from the table below, indicating that the various components in combination contribute appreciably towards the yield of fruits.

TABLE.XIX

Multiple correlation between yield of fruits,plant height,number of branches, number of flowers and number of fruits

Sl. No.	Particulars	Degrees of freedom	Co-efficient of correlation(r0
1	R1.23	297	0.702**
2	R1.234	296	0.759**
3	R1.2345	295	0.761**

** Significant at 1% level

B.DISCRIMINANT FUNCTION

i)Genetic components of variances and co-variancesof characters

The phenotypic, genotypic and error variances for the five characters namely, yield of fruits, plant height, number of branches, number of flowers and number of fruits, used for the formulation of the discriminant function were computed and are presented in Tables XX,XXI and XXII,

Table XX indicates, wide range of phenotypic variability in the five characters. The relative amount of heritable(genotypic) and non-heritable(error) components of the variability suggest that the genetic component of variability is fairly large in all the characters.

TABLE.XX

Estimate of phenotypic variances and co-variances for the different characters(components of variances in parenthesis)

Characters	Yield of fruits	Plant height	Number of branches	Number of flowers	Number of fruits
Yield of fruits	(20763.34)	25429.53	-8697.00	38041.99	-3401.13
Plant height		(464.70)	2280.28	1426.34	1354.55
Number of branches			(13441.06)	8428.32	3782.77
Number of flowers				(7590.94)	4651.60
Number of fruits					(4069.54)

TABLE.XXI

Estimate of genotypic variances and co-variances for the different characters(components of variances in parenthesis)

Characters	Yield of fruits	Plant height	Number of branches	Number of flowers	Number of fruits
Yield of fruits	(17319.88)	38775.76	1058.30	60813.54	-1296.44
Plant height		(447.45)	2243.85	1355.59	1912.02
Number of branches			(3248.75)	7994.87	876.64
Number of flowers				(7383.30)	4901.60
Number of fruits					(4005.80)

TABLE.XXII

Estimate of error variances and co-variances for the different characters(components of variances in parathesis)

Characters	Yield of fruits	Plant height	Number of branches	Number of flowers	Number of fruits
Yield of fruits	(3443.46)	-13346.23	-9755.30	-22771.55	-1296.44
Plant height		(310.44)	37.43	77.75	- 557.47
Number of branches			(192.31)	433.45	2906.13
Number of flowers				(207.64)	- 250.00
Number of fruits					(63.74)

ii) Selection indices

The construction of selection indices for selection for yield of fruits was made by adopting the discriminant function technique. The characters included in the discriminant function are the following.

1. Yield of fruits ... (X_1)
2. Height of plants ... (X_2)
3. Number of branches... (X_3)
4. Number of flowers ... (X_4)
5. Number of fruits ... (X_5)

Thirty one discriminant functions were formulated in the form

$Z = B_1 x_1 + b_2 x_2 \cdots\cdots b_n x_n$, where b_1's and x_1's represent the weights and the individual phenotypic value respectively for the first character, are listed in table XXII along with the expected genetic advance in yield of fruits from the use of different indices and their relative efficiency computed by putting the efficiency of selection for yield alone as 100.

It is seen from the table that all the selection indices constructed, combining the best components of yield, namely, plant height, number of branches, number of flowers

TABLE.XXIII

Discriminant function, expected genetic advance in yield of fruits and relative efficiency from the use of different selection indices

Selection index	Discriminant function	Genetic advance	Relative efficiency
x1	Z = 0.8341 x1	120.194	100.000
x1,x2	Z = 0.9316 x1 + 0.3048 x2	131.594	101.176
x1,x3	Z = 0.8506 x1 + 0.0393 x3	124.956	101.039
x1,x4	Z = 0.5051 x1 + 0.4683 x4	233.553	101.943
x1,x5	Z =-1.0934 x1 + 1.1768 x5	45.236	100.376
x1,x2,x3	Z = 1.2020 x1 + 0.5816 x2 + 1.7818 x3	249.453	102.076
x1,x2,x4	Z = 1.3160 x1 + 0.4122 x2 + 0.1146 x4	213.628	101.778
x1,x2,x5	Z = 0.5964 x1 + 0.1096 x2 + 0.1178 x5	121.375	101.009
x1,x3,x4	Z = 0.4255 x1 + 0.2580 x3 + 0.5949 x4	205.272	101.707
x1,x3,x5	Z = 1.4384 x1 + 0.1619 x3 + 0.9087 x5	154.644	101.283
x1,x4,x5	Z = 1.5809 x1 + 0.5757 x4 + 0.6252 x5	248.155	102.065
x1,x2,x3,x4	Z = 1.1075 x1 + 0.9112 x2 - 0.4375 x3 +0.0148 x4	234.417	101.950
x1,x2,x3,x5	Z = 0.1129 x1 + 0.0353 x2 + 0.5920 x4 +0.8258 x5	195.589	101.610
x1,x2,x3,x5	Z = 1.0414 x1 + 1.3871 x2 + 0.3971 x3 +0.7583 x5	268.687	102.237
x1,x3,x4,x5	Z = 1.7790 x1 + 0.8610 x3 + 0.2364 x4 +0.3192 x5	141.589	101.178
x1,x2,x3,x4,x5	Z =-0.8743 x1 - 0.3205 x2 - 0.3236 x3 -0.5850 x4 + 0.4277 x5	181.859	101.513

Table XXXIII.contd...

17.	x4	Z	= 0.9726 x4	87.563	100.727
18.	x5	Z	= 0.9843 x5	62.791	100.522
19.	x2	Z	= 0.9629 x2	20.756	100.172
20.	x3	Z	= 0.9857 x3	114.325	100.951
21.	x2,x3	Z	= 0.2131 x2 + 0.7979 x3	95.433	100.793
22.	x2,x4	Z	= 0.4007 x2 + 1.4131 x4	318.571	102.651
23.	x2,x5	Z	= 0.2893 x2 + 1.9900 x5	117.466	100.993
24.	x3,x4	Z	= 0.5120 x3 + 0.2327 x4	121.211	101.083
25.	x3,x5	Z	= 0.3830 x3 + 0.3818 x5	29.301	100.244
26.	x4,x5	Z	= 0.1675 x4 + 0.4119 x5	98.245	100.817
27.	x2,x3,x4	Z	= 1.2146 x2 + 0.3957 x3 + 0.1300 x4	221.658	101.844
28.	x2,x3,x5	Z	= 1.0317 x2 + 0.7698 x3 + 0.3351 x5	200.956	101.672
29.	x2,x4,x5	Z	= 0.5715 x2 + 0.7396 x4 + 0.5076 x5	257.837	102.146
30.	x3,x4,x5	Z	= 0.5893 x3 + 0.5362 x4 - 0.3004 x5	68.375	100.543
31.	x2,x3,x4,x5	Z	= 0.4856 x2 + 0.4494 x3 + 0.1959 x4 +0.0253 x5	176.594	101.461

and number of fruits in different combinations with yield give slightly increased efficiency over selection for yield of fruits alone. Considerable increase in efficiency was noticed when number of flowers alone and plant height and number of branches in combination were included in the index along with yield of fruits.

DISCUSSION

DISCUSSION

Yield is a complex character resulting from the action of a polygenic system, influenced by environmental factors occurring at the different stages of growth of a plant. Hence selection for yield, based on the phenotype alone may not always be efficient. So to make selection efficient,genotypic values are relied upon.

Measures of correlation are important to the crop breeder as they serve as an aid in determining the relationship between characters. These correlational properties are best utilised for selecting of plants by formulating suitable selection indices, combining two or more characters associated with yield, in such a way that the phenotypic value of the character is highly correlated with the genotypic value. This is achieved by making uses of the concept of discriminant function.

The present investigation was undertaken to formulate suitable selection indices for yield in capsicum by the utilization of direct function involving some of the closely associated components noticed. Some important points of interest arising from the results presented in the foregoing section are discussed below.

1. INTER VARIETAL VARIABILITY OF THE DIFFERENT CHARACTERS

The mean values of yield of fruits and seven other associated characters studied, viz. plant height, number of branches, number of flowers, number of fruits, percentage of fruit setting, weight of seeds per fruit and duration of maturity showed marked variation in all the ten varieties.(Table.II).

A general indication from the data is that the varieties which combine high mean values for plant height, number of branches, number of flowers and number of fruits are found to be high yielders in varieties with comparatively small sized fruits.(Varieties,Purple long, Red long, and Red Chilli). Of the remaining varieties eventhough the mean values for the above characters are less, the mean yield is high because of the large size of fruits.(varieties - Hungarian Wax, California Wonder, Chinese Giant and White Long).

The analysis of variance worked out for the different characters(Table III to X) has made evident that the varieties exhibited wide range of variability with respect to all the eight characters analysed.

The response of selection for a character depends on the extent of variability available in that particular character; the greater the variability, the more is the response to selection.(Mather 1955). According to Hayes *et al.*, variability has a direct hold on the correlation between two related variables as the correlation coefficient is a measure of the total variation accounted for by the variables. Thus the high values of correlation for the different characters show their advantageous use in the selection for yield.

2. CORRELATIONS OF YIELD OF FRUITS AND SOME OF ITS COMPONENT CHARACTERS

Yield of fruits and plant height have showed significant positive values of coreelation coefficients in six varieties. The correlation in the remaining varieties was positive and of a low magnitude(table.XI). Regarding combined correlation, taking all the varieties together, the correlation coefficient was positive and highly significant(table.XII). This might be due to the closer association of the tested characters in the varieties1,2,4 and 8.

Elimination of the influence of the three variables namely, number of branches, number of flowers and number of fruits in combination did not decrease the value of absolute correlation between yield and plant height. This is indicative of the low amount of influence, that these eliminated variables have, on the association of the two characters. Elimination of the effect of variables 3 and 5(number of branches and number of fruits) increased the strength of association between yield and plant height considerably.(Table XIV).

Similar findings were recorded in various other crops. Chandramohan and Ponnaiya(1961) showed variation of correlation among varieties with respect to yield and plant height in rice. Working in the same crop Ramiah(1953) and Ghose et al.(1956) reported only feeble correlation between these characters, while, Ganguli and Sen(1941) and Chandramohan(1964) recorded positive significant correlation between yield and plant height. Positive correlations between the two characters were recorded by other workers, Love(1912) and Hayes et al.(1925) in wheat, Kottur and Chavan(1928) and Khole(1951) in sorghum, Jenkins(1924) in corn, Kumar and Ranga Rao(1949) and Sikka and Gupta(1949) in sesamum.

Yield of fruits and number of branches showed moderately high correlation values in all the varieties studied(Table XI). When all the varieties were taken together the correlation coefficient was high and positive. (Table XII). The uniform high values of correlation at the varietal level and when all the varieties were treated as a whole, presumably indicate the genetic basis of this association. A similar result has already been put forward by Kedharnath et al.(1960) in their experiments with linseed.

Elimination of the effect of other three variables namely, plant height, number of flowers and number of fruits did not affect in any direction the strength of the relationship of these two characters(Table.XV). This clearly revealed that the eliminated variables did not exert any appreciable amount of influence on the relationship of these two characters. However, the exclusion of the components, plant height and number of flowers in combination has reduced the value of partial correlation coefficient. But it did not affect the strength of the association to such an extent as to render the correlation nonsignificant.

Significant correlations between yield and number of branches has been reported in other crops by Deshpande and Malik(1937) in linseed, Shih(1949) in soybean, Kumar and Ranga Rao(1941) and Sikka and Gupta(1949) in gingelly and Stroman(1949) in cotton.

Of the eight characters analysed, number of flowers and number of fruits appeared to be the most intimately correlated characters with yield of fruits(Table.XI). The correlation coeffcients in both cases were high and positive invariably in all the varieties which might be due to the strong genetic basis of the relationship of these two characters towards yield.

Highly significant values of correlation were obtained when all the varieties were treated as a whole (Table.XII) in the case of the relationship between yield and number of flowers. This is suggestive of the greater intensity of relationship between these characters.

Partial correlation between yield and number of flowers, eliminating the effects of three variables namely, plant height, number of branches and number of fruits was negative(Table.XVI). This is indicative of the appreciable degree of influence these eleminated characters have got in the interrelationship of the tested characters.

With regard to yield and number of fruits when all the varieties, were taken together so as to get the combined correlation coefficient, the value was positive and highly significant.

Elimination of the effects of plant height, number of branches and number of flowers in combination, resulted in a negative value of correlation coefficient. This is suggestive of the remarkable amount of influence, these eliminated variables have got on the relationship of the two characters. However, the elimination of the effect of the variables 2 and 3 (Plant height and number of branches) decreased the value of correlation coefficient considerably (Table XVII), which suggests the appreciable amount of influence these characters have got upon the intensity of relationship between yield and number of fruits. Similar association was reported by Weatherspoon and Wentz(1934), Shigh(1937), Waddle(1954), Johnson et al.(1955) and Brim et al.(1959) in soybean, Ling(1954) and Mishra(1958) in groundnut, Kedharnath et al.(1960) in linseed, Kumar and Ranga Rao(1941) and Sikka and Gupta(1949) in gingelly.

The correlation of yield with percentage of fruit setting and weight of seed per fruit was found to be feeble when compared to those with other components studied. (Table.XI). Correlation of percentage of fruit setting with yield was significant in six varieties and in the rest, the value tended to be of a low magnitude. In the case of the combined estimate of correlation also the result was not much different, giving a value which was significant at 5 per cent level.

Among the components evaluated, weight of seeds per fruit possessed no appreciable association with yield of fruits. In one variety the correlation was found to be negative. The low values of correlation fluctuating in both positive and negative directions is suggestive of the feeble relationship of this character with yield.

Further the combined estimate of correlation gave the lowest positive value among all the characters studied. In general, yield and weight of seeds per fruit did not appear to be strongly correlated. Similar in consistant relationship between yield and weight of seeds has been reported by Kedharnath et al.(1960) in linseed. However, strong association between yield and seed weight has been recorded in other crops; by Woodworth(1932),Shih(1947) and Waddle(1954) in soybean and Deshpande and Malik(1937) and Batecha(1959) in linseed.

Between yield of fruits and duration of maturity, the different varieties showed no consistant association. In most cases the coefficient of correlation was low and tended towards negative direction. In one variety, the correlation coefficient was found to be positive and significant(Table.XI). In all other varieties the values were low in magnitude and fluctuated in positive and negative directions. In the case of the combined estimate of correlation also, the coefficient of correlation was found to be very low and negative(Table.XIII).

Such a relationship between yield of fruits and duration of maturity is not in conformity with the results of Webber(1952), Hanway(1956) in soybean, who recorded high and positive correlation between yield and number of days from flowering to the first maturity of pods.

INTERRELATIONSHIP BETWEEN THE YIELD COMPONENTS

Table XIII reveals the features of interrelationship between the four contributory factors of yield, which showed relatively stronger association with yield viz. plant height, number of branches, number of flowers, number of fruits. Plant height possessed an apparent correlation with humber of branches, number of flowers and number of fruits per plant. Similarly mutual correlation of number of branches with number of flowers and number of fruits also are highly significant. The components of yield, number of flowers and number of fruits also showed a high degree of association. This is suggestive of the usefulness of these characters for the formulation of a multiple selection criterion for yield of fruits.

Significant and positive values of multiple correlation between yield and all the four components of yield might be a further clue to the high magnitude of contribution of these characters towards yield.(Table XIX). and their useful application in selection indices.

DISCRIMINANT FUNCTION AND SELECTION INDICES

The construction of suitable selection indices for yield was based on the discriminant function technique. The foregoing discussion of the results suggests that the characters, number of branches, plant height, number of flowers and number of fruits are strongly associated with yield in the order given and hence they serve as important indicators of yield.

Panse(1940) stressed the importance of heritable variability and genetic analysis of characters for selection efficiency. The genotypic and error components of variances and covariances of weight of fruits(Yield) as well as those of other characters showed that heritable portion of variability was largest in the case of weight of fruits(yield) and decreased for the other characters in the order of number of branches, number of flowers and plant height. Low values of heritability was also reported by Burton(1951) in pearl millet, Johnson et al.(1955) in soybean and Vishnu Swarup and Chaugale(1962) in jowar.

The components, namely, plant height, number of branches, number of flowers and number of fruits together with yield of fruits were used in the formulation of selection indices individually and in combination using the discriminant function technique; as the basis.

All the selection indices constructed, gave either the same or slightly increased efficiency than that obtained from selection for yield of fruits alone. It was also indicated that selection based on any individual components did not give a better genetic advance than that obtained from straight selection for yield.

When plant height and number of flowers, the two strongly associated characters to yield were included in the selection index, the efficiency increased as compared to that in which these two characters were not included ie. even without the inclusion of yield of fruits in the index, the above correlation of variables gave the maximum efficiency. However, when number of branches also was included along with number of flowers, the efficiency decreased considerably.

Hasel(1943) stated that selection based on a suitable index is more efficient than individual selection for the various characters, According to Goulden(1959) the discriminant function formula gives an indication of the concentration of the desired genes in the plants or in the lines selected.

Panse(1957) expressed the view that an index based on yield alone as a measure of networth can seldom be made more efficient by including the direct components of yield, so that the use of certain other associated characters, become necessary. Panse and Kargaonkar(1949) in cotton, Abraham et al.(1954) in rice, Sikka and Jain(1958) in wheat and Vishnuswarup and Chaugale(1962) in jowar, corroborate this view point. On the other hand, Simlote(1947) in wheat, Manning(1955) and Fryxell(1956) in cotton, Johnson et al.(1955) in soybean and Sankar et al.(1963)pearl millet, constructed certain indices based on yield and its direct components to be quite useful in selecting for high yielding varieties. The present study also is in accordance with the latter contention. There are several possible factors which could have been responsible for such a disagreement among their results such as, design and layout of the experiment choice of the material and the criteria for the assignment of économic weights. From this investigation the following conclusions can be made.

1. Yield in capsicum is strongly associated with plant height, number of branches, number of flowers and number of fruits.

2. Selection indices using the suitable combination of the above components, particularly plant height and number of flowers per plant showed higher efficiency over direct selection of yield.

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SUMMARY

Ten divergent varieties of capsicum were grown in a randomised block design with three replications, with a view to study the association between yield of fruits and some contributorycharacters of yield, and to further formulate a suitable selection index for yield, by means of the discriminant function technique.

The components of yield considered in the study were, plant height, number of branches, number of flowers, number of fruits, weight of seeds per fruit, percentage of fruit setting and duration of maturity of fruit. The analysis of variance indicated that the varieties differed significantly among themselves with respect to these characters.

Coefficients of simple correlation were worked out between and all the seven component characters for the ten varieties, treated singly as well as combined.

Partial and multiple correlations between yield and its four important contributory factors namely plant height, number of branches, number of flowers, and number of fruits per plant and also total correlations between these four components interse were calculated.

Discriminant function technique was adopted for the construction of thirty one selection indices for the selection for yield of fruits using all the possible combinations of characters such as yield of fruits and plant height, number of branches, number of flowers and number of fruits, which showed relatively more intimate association with yield.

Salient results emanating from the studies are summarised:-

1. Simple correlation between yield and only four of the components, viz., plant height, number of branches, number of flowers and number of fruits, showed positive and highly significant values, both at the varietal level and when the varieties were considered together. Number of fruits showed the strongest association with yield followed in the order by number of flowers, plant height and number of branches.

2. Mutual correlations among the above four components showed highly significant values of correlation coefficients namely plant height and number of branches and number of flowers and number of fruits. Between plant height and number of branches, the correlation was apparently very high and positive.

3. Absolute correlation coefficients between yield of fruits and any one of the above mentioned four components, after eliminating the influence of the other three variables, were highly significant and positive. Based on absolute correlation, number of branches showed the strongest relationship with yield followed by plant height, number of flowers and number of fruits.

4. Multiple correlations showed that these components jointly contributed towards yield in appreciable measure.

5. Partitioning of the variability of yield and four of its strongly associated component characters namely plant height, number of branches, number of flowers and number of fruits per plant, into its heritable(genotypic) and non-heritable(error) portions indicated that the heritable portion of the variability was the largest with respect to yield of fruits, followed in the order by, number of branches, number of flowers, number of fruits and plant height.

6. Among the thirty one selection indices constructed combining yield of pods and the four above mentioned components, the one based on height of plants and number of flowers was found to be most advantageous.

In general it is clear from the studies that plant height and number of flowers per plant are the most potent components of yield in capsicum and that, these easily determinable yield components, in suitable combination can form a valuable index for selection for yield in capsicum.

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