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Phenotypic and genotypic variations in fruit characteristics of guava (*Psidium guajava*)*

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Guava (*Psidium guajava* L.) have originated from tropical America. Its cultivation is becoming commercially viable as the demand for its fresh fruit and processed products is increasing. Basically there are 2 types of varieties, in one having white pulp and the other having pink pulp. The pink pulp varieties are known to be a good source of a carotenoid called lycopene. The demand for varieties with pink pulp is increasing as consumers prefer pink pulp types.

However, most of the pink pulp varieties are hard seeded with high acidity. Few varieties with pink pulp, like 'Lalit' have been developed by selection (CISH 1999). Hence, a hybridization programme was taken up at the Indian Institute of Horticultural Research, Bangalore using the varieties 'Kamsari' and 'Purple Local' to develop hybrids suitable for both table as well as for processing, which would have fruits with uniform shape, size, good colour, firm and thick pulp, good aroma, soft seeds, high TSS and high pectin and long shelf-life.

Hybridization was carried out using the varieties, 'Kamsari'×'Purple Local'. 'Kamsari' yields medium sized fruits weighing about 170 to 180 g, with pink pulp colour, TSS of 9.8 °Brix, having less seed bearing portion, strong flavour and hard seeds. 'Purple Local' has dark purple skin colour, dull pink pulp and with less pulp and soft seeds. A progeny population of 513 fullsibs from the above cross was planted in the field during 2007 with a spacing of 2 m×1.5 m using trench planting method were analyzed for fruit characteristics like fruit weight (g), seed hardiness and TSS. Seed hardiness was recorded as kg/cm^2 by using the instrument manufactured by M/S Hardson & Co. The 'Analysis of Variance' (ANOVA) was carried out with 3 replications consisting of 515 treatments including the parents. The coefficients of phenotypic variability (PCV) and genotypic variability (GCV) were calculated for fruit weight (g), TSS (°Brix) and seed hardiness. The phenotypic, genotypic covariance and heritability estimates and variance were calculated using the software provided by the Statistics Division of the Institute.

Five hundred thirteen hybrid seedlings from the cross 'Kamsari'×'Purple Local' were raised with 2 m×1.5 m spacing. The progenies were analyzed for fruit characteristics like fruit weight (g), TSS and seed hardiness. The range of values for fruit characteristics of 513 hybrid progenies and 2 parents evaluated are given in Table 1. The fruit weight ranged from 100 to 400 g, TSS ranged from 8 to 14 ^{o}B and seed hardiness ranged from 8 to 14.5 kg/cm^2 in various progenies. The analysis of variance showed that there is significant difference among the progenies for the characters fruit weight, TSS and seed hardiness, which gives good scope for selection in the progenies. The phenotypic coefficient of variation for the characters studied was higher than the genotypic coefficient of variation implying greater role of the environment.

The coefficients of variation indicate only the extent of variability present in different characters and do not indicate

Table 1 Range of values for fruit characteristics of hybrid progenies

Trait	Range	No of progenies
Fruit weight (g)	100–150 g	5
	151–200 g	87
	201–250 g	214
	251–300 g	137
	301–350 g	56
	351–above	16
TSS (^{o}B)	8.0 to 9.0	157
	9.1 to 10.0	182
	10.1 to 11.0	117
	11.1 to 14.0	59
Seed hardiness (kg/cm^2)	6.0 to 9.0	28
	9.1 to 10.0	57
	10.1 to 12.0	242
	12.1 above	188

*Short note

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Table 2 Estimates of variance, heritability, correlation and coheritability

Estimate	Character		
	Fruit weight(g)	TSS (^oB)	Seed hardiness (kg/cm^2)
Genotypic variance	1423.54	0.61	0.84
Phenotypic variance	4050.62	2.62	4.99
Heritability (bs)	0.35	0.23	0.16
Phenotypic coefficient of variation (%)	20.93	14.69	17.78
Genotypic coefficient of variation (%)	15.41	8.08	8.03
CD (*P*=0.05)	82.84	2.29	3.29
	Fruit weight: TSS	*Fruit weight: seed hardiness*	*TSS seed: hardiness*
Phenotypic covariance	15.67	3.26	0.09
Genotypic covariance	6.94	5.23	0.08
Phenotypic correlation	0.15	0.02	0.02
Genotypic correlation	0.24	0.15	0.12
Coheritability	0.44	1.60	0.94

the heritable portion. This could be obtained from the heritability estimates. The heritability estimates in broad sense (Table 2) were found to be low for fruit weight, TSS and seed hardiness, which is understandable as PCV is also higher than GCV. This implies that going in for hybridization by raising large number of progenies is feasible and practicable for exploiting the heterosis. Rajan *et al.* (2007) reported that the efficiency of guava breeding programme for low seed content can be enhanced by choosing superior cross combination made by divergent clones. The varieties 'Kamsari' and 'Purple Local' being totally divergent, improvement in these characters, can be brought about by hybridization, which is confirmed by this work. The character fruit weight is negatively correlated with TSS and positively correlated with seed hardiness, implying that selecting fruits beyond a certain size will result in bringing down its quality. Genotypic correlation is higher in the case of the pair of characters fruit weight and seed hardiness, which goes to show that intrinsic correlations are reduced at the phenotypic level due to environmental effects. It can be seen in this study that the genotypic correlation coefficients (Table 2) are higher than the phenotypic correlation coefficient in certain cases. This happens when genes governing the two traits are similar but the environmental factors pertaining to the expression of the traits have a small effect. The higher genotypic correlation coefficients are attributed to relative stability of the genotypes. In general, the genotypic and phenotypic correlation coefficients were different in magnitude but not in direction.

The genetical studies conducted have indicated that the strength and direction of correlation in different character combinations depend on the nature of experimental material and growing conditions. In such studies, what is more important is to understand the general trend in association of characters rather than actual value itself and the results are to be used relatively as general guidelines rather than absolutely, using the discretion of the workers concerned under prevailing situations. The coheritability estimates come in handy in explaining such correlations. High coheritability was seen between TSS and seed hardiness and fruit weight and seed hardiness (Table 2). Dinesh and Yadav (1998) also obtained high coheritability estimate for TSS. However, fruit weight and TSS showed moderate coheritability estimate, which indicate that exploitation of heterosis by going in for hybridization between distant parents as envisaged by Rajan *et al.* (2007) and then selecting the desirable ones by raising a large number of progenies should enable in developing varieties having medium sized fruits with high TSS and soft seeds.

SUMMARY

A hybridization programme was taken up during 2006 using the varieties 'Kamsari' and 'Purple Local' to develop hybrids suitable for both table as well as for processing, which would have fruits with uniform shape, size, good colour, firm and thick pulp, good aroma, soft seeds and high TSS. Evaluation of the progeny population of 513 full sibs for fruit weight, TSS and seed hardiness showed significant differences among the progenies for the characters studied. The phenotypic coefficient of variation for the characters studied was higher than the genotypic coefficient of variation implying greater role of the environment. The heritability estimates in broad sense were found to be low for fruit weight, TSS and seed hardiness implying that heterosis can be exploited for the improvement of these characters by going in for hybridization.

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