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Genetic analysis of yield and its components in pumpkin

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Abstract : Evaluation of 28 nonreciprocal F_1 hybrids of pumpkin over 2 locations showed the involvement of both additive and non-additive genetic variances regulating the inheritance of yield and its components except average fruit weight which was exclusively controlled by non-additive gene action. Additive gene effect was predominant for earliness, while non-additive gene aciton was preponderant with pronounced epistasis and over dominance for expression of other characters. Prediction of hybrid performance for earliness should be based on gca component which was endured by high fertitability in narrow sense, whereas sca was more important for the remaining traits as also evidenced by low heritability in narrow sense. Reciprocal recurrent selection. biparental mating and/or diallel selective mating was proposed for improvement in earliness and productivity of pumpking withother desirable characters.
(*Key words : Pumpkin, Combining ability, Gene effect, Additive, Non-additive*)

Utilization and exploitation of yield and its contributing characters require a clear knowledge of their mode of inheritance. combing ability analysis of diallel crosses efficiently reproduces the genetics of such traits. Since the quantitative characters are considerably influenced by the environment, a study under different locations and years is likely to bring out genotype-environment interaction for precise estimation of the gene effects. The present study aims to assess the gene effects fo yield and its components in pumpkin (*Cucurbita moschata* Duch. ex. Poir) through combining ability analysis of an 8-parent diallel cross over two locations.

Materials and Methods

Eight diverse genotypes of pumpkin, *viz.* Guamal local, Ambili, Baidyabati, Kurda local, Cuttack local, BBS 8, BBS 10 and Pusa Vishwas were crossed in all possibnle combination without reciprocals to obtain 28 F_1 hybrids. The crosses and their parents were evaluated in a randomized block design with 3 replications simultaneously at 2 locations, i.e., Horticultural Research Station. Bhubaneswar and Regional Research Station, Bhawanipatna of Orissa University of Agriculture and Technology. during *rabi* (winter season) of the year, 1994-95. Each of the 36 genotypes in a replication comprised of 4 hills spaced 2.0 m apart in a plot of 4.0 m x 4.0 m with 2 plants/hill. Recommended cultural practices were followed during experimentation to raise a successful crop for better phenotypic expression of characters. Observations were recorded on 7 quantitative characters, *viz.* days to anthesis of first male and female flower, number of male and female flowers/plant, average fruit weight, number of frutis and yield/plant from 4 randomly selected competitive plants in each genotype at both locations. Progency means pooled over environments were analysed for combining ability following Method-2, Model-I of Griffing (1956). Equivalent variance components were used to compute the general predictability ratio (Baker, 1978), heritability in narrow sense (Falconer. 1981) and average degree of dominance (Robinson *et al.* 1949).

Results and Discussion

Pooled analysis of variance for combining ability (Table 1) revealed that the mean squares due to general (gca) and specific combining ability (sca) were significant for all the characters except average fruit weight indicating the contribution of both additive and nonadditive genetic variances regulating their inheritance. Significant mean square due to sca alone suggested the existence of nonadditive gene effect exclusively governing average fruit weight. Additive as well as nonadditive genetic components controlling the attributes studied except the yield were detected earlier (Doijode, 1981; Sirohi *et al.* 1986 and Sirohi, 1994). The yiled was reported to be determined solely by nonadditive gene action (Sirohi *et al.* 1986). Significant mean square due to location for number of female flowers/plant and days to anthesis of first male and female flower illustrated substantial difference between the cropping environments. The mean squares due to interactions of gca and sca with location were nonsignificant for all the traits except days to anthesis of first male flower explaining that the parents and hybrids were resistant to environmental fluctuations and multilocational testing might not be essential to identify a stable genotype showing explicability in earliness and productivity in pumpkin. However, the sca effect which is less table as compared to gca and likely to drift under changing environment surprisingly exhibited consistency to such variation.

The estimates of components of variation and genetic parameters for the characters studied are presented in Table 2. All the traits were appreciably influened by the environment which was evident from the estimate of s^2. The magnitude of the estimated component of sca variance s^2_{sca} was greater than the corresponding gca variance s^2_{gca} for all the attributes except days to anthesis of first male flower, emphasizing preponderence of nonadditive gene action governing their expression which was also reflected by the low s^2_{gca} / s^2_{sca} ratio (less than unity). This also imparted predominance of additive gene effect conditioning days to anthesis of first male flower. The result was in accordance with the of Doijode (1981) and Sirohi *et al.* (1986) in all respects, except days to anthesis of first male flower. On the contrary, pronounced additive gene action for earliness (days to first male and female flower opening) was ascertained by Sirohi (1994).

Baker (1978) postulated that the relative importance of gca and sca in determining progeny performance can be obtained by calculating the general predictability ratio on the basis of gca and sca equivalent components of mean square, i.e., $s^2_{gca} \backslash (27^2_{gca} + s^2_{sca})$. High values of the general predictability ratio for days to anthesis of first male (0.681) and female flower (0.549) described that the performance of the hybrids for earliness could be anticipated with greater reliability basing primarily on gca component. This implied that 68.1 and 54.9 per cent improvement in days to anthesis of first male and female flower respectively should be expected from gca and the rest from sca if inbreeding and crossing are imposed to this population and selection is applied to the crosses. It appears that the largest part of amenability in earliness of hybrid pumpkin should come from fca and ultimately from additive genetic variance in the base populaiton. High heritability in narrow sense also supported greater contribution of additive gene effect for expression of the above traits. Low values of the general predictability ratio (less than 0.5) for the remaining characters depicted that prediction of hybrid performance based only on sca component would be effective. This assured that nonadditive genetic variance was more important to circumvent these attributes which was well corroborated by low heritability in narorow sense. This might be due to the fact that the parental materials included in the study were highly selected for the traits under consideration (Falconer, 1981). Consequently, the high sca manifested by them is largely ascribed to epistatic interaction (Hayman, 1957).

The average degree of dominance was less than unity for days to anthesis of first male and female flower signifying the occurrence of partial dominance which confirmed the findings of Sirohi (1994). The value of this parameter was more than unity for the rest of the characters studied denoting the prevalence of over dominance which is in consonance with the work of Doijode (1981), Sirohi *et al.* (1986) and Sirohi (1994). The mean degree of dominance might have been inflated from partial dominance to over dominance due to complementary gene action (Allard 1956) or correlated distribution of genes or presence of linkage (Comstock and Robinson, 1952). Complementary epistasis should, persumably, be absent for the traits displaying over dominance in the present study on account of the low estimate of heritability in narrow sense. Hence, the over dominance could result from repulsion phase linkages genes no more than partially or completely dominan (Gardener *et al.* 1953).

Although significant mean squares due to gca were observed for number of fruits, number of males and female flowers and yield/plant, low estimates of heritability in narrow sense did not lend any support to the major operation of the additive components of genetic variance in their inheritance. Since these traits had highly significant value of nonadditive components achieving over dominance associated with quite higher magnitude of sca variance as compared to gca variance, low heritability in narrow sense and low general predictability ratio, it was inferred that the aforesaid characters had predominant role of nonadditive genetic components in their inheritance. However, the presence of additive gene effects may ensure certain amount of improvement of straight selection. At the same time, the extent of progress is doubtful because of the poor heritability of these attributes.

The present investigation has stressed preponderance of nonadditive gene action registering over dominance along with pronounced epistasis and abundance of undesirable linkages conditioning the inheritance of yield and its components in pumpki, but considerable amenability in earliness is expected from additive gene effect. There is little scope for adifying the productivity by selection. Heterosis could be exploited for developing inbreds and hybrids. Maximum gain could be obtained by mainitaining considerable heterozygosity coupled with selection in early segregating generations to provide opportunity to dissociate unworthy linkages, enhance the frequency of genetic recombination, provide transgressive segregation and create a broad genetic

Table1. Pooled analysis of variance for combining ability of yield and its components in pumpkin

Source of variation	Degree of freedom	Mean square: Days to anthesis of first male flower	No. of male of first female	No. of female flowers/plant	No. of flowers/plant	Average fruit fruits/plant	Yield/ plant(kg)	Weight (kg)
Location	1	909.29**	500.46**	8.05	7.80**	1.13	1.39	22.70
gca	7	239.56**	183.59**	28.71**	0.77*	1.55**	1.32	42.62**
sca	28	28.35**	36.79**	24.65**	1.40**	1.27**	1.53**	57.73**
gca x location	7	16.09*	11.75	1.80	0.06	0.22	0.10	4.77
sca x location	28	3.42	4.99	1.30	0.07	0.12	0.05	1.77
Pooled Error	140	6.54	7.93	6.22	0.35	0.39	0.84	7.12

Significant at *P = 0.05, **P = 0.01

Table 2. Estimates of components of variation and genetic parameters for yield and its components in pumpkin

Character	s^2_{gca}	s^2_{bca}	s^2_e	s^2_{gca}/s^2_{bca}	General predictability ratio	Heritability in narrow sense (%)	Average degree of dominance
Days to anthesis of first male flower	11.651	10.905	6.543	1.068	0.681	57.2	0.68
Days to anthesis of first female flower	8.783	14.430	7.929	0.609	0.549	44.0	0.91
Number of male flowers/plant	1.125	9.216	6.215	0.122	0.196	12.7	2.02
Number of female flowers/plant	0.021	0.527	0.348	0.040	0.074	4.6	3.54
Number of fruits/plant	0.058	0.442	0.389	0.131	0.208	12.2	1.95
Average fruit weight (kg)	0.024	0.348	0.838	0.069	0.121	3.9	2.69
Yield/plant (kg)	1.775	25.305	7.117	0.070	0.124	9.9	2.67

base against which maximum number of potentially functional genes may be accumulated, reassembled and expressed, leading to isolation of stable and widely adapted genotypes. Since development of intermating population is a long time approach, population improvement through methods like reciprocal recurrent selection, biparental mating and/or diallel selective mating as a supplement to conventional breeding sstem is advocated. Recombination breedingl through multiple crosses followed by intermating among desirable selected segregants may also prove a rewarding approach for simultaneous amelioration of earliness, yield and its components in pumpkin.

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Influence of seed size and duration of acid scarification on seed germination of tamarind (*Tamarindus indica* linn.)

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Abstract : Studies were made to traceout the relationship between seed size and duration of acid scarification in tamarind seed for removal of hard seededness without affecting the quality of seed. The experiment was formulated with different size grades (27/64", 25/64" and 23/64" round perforated metal sieve) and various durations (20, 15 and 10 minutes) of acid scarification with commercial sulphuric acid @ 200 ml kg^{-1} of seed. The study revealed that seed size and durations of acid scarification are positively related, where bigger sized seed require 20 minutes of acid scarification while it reduced to 15 and 10 minutes with medium and smaller sized seeds, respectively.

(Key words: Tamarind, Sulphuric acid, Seed polymorphism.)

Tamarind is one of the arid zone fruit of multipurpose nature, which is highly recommended for social and urban forestry. This tree has higher medicinal, industrial and nutritional value in addition to their main use as food, fodder and timber (Troup, 1921 and Chundwat, 1990). In this tree, seed is the propagative mateial. Srimathi *et al.* (1991) recommended 10 minutes acid soaking for