

Estimation of magnitude of heterosis for growth traits in onion (*Allium cepa*)

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ABSTRACT

The experiment was conducted to estimate the magnitude of heterosis for growth traits in onion (*Allium cepa* L.) for 28 F₁s crosses at SKN College of Agriculture, Jobner, Rajasthan. These genotypes were planted in randomized block design with three replications under 3 date of sowing during *rabi* season, 2022-23. The most heterotic crosses for growth contributing characters were RO-59 × Bhima Shakti, Pusa Shobha × Pusa Red, Bhima Shakti × Pusa Shobha, RO-59 × Pusa Shobha, Kashi No. 1 × Pusa Red and RO-1 × Pusa Red. The crosses had significant heterobeltiosis for growth contributing characters RO-59 × Bhima Shakti, Bhima Shakti × Pusa Shobha, Pusa Shobha × Pusa Red, RO-1 × Kashi No. 1, RO-1 × RO-59 and RO-1 × Pusa Madhavi. These crosses were considered promising for their use for growth improvement in onion.

Key words: Heterosis, Growth, Heterobeltiosis, Crosses, Improvement.

Onion (*Allium cepa* L.), 2n = 16, is a member of family Alliaceae. In India, onion is cultivated mainly in Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Rajasthan and Bihar, occupying 1914 thousand ha with a total production of 31.12 million tonnes. In Rajasthan, it is grown extensively in Alwar, Ajmer, Jodhpur, Sikar, Nagaur, Jhunjhunu, Heterosis can be defined as superiority or inferiority of F₁ hybrid over its parents. It can be measured over mid-parent value (relative heterosis), better parent value (heterobeltiosis) and check parent (standard heterosis). Heterosis leads to superiority in adaptation, yield, quality, disease resistance, maturity and general vigour over its parents (Shull, 1914). The magnitude of heterosis depends on accumulation of favourable dominant alleles in F₁ population. If parental population differ from each other for more favourable alleles, magnitude of heterosis will also be proportionately higher. Heterosis helps to identify potential genotypes or crosses to develop high potential cultivars for growth traits in onion.

Materials and Methods

The experiment was conducted at Horticulture farm, SKN College of Agriculture, Jobner (Jaipur) (Rajasthan), during *rabi* season of 2022-23. Eight genetically diverse parents namely, RO-1, RO-59, Bhima Kiran, Bhima Shakti, Pusa Shobha, Pusa Madhavi,

Kashi No. 1 and Pusa Red were crossed in diallel fashion excluding reciprocals. All the 28 F₁s were evaluated in a randomized block design with three replications under 3 different date of sowing. The seedlings were planted in row 15 cm apart by hand dibbling method with a row-to-row spacing of 10 cm. The standard cultural practices were followed to raise the crop. Five plants were randomly selected from each genotype. The observations were recorded on plant height, number of leaves, total chlorophyll content, number of days to 50% neckfall. Heterosis and heterobeltiosis were calculated as per the method of Shull (1914) and Fonseca and Patterson (1968).

Results and Discussion

The parents vs. crosses component of variance was significant for most of the characters in different environments as well as over environments, indicating presence of sufficient heterosis. Among crosses, wider range in heterosis over mid-parent was found for number of leaves (-21.63 to 37.22), followed by total chlorophyll content (-28.89 to 32.51), plant height (-20.93 to 31.35) and number of days to 50% neckfall (-8.36 to 6.08) in all environments. Maximum desirable heterosis over better parent (heterobeltiosis) was 33.04 (RO-59 × Pusa Shobha in E₁) for number of leaves, followed by 25.99 (RO-59 × Bhima Shakti in E₁) for plant height, 25.85 (RO-1 × Pusa Shobha in E₂) for total chlorophyll content and -7.5 (RO-1 × RO-59 in E₂) for number of days to 50% neckfall in different environments.

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Table 1 : Estimates of per cent heterosis over mid parent and better parent in individual environment

Character	Env.	Heterosis	%	Heterobeltiosis	%
Plant height (cm)	E ₁	RO-59 × Bhima Shakti	31.35**	RO-59 × Bhima Shakti	25.99**
		Pusa Shobha × Pusa Red	26.8**	RO-1 × RO-59	17.42**
		Bhima Shakti × Pusa Shobha	22.19**	Pusa Shobha × Pusa Red	16.04**
	E ₂	Pusa Shobha × Pusa Red	26.53**	RO-59 × Bhima Shakti	22.29**
		RO-59 × Bhima Shakti	26.03**	Bhima Shakti × Pusa Shobha	20.17**
		RO-1 × Pusa Shobha	22.39**	Pusa Shobha × Pusa Red	20.08**
	E ₃	Kashi No. 1 × Pusa Red	25.92**	RO-59 × Bhima Shakti	19.24**
		RO-1 × Kashi No. 1	22.62**	RO-1 × Kashi No. 1	18.56**
		RO-59 × Bhima Shakti	19.38**	RO-1 × RO-59	17.39**
Number of leaves/plant	E ₁	RO-59 × Pusa Shobha	37.22**	RO-59 × Pusa Shobha	33.04**
		Kashi No. 1 × Pusa Red	27.8**	Kashi No. 1 × Pusa Red	25.96**
		RO-59 × Bhima Shakti	26.92**	Bhima Shakti × Kashi No. 1	19.8**
	E ₂	RO-59 × Pusa Shobha	23.92**	Pusa Madhavi × Pusa Red	17.16**
		Pusa Madhavi × Pusa Red	21.24**	RO-1 × Kashi No. 1	16.28**
		RO-1 × RO-59	19.69**	RO-59 × Bhima Shakti	15.45*
	E ₃	RO-59 × Pusa Shobha	32.63**	RO-59 × Pusa Shobha	28.57**
		Bhima Shakti × Kashi No. 1	32.29**	Kashi No. 1 × Pusa Red	17.59**
		Kashi No. 1 × Pusa Red	24.62**	RO-1 × RO-59	17.48**
Total chlorophyll Content (mg/g)	E ₁	RO-1 × RO-59	19.04**	RO-1 × Pusa Madhavi	14.97**
		Pusa Shobha × Pusa Red	16.98**	Pusa Shobha × Pusa Red	14.79**
		RO-1 × Pusa Madhavi	16.3**	RO-1 × Pusa Shobha	14.34**
	E ₂	RO-1 × Pusa Madhavi	32.51**	RO-1 × Pusa Shobha	25.85**
		Pusa Shobha × Pusa Red	30.75**	RO-1 × Pusa Madhavi	20.97**
		RO-1 × Pusa Shobha	27.59**	RO-1 × Kashi No. 1	17.82**
	E ₃	Bhima Shakti × Kashi No. 1	23.21**	Kashi No. 1 × Pusa Red	18.53**
		RO-1 × Kashi No. 1	22.64**	RO-1 × Kashi No. 1	15.68**
		Kashi No. 1 × Pusa Red	22.11**	Bhima Shakti × Kashi No. 1	14.45**
Number of days to 50% neckfall	E ₁	RO- 1 × Pusa Madhavi	-7.86**	RO-1 × Pusa Red	-7.05**
		RO-1 × Pusa Red	-7.71**	RO- 1 × RO-59	-6.11**
		Pusa Madhavi × Pusa Red	-7.29**	Pusa Madhavi × Pusa Red	-5.52**
	E ₂	RO- 1 × RO-59	-7.81**	RO- 1 × RO- 59	-7.5**
		Pusa Madhavi × Pusa Red	-7.52**	RO- 1 × Pusa Shobha	-5.66**
		RO- 1 × Pusa Madhavi	-6.35**	Pusa Shobha × Pusa Red	-5.08**
	E ₃	RO-1 × Kashi No. 1	-8.36**	Kashi No. 1 × Pusa Red	-7.31**
		Kashi No. 1 × Pusa Red	-7.67**	RO-1 × Kashi No. 1	-5.49*
		RO- 1 × RO-59	-7.21**	Bhima Shakti × Kashi No. 1	-5.22*

* and ** significant at 5 and 1 per cent level of significance, respectively

Out of a total 28 cross combinations, 6 crosses indicated significant heterosis in more than one environment for growth characters. Such cross combinations were RO-59 × Bhima Shakti, Pusa Shobha × Pusa Red, Bhima Shakti × Pusa Shobha RO-59 × Pusa Shobha, Kashi No. 1 × Pusa Red and RO-1 × Pusa Red. [Table 1]. These crosses were considered promising for use for growth improvement because of having high heterotic effect for yield as well some component characters. Similar results in varying environments for different characters were reported by Mallikarjun (2006), Evoor *et al.* (2007), Ambresh and Gowda (2013), Gowda and Ambresh (2014), Satyanarayan (2014), Quartiero *et al.* (2014), Chaudhary *et al.* (2017), Popat *et al.* (2020).

Out of 28 cross combinations, 7 crosses exhibited significant heterobeltiosis in more than one environments, showing significant heterobeltiosis for growth. Such cross combinations were RO-59 × Bhima Shakti, Bhima Shakti × Pusa Shobha, Pusa Shobha × Pusa Red, RO-1 × Kashi No. 1, RO-1 × RO-59 and RO-1 × Pusa Madhavi. [Table 1]. These crosses were considered promising for their use for growth improvement. Highly variable heterosis and heterobeltiosis for growth and associated characters were also reported Evoor *et al.* (2007), Ambresh and Gowda (2013), Gowda and Ambresh (2014), Satyanarayan (2014), Quartiero *et al.* (2014), Tripathi *et al.* (2018), Popat *et al.* (2020), Ara and Deb (2021), Sharma (2022) and Gangadhara (2023b).

Conclusion

The most heterotic crosses for growth contributing characters were RO-59 × Bhima Shakti, Pusa Shobha × Pusa Red, Bhima Shakti × Pusa Shobha RO-59 × Pusa Shobha, Kashi No. 1 × Pusa Red and RO-1 × Pusa Red. The crosses having significant heterobeltiosis for growth contributing characters were RO-59 × Bhima Shakti, Bhima Shakti × Pusa Shobha, Pusa Shobha × Pusa Red RO-1 × Kashi No. 1, RO-1 × RO-59 and RO-1 × Pusa Madhavi. These crosses were considered promising.

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