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GENETIC VARIABILITY AND CORRELATION STUDIES IN 'EGUSI' MELON (*CITRULLUS LANATUS* (THUNB.) MATSUM & NAKAI)

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ABSTRACT

Genetic variability and correlation analysis were carried out on 20 accessions of melon during two growing seasons. The genotypic correlation coefficients of some characters with seed yield were partitioned into direct and indirect effects. Heritability in the broad sense ranged from 17% for fruit circumference to 90% for days to germination and flowering in the early season, while in the late season this parameter ranged from 7% for seed weight per fruit to 88% for days to germination. High phenotypic and genotypic coefficients of variation were recorded for seed yield while days to maturity had the least in both seasons. Fruit circumference and fruit weight had significant genotypic and phenotypic correlation with seed yield in the early season while number of branches per plant, vine length per plant, number of fruits per plant and fruit circumference per plant showed significant genotypic and phenotypic correlation with seed yield in the late season. Environmental correlation coefficients were significant between seed yield and vine length per plant, number of fruits per plant and fruit size per plant. Path coefficient analysis revealed that vine length per plant and fruit circumference per plant had the largest positive direct effect on seed yield. The implications of these findings in the selection of superior genotypes are discussed.

Key words: Genetic variability, melon, correlation, coefficient of variation, heritability.

INTRODUCTION

Melon *Citrullus lanatus* (Thunb.) Matsum. & Nakai is one of the most important vegetable crops in the tropical and subtropical regions of the world. The mesocarp of the fruits is extremely bitter, but the seeds are important sources of vitamin E and it is rich in proteins and oils, which can be extracted for cooking purposes. The seeds can also be ground into a powder and used as a soup thickner or flavouring agent (Badifu and Ogunsua, 1991). Melon seed contains about 314 g kg^{-1}DM crude protein, 439.3 g kg^{-1}DM crude fat, 31.4 – 90.6 g kg^{-1}DM crude fibre, 2.4 – 4.6 g kg^{-1}DM phosphorus, 3.9 – 6.5 g kg^{-1}DM potassium and 4.1 – 5.9MCalKg^{-1} DM energy (Enujuigha and Ayodele, 2003).

Information on the nature and extent of genetic variability and degree of transmission of characters is of paramount importance in enhancing the efficiency of selection. However, the knowledge of correlations among various characters and their relative contribution to yield is useful for multiple character selection.

Phenotypic variability and the heritability of characters determine, to a large extent, the rate of genetic advance. Hence, it is essential to partition the overall heritability into its heritable and non-heritable components in order to determine the most effective breeding procedures (Poole *et al*., 1941). Knowledge of inter-character relationships is very important in plant breeding for direct selection of characters that are not easily measured and for those that exhibit low heritability. Correlations between characters have also been of great value in the determination of the most effective breeding procedures. As the number of independent characters affecting a dependent character increases, there is bound to be some amount of interdependence. Under such complex situation, correlations alone become insufficient to explain relationships among characters. Path analysis permits identification of direct and indirect causes of association and measures the relative importance of each character (Dewey and Lu, 1959).

Whitaker and Davies (1962) reported a positive correlation between seed yield with fruits per vine and fruit weight. Brar and Sukhija (1977) showed that the fruit number and fruit weight were important yield components and reported a significant positive correlation between fruit yield with length of the main stem, number of primary branching and mean fruit weight, similar reports were also shown by Vijay (1987); Neppl (2001) and Taha *et al*. (2003).

This study was undertaken to access the magnitude of genetic variability of important economic characters, inter-character associations and the components of seed yield in melon (*Citrullus lanatus* (Thunb.) Matsum. & Nakai).

MATERIALS AND METHODS

Twenty accessions of melon (*Citrullus lanatus* (Thunb.) Matsum. & Nakai) were used in this research. Fourteen were obtained from the germplasm of National Institute of Horticultural Research (NIHORT) Ibadan, Nigeria and six from different towns in Nigeria. The field evaluation of these accessions were carried out at the Teaching and Research Farms, University of Agriculture, Abeokuta (Latitude 7.35^{0}N, 3.88^{0}E 450m asl) during the early (March) and late (August) growing seasons in 2005. Double-row plot was adopted for the study in a Randomized Complete Block Design (RCBD) with three replications. A block consisted of 40 rows and planting was done in 6- meter-long rows and each accession was given two rows. The rows were 1 meter apart while the plant – to – plant distance was also 1 meter. Two seeds of each accession were planted per hole and later thinned to 1 plant per stand. Each row therefore contained seven plants and five competitive plants within each row were observed. Manual weeding was carried out when necessary.

Data on quantitative characters were collected on ten competitive plants for each accession. These data were: Days to germination, days to flowering, fruit circumference per plant, fruit weight per plant, number of branches per plant, vine length per plant, number of fruits per plant, number of seeds per fruit, seed weight per fruit, 100- seed weight, days to maturity and seed yield. Mean data were subjected to analysis of variance to estimate the variance components and coefficients of variation following Burton (1952). The broad sense heritability (h^2_B) was estimated as percentage of ratio of genotypic variance (Vg) to the phenotypic variance (Vp) as described by Allard (1960). The genetic advance (GA) was estimated in accordance with the methods illustrated by Allard (1960) as GA = K [Vp] $h^2_{B,}$ where: K is a constant (2.06). The genotypic coefficient of variation and phenotypic coefficient of variation were calculated according to the procedure of Miller et al. (1958). The direct and indirect effects were calculated according to Wright (1921, 1934) and Dewey and Lu (1959).

RESULTS AND DISCUSSION

Significant differences were observed among accessions for most of the characters indicating that there is sufficient variability available to have an effective selection (Table 1). The phenotypic coefficient of variation (PCV) was generally higher than the genotypic coefficient of variation (GCV) for all the characters across the two growing seasons and in many cases the values differed slightly indicating that environmental factors influencing their expression to some degree minimal.

In the early season (Table 1), a high PCV was obtained for fruit weight per plant (29.44), seed weight per fruit (27.57), moderate for days to germination (21.44), fruit circumference per plant (24.79) and low for days to flowering (7.66), days to maturity (5.31) and fruit circumference (6.15). A similar trend was obtained in the late season with high PCV obtained for fruit weight per plant (35.94), seed weight per fruit (25.71), moderate for number of fruits per plant (23.43) and low for days to flowering (7.41) and days to maturity (5.59). These implied greater genetic variability among the accessions and responsiveness of the characters for making further improvement by selection. It also implied minimal inter-seasonal variation. Generally, the higher heritability estimates for days to germination and flowering, fruit circumference per plant, number of branches per plant and vine length per plant indicated that environmental factors did not greatly affect phenotypic variation of such characters and selection for these characters on the basis of phenotypic performance is likely to be dependable and effective. The high heritablilty estimates for yield coupled with high genotypic and phenotypic coefficients of variation provide a more dependable measure of amount of genetic advance to be expected from selection (Burton, 1952).

The relatively low heritability estimates in Table 1, for days to maturity, fruit circumference and fruit weight suggests the ineffectiveness of direct selection for such characters. High estimates of genetic advance were observed for seed yield in both seasons as well as moderate for days to germination, fruit weight per plant, number of fruits per plant and vine length per plant, which suggests good prospects for selection.

The moderate to high values of heritability, GCV and GA observed for days to germination, fruit circumference per plant, fruit weight per plant, number of branches per plant, number of fruits per plant, seed weight per fruit and vine length per plant could be attributed to additive gene action, thus making selection for them simple. However, the moderate to low estimates of heritability coupled with low GCV and GA observed for 100-seed weight, fruit size and days to maturity suggests that these characters were governed by non-additive gene action the heritability observed might be due to favourable influence of the environment rather than the genotype and simple selection will not be rewarding. However, these characters could be improved by development of hybrid varieties or isolation of transgressive segregants in heterosis. The estimates of phenotypic and genotypic correlation coefficients (Table 1), revealed that genotypic correlation were higher than the corresponding values for all the characters studied indicating that the inherent association between the characters is governed largely by genetic causes.

Phenotypic correlation coefficients among 14 characters in melon in two seasons are presented in Table 2. In the early season, significant phenotypic correlation was observed between seed yield and number of branches per plant, number of fruits per plant, fruit weight per plant and fruit circumference per plant, while in the late season, significant phenotypic correlation was observed between number of branches per plant, vine length per plant, number of fruits per plant, fruit circumference per plant and seed yield. This suggests that these characters possessed greater practical values for selection than the other component characters. The seasonal variation observed is as a result of differences in environmental conditions, which could affect the expression of these characters.

Only characters that are phenotypically and genotypically correlated with seed yield would produce repeatable estimates of inter-character association and selection based on their relationship would result in significant improvement in seed yield in 'egusi' melon (*Citrullus lanatus* (Thunb.) Matsum. & Nakai).

Significant genotypic (Table 3) and phenotypic correlation between days to maturity and days to flowering implied that number of days to flowering can be used as a criterion for selecting lines with short life span by selecting lower number of days to flowering. Early flowering Lines that flower early will be suited for areas with short growing season. Significant positive correlation between vine length per plant and number of fruits per plant implies that plants with longer vines produce more fruits because of increased fruit bearing nodes and greater photosynthetic area and subsequently higher seed yield as observed in the early season.

During the late season, significant genotypic and phenotypic correlation between seed yield and number of branches per plant, vine length per plant, number of fruits per plant and fruit circumference per plant suggests that selection based on phenotypic performance will be rewarding.
Significant phenotypic and environmental correlation (Table 4) between seed yield and vine length per plant, number of fruits per plant, fruit weight per plant and fruit circumference per plant showed the ineffectiveness of direct selection for seed yield via these characters as they were under profound effect of the environmental factors.

The correlation analysis measures mutual association with no regard to causation, whereas path analysis specifies causes and measures their relative importance (Dewey and Lu, 1959). Direct and Indirect effects of some characters on seed yield in melon is presented in Table 5.

In the early season, vine length per plant had the largest direct effect on seed yield (5.76), though it's correlation with seed yield was not significant because of the high negative indirect effects via days to flowering (-3.03) and fruit circumference per plant (-2.36). Despite the strong positive association of number of fruits per with seed yield (0.92), its direct effect was negative (-0.44), thus indicating the inefficiency on selection based on correlation alone. Number of branches per plant, vine length per plant, number of seeds per fruit and to a lesser extent seed weight per fruit can be used for direct selection to improve seed yield in 'egusi' melon.

During the late season, fruit circumference per plant had the largest direct effect on seed yield (2.21) followed by number of seeds per fruit (1.29) and their association with seed yield was significant. Number of fruits per plant had a negative direct effect on seed yield (-0.44) but its correlation with seed yield was positive and significant (0.92), this is due to the large indirect effects via fruit circumference per plant (2.03) and number of seeds per fruit (1.01).

The residual effect of 0.39 for the early season and 0.44 for the late season implied that 61% and 56% of the total variation in seed yield in the early and late seasons respectively had been accounted for by the parameters considered so far, therefore suggested the existence of some factors, not considered in this study, which may contribute to seed yield in 'egusi' melon.

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Table 1: Range, general mean, estimate of genotypic and phenotypic variance, genotypic and phenotypic coefficient of variability, broad sense heritability and genetic advance expressed as percentage of the mean in two seasons for twenty melon accessions

Character	Season	Range	Mean	Genotypic variance	Phenotypic variance	Genotypic coefficient of variation (%)	Phenotypic coefficient of variation (%)	Heritability (%)	Genetic advance as % of the mean
Days to flowering	ES	34 – 52	41.46	9.04	10.08	7.25	7.66	90	14.15
	LS	33.3 - 53.2	39.06	7.40	8.38	6.96	7.41	88	13.48
Days to germination	ES	4.0 – 10	6.84	1.93	2.15	20.31	21.44	90	39.64
	LS	4.0 - 8.8	6.13	0.82	0.97	14.77	16.07	85	27.98
Days to maturity	ES	76 – 101	87.53	8.78	21.6	3.39	5.31	41	4.45
	LS	80 – 104	90.83	12.14	25.75	3.84	5.59	47	5.43
Fruit circumference/ plant(cm)	ES	26.45 – 110	62.23	163.28	237.91	20.53	24.79	69	35.04
	LS	22 - 120.1	58.58	122.55	226.02	18.90	25.66	54	28.67
Fruits size(cm)	ES	23.01 - 37.68	30.69	0.60	3.56	2.52	6.15	17	2.13
	LS	25.5 - 47.2	36.34	5.93	12.87	6.70	9.87	46	9.37
Fruit weight/plant (gm)	ES	350 – 3090	1012.50	43805.79	88841.96	20.67	29.44	49	29.90
	LS	250 – 4100	1173.17	94124.56	177771.32	26.15	35.94	53	39.20
Fruit weight(gm)	ES	247 – 1068	546.84	6750.06	14086.49	15.02	21.70	48	21.42
	LS	200 – 1450	758.00	10356.14	43391.11	13.43	27.48	24	13.51
Number of branches/ plant	ES	2.0-5.0	3.47	0.17	0.23	11.88	13.82	74	21.04
	LS	1.0 - 3.3	2.42	0.15	0.19	16.00	18.01	79	29.29
Number of fruits/plant	ES	1.0 - 3.6	2.02	0.13	0.19	17.85	21.58	68	30.41
	LS	1.0 - 3.0	1.76	0.10	0.17	17.97	23.43	59	28.39
Number of seeds/fruit	ES	53 – 219	141.45	199.65	619.84	9.99	17.60	32	11.68
	LS	36 – 442	194.38	1170.92	2676.74	17.60	26.62	44	23.99
Seed weight/fruit(gm)	ES	6.45 – 33	17.06	12.33	22.08	20.58	27.54	56	31.68
	LS	5.74 - 61.44	25.92	3.23	44.4	6.93	25.71	7	3.85
100-seedw eight (gm)	ES	7.18 - 16.24	11.69	0.62	1.39	6.74	10.09	45	9.27
	LS	9.17 - 16.18	12.47	0.19	0.78	3.50	7.08	24	3.55
Vine length/pant (cm)	ES	130 – 494	236.08	2758.54	3198.47	22.25	23.96	86	42.56
	LS	126.2 - 390.4	258.16	1240.16	2010.53	13.64	17.37	62	22.07
YLD (kg/ha)	ES	18.01 - 277.90	101.79	908.83	1740.05	29.62	40.98	52	44.09
	LS	9.55 – 600	221.55	10570.05	15231.17	46.41	55.71	69	79.64

ES – Early season **LS- Late season**

Table 2: Phenotypic correlation coefficients among 14 characters in melon in two seasons

Characters	Seasons	Days to flowering	Number of branches/ plant	Vine length/ plant (cm)	Number of fruits/ plant	Fruit weight/ plant (gm)	Fruit circumference/ plant (cm)	Fruit circumference (cm)	Fruit weight (gm)	Number of seeds/ fruit	Seed weight/ fruit (gm)	100-seed weight (gm)	Days to maturity	Seed yield (kg/ha)
Days to germination	ES	0.52**	0.00	-0.07	-0.66**	-0.35**	-0.58**	0.14	0.14	-0.29*	-0.11	0.24	0.43**	-0.62**
	LS	-0.06	-0.36**	-0.65**	-0.66**	-0.40**	-0.67**	0.31*	0.33**	-0.14	0.06	0.30*	0.56**	-0.52**
Days to flowering	ES		-0.52**	0.63**	-0.23*	-0.38**	-0.04	0.34**	0.32*	-0.17	0.27*	0.56**	0.61**	-0.59**
	LS		-0.46**	0.39**	0.04	0.81**	0.33**	0.10	0.20	0.04	0.24	0.23	0.39**	-0.18
Number of branches/plant	ES			-0.51**	0.06	0.39**	-0.07	-0.05	-0.28*	-0.20	-0.39**	-0.15	-0.63**	0.48**
	LS			0.18	0.44**	-0.25*	0.36**	0.00	-0.25*	0.19	0.00	-0.08	-0.73**	0.64**
Vine length/plant (cm)	ES				0.28	0.09	0.54**	0.58**	0.51**	0.31*	0.60**	0.51**	0.38**	0.03
	LS				0.66**	0.71**	0.81**	0.24	0.24	0.41**	0.34**	-0.30*	-0.30*	0.53**
Number of fruits/ plant	ES					0.48**	0.85**	-0.07	0.16	0.45**	0.39**	0.17	-0.31*	0.60**
	LS					0.43**	0.88**	-0.16	-0.31*	0.40**	0.25*	-0.18	-0.66**	0.81**
Fruit weight/plant (gm)	ES						0.58**	0.43**	0.55**	0.30*	0.18	0.14	-0.25*	0.73**
	LS						0.69**	0.08	0.19	0.11	0.24	0.07	0.13	0.18
Fruit circumference/plant(cm)	ES							0.40**	0.43**	0.54**	0.64**	0.30*	-0.10	0.64**
	LS							-0.03	-0.11	0.35**	0.25*	-0.12	-0.46**	0.74**
Fruit circumference(cm)	ES								0.68**	0.20	0.48**	0.44**	0.38**	0.24
	LS								0.90**	0.43**	0.52**	-0.27*	0.22	0.06
Fruit weight(gm)	ES									0.28*	0.55**	0.40**	0.58**	0.06
	LS									0.38**	0.52**	-0.19	0.40**	-0.06
Number of seeds/ fruit	ES										0.73**	0.15	0.05	0.47**
	LS										0.90**	-0.28*	-0.29*	0.60**
Seed weight/fruit (gm)	ES											0.52**	0.42**	0.21
	LS											-0.07	-0.03	0.41**
100-seed weight (gm)	ES												0.39**	0.02
	LS												0.39**	-0.35**
Days to maturity	ES													-0.59**
	LS													-0.75**

ES: Early season, LS: Late season n = 60

*, ** Significant at 5% and 1% level of probability respectively

Table 3: Genotypic correlation coefficients among 14 characters in melon in two seasons

Characters	Seasons	Days to flowering	Number of branches/plant	Vine length/plant (cm)	Number of fruits/plant	Fruit weight/plant (gm)	Fruit circumference/plant (cm)	Fruit circumference (cm)	Fruit weight (gm)	Number of seeds/fruit	Seed weight/fruit (gm)	100-seed weight (gm)	Days to maturity	Seed yield (kg/ha)
Days to germination	ES	0.58**	0.02	-0.07	-0.79**	-0.51**	-0.68**	0.23	0.19	-0.45**	-0.12	0.40**	0.74**	-0.83**
	LS	-0.09	-0.43**	-0.79**	-0.85**	-0.51**	-0.85**	0.50**	0.79**	-0.22	0.33*	0.77**	0.79**	-0.61**
Days to flowering	ES		-0.59**	0.74**	-0.27*	-0.50**	-0.01	1.17**	0.59**	-0.21	0.41**	0.88**	1.02**	-0.77**
	LS		-0.55**	0.53**	0.05	1.20**	0.44**	0.22	0.54**	0.16	1.11**	0.55**	0.56**	-0.23
Number of branches/plant	ES			-0.65**	-0.06	0.38**	-0.24	-0.62**	-0.67**	-0.58**	-0.66**	-0.27*	-1.22**	0.60**
	LS			0.24	0.60**	-0.54**	0.46**	-0.03	-0.58**	0.30*	-0.10	-0.16	-1.14**	0.77**
Vine length/plant(cm)	ES				0.26*	0.07	0.62**	1.46**	0.74**	0.52**	0.83**	0.76**	0.66**	-0.02
	LS				0.72**	0.93**	0.87**	0.48**	0.72**	0.96**	2.20**	-0.56**	-0.20	0.47**
Number of fruits/plant	ES					0.38**	0.87**	-0.27*	0.14	0.72**	0.52**	0.29*	-0.54**	0.86**
	LS					0.50**	0.92**	-0.27*	-0.88**	0.78**	1.47**	0.11	-0.99**	0.92**
Fruit weight/plant(gm)	ES						0.49**	0.50**	0.39**	0.36**	0.06	0.05	-0.52**	1.28**
	LS						0.79**	0.25*	0.62**	0.55**	2.13**	-0.06	0.51**	-0.09
Fruit circumference/plant(cm)	ES							0.79**	0.48**	0.89**	0.80**	0.50**	-0.27*	0.84**
	LS							-0.04	-0.29*	0.85**	1.81**	0.06	-0.52**	0.69**
Fruit circumference(cm)	ES								0.70**	-0.29*	0.74**	0.91**	1.49**	0.39**
	LS								0.94**	0.02	-0.48**	-0.77**	0.24	0.19
Fruit weight (gm)	ES									0.30*	0.69**	0.61**	1.43**	-0.04
	LS									-0.37**	-1.68**	-0.60**	0.80**	0.00
Number of seeds/fruit	ES										0.67**	-0.09	0.32*	0.83**
	LS										1.35**	-0.57**	-0.79**	1.24**
Seed weight/fruit(gm)	ES											0.60**	0.95**	0.14
	LS											-0.20	-0.71**	2.45**
100-seed weight (gm)	ES												0.49**	-0.21
	LS												0.99**	-0.75**
Days to maturity	ES													-1.67**
	LS													-0.96**

ES: Early season, LS: Late season n = 60
*, ** Significant at 5% and 1% level of probability respectively

Table 4: Environmental correlation coefficients among 14 characters in melon in two seasons

Characters	Seasons	Days to flowering	Number of branches/ plant	Vine length /plant (cm)	Number of fruits/ plant	Fruit weight /plant (gm)	Fruit circumference/ plant (cm)	Fruit circumference (cm)	Fruit weight (gm)	Number of seeds/ fruit	Seed weight/ fruit (gm)	100-seed weight (gm)	Days to maturity	Seed yield (kg/ha)
Days to germination	ES	0.03	-0.12	-0.08	-0.21	-0.05	-0.22	0.17	0.04	-0.18	-0.14	-0.04	-0.09	-0.23
	LS	0.12	0.00	-0.31*	-0.24	-0.23	-0.35**	0.01	-0.08	-0.04	-0.06	-0.15	0.20	-0.24
Days to flowering	ES		-0.22	-0.19	-0.14	-0.21	-0.17	-0.38**	-0.28*	-0.21	-0.08	0.01	-0.03	-0.29*
	LS		0.04	0.00	0.01	-0.04	0.11	-0.18	-0.15	-0.25*	-0.13	-0.10	0.12	0.04
Number of branches/plant	ES			0.09	0.36**	0.40**	0.34**	0.35**	0.33**	0.20	0.11	0.02	0.12	0.29*
	LS			0.06	0.09	0.35**	0.21	0.06	0.02	0.02	0.05	-0.02	-0.09	0.26*
Vine length/ plant(cm)	ES				0.35**	0.15	0.28*	0.07	0.13	0.13	0.11	0.13	-0.03	0.18
	LS				0.58**	0.43**	0.74**	-0.05	-0.06	-0.18	-0.21	-0.16	-0.43**	0.66**
Number of fruits/plant	ES					0.65**	0.82**	0.05	0.21	0.23	0.17	0.01	-0.06	0.22
	LS					0.35**	0.86**	-0.04	0.03	0.00	-0.09	-0.41**	-0.31*	0.65**
Fruit weight/ plant(gm)	ES						0.74**	0.44**	0.70**	0.27*	0.32*	0.22	-0.04	0.16
	LS						0.59**	-0.10	-0.06	-0.29*	-0.27*	0.15	-0.24	0.63**
Fruit circumference/plant (cm)	ES							0.26*	0.39**	0.27*	0.39**	0.07	0.11	0.36**
	LS							-0.03	-0.01	-0.12	-0.16	-0.24	-0.39**	0.83**
Fruit circumference(cm)	ES								0.74**	0.35**	0.41**	0.28*	-0.01	0.19
	LS								0.91**	0.76**	0.86**	-0.03	0.21	-0.10
Fruit weight (gm)	ES									0.27*	0.41**	0.23	-0.10	0.16
	LS									0.76**	0.88**	-0.06	0.21	-0.13
Number of seeds/fruit	ES										0.82**	0.30*	-0.11	0.22
	LS										0.92**	-0.15	0.13	-0.21
Seed weight/ fruit(gm)	ES											0.44**	-0.06	0.30*
	LS											-0.05	0.14	-0.27*
100-seed weight(gm)	ES												0.32*	0.23
	LS												0.08	-0.07
Days to maturity	ES													0.34*
	LS													-0.49**

ES: Early season, LS: Late season n = 60
*, ** Significant at 5% and 1% level of probability respectively

Table 5:Direct and Indirect effects of some characters on seed yield in melon

Characters	Sea-sons	Direct effect on seed yield	Days to flower-ing	Number of branches/ plant	Vine length/ plant(cm)	Number of fruits/ plant	Fruit weight/ plant(gm)	Fruit circum-ference/ plant(cm)	Number of seeds/ fruit	Seed weight/ fruit (gm)	Genotypic correlation coeffi-cients
Days to flowering	ES	-4.09		-0.73	4.26	-0.51	0.22	0.04	0.03	0.02	-0.77**
	LS	-1.05		0.48	-0.26	-0.02	0.01	0.97	0.21	-0.57	-0.23
Number of branches/plant	ES	1.24	2.41		-3.74	-0.11	-0.16	0.91	0.09	-0.03	0.60**
	LS	-0.88	0.58		-0.12	-0.26	-0.01	1.02	0.39	0.05	0.77**
Vine length/ plant(cm)	ES	5.76	-3.03	-0.81		0.49	-0.03	-2.36	-0.08	0.04	-0.02
	LS	-0.49	-0.56	-0.21		-0.32	0.01	1.92	1.24	-1.12	0.47**
Number of fruits/ plant	ES	1.90	1.10	-0.07	1.50		-0.16	-3.31	-0.11	0.03	0.86**
	LS	-0.44	-0.05	-0.53	-0.35		0.01	2.03	1.01	-0.75	0.92**
Fruit weight/ plant(gm)	ES	-0.43	2.05	0.47	0.40	0.72		-1.87	-0.05	0.00	1.28**
	LS	0.01	-1.26	0.48	-0.46	-0.22		1.75	0.71	-1.09	-0.09
Fruit circumfer-ence/plant(cm)	ES	-3.81	0.04	-0.30	3.57	1.65	-0.21		-0.13	0.04	0.84**
	LS	2.21	-0.46	-0.40	-0.43	-0.40	0.01		1.10	-0.92	0.69**
Number of seeds/ fruit	ES	-0.15	0.86	-0.72	3.00	1.37	-0.15	-3.39		0.03	0.83**
	LS	1.29	-0.17	-0.26	-0.47	-0.34	0.01	1.88		-0.69	1.24**
Seed weight/ fruit(gm)	ES	0.05	-1.68	-0.82	4.78	0.99	-0.03	-3.05	-0.10		0.14
	LS	-0.51	-1.17	0.09	-1.08	-0.65	0.02	4.00	1.74		2.45**

Residual effects: ES = 0.39; LS = 0.44

ES: Early season, LS: Late season

*, ** Significant at 5% and 1% level of probability respectively