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Short communication

Genetic diversity analysis for quantitative traits in hermaphrodite ridge gourd [*Luffa acutangula* (Roxb.) L.]

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ABSTRACT

A study was carried out to determine variability, heritability, genetic advance, correlation and path analysis in hermaphrodite ridge gourd for eight quantitative characters. The fruit length had the highest heritability (93.5%) followed by node at which first hermaphrodite flower appeared (78.0%). This trait provides ample scope for varietal improvement through selection. Significant positive correlation was found between fruit yield per plant and fruit weight (0.877), number of fruits per cluster (0.590) and fruit length (0.356) at phenotypic level. Significantly negative and desirable correlation at phenotypic level was observed between fruit yield per plant and days to first fruit harvest (-0.403), days to first hermaphrodite flower (-0.337) and node at which first hermaphrodite flower appeared (-0.315). The maximum direct and desirable effect on fruit yield per plant was exerted by fruit length (0.850), number of fruits (0.334), days to first fruit harvest (-0.019) and node at which first hermaphrodite flower appeared (-0.057) at phenotypic level.

Key words: Ridge gourd, variability, heritability, genetic advance.

Hermaphrodite ridge gourd [*Luffa acutangula* (Roxb.) L.] is an important underutilized crop belonging to Cucurbitaceae family. Plants bears hermaphrodite flowers in cluster and economically important for their tender fruits (Chandra, 1). Hermaphrodite ridge gourd is widely cultivated in Bihar and adjoining areas as mixed crop and as mono-crop in both summer as well as rainy seasons (Choudhary *et al.*, 2). Despite the presence of considerable variability in hermaphrodite ridge gourd, still no thrust has been paid on its improvement. Hence, concerted efforts are needed towards developing improved varieties/ hybrids. Knowledge of genetic variation in a specific population is of great importance for selecting genotypes for successful breeding programme (Debnath, 5). Heritability estimate alone does not provide clear idea about the expected gain in next generation; therefore it should be estimated along with genetic advance. Correlation analysis established the extent of association between yield and its components. Path analysis gives a clear understanding of character association with yield. Further, very limited information on assessment of genetic diversity in hermaphrodite ridge gourd is available (Ram *et al.*, 8). Hence, a study was carried out for determining the variability, heritability and genetic advance for horticultural traits and relationship among them in hermaphrodite ridge gourd.

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The experimental materials consisted of thirty-five diverse genotypes of hermaphrodite ridge gourd selected from collection maintained at IIVR Seed Production Centre, Sargatia, Kushinagar (UP) on the basis of yield performance. These lines were evaluated in a Randomized Block Design with three replications at Experimental Farm of IIVR Seed Production Centre, Sargatia, Kushinagar (UP) during rainy season of 2008 and 2009. Sowing was done in hill at spacing of 2.5 m between rows and 0.5 cm within rows. All standard cultural practices including plant protection measures were followed to raise a healthy crop. Data on node at which first hermaphrodite flower appeared, days to first hermaphrodite flower, days to first fruit harvest, number of fruits per cluster, fruit length (cm), fruit weight (g), number of fruits per plant and fruit yield per plant (kg) were recorded from five randomly selected plants in each genotype and replication. Data were averaged and statistically analyzed for genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability, genetic advance, correlation coefficient and path analysis using INDOSTAT statistical package.

The analysis of variance showed highly significant differences among 35 genotypes for all the characters (Table 1). The extent of variability in hermaphrodite ridge gourd genotypes was measured in terms of mean, range, PCV, GCV, heritability and genetic advance (Table 2). The range of variation was widest for fruit length (3.90-16.42 cm) followed by

Table 1. Analysis of variance for different guantitative traits in ridge gourd.

Trait	Source of variation		
	Replication	Treatment	Error
d.f.	2	34	68
Node at which first hermaphrodite flower appeared	1.41	9.45**	0.81
Days to first hermaphrodite flower	0.62	20.18**	10.79
Days to first fruit harvest	2.64	14.74**	5.15
No. of fruits/cluster	0.005	1.43*	0.34
Fruit length (cm)	0.44	27.04**	0.61
Fruit weight (g)	11.68	61.02**	11.65
No. of fruits/ plant	82.00	152.48**	111.53
Yield/plant (kg)	0.30	1.51*	0.26

*P = 0.05 and **P = 0.01

Table 2. Range, mean, variability, heritability and genetic advance in ridge gourd.

Trait	Range	Mean	Variability (%)		Heritability (h^2)	Genetic advance (GA)	GA as % of mean
			PCV	GCV			
Node at which first hermaphrodite flower appeared	6.40-13.53	7.78	24.70	21.83	78.0	3.09	39.72
Days to first hermaphrodite flower	41.13-52.67	48.77	7.65	3.63	22.5	1.73	3.55
Days to first fruit harvest	45.07-57.67	53.55	6.38	4.77	55.9	3.94	7.36
No. of fruits/cluster	3.93-5.93	4.49	14.73	6.81	21.4	0.29	4.46
Fruit length (cm)	3.90-16.42	12.09	25.39	24.56	93.5	5.91	48.88
Fruit weight (g)	18.42-38.64	27.09	19.57	14.97	58.5	6.39	23.59
No. of fruits/plant	122.93-147.53	138.67	8.07	2.66	10.9	2.51	1.81
Yield/plant (kg)	1.60-4.69	3.74	20.36	14.99	54.2	0.85	22.73

fruit yield per plant (1.60-4.69 kg). The narrowest range was observed in number of fruits per cluster (3.93-5.93). The PCV were invariably higher than their corresponding GCV due to environmental influence. Fairly high magnitude of PCV and GCV was recorded in fruit length (25.39, 24.56) and node at which first hermaphrodite flower appeared (24.70, 21.83), respectively. The difference between PCV and GCV was narrow for days to first fruit harvest and number of fruits per plant, indicating less influence of environment on the expression of these traits. The narrow difference between PCV and GCV was also reported by Chowdhury and Sharma (4), Shaha and Kale (11), Karuppaiah *et al*. (7) in ridge gourd, and Ram *et al*. (8) in hermaphrodite ridge gourd. Heritability (in broad sense) was high (>70%) for fruit length (93.5%) and node at which first hermaphrodite flower appeared (78.0%) coupled with high genetic advance indicated that heritability of these traits is mainly due to additive effects which could be effectively used in selection on the basis of phenotypic performance (Johnson *et al*., 6). These results are in close conformity with that of Varalakshmi *et al.* (12), Rao *et al.* (10) and Choudhary *et al.* (3) in ridge gourd. Ram *et al.* (8) also reported high GCA, PCV and genetic advance for fruit weight, number of fruits per plant and fruit yield per hectare in hermaphrodite ridge gourd.

Correlation studies showed that for most character pairs, genotypic and phenotypic associations were in the same direction and genotypic estimates were higher than the phenotypic ones, indicating an inherent association between the characters (Table 3). The correlation studies revealed that yield per plant had positive and highly significant correlation with fruit weight (0.877), fruit length (0.590) and number of

Table 3. Estimates of genotypic (rg) and phenotypic (rp) correlation coefficients.

Trait	Node at which first hermaphrodite flower appeared	Days to first hermaphrodite flower	Days to first fruit harvest	No. of fruits/ cluster	Fruit length (cm)	Fruit weight (g)	No. of fruits/ plant	Yield/plant (kg)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	rg	0.920**	0.837**	-0.403*	-0.218	-0.468**	-0.208	-0.505**
	rp	0.504**	0.560**	-0.147	-0.008	-0.325*	-0.007	-0.315*
(2)			0.986**	-0.948**	-0.318	-0.852**	-0.875**	-0.964**
			0.451**	-0.327*	-0.139	-0.331*	-0.112	-0.337*
(3)				-0.986**	-0.066	-0.583**	-0.335*	-0.619**
				-0.233	-0.073	-0.402*	0.004	-0.403*
(4)					0.653**	0.896**	0.176	0.979**
					0.287	0.304	0.130	0.356*
(5)						0.817**	-0.365*	0.779**
						0.630**	-0.110	0.590**
(6)							-0.350*	0.997**
							-0.151	0.877**
(7)								0.011
								0.195

*P = 0.05 and **P = 0.01

fruits per cluster (0.356) at phenotypic level. Thus, these characters may contribute to increase fruit yield in hermaphrodite ridge gourd. Ram *et al.* (8) also observed positive and significant correlation of fruit weight and number of fruits per plant on fruit yield per hectare in hermaphrodite ridge gourd. Similar findings have also been reported by Rao *et al.* (9), Chowdhury and Sharma (4), and Choudhary *et al.* (3) in ridge gourd. Fruit weight and fruit length had positive and significant correlation between themselves thus these traits should be considered during selection in breeding programme. The days to first fruit harvest (-0.403), days to appearance of first hermaphrodite flower (-0.337), and node at which first hermaphrodite flower appeared (-0.315) was found to be negatively and significantly correlated with fruit yield per plant at phenotypic level, which is desirable to get early yield as also reported by Rao *et al.* (9), Ram *et al.* (8), and Choudhary *et al.* (3).

Path analysis helps in understanding the magnitude of direct and indirect contribution of each character on the dependent character, *i.e.*, yield. The results presented in Table 4 revealed that fruit weight (0.850) and number of fruits per plant (0.334) exerted maximum direct effect on fruit yield per plant at phenotypic level indicating that these are the main contributor towards yield improvement. The characters like days to first fruit harvest (-0.057) and node at which first hermaphrodite flower appeared (-0.019) had negative direct effect on fruit yield per plant. This indicated that direct selection based on these characters results in appreciable improvement in yield as suggested by Rao *et al.* (9). Fruit weight is a prime attribute for yield improvement which exerted negative direct effect on fruit yield per plant but had positive and significant correlation with fruit yield per plant through positive indirect effect *via* node at which first hermaphrodite flower appeared (0.001), days to first fruit harvest (0.001) and number of fruits per cluster (0.003).

From the of above findings, it may be concluded that improvement of characters like node at which first hermaphrodite flower appeared, days to first fruit harvest, fruit weight and number of fruits per cluster will help in improving the yield in hermaphrodite ridge gourd both directly and indirectly. Therefore, these characters would be useful in improvement program of hermaphrodite ridge gourd through selection as well as hybridization.

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Table 4. Direct (diagonal) and indirect effect of different traits on yield at genotypic (G) and phenotypic (P) level.

Trait		Node at which first hermaphrodite flower appeared	Days to first hermaphrodite flower	Days to first fruit harvest	No. of fruits/ cluster	Fruit length (cm)	Fruit weight (g)	No. of fruits/ plant	Correlation with yield/ plant (kg)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	G	**-6.129**	2.440	-5.008	-2.238	-0.089	9.365	1.154	-0.505**
	P	**-0.019**	0.019	-0.032	-0.004	-0.001	-0.276	-0.002	-0.315*
(2)	G	-6.927	**2.158**	-8.888	-4.153	-3.117	16.264	3.698	-0.964**
	P	-0.009	**0.003**	-0.026	-0.008	-0.012	-0.281	-0.037	-0.337*
(3)	G	-5.132	3.208	**-5.981**	-5.475	-0.768	11.667	1.862	-0.619**
	P	-0.011	0.017	**-0.057**	-0.006	-0.006	-0.342	0.001	-0.403*
(4)	G	2.472	-1.615	5.899	**5.551**	7.589	-17.941	-0.976	0.979**
	P	0.003	-0.012	0.013	**0.025**	0.024	0.259	0.044	0.356*
(5)	G	0.047	-0.579	0.395	3.623	**11.627**	-16.364	2.030	0.779**
	P	0.001	-0.005	0.004	0.007	**0.085**	0.535	-0.037	0.590**
(6)	G	2.867	-1.753	3.485	4.974	9.503	**-20.022**	1.944	0.997**
	P	0.006	-0.012	0.023	0.008	0.053	**0.850**	-0.051	0.877**
(7)	G	1.272	-1.436	2.003	0.974	-4.245	7.001	**-5.560**	0.011
	P	0.001	-0.004	0.001	0.003	-0.009	-0.129	**0.334**	0.195

*P = 0.05 and **P = 0.01. Residual effect at genotypic level = 1.818 and phenotypic level = 0.114

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