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Short Communication

Heterosis studies for root and productivity traits in *rabi* sorghum [*Sorghum bicolor* (L.) Moench.]

P. R. Patil and B. D. Biradar

AICRP on Rabi Sorghum, Regional Agricultural Research Station, Bijapur 586 101

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Heterosis in sorghum for yield and its components has been studied fairly extensively but the root system has not received adequate attention. The root traits such as maximum root length, root dry weight, root number etc., were found to play an important role to overcome moisture stress [1]. In the present study, heterosis for root traits in relation with the productivity traits has been thoroughly analyzed.

A total of twelve hybrids were developed using four distinct varieties *viz.*, M 35-1 (Most popular rabi sorghum variety), CSV 8R (Improved variety released at National level), DSV 4 and DSV 5 (Charcoal rot resistant high yielding varieties released for Karnataka state). The seeds of 12 hybrids along with five parents were sown in polythene bags during the year 2002 rabi. The bags of size 60cm length × 30cm diameter were placed in pits of 60cm depth in a deep black soil The experiment was laid out in a randomized block design with three replications. Each entry was represented by 5m length with a 15 plants / row with a spacing of 60 × 30cm. Observations on five randomly selected plants for days to 50% flowering, grain yield per plant, 500 seed weight, root number per plant, root length and root dry weight were recorded. For taking observations on root traits, polythene bags were removed from the soil and with the help of blade, ploythene sheet was cut and slowly removed. Later, water was sprayed to remove the soil and wash the roots. After washing the roots, the observations were taken. Heterosis was estimated over mid parent and better parent by following standard procedures.

The analysis of variance revealed the significant differences among parents and F_1 hybrids for all the characters. The estimates of heterosis of F_1's over the mid parent and better parent for all the characters studied are presented in the Table 1.

All the hybrids except one (DSV 4 × M 35-1) exhibited earliness to their respective batter parent. However, only seven out of twelve, showed significant better parent heterosis. Heterosis for earliness is most desirable trait in rabi sorghum for overcoming drought stress. Heterosis for earliness in sorghum has been reported earlier [2].

The grain yield per plant exhibited heterobeltiosis in the range of-12.08 to 63.10. The cross DSV 5 × M 35-1 recorded highest significant positive heterosis over both mid parent (83.58%) and better parent (63.10%). The results are in conformity with earlier findings [3, 4].

For 500 seed weight, heterosis was ranged from -19.23 to 45.09 percent over mid parent and -36.18 to 2.98 percent over better parent. When both the parents are bold seeded heterobeltoisis for seed size is not observed. In the earlier studies, very limited heterosis was observed for this trait by Imai and Qomez [5] and negative heterosis was reported by Desai *et al.* [6].

All the twelve hybrids showed significant positive heterosis for root number over mid parent while only six over better-parent. The cross CSV 8R × DSV 4 exhibited highest positive heterosis (47.38%) over better parent. Interestingly, all the hybrids that have exhibited positive heterosis for root number have also exhibited similar trend of positive heterosis for grain yield per plant. This indicates that root number play important role in determining the productivity of grain yield in rabi sorghum. Significant heterosis for root number was reported earlier by Damodar *et al.* [7].

For root length, seven crosses over mid parent and six crosses over better parent exhibited significant positive heterosis. The cross CSV 8R × M 35-1 showed maximum heterosis of 34.18% and 19.27% over mid parent and better parent, respectively. This is in agreement with the observations made earlier in sorghum [7].

All the hybrids except one exhibited significant positive heterosis over mid parent, while only four over

Table 1. Percent heterosis in rabi sorghum over mid parent (MP) and over better parent (BP) for root and productivity traits

Crosses		Days to 50% flowering		Grain yield/ plant		500-grain weight		Root number/plant		Root length		Root dry weight	
		MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
1	DSV4 × CSV8R	−1.93	−1.89	48.13**	43.06**	19.20**	2.98	34.62**	24.95**	20.39**	16.80**	33.12**	29.28**
2	DSV4 × DSV5	−9.80**	−5.34**	−24.76**	−29.61**	−13.79**	−31.88**	5.38*	−14.57**	−13.37**	−26.18**	20.93**	−10.71**
3	DSV4 × M35-1	0.10	1.26	40.01**	48.07**	20.95**	−0.66	20.69**	17.60**	0.96	−8.44**	−1.18	−14.71**
4	CSV8R × DSV4	−2.14	−2.10	54.12**	48.84**	−2.58	−11.35**	58.79**	47.38**	21.45**	17.83**	15.53**	12.47**
5	CSV8R × DSV5	−3.43**	−1.38	9.46**	−24.43**	−15.37**	−23.95**	9.06**	-16.45**	25.87**	4.59**	6.67**	−21.70
6	CSV 8R × M 35-1	−2.63*	−3.85**	39.36**	20.34**	36.52**	−21.75**	32.06**	20.69**	34.18**	19.27**	22.85**	3.68
7	DSV5 × DSV4	−12.09**	−7.70	−11.71**	−37.80**	−19.23**	−36.18**	5.91*	−14.13**	−3.81*	−18.04**	28.34**	−5.29
8	DSV5 × CSV8R	−10.31**	−5.78**	−11.95**	−39.21**	−12.58**	−21.29**	7.89**	−9.69**	2.65	0.26	16.39**	15.64**
9	DSV 5 × M 35-1	−9.25**	−5.80**	15.20**	−12.08**	9.97**	−24.51**	20.40*	−1.11	−4.73	−11.84**	17.53**	−2.87
10	M35-1 × DSV4	−6.78**	−5.70**	83.58**	63.10**	13.90**	−6.62**	8.34**	6.33*	6.06**	−3.10	7.30*	−7.40*
11	M 35-1 × CSV 8R	−1.95**	−5.70**	45.08**	25.02**	45.09**	−6.84**	41.32**	29.14**	19.11**	5.86**	51.33**	27.70**
12	M 35-1 × DSV 5	−11.32**	−8.02**	11.99**	−15.12**	14.54**	−21.39**	9.92**	−9.70**	3.72*	−3.98*	11.45**	−7.88*
	Sem ±.	1.04	1.27	1.11	1.31	1.26	1.52	2.39	2.46	1.76	1.82	3.21	3.37
	CD at 5%	2.15	2.63	2.36	2.71	2.61	3.15	4.75	5.10	3.65	3.72	6.65	6.86
	CD at 1%	2.93	3.58	3.12	3.69	3.55	4.28	6.37	6.90	4.96	5.13	9.04	9.33

*,**Significant at 5% and 1% respectively

better parent for root dry weight. Heterosis over mid parent for root dry weight was observed earlier in CSH 15 and CSH 7 [8].

From the results of the present study it was evident that appreciable amount of heterosis and heterobeltoosis could be realised for both root and productivity traits. The very low and negative heterosis for some characters may be due to the presence of large epistatic gene effects or due to incomplete dominant gene effects. The relationship between grain yield and root number was evident in the top high yielding crosses. This indicates that more the root number greater is the accessibility to moisture and nutrients. Hence, the present study reveals the scope of developing early maturing, high yielding rabi sorghum hybrid with more number of roots which can exploit available moisture and nutrients efficiently.

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