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Promising dual purpose heterotic cross combinations in post rainy sorghum

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Abstract
Five lines and ten testers were crossed in line x tester design to produce 50 cross combinations in order to indentify the dual purpose rabi sorghum hybrids. Promising hybrids were sorted out based on positive significant standard heterosis for grain yield along with fodder yield. Nine hybrids viz., AKRMS-66-2A(38) x Rb-Local-1-1-sel-1, AKRMS-66-2A(38) x SLR-137, AKRMS-66-2A(38) x Elangovan-35, AKRMS-66-2A(38) x Rb-Local-5(Bold), AKRMS-66-2-3A x Elangovan-35,AKRMS-66-2A(40) x Rb-Local-1-1-sel-1, AKRMS-80-1A(39) x Elangovan-35, AKRMS-80-1A(39) x PKV-Kranti and AKRMS-66-2A(38) x RSV-962 exhibited positive significant standard heterosis for grain yield as well as fodder yield. The best dual purpose cross combination was AKRMS-66-2A(38) x Rb-Local-1-1-sel-1 with standard heterosis of 31.89% for grain yield per plant along with the standard heterosis of 26.73% for fodder yield per plant.

Keywords: Heterosis, standard heterosis, sorghum

Introduction
Dual purpose sorghum hybrid is the one with high grain yield along with fodder yield. It is well known that the fodder quality of *rabi* genotype is better than *kharif* genotype and such good quality *rabi* fodder has good demand and fetches good price. In order to identify such dual purpose *rabi* sorghum hybrids, promising hybrids were sorted out based on positive significant standard heterosis for grain yield along with fodder yield. In this study, an effort was made to identify the high grain and fodder yielding i.e. dual-purpose hybrid cross combinations produced by crossing newly developed parental lines of *rabi* sorghum. The promising hybrids were sorted out based on positive significant standard heterosis for grain yield along with fodder yield

Materials 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. The observations were recorded on five randomly selected plants per plot per replication for grain yield/ plant (g) and fodder yield/ plant (g). 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.

Results and Discussion
Analysis of variance revealed the significant variation for both grain yield per plant and fodder yield per plant. 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 grain yield per plant and fodder yield per plant. Top ranking crosses with positive standard heterosis for grain yield are presented in Table-1. Out of fifty crosses under study, fifteen crosses exhibited positive standard heterosis over the check CSH 19 R for grain yield/ plant and appeared best for development of high yielding hybrids. But in sorghum high grain yield alone is not sufficient. Along with high grain yield, the fodder yield is also equally important character. Present need is of development of dual purpose *rabi* sorghum hybrid with

high grain yield along with high fodder yield also. Total nine hybrids viz., AKRMS-66-2A(38) x Rb-Local-1-1-sel-1, AKRMS-66-2A(38) x SLR-137, AKRMS-66-2A(38) x Elangovan-35, AKRMS-66-2A(38) x Rb-Local-5(Bold), AKRMS-66-2-3A x Elangovan-35,AKRMS-66-2A(40) x Rb-Local-1-1-sel-1, AKRMS-80-1A(39) x Elangovan-35, AKRMS-80-1A(39) x PKV-Kranti and AKRMS-66-2A(38) x RSV-962 exhibited significant standard heterosis for grain yield and fodder yield. In all the crosses positive significant standard for grain yield was accompanied by positive significant standard heterosis for fodder yield. This clearly indicated that these crosses can be very well exploited using heterosis breeding for development of dual purpose *rabi* sorghum hybrids (Table-2). Among the nine crosses, the best dual-purpose cross combination was AKRMS-66-2A (38) xRb-Local-1-1-sel-1 with the mean grain yield of 73.18 g. and fodder yield of 108.51 g. This cross combination recorded the highest significant standard heterosis of 31.89% for grain yield per plant along with the significant standard heterosis of 26.73% for fodder yield per plant.

The second promising dual-purpose cross combination was AKRMS-66-2A (38) X SLR-137 with the mean grain yield of 72.21 g. and fodder yield of 106.27 g. This cross combination recorded the positive significant standard heterosis of 30.15% for grain yield per plant along with the positive significant standard heterosis of 24.11% for fodder yield per plant.

The third promising dual-purpose cross combination was AKRMS-66-2A (38) x Elangovan-35 with the mean grain yield of 71.19 g. and fodder yield of 107.34 g. This cross combination recorded the positive significant standard heterosis of 28.30% for grain yield per plant along with the positive significant standard heterosis of 25.37% for fodder yield per plant. Besides these three crosses, remaining six crosses were also found suitable for development of dual-purpose hybrids in sorghum.

Table 1: Heterotic cross combinations for grain and fodder yield per plant.

S. No.	Crosses	*Per se (g)*		Heterosis (%) for grain yield/ plant over			Heterosis (%) for fodder yield/ plant over		
		Grain yield/ plant (g)	Fodder yield/ plant (g)	MP	BP	SC	MP	BP	SC
1	AKRMS-66-2A(38) xRb-Local-1-1-sel-1	73.18	108.51	49.03**	13.89**	31.89**	81.26**	52.46**	26.73**
2	AKRMS-66-2A(38) X SLR-137	72.21	106.27	23.95**	12.39**	30.15**	152.86**	118.87**	24.11**
3	AKRMS-66-2A(38) x Elangovan-35	71.19	107.34	17.90**	10.79**	28.30**	139.24**	121.08**	25.37**
4	AKRMS-66-2A(38) x AKSV-370	69.91	86.18	31.31**	8.81*	26.01**	53.75**	35.60**	0.65
5	AKRMS-80-1A(39) x Rb-Local-1-1-sel-1	69.87	32.24	103.28**	100.83**	25.93**	-37.83**	-54.70**	-62.34**
6	AKRMS-66-2-3A x SLR-136	69.17	76.60	75.80**	66.24**	24.67**	85.37**	55.03**	-10.53*
7	AKRMS-66-2A(38) X Rb-Local-5(Bold)	68.92	103.27	23.32**	7.26*	24.21**	107.24**	102.06**	20.61**
8	AKRMS-66-2-3A X Elangovan-35	68.52	103.55	46.43**	21.27**	23.50**	178.29**	151.44**	20.94**
9	AKRMS-66-2A(40) x Rb-Local-1-1-sel-1	68.00	111.04	39.44**	6.95	22.57**	67.93**	56.01**	29.68**
10	AKRMS-80-1-1A(62) X Rb-Local-1-1-sel-1	67.46	97.27	68.79**	46.71**	21.59**	75.76**	36.67**	13.61**
11	AKRMS-80-1A(39) X Elangovan-35	66.76	106.27	46.25**	18.15**	20.32**	188.24**	158.05**	24.12**
12	AKRMS-80-1A(39) X PKV-Kranti	66.42	113.26	74.66**	60.95**	19.72**	204.14**	170.17**	32.28**
13	AKRMS-66-2-3A X AKSV-370	65.36	74.92	64.81**	54.77**	17.80**	54.82**	17.89**	-12.50*
14	AKRMS-66-2A(38) X RSV-962	65.26	111.55	13.82**	1.56	17.61**	78.73**	46.25**	30.28**
15	AKRMS-66-2-3A X Rb-Local-5(Bold)	63.42	83.82	49.93**	33.47**	14.30**	98.28**	63.61**	-2.34

MP- Mid Parent**, BP**-Better Parent**, SC**- Standard Check

* - significant at 5% level of significance

** - significant at 1% level of significance

Table 2: Promising dual-purpose cross combinations

S. No.	Crosses	Standard heterosis (%) for Grain yield per plant over CSH-19R	Standard heterosis (%) for fodder yield per plant over CSH-19R
1	AKRMS-66-2A(38) x Rb-Local-1-1-sel-1	31.89**	26.73**
2	AKRMS-66-2A(38) x SLR-137	30.15**	24.11**
3	AKRMS-66-2A(38) x Elangovan-35	28.30**	25.37**
4	AKRMS-66-2A(38) x Rb-Local-5(Bold)	24.21**	20.61**
5	AKRMS-66-2-3A x Elangovan-35	23.50**	20.94**
6	AKRMS-66-2A(40) x Rb-Local-1-1-sel-1	22.57**	29.68**
7	AKRMS-80-1A(39) x Elangovan-35	20.32**	24.12**
8	AKRMS-80-1A(39) X PKV-Kranti	19.72**	32.28**
9	AKRMS-66-2A(38) x RSV-962	17.61**	30.28**

* - significant at 5% level of significance

** - significant at 1% level of significance

Taking in to consideration positive standard heterosis for grain yield per plant along with positive significant standard heterosis for fodder yield per plant, these nine crosses need to be tested in the multilocation multiseason trials to find out the good dual purpose rabi sorghum hybrid.

Jain *et al.* (2014) [2] reported the hybrid SPV 2110 x GFS 5 based on significant standard heterosis for grain yield along with fodder yield over the check GJ-39 in his study.

Ghorade *et al.* (2015) [5] reported four crosses exhibiting positive significant standard heterosis for grain yield as well as for fodder yield in *kharif* sorghum.

Sakhare *et al.* (2015) [5] reported two crosses (AKRMS-80-A x Rb-307-11 and AKRMS-47A x AKSV-70R) as promising dual-purpose cross combinations in *rabi* sorghum with positive significant standard heterosis for grain yield as well as fodder yield.

Kalpande *et al*. (2016) [3] reported ten crosses exhibiting positive significant standard heterosis for grain yield as well as for fodder yield in post rainy sorghum.

Mangal *et.al.* (20107) [4] reported the cross-combination ICS 751 A x AKR 530 exhibited standard heterosis of 44.27% for grain yield per plant and for fodder yield 29.16% indicating its importance in development of dual-purpose hybrid in sorghum.

Thus, it was concluded from the present study that the total nine hybrids viz., AKRMS-66-2A (38) x Rb-Local-1-1-sel-1, AKRMS-66-2A (38) x SLR-137, AKRMS-66-2A (38) x Elangovan-35, AKRMS-66-2A(38) x Rb-Local-5(Bold), AKRMS-66-2-3A x Elangovan-35,AKRMS-66-2A(40) x Rb-Local-1-1-sel-1, AKRMS-80-1A(39) x Elangovan-35, AKRMS-80-1A(39) x PKV-Kranti and AKRMS-66-2A(38) x RSV-962 appeared best crosses for development of dual purpose rabi sorghum hybrids and need to be evaluated further by their testing on large scale multilocation and multiseason trials to find out the most stable dual purpose rabi sorghum genotype for further exploitation.

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