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HETEROSIS STUDIES FOR GRAIN YIELD AND YIELD COMPONENTS IN POST RAINY SORGHUM

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Abstract

Three lines and eighteen testers were crossed in line × tester design to produce 54 cross combinations. In order to identify the high yielding *Rabi* sorghum hybrids, promising hybrids were sorted out based on positive significant standard heterosis for grain yield per plant. Total seventeen hybrids exhibited significant standard heterosis for grain yield per plant. The best cross combination was AKRMS-68-1A × AKSV-219R with the highest significant standard heterosis of 30.11% followed by the cross AKRMS-66-2A × Rb local 3 with the standard heterosis of 28.22% and the cross AKRMS-80-1A × Rb-369-1 with 27.92% standard heterosis for grain yield per plant.

Key words : average heterosis, heterosis, heterobeltiosis, standard heterosis, sorghum.

Introduction

Hybrid vigour and its commercial exploitation have paid rich dividends in *kharif* sorghum leading to quantum jump in sorghum production. However, the progress in *Rabi* sorghum is limited and there is a need for critical studies on exploitation of the phenomenon of heterosis in post rainy (*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 promising hybrids were sorted out based on positive significant standard heterosis for grain yield.

Materials and Methods

The experimental material comprised of three male sterile lines [AKRMS-80-1A, AKRMS-68-1A, AKRMS-66-2A] were crossed with eighteen testers [Rb-413-1, AKSV-178R, (13R × 104B × 36074-30-3-1), Rb-304-4-1, ICS-93-2-1, Rb local-5, G-45-3-1-1, Rb-400, Rb local 6-3, AKSV-257R, Rb local 6-4, (AKR-73 × SPV-504), AKRb-325, *Rabi* local 5-6, AKSV-219R, (275 × 104 × 1204 × Ringni × 18551 × 89022 36-2-1-1), Rb local 3 and Rb-369-1] and 54 cross combinations resulting from crossing of these three lines and eighteen testers in line × tester design along with one standard check CSH-19R. The experiment was sown at Sorghum Research Unit, Dr. P.D.K.V. Akola, during *Rabi* 2013-14 in randomized block design with three replications. The observations were recorded on five randomly selected plants per plot per replication for number of leaves plant^{-1}, plant height (cm), panicle length (cm), panicle breadth (cm), number of primaries panicle^{-1}, number of grains panicle^{-1}, 1000 seed weight (g), grain yield plant^{-1} (g) and fodder yield plant^{-1} (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 F_1 over its mid parent and better parent values respectively. For computation of standard heterosis checks CSH 19 R was used.

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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^{-1} the range was 32.51-54.67 g. in parental lines and 22.24-71.39 g. in crosses while for the fodder yield plant^{-1} the range was 33.63-98.53 g. in parental lines and 32.93-114.53 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^{-1}. For the important characters like grain yield plant^{-1} and fodder yield plant^{-1}

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

S. no.	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	75.67-86.00	75.33-87.33	-8.58-8.04	-11.37-3.57	-5.83-9.17	—
2.	Days to maturity	118.33-129.67	115.33-129.00	-8.12-4.74	-9.66-4.31	-7.73-3.20	AKRMS-66-2A× AKRb-325
3.	Plant height (cm)	114.47-118.33	152.33-216.60	4.87-53.73	-15.23-39.85	-18.71-15.58	—
4.	Number of leaves/plant	5.60-7.90	6.40-8.80	-3.03-35.71	-13.51-35.71	-17.95-12.82	AKRMS-66-2A × AKSV- 178 R
5.	Panicle length (cm)	20.35-28.56	19.67-29.12	-20.01-37.53	-28.29-35.32	-27.05-8.01	—
6.	Panicle breadth (cm)	3.54-4.76	2.14-5.08	-48.81-25.81	-49.37-21.04	-50.23-18.14	AKRMS-66-2A × Rb-400
7.	Number of primaries/ panicle	40.52-71.38	31.64-71.48	-43.42-42.70	-46.98-38.50	-50.42-12.02	—
8.	Number of grains/ panicle	986.10-2902.44	640.87-2490.27	-62.67-66.96	-63.78-51.27	-59.55-57.18	AKRMS-80-1A × AKRb-325
9.	1000 seed weight (g)	18.37-38.95	21.43-46.36	-29.03-100.31	-44.87-79.81	-45.11-18.74	AKRMS-68-1A × ICS-93-2-1
10.	Grain yield/plant (g)	32.51-54.67	22.24-71.39	-45.71-108.10	-50.80-103.77	-59.46-30.11	AKRMS-68-1A × AKSV- 219 R
11.	Fodder yield/plant (g)	33.63-98.53	32.93-114.53	-28.20-186.88	47.70-154.77	-62.80-29.37	AKRMS-80-1A × AKSV-257 R

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 (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 four crosses under study, seventeen crosses exhibited positive significant standard heterosis over the check CSH 19 R for grain yield plant^{-1} and appeared best for development of high yielding post rainy sorghum hybrids. Along with grain yield, these seventeen cross combinations also showed desirable and significant standard heterosis for some the component traits also.

The best cross combination was AKRMS-68-1A × AKSV-219R with the highest positive significant standard heterosis of 30.11% for grain yield per plant (table 2). Similarly, this cross recorded mid parent heterosis of 63.58% and heterobeltiosis of 46.14% for grain yield per plant. This cross also showed positive significant standard heterosis for 1000 seed weight (13.19%). The second top ranking cross combination was AKRMS-66-2 A × Rb local 3 with the standard heterosis of 28.22%. Similarly, this cross recorded mid parent heterosis of 108.10% and heterobeltiosis of 103.77% for grain yield per plant. This cross also showed positive significant standard heterosis for number of grains per panicle. The third best cross combination was AKRMS-80-1A × Rb-369-1 with standard heterosis of 27.95%, mid parent heterosis of 75.47% and the heterobeltiosis of 47.77% for grain yield per plant. Along with grain yield this cross also recorded positive significant standard heterosis for the component characters like number of grains per panicle and fodder yield per plant. The fourth top ranking cross combination was AKRMS 80-1 A × Rb-400 with the standard heterosis of 26.89%, mid parent heterosis of 63.73% and the heterobeltiosis of 32.52% for grain yield per plant. This cross also recorded positive significant standard heterosis for fodder yield per plant. The fifth promising cross combination was AKRMS 66-2 A × Rb 413-1 with the positive significant standard heterosis of 26.48% along with the average heterosis of 91.41% and the heterobeltiosis of 76.02% for grain yield per plant. This cross also recorded the desirable and significant standard heterosis for the component traits like days to maturity, number of grains per panicle and fodder yield per plant.

Table 2 : Significant heterosis in desirable direction for grain yield and its components.

S. no.	Crosses	Mean grain yield/plant (g)	Heterosis for grain yield/ plant over			Significant standard heterosis for component characters
			Standard check	Mid parent	Better parent	
1.	AKRMS-68-1A × AKSV-219R	71.39	30.11**	63.58**	46.14**	1000 seed weight
2.	AKRMS-66-2A × Rb local 3	70.35	28.22**	108.10**	103.77**	Number of grains per panicle.
3.	AKRMS-80-1A × Rb-369-1	70.21	27.95**	75.47**	47.77**	Number of grains per panicle, fodder yield per plant.
4.	AKRMS-80-1A × Rb-400	69.62	26.89**	63.73**	32.52**	Fodder yield per plant.
5.	AKRMS-66-2A × Rb-413-1	69.40	26.48**	91.41**	76.02**	Days to maturity, number of grains per panicle, fodder yield per plant.
6.	AKRMS-66-2A × AKSV-219R	68.65	25.12**	58.85**	21.83**	Number of grains per panicle.
7.	AKRMS-68-1A × Rb-304-4-1	68.09	24.09**	46.86**	25.42**	Fodder yield per plant.
8.	AKRMS-80-1A × G-45-3-1-1	67.39	22.82**	56.98**	26.32**	—
9.	AKRMS-66-2A × (275 × 104 × 1201 × Ringini × 18551 × 89022 36-2-1-1)	67.14	22.36**	79.78**	61.37**	—
10.	AKRMS-80-1A × AKRb-325	66.54	21.27**	62.23**	34.37**	Number of grains per panicle.
11.	AKRMS-66-2A × Rb local 6-4	66.26	20.76*	51.00**	21.19**	—
12.	AKRMS-68-1A × Rb local 6-3	65.86	20.03*	69.17**	67.04**	Number of grains per panicle.
13.	AKRMS-66-2A × G-45-3-1-1	65.59	19.53*	50.12**	20.81**	—
14.	AKRMS-80-1A × Rb local 6-4	65.57	19.49*	51.08**	20.77**	Number of grains per panicle.
15.	AKRMS-66-2A × Rb-400	64.92	18.31*	76.08**	59.70**	Panicle length.
16.	AKRMS-80-1A × AKSV-257R	64.47	17.50*	47.90**	17.92**	Fodder yield per plant.
17.	AKRMS-80-1A × Rb local 3	63.53	15.78*	72.53**	54.44**	Fodder yield per plant.

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

Rest of the twelve cross combinations also showed positive and significant standard heterosis, average heterosis and heterobeltiosis for grain yield per plant. This clearly indicated that these crosses can be very well exploited using heterosis breeding for development of high yielding *Rabi* sorghum hybrids. Jhansi Rani *et al*. (2008), Mahdy *et al*. (2011), Hariprasanna *et al*. (2012), Prabhakar *et al*. (2013) and Ghorade *et al*. (2014) also reported high heterosis in the top ranking crosses for grain yield.

Conclusion

From the results, good amount of standard heterosis was evident for grain yield per plant along with substantial amount of mid parent and better parent heterosis in seventeen cross combinations. The top five promising cross combinations were AKRMS-68-1A × AKSV-219R, AKRMS-66-2A × Rb local 3, AKRMS-80-1A × Rb-369-1, AKRMS 80-1 A × Rb-400 and AKRMS 66-2 A × Rb 413-1. Along with grain yield, most of the promising cross combinations recorded desirable and significant standard heterosis for some of the component traits also. These seventeen 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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