RESEARCH ARTICLE

Heterosis Studies for Oil Content, Yield and Yield Contributing Characters in Hybrids of Sunflower

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ABSTRACT

The prevailing investigation was undertaken with the goals to study the heterosis for oil content, seed yield and its components traits in sunflower. Six female lines were crossed with 4 male lines in order to obtain 24 F1s. The crosses and parents with checks, have been evaluated in a Randomized Block design with two replications, at experimental farm at Oilseeds research station, Latur. Data had been recorded on ten characters. An extensive range of heterosis for all the characters was determined in two hybrids viz., CMS-108A x EC-198075 and CMS-108A x EC-601957, exhibited significant negative heterosis for early flowering and days to maturity over each check LSFH-35 and LSFH-171.The hybrids viz., CMS-207A x IB-22 and CMS-207A x EC-178178 recorded excessive significant heterosis in desirable direction over each standard check LSFH-35 and LSFH-171for yield and yield components

Keywords: Heterosis, Standard heterosis, Hybrid, Check, Line x tester, Sunflower.

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INTRODUCTION

The sunflower, or Helianthus annuus L. 2n=34, is a substantial oilseed crop that is a member of the 'Asteraceae' (comositae) genus and family. It is also referred to as 'Surajmukhi' in Hindi and 'Suryaphul' in Marathi. It is indigenous to Mexico and the Southern United States. It has just been three decades since sunflower became significant as an oilseed crop in India. But its contribution to the country's "yellow revolution" and achieving self-sufficiency in edible oil is unworthy (Mangala Rai, 2002).

Sunflower leaves often grow into whorled phyllotoxy and are opposite at the base and alternating at the top. The size, shape, amount of hair, and petiole length of leaves vary. The inflorescence is a head made up of two different kinds of flowers, called ray and disc florets. While disc florets are a fertile hermaphrodite flower with a lower ovary, ray florets are sterile and make up the outer whorl of the head. It is necessary to create new sunflower hybrids with higher seed production and oil content that are suitable for India's various agro-climatic zones given the rise in demand for edible oils. Understanding the genetic architecture of sunflower is crucial because it offers important guidance for identifying the source population and allows for the development of appropriate genotypes with desired characteristics. In a heterosis breeding programme, many hybrids are created and assessed in order to take advantage of hybrid vigour, which often calls for additional resources and labour. If there is a correlation between heterosis for yield and genetic variety, it may be possible to choose the parental lines depending on their level of genetic diversity to effect restricted crossings more successfully.

MATERIALS AND METHODAS

Four CMS lines as the female parents, six restorers as the male parents, and 24 novel hybrids were created in Rabi, 2018–19, using these parents as the experimental material for the current work. The specifics of the hybrids, checks, and parental lines that were analysed at Kharif 2019–20 During the Kharif 2019 seasons, the entire set of experimental material include 36 genotypes, total four CMS lines, six restorer lines, 24 hybrids, and two standard checks, were seeded in a Randomized Block Design with two replications. Ten features, including days to 50% flowering, days to maturity, plant height (cm), head diameter (cm), seed filling (percent), 100-seed weight (g), volume weight (g100/ml), hull content (percent), seed yield per plant (g), and oil content (percent), were recorded with data. The study was done on the Kempthorne-recommended line x tester mating design (1957). Theoretically heterosis is deviation of F1 from mid parental value but, an increase in F1 over poor parents may not be of practical importance. In addition, an increase in F1 over the standard check hybrids (standard heterosis) is of commercial importance. Hence, the standard heterosis was worked-out by using popular two standard check hybrids, LSFH- 35(Check-1) and LSFH-171(Check-2).

RESULTS AND DISCUSSION

The analysis of variance of the parents and their hybrids for the numerous qualities under study revealed extremely significant genotype differences for each of the 10 characters, showing that the parents had enough variation and diversity (Table 1). The objective of the current study's evaluation of heterosis was to identify the optimal combination of parents that provided a high degree of beneficial heterosis for seed yield and yield-contributing character for their prospects for use in breeding

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Table 1: Analysis of variance for parents and crosses for ten different characters in sunflower.

Source of variation	*d. f.*	*Days to 50 % flowering*	*Days to maturity*	*Plant height (cm)*	*Head diameter (cm)*	*Seed filling (%)*	*Hull content (%)*	*100 Seed weight (g)*	*Seed Yield / plant (g)*	*Oil content (%)*	*Volume weight (g/100 mL)*
Replication	1	6.485	16.014	8.47	2.7	5.292	0.381	0.371	0.044	0.214	29.554
Treatment	35	7.520**	21.399**	620.02**	4.553**	106.94**	37.874**	0.696**	120.136**	11.386**	46.584**
Parents	9	7.755*	39.800**	881.27**	3.486**	160.02**	33.662	0.7801**	40.051**	21.986**	11.71
CMS lines	3	8.5	30.791**	728.44**	2.219	120.44**	4.547	1.892**	58.817**	40.165**	9.087
Tester	5	6.933	49.483**	1071.23**	4.920**	160.28**	20.622	0.250**	30.053**	4.4925**	10.408
Crosses	23	7.187**	14.716*	263.68**	1.84	12.396**	32.717	0.5815**	231.27**	3.7113**	47.793**
Line x Tester	1	9.633	18.408	389.98**	0.119	277.46**	186.20**	0.0891	33.739**	54.918**	26.096
Parents v/s Crosses	1	13.078*	9.512	6464.61**	76.566**	1803.97**	194.412**	2.603**	1186.5**	92.512**	332.64**
Error	35	2.9398	6.59	22.992	1.0875	14.093	21.821	0.0392	1.9188	0.7621	7.825

** and * indicates significant at 1% and 5%, respectively.

ranged from -17.47% (CMS 108A x IB-22) to 27.57%. (CMS-250A x IB-22). Three hybrids reported the most significant negative heterosis over both the tests LSFH-35 and LSFH-171 for plant height, specifically CMS-108A x GP-6-116 (-23.67 %, -5.68 %), CMS-108A x EC- 198075 (-19.66 %, -8.73 %), and CMS-108A x IB-22 (-8.21 %, -17.47 %). Seven cross combinations over the check LSFH-35 showed a significant and desirable (positive) standard heterosis for head diameter. From -22.83 % (CMS-108A x GP-6-116) to 40.97 % was the standard heterosis range (CMS-250A x IB-22). Seven promising high heterotic hybrids outperformed check-1 in the following order: CMS 250A x IB-22 (40.97%), CMS-108A x GP-6-116 (37.00%), CMS 250A x EC-178178 (29.11%), CMS 108A x EC-601957 (28.36%), CMS-207A x GP-6-263 (27.27%), CMS-108A x EC-198075 (23.63%) (LSFH-35). In the case of check-2, the standard heterosis ranged from -30.22 % (CMS- 249 x EC-178178) to 22.41 % (CMS-207A x EC-178178). Only CMS-207A x EC-178178 (17.34 %, 22.41 %) showed positive and substantial heterosis over both checks for this trait. Shamshad *et al.* reported a similar high heterosis for sunflower head diameter (2016). For a larger seed yield, there should be more full seeds per head. Therefore, a positive significant heterosis is preferred. Over check-1, a total of three hybrids showed strong positive heterosis (LSFH-35). Standard heterosis ranged from -12.32 to 10.79 % (CMS-108A x EC-601957) (CMS-207A x GP-6-116). The three high heterotic hybrids CMS-207A x GP-6-116 (10.79%) and CMS-250A x EC-601957 were all promising (9.81 %). The standard heterosis for check-2 (LSFH-171) ranged from -16.88 % (CMS-207A x IB-22) to 9.52 % (CMS-108A x GP-6-263). The cross combination viz., CMS-108A x GP-6-263 (9.52%), CMS-250A x EC-198075 (9.43%) and CMS-207A x GP-6-116 (10.79%, 8.13%) recorded highest significant positive heterosis over the checks LSFH -171 for this trait one hybrid CMS-207 x GP-6-116 (10.79%, 8.13%) recorded significant positive heterosis over both the checks LSFH-35 and LSFH-171. Desirable positive heterosis results were in accordance with the results of Bhoite *et al* (2018) and Ingle *et al.* (2017).

The analysis of the data showed that six hybrids showed negative heterosis over check-1, with the standard heterosis for trait hull content over check-1 (LSFH-35) ranging from -9.94 % (CMS-249A x GP-6-116) to 24.42 % (CMS-108A x EC-178178) (LSFH-35) Standard heterosis over check-2(LSFH-171) ranged between -19.49 % (CMS-249A x EC-198075) and -14.01 % (CMS-108A x IB-22). For this trait, 17 cross combinations displayed negatively significant heterosis over check-2 (LSFH-171). Six crosses viz., CMS-249 x IB-22 (-5.12%, -34.58 %), CMS-249xGP-6-116 (-9.94%, -37.90%) CMS-249xEC198075 (-8.04%,-36.59%), CMS-207A x EC-198075 (-7.89%, -36.49%), CMS-250 programmes in the future. For all the characters, heterosis was calculated as the percentage of F1 over the standard check hybrid that increased or decreased (Standard heterosis). The assessment of heterosis over greater parental value has significantly less significance than normal heterosis aside from identifying gene interaction. In order to measure heterosis more accurately, it is preferable to compare it to the standard check hybrid rather than a better parent. For each character in the current investigation, the degree of heterosis varied from cross to cross. It was implied that the form of gene activity varied depending on the genetic make-up of the parents by the noticeably high heterosis in some crosses and the low heterosis in the others. Table 2 displays the results of standard heterosis for 10 distinct features.

Negative heterosis is preferred for days up to 50% flowering. Standard heterosis over check-1 (LSFH-35) ranged from -17.75 to 8.69 % (CMS-250A x EC-601957) (CMS-108A x IB-22). Significantly negative heterosis was found for this trait in twelve hybrids. Four earliest flowering hybrids were CMS-250A x EC-60195 (17.75%), CMS-207A x GP-6-263 (-15.96 %), CMS-207A x GP-6-116 (-14.13 %), CMS-108A x GP-6-116R and CMS-250A x IB-22 (-12.31 %). From -6.50 % (CMS-250A x EC-178178) to 6.50 % (CMS-108A x EC-198075), the standard heterosis over check-2 (LSFH-171) ranged. Only one hybrid (CMS-250A x EC-178178) significantly outperformed the two standard checks in terms of negative heterosis. Additionally, negative heterosis is preferred for days to maturity. In terms of days to maturity, 3 of the 24 hybrids had negative standard heterosis over check-1 (LSFH-35). The range of the CMS-250A x EC-198075-derived standard heterosis for check-1 (LSFH-35) was -6.71 to 6.7 % (CMS-108A x IB-22). For this trait, the cross combinations CMS 250A x EC 198075 (-6.71%), CMS-250A x EC 178178 (-4.88%), and CMS-207A x IB-22 (-0.61%) each showed significant and negative heterosis. The standard heterosis for check-2 (LSFH-171) ranged from -11.56 % (CMS-250 x EC-198075) to 0.00 % (CMS-207A x GP-6-116). Over both the checks LSFH-35 and LSFH-171, only one hybrid CMS- 250A x EC-198075(-4.88, -9.83 percent) registered significant negative heterosis. These findings are in agreement with those made in Sunflower by Sugoor (1992) and Rathi *et al.* (2016).

For the development of hybrids with the dwarf plant type, negative heterosis for plant height is preferred. Three of the 24 hybrids displayed a notable negative heterosis over check-1 (LSFH-35). CMS-108A x GP-6-116 (-23.67%), CMS-108A x EC-198075 (-19.66%), and CMS-108A x IB-22 (-23.67%) were three potential hybrids (-8.21). Standard heterosis over check-2(LSFH-171)

Table 2: Estimate of standard heterosis for ten characters over two checks LSFH-35 (SC-1) and LSFH-171 (SC-2) for 24 crosses of Sunflower.

S. No.	*Hybrid*	*Days to 50 % flowering*		*Days to maturity*		*Plant height (cm)*		*Head diameter (cm)*		*Seed filling (%)*	
		SC-1	SC-2	SC-1	SC-2	SC-1	SC-2	SC-1	SC-2	SC-1	SC-2
1	CMS-108A x IB-22R	-7.24*	-4.07	6.71*	1.16	-8.21**	-17.47**	11.34	-26.38**	6.99	-11.28*
2	CMS108A x EC-601957R	-7.24*	-4.07	1.22	-1.05	21.95**	-6.99**	28.36**	-15.13*	-12.32**	6.86
3	CMS-108A x EC-198075	-5.07	-5.69	5.49	0.00	-19.66**	-8.73**	23.63*	-18.25*	8.20	-10.28**
4	CMS-108A x EC-178178R	8.69*	-2.44	5.49	0.00	24.81**	-4.80	13.42	-25.00**	4.14	-13.64**
5	CMS-108A x GP-6-263R	-7.24*	-3.25	4.88	-0.58	24.81**	-4.80	37.00**	-9.41	-9.11*	9.52**
6	CMS-108A x GP-6-116R	-14.13**	0.00	0.61	-4.62	-23.67**	-5.68**	-22.83*	-18.78**	6.99	-11.28*
7	CMS-250A x IB-22R	-12.31**	-3.25	1.22	-4.05	67.18**	27.51**	40.97**	-6.78	1.08	-16.18**
8	CMS-250A x EC-601957R	17.75**	3.25	1.83	-3.47	38.55**	5.68**	7.09	-29.19**	9.81*	-8.94*
9	CMS-250A x EC-198075R	8.69**	0.81	-6.71*	-11.56**	47.14**	12.23**	16.54	-22.94**	-9.23*	9.43**
10	CMS-250A x EC-178178R	-10.50**	-6.50*	-4.88*	-9.83**	43.88**	9.74**	29.11**	-14.63*	5.12	-12.83**
11	CMS-250A x GP-6-263R	-7.24*	-1.63	1.83	-3.47	38.55**	5.68	14.98	-23.97**	5.93	-12.16**
12	CMS-207A x GP-6-116R	-14.13**	-0.81	4.27	1.16	47.14**	12.23**	27.27*	-15.84*	7.17	-11.13*
13	CMS-249A x IB-22R	8.69*	-4.07	3.66	-1.73	29.39**	-1.31	11.53	-26.25**	2.58	-14.93**
14	CMS-249A x EC-601957R	-10.50**	0.81	6.10	0.58	32.63**	1.16	11.01	-26.59**	3.34	-14.31**
15	CMS-249A x EC-198075R	-7.24**	3.25	6.10	0.58	45.43**	10.92**	13.37	-25.03**	2.64	-14.89**
16	CMS-249A x EC-178178R	10.50*	-2.44	2.44	-2.89	37.41**	4.80	5.53	-30.22**	1.45	-15.87**
17	CMS-249A x GP-6-263R	8.69**	-0.81	0.61	-4.62	52.87**	16.59**	10.87	-26.69**	5.71	-12.34**
18	CMS-249A x GP-6-116R	-7.24*	-3.25	4.88	-0.58	38.55**	5.68**	16.60	-23.56**	0.96	-16.28**
19	CMS-207A x IB-22R	-10.50**	0.00	-0.61*	-5.78	33.97**	2.18	13.56	-24.91**	0.24	-16.88**
20	CMS-207A x EC-601957R	8.69*	-1.63	1.22	-4.05	38.55**	5.68	15.78	-23.44**	2.87	-14.70**
21	CMS-207A x EC-198075R	-7.24*	-4.07	0.61	-4.62	41.99**	8.30	14.65	-24.19**	5.63	-12.41**
22	CMS-207A x EC-178178R	8.69*	-1.63	4.88	-0.58	40.27**	6.99**	17.34*	22.41**	5.39	-12.61**
23	CMS-207A x GP-6-263R	15.96**	4.07	4.27	-1.16	56.88**	19.65**	14.04	-24.59**	5.58	-12.45**
24	CMS-207A x GP-6-116R	-14.13**	2.44	1.83	-3.47	48.86**	13.54**	10.26	-27.09**	10.79**	8.13*

Table 2: Continued

Sr. No	*Hybrid*	*Hull content (g)*		*100-Seed weight*		*Oil Content (%)*		*Volume weight (g/100 mL)*		*Seed Yield /plant (g)*	
		SC-1	SC-2	SC-1	SC-2	SC-1	SC-2	SC-1	SC-2	SC-1	SC-2
1	CMS-108A x IB-22R	24.99	-14.01	-16.55**	-29.24**	5.01	17.57**	6.66	5.30	3.02	-33.51**
2	CMS-108A x EC-601957R	22.08	-15.83	-17.69**	-30.20**	-0.27	11.66**	27.69**	-28.68**	7.40	-30.68**
3	CMS-108A x EC-198075R	12.13	-22.68*	8.56	-7.94	-6.55*	4.63**	7.61	6.13	3.82	-32.99**
4	CMS-108A x EC-178178R	24.42	-14.21	-20.21**	-32.33**	-1.41	10.38**	5.20	3.76	-9.15	-41.36**
5	CMS-108A x GP-6-263R	23.39	-14.92	-25.23**	-36.59**	-1.01	13.10**	8.16**	6.67**	-1.85	-36.65**
6	CMS-108A x GP-6-116R	14.33	-21.17*	-13.93**	.27.01**	-1.30	13.42**	23.84**	22.14**	83.33**	18.33**
7	CMS-250A x IB-22R	0.29	-30.85**	-16.44**	-29.14**	-1.37	13.50**	6.72	5.25	-24.58**	-51.32**
8	CMS-250A x EC-601957R	1.46	-30.04**	7.76	-8.62**	-1.53	10.26**	-4.87	-6.18	-8.88	-41.19**
9	CMS-250A x EC-198075R	20.32	-17.04	-20.21**	-32.33**	-4.12	7.35*	-2.80	-4.14	-4.31	-38.23**
10	CMS-250A x EC-178178R	7.31	-26.01*	-15.07**	-27.98**	0.54	12.57**	-21.00*	-22.09*	-5.11	-38.75**
11	CMS-250A x GP-6-263R	-6.43	-35.48**	-2.28	-17.13**	-3.41	8.15**	4.55	3.11	-19.71**	-48.18**
12	CMS-250A x GP-6-116R	-4.39	-34.07**	-20.21**	-32.33*	1.58	13.74**	4.84	3.39	-12.41	-43.47**
13	CMS-249A x IB-22R	-5.12	-34.58**	1.48	-13.94**	0.81	12-.88**	-19.24	-20.35*	-30.25**	-54.98**
14	CMS-249A x EC-601957R	5.85	-27.02**	-20.21**	-32.33**	2.30	14.54**	-23.07*	-24.13*	-26.21**	-52.37**
15	CMS-249A x EC-198075R	-8.04	-36.59**	-11.19*	-24.69**	4.44	16.53**	-15.50	-16.66	-28.91**	-54.12**
16	CMS-249A x EC-178178R	15.50	-20.36*	-21.35**	-33.30**	6.72*	19.49**	-12.51	-13.71	-35.12**	-58.12**
17	CMS-249A x GP-6-263R	0.00	-31.05**	-16.21**	28.94**	6.43*	19.17**	6.73	5.27	-31.59**	-55.84**
18	CMS-249A x GP-6-116R	-9.94	-37.90**	8.56	-7.94	1.63	13.79**	-8.93	-10.18	-35.31**	-57.60**
19	CMS-207A x IB-22R	0.29	-30.85**	31.39**	41.82**	4.37	7.08**	-3.14	-4.47	83.33**	18.33**
20	CMS-207A x EC-601957R	20.61	-16.83	-12.90**	-26.14**	1.66	13.82**	-17.48	-18.61	-26.19**	-52.36**
21	CMS-207A x EC-198075R	-7.89	-36.49**	6.16	-9.97*	7.79**	3.24**	-10.36	-18.59	-22.12**	-49.73**
22	CMS-207A x EC-178178R	5.85	-27.02**	23.74**	35.33**	0.30	12.30**	-45.92**	-46.66**	-22.15**	-49.75**
23	CMS-207A x GP-6-263R	22.08	-15.83	-16.21**	-28.94**	-3.98	7.51**	-31.01**	-31.96**	-22.61**	-50.05**
24	CMS-207A x GP-6-116R	4.39	-28.02**	9.82*	-6.87	-5.14	6.21**	13.82**	12.25**	76.03**	13.62**

* and ** Significant at 5% and 1% levels, respectively.

x GP-6-263 (-6.43%, -35.48%) CMS-250A x GP-6-116 (34.07 %) recorded highest negative heterosis for this trait over both checks, LSFH-35 and LSFH-171 respectively. For character, 100 seed weight (g), the estimate of standard heterosis revealed that three hybrids have manifested significant positive heterosis over check-1(LSFH-35). The cross combinations CMS-207A x IB-22 (31.39%), CMS-207A x EC-178178 (23.74%) and CMS-207A x GP-6-116 (9.82%), were recorded significant positive heterosis. Three hybrids showed strong positive standard heterosis in the instance of check-2 (LSFH-171). The two crosses CMS-207A x IB-22 (31.39%, 41.82%), and CMS-207A x EC-178178 (23.74%, 35.33%), respectively, showed the most significant positive heterosis for this trait over the two checks LSFH-35 and LSFH-171. The current results showed that 3 hybrids had substantial positive standard heterosis for trait oil content, with the range of standard heterosis over check-1 (LSFH-35) being between -6.55 % (CMS-108A x EC-198075) and 7.79 % (CMS-207A x EC-601957). For this trait, there was considerable positive heterosis for the cross combinations CMS-207A x EC-601957 (7.79%), CMS-249A x EC-178178 (6.72%), and CMS-249A x GP-6-116 (6.43%). From -3.24 % (CMS-207A x EC-198075) to 19.49 %, standard heterosis over check-2(LSFH-171) was seen (CMS-249A x EC-178178). 24 hybrids produced notable positive standard heterosis data. Three crosses viz., CMS-207A x EC-198075 (7.79 %, 3.24 %) CMS-249A x EC-178178 (6.72%, 19.49%) and CMS-249A x GP-6-263(6.43%,19.17%) recorded highest significant heterosis over both the checks LSFH-35 and LSFH-171 for this trait. Further for trait volume weight (g/100ml), the perusal of data revealed that the range of standard heterosis over check-1(LSFH-35) was from -45.92% (CMS-207A x EC-178178) to 23.84 % (CMS-108A x GP-6-116). Three hybrids—CMS-108A x GP-6-116 (23.84 %), CMS-207A x GP-6-116 (13.82 %), and CMS 108A x GP-6-116—recorded significant positive standard heterosis over check-1(LSFH-35) (8.16 %). Three hybrids in total showed significant positive heterosis, with the standard heterosis over check-2 (LSFH-171) ranging from -10.18 % (CMS-249A x GP-6-116) to 46.66 % (CMS-207A x EC-178178). Cross combinations viz., CMS-108 x GP-6-116 (23.14%, 22.14%), CMS-108A x GP-6-263 (8.16%, 6.67%) and CMS-207A x GP-6-116 (13.82 %, 12.25%) recorded highest significant heterosis over both the checks LSFH-35 and LSFH-171 for these traits. For trait seed yield per plant (g), the range of significant heterosis over check-1(LSFH-35) was observed from -35.31% (CMS-249A x GP-6-116) to 83.33% (CMS-207A x IB-22) Three hybrids recoded significant positive standard heterosis. CMS 207A x IB-22 (83.33%), CMS-108A x GP-6-116 (83.33%) and CMS-207A x GP-6-116 (76.03%). The range of significant heterosis over check-2 (LSFH-171) was between -57.60 % (CMS-249A x EC-178178) and 18.3 % (CMS 108A x GP-6-116). There was notable positive heterosis in three hybrids. In terms of seed yield per plant, three cross combinations—CMS 207A x GP-6-116 (76.03 %, 13.62 %), CMS 207A x IB-22 (82.33 %, 18.33 %), and CMS-108A x GP-6-116 (88.33 %, 18.33 %)—recorded the highest significant heterosis. Jeena and Sheikh (2004), Latha *et al.* (2005), and Thombare *et al.* (2006) all reported heterosis for seed yield as well (2007).

CONCLUSION

Two hybrids, CMS-108A x IB-22 and CMS-250A x EC-198075, showed significant negative heterosis for early flowering and days to maturity over both checks. These hybrids showed a wide range of heterosis for all the traits. These hybrids can be used extensively. The hybrids, CMS-207A x IB-22 and CMS-207A x EC-178178, both outperformed the standard checks LSFH-35 and LSFH-171 in terms of yield and yield components with high significant heterosis in the desired direction. These hybrids can either be used in heterosis breeding or released as hybrids.

REFERENCES

Bhoite, K.D., Dubey, R.B., Mukesh, Vyas., Mundra S.L and Ameta, K.D., 2018. Evaluation of combining ability and heterosis for seed yield in breeding lines of sunflower (Helianthus annuus L.) using line x tester analysis. J. of Pharmacognosy and Phytochemistry. 7(5): 1457-1464.

Ingle, A.U., Nichal, S.S., Gawande, V.L. and Garkal V.K. 2017. Heterosis in relation to combinig ability for seed yield and oil content in sunflower (Helianthus annuus L.) Trends in Bio.sci., 10(1): 379-383.

Jeena, A.S. and Sheikh F.A. 2004. Standard heterosis in sunflower (Helianthus annuus L.) J. Maharashtra agric. Univ., 29(3): 261-263.

Kempthorne, O., 1957. An Introduction of Genet. Stat., The Iowa University Press.

Latha K.M., Vishnuvardhan Reddy A. and Devasenamma V. 2005. Hybrid vigour and combining ability in sunflower, (Helianthus annuus L.) hybrids involving CMS lines. J. Oilseed Res., 23(2): 154-156.

Mangla Rai, (2002). Oilseeds in India. Andhra Pradesh Agric. Res.J., pp. 13-15

Shamshad, M., Dhillon, S.K. And Kaur, G. 2016. Heterosis for oil content and oil quality in sunflower (Helianthus annuus L.). Current Advances in Agril. Sci. 8(1): 44-48.

Sugoor R.K., 1992. Heterosis and combining ability of induced mutant restorer lines in sunflower (Helianthus annuus L.). M. Sc. (Agri.) Thesis Univ. Agric. Sci. Dharwad (India).

Thombare, V., Makane V.G. and Borgaonkar S.B., 2007. Combining ability studies in sunflower (Helianthus annuus L.). Internat. J. Plant. Sci. (2): 133-136.