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Promising parents for grain yield and early maturity in rabi sorghum (*Sorghum bicolor* L. Moench)

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Abstract
Four male sterile lines**,** twelve testers and their 48 crosses were evaluated along with check for days to 50% flowering, Days to physiological maturity and grain yield per plant for combining ability analysis. The general combining ability study revealed that among the lines, the line RMS 2010-10A and among the testers RSV 1941 were found to be the good general combiners for grain yield along with earliness. This one line and one tester need to be extensively used in crossing programme for development of high yielding and early maturity rabi sorghum hybrids.

Keywords: Sorghum, *gca*, combining ability analysis, line x tester, randomised block design (RBD)

Introduction
Maharashtra is one of the kharif and rabi sorghum growing state in India. The lower productivity during *rabi* is due to severe moisture stress and also due to small coverage under hybrids. In case of *rabi* sorghum, a significant increase in productivity, as it much happened in kharif could not be achieved because of biological and environmental limitations posing difficult hurdle in *rabi* sorghum productivity. Major constraints for low yield in Maharashtra are variation in soil types (23% shallow, 48% medium and 29% deep soil), variation in rainfall, susceptibility to low temperature, moisture stress at the GS2 stage and climate change. Even with this productivity, the farmers have still maintained their traditional attachment with *rabi* sorghum cultivation only because of the food and animal feed security. Therefore, the genetic improvement in *rabi* sorghum has received the top priority there is need to develop the high yielding and early maturing hybrid in *rabi* sorghum. For this identification of suitable parental line having potential for earliness and high grain yield needs to be identified.

Material and Methods
Four male sterile lines *viz*., CMS 185 A, RMS 2010-10A, RMS 2010-24A, 1409A were crossed with twelve testers *viz*., RSV -1822, RSV -1917, RSV-1921, RSV-1941, RSV-1838, RSV-1850, RSV-1979, RSV-1945, RSR-1026, RSR-1027, RSV-1976, RSV-1906. These Eighteen genotypes were crossed in line x tester fashion. Eighteen parents and their resulting 48 hybrids along with one standard check CSH-15 were sown at PGI, farm, M.P.K.V., Rahuri (M.S) India, during *rabi* 2016-17 in RBD with two replications. Each entry was sown in two rows of 3.0-meter length and spaced at 45 cm. Plants were spaced at 15 cm within a row. The observations were recorded on five randomly selected plants per entry per replication for grain yield per plant (g), days to 50% flowering and days to maturity. The data on all above characters was subjected to combining ability analysis by following Kempthorne (1957) [1] method.

Results and Discussion
The analysis of variance for combining ability in *rabi* sorghum is presented in Table 1. It was observed from the data that, the mean squares due to lines, testers as well as lines vs tester interaction and hybrids were significant for all the traits.
The estimates of general combining ability effects of the line and testers are presented in Table 2. In sorghum, positive gca effects is desirable for grain yield per plant while for days to 50% flowering and days to physiological maturity negative gca effects are desirable.

Table 1: The analysis of variance for combining ability

Name of parents/ crosses	DF	Days to 50% flowering	Days to physiological maturity	Grain yield/ plant
Replication	1	8.23	4.17	80.38
Treatments	63	22.28**	22.83**	91.21**
Parents	15	12.62**	10.11**	56.01**
Lines	3	19.17**	17.33**	54.99
Testers	11	9.93**	8.65**	50.60*
Line vs. Tester	1	22.57**	4.59	118.55*
Parent vs. Hybrid	1	248.09**	178.36**	1.22
Hybrids	47	20.56**	23.58**	104.37**
Error	63	2.45	2.47	21.60

Among the three lines, the line RMS 2010-10 A recorded significant and desirable gca effects for grain yield per plant (2.29*) as well as for days to 50% flowering (-1.84*) and days to physiological maturity (-2.23*) Thus the line RMS 2010-10A was found to be suitable for developing high yielding and early maturity hybrids in *rabi* sorghum due to its positive significant gca effects for grain yield along with negative significant gca effects for days to 50% flowering and days to physiological maturity. The early maturing hybrids escape this terminal drought so this line need to be extensively used in *rabi* hybridization programme for developing high yielding and early maturing hybrids.

Premlatha *et al.,* (2006) [3] also reported that negative gca effects for days to 50% flowering might be useful in breeding programme for earliness. Prabhakar *et al*., (2013) [2] also identified one line SL-39B with positive significant gca for days to 50% flowering and reported the use of this line in developing high yielding early maturing hybrids in *rabi* sorghum.

Among testers, RSV 1941 recorded significant and desirable gca effects for grain yield per plant (7.90**) as well as for days to 50% flowering (-4.26**) and days to physiological maturity (-4.26**) Thus the tester RSV-1941 was found to be suitable for developing high yielding and early maturity hybrids in *rabi* sorghum due to its positive significant gca effects for grain yield along with negative significant gca effects for days to 50% flowering and days to physiological maturity. Prabhakar *et al*., also reported the tester SLR-66 with significant desirable gca effects for grain yield per plant along with days to 50% flowering and reported the usefulness of this tester in developing high yielding and early maturing hybrids in *rabi* sorghum.

Thus, it was concluded from the present study that there is need to extensively use the line RMS 2010-10A and the tester RSV-1941 in the hybridization programme for developing high yielding and early maturing hybrids in *rabi* sorghum.

Table 2: Estimates of general combining ability (*gca*) effects of lines and testers

Sr. No.	Name of parents	Days to 50% flowering	Days to physiological maturity	Grain yield/ plant (g)
Females (Lines)				
1	185A	-0.88**	-0.57	1.60
2	10A	-1.84**	-2.23**	2.29**
3	24A	2.82**	3.50**	0.11
4	1409A	-0.09	-0.69*	-1.72
	SE ±	0.31	0.321	0.94
Males (Testers)				
5	RSV1822	1.86**	2.05**	-0.94
6	RSV1917	0.865	-0.57	-1.81
7	RSV1921	0.865	1.39*	2.99
8	RSV1941	-4.26**	-1.32*	7.90**
9	RSV1838	-1.26*	-3.07**	-1.44
10	RSV1850	0.49	-0.19	0.37
11	RSV1979	0.365	0.30	2.46
12	RSV 1945	0.99	0.55	2.13
13	RSR1026	0.99	1.05	6.88**
14	RSR1027	1.49**	2.18**	2.46
15	RSR1976	-0.135	-0.19	-1.49
16	RSR1906	-2.26**	-2.19**	-3.70*
	SE ±	0.55	0.55	1.64

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