Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 2915-2921
Received: 25-03-2019
Accepted: 27-04-2019

Ranjana Tiwari
Ph.D. Student, Department of Agricultural Botany, College of Agriculture VNMKV, Parbhani, Maharashtra, India

HV Kalpande
Associate Professor, Department of Agricultural Botany, College of Agriculture VNMKV, Parbhani, Maharashtra, India

SV Kalyankar
Assistant Professor, Department of Agricultural Botany, College of Agriculture VNMKV, Parbhani, Maharashtra, India

Correspondence
Ranjana Tiwari
Ph.D. Student, Department of Agricultural Botany, College of Agriculture VNMKV, Parbhani, Maharashtra, India

Heterosis studies for yield and its component in sorghum genotype

Ranjana Tiwari, HV Kalpande, and SV Kalyankar

Abstract
The present investigation entitled as "Genetics of Shootfly Resistance, Heterosis and Combining Ability in Sorghum (*Sorghum bicolor* (L.) Moench)" was conducted in *kharif* 2015 at sorghum research station Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The present experiment was carried out to estimate the amount of heterosis, heterobeltiosis, general and specific combining ability for selection of potential parents, crosses and to study important quantitative characters associated with grain mould resistance. In the present study, a set of 15 Parents (7 lines and 8 testers), 56 Hybrids and 3 checks were evaluated to study the inheritance of yield traits.
Crosses ICSA101 × KR125 (30.28), PMS71A × AKR456 (29.79), PMS74A × AKR456 (28.63), PMS232A × C43 (28.00) and PMS74A × KR125 (24.15) recorded significantly higher heterosis over standard checks for grain yield per plant. Similar trend was the trend in yield contributing characters.

Keywords: Heterosis studies, yield, sorghum genotype

Introduction
Sorghum (*Sorghum bicolor* (L.) Moench) is an important cereal crop in India. Sorghum belongs to natural order Poaceae, tribe Andropogenae, with ten pairs of chromosomes (2n=20) And considered to be of Ethiopian origin (Vavilov, 1935) [10].
Recent FAO statistics indicates a world production of 60 million tonnes of grain sorghum from 44 million hectare of land with productivity of 1238 kg/ ha (FAO stat 2016). Area under sorghum in India is 9.1 million hectare with 6.7 million tonnes of production and 783 kg productivity per hectare. Maharashtra which contributes about 49.14 per cent of area and 42.07 per cent production with an area of 28.58 lakh hectares, production of 25.07 lakh tonnes and productivity of 1971 kg/ha (Anonymous 2015) [2]. In India, hybrid sorghum project was started in 1962 and breakthrough has been achieved in yield potential and consumer's acceptability with the release of hybrids Several high yielding however early maturing hybrids lack mould escape mechanism of the local sorghum due to their earliness. Rain damaged grains fetches less value then normal grains and seed loses its viability. Line × tester analysis studies furnish useful information regarding the selection of suitable parents for effective hybridization programme (Sprague and Tatum, 1942). This approach has practical utility in breeding programme aimed at genetic improvement in yield.
Heterosis or hybrid vigour is the increased or decreased vigour growth, fitness or yield of a hybrid over the parental values, resulting from the crossing of genetically unlike organisms. Heterosis has positive association with specific combining ability (sca) variance.
The present investigation was carried out to obtain information on the following objectives:-
1. To study the general and specific combining ability of the genotypes
2. To estimate the magnitude of heterosis for yield and yield parameters
3. To identify potential crosses for future crop improvement programme

Material and Methods
In *Rabi*, 2015 seven lines i.e. PMS28A, PMS74A, PMS71A, PMS98A, ICSA101A, PMS42A, PMS232A, were crossed with the eight testers i.e. I2, AKR456, KR191, KR196, KR125, C43, 9825REC and ICSR196. In *kharif* 2016 15 parents, 56 hybrids along with three checks i.e. CSH 25, SPH 1641 and CSH 16 were raised with 2 rows per treatment in randomized block design with 3 replications with a spacing 45 × 15 at sorghum research station vasantrao naik marathwada Krishi Vidyapeeth parbhani. Parbhani is located in the South-west part of Maharashtra, India, comes under agro-climatic zone-VII in the state. The site of experiment is located at 19° 16' N latitude, 67° 47' E longitude and 409 meter above the sea level. This region has Sub-tropical climate with extreme of summer and medium winter. The temperature falls down to as low as 12-14 ^{0}C during winter season especially in the month of December

and January. The mercury rises up to 46-48 ^{0}C during summer. The average rainfall in this area is around 950 mm annually. Observation recorded were Days to 50 per cent flowering, Plant Height (cm), Flag leaf area (cm^2), Days to maturity, Grain yield per plant (gm), Fodder yield per plant (gm), Test weight (gm) and Harvest index (%)

The data recorded on the material generated as per Line x Tester model were subjected to analysis of variance as per the Line x Tester model given by Kempthorne (1957) [6]. Heterosis over better parent, Mid parent and over standard checks was estimated. as per the formula of Fonesca and Patterson (1968) [5].

Results

1) Heterosis, Heterobeltiosis and Economic Heterosis

The character wise results of heterosis and heterobeltiosis and economic heterosis are detailed below:

2) Days to 50% flowering

The negative heterosis for this trait is of interest to the breeder as it indicates the earliness. Nine crosses recorded significant negative heterosis over mid parent. Highest negative heterosis over mid parent was recorded by cross ICSA101 × KR125 (-14.15) Twelve crosses recorded negative heterobeltiosis among fifty six crosses. The highest significant negative heterosis over better parent i.e., heterobeltiosis was recorded by ICSA101 × KR125 (-14.15)

Four crosses recorded significant negative heterosis over standard check CSH25. Significantly highest negative heterosis over standard check CSH25 was recorded by cross PMS71A × AKR456 (-9.19) Only one cross ICSA101 × KR125 (-5.73) recorded significantly highest negative heterosis over standard check SPH1641. Heterosis in desired direction (negatively significant) was exhibited by four crosses out of fifty six crosses. Significantly highest negative heterosis over standard check CSH16 was recorded by cross PMS71A × AKR456 (-8.51). similar results were reported by Prabhakar, 2002 and Rafiq *et al.* (2002).

3) Days to maturity

The negative heterosis for this trait is of interest to the breeder as it indicates the earliness. Thirty six crosses recorded significant negative heterosis over mid parent indicates the standard heterosis. Highest negative heterosis over mid parent was recorded by cross PMS71A × AKR456 (-10.03) Fourty two crosses recorded negative heterosis over better parent which indicates the presence of heterobeltiosis in hybrids. The highest significant negative heterosis over better parent was recorded by cross PMS71A × AKR456 (-10.03) Fourty four crosses recorded significant negative heterosis over standard check CSH25. Significantly highest negative heterosis over standard check CSH25 was recorded by cross PMS71A × AKR456 (-10.28), ICSA 101×KR125(-10.28) Fifty crosses showed significant negative heterosis over check SPH1641 among the fifty six crosses. Highest economic heterosis over this check recorded by cross PMS71A × AKR456 (-11.02), ICSA101 × KR125 (-11.02). Heterosis in desired direction (negatively significant) was exhibited by twenty nine crosses over standard check CSH16 and significantly highest economic heterosis recorded by cross PMS71A × AKR456 (-7.98), ICSA101 × KR125 (-7.98). These results are in conformity with Mohammed (2009).

4) Plant height (cm)

Significant heterosis in desired direction (positive significant) for plant height was desirable for this trait. Fourty one crosses recorded significant positive heterosis over mid parent. Highest positive standard heterosis over mid parent was recorded by cross PMS28A × KR191 (41.18) and cross PMS28A × KR196 (37.46) Twenty six crosses recorded significant superior positive heterosis over better parent, which indicates the presence of heterobeltiosis in hybrids. The highest significant positive heterosis over better parent was recorded by cross PMS28A × KR191 (32.95) Thirteen crosses recorded significant positive heterosis over standard check CSH25. Significantly highest positive heterosis over standard check CSH25 in desired direction was recorded by cross ICSA 101 × KR125 (19.37). Seventeen crosses showed significant positive heterosis over standard check SPH1641 among the fifty six crosses. Highest economic heterosis over this check recorded by cross ICSA101 × KR125 (20.93) Economic heterosis in desired direction (positively significant) was exhibited by eighteen crosses over standard check CSH16 and significantly highest economic heterosis recorded by cross ICSA101 × KR125 (22.63). Simillar results were reported by Umakanth *et al.*, (2002) Chaudhary and Narkhede, (2004) [4] Swarnalata Kaul *et al*. (2003) [8].

5) Flag leaf area (cm²)

The positive heterosis for this trait is of interest to the breeder as it results in increased yield. Heterosis in desired direction (positive significant) was exhibited by fourteen crosses out of fifty six crosses over mid parent. Highest positive standard heterosis over mid parent was recorded by cross PMS98A × 9825REC (75.68) Nine crosses recorded significant superior positive heterosis over better parent, indication of presence of heterobeltiosis in hybrids. The highest significant positive heterosis over better parent was recorded by cross PMS98A × 9825REC (47.20) Five crosses recorded significant positive heterosis over standard check CSH25. Significantly highest positive heterosis over standard check CSH25 was recorded by cross ICSA 101 × KR125 (28.60) Six crosses showed significant positive heterosis over standard check SPH1641 among the fifty six crosses. Highest economic heterosis over this check recorded by cross ICSA101 × KR125 (37.42) Eleven crosses recorded heterosis in desired direction (positively significant) over standard check CSH16 and significantly highest economic heterosis recorded by cross ICSA101 × KR125 (42.72) Prakash *et al.* (2010).

6) Grain yield (gm)

The positive heterosis for this trait is of interest to the breeder as it results in increase of yield. Heterosis in desired direction (positive significant) was exhibited by ten crosses out of fifty six crosses. Highest significant positive standard heterosis over mid parent was recorded by PMS232A × C43 (26.48).For Grain yield (gm), eight crosses recorded heterobeltiosis in desired (positive and significant) direction over better parent. Highest significant positive heterobeltiosis over better parent was recorded by cross ICSA101 × KR125 (30.28), PMS232A × C43 (23.86). Eight crosses recorded significant positive heterosis over standard check CSH25. Significantly highest positive heterosis over standard check CSH25 was recorded by cross ICSA101 × KR125 (27.87) Seven crosses showed significant positive heterosis over standard check SPH1641 among the fifty six crosses. Highest economic heterosis over this check recorded by cross ICSA101 × KR125 (17.51) Eight crosses recorded economic heterosis in desired direction (positively significant) over standard check CSH16 and significantly highest economic heterosis recorded by cross ICSA101 × KR125 (30.28). Boratkar (2010) reported similar results for grain yield in sorghum.

7) Fodder yield per plant (gm)

Significant heterosis in desired direction (positive significant) for fodder yield per plant is desirable for this trait. Nine crosses recorded significant positive heterosis over mid parent. Highest significant positive standard heterosis over mid parent was recorded by cross PMS42A × KR125 (23.58) Six crosses recorded significant superior positive heterosis over better parent, which indicates the presence of heterobeltiosis in hybrids. The highest significant positive heterosis over better parent was recorded by cross PMS232A × C43 (18.88). Nine crosses recorded significant positive heterosis over standard check CSH25. Significantly highest positive heterosis over standard check CSH25 was recorded by cross ICSA101 × KR125 (28.77) followed by cross PMS7A × AKR456 (27.75). Seven crosses showed significant positive heterosis over standard check SPH1641 among the fifty six crosses. Highest economic heterosis over this check recorded by cross ICSA101 × KR125 (23.32). Heterosis in desired direction (positively significant) was exhibited by eleven crosses over standard check CSH16 and significantly highest economic heterosis recorded by cross ICSA101 × KR125 (29.05). These results are in conformity with the results of Chalawadi (2007) [3].

8) Test weight (gm)

The positive heterosis for this trait is of interest to the breeder as it results in increase of yield parameter. Heterosis in desired direction (positive significant) was exhibited by eleven crosses out of fifty six crosses. Highest positive heterosis over mid parent was recorded by cross PMS71A × AKR456 (24.92)

For Test weight (gm), six crosses recorded heterobeltiosis in desired (positive and significant) direction over better parent. Highest significant positive heterobeltiosis over better parent was recorded by cross PMS71A × AKR456 (22.85)

Six crosses recorded significant positive economic heterosis over standard check CSH25. Significantly highest positive economic heterosis over standard check CSH25 was recorded by cross ICSA101 × KR125 (21.00) Ten crosses showed significant positive heterosis over standard check SPH1641 among the fifty six crosses. Highest economic heterosis over this check recorded by cross ICSA101 × KR125 (29.99) Heterosis in desired direction (positively significant) was exhibited by six crosses over standard check CSH16 and significantly highest economic heterosis recorded by cross ICSA101 × KR125 (22.57). similar results were reported by Umakanth *et al.* (2003) [9].

9) Harvest index (%)

The positive heterosis for this trait is of interest to the breeder as it results increase in yield. Significant heterosis in desired direction (positive significant) for harvest index was desirable for this trait. Twelve crosses recorded significant positive heterosis over mid parent. Highest positive heterosis over mid parent was recorded by cross PMS71A × KR191 (34.53) Six crosses recorded significant superior positive heterosis over better parent, which indicates the presence of heterobeltiosis in hybrids. The highest significant positive heterosis over better parent was recorded by cross PMS71A × KR191 (26.58) Nineteen crosses recorded significant positive heterosis over standard check CSH25. Significantly highest positive heterosis over standard check CSH25 was recorded by cross ICSA101 × KR125 (37.22) Twenty seven crosses showed significant positive heterosis over standard check SPH1641 among the fifty six crosses. Highest economic heterosis over this check recorded by cross ICSA101 × KR125 (47.92) followed by PMS71A × KR191 (47.64). Economic heterosis in desired direction (positively significant) was exhibited by twenty six crosses over standard check CSH16 and significantly highest economic heterosis recorded by cross ICSA101 × KR125 (43.63). Swarnalata Kaul *et al.* (2003) [8] reported similar results for harvest index.

Table 1: Percent heterosis over mid parent, better parent and standard heterosis over checks

S. No.	Crosses	Days to 50 % flowering					Days to Maturity				
		MP	BP	SH1 CSH25	SH2 SPH1641	SH3 (CSH16)	MP	BP	SH1 (CSH25)	SH2 SPH1641	SH3 CSH16
1.	PMS28A × I26	1.00	-2.90	4.44	8.41*	5.21	-1.01	-3.38	-4.72 *	-5.51*	-2.28
2.	PMS28A × AKR456	-3.61	-4.71	2.49	6.39	3.25	-3.36	-3.90	-4.17	-4.96*	-1.71
3.	PMS28A × KR191	-1.75	-1.98	5.43	9.44*	6.21	-3.24	-3.38	-4.72 *	-5.51*	-2.28
4.	PMS28A × KR196	0.64	-4.46	2.76	6.67	3.52	-4.64 *	-7.32**	-8.61 **	-9.37**	-6.27**
5.	PMS28A × KR125	-8.48**	-9.23 **	-2.37	1.34	-1.65	-8.15 **	-8.40**	-9.17 **	-9.92**	-6.84**
6.	PMS28A × C43	-4.39	-5.28	1.88	5.75	2.63	-6.01 **	-6.67**	-6.67 **	-7.44**	-4.27
7.	PMS28A × 9825REC	-0.24	-5.90	1.21	5.06	1.96	-5.60 **	-7.32**	-8.61 **	-9.37**	-6.27**
8.	PMS28A × ICSR196	-5.01	-5.51	1.63	5.49	2.38	-6.10 **	-6.76**	-8.06 **	-8.82**	-5.70*
9.	PMS74A × I26	3.53	1.88	4.44	8.41*	5.21	-5.01 *	-8.03**	-7.78 **	-8.54**	-5.41*
10.	PMS74A × AKR456	-11.70 **	-12.79 **	-8.34*	-4.86	-7.66*	-7.22 **	-7.48**	-7.22 **	-7.99**	-4.84*
11.	PMS74A × KR191	0.19	-1.94	4.98	8.97*	5.76	-4.34 **	-5.26*	-5.00 *	-5.79*	-2.56
12.	PMS74A × KR196	2.04	-0.87	1.62	5.48	2.37	-2.01	-5.54*	-5.28 *	-6.06**	-2.85
13.	PMS74A × KR125	-10.05 **	-11.45 **	-6.32	-2.76	-5.63	-9.47 **	-9.97**	-9.72 **	-10.47**	-7.41**
14.	PMS74A × C43	-3.48	-4.87	0.41	4.23	1.15	-9.57 **	-9.70**	-9.44 **	-10.19**	-7.12**
15.	PMS74A × 9825REC	7.01 *	3.28	5.87	9.90*	6.65	-5.55 **	-8.03**	-7.78 **	-8.54**	-5.41*
16.	PMS74A × ICSR196	-6.24 *	-7.97 *	-2.05	1.68	-1.32	-4.92 *	-6.37**	-6.11 **	-6.89**	-3.70
17.	PMS71A × I26	-4.48	-6.87	-2.71	0.99	-1.99	-6.17 **	-8.91**	-9.17 **	-9.92**	-6.84**
18.	PMS71A × AKR456	-13.33 **	-13.60 **	-9.19*	-5.73	-8.51*	-10.03 **	-10.03**	-10.28 **	-11.02**	-7.98**
19.	PMS71A × KR191	-0.74	-1.94	4.98	8.97*	5.76	-7.43 **	-8.08**	-8.33 **	-9.09**	-5.98*
20.	PMS71A × KR196	-1.32	-5.01	-0.77	3.00	-0.03	-3.17	-6.41**	-6.67 **	-7.44**	-4.27
21.	PMS71A × KR125	-1.83	-2.44	3.20	7.13	3.96	-6.70 **	-6.96**	-7.22 **	-7.99**	-4.84*
22.	PMS71A × C43	-2.75	-3.26	2.12	6.00	2.87	-7.37 **	-7.50**	-7.50 **	-8.26**	-5.13*
23.	PMS71A × 9825REC	2.44	-2.03	2.35	6.24	3.10	-3.00	-5.29*	-5.56 *	-6.34**	-3.13

24.	PMS71A × ICSR196	-4.62	-5.50	0.58	4.40	1.32	-6.91 **	-8.08**	-8.33 **	-9.09**	-5.98*
25.	PMS98A × I26	-0.13	-0.45	-1.20	2.55	-0.47	-1.89	-3.70	-6.11 **	-6.89**	-3.70
26.	PMS98A × AKR456	-0.72	-3.80	1.12	4.96	1.86	-4.51 *	-5.57*	-5.83 *	-6.61**	-3.42
27.	PMS98A × KR191	3.12	-0.95	6.04	10.07**	6.82	-0.43	-0.85	-2.50	-3.31	0.00
28.	PMS98A × KR196	3.00	1.98	0.56	4.38	1.30	-2.92	-5.13*	-7.50 **	-8.26**	-5.13*
29.	PMS98A × KR125	-3.88	-7.15 *	-1.77	1.96	-1.05	-7.06 **	-7.84**	-8.61 **	-9.37**	-6.27**
30.	PMS98A × C43	-0.23	-3.51	1.84	5.72	2.60	-2.95	-4.17	-4.17	-4.96*	-1.71
31.	PMS98A × 9825REC	4.36	2.65	1.21	5.06	1.96	-5.63 **	-6.84**	-9.17 **	-9.92**	-6.84**
32.	PMS98A × ICSR196	-4.45	-7.97 *	-2.05	1.68	-1.32	-7.28 **	-7.41**	-9.72 **	-10.47**	-7.41**
33.	ICSA101 × I26	1.12	-2.00	3.67	7.61*	4.44	-2.16	-4.51	-5.83 *	-6.61**	-3.42
34.	ICSA101 × AKR456	-4.65	-4.95	0.55	4.37	1.29	-5.88 **	-6.41**	-6.67 **	-7.44**	-4.27
35.	ICSA101 × KR191	-1.86	-2.44	4.44	8.41*	5.21	-7.19 **	-7.32**	-8.61 **	-9.37**	-6.27**
36.	ICSA101 × KR196	9.81 **	5.07	11.16**	15.38**	11.98**	-2.90	-5.63*	-6.94 **	-7.71**	-4.56
37.	ICSA101 × KR125	-14.15 **	-14.15 *	-9.19*	-5.73	-8.51*	-9.27 **	-9.52**	-10.28 **	-11.02**	-7.98**
38.	ICSA101 × C43	-6.90 *	-7.01 **	-1.62	2.12	-0.90	-5.45 **	-6.11**	-6.11 **	-6.89**	-3.70
39.	ICSA101 × 9825REC	-1.96	-6.80	-1.40	2.35	-0.67	1.58	-0.28	-1.67	-2.48	0.85
40.	ICSA101 × ICSR196	-3.16	-3.45	2.76	6.67	3.52	-5.53 **	-6.20**	-7.50 **	-8.26**	-5.13*
41.	PMS42A × I26	4.72	2.42	6.32	10.36**	7.10	-3.04	-5.10*	-6.94 **	-7.71**	-4.56
42.	PMS42A × AKR456	1.78	1.15	6.32	10.36**	7.10	-7.58 **	-8.36**	-8.61 **	-9.37**	-6.27**
43.	PMS42A × KR191	-7.51 *	-8.92 *	-2.49	1.22	-1.77	-7.78 **	-7.91**	-9.44 **	-10.19**	-7.12**
44.	PMS42A × KR196	1.61	-1.89	1.84	5.72	2.60	-4.36 *	-6.80**	-8.61 **	-9.37**	-6.27**
45.	PMS42A × KR125	-10.45 *	-11.29 **	-6.15	-2.59	-5.46	-6.76 **	-7.28**	-8.06 **	-8.82**	-5.70*
46.	PMS42A × C43	-5.19	-5.97	-0.75	3.03	-0.01	-6.03 **	-6.94**	-6.94 **	-7.71**	-4.56
47.	PMS42A × 9825REC	4.08	-0.15	3.65	7.59*	4.41	-6.76 **	-8.22**	-10.00 **	-10.74**	-7.69**
48.	PMS42A × ICSR196	-1.72	-2.93	3.31	7.24	4.08	-1.28	-1.70	-3.61	-4.41	-1.14
49.	PMS232A × I26	-3.51	-6.20	-1.40	2.35	-0.67	1.43	-1.67	-1.67	-2.48	0.85
50.	PMS232A × AKR456	-6.99 *	-6.99 *	-2.23	1.48	-1.51	-5.15 *	-5.28*	-5.28 *	-6.06**	-2.85
51.	PMS232A × KR191	-0.94	-1.84	5.09	9.08*	5.86	-3.36	-4.17	-4.17	-4.96*	-1.71
52.	PMS232A × KR196	-0.33	-4.34	0.55	4.37	1.29	-0.72	-4.17	-4.17	-4.96*	-1.71
53.	PMS232A × KR125	-2.81	-3.12	2.49	6.39	3.25	-8.23 **	-8.61**	-8.61 **	-9.37**	-6.27**
54.	PMS232A × C43	-12.93 *	-13.11 **	-8.29*	-4.80	-7.61*	-9.44 **	-9.44**	-9.44 **	-10.19**	-7.12**
55.	PMS232A × 9825REC	2.23	-2.51	2.47	6.37	3.23	-1.14	-3.61	-3.61	-4.41	-1.14
56.	PMS232A × ICSR196	-4.33	-4.92	1.19	5.04	1.94	-1.13	-2.50	-2.50	-3.31	0.00

*and ** significant level at 5% and 1 % respectively

Table 2: Percent heterosis over mid parent, better parent and standard heterosis over checks

S. No.	Crosses	Plant Height (cm)					Flag Leaf Area (cm²)				
		MP	BP	SH1 (CSH25)	SH2 (SPH1641)	SH3 (CSH16)	MP	BP	SH1 (CSH25)	SH2 (SPH1641)	SH3 (CSH16)
1.	PMS28A × I26	25.22**	8.46	-2.59	-1.32	0.07	-25.78**	-38.48**	-20.55**	-15.10 **	-11.83 **
2.	PMS28A ×AKR456	18.89 **	4.10	-8.85	-7.66	-6.36	-0.26	-5.35	-10.45**	-4.31	-0.62
3.	PMS28A × KR191	41.18 **	32.95 **	-1.01	0.28	1.69	-13.38**	-13.75**	-26.11**	-21.05 **	-18.00 **
4.	PMS28A × KR196	37.43 **	21.39 **	4.15	5.51	6.99	7.84*	6.32	-7.07	-0.70	3.13
5.	PMS28A × KR125	17.68 **	-0.20	-5.71	-4.48	-3.14	12.96**	5.03	3.79	10.91 **	15.18 **
6.	PMS28A × C43	27.27 **	11.37 *	-2.35	-1.07	0.32	-29.37**	-33.76**	-35.75**	-31.35 **	-28.70 **
7.	PMS28A × 9825REC	29.03 **	8.77	4.29	5.65	7.14	-14.94**	-24.03**	-35.47**	-31.04 **	-28.39 **
8.	PMS28A × ICSR196	25.39 **	8.47	-2.29	-1.01	0.38	-8.53*	-11.07*	-20.02**	-14.53 **	-11.24 *
9.	PMS74A × I26	2.19	-0.18	-5.98	-4.75	-3.41	-35.55**	-46.51**	-30.91**	-26.17 **	-23.33 **
10.	PMS74A × AKR456	27.83 **	23.33 **	16.16**	17.68 **	19.33**	34.40**	27.74**	20.86**	29.15 **	34.13 **
11.	PMS74A × KR191	11.41 *	-0.26	-6.06	-4.83	-3.49	-33.78**	-33.94**	-43.41**	-39.53 **	-37.20 **
12.	PMS74A × KR196	8.32	3.50	-2.52	-1.24	0.14	-26.70**	-27.61**	-36.72**	-32.38 **	-29.78 **
13.	PMS74A × KR125	17.88 **	17.69 **	11.20*	12.65 *	14.24**	24.13**	15.60**	14.23**	22.07 **	26.77 **
14.	PMS74A × C43	24.21 **	19.92 **	12.95**	14.42 **	16.03**	-27.54**	-31.93**	-33.98**	-29.45 **	-26.73 **
15.	PMS74A × 9825REC	7.04	6.09	1.72	3.05	4.50	-46.27**	-52.09**	-59.16**	-56.36 **	-54.68 **
16.	PMS74A × ICSR196	19.78 **	17.16 **	10.35*	11.80 *	13.37**	-14.22**	-16.46**	-24.86**	-19.71 **	-16.61 **
17.	PMS71A × I26	13.43 **	9.97	-1.24	0.05	1.46	-26.14**	-38.03**	-19.97**	-14.48 **	-11.18 *
18.	PMS71A × AKR456	33.36 **	30.90 **	14.61**	16.11 **	17.74**	36.08**	30.99**	23.94**	32.44 **	37.55 **
19.	PMS71A × KR191	22.71 **	15.53 **	-2.58	-1.31	0.08	-11.53**	-12.49**	-23.38**	-18.13 **	-14.97 **
20.	PMS71A × KR196	-3.38	-4.21	-17.82**	-16.74 **	-15.57**	3.00	2.92	-9.90*	-3.72	-0.01
21.	PMS71A × KR125	11.44 *	5.45	-0.37	0.93	2.35	-2.24	-7.82*	-8.91*	-2.66	1.09
22.	PMS71A × C43	28.26 **	25.80 **	10.31*	11.75 *	13.32**	2.38	-2.61	-5.54	0.94	4.83
23.	PMS71A × 9825REC	5.41	-0.94	-5.02	-3.77	-2.42	-2.93	-14.45**	-25.10**	-19.96 **	-16.88 **
24.	PMS71A × ICSR196	-0.67	-3.84	-13.38**	-12.25 *	-11.02*	-13.30**	-14.45**	-23.06**	-17.79 **	-14.62 **
25.	PMS98A × I26	22.86 **	19.07 **	6.94	8.34	9.86*	3.65	-30.07**	-9.68*	-3.48	0.24
26.	PMS98A × AKR456	6.63	4.63	-8.40	-7.20	-5.89	10.07*	-18.72**	-23.09**	-17.81 **	-14.65 **
27.	PMS98A × KR191	35.46 **	27.57 **	7.50	8.91	10.44*	21.73**	-7.07	-20.40**	-14.94 **	-11.66 **
28.	PMS98A × KR196	10.46 *	9.48	-6.07	-4.84	-3.51	3.09	-21.84**	-31.68**	-27.00 **	-24.19 **
29.	PMS98A × KR125	22.48 **	15.86 **	9.47	10.90 *	12.46*	-5.20	-30.96**	-31.77**	-27.09 **	-24.28 **

30.	PMS98A × C43	7.34	5.25	-7.72	-6.51	-5.19	17.69**	-13.78	-16.38**	-10.64 *	-7.20
31.	PMS98A × 9825REC	23.83 **	16.33 **	11.54*	13.00 **	14.59**	75.68**	47.20**	-1.70	5.04	9.09 *
32.	PMS98A × ICSR196	24.33 **	20.32 **	8.38	9.80 *	11.34*	-4.05	-27.95**	-35.20**	-30.76 **	-28.09 **
33.	ICSA101 × I26	20.48 **	19.05 **	9.52	10.96 *	12.52*	-42.49**	-51.44**	-37.28**	-32.98 **	-30.39 **
34.	ICSA101 × AKR456	10.32 *	7.66	-0.96	0.34	1.75	9.02*	5.77	0.08	6.94	11.06 *
35.	ICSA101 × KR191	18.70 **	7.39	-1.21	0.08	1.9	-14.18**	-15.78**	-25.06**	-19.92 **	-16.84 **
36.	ICSA101 × KR196	15.80 **	11.89 *	2.94	4.28	5.75	-19.82**	-20.53**	-29.28**	-24.43 **	-21.52 **
37.	ICSA101 × KR125	28.03 **	26.34 **	19.37**	20.93 **	22.63**	36.96**	30.14**	28.60**	37.42 **	42.72 **
38.	ICSA101 × C43	6.42	3.92	-4.40	-3.15	-1.78	-32.96**	-35.73**	-37.67**	-33.39 **	-30.83 **
39.	ICSA101 × 9825REC	15.33 **	12.99 *	8.34	9.76 *	11.30*	-19.44**	-29.49**	-37.26**	-32.95 **	-30.37 **
40.	ICSA101 × ICSR196	14.53 **	13.33 *	4.26	5.62	7.11	-21.20**	-21.62**	-29.51**	-24.67 **	-21.77 **
41.	PMS42A × I26	9.20	5.55	-5.20	-3.96	-2.61	-35.18**	-45.24**	-29.28**	-24.43 **	-21.51 **
42.	PMS42A × AKR456	10.39 *	8.03	-5.41	-4.17	-2.83	0.78	-2.18	-7.45	-1.10	2.71
43.	PMS42A × KR191	28.73 **	21.54 **	1.87	3.20	4.65	20.85**	18.54**	5.57	12.81 **	17.16 **
44.	PMS42A × KR196	10.89 *	9.61	-5.96	-4.73	-3.39	-18.94**	-19.70**	-28.48**	-23.58 **	-20.63 **
45.	PMS42A × KR125	26.60 **	19.45 **	12.86**	14.34 **	15.95**	13.72**	8.11*	6.83	14.15 **	18.55 **
46.	PMS42A × C43	13.12 **	10.62	-3.00	-1.74	-0.35	15.29**	10.58**	7.25	14.61 **	19.02 **
47.	PMS42A × 9825REC	-5.68	-11.61 *	-15.25**	-14.14 **	-12.94*	6.69	-6.66	-16.87**	-11.17 **	-7.74
48.	PMS42A × ICSR196	26.61 **	22.21 **	10.08*	11.52 *	13.09**	-15.71**	-16.12**	-24.56**	-19.38 **	-16.28 **
49.	PMS232A × I26	12.80 **	7.22	6.86	8.26	9.78	-27.72**	-37.84**	-19.71**	-14.21 **	-10.90 *
50.	PMS232A × AKR456	18.33 **	11.14 *	10.76*	12.21 *	13.79**	8.09*	7.16	1.39	8.34 *	12.52 **
51.	PMS232A × KR191	12.27 *	-1.92	-2.25	-0.97	0.42	2.11	-1.92	-8.79*	-2.54	1.22
52.	PMS232A × KR196	6.57	-0.85	-1.18	0.11	1.52	-25.80**	-28.03**	-33.07**	-28.48 **	-25.72 **
53.	PMS232A × KR125	12.95 **	10.02 *	9.65*	11.08 *	12.64*	-26.12**	-28.30**	-29.15**	-24.29 **	-21.37 **
54.	PMS232A × C43	20.96 **	13.69 **	13.31**	14.79 **	16.40**	21.90**	19.39**	15.79**	23.73 **	28.50 **
55.	PMS232A × 9825REC	6.47	4.45	4.10	5.47	6.95	-2.77	-16.47**	-22.33**	-17.00 **	-13.80 **
56.	PMS232A × ICSR196	2.66	-2.28	-2.61	-1.34	0.05	-2.56	-4.16	-10.88**	-4.77	-1.10

*and ** significant level at 5% and 1 % respectively

Table 3: Percent heterosis over mid parent, better parent and standard heterosis over checks

S. No.	Crosses	Grain Yield (g)					Fodder Yield per plant (g)				
		MP	BP	SH1 (CSH25)	SH2 (SPH1641)	SH3 (CSH16)	MP	BP	SH1 (CSH25)	SH2 (SPH1641)	SH3 (CSH16)
1.	PMS28A × I26	3.77	0.39	3.59	-4.81	5.54	-21.99**	-22.87 **	-27.62 **	-30.68 **	-27.46 **
2.	PMS28A × AKR456	5.15	0.58	6.27	-2.34	8.27	-15.74**	-21.84 **	-16.16 **	-19.71 **	-15.98 **
3.	PMS28A × KR191	-2.56	-3.91	-4.65	-12.38*	-2.85	-11.55**	-16.97 **	-13.19 **	-16.86 **	-13.00 *
4.	PMS28A × KR196	-7.99	-9.04	-12.24*	-19.36**	-10.59 *	1.99	-2.06	-2.40 **	-6.53	-2.19
5.	PMS28A × KR125	10.61 *	7.49	9.90	0.99	11.97 *	14.21**	6.10	13.43 **	8.63	13.68 **
6.	PMS28A × C43	3.04	2.64	-0.20	-8.30	1.67	-13.60**	-19.70 **	-14.23 **	-17.86 **	-14.04 **
7.	PMS28A × 9825REC	-42.80 **	-46.71**	-48.59 **	-52.76**	-47.62 **	-7.57	-11.63 *	-18.94 **	-22.37 **	-18.76 **
8.	PMS28A × ICSR196	-15.87 **	-25.75**	-28.37 **	-34.18**	-27.02 **	-34.33**	-38.92 **	-34.86 **	-37.62 **	-34.72 **
9.	PMS74A × I26	1.77	0.79	6.06	-2.54	8.06	-16.13**	-23.10 **	-13.46 **	-17.12 **	-13.27 **
10.	PMS74A × AKR456	19.74 **	19.49**	26.26 **	16.02**	28.63 **	15.78**	13.07 **	27.24 **	21.85 **	27.52 **
11.	PMS74A × KR191	1.14	-1.74	3.40	-4.98	5.35	-13.75**	-16.81 **	-6.37	-10.34 *	-6.17
12.	PMS74A × KR196	-36.19 **	-39.51**	-36.34 **	-41.50**	-35.14 **	-23.97**	-28.32 **	-19.33 **	-22.75 **	-19.16 **
13.	PMS74A × KR125	17.47 **	15.80**	21.86 **	11.98*	24.15 **	14.28**	11.42 *	25.39 **	20.08 **	25.66 **
14.	PMS74A × C43	-18.82 **	-21.91**	-17.82 **	-24.49**	-16.28 **	1.66	-0.93	11.49 *	6.77	11.74 *
15.	PMS74A × 9825REC	-18.18 **	-26.71**	-22.87 **	-29.13**	-21.42 **	-14.92**	-25.83 **	-16.53 **	-20.07 **	-16.35 **
16.	PMS74A × ICSR196	-45.13 **	-53.32**	-50.88 **	-54.86**	-49.95 **	-28.58**	-30.45 **	-21.74 **	-25.05 **	-21.56 **
17.	PMS71A × I26	13.85 **	10.21*	21.49 **	11.64*	23.77 **	14.07**	3.52	19.20 **	14.15 **	19.46 **
18.	PMS71A × AKR456	18.02 **	15.57**	27.39 **	17.07**	29.79 **	14.88**	10.95 *	27.75 **	22.34 **	28.03 **
19.	PMS71A × KR191	-30.69 **	-34.15**	-27.41 **	-33.30**	-26.05 **	-11.85**	-15.90 **	-3.16	-7.26	-2.95
20.	PMS71A × KR196	-0.46	-7.66	1.79	-6.47	3.70	5.13	-1.95	12.91 *	8.13	13.16 **
21.	PMS71A × KR125	-19.92 **	-22.82**	-14.93 **	-21.83**	-13.33 *	-25.95**	-28.60 **	-17.78 **	-21.27 **	-17.60 **
22.	PMS71A × C43	-24.74 **	-29.18**	-21.94 **	-28.27**	-20.47 **	-33.20**	-35.62 **	-25.86 **	-29.00 **	-25.70 **
23.	PMS71A × 9825REC	10.16 *	-3.30	6.59	-2.05	8.60	-16.27**	-27.71 **	-16.76 **	-20.29 **	-16.58 **
24.	PMS71A × ICSR196	-11.70 *	-26.29**	-18.75 **	-25.34**	-17.22 **	-18.77**	-21.77 **	-9.92 *	-13.73 **	-9.72
25.	PMS98A × I26	-39.01 **	-41.12**	-39.24 **	-44.17**	-38.10 **	-21.55**	-22.26 **	-27.05 **	-30.14 **	-26.89 **
26.	PMS98A × AKR456	1.34	-3.27	2.20	-6.08	4.13	-17.91**	-23.69 **	-18.15 **	-21.62 **	-17.97 **
27.	PMS98A × KR191	6.47	4.76	3.96	-4.47	5.92	-9.04*	-14.44 **	-10.55 *	-14.33 **	-10.35 *
28.	PMS98A × KR196	-49.51 **	-49.97**	-51.95 **	-55.84**	-51.04 **	-14.88**	-18.08 **	-18.37 **	-21.83 **	-18.19 **
29.	PMS98A × KR125	-29.52 **	-31.65**	-30.12 **	-35.79**	-28.81 **	-18.02**	-23.68 **	-18.41 **	-21.87 **	-18.23 **
30.	PMS98A × C43	6.40	5.76	2.83	-5.51	4.76	-14.33**	-20.21 **	-14.78 **	-18.39 **	-14.59 **
31.	PMS98A × 9825REC	-5.95	-12.19*	-15.67 **	-22.50**	-14.08 **	-1.49	-6.02	-13.41 **	-17.08 **	-13.22 **
32.	PMS98A × ICSR196	-38.80 **	-45.89**	-48.03 **	-52.24**	-47.05 **	-14.25**	-20.08 **	-14.77 **	-18.38 **	-14.58 **
33.	ICSA101 × I26	1.14	0.73	4.78	-3.72	6.75	-13.25**	-20.66 **	-10.22 *	-14.02 **	-10.02 *
34.	ICSA101 × AKR456	-5.24	-5.98	-0.66	-8.71	1.21	-20.33**	-22.41 **	-12.20 *	-15.92 **	-12.00 *
35.	ICSA101 × KR191	-27.80 **	-29.46**	-26.63 **	-32.58**	-25.25 **	-25.15**	-27.99 **	-18.51 **	-21.96 **	-18.33 **

36.	ICSA101 × KR196	8.53	3.45	7.61	-1.12	9.63	-17.46**	-22.39 **	-12.17 *	-15.89 **	-11.97 *
37.	ICSA101 × KR125	24.00 **	22.94**	27.87 **	17.51**	30.28 **	17.03**	13.79 **	28.77 **	23.32 **	29.05 **
38.	ICSA101 × C43	-26.10 **	-28.51**	-25.64 **	-31.66**	-24.24 **	-31.51**	-33.44 **	-24.68 **	-27.87 **	-24.51 **
39.	ICSA101 × 9825REC	-21.51 **	-29.33**	-26.49 **	-32.45**	-25.10 **	-14.30**	-25.47 **	-15.66 **	-19.23 **	-15.47 **
40.	ICSA101 × ICSR196	-23.54 **	-34.64**	-32.02 **	-37.53**	-30.74 **	-30.34**	-32.35 **	-23.44 **	-26.68 **	-23.27 **
41.	PMS42A × I26	-9.05 *	-10.94*	-8.10	-15.55**	-6.37	-4.56	-5.79	-9.25	-13.09 **	-9.05
42.	PMS42A × AKR456	-55.66 **	-57.08**	-54.65 **	-58.32**	-53.79 **	-20.43**	-24.48 **	-19.00 **	-22.43 **	-18.82 **
43.	PMS42A × KR191	14.18 **	13.99**	13.12 *	3.94	15.25 **	18.25**	13.60 **	18.77 **	13.74 **	19.04 **
44.	PMS42A × KR196	-5.57	-7.77	-8.79	-16.18**	-7.07	-7.73	-9.26	-9.58	-13.41 **	-9.38
45.	PMS42A × KR125	19.40 **	17.45**	20.08 **	10.35*	22.34 **	23.58**	17.47 **	25.58 **	20.26 **	25.85 **
46.	PMS42A × C43	-33.43 **	-33.99**	-34.72 **	-40.01**	-33.49 **	-21.96**	-25.79 **	-20.73 **	-24.09 **	-20.56 **
47.	PMS42A × 9825REC	-6.09	-13.50*	-14.45 **	-21.38**	-12.84 *	-1.54	-8.01	-11.39 *	-15.14 **	-11.19 *
48.	PMS42A × ICSR196	-13.26 *	-24.27**	-25.10 **	-31.17**	-23.69 **	-22.21**	-25.97 **	-21.05 *	-24.39 **	-20.88 **
49.	PMS232A × I26	2.54	1.67	4.91	-3.59	6.89	2.62	0.01	-1.12	-5.31	-0.90
50.	PMS232A × AKR456	3.28	1.21	6.94	-1.73	8.95	5.36	1.24	8.59	3.99	8.83
51.	PMS232A × KR191	-50.85 **	-51.38**	-50.68 **	-54.68**	-49.76 **	-1.68	-4.36	0.00	-4.24	0.22
52.	PMS232A × KR196	-20.20 **	-23.01**	-21.91 **	-28.24**	-20.44 **	-20.84**	-21.15 **	-21.43 **	-24.76 **	-21.25 **
53.	PMS232A × KR125	1.20	0.80	3.06	-5.30	5.00	-7.24	-10.73 *	-4.56	-8.61	-4.35
54.	PMS232A × C43	26.48 **	23.86**	25.64 **	15.45**	28.00 **	23.47**	18.88 **	26.97 **	21.59 **	27.25 **
55.	PMS232A × 9825REC	-19.21 **	-26.43**	-25.38 **	-31.43**	-23.97 **	-13.33**	-19.99 **	-20.89 **	-24.25 **	-20.72 **
56.	PMS232A × ICSR196	-36.17 **	-44.86**	-44.07 **	-48.61**	-43.02 **	-11.22**	-14.45 **	-8.77	-12.63 **	-8.57

*and ** significant level at 5% and 1 % respectively

Table 4: Percent heterosis over mid parent, better parent and standard heterosis over checks

S. No.	Crosses	Test Weight (g)					Harvest Index (%)				
		MP	BP	SH1 (CSH25)	SH2 (SPH1641)	SH3 (CSH16)	MP	BP	SH1 (CSH25)	SH2 (SPH1641)	SH3 (CSH16)
1.	PMS28A × I26	14.00 **	6.26	2.18	9.77 *	3.50	-0.38	-1.98	-1.20	6.50	3.42
2.	PMS28A × AKR456	1.19	0.79	-2.30	4.95	-1.04	-3.94	-10.09	3.93	12.04	8.79
3.	PMS28A × KR191	-1.65	-5.95	-0.90	6.46	0.39	8.19	5.30	6.13	14.41	11.10
4.	PMS28A × KR196	8.52	-2.53	-6.27	0.69	-5.06	-7.89	-10.12	-4.79	2.63	-0.34
5.	PMS28A × KR125	-1.69	-4.06	-3.07	4.13	-1.82	-11.92 *	-18.66**	-3.21	4.33	1.31
6.	PMS28A × C43	-5.71	-6.99	-8.07	-1.24	-6.87	-11.45	-16.86**	-4.54	2.91	-0.07
7.	PMS28A × 9825REC	-10.92 **	-11.45*	-13.83 **	-7.43	-12.71**	-7.71	-9.48	-5.12	2.28	-0.68
8.	PMS28A × ICSR196	6.46	2.00	-1.92	5.36	-0.65	9.41	7.81	11.94	20.67**	17.18*
9.	PMS74A × I26	11.96 **	5.14	-0.51	6.88	0.78	13.28 *	6.07	18.57 *	27.82**	24.12**
10.	PMS74A × AKR456	23.13 **	21.66**	17.93 **	26.69 **	19.46**	14.37 *	12.49*	30.03 **	40.17**	36.12**
11.	PMS74A × KR191	4.61	-0.73	4.61	12.38 **	5.97	13.11 *	4.83	17.18 *	26.32**	22.66**
12.	PMS74A × KR196	14.58 **	3.65	-1.92	5.36	-0.65	8.09	5.26	17.66 *	26.84**	23.17**
13.	PMS74A × KR125	17.80 **	14.07**	15.24 **	23.80 **	16.73**	6.37	3.15	22.73 **	32.30**	28.47**
14.	PMS74A × C43	-0.99	-3.11	-4.23	2.89	-2.98	12.72 *	11.22	27.71 **	37.67**	33.69**
15.	PMS74A × 9825REC	-0.20	-1.58	-4.23	2.89	-2.98	-4.84	-7.81	3.06	11.09	7.88
16.	PMS74A × ICSR196	-1.89	-5.28	-10.37 *	-3.71	-9.21*	10.37	6.44	18.99 **	28.26**	24.55**
17.	PMS71A × I26	23.82 **	16.80**	9.48 *	17.61 **	10.89*	24.64 **	18.52**	28.23 **	38.23**	34.23**
18.	PMS71A × AKR456	24.92 **	22.85**	19.08 **	27.92 **	20.62**	4.61	1.26	17.06 *	26.19**	22.54**
19.	PMS71A × KR191	-7.27	-12.39**	-7.68	-0.83	-6.49	34.53 **	26.58**	36.96 **	47.64**	43.36**
20.	PMS71A × KR196	6.62	-3.14	-9.22 *	-2.48	-8.04	-3.93	-4.94	2.85	10.87	7.66
21.	PMS71A × KR125	-0.07	-3.68	-2.69	4.54	-1.43	-1.23	-5.70	12.20	20.95**	17.45*
22.	PMS71A × C43	1.46	-1.17	-2.30	4.95	-1.04	-6.63	-9.32	4.12	12.24	8.99
23.	PMS71A × 9825REC	-1.47	-3.29	-5.89	1.10	-4.67	-18.24 **	-19.52**	-12.92	-6.13	-8.85
24.	PMS71A × ICSR196	0.28	-2.73	-8.83 *	-2.06	-7.65	-4.88	-6.80	0.84	8.71	5.56
25.	PMS98A × I26	-10.79 **	-24.16**	-9.99 *	-3.30	-8.82*	-10.47	-12.33	-14.47 *	-7.80	-10.47
26.	PMS98A × AKR456	-11.64 **	-19.74**	-4.74	2.34	-3.50	13.61 *	2.75	18.78 *	28.04**	24.33**
27.	PMS98A × KR191	-14.97 **	-19.74**	-4.74	2.34	-3.50	22.20 **	20.98**	15.43 *	24.43**	20.83**
28.	PMS98A × KR196	-5.84	-22.55**	-8.07	-1.24	-6.87	-17.26 **	-22.11**	-17.49 *	-11.06	-13.63
29.	PMS98A × KR125	-19.81 **	-25.78**	-11.91 **	-5.36	-10.77*	-7.45	-17.36**	-1.67	6.00	2.93
30.	PMS98A × C43	-10.89 **	-18.34**	-3.07	4.13	-1.82	-16.59 **	-24.33**	-13.11	-6.33	-9.05
31.	PMS98A × 9825REC	-17.72 **	-25.13**	-11.14	-4.54	-9.99*	-24.26 **	-28.34**	-24.90 **	-19.04*	-21.38**
32.	PMS98A × ICSR196	-14.80 **	-25.78**	-11.91 **	-5.36	-10.77*	18.50 **	12.61	16.92 *	26.04**	22.39**
33.	ICSA101 × I26	-5.32	-12.24**	-14.60 **	-8.25	-13.49**	-9.06	-17.40**	-1.31	6.39	3.31
34.	ICSA101 × AKR456	-1.91	-2.11	-4.74	2.34	-3.50	-3.98	-5.54	12.87	21.67**	18.15*
35.	ICSA101 × KR191	-5.50	-9.11*	-4.23	2.89	-2.98	14.18 *	2.67	22.68 **	32.25**	28.42**
36.	ICSA101 × KR196	14.43 **	2.24	-0.51	6.88	0.78	-19.69 **	-24.25**	-9.48	-2.43	-5.25
37.	ICSA101 × KR125	22.01 **	19.77**	21.00 **	29.99 **	22.57**	15.08 **	14.84*	37.22 **	47.92**	43.63**
38.	ICSA101 × C43	-7.05	-7.77	-8.83 *	-2.06	-7.65	-2.56	-4.46	14.16	23.06**	19.50*
39.	ICSA101 × 9825REC	2.24	2.24	-0.51	6.88	0.78	-8.20	-13.83*	2.96	10.98	7.77
40.	ICSA101 × ICSR196	-0.14	-4.87	-7.43	-0.55	-6.23	-7.52	-13.57*	3.26	11.32	8.09
41.	PMS42A × I26	13.31 **	8.96	-1.92	5.36	-0.65	2.90	0.35	3.01	11.04	7.82

42.	PMS42A × AKR456	-2.05	-5.55	-8.45	-1.65	-7.26	7.76	1.72	17.59 *	26.76**	23.09**
43.	PMS42A × KR191	4.98	-2.67	2.56	10.18 *	3.89	26.94 **	22.46**	25.70 **	35.51**	31.58**
44.	PMS42A × KR196	5.76	-2.13	-11.91 **	-5.36	-10.77*	1.39	-0.18	5.74	13.98	10.68
45.	PMS42A × KR125	6.17	0.38	1.41	8.94	2.72	4.18	-2.97	15.45 *	24.45**	20.85**
46.	PMS42A × C43	-0.75	-5.18	-6.27	0.69	-5.06	-3.14	-8.27	5.33	13.54	10.25
47.	PMS42A × 9825REC	-1.85	-5.53	-8.07	-1.24	-6.87	-8.78	-9.72	-5.38	2.00	-0.95
48.	PMS42A × ICSR196	-10.28 *	-11.24*	-20.10 **	-14.17 **	-19.07**	1.91	1.32	5.21	13.41	10.13
49.	PMS232A × I26	11.09	4.93	-1.92	5.36	-0.65	7.70	4.78	8.09	16.52*	13.15
50.	PMS232A × AKR456	7.73	5.81	2.56	10.18 *	3.89	-4.10	-9.26	4.90	13.08	9.80
51.	PMS232A × KR191	-9.47 *	-14.58**	-9.99 *	-3.30	-8.82*	0.13	-3.63	-0.58	7.17	4.06
52.	PMS232A × KR196	8.13	-1.64	-8.07	-1.24	-6.87	8.01	6.60	12.92	21.73**	18.20*
53.	PMS232A × KR125	4.28	0.38	1.41	8.94	2.72	1.57	-5.18	12.82	21.62**	18.09*
54.	PMS232A × C43	20.64 **	17.36**	16.01 **	24.62 **	17.51**	15.24 **	9.38	25.60 **	35.40**	31.47**
55.	PMS232A × 9825REC	-3.62	-5.53	-8.07	-1.24	-6.87	6.16	5.33	10.40	19.00*	15.56*
56.	PMS232A × ICSR196	5.92	2.88	-3.84	3.30	-2.59	-6.17	-6.47	-2.89	4.69	1.65

*and ** significant level at 5% and 1 % respectively

Summery and Conclusion

In general, crosses (hybrids) were early in maturity and high yielding compared to the parents, which is desirable and may be exploited for development of high yielding hybrids. The parent ICSA101, KR125, PMS71A, AKR456, PMS74A, PMS232A and C43 recorded early flowering and early maturity along with significantly higher Plant height (cm), Flag leaf area (cm²), Grain yield (gm), Fodder yield per plant (gm) and harvest index. Amongst the hybrids ICSA101 × KR125, PMS71A × AKR456, PMS74A × AKR456 and PMS232A × C43 exhibited significant earliest flowering and early maturity along with significantly higher Plant height (cm), Flag leaf area (cm²), Grain yield (gm), Fodder yield per plant (gm) and harvest index.

Out of fifty six crosses, ICSA101 × KR125 (47.97 gm) and PMS71A × AKR456 (47.79 gm) exhibited significant highest grain yield followed by cross PMS74A × AKR456 (47.36 gm) and PMS232A × C43 (46.13 gm). Similar is the trend in yield contributing characters.

Crosses ICSA101 × KR125 (30.28), PMS71A × AKR456 (29.79), PMS74A × AKR456 (28.63), PMS232A × C43 (28.00) and PMS74A × KR125 (24.15) recorded significantly higher heterosis over standard checks for grain yield per plant.

References

1. Anonymous. Economic survey 2014-15. Directorate of Economics and Statistics. Department of Agriculture and Cooperation, Government of India, 2014.
2. Anonymous. Economic survey of Maharashtra 2015-16. Directorate of Economics and Statistics. Planning Department, Government of Maharashtra, 2015.
3. Chalawadi J. Heterosis and combining ability for grain yield and downey mildew resistance in *kharif* sorghum (*Sorghum bicolor* (L.) Moench). M.Sc. (Agri.) thesis (unpub.) UAS, Dharwad (Karnatka), 2007.
4. Chaudhary SB, Narkhede BN. Line × tester analysis in rabi sorghum hybrids. Journal of Soils and crops. 2004; 14(1):209-210.
5. Fonseca S, Patterson P. Hybrid vigor in a seven parent diallel crosses in common winter wheat. Crop Science, 1968; 8:85-88.
6. Kempthrone O. An introduction to genetic statistics. John Wiley, 1957.
7. Premalatha N, Kumaravadivel N, Veerabadhiran P. Heterosis and combining ability for grain yield and its components in sorghum [*Sorghum bicolor* (L.) Moench]. Indian Journal of Genetics. 2006; 66(2):123-126.
8. Swarnalata K, Rafiq KS, Singh K. Heterobeltiosis and combining ability for grain yield components in post rainy season sorghum. International Sorghum and Millets News Letter. 2003; 44:21-23.
9. Umakanth AV, Madhusudan R, Latha KM, Swarnalata K, Rana BS. Heterosis studies for yield and its component in rabi sorghum (*Sorghum bicolor* (L.) Moench). Indian Journal of Genetetics. 2003; 63(2):159-161.
10. Vavilov NI. The origin, variation, immunity and breeding of cultivated, 1935.