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Heterosis for Grain Yield and Yield Components in post rainy Sorghum

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ABSTRACT
Fifty cross combinations were produced by crossing five lines and ten testers in line x tester design. In order to indentify the high yielding rabi sorghum hybrids, promising hybrids were sorted out based on positive standard heterosis for grain yield per plant. Total fifteen hybrids exhibited positive significant standard heterosis for grain yield per plant along with desirable significant standard heterosis for some of the component traits. For grain yield per plant, the top ranking hybrids based on standard heterosis were AKRMS-66-2A(38) x Rb-Local-1-1-sel-1 (31.89%) followed by AKRMS-66-2A(38) x SLR-137 (30.15%), AKRMS-66-2A(38) x Elangovan-35(28.30%), AKRMS-66-2A(38) x AKSV-370 (26.01%) and AKRMS-80-1A(39) x Rb-Local-1-1-sel-1 (25.93%).
Keywords- *average heterosis, heterosis, heterobeltiosis, standard heterosis, sorghum*

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INTRODUCTION

Sorghum is a staple cereal grown in both rainy (*kharif*) and post rainy (*rabi*) seasons in the semi-arid parts of India, especially in marginal areas with least fertile and low water holding capacity soils where, only few other crops can survive. It is also an important source of green and dry fodder crop for animals. With the increase in human and animal population and a fragile balance between food supply and demand for it, production of sorghum must be increased to meet the current and future food and fodder needs. In *kharif* sorghum heterosis breeding has played a major role in increasing the productivity. But in post rainy sorghum the phenomenon of heterosis breeding has been exploited to the limited extent and there is a need for critical studies on the phenomenon of heterosis in *rabi* sorghum. In this study, an effort was made to identify the high grain yielding cross combinations produced by crossing newly developed parental lines of post rainy (*rabi*) sorghum. The hybrids were sorted out on the basis of positive significant standard heterosis for grain yield.

MATERIAL AND METHODS

The experimental material comprised of five male sterile lines viz.,AKRMS-66-2A(38), AKRMS-66-2A(40), AKRMS-66-2-3A ,AKRMS-80-1A(39) and AKRMS-80-1-1A(62) and ten testers viz., SLR-136, SLR-137,Elangovan-35,AKSV-252,Rb-Local-1-1-sel-1,Rb-Local-5(Bold), RSV-962,AKSV-330, PKV-Kranti and AKSV-370. These fifteen genotypes were crossed in line x tester fashion. Fifteen parents and their resulting 50 hybrids along with one standard check CSH-19R were sown in randomized block design with three replications on sorghum research unit, Dr P.D.K.V.,Akola during 2015-16. The observations were recorded on five randomly selected plants per plot per replication for plant height (cm), number of primaries per cob, number of secondaries per cob, shootfly dead heart count 28 DAE, panicle weight (g), panicle length (cm), panicle breadth (cm), number of grains per panicle, 1000 seed weight (g), grain yield per plant (g) and fodder yield per plant (g). For days to 50% flowering and days to maturity, observations were recorded on plot basis. The average heterosis and heterobeltiosis were estimated as per cent

increase or decrease of the mean of F1 over its mid parent and better parent values respectively. For computation of standard heterosis checks CSH 19 R was used.

RESULTS AND DISCUSSION

Analysis of variance revealed the significant variation for all the characters under study. The range of mean performance, heterosis over mid parent, better parent and standard check is presented in Table-1. For grain yield/ plant the range was 33.95-64.25 g in parental lines and 28.07-73.18 g in crosses while for the fodder yield/ plant the range was 32.56-76.27 g in parental lines and 30.68-113.26 g in crosses. It can be observed from Table 1 that the range for mean performance did not vary significantly for most of the characters except grain yield plant-1 and fodder yield/ plant. For the important characters like grain/ yield plant and fodder yield/ plant range appeared to be widened in crosses as compared to parents.

To determine the heterotic potential of the hybrids, average heterosis (over mid parent), heterobeltiosis (over better parent) and standard heterosis (over standard check) were calculated for all the characters under study. The range of average heterosis, average heterosis and standard heterosis are presented in Table-1. Top ranking crosses with significant standard heterosis for grain yield along with the desirable and significant standard heterosis for the component traits are presented in Table-2. Out of fifty crosses under study, fifteen crosses exhibited positive significant standard heterosis over the check CSH 19 R for grain yield/ and appeared best for development of high yielding post rainy sorghum hybrids. Along with grain yield, these fifteen cross combinations also showed desirable and significant standard heterosis for some the component traits also.

The best cross combination was AKRMS-66-2A (38) x Rb-Local-1-1-sel-1 with the highest positive significant standard heterosis of 31.89% for grain yield per plant (Table- 2). Similarly this cross recorded mid parent heterosis of 49.03 % and heterobeltiosis of 31.89 % for grain yield per plant. This cross also showed positive significant standard heterosis for all the yield component traits except days to 50% flowering.

On second position, hybrid AKRMS-66-2A (38) x SLR-137 recorded significant useful heterosis (30.15%) over the check CSH-19R for grain yield; it also showed significant average heterosis (23.95%) and heterobeltiosis (12.39%). This cross combination exhibited positive significant standard heterosis for all other characters except days to 50% flowering and days to maturity.

Another hybrid AKRMS-66-2A (38) x Elangovan-35 ranked third for the standard heterosis and recorded positive significant standard heterosis of 28.30%. It also showed positive significant average heterosis (17.90%) and heterobeltiosis (10.79%). This cross combination exhibited positive significant standard heterosis for all other characters except days to 50% flowering.

The cross AKRMS-66-2A(38) x AKSV-370 ranked fourth and exhibited positive significant standard heterosis for grain yield per plant (26.01%) along with all other component characters except fodder yield per plant, panicle length, shootfly dead heart count (28 DAE) and days to 50% flowering. It also recorded positive significant average heterosis (31.31%) and heterobeltiosis (8.81%) for grain yield per plant.

On the fifth position, hybrid AKRMS-80-1A (39) x Rb-Local-1-1-sel-1 recorded positive significant useful heterosis (25.93%) over the check CSH-19R. It also showed positive significant average heterosis (103.28%) and heterobeltiosis (100.83%).This cross combinations also exhibited positive significant standard heterosis for all other component characters except plant height, number of secondaries per cob, shootfly dead heart count and fodder yield per plant.

Remaining 10 cross combinations also exhibited positive significant standard heterosis (Table 2). This clearly indicated that all these crosses can be very well exploited using heterosis breeding for development of high yielding *rabi* sorghum hybrids.

Umakanth *et al.* [7] reported positive significant standard heterosis over the check CSH-19R in his study in *rabi* sorghum. Gunjal [2] reported that the hybrid AKRMS-68-1A x AKSV-219 R (30.11%) exhibited positive significant standard heterosis over the check CSH-19R for grain yield. Sakhare *et al.* [6] reported the cross AKRMS-80-A x Rb-307-11 with the highest positive significant standard heterosis of 28.99% over the check CSH-19 R. Kalpande *et al.* [3] reported that the hybrid AKRMS-80-A x SLR-91 exhibited highest standard heterosis (33.05%) over check-19R for grain yield. Mangal *et al.* [4] reported that out of 66 crosses, total nine promising crosses exhibited significant standard heterosis along with higher mean performance for grain yield per plant. More *et al*. [5] revealed that out of 24 hybrids, the crosses PMS 98 A x C 43, DNA 10 x KR 199, MS 372 x C 43 and PMS 8 A x KR 199 exhibited positive significant high standard heterosis for grain yield. Ghorade *et al*. [1] reported the cross AKMS 90 A x AKR 337 with highest standard heterosis of 23.91%.

Table -1 Range of mean and heterosis for grain yield and its components

SN	Characters	Range for mean		Range for heterosis (%) over			Best significant heterotic cross over check
		Parents	Crosses	Mid parent	Better parent	Standard check	
1	**Days to 50 % flowering**	67.00-77.33	67.33-81.00	-9.01-11.43	-7.76-15.42	-8.60-9.95	AKRMS-66-2-3A X AKSV-370 (-8.60%)
2	**Days to maturity**	108.00-120.67	106.67-121.67	-8.02-5.15	-6.40-8.02	-9.86-3.1	AKRMS-66-2-3A x AKSV-370 (-9.86%)
3	**Plant height(cm)**	107.44-192.22	84.44-220.00	-41.92-52.23	-53.94-31.58	-49.30-32.09	AKRMS-80-1A(39) X PKV-Kranti (32.09%)
4	**Number of primaries/ cob**	35.67-62.33	36.67-70.00	-34.12-55.81	-40.11-39.47	-30.38-32.91	AKRMS-66-2A (38) x RSV-962 (32.91%),
5	**Number of secondaries/ cob**	115.67-360.00	127.33-456.00	61.30-117.22	-64.63-115.31	-63.34-31.29	AKRMS-66-2A (40) x Rb-Local-1-1-sel-1(31.29%)
6	**Shoot fly dead heart count (28 DAE)**	0.00-55.2	11.30-64.15	-60.72-228.42	-55.40-556.84	-56.41-146.84	AKRMS-66-2A(38) x RSV-962 (-56.41%)
7	**Panicle weight(g)**	41.07-76.78	35.65-85.65	-44.14-88.94	-48.45-81.65	-44.57-33.17	AKRMS-66-2A(38) x Rb-Local-1-1-sel-1(33.17%)
8	**Panicle length (cm)**	20.44-26.65	19.65-27.40	-23.16-27.26	-26.27-24.51	-8.51-27.62	AKRMS-66-2A(38) x SLR-137(27.62%)
9	**Panicle breadth (cm)**	4.21-5.35	3.06-6.16	-31.46-29.27	-34.03-26.09	-33.74-33.60	AKRMS-66-2-3A x Elangovan-35(33.60%)
10	**Number of grains/ panicle**	1017.65-1810.79	686.57-2435.11	-55.68-59.90	-59.66-51.45	-57.10-52.14	AKRMS-66-2A(38) x SLR-137 (52.14%)
11	**1000 seed weight(g)**	24.26-39.36	20.96-42.86	-41.38-55.60	-46.02-53.91	-38.61-25.53	AKRMS-80-1A(39) x PKV-Kranti (25.53%)
12	**Grain yield/ plant(g)**	33.95-64.25	28.07-73.18	-42.93-103.28	-55.17-100.83	-49.40-31.89	AKRMS-66-2A(38) x Rb-Local-1-1-sel-1 (31.89%)
13	**Fodder yield/ plant (g)**	32.56-76.27	30.68-113.26	-37.83-204.14	-54.70-174.01	-64.16-32.28	AKRMS-80-1A(39) x PKV-Kranti (32.28%)

Table -2.Heterotic crosses for grain yield and its components.

SN	Crosses	Grain yield/ plant (g)	Heterosis(%) for grain yield/ plant over			Significant Standard heterosis for component characters.
			Mid parent	Better parent	Standard check	
1	AKRMS-66-2A(38) xRb-Local-1-1-sel-1	73.18	49.03**	13.89**	31.89**	2,3,4,5,6,7,8,9,10,11,12,13
2	AKRMS-66-2A(38) X SLR-137	72.21	23.95**	12.39**	30.15**	3,4,5,6,7,8,9,10,11,12,13
3	AKRMS-66-2A(38) x Elangovan-35	71.19	17.90**	10.79**	28.30**	2,3,4,5,6,7,8,9,10,11,12,13
4	AKRMS-66-2A(38) x AKSV-370	69.91	31.31**	8.81*	26.01**	2,4,5,7,9,10,12
5	AKRMS-80-1A(39) x Rb-Local-1-1-sel-1	69.87	103.28**	100.83**	25.93**	1,2,4,7,8,9,10,11,12
6	AKRMS-66-2-3A x SLR-136	69.17	75.80**	66.24**	24.67**	2,4,5,6,7,8,9,10,11,12
7	AKRMS-66-2A(38) X Rb-Local-5(Bold)	68.92	23.32**	7.26*	24.21**	3,4,5,6,7,8,10,11,12,13
8	AKRMS-66-2-3A X Elangovan-35	68.52	46.43**	21.27**	23.50**	2,3,4,5,7,8,9,10,11,12,13
9	AKRMS-66-2A(40) x Rb-Local-1-1-sel-1	68.00	39.44**	6.95	22.57**	2,3,4,5,6,7,8,9,10,11,12,13
10	AKRMS-80-1-1A(62) X Rb-Local-1-1-sel-1	67.46	68.79**	46.71**	21.59**	2,3,4,5,6,7,8,9,10,11,12,13
11	AKRMS-80-1A(39) X Elangovan-35	66.76	46.25**	18.15**	20.32**	2,3,4,5,6,7,8,10,11,12,13
12	AKRMS-80-1A(39) X PKV-Kranti	66.42	74.66**	60.95**	19.72**	2,3,4,5,7,8,9,10,11,12,13
13	AKRMS-66-2-3A X AKSV-370	65.36	64.81**	54.77**	17.80**	1,2,3,4,5,7,8,10,11,12
14	AKRMS-66-2A(38) X RSV-962	65.26	13.82**	1.56	17.61**	3,4,5,6,7,8,10,11,12,13
15	AKRMS-66-2-3A X Rb-Local-5(Bold)	63.42	49.93**	33.47**	14.30**	2,4,5,7,8,9,10,11,12

* - significant at 5% level of significance ** - significant at 1% level of significance

1) Days to 50 % flowering 2) Days to maturity 3) Plant height (cm) 4) Number of primaries per cob 5) Number of secondary's per cob 6) Shootfly dead heart count (28 DAE) 7) Panicle weight (g) 8) Panicle length (cm) 9) Panicle

breadth (cm) 10) Number of grains per panicle 11) 1000 seed weight (g) 12) Grain yield per plant (g) 13) Fodder weight per plant (g)

CONCLUSION

It was concluded from the study that positive standard heterosis was evident for grain yield per plant along with high amount of mid parent and better parent heterosis in fifteen cross combinations. The five promising cross combinations with positive significant standard heterosis for grain yield per plant were AKRMS-66-2A(38) xRb-Local-1-1-sel-1, AKRMS-66-2A(38) X SLR-137, AKRMS-66-2A(38) x Elangovan-35, AKRMS-66-2A(38) x AKSV-370, AKRMS-80-1A(39) x Rb-Local-1-1-sel-1. These promising cross combinations recorded desirable and significant standard heterosis for some of the component traits also. So these five crosses need to be evaluated further by their testing on large scale multilocation and multiseason trials to find out the most stable genotype for further exploitation.

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