EVALUATION OF DIPLOIDS AND POLYPLOIDS OF IVY GOURD (*Coccinia grandis* [L.] Voigt)

By

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THESIS

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DECLARATION

I hereby declare that the thesis entitled **'Evaluation of diploids and polyploids of Ivy gourd (*Coccinia grandis* [L.] Voigt)'** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title of any other University or Society.

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SHINU JOSEPH

DEDICATED TO

MY BELOVED

PAPPA AND MUMMY

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Introduction

1. INTRODUCTION

Vegetables play a vital role in human diet by providing vitamins, minerals besides supplying of energy and protein. Among different vegetables Cucurbitaceous vegetable are very important which consist of approximately thirty species of cultivated plants. They are significant for supplying vitamins and minerals especially vitamin A and C to our daily diet. These group of vegetables are grown throughout the world from the tropics to the temperate zones. One of the important cucurbitaceous vegetable is Ivy gourd (*Coccinia grandis* [L.] Voigt) which is a popular as perennial and quick growing vegetable grown in many parts of India, Ceylon, Malaya and tropical Africa. In India it is widely grown in Madhya Pradesh, Maharashtra, Karnataka and Tamil Nadu. The original home of Ivy gourd is believed to be India. It is also known as little gourd or koval.

Ivy gourd is a soft stemmed evergreen climber with simple or lobed leaves. It is vegetatively propagated and plants are dioecious. Flowers are white in colour, fruits cylindrical or elongated in shape with or without white stripes Fruits are parthenocarpic and bright green at the edible stage when it is used as vegetable. It is rich source of vitamine A and C and also minerals like iron and calcium. It has got therapeutic value as per ayurvedic system of medicine particularly in the treatment of diabetes.

The nutritional qualities of vegetable have got importance in the present day vegetable farming. Even though Ivy gourd is rich source of vitamins and minerals, the presence of polyphenol affects its palatability adversely. The

evaluation of divergent accessions will make it possible to find out accessions having more nutrients and less of polyphenol so that it can be more used as a salad vegetable.

This crops is a fastly becoming a commercial vegetable crop of Kerala. Having an easy method of propagation, relatively free of pest and disease and ready market for the produce several farmers have taken up its cultivation on a large scale utilising locally available accessions. The occurrence of great diversity in many quantitative and qualitative characters of this crop has made a lot of scope for the crop improvement. The availability of induced triploids and tetraploids has added its crop diversity. Collecting all the available accessions and evaluating them based on the morphology, yield and yield contributing traits will help to identify desirable forms for direct use.

In Ivy gourd a great diversity in the vine and fruit morphological characters exists in north eastern, central and southern India. Various types occur such as small fruited type, long fruited type and dwarf to long vine type. The colour variability of fruit ranges from dark green to light green with or without white stripes. But there is a no systematic effort to collect, conserve and evaluate various types in this crop.

The crop being vegetatively propagated the maintenance of genetic purity of the desirable accessions will be easy. Keeping the above points in view the present study entitled "Evaluation of diploids and polyploids of Ivy gourd (*Coccinia grandis* [L.] Voigt)" was conducted with the following specific objectives.

1. To study the genetic variability in Ivy gourd for different characters by estimating phenotypic and gentotypic coefficients of variation.
2. To estimate the heritability and gentic advance for different characters in Ivy gourd.
3. To study the association between yield and its components by estimating phenotypic, genotypic and environmental correlation coefficients
4. To determine the direct and indirect effect of each component on yield by path coefficient analysis
5. To study the genetic divergence among the different genotypes in Ivy gourd and to group them into different genetic clusters.

Review of literature

2. REVIEW OF LITERATURE

The information available in Ivy gourd (*Coccinia grandis* [L.] Voigt) is very scanty, literature on similar studies conducted in other cucurbitaceous vegetables are reviewed under following heads.

1. Variability studies
2. Heritability and genetic advance
3. Correlation
4. Path coefficient analysis
5. Genetic divergence studies

2.1 Variability studies

Thakur and Nandpuri (1974) reported significant differences among the varieties for length of vine, branches per plant, sex ratio, fruits per plant, fruit weight, yield per plant, seed per kilogram of fruit weight and 100 seed weight in water melon. Srivastava and Srivastava (1976) observed variability in bitter gourd for all the characters except male flowers per plant. The highest genotypic coefficient of variation (37.45) was recorded for fruits per plant followed by yield per plant (32.13). In 25 bitter gourd types significant differences were found among the types by Ramachandran (1978) for primary branches per plant, length of main vine, node at which first female flower appeared, days to opening of the first female flower, female flowers per plant, per cent of female flowers, yield per plant, fruits per plant, fruit weight, length of fruit, girth of fruit, flesh thickness, seed per fruit and 100 seed weight. Gopalakrishnan (1979) obtained considerable variability in eighteen pumpkin genotypes for yield and its component characters

like days to first male and female flower, anthesis, length of main vine, male flowers per plant, female flowers per plant, per cent of female flowers, average fruit weight, weight of first mature fruit, fruits per plant and per cent of fruit set. The maximum value of genotypic coefficient of variation was observed for male flowers per plant followed by fruits per plant. Deshpande *et al.* (1980) studied the floral biology in ridge gourd and found that the varieties differed in bud development, number of days to flowering, flower size and ovary length. Ramachandran and Gopalakrishnan (1980) estimated variance components viz., genotypic coefficients of variation, heritability, genetic advance and genetic gain for six biochemicals fruit characters in twenty five diversed type of *Momordica charantia.* The range of variation was wide and difference between type highly significant. High or moderate estimates of heritability and high genetic gain were found in the content of vitamin C, phosphorus, total soluble solids and iron. It was suggested that these traits were controlled by additive gene while protein and potassium content were controlled by non additive gene. Results of association analysis indicated that breeding for an increase in total soluble solids will improve the content of vitamin C, potassium and phosphorus while maintaining reasonably high protein contents, but that improving iron content would require a separate breeding programme. The large variation in chemical composition in these cultivar suggested that there was scope for *M. charantia* breeding for high yield and nutritive value. High genotypic coefficient of variation for fresh weight of fruits, yield per plant and fruit length were recorded by Indiresh (1982) in bitter gourd. Arora *et al.* (1983) reported significant varietal difference

for all the characters studied in sponge gourd. Genotypes HS-12 and HS – 13 with good yield performance were comparable for most of the characters. Singh *et al.* (1986) observed significant differences for all characters including days to flowering, days to fruit set, days to ripening, fruits per plant, fruit length and yield in 18 lines of pointed gourd (*Trichosanthes dioica* Roxb.). Sahni *et al.* (1987) reported genotypic and phenotypic variability in 21 genotypes of ridge gourd. The genotypes showed considerable variability for all the characters and it was the highest for yield per vine and the lowest for fruit diameter. Differences between phenotypic and genotypic variance for fruits per vine, fruit weight, female flowers per vine, node number for the appearance of fruit, female flowers and branches per vine were very low in magnitude indicating that the characters were not much influenced by environment. The fruits per vine showed the highest phenotypic and genotypic coefficients of variation. Prasad and Singh (1989) reported variability in eleven genotypes of ridge gourd. Five characters viz., number of fruits, fruit length, fruit diameter, yield per plot and yield in quintals per hectare exhibited high significant differences among the genotypes. The characters viz., vine length, node number, node on which first flower appeared and fruit diameter did not showed any significant difference. The pcv ranged from 10.5 to 59.8 and the gcv from 3.72 to 50.90 for the characters studied. High gcv and pcv for the characters like yield per plot (50.4 and 59.8) yield in quintals per hectare (50.9 and 59.1) and number of fruits (26.33 and 40.4) indicate that maximum amount of variability existed in the genotypes for these characters. Jaiswal *et al.* (1990) reported considerable variation in quality traits on bitter gourd (*Momordica charantia* L.) cultivars.

They analysed fruits of *M. charantia* cultivars viz., Priya, Arka Harit, Sakaldiha, Jakhani – 12, Jakhani – 30, Pusa Do Mausami and Baramasi for variations in colour, size, weight, contents of protein, carbohydrates, sugars, ash, phosphorus, iron, total S, vitamin C, acidity and total phenol. Priya fruits contained highest crude protein (2.32 per cent), ash (1.24 per cent), phosphorus (76.5 mg/100g), iron (3.1 mg/100g), total S (14.95 mg/100g) and lowest acidity (1.7 per cent) and total phenol content (41.7 mg/100g), carbohydrate, total sugar and vitamin C content of Priya fruits were (8.07 per cent, 2.94 per cent and 112.2 mg/100g respectively) and were only slighltly lower than those found in Arka Harit. It was therefore concluded that Priya fruits were of better overall quality than any cultivar studied. Rahman *et al.* (1994) conducted biochemical studies in different types of Bottle gourd (*Lagenaria siceraria*) and Sweet gourd (*M. dioica*) and observed considerable variability in the content of nitrogen, phosphorus, potassium, chlorophyl a and b, caratenoids, sucrose, maltose and monosaccharides in their leaves and protein, vitamin A and C and starch in their fruits. Among 30 indigenous and exotic genotypes of watermelon, Rajendran and Thamburaj (1994) observed high genetic variability. The genotypes showed variation in 11 biometric traits. Similar studies reported by Thakur *et al.* (1994) in bitter gourd in which mean square estimate for genotypes were significant for all the characters studied.

Raju and Peter (1995) reported considerable variability in fruit length, fruit weight and fruit girth in *Coccinia grandis*. Among the accessions CG-1, CG-2, CG-4, CG-7, CG-9, CG-23, CG-27 and CG-37 were promising genotypes. Babu and Rajan (1995) reported the induction of tetraploid in *C. grandis* by treatment of

colchicine (0.2 per cent) on a diploid accession (CG-23). The induced tetraploids (2n = 48) were vigorous in growth and the fruits were having more girth compared to diploid parents further the tetraploid was crossed with diploid male parent to raise triploid (3n = 36) plants. Triploid plants were found to produce bigger sized fruit compared to diploid and tetraploid.

Babu *et al.* (1996) reported considerable variability in carotene content and iron content in the fifty pumpkin genotypes. Katiyar *et al.* (1996) reported that all the characters in bitter gourd showed variation in various genetical parameters. The phenotypic coefficient of variation (pcv) was maximum for yield per plant followed by length of main vine. Genotypic coefficient of variation was minimum for female flower and maximum for yield per plant. Ram *et al.* (1996) obtained high variability for days to first male flower (except in muskmelon), days to first female flower, number of nodes at which first male or female flower emerged, vine length (except in muskmelon), number of primary laterals, number of nodes on main vine, number of fruits per plant and fruit length, breadth and weight in various cucurbits including pumpkin, watermelon, cucumber, bottle gourd, bitter gourd and muskmelon. Rajput *et al.* (1996) observed large variation for yield and its components both at phenotypic and genotypic level in twenty one diverse bitter gourd genotypes when evaluated for eleven characters.

2.2 Heritability and genetic advance

Heritability and genetic advance provides the degree of improvement in performance of selected lines over the original population (Lush, 1949).

Thakur and Nandpuri (1974) obtained high heritability for length of plant, sex ratio, number of fruits per plant, fruit weight, total soluble solids, number of seeds per kilogram of fruit and 100 seed weight in watermelon. Low heritability estimates were reported for number of branches per plant, number of days to fruit harvest and yield per plant of which the minimum was for number of branches per plant (25.95 per cent). The heritability estimate was 92.92 per cent for 100 seed weight and 84.97 per cent for seeds per kilogram of fruit. Expected genetic advance was high for number of seed per kilogram of fruit. Srivastava and Srivastava (1976) reported fruits per plant in bitter gourd had the highest estimate of heritability (99.31 per cent) and genetic advance (71.73 per cent). Fruit weight, length of fruit and yield per plant had high heritability along with high genetic gain. Male flowers per plant recorded the lowest estimate of genetic gain (16.73 per cent) and heritability (49.93 per cent). The characters like yield, duration of female phase and number of female flowers per plant in watermelon which showed low estimates of narrow sense heritability and were highly susceptible to environmental fluctuations (Brar and Nandpuri, 1978). According to Ramachandran (1978) in bitter gourd highest heritability recorded as 99.80 per cent by fruits per plant and the lowest was 43.37 per cent by seed per fruit. High heritability along with high expected genetic advance was obtained for female flowers per plant fruits per plant and yield. Genetic advance was found to be highest for yield per plant (81.93 per cent). Gopalakrishnan (1979) observed highest heritability estimate of 99.14 per cent for male flowers per plant followed by per cent of female flowers and female flowers per plant in pumpkin. The lowest

heritability estimates of 76.97 per cent was observed for percent of fruit set. In cucumber Solanki and Seth (1980) reported the characters with high heritability and high genetic advance implied additive gene effects which could be improved by selection is cucumber. Indiresh (1982) observed high heritability estimates for leaf number per plant, leaf area, vine length, girth and volume of fruits and fresh fruit weight in bitter gourd. Low heritability was estimated for yield per plant and days for fruit development. In nineteen lines of pumpkin, high estimates of heritability and genetic advance was obtained for vine length and percentage fruit set (Rana, 1982). Vashistha *et al.* (1983) obtained high heritability estimates for all characters except yield per plant in watermelon. Prasad *et al.* (1984) reported high heritability and genetic advance for yield, number of fruits and fruit size in sponge gourd (*Luffa cylindrica* Roem.). In pointed gourd (*Trichosanthes dioica* Roxb.) similar observation were recorded by Singh *et al.* (1986). Vijay (1987) reported that in muskmelon heritability and genetic advance were high for fruit per vine, flesh thickness, total soluble solids and yield per vine. In watermelon higher estimates of heritability and genetic advance for yield per vine, sex ratio, average fruit weight, number of seeds per fruit and 100 seed weight was observed by Rajendran (1989). These traits were recommended for use as selection criteria. In bitter gourd Thakur *et al.* (1994) obtained high heritability in broad sense for all characters which ranged from 56.41 to 87.79 per cent. High heritability was recorded for total yield, marketable yield and fruit fly infestation. Rajput *et al.* (1996) observed that heritability in bitter gourd were high for almost all the yield and related characters. The joint consideration of genetic advance and heritability

suggested that all the characters were controlled by additive gene effects except days to first harvest which was under non-additive gene control. According to Wehner and Cramer (1996) fruit yield, earliness and quality have low to moderate heritability but were traits of major importance in cucumber. Genetic evaluation and correlation study by De-Paiva (1997) in cucumber reported that heritability was lowest for fruit number and highest for quality index. High heritability values were also obtained for number of fruits greater than 18 cm in length.

2.3 Correlation

In bitter gourd (*Momordica charantia* L.), Singh (1953) reported that there was no significant relationship between the number of staminate and pistillate flowers and between nodal position of first staminate flower and sex ratio. In pumpkin and ash gourd, Thamburaj and Kamalanathan (1973) observed significant and positive correlation between incidence of female flowers at lower nodes and the number of female flowers per vine and between flowering at lower nodes and earliness of flowering. The sex ratio was positively correlated with incidence of female flowers at lower nodes and with early appearance of female flowers. Tsybulevskii (1974) reported positive correlation between flower organ and fruit flesh in two species of cucurbita which was important for selection of plants with high carotene content. Srivastava and Srivastava (1976) reported that in bitter gourd fruit yield per plant was positively associated with female flowers per plant (rg=0.87), fruits per plant (rg=0.86) and lateral branches per plant (rg=0.59). Female flowers and lateral branches per plant were found positively associated

with fruits per plant. Days to first female flower opening was negatively correlated with fruits per plant and female flowers per plant but positively with fruit weight. A negative correlation existed between number of fruits per plant and individual fruit weight. Kavasnikov and Tsybulevskii (1980) observed that in *C. maxima* and *C. moschata*. Selection for carotene content of the fruit might be effected visually on the basis of intensity of corolla colour (in *C. maxima*) and intensity of pistil colour (in *C. moschata*). Sidhu and Brar (1981) reported that yield in bitter gourd was highly correlated with length of main vine, fruit weight, fruit length, number of fruits per plant, number of female flowers per plant and number of primary branches per plant. Number of seeds per kilogram of flesh showed negative correlation with yield. Salk (1982) made correlation studies of five varieties of melon and reported that total fruit yield per plant was positively correlated with number of fruits per plant and negatively correlated with fruit weight. Positive correlation was found between flesh thickness, fruit weight and fruit diameter but selection for the last two characters did not necessarily result in greater flesh thickness in fruits of a given diameter. Rana (1982) observed highly significant positive association for female flowers per plant, fruit number, fruit weight and flesh thickness with yield per plant in pumpkin. Correlation between most yield components were positive and significant. According to Indiresh (1982) yield in bitter gourd was positively and significantly correlated with number of leaves per plant, leaf area, fresh weight of fruit, length, girth and volume of fruit and length of vine. Singh *et al.* (1986) reported that yield was positively and significantly correlated with fruits per plant ($r=0.95$) and length of vine ($r=0.60$) in

pointed gourd. Days to flowering, days to fruit set and days to ripeness were negatively correlated with all other related characters with the exception of a positive correlation between days to flowering and fruit weight.

Choudhary and Mandal (1987) observed high positive correlation at the genotypic and phenotypic levels between yield per plant and number of fruits, female flowers per plant, fruit length and fruit weight in 30 diverse genotypes of cucumber. These characters along with fruit diameter were the most important characters determining yield. When 20 cultivars of *Triichosanthes dioica* were grown, Singh *et al.* (1987) observed that yield was significantly correlated with length of fruit (r=0.59), diameter of fruit (r=0.51) and weight of seed (r=0.48). Days to flowering was negatively correlated with seed size (-0.69) and length of fruit was significantly correlated with fruit diameter (0.54), fruit weight (0.55), seed size (0.55) and seed weight (0.54), pulp thickness of fruit with seed size (0.73), weight of fruit with seed number per fruit (0.74) and weight of seed (0.61). Singh and Singh (1988) evaluated eleven genotypes of watermelon and found that yield per vine was correlated with number of fruits per vine (r=0.95), which also has highest direct effects on yield. Yield was negatively correlated with rind thickness, fruit weight, number of days and node number for the appearance of the first female flower. Prasad and Singh (1990) studied on the morphological and agronomical components of pointed gourd and revealed positive correlations of yield with lateness in flowering and number of seeds per fruit with fruit weight. Rajput *et al.* (1991) indicated significant positive correlation between number of fruits and yield, and number of branches with yield in cucumber. In pumpkin

genotypic estimates showed better correlation than the phenotypic and environmental with all pairs of characters showing positive genotypic correlation (r>0.75) (Amaral *et al.*, 1994). When Chen *et al.* (1994) compared seven monoecious cucumber cultivars for four parthenocarpic yield components there were significant positive correlation between number of pistillate flowers, numbers of parthenocarpic fruits and yield, and between parthnocarpic yield, number of fruits and average single fruit weight. In summer squash (*cucurbita pepo* L.) Damarany *et al.* (1995) observed a negative relationship between total yield and relative early yield. In cucumber total yield had significant positive correlation with total fruit number (r=0.84 or 0.83) fruit growth rate (r=0.66 or 0.67) and average fruit weight (r=0.42 or 0.41). Stem diameter and plant height also had an effect on total yield (Ma *et al.*, 1995). Similar observation made by Neikov and Alexandrova (1995) in cucumber where the yield was significantly correlated with fruit number and weight. Paranjape and Rajput (1995) observed that yield was mainly contributed by number of fruits per vine, average fruit weight, fruit length and number of female flowers in 21 bitter gourd genotypes. The physiological attributes like vine length, primary branches and average leaf area were mutually associated and had effects on yield. Correlation studies by Saikia *et al.* (1995) in eight genotypes of cucumber and revealed that yield per plant had strong positive association with main vine length, number of secondary branches, leaf area, fruiting percentage, number of fruits per plant, fruit weight and fruit length both at genotypic and phenotypic levels. De-Paiva (1997) observed high phenotypic and

genotypic correlation coefficients between yield and number of fruits having a length greater than 18 cm in cucumber.

2.4 Path coefficient analysis

In bitter gourd according to Srivastava and Srivastava (1976) female flower per plant had the maximum direct effect on yield (2.75) followed by fruits per plant (0.90) and lateral branches per plant (0.89). The indirect effects of other characters towards yield were mainly through lateral branches per plant, female flowers per plant and fruits per plant. Fruits per plant also had high indirect contribution towards yield through weight of fruits. Further in bitter gourd Ramachandran (1978) observed that fruit weight (0.55), fruits per plant (0.40) and length of main vine (0.30) had high positive direct effects on yield, primary branches per plant, female flowers per plant and fruit length had negative direct effects on fruit yield. Gopalakrishnan *et al.* (1980) examined 25 quantitative characters in 18 genetically distinct types of pumpkin, main stem length and average fruit weight proved to have the greatest direct effects on yield. Sidhu and Brar (1981) studied path coefficient analysis in watermelon and found that the number of nodes to the first female flower and flesh weight had high positive direct effect on fruit yield. Rana (1982) conducted path coefficient analysis in pumpkin and observed the magnitude of direct effects of the characters studied on yield depended on environment. Vijay (1987) obtained strong direct effect for fruits per vine and fruit weight on yield in musk melon. Singh *et al.* (1987) reported direct and indirect effects in parwal. Days to flowering, fruit diameter, fruit weight, size of fruit and

weight of seed had direct effects on yield while fruit length, pulp thickness and seed number per plant had indirect effects. Rajendran and Thamburaj (1989) studied 10 yield traits in watermelon. They indicated that mean fruit weight had a marked direct effect on fruit yield while number of fruits per stem, harvest index, number of seeds per fruit and leaf index on 60th day contributed indirectly to yield. In cucumber, internodal length, number of female flowers and days to maturity had a positive highly significant direct effect on fruit yield (Solanki and Achal Shah, 1989). According to Chen *et al.* (1994) direct effect for the number of pistillate flowers on yield which was much lower than its indirect effect on number of fruits in cucumber. In bitter gourd fruit weight had maximum direct bearing on yield while length of vine. primary branches, nodes on main axis, leaf area, fruit length, number of fruits per vine, and seed content indirectly contributed towards yield (Paranjape and Rajput, 1995).

2.5 Genetic divergence studies

In bitter gourd Ramachandran (1978) studied genetic divergence using Mahalanobis D^2 statistic for eight quantitative characters, primary branches per plant, length of main vine, days to opening of the first female flower, female flowers per plant, fruits per plant, weight of individual fruit, length of fruit and yield per plant. The 25 types differed significantly for the characters he studied and were grouped into 10 clusters based on the magnitude of D^2 value. Considerable diversity within and between clusters were noted. Length of main vine, fruit per plant, weight of individual fruit and yield per plant were the important factors contributing to divergence. Further Wahab and Gopalakrishnan

(1993) estimated genetic divergence among 50 diverse *M. charantia* geneotypes and were grouped them into 5 clusters on the basis of D^2 analysis of data on 18 vegetative production and quality characters. Genetic diversity was not significantly correlated with geographic diversity. Intra cluster and intercluster genetic distances were tabulated. The largest clusters with 23 genotypes contained most of the high yielding genotypes.

Genetic divergence studies in 58 genotypes of ridge gourd was reported by Varalakshmi *et al.* (1994). Mahalanobis D^2 statistic was applied to study genetic divergence and Tochers method was used to form the clusters. There was substantial variation in cluster means for whole plant, fruit length and yield per plant. The inter cluster D^2 values indicated that in cluster III, the variety CO – 1 from Tamilnadu was most divergent from the other clusters.

Materials and methods

3. MATERIALS AND METHODS

The present investigation was carried out in the vegetable research Farm of the Department of Olericulture, College of Horticulture, Kerala Agricultural University, Vellanikkara which is located at an altitude of 23m above MSL and between 10° 32" and 76° 16" east longitude. The experiment was conducted during November 1997 to September 1998 as detailed below.

The project consisted of evaluation of genetic variability, biometrical and divergence studies in Ivy gourd.

3.1 Experimental materials

Experimental material consisted of one tetraploid, four triploids and fifteen diploid accessions. The diploid accessions collected from farmers field and Department of Olericulture were used. The polyploids were developed and maintained in the same department. The list of accessions and their sources are given in the Table 1.

3.1.1 Experimental methods

The experiment was laid out in randomised block design with two replications. Each replication consisted of twenty plots and each plot having two pits. Crop was raised during November 1997 to September 1998. Pits were taken at a spacing of 1.5m x 1.5m. Farmyard manure was applied at base at the rate of 10 kilograms per pit. Two cuttings each having three nodes were planted in each pit.

The cultural practices were followed as recommended by the Package of Practices of KAU, 1996. The field was irrigated on alternate days during the

Table 1. Morphological characters of Ivy gourd germplasm

Sl. No.	Accession No.	Source	Colour of petal	Fruit colour	Striation of fruit skin	Fruit shape	Leaf lobe
	Diploids						
1	CG - 8	Mattampuram	Pale white	Light green	Continuous	Cylindrical	Narrow
2	CG - 10	Chenganoor	Pale white	Green	Continuous	Cylindrical	Narrow
3	CG - 11	Vellanikkara	Cream	Pale green	Continuous	Cylindrical	Medium
4	CG - 13	Vellanikkara	White	Dark green	Broken	Cylindrical	Medium
5	CG - 19	Mattampuram	Creamy white	Light green	Broken	Cylindrical	Deep
6	CG - 20	Thanikudam	Pale white	Pale green	Continuous	Cylindrical	Medium
7	CG - 23	Kollam	Pale white	Pale green	Continuous	Cylindrical	Narrow
8	CG - 44	Thiruvillamala	Cream	Light green	Broken	Cylindrical	Medium
9	CG - 45	Cherppulassery	Pale white	Green	Continuous	Cylindrical	Medium
10	CG - 50	Mattampuram	Pale white	Green	Continuous	Cylindrical	Medium
11	CG - 52	Poonkunam	Cream	Green	Continuous	Cylindrical	Medium
12	CG - 57	Arimbur	Pale white	Green	Continuous	Cylindrical	Medium
13	CG - 71	Local collection, Thrissur	White	Light green	Continuous	Long	Narrow
14	CG - 72	Local collection, Kayamkulam	Pale white	Light green	Continuous	Long	Narrow
15	CG - 73	Local collection, Thrissur	White	Pale green	Continuous	Long	Narrow
	Triploids						
16	CG - 74	Vellanikkara	Creamy white	Green	Broken	Cylindrical	Medium
17	CG - 75	Vellanikkara	Pale white	Dark green	Broken	Cylindrical	Narrow
18	CG - 76	Vellanikkara	Pale white	Green	Broken	Cylindrical	Medium
19	CG - 77	Vellanikkara	Creamy white	Green	Broken	Cylindrical	Medium
	Tetraploid						
20	CG - 78	Vellanikkara	Pale white	Green	Broken	Oval	Deep

summer season. When plants started trailing, wooden frames were fixed around each pit and vines were trailed on them.

Observations were recorded for both qualitative and quantitative characters on four plants per replication.

Qualitative characters observed were colour of petals, colour of fruit and shape of fruit.

The quantitative characters observed were

Vine length

Length was measured from the collar region to the tip of the main vine in meters.

Number of primary branches

The number of primary branches arising from the main vine was counted.

Internodal length

The length of the internode at three different points of the vine were recorded in centimeters.

Days to first flowering

The number of days from the date of planting to the date of first flower opening was taken.

Nodes to first female flower

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

Length of flower bud

The length of six flower bud from each plant was recorded separately in centimeters and average was worked out.

Length of petal

The length of six flower petals from each plant was recorded separately in centimeters and mean was worked out.

Width of petal

Width of six flower petals from each plant was recorded separately in centimeter and average was worked out.

Length of leaf

Length of six leaves from each plant was recorded separately in centimeter and average was worked out.

Width of leaf

Width of six leaves from each plant was recorded separately in centimeter and average was worked out.

Days to fruit maturity

The number of days taken from the opening of the first flower to the maturity and harvest of the fruit was counted in six fruit per plant and mean was taken.

Length of fruit

The length of six fruits from each plant were recorded separately in centimeters after harvest and average was worked out.

Girth of fruit

The girth at the middle of six fruits were recorded separately in centimeters after harvest and average was worked out.

Average fruit weight

The weight of six fruits were recorded and their average was calculated in grams.

Number of fruit per plant

The total number of fruits produced per plant was recorded.

Fruit yield per plant

The weight of fruits harvested from each plant was recorded separately and their average was calculated in kilogram.

Carotene content

The carotene content of dried fruit sample at mature stage was estimated using a spectro photometer (Milton Roy Co. Spectronic 20 D) at 438.5 nm after extracting with water saturated n-Butanol by A.O.A.C. 1980.

Vitamin –C

The vitamin C content of the fresh sample was estimated by the method of A.O.A.C. 1960 using 2,6 dichloro phenol indophenol dye.

Calcium

For estimating the calcium content of the dried sample, Nitric perchloric acid (2:1) digestion was prepared and was estimated by versanate method (Hesse, 1971).

Polyphenol

Tannin content was estimated by Folin – Denis method (Sadasivam and Manikam,1992).

3.1.2 Statistical analysis

The data were statistically analysed and analysis of variance, genotypic and phenotypic variance, heritability, genetic advance, genetic gain, genotypic and phenotypic coefficient of variation, genotypic and phenotypic correlation coefficients and path coefficients were estimated. The analysis techniques suggested by Fisher (1954) was employed for estimation of various genetic parameters.

3.1.2.1 Phenotypic, genotypic and environmental variance

The variance component was estimated using the formula suggested by Burton (1952).

Phenotypic variance (V_p) = $V_g + V_e$ where, V_g = genotypic variance

V_e = environmental variance

Genotypic variance (V_g) = ($V_T - V_E$) / N

where, V_T = mean sum of squares due to treatment

V_E = mean sum of square due to error

N = number of replication

Environmental variance (V_e) = V_E

3.1.2.2 Phenotypic and genotypic coefficient of variation

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

Phenotypic coefficient of variation (pcv) = $(V_p^{1/2}/\bar{x}) \times 100$

where , V_P = phenotypic variance, $\bar{x}$ = Mean of character under study

Genotypic coefficient of variation (gcv) = $(V_g^{1/2}/\bar{x}) \times 100$

where, V_g = genotype variance, $\bar{x}$ = mean of characters under study

3.1.2.3 Heritability

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

Heritability in broad sense (H) = $(V_g/V_p) \times 100$

where, V_g = Genotypic variance

V_p = phenotypic variance

3.1.2.4 Expected genetic advance

The genetic advance expected to the genotype at five per cent selection pressure was calculated using the formula by Lush (1949) and Johnson *et al.* (1955) with value of the constant K as 2.06 as given by Allard (1960).

Expected genetic advance GA= $(V_g/V_p) \times K$ where

V_g = Genotypic variance

V_p = phenotypic variance

K = Selection differential

3.1.2.5 Genetic gain (Genetic advance as percentage of Mean)

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

Genetic gain, GG = $(GA/\bar{x}) \times 100$

where, GA = Genetic advance

$\bar{x}$ = Mean of character under study

3.2 Phenotypic, genotypic and environmental correlation coefficients.

Phenotypic, genotypic and environmental correlation coefficients were worked out to study the extent of association between the characters. The phenotypic, genotypic and environmental covariances were worked out in the same way as the variances were calculated. Mean product expectations of the covariance analysis are analogous to the mean square expectation of the analysis of variance. The different covariance estimates were calculated by the method suggested by Fisher (1954).

Phenotypic covariance between two characters 1 and 2

$(COV_p 12) = COV_g 12 \times COVe12$

$COV_g 12$ = genotypic covariance between characters 1 and 2

$COV_e 12$ = environmental covariance between characters 1 and 2

Genotypic covariance between character 1 and 2

$COV_g 12 = (M_t 12 - M_e 12)/N$

Where,

$M_t 12$ = Mean sum of product due to treatment between character 1 and 2

$M_e 12$ = Mean sum of product due to error between characters 1 and 2

N= Number of replication.

The phenotypic, genotypic and environmental correlation coefficient among the various characters were worked out in all possible combination according to the formula suggested by Johnson *et al.* (1955). Phenotypic

correlation coefficient between two characters 1 and 2 (r_p12) = $COV_p12/(V_p1$ $V_p2)^{1/2}$

where,

COVp12 = phenotypic covariance between character 1 and 2

Vp1 = phenotypic variance of character 1

Vp2 = phenotypic variance of character 2

Genotypic correlation coefficient between two characters 1 and 2

(r_g 12) = COV_g 12/(V_g 1 V_g 2)$^{1/2}$

where,

COV_g12 = Genotypic covariance between character 1 and 2

V_g1 = Genotypic variance of character 1

V_g2 = Genotypic variance of character 2

Environmental correlation coefficient between two characters 1 and 2

(r_e12) = $COV_e12/(V_e$ 1 V_e 2)$^{1/2}$

where,

COV_e 12= Environmental covariance between characters 1 and 2

V_e 1 = Environmental variance of character 1

V_e 2 = Environmental variance of character 2

3.3 Path coefficient analysis

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

The character which showed significant correlation with yield at one per cent level of significance alone were considered for path coefficient analysis.

3.4 Genetic divergence

The genetic divergence was calculated according to the method suggested by Mahalonobis (1928). Clustering of genotypes was done using Tocher's method (Rao, 1952).

Results

4. RESULTS

The present study on "Evaluation of diploids and polyploids of Ivy gourd (*Coccinia grandis* [L.] Voigt)", included genetic variability, divergence and biometrical investigation involving twenty genotypes of Ivy gourd (*Coccinia grandis*). The results pertaining to the above aspects have been depicted in this chapter.

4.1 Variability, biometrical and divergence studies in Ivy gourd

4.1.1 Variability, heritability and genetic advance.

The general analysis of variance of the 20 accessions of Ivy gourd was performed and found that there was significant difference for most of the characters studied (Appendix I). The population mean, range, genotypic and phenotypic coefficients of variation, heritability, genetic advance and genetic gain for all the 20 characters are given in Table 3.

4.1.1.1 Vine length

There was no significant difference observed between the accessions in the character vine length. The vine length ranged from 1.80 m to 4.90 m. The overall mean vine length was 3.56 m. The minimum vine length was observed in the tetraploid accession CG-78 (Plate 1) and maximum was in CG-71 (Plate 2). The heritability observed was 0.089. The phenotypic and genotypic coefficient of variation were 31.57 and 9.43 respectively. The genetic advance was 0.21 and genetic gain was 5.89 per cent.

Table 2. Mean value of twenty genotypes in Ivy gourd

Genotype	Length of main vine (m)	Primary branches per plant	Internodal length (cm)	Days to first flowering	Nodes to first female flower	Length of flower bud (cm)	Length of petal (cm)	Width of petal (cm)	Length of leaf (cm)	Width of leaf (cm)
CG - 44	3.99 AB	7.00 CDEF	7.16 CDE	40.25 DEF	5.50 ABC	1.55 ABCDE	2.47 DEF	0.67 B	7.95 AB	9.70 BC
CG - 11	4.82 A	12.00 A	6.90 CDE	35.75 F	3.00 CDEF	1.58 ABCDE	2.61 BCDEF	0.76 B	8.20 AB	10.25 BC
CG - 45	4.39 AB	11.00 AB	9.95 AB	41.50 CDEF	4.00 ABCDEF	2.18 A	3.07 BC	1.35 AB	7.95 AB	7.95 C
CG - 20	3.56 AB	8.50 ABCDE	7.20 CDE	43.50 BCDEF	5.00 ABCD	1.98 AB	2.83 BCDEF	1.13 AB	8.60 AB	10.30 BC
CG - 50	3.55 AB	10.50 ABC	7.25 BCDE	58.25 AB	6.00 AB	1.99 AB	2.31 EF	0.92 B	7.70 AB	8.95 BC
CG - 52	4.61 A	9.50 ABCD	11.75 A	49.25 ABCDEF	1.50 F	1.76 ABCD	2.15 F	1.46 AB	7.40 AB	8.65 BC
CG - 74	2.91 AB	6.50 CDEF	5.90 E	53.50 ABCDE	3.50 BCDEF	1.55 ABCD	2.22 F	0.96 B	6.65 B	4.80 D
CG - 10	3.12 AB	6.00 DEF	7.10 CDE	52.50 ABCDE	4.50 ABCDE	1.91 ABC	2.17 F	1.34 AB	7.65 AB	9.80 BC
CG - 23	4.57 A	6.00 DEF	7.24 CDE	54.75 ABCD	6.50 A	1.31 BCDE	2.55 CDEF	1.87 A	9.55 A	8.80 BC
CG - 13	3.80 AB	7.00 CDEF	6.32 DE	53.50 ABCDE	2.50 DEF	1.55 ABCDE	2.44 DEF	0.62 B	7.05 AB	9.15 BC
CG - 19	2.55 AB	7.50 BCDEF	6.00 E	60.75 A	3.50 BCDEF	1.19 DE	3.05 BC	0.93 B	6.55 B	9.25 BC
CG - 71	4.90 A	12.00 A	9.19 BC	58.60 AB	3.50 BCDEF	1.40 BCDE	2.44 DEF	1.07 AB	8.85 AB	11.70 AB
CG - 57	3.64 AB	7.50 BCDEF	9.52 ABC	43.75 BCDEF	6.50 A	1.63 ABCDE	2.65 BCDEF	0.80 B	8.75 AB	9.55 BC
CG - 8	4.06 AB	4.00 F	6.87 CDE	46.25 ABCDEF	3.00 CDEF	1.60 ABCDE	2.35 DEF	0.73 B	7.90 AB	10.15 BC
CG - 75	3.13 AB	5.00 EF	8.97 BCD	39.25 EF	4.50 ABCDE	1.81 ABCD	2.49 DEF	0.91 B	7.15 AB	9.45 BC
CG - 72	3.10 AB	7.50 BCDEF	6.20 E	61.00 A	2.50 DEF	1.10 E	3.08 BC	1.17 AB	6.70 B	9.75 BC
CG - 78	1.80 B	4.50 EF	6.90 CDE	58.50 AB	2.50 DEF	1.28 CDE	3.72 A	1.45 AB	8.15 AB	11.50 ABC
CG - 73	2.76 AB	10.50 ABC	7.95 BCDE	53.25 ABCDE	2.00 EF	1.79 ABCD	3.07 BC	1.11 AB	9.45 A	13.75 A
CG - 76	2.95 AB	12.00 A	7.95 BCDE	43.50 BCDEF	3.50 BCDEF	1.82 ABCD	3.14 B	1.17 AB	6.55 B	11.35 ABC
CG - 77	3.07 AB	4.50 EF	7.24 CDE	56.50 ABC	1.50 F	1.62 ABCDE	2.89 BCD	1.42 AB	7.30 AB	10.50 ABC

(Contd.....)

Table 2. (contd.....)

Genotype	Days to fruit maturity	Length of fruit (cm)	Girth of fruit (cm)	Average fruit weight (g)	Fruits per plant	Fruit yield per plant (kg)	Carotene (ppm)	Vitamine- C (mg/100g)	Calcium (%)	Polyphenol (mg/100g)
CG - 44	7.50 BCD	6.37 CDE	7.50 A	10.95 BCDE	336.50 ABCD	4.02 BCDEFG	48.20 MN	11.95 EF	0.83 A	0.110 BC
CG - 11	7.00 CD	6.55 BCD	7.50 A	13.40 B	506.00 AB	7.19 A	47.60 MN	13.90 BC	0.53 CD	0.100 FG
CG - 45	7.00 CD	6.60 BCD	7.15 ABC	11.25 BCDE	320.50 ABCD	5.68 ABCDE	48.60 M	16.50 A	0.47 DE	0.110 BC
CG - 20	7.50 BCD	6.80 BC	7.50 A	12.80 BC	372.00 ABCD	4.36 ABCDEFG	79.70 H	10.70 GH	0.54 CD	0.100 EFG
CG - 50	7.50 BCD	4.95 GHI	6.10 ABCD	11.75 BCDE	234.00 ABCD	3.03 DEFG	88.20 F	11.30 FG	0.47 DE	0.120 A
CG - 52	8.00 ABC	5.25 EFGH	6.30 ABCD	9.60 CDEFG	472.25 ABC	3.47 BCDEFG	87.10 F	13.25 CD	0.62 BC	0.110 CDEF
CG - 74	8.50 ABC	4.35 HI	6.20 ABCD	7.15 FGH	176.00 CD	1.37 G	40.70 P	12.60 DE	0.47 DE	0.096 G
CG - 10	8.00 ABC	6.20 CDEF	5.80 CD	10.35 BCDEF	238.50 ABCD	2.70 EFG	113.60 C	9.35 IJ	0.40 EF	0.120 A
CG - 23	8.50 ABC	5.25 EFGH	6.70 ABCD	8.30 EFGH	266.50 ABCD	3.28 CDEFG	133.70 A	10.05 HI	0.47 DE	0.110 B
CG - 13	9.00 AB	5.15 FGHI	5.70 D	8.95 DEFGH	265.75 ABCD	3.05 DEFG	84.90 G	8.70 J	0.62 BC	0.100 CDEF
CG - 19	6.00 D	4.40 HI	6.00 BCD	6.45 GH	268.75 ABCD	2.48 FG	120.50 B	12.70 DE	0.32 F	0.100 DEFG
CG - 71	7.00 CD	5.25 FGH	6.55 ABCD	8.80 DEFGH	288.50 ABCD	2.44 FG	108.90 D	13.35 CD	0.62 BC	0.110 BCDE
CG - 57	8.50 ABC	6.05 CDEFG	7.00 ABCD	11.15 BCDE	401.50 ABCD	5.08 ABCDEF	57.40 K	12.05 EF	0.54 CD	0.100 EFG
CG - 8	9.50 A	5.80 CDEFG	7.10 ABCD	12.00 BCD	395.75 ABCD	4.89 ABCDEF	47.30 N	10.80 GH	0.32 F	0.110 BCD
CG - 75	8.00 ABC	6.85 BC	7.45 A	11.80 BCDE	432.00 ABCD	6.48 AB	53.10 L	13.35 CD	0.65 B	0.096 G
CG - 72	7.00 CD	7.60 B	7.35 AB	12.85 BC	278.75 ABCD	4.48 ABCDEFG	45.50 O	14.65 B	0.62 BC	0.110 B
CG - 78	8.00 ABC	4.10 I	6.65 ABCD	5.75 H	207.50 G	1.41 G	40.70 P	11.40 FG	0.36 F	0.096 G
CG - 73	9.00 AB	8.65 A	6.55 ABCD	19.05 A	330.50 ABC	6.20 ABC	70.70 J	14.65 B	0.62 BC	0.110 B
CG - 76	8.00 ABC	6.50 BCD	6.45 ABCD	12.15 BCD	445.00 ABCD	6.04 ABCD	77.30 I	12.70 DE	0.32 F	0.098 FG
CG - 77	7.00 CD	5.50 DEFG	6.75 ABCD	11.25 BCDE	117.75 FG	2.47 FG	94.80 E	10.80 GH	0.54 CD	0.098 FG

Table 3. Range, mean, gcv, pcv, heritability, genetic advance and genetic gain as percentage of mean of Ivy gourd germplasm

Sl. No.	Characters	Range	Mean	gcv	pcv	Heritability	Genetic advance	Genetic gain(%)
1	Length of main vine	3.56 ± 0.780	3.56	9.43	31.57	0.089	0.21	5.89
2	Primary branches per plant	7.97 ± 0.82	7.97	29.76	37.34	0.630	3.90	48.93
3	Internodal length	7.70 ± 0.78	7.70	16.46	21.89	0.560	1.96	25.45
4	Days to first flowering	50.20 ± 1.14	50.20	13.01	17.99	0.520	9.73	19.38
5	Node to first female flower	3.75 ± 0.78	3.75	35.04	46.47	0.560	2.04	54.40
6	Length of flower bud	1.63 ± 0.19	1.63	12.30	20.97	0.340	0.24	14.72
7	Length of petal	2.68 ± 0.16	2.68	13.90	16.40	0.710	0.65	24.25
8	Width of petal	1.09 ± 0.24	1.09	18.15	37.36	0.230	0.20	18.34
9	Length of leaf	7.80 ± 0.78	7.80	7.06	14.98	0.220	0.53	6.79
10	Width of leaf	9.76 ± 0.80	9.76	14.44	20.74	0.480	2.03	20.79
11	Days to fruit maturity	7.82 ± 0.54	7.82	8.50	13.07	0.420	0.89	11.38
12	Length of fruit	5.91 ± 0.33	5.91	18.36	20.04	0.830	2.05	34.68
13	Girth of fruit	6.71 ± 0.40	6.71	6.27	10.64	0.340	0.51	7.60
14	Average fruit weight	10.78 ± 0.80	10.78	25.38	28.72	0.780	4.98	46.19
15	Fruits per plant	322.71 ± 2.21	322.71	20.80	43.89	0.220	65.56	20.31
16	Fruit yield per plant	4.00 ± 0.79	4.00	36.12	48.27	0.560	2.23	55.75
17	Carotene	74.42 ± 0.37	74.42	38.93	38.93	1.000	59.67	80.18
18	Vitamin C	12.23 ± 0.32	12.23	15.51	15.96	0.944	3.80	31.07
19	Calcium	0.51 ± 0.37	0.51	24.52	26.14	0.880	0.24	47.05
20	Polyphenol	0.10 ± 1.23	0.10	6.93	7.35	0.890	0.01	10.00

Plate 1.	Tetraploid accession CG-78

Plate 2.	Accession CG-71 having maximum vine length


Tetra-1


CG71

4.1.1.2 Number of primary branches

There was a large and significant variation for the number of primary branches among the accessions. CG-8 had minimum number of primary branches (4.00) and accessions which had maximum number of primary branches were CG-71, CG-11 and CG-77 (12.00). The overall mean observed was 7.97. The heritability was 0.63. The pcv and gcv were 37.34 and 29.76 respectively. The estimated genetic advance was 3.90 and genetic gain, 48.93 per cent.

4.1.1.3 Internodal length

The accessions showed large and significant difference in the internodal length, it ranged from 5.90 cm in CG-74 (Plate 3) to 11.75 cm in CG-52. The over all mean was 7.70 cm. Heritability observed was 0.56. The pcv and gcv for this character was 21.89 and 16.46 respectively. Genetic advance was 1.96 and genetic gain was 25.45 per cent.

4.1.1.4 Days to first flowering

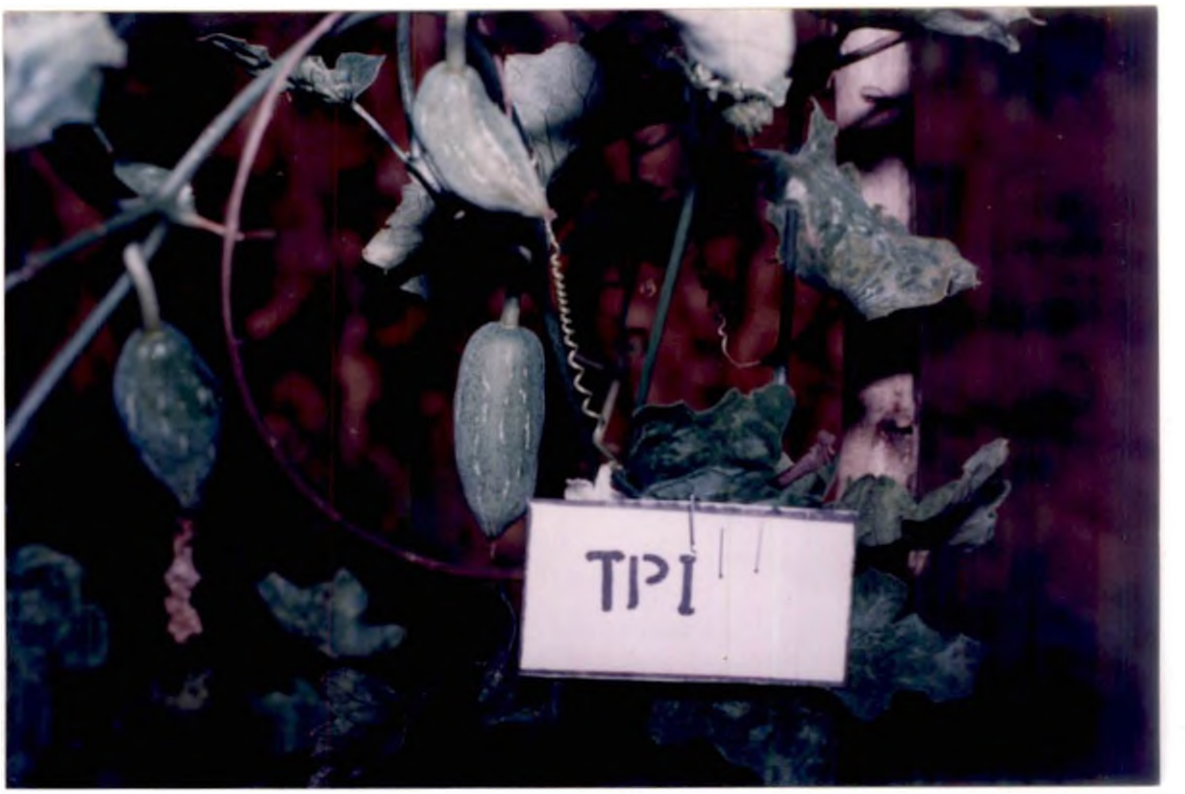
There was large and significant difference observed in this character. CG-11 took minimum number of days to produce first female flower (35.75 days) and the maximum was observed in CG-72 (61.00 days (Plate 4)). The genetic advance was 9.73 and genetic gain was 19.38 per cent. The heritability was 0.52. The pcv and gcv were 17.99 and 13.01 respectively. Over all mean was recorded as 50.20 days.

4.1.1.5 Nodes to first female flower

The genotype differed significantly for this character. It ranged from 1.5(CG-76) to 6.5 (CG-57). The over all mean was 3.75. The heritability observed

Plate 3.	Accession CG-74 (TP-1) having less internodes

Plate 4.	A late flowering accession CG-72


TPI


CG72

was 0.56. The genetic advance was 2.04 and genetic gain was 54.4 per cent. The pcv and gcv were 46.47 and 35.04 respectively.

4.1.1.6 Length of flower bud

There was no significant difference among the accessions. Over all mean was 1.63cm. The accession which had the longest flower bud was CG-45 (2.18cm) and that with the shortest flower bud was CG-72 (1.10 cm). The heritability and genetic advance were 0.34 and 0.24 respectively. The genetic gain 14.72 per cent. The pcv and gcv were 20.97 and 12.3 respectively.

4.1.1.7 Length of petal

There was large and significant difference observed among the accessions. CG-78 had the longest petal (3.72cm) and CG-52 had the shortest petal (2.15cm). The overall mean observed was 2.68cm. The heritability and genetic advance were 0.71 and 0.65 respectively. The pcv and gcv recorded were 16.40 and 13.90 respectively. Genetic gain was 24.25 per cent.

4.1.1.8 Width of petal

There was no significant difference among the accessions in this character. CG-23 had the maximum width of petal (1.87cm) and CG-13 had the minimum width of petal (0.62cm). The heritability observed was 0.23. Overall mean observed was 1.09cm. Genetic advance was 0.20 and genetic gain observed was 18.34 per cent. The pcv and GCV were 37.36 and 18.15 respectively.

4.1.1.9 Length of leaf

There was no significant difference among the accessions for this character. CG-19 had the minimum length of leaf (6.55cm) and the maximum length of leaf

observed in CG-23 (9.55 cm). The overall mean observed was (7.80cm). The heritability observed was 0.22. The genetic advance was 0.53. Genetic gain was 6.79 per cent. The pcv and gcv estimated were 14.98 and 7.06 respectively.

4.1.1.10 Width of leaf

There was significant difference among the accessions for the width of leaf. The maximum width of leaf was observed in CG-73 (13.75cm) and minimum was in CG-74 (4.80cm). The overall mean was 9.76cm. The heritability was 0.48. The genetic advance observed was 2.03. Genetic gain was 20.79 per cent. The pcv and gcv were 20.74 and 14.47 respectively.

4.1.1.11 Days to fruit maturity

There was significant difference among the accessions for this character. CG-8 took maximum days for fruit maturity (9.50) and CG-19 took minimum days for fruit maturity (6.00). The overall mean was 7.82. The heritability was 0.42. The genetic advance was 0.89 and genetic gain was 11.38 per cent. The pcv and gcv recorded as 13.07 and 8.50 respectively.

4.1.1.12 Length of fruit

There was large and significant difference between the accessions (Plate 5). The longest fruit found in CG-73 (8.65cm) and the shortest fruit was in CG-78 (4.10cm). The overall mean was (5.91cm). The heritability was 0.83. The pcv and gcv recorded as 20.04 and 18.36 respectively. The genetic advance observed was 2.05 and genetic gain was 34.68 per cent.

4.1.1.13 Girth of fruit

There was no significant difference among the accessions for this character. The overall mean observed was (6.71cm). The maximum girth observed in accessions CG-44, CG-11 and CG-20 (7.50cm (Plate 6)) and the minimum girth was observed in CG-13 (5.70cm (Plate 7)). The heritability was 0.34. The pcv and gcv were 10.64 and 6.27 respectively. The genetic advance was 0.51 and the genetic gain observed was 7.60 per cent.

4.1.1.14 Average fruit weight

There was large and significant difference among accessions in average fruit weight. The overall mean was observed as (10.78g). The maximum fruit weight was observed in CG-73 (19.05g (Plate 8)) and minimum was in CG-78 (5.70g). The heritability was recorded as 0.78. The pcv and gcv were 28.72 and 25.38 respectively. The genetic gain was 46.19 per cent and genetic advance observed was 4.98.

4.1.1.15 Number of fruit per plant

There was no significant difference among accessions for this character. The overall mean was (322.71). The maximum number of fruits per plant was observed in CG-11 (506.00) and minimum number in CG-76 (117.75). The heritability was 0.22. The pcv and gcv recorded as 43.89 and 20.80 respectively. The genetic advance was 65.56 and genetic gain was 20.31 per cent. The accession CG-78 was not significantly different from CG-76 and they both formed one group. There was not significant difference observed between the rest of accessions.

Plate 5.	Variability in fruit size in the *Coccinia grandis* accessions evaluated

Plate 6.	Accession CG-20 having maximum fruit girth


VARIABILITY IN Coccinia grandis


CG 2()

Plate 7.	Accession CG-13 having minimum fruit girth

Plate 8.	Accession CG-73 having highest average fruit weight


CG13


CG73

Plate 9.	Accession CG-11 having highest yield, fruits per plant and earliest flowering

Plate 10.	Accession CG-23 having maximum carotene content


CG11


CG23

4.1.1.16 Fruit yield per plant

There was large and significant difference observed among accessions for this character. The overall mean was 4.00 kg. The lowest yield was recorded by CG-74 (1.37kg) and highest byCG-11 (7.19kg (Plate 9)).

The heritability was 0.56. The pcv and gcv values were 48.27 and 36.12. The genetic advance was 36.12 and genetic gain was 2.23 per cent.

4.1.1.17 Carotene content

There was large and significant difference among the accessions for this character. The overall mean was (74.42 ppm). The minimum carotene content was observed in CG-78 and CG-74 (40.70 ppm and the maximum in CG-23 (133.70 ppm (Plate 10)). The heritability was 1. The pcv and gcv values were 38.93 and 38.93 respectively. The genetic advance was 59.67 and genetic gain was 80.18 per cent.

4.1.1.18 Vitamin C

There was large and significant difference between the accessions for this character. The overall mean was 12.23 mg / 100g. The minimum vitamin C content was in CG-13 (8.7 mg/100g) and the maximum in CG-45 (16.50 mg/100g) The heritability was 0.944. The pcv and gcv was 15.96 and 15.51 respectively. The genetic advance was 3.80 and genetic gain was 31.07 per cent.

4.1.1.19 Calcium content

There was large and significant difference between accessions for calcium content. The overall mean was (0.51 per cent). The maximum calcium content was in CG-44 (0.83 per cent). The heritability was 0.88. The pcv and gcv value

were 26.14 and 24.52 respectively. The genetic advance was 0.24 and genetic gain was 47.05 per cent.

4.1.1.20 Polyphenol

There was large and significant difference between the accessions for this character. The overall mean was 0.10mg/100g. The minimum polyphenol content was in CG-78, CG-74 and CG-75 (0.096mg/100g) and maximum was in CG-10 and CG-50 (0.12mg/100g). The heritability was 0.890 and pcv and gcv were 7.35 and 6.93 respectively. Genetic advance was 0.01 and genetic gain was 10 per cent

4. 2 correlation studies

The genotypic and phenotypic correlation of various yield components with yield were worked out. The results are presented in Table 4 and 5. The characters having significant genotypic and phenotypic correlation with yield were number of fruits per plant, average fruit weight, girth of fruit, length of fruit, days to first flowering and number of primary branches. Among these six characters viz., number of primary branches, length of fruit, girth of fruit, average fruit weight and number of fruits per plant had positive and significant correlation with yield. Number of fruit per plant had the highest positive and significant phenotypic correlation with yield (rp=0.80) whereas the highest positive and significant genotypic correlation was obtained with the length of fruit (rg=0.94). Next highest positive and significant phenotypic correlation of yield was found with length of fruit (rp =0.67) where as second highest positive and significant genotypic correlation was found in average fruit weight (rg = 0.93). The correlation values of the character number of primary branches to fruit yield was rp = 0.29. This

Table 4. Phenotypic correlation coefficients(r_p) among yield and yield components in Ivy gourd

Characters	Number of primary branches per plant	Internodal length	Days to first flowering	Nodes to first female flower	Length of flower bud	Length of petal	Width of petal	Length of leaf	Width of leaf	Days to fruit maturity	Length of fruit	Girth of fruit	Average fruit weight	Fruits per plant	Fruit yield per plant	Carotene	Vitamine- C	Calcium	Polyphenol
Length of main vine	0.168	0.377 *	-0.121	0.230	0.129	-0.351 *	0.135	0.403 **	-0.108	-0.050	-0.027	0.093	0.075	0.142	0.137	0.117	0.106	0.285	0.119
Primary branches per plant		0.208	-0.091	0.031	0.272	0.010	-0.080	0.080	0.093	-0.267	0.244	0.011	0.304 *	0.160	0.293 *	0.052	0.489 **	0.064	0.083
Internodal length			-0.239	0.060	0.348 *	-0.152	0.209	0.222	0.019	0.118	0.117	0.096	0.098	0.305 *	0.197	0.023	0.361 *	0.233	0.024
Days to first flowering				-0.088	-0.293 *	0.106	0.410	0.050	0.002	-0.118	-0.407 **	-0.554 **	-0.303 *	-0.614 **	-0.624 **	0.391 **	-0.165	-0.152	0.188
Node to first female flower					0.154	-0.274	-0.044	0.307 *	-0.261	0.047	-0.047	0.148	-0.054	-0.006	0.027	0.145	-0.223	0.013	0.215
Length of flower bud						-0.187	0.101	0.227	-0.115	0.17	0.218	-0.144	0.364	0.233	0.276	-0.056	0.072	0.039	0.129
Length of petal							0.202	0.026	0.376 *	-0.138	0.093	0.092	-0.030	-0.096	0.053	-0.198	0.269	-0.250	-0.281
Width of petal								0.302 *	0.031	-0.013	-0.112	-0.209	-0.127	-0.188	-0.176	0.330 *	0.043	-0.134	0.043
Length of leaf									0.338 *	0.224	0.154	0.008	0.245	-0.032	0.045	0.127	-0.027	0.188	0.131
Width of leaf										-0.018	0.451 **	0.151	0.465 **	0.144	0.231	0.099	0.042	0.074	0.04
Days to fruit maturity											0.063	-0.140	0.122	0.095	0.056	-0.161	-0.334 *	-0.051	0.01
Length of fruit												0.506 **	0.862 **	0.360 *	0.676 **	-0.249	0.415 **	0.348 *	0.197
Girth of fruit													0.353 *	0.331 *	0.481 **	-0.449 **	0.337 *	0.256	-0.11
Average fruit weight														0.315 *	0.640 **	-0.219	0.333 *	0.305 *	0.191
Fruits per plant															0.803 **	-0.215	0.277	0.139	-0.149
Fruit yield per plant																-0.321 *	0.443 **	0.153	-0.067
Carotene																	-0.416 **	-0.176	0.232
Vitamin C																		0.176	-0.041
Calcium																			0.014

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

Table 5. Genotypic correlation coefficients(r_g) among yield and yield components in Ivy gourd

Characters	Number of primary branches per plant	Internodal length	Days to first flowering	Nodes to first female flower	Length of flower bud	Length of petal	Width of petal	Length of leaf	Width of leaf	Days to fruit maturity	Length of fruit	Girth of fruit	Average fruit weight	Fruits per plant	Fruit yield per plant	Carotene	Vitamine- C	Calcium	Polyphenol
Length of main vine	1.597 **	0.891 **	-1.687 **	0.125	0.484 **	-1.609 **	-1.291 **	0.171	-0.405 **	0.142	0.430 **	1.136	0.211	2.071 **	0.943 **	0.378	0.174	0.720 **	0.417 **
Primary branches per plant		0.689 **	-0.388 **	-0.065	0.488 **	0.116	-0.062	0.344 *	0.376 *	-0.424 **	0.363 *	-0.036	0.445 **	0.816 **	0.591 **	0.068	0.648 **	0.146	0.090
Internodal length			-0.461 **	-0.038	0.754 **	-0.207	0.338 *	0.358 *	0.158	-0.201	0.184	0.133	0.220	1.010 **	0.436 **	0.030	0.457 **	0.282	0.023
Days to first flowering				-0.539 **	-1.068 *	0.260	0.110	-0.599 **	0.136	-0.185	-0.421 **	-0.710 **	-0.468 **	-1.221 **	-0.943 **	0.545 **	0.277	-0.337 *	0.400 **
Node to first female flower					0.319 *	-0.231	-0.120	0.473 **	-0.233	-0.021	-0.049	0.224	0.147	0.327 *	0.120	0.196	-0.241	0.041	0.283
Length of flower bud						-0.361 *	-0.366 *	-0.305 *	0.096	0.105	0.124	0.527 **	0.599 **	0.405 **	0.620 **	-0.093	0.118	0.076	0.304
Length of petal							0.439 **	0.013	0.617 **	-0.533 **	0.221	0.461 **	0.135	0.285	0.168	-0.239	0.376 *	-0.295 *	-0.363 *
Width of petal								-0.003	0.071	-0.378 *	-0.043	0.205	0.341 *	-0.719 **	0.523 **	0.682 **	-0.061	-0.543 **	0.508
Length of leaf									0.719 **	0.392 **	0.495 **	1.194 **	0.473 **	0.533 **	0.527 **	0.269	-0.015	0.223	0.328 *
Width of leaf										0.123	0.491 **	0.131	0.57 **	0.255	0.476 **	0.135	0.061	0.044	0.074
Days to fruit maturity											0.127	-0.198	0.299 *	0.214	0.160	-0.253	-0.459 **	-0.012	0.024
Length of fruit												0.558 **	0.954 **	0.679 **	0.937 **	-0.273	0.464 **	0.438 **	0.228
Girth of fruit													0.483 **	0.991 **	0.844 **	-0.771 **	0.554 **	0.603 **	-0.316 *
Average fruit weight														0.621 **	0.925 **	-0.247	0.366 *	0.314 *	0.241
Fruits per plant															0.831 **	-0.453 **	0.535 **	0.328 *	-0.470 **
Fruit yield per plant																-0.428 **	0.564 **	0.226	-0.132
Carotene																	-0.429 **	-0.186	0.244
Vitamin C																		0.179	-0.038
Calcium																			0.014

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

character was having least positive and significant phenoyptic correlation value. But the least positive and significant genotypic value was found to be for internodal length (rg = 0.43).

4. 2.1 Inter correlation among different characters

Among the different characters studied, six characters were found to have very significant positive correlation with yield and their associations were estimated. Length of main vine was found to have significant positive correlation with number of primary branches (rg = 1.597), internodal length (rg = 0.891), nodes to first female flower (rg = 0.125), length of flower bud (rg = 0.484), length of fruit (rg = 0.43) girth of fruit (rg = 1.136), number of fruits per plant (rg=0.071), calcium and polyphenol contents (rg = 0.720 and 0.417 respectively). But length of petal, days to flowering, width of petal and width of leaf were found to have negative and significant association with the length of vine (rg = ¯1.609, ¯1.687, ¯1.291, and ¯0.405 respectively). Number of primary branches had positive and significant correlation with internodal length (rg = 0.689), length of flower bud (rg = 0.488), length of leaf (rg = 0.344), width of leaf (rg = 0.376) length of fruit (rg = 0.363), average fruit weight (rg = 0.445), numbers of fruits per plant (rg = 0.816) and vitamin C content (rg = 0.648). The internodal length had positive and significant correlation with length of flower bud, width of petal, length of leaf, number of fruits per plant and vitamin C content (rg = 0.754, 0.338, 0.358, 1.010 and 0.457). Days to first flowering had positive and significant correlation with carotene and polyphenol content (rg = 0.545 and 0.400). But nodes to first female flower, length of flower bud, length of leaf, length of fruit, girth of fruit, average

fruit weight, number of fruit per plant and calcium content were found to have negative and significant association with days to first flowering (rg = ¯0.539, ¯1.068, ¯0.599, ¯0.421, ¯0.710, ¯0.468 , ¯1.221 and ¯0.337). Nodes to first female flower had positive and significant correlation with length of flower bud, length of leaf and number of fruits per plant (rg = 0.319, 0.473 and 0.327). Length of flower bud had positive correlation with girth of fruit, average fruit weight and number of fruits per plant (rg = 0.527, 0.599 and 0.405). Length of petal had positive and significant correlation with vitamin C (rg = 0.376). But days to fruit maturity, polyphenol and calcium contents were found to have negative and significant association with length of petal (rg = ¯0.533, ¯0.363 and ¯0.295). Width of petal had positive and significant correlation with carotene content (rg = 0.682). But days to fruit maturity (rg = ¯0.378), number of fruit per plant (rg = ¯0.719), average fruit weight (rg = ¯0.341) and calcium content (rg = ¯0.543) were found to have negative and significant association with width of petal.. Length of leaf had positive and significant correlation with width of leaf, days to fruit maturity, length of fruit, girth of fruit, average fruit weight, number of fruits per plant and polyphenol content (rg = 0.719, 0.392, 0.495, 1.194, 0.473, 0.533 and 0.328 respectively). Width of leaf had positive and significant correlation with length of fruit and average fruit weight (rg = 0.491 and 0.570 respectively. Days to fruit maturity positively and significantly correlated with average fruit weight (rg = 0.299). But vitamin C content had negative and significant association with days to fruit maturity (rg = ¯0.459). Length of fruit had positive correlation with girth of fruit (rg = 0.558), average fruit (rg = 0.954), number of fruits per plant (rg = 0.679),

Vitamin C (rg = 0.464) and calcium content (rg = 0.438). Girth of fruit had positive and significant correlation with average fruit weight (rg = 0.483), number of fruits per plant (rg = 0.991), vitamin C (rg = 0.554) and calcium content (rg = 0.603). But carotene and polyphenol contents found to have negative and significant association with girth of fruit (rg = ⁻0.771 and ⁻0.316). Average fruit weight was positively and significantly correlated with number of fruits per plant (rg = 0.621), vitamin C content (rg = 0.366) and calcium content (rg = 0.314). Fruits per plant had positive and significant correlation with calcium and vitamin C content (rg = 0.328 and 0.535 respectively). But carotene and polyphenol content had negative and significant association with fruits per plant (rg = ⁻0.470 and ⁻0.453). Fruit yield had positive and significant correlation with vitamin C content (rg = 0.564). But carotene content had negative and significant association with fruit yield (rg = ⁻0.428). Carotene content had negative and significant association with vitamin C content (rg = ⁻0.429).

4.3 Path coefficient analysis

The direct and indirect contribution of the component characters on yield can be found out by partitioning the correlation between yield and their component characters into direct and indirect effects (Table 6 and Fig.1). Step down regression was performed and the characters which showed significant correlation with yield were selected for path coefficient analysis. These character were width of petal(x_1), width of leaf(x_2), average fruit weight(x_3) and number of fruits per plant (x_4).

Table 6. Direct and indirect effects of yield components in Ivy gourd

Characters	Width of petal	Width of leaf	Average fruit weight	Number of fruit per plant	Correlation with yield
Width of petal	**0.1894**	-0.0639	-0.0033	-0.0720	0.0501
Width of leaf	0.0713	**-0.1697**	0.2295	0.0989	0.2300
Average fruit weight	-0.0012	-0.0782	**0.4982**	0.2064	0.6251
Number of fruits/plant	-0.0195	-0.0240	0.1470	**0.6991**	0.8027

Diagonal values (in bold) indicate direct effects
Residual : 0.1570

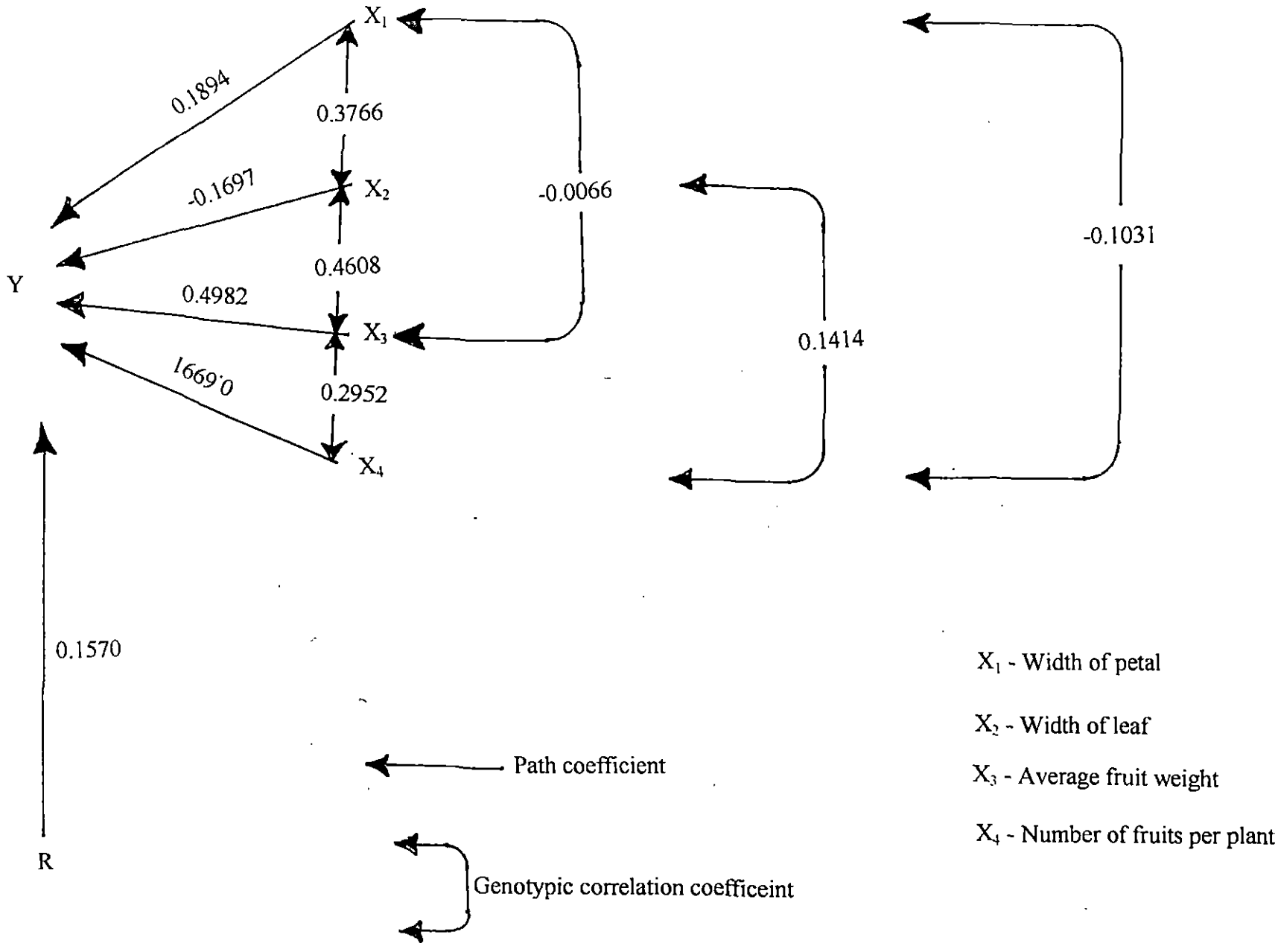


Fig. 1. Path diagram showing direct and indirect effects of the components of yield

The number of fruits per plant exhibited the highest positive direct effect on fruit yield (0.6991) and was followed by average fruit weight (0.4982). The width of petal showed the lowest positive direct effect on yield (0.1894). The width of leaf exhibited a negative direct effect on yield (-0.1697).

The number of fruits per plant had a high positive correlation with yield (0.8027). It may be due to its highest direct effect on yield (0.6991). But its indirect effect on yield through width of petal and width of leaf were negative (-0.0195 and -0.0240 respectively). The indirect effect of number of fruits per plant through average fruit weight was the lowest and positive (0.1470). The average fruit weight had the second highest correlation with yield (0.6251) even though its indirect effects on yield though width of petal and width of leaf were negative (-0.0012 and -0.0782 respectively.). But its indirect effect on yield through number of fruits per plant was positive and low (0.2064). The width of leaf had positive correlation with yield (0.2300) even though its direct effect on yield was negative (-0.1697). But the indirect effects through other characters were positive (0.0713, 0.2295 and 0.0989 respectively). The width of petal had the lowest positive correlation with yield (0.0501). The indirect effects on yield through width of leaf, average fruit weight and number of fruits per plant were negative (-0.0639, -0.0033 and -0.0720 respectively).

4.4. Genetic divergence studies

The twenty accessions of Ivy gourd were grouped into four clusters (Table 7 and 8).

Table 7. Clustering pattern in Ivy gourd germplasm

Cluster number	Number o genotype in each cluster	Genotypes
I	5	CG- 50, CG- 52,CG- 10, CG- 23,CG- 71
II	9	CG- 44, CG- 11, CG- 45, CG- 20, CG- 57, CG- 8, CG- 72, CG- 75, CG- 77
III	5	CG- 74, CG- 13, CG- 19, CG- 78, CG- 76
IV	1	CG- 73

Table 8. Inter and Intra cluster D^2 value among four clusters of Ivy gourd germplasm

Cluster	I	II	III	IV
I	**3.325**			
II	4.129	**3.303**		
III	4.224	4.884	**3.300**	
IV	6.731	5.335	7.814	**0.000**

Diagonal figures (bold) indicate intracluster distance

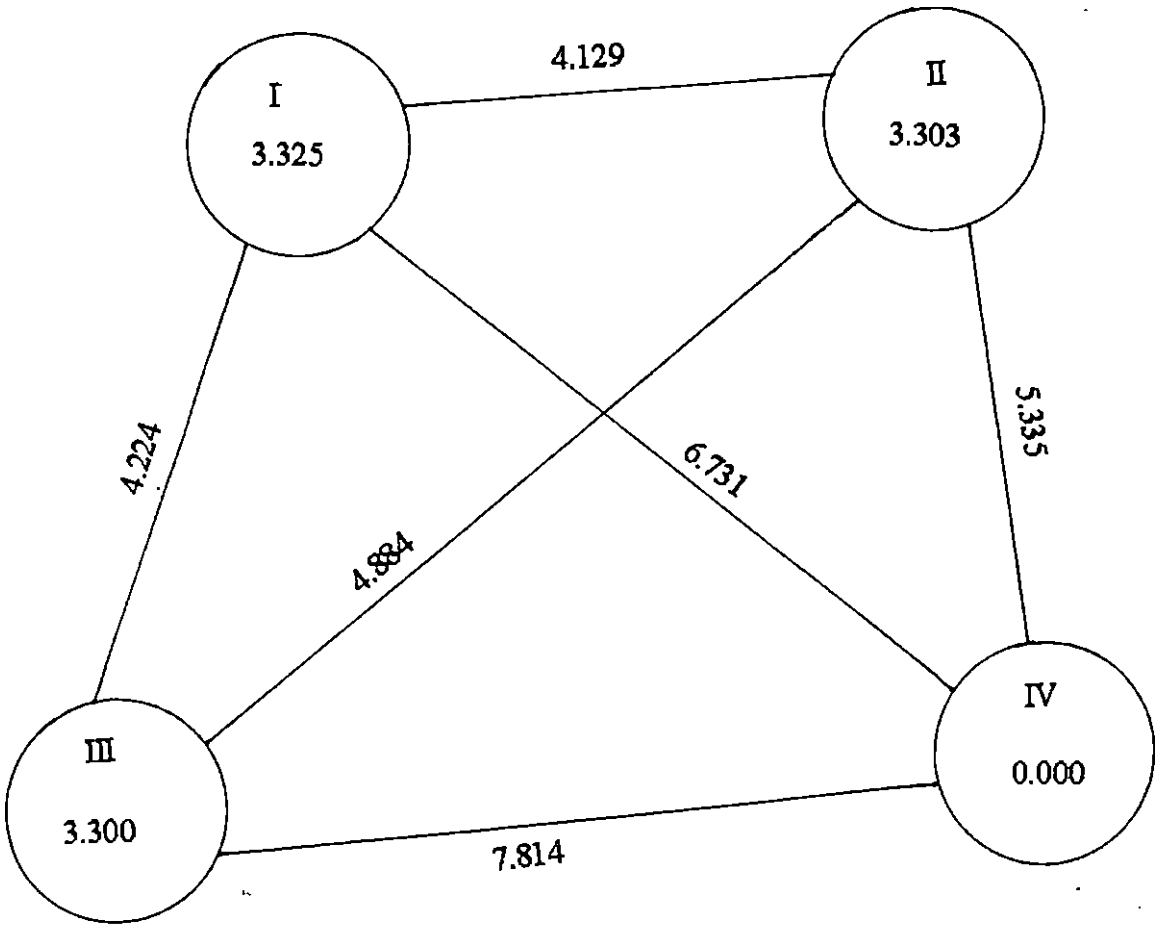


Fig. 2. Diagramatic representation of clustering of 20 genotypes of Ivy gourd

Cluster II had the largest number of accessions (9). This was followed by cluster I and III both having five accessions. Cluster four had only one accession. All the members included in cluster I were diploid and they are CG-50, CG-52, CG-10, CG-23 and CG-71. They took more number of days for the first female flower (49.25 to 58.60) compared to other accessions. They also had higher number of fruits per plant (234.00 to 472.25) and highest length of leaf (7.40 to 9.55cm). The members of cluster II are CG-44, CG-11, CG-45, CG-20, CG-57, CG-8, CG-72, CG-75 and CG-77. Among these, CG-75 and CG-77 are triploids and rests of them were diploids. They had longest vine, (2.95 to 4.82m), girith of fruit (6.45 to 7.50 cm) average fruit weight (10.95 to 13.40g) and number of fruits per plant (278.75 to 532.50). They were moderately high in width of petal (0.67 to1.35cm). The members of cluster III were CG-74, CG-13, CG-19, CG-78 and CG-76. Among these CG-13 and CG-19 were diploids, CG-74 and CG-76 triploids and CG-78 tetraploid. They took maximum days for the first female flower (53.50 to 60.75). CG-73 alone forms cluster IV and had maximum average fruit weight (19.05g).

The cluster I had maximum intracluster distance (3.325) and minimum cluster IV (0.000). The intracluster distance in the other two clusters, viz., cluster II and III are 3.303 and 3.300 respectively. The maximum inter cluster distance was between the clusters III and IV (7.814) and minimum inter cluster distance was between clusters I and II (4.129). A diagramatic representation of clustering of genotypes in Fig. 2.

Discussion

5. DISCUSSION

Ivy gourd (*Coccinia grandis* [L.] Voigt) is a important cucurbitaceous vegetable grown in many parts of India. It has got good potential to become a commercial cucubitaceous vegetable. At present farmer resort to locally available cultivar for its cultivation so any crop improvement in this crop will ultimately benefit farmers to booster Ivy gourd production .

The present study was aimed at the evaluation of diploids and polyploids in Ivy-gourd. The study explored the variability and genetic divergence occuring in the accessions evaluated. It also pinpointed different biometric characters to be considered for further crop improvement. The result obtained under this investigation are discussed below.

5.1 Variability of genotypes

The success of crop improvement mainly depend on the magnitude of variability and the extent of heritability exhibited by the desirable characters. In cucurbits the existence of very high variability with respect to vegetative, productive and quality character had been reported by many workers like Nath and Dutta (1970), Thakur and Nandpuri (1974) and Bhathal and sandhu (1984) in water melon and Wahab and Gopalakrishnan (1993) in bitter gourd.

In the present study there was significant difference among the 20 accessions which comprised of diploids and polyploids for most of the characters studied. The existence of considerable variability provide scope for improving the crop further. The studies conducted by Raju and Peter (1995) had also revealed a wide range of variability in most of the characters in Ivy-gourd.

The earliest flowering accession was CG-11 (35.75days) followed by CG-72 (61.00 days). CG-76 produced first flower at the lowest node (1.50). CG-73 was having longest fruit (8.65cm) and the shortest fruit for CG-78 (4.10cm). The accessions CG-44, CG-11 and CG-20 recorded maximum fruit girth (7.50cm) and the minimum girth was observed in CG-13 (5.70 cm). The average fruit weight was for CG-73 (19.05g) and the lowest for CG-78 (5.70g). The number of fruits per plant was maximum in CG-11(506.00) and minimum for CG-76(117.75). The yield per plant was the highest in CG-11(7.19kg).

Carotene content was maximum for CG-23 (133.70 ppm) and minimum for CG-78 and CG-74 (40.70 ppm). Vitamin C content was high in CG-45 (16.50mg/100g) and low level was observed in CG-13 (8.7mg/100g). Calcium content was the maximum in CG-44 (0.83 per cent) and minimum in CG-19 (0.32 per cent). Polyphenol was maximum in CG-10 and CG-50 (0.12mg/100g) and minimum for CG-78 and CG-74 (0.096mg/100g). Polyphenol content in fruit determine the palatability of fruits at the edible stage. The fruits having high polyphenol are more astringent and less palatable. In the present study two polyploid accessions CG-78 and CG-74 were found to have very low polyphenol content hence further improvement of these accessions will help to evolve salad types *Coccinia grandis*.

The genotypic coefficient of variation was high for primary branches per plant, fruit yield per plant and nodes to first flower and it resulted in high heritability. This indicated that the expression of these characters was least influenced by environment. Thakur and Nandpuri (1974), Srivastava and

Srivastava (1976), Ramachandran (1978), Gopalakrishnan (1979), Iindiresh (1982), Singh *et al.* (1986) Prasad and Singh (1989) and Rajput *et al.* (1996) have reported a high genotypic coefficient of variation for many biometrical characters coupled with high heritability in some cucurbits. The characters like girth of fruit, length of leaf, days to fruit maturity and length of main vine had comparatively the lowest gcv indicating that these characters are the least influenced by environment. Accuracy of selection depends upon, heritability and genetic advance of the characters studied. High heritability along with high genetic gain was observed in the present study for characters viz. primary branches per plant, fruit yield per plant, nodes to first female flower production, average fruit weight, carotene content, and calcium content. This indicates the involvement of additive genes and shows that this character can be improved by selection. In cucurbits similar inference had been made by Srivastava and Srivastava (1976), Rana(1982), Vashistha *et al.* (1983) and Rajendran and Thamburaj (1994).

In the present study also indicated that high heritability was not always coupled with high genetic gain with respect to some biometrical characters in bitter gourd as observed by Indiresh (1982). Therefore direct selection have limited scope for improving these characters.

5.2. Correlation studies

Improvement of genoptypes becomes more effective if the relationship between yield and its component characters are known. In the present study significant positive phenotypic and genotypic correlations with fruit yield was shown by characters like fruits per plant, average fruit weight, girth of fruit and

length of fruit. Similar results were also obtained by Srivastava and Srivastava (1976) and Ramachandran (1978) in bitter gourd, Salk (1982) in melon, Singh *et al.* (1986) in pointed gourd, Choudhary and Mandal (1987) in cucumber and Singh *et al.* (1987) in parwal. Therefore an improvement in these characters will lead to a simultaneous improvement in yield. The highest yielding genotypic CG-11 had the maximum number of fruits per plant which directly influence the yield.

Days to first flowering, and width of petal showed negative correlation with yield. Hence for breeding for high yield these traits need not be considered. Negative correlation of some quantitative characters with yield in cucurbits had been reported by Singh *et al.*(1987), Singh and Singh (1988).

The phenotypic correlation was smaller than genotypic correlation for all the characters studied. Days to first flowering and width of petal showed negative and significant correlation with yield indicating that environment had smaller but similar effect on these characters.

The above findings show that genotypes producing long fruit, high fruit girth, high fruit weight as well as plants having more fruits per plant may be selected for future breeding programmes.

5.3 Path coefficient analysis

Path coefficient analysis showed maximum direct positive effect for number of fruits per plant (0.8027) on yield followed by average fruit weight (0.6251). Therefore it can be inferred that fruits per plant is the most improtant component character for yield followed by fruit weight. This is in

accordance with the findings of Ramachandran (1978) who reported that yield of bitter gourd was highly correlated with fruits per plant. Studies conducted by Choudhary and Mandal (1987) in cucumber also revealed similar findings as Vijay (1987) in which fruits per plant had direct effect on fruit yield in musk melon. The direct effect of width of petal was positive. Its correlation with yield was also positive probably due to the negative indirect effect through width of leaf, average fruit weight and number of fruits per plant. The direct effect of leaf on yield was negative but positive correlation with yield was probably due to indirect effect, through width of petal, average fruit weight and number of fruits per plant. The direct effect of average fruit weight on yield was positive and its correlation with yield was also positive due to the indirect effect through number of fruits per plant. A high direct effect of fruits per plant and average fruit weight on yield was observed. This is supported by inference that correlation of fruits per plant and average fruit weight was highly significant. Such an observation was earlier noted by many workers like Srivastava and Srivastava (1976), Ramachandran (1978) Gopalakrishnan *et al.* (1980), Vijay (1987) and Paranjape and Rajput (1995) in other cucurbits. The residual effects of 0.1570 indicated that eighty four per cent variation in fruit yield was due to the character viz., width of petal, length leaf, average fruit weight and number of fruits per plant.

5.4 Genetic divergence studies

Studies on the genetic divergence based on D^2 values help to compare the possible pairs of population in any group. Twenty accessions of Ivy gourd including diploids and polyploids were grouped into four clusters following

Tocher's method. The maximum distance (d = 7.814) between cluster III and cluster IV indicated maximum genetic divergence in the accessions belonging to these clusters. Distance between cluster I and cluster IV (d = 6.731) was the next highest and it was followed by cluster II and cluster IV (d = 5.335). Somewhat similar genetic diversity within and between clusters had been reported by Ramachandran (1978), Wahab and Gopalakrishnan (1993) and Varalakshmi *et al.* (1994) in different cucurbit vegetable crops.

In the present study cluster IV consisted of CG-73 alone. This accession had the longest fruit. This trait made the accession quite distinct from others thus it formed a solitary cluster. Morphological characters of polyploids are quite similar in many ways with the diploid accessions so that they were grouped in different clusters. Out of five polyploid evaluated three accessions were included in cluster III probably due to their genetic similarities.

Thus the present investigation threw light on the variability existing in characters such as fruit length, average fruit weight, number of fruits per plant, nutritional qualities and fruit yield per plant. It has also been able to work out the phenotypic and genotypic correlation for fruit yield with various yield contributing traits. The direct and indirect contribution of the component characters on yield was also found out by partitioning the correlation between yield and their component characters into direct and indirect effects. By genetic divergence studies the accessions could be grouped into different clusters. The present study, resulted in the identificaiton of accession CG-11, CG-73 and CG-78 having high yield, fruit length and less polyphenol respectively. These promising accessions will be used for future breeding and variety development programme in Ivy gourd.

Summary

6. SUMMARY

The present study on "Evaluation of diploids and polyploids of Ivygourd (*Coccinia grandis* [L.] Voigt)" was conducted at the vegetable Research Farm, Department of Olericulture, College of Horticulture, Vellanikkara during 1996-1998. The major objectives of the investigation were to estimate the extent of genetic variability in Ivy gourd and identify promising accessions among them. Twenty accessions were included in the study. The estimates were made on phenotypic and genotypic coefficient of variations, heritability and genetic advance for different characters, the association between yield and its components by evaluating phenotypic, genotypic and enviornmental correlation coefficients, the direct and indirect effects of each components on yield by path coefficient analysis and the genetic divergence among the accessions were made.

The accessions showed significant variation for most of the characters. The existance of considerable variation indicates the scope for improving the population. The accession CG-73 produced the longest fruit (8.65 cm) and maximum average fruit weight (19.05g). The accession CG-11 recorded maximum number of fruits per plant (506.00) and high fruit yield (7.19 kg).

High value of genotypic coefficient of variation combined with high heritability was shown by characters like primary branches per plant, fruit yield per plant and nodes to first flower showed that these characters were least

influenced by enviornment. High heritability along with high genetic gain was shown by primary branches per plant, fruit yield per plant, nodes to first female flower, average fruit weight, carotene and calcium content. This indicates the presence of additive genes for these characters and shows that these characters can be improved by selection. Carotene content was maximum for CG-23 (133.70 ppm) and minimum for CG-78 and CG-74 (40.70 ppm) Vitamin C was high in CG-45 (16.50 mg/100g) and low in CG-13 (8.7 mg/100g). Calcium content was maximum in CG-44 (0.83 per cent) and minimum in CG-19 (0.32 per cent) Polyphenol was maximum in CG- 10 and CG-50 (0.12 mg/100g) and minimum for CG-78 and CG-74 (0.096 mg/100g).

Significant positive phenotypic and genotypic correlation with fruit yield was shown by characters like fruit per plant, average fruit weight, girth of fruit and length of fruit indicating that an improvement on these characters will produce a simultaneous improvement in yield.

The path coefficient analysis showed that number of fruits per plant had the highest positive direct effect on yield. Positive direct effects on yield were shown by width of petal and average fruit weight. The residual effect was 0.1570 indicating eighty four percent of the variation in yield was contributing by the component characters viz., width of petal, length of leaf, average fruit weight and number of fruits per plant.

The 20 accessions were grouped into four clusters based on Tochers method. Cluster II had the maximum number of accessions (9) followed by cluster I and II both have five accessions. Cluster IV had only one accession

CG-73. The maximum intra cluster distance was for cluster I followed by Cluster II. Cluster I consisted of plants with more number of days for first female flower production, higher number of fruits per plant and highest length of leaf. In cluster II plants having high length of vine, girth of fruit, average fruit weight, number of fruits per plant and having petal with moderately high in width were included. The Cluster III consisted of plant with maximum days for first female flower production. The single accession CG-73 included in cluster IV had the maximum average fruit weight and was quite distinct from other accessions.

References

REFERENCES

Allard, R.W. 1960. *Principles of plant Breeding*. John Wiley and Sons Inc., New York. p. 89-98

Amaral, J.A.T., Casali, V.W.D., Cruz, C.D., Da-Silva, D.J.H. and Da-silva, L.F.C. 1994. Estimates of phenotypic, genotypic and environmental correlations between seven morphological and agronomic characters in eight pumpkin accessions. *Bragantia* **53**:163-166

A.O.A.C. 1960. Official and Tentative methods of Analysis. 12th ed. Association of Official Agricultural chemist, Washington, D.C.

A.O.A.C. 1980. Official methods of Analysis of the Association of Official Analytical chemist. 13th ed. Washington, D.C.

Arora, S.K., Pandita, M.L., Pratap, P.S. and Sidhu, A.S. 1983. Variability and correlation studies in sponge gourd (*Luffa cylindrica Roem.*) *Haryana agric. Univ. J. Res.* **13**(1): 146-149

Babu, K.V.S. and Rajan, S. 1995. Improvement of underexploited vegetatively propagated vegetable crops through polyploidy. Research Report 1994 – 95. Kerala Agricultural University, Thrissur

Babu, V.S., Gopalakrishnan, T.R. and Peter, K.V. 1996. Variability and divergence in pumpkin (*Cucurbita moschata* Poir). *J. trop. Agric.* **34**(1): 10-13

Bhathal, G.S. and Sadhu, J.S. 1984. Evalution of hybrids in watermelon (*Citrullus lanatus* Thunb.Mansf.). *The Punjab Veg. Grower* **19**: 11-17

Brar, J.S. and Nandpuri, K.S. 1978. Genetic analysis of yield and fruit number in watermelon (*Citrullus lanatus* Thunb. Mansf.) *Indian J. Hort.* **35**: 226-228

Burton, G.W. 1952. Quantitative inheritance in grass. *6 th Int.Grassld. Cong. Proc.* **1**: 277-283

Burton, G.W. and Devane, E.H. 1953. Estimating heritability in tall fescue from replicated clonal material. *Agron. J.* **45** : 478-481

Chen, X.H., Cao, P.S. and Xu, Q. 1994. Genetic correlation and path–coefficient analysis of parthenocarpic yield component in cucumber. *Advances in Horticulture* (ed. Dong, G. and Meng, L.V.). China Agriculture Press, Beijing, p.249-251

Choudhary, M.L. and Mandal, G. 1987. Correlation and path analysis in cucumber (*Cucumis sativus* L.). *Haryana J. hort. Sci.* **16**: 269-273

Damarany, A.M., Aboul – Nasr, M.H. and Abdulla, M.M.A. 1995. Yield and yield components of some cucurbita spp. cultivar and hybrids under Assiut conditions 1. Summer squash (*Cucurbita pepo* L.). *Assiut J. agric. Sci.* **26**: 51-58

De–Paiva, W.O. 1997. Genetic evaluation and correlation study in cucumber. *Pesquisa – Agropecuaria – Brasiliera* **32**: 719-723

Deshpande, A.A., Bankapur, V.M. and Venkatasubbaiah, K. 1980. Floral biology of ridge gourd (*Luffa acutangula* Roxb.). *Mysore J. agric. Sci.* **14**(1): 5-7

Dewey, D.R. and Lu, K.H. 1959. A correlation and path coefficent analysis of components of crested wheat grass seed production. *Agron. J.* **51**: 515-518

Fisher, R.A. 1954. A fuller theory of "junctions" in breeding. *Heredity* **8**: 187-197

Gopalakrishnan, T.R. 1979. Genetic variability and correlation studies in pumpkin (*Cucurbita moschata* Poir). M.Sc.(Hort) thesis, Kerala Agricultural Univeristy, Thrissur

Gopalakrishnan, T.R., Gopalakrishnan, P.K. and Peter, K.V. 1980. Variability, heritability and correlation among some polygenic characters in Pumpkin. *Indian J. agric. Sci.* **50**: 925-930

Hesse, P.R. 1971. Sulphur. *A Text Book of Soil Chemical Analysis.* John Murray (publ.) Ltd., London. p.319-322

Indiresh, B.T. 1982. Studies on genotypic and phenotypic variability in bittergourd (*Momordica charantia* L.). Thesis abstracts, University of Agricultural Sciences, Bangalore. **8**(1): 52

Jaiswal, R.C., Kumar, S., Raghav, M. and Singh, D.K. (1990). Variation in quality traits of bittergourd (*Momordica charantia* L.) cultivars. *Veg. Sci.* **17**(2): 186-190

Johnson, H.W., Robinson, H.P. and Comstock, R.E. 1955a. Estimates of genetical and environmental variability in soyabeans. *Agron. J.* **47**: 314-318

Johnson, H.W., Robinson, H.P. and Comstock, R.E. 1955b. Genotypic and phenotypic correlations in soyabean and their implications in selection. *Agron. J.* **47**: 477-482

KAU, 1996. Package of practices Recommendations (Crops). Kerala Agricultural University, Thrissur. p.177-178

Katiyar, R.S., Mishra, A. and Prasad, A. 1996. Genetics of bittergourd (*Momordica charantia*). *Indian J. agric. Sci.* **66**: 551-552

Kvasnikov, B.V. and Tsybulevskii, N.I. (1980). Use of correlation between qualitative and morphological characters in breeding cucurbita. *Sel'skokhozyaistvennaya – Biologiya* **15**(3): 392-395

Li, C.C. 1995. *Population Genetics.* The University of Chicago Press, London. p.144 - 171

Lush, J.L. 1949. *Animal Breeding Plans.* Iowa state University Press, Ames. p.443

Ma, D.H. , Lu, S.Z., Shen, W.Y., Hua, Z.R., Li, S.J. and Zhang, Q.D. 1995. Phenotypic correlation and path analysis on some characters in cucumber. *Acta Agriculturae Boreali – Sinica* **10**(2): 34-37

Mahalanobis, P.C. 1928. A Statistical study at Chinese head measurements. *J. Asiatic Soc. Bengal* **25**: 301-377

Nath, P. and Dutta, O.P. 1970. A note on heterosis in watermelon. *Indian J. Hort.* **27**: 176-177

Neikov, S. and Alexandrova, M. 1995. Correlation between some quantitative characters of salad cucumber cultivars. *Bulgarian J. agric. Sci.* **1**: 275-278

Paranjape, S.P. and Rajput, J.C. 1995. Association of various characters in bitter gourd and their direct and indirect effects on yield. *J. Maharashtra agric. Univ.* **20**: 193-195

Prasad, A., Singh, P.D. and Nalini, K.M. 1984. Heritability and genetic advances in (*Luffa cylindrica* L.). *Progve Hort.* **16**: 312-315

Prasad, V.S.R.K. and Singh, D.P. 1989. Studies on heritability genetic advance and correlation in ridgegourd (*Luffa acutangula*, Roxb.). *Indian J. Hort.* **46**(3): 390-394

Prasad, V.S.R.K. and Singh, D.P. 1990. Studies on morphological and agronomical omponents of pointed gourd (*Trichosanthes dioica* Roxb.). *Indian J. Hort.* **47**: 337-340

Rahman, M.A., Alamgir, A.N.M. and Khan, M.A.A. 1994. Studies on biochemical characteristics of leaves and fruits of some cultivars of two cucurbit. *Chittagong Univ. Stud. Sci.* **18**(1): 77-81

Rajendran, P.C. 1989. Crop improvement in watermelon *Citrullus lanatus* Thunb. Mansf.) Ph.D. thesis, Tamil Nadu Agricultural University, Coimbatore

Rajendran, P.C. and Thamburaj, S. 1989. Path coefficient analysis in watermelon (*Citrullus lanatus* Thunb. manif.) *S. Indian Hort.* **37**: 138-140

Rajendran, P.C. and Thamburaj, S. 1994. Genetic variability in biotechnical traits in watermelon (*Citrullus lanatus*). *Indian J. agric. Sci.* **64** (1): 5-8

Raju, V.K. and Peter, K.V. 1995. Final Report of the ICAR Adhoc scheme on survey, collection, Evaluation, Conservation and cataloguing of germplasm of certain underexploited perennial vegetables. Kerala Agricultural University, Thrissur p.18-60

Rajput, J.C., Palve, S.B. and Jamadagni, B.M. 1991. Correlation and path analysis studies in cucumber (*Cucumis*) (*Sativus* L). *Maharashtra J. Hort.* **5**(2): 52-55

Rajput, J.C., Paranjape, S.P. and Jamadagni, B.M. 1996. Variability, heritability and scope of improvement in yield components in bittergourd (*Momordica charantia* L.). *An. agric. Res.* **17**(1): 92-93

Ram, H.H., Singh, D.K., Tripathi, P.C. and Rai, P.N. 1996. Indigenous germplasm resource in cucurbits. *Recent Hort.* **3**(1): 70-75

Ramachandran, C. 1978. Genetic variability, correlation studies and path coefficient analysis in bittergourd (*Mormodica charanatia* L.). M.Sc. (Hort.) thesis, Kerala Agricultural University, Thrissur

Ramachandran, C. and Gopalakrishnan, P.K. (1980). Variability studies for biochemical traits in bittergourd. *Agric. Res. J. Kerala* **18**(1): 27-32

Rana, T.K. 1982. Variability and correlation studies in pumpkin (*Cucurbita moschata* pour). *Thesis Abstracts,* Haryana Agricultural University, Hisar. **8**(1): 90-91

Rao, C.R. 1952. *Advanced Statistical Methods in Biometrical Research.* John Wiley and Sons Ltd., London. p.301

Saikia, J., Shadeque, A. and Bora, G.C. 1995. Genetic studies in cucumber 3. Correlation and path coefficient analysis. *Haryana . J. hort. Sci.* **24**: 126-130

Sadasivam, S. and Manikam, A. 1992. Biochemical Methods for Agricultural Sciences. Wiley Eastern Ltd and Tamilnadu Agricultural University, Coimbatore

Sahni, G.P., Singh, R.K. and Saha, B.K. 1987. Genotypic and phenotypic variability in ridge-gourd. *Indian J. agric. Sci.* **57**(9): 666-668

Salk, A. 1982. Studies of correlations among some characters associated with yield in melons. *Ege Universitiesi Ziraat Fakulties Dergisi* **19**(2): 19-26

Sidhu, A.S. and Brar, J.S. 1981. Correlation and path coefficient analysis for yield, quality and earliness in watermelon (*Citrullus lanatus Thunb. Mansf.*). *Indian J. agric. Res.* **15**(1): 33-37

Singh, V.P., Kirti Singh, Jaiswal, R.C.1986. Genetic variability and correlation studies in pointed gourd (*Trichosanthes dioica* Roxb.). *Narendra Deva J. agric. Res.* **1**:120-124

Singh, R.R., Mishra, G.M. and Njha, R. 1987. Inter relationship between yield and its components in parwal. *S. Indian Hort.* **35**: 245-246

Singh, S.N. 1953. Studies in expression, sex ratio and floral abnormalities in Trichosanthes. *Indian J. Hort.* **10**: 98

Singh, N.K. and Singh R.K. 1988. Correlation and path coefficient analysis in watermelon (*Citrullus lanatus* Thunb. Mansf.) *Veg. Sci.* **15**(1): 95-100

Solanki, S.S. and Seth, J.N. 1980. Studies on genetic variability in cucumber (*Cucumis sativus* L.). *Progve Hort.* **12**: 43-49

Solanki, S.S. and Achal Shah. 1989. Path analysis of fruit yield components in cucumber. *Progve Hort.* **21** : 322-324

Srivastava, V.K. and Srivastava, L.S. 1976. Genetic parameter, cororelation coefficients and path coefficient analysis in bittergourd (*Momordica charantia* L.). *Indian J. Hort.* **33**(1): 66-70

Thakur, J.C. and Nandpuri, K.S. 1974. Studies on variability and heritabiliity of some important quantitative characters in watermelon (*Citrullus lanatus* Thunb. Mansf.). *Veg. Sci.* **1**: 1-8

Thakur, J.C., Khattra, A.S. and Brar, K.S. 1994. Genetic variability and heritability for quantitative traits and fruitfly infestation in bittergourd. *Punjab agric. Univ. J. Res.* **31**: 161-166

Thamburaj, S. and Kamalanathan, S. 1973. Sex expression in *cucurbita moschata* Poir. and *Benincasa hispida* Cogn. *Madras agric. J.* **60**: 1673-1681

Tsybulevskii, N.I. 1974. Correlated characters in cucurbita species. *Sb. –statei – molodykh – uchemykh – i – aspirantov. – NII – ovoshch. – kh – va.* **6**: 132-133

Varalakshmi, B., Reddy, Y.N. and Reddy, B.M. 1994. Genetic divergence in ridge gourd (*L. acutangula* (Roxb.)) L.7. *J. Genet. Breed.* **48**(2): 131-134

Vashisthan, R.N., Partap, P.S. and Padita, M.L. 1983. Studies on variability and heritability in watermelon (*Citrullus lanatus* Thunb. Mansf.). *Haryana agric. Univ. J. Res.* **13**: 319-324

Vijay, O.P. 1987. Genetic variability, correlation and path-analysis in musk melon (*cucumis melo* L.). *Indian J. Hort.* **44**: 233-238

Wahab, M.A. and Gopalakrishnan, P.K. 1993. Genetic divergence is bittergourd (*Momordica charantia* . L). *S. Indian Hort.* **41**: 232-234

Wehner, T.C. and Cramer, C.S. 1996. Ten cycles of recurrent selection for fruit yield, earliness and quality in three slicing cucumber populations. *J. Am. Soc. hort. Sci.* **121**: 362-366

Wright, S. 1921. Correlation and causation. *J. agric. Res.* **20** : 557-585

EVALUATION OF DIPLOIDS AND POLYPLOIDS OF IVY GOURD

(*Coccinia grandis* [L.] Voigt)

BY

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ABSTRACT OF A THESIS

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ABSTRACT

The present study on 'Evaluation of diploids and polyploids of Ivy gourd (*Coccinia grandis* [L.] Voigt)' was conducted at the vegetable research Farm of the Department of Olericulture, College of Horticulture, Vellanikkara during the year 1996-1998. Twenty accessions of Ivy gourd were raised in randomised block design. The accessions studied showed significant variations among themselves for most of the characters studied. Accession CG-73 produced the longest fruit and the highest average fruit weight per plant whereas accession CG-11 produced maximum number of fruits per plant and maximum yield. Accessions CG-23, CG-45 and CG-44 were found to be high of carotene, vitamin C and calcium content respectively. Polyphenol was minimum in the accessions CG-78 and CG-74.

High genotypic coefficient of variation combined with high heritability was shown by characters like primary branches per plant, fruit yield per plant and nodes to first flower production. Fruit per plant, average fruit weight, girth of fruit and length of fruit showed significant positive correlation with yield. Fruits per plant showed the highest positive direct effect on yield. Using Tochers method the twenty accessions were grouped into four clusters each having nine, five, five and one accessions having a distance of 3.325, 3.303,3.300 and 0.00 respectively. The solitary cluster IV consisted of CG-73.

Appendix I. General analysis of variance of twenty genotypes in Ivy gourd

Source of Variance	Degrees of freedom	Mean sum of squares									
		Length of main vine	Primary branches per plant	Internodal length	Days to first flowering	Nodes to first female flower	Length of flower bud	Length of petal	Width of petal	Length of leaf	Width of leaf
Replication	1	0.046	2.025	0.282	212.521	0.100	0.912	0.102	1.040	2.756	0.100
genotype	19	1.379	14.499 **	4.449 **	124.236 **	4.763 **	0.157	0.333 **	0.206	1.669	6.098 *
Error	19	1.153	3.236	1.235	38.887	1.311	0.077	0.055	0.127	1.063	2.106

Source of Variance	Degrees of *freedom*	Mean sum of squares									
		Days to fruit *maturity*	Length of fruit	Girth of fruit	Average fruit weight	Fruits per plant	Fruit yield per plant	Carotene	Vitamine- C	Calcium	Polyphenol
Replication	1	0.025	1.866	0.289	13.689	3600.506	0.047	2.025	0.156	0.004	0.000
genotype	19	1.488 *	2.582 **	0.688	17.085 **	24564.648	5.841 **	1679.044 **	7.417 **	0.034 **	0.000 **
Error	19	0.604	0.226	0.333	2.103	15549.796	1.648	0.286	0.212	0.002	0.000

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