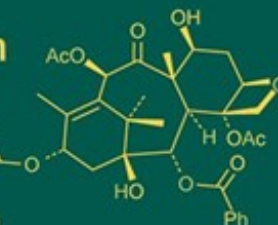


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
Indexing: Embase
IJABR 2026; SP-10(10): 544-550
www.biochemjournal.com
Received: 28-07-2026
Accepted: 25-09-2026
Published: 07-10-2026

Sangita U Fatak

Oilseeds Research Unit, Dr.
Panjabrao Deshmukh Krishi
Vidyapeeth, Akola,
Maharashtra, India

SJ Gahukar

Senior Research Scientist,
Oilseeds Research Unit, Dr.
Panjabrao Deshmukh Krishi
Vidyapeeth, Akola,
Maharashtra, India

RB Ghorade

Head of the Department of
Agricultural Botany and a
Senior Research Scientist, Dr.
Panjabrao Deshmukh Krishi
Vidyapeeth, Akola,
Maharashtra, India

HP Meena

Senior Scientist (Plant
Breeding), ICAR-Indian
Institute of Oilseeds Research
Rajendranagar, Hyderabad,
Telangana, India

VL Gawande

Associate Professor,
Department of Agricultural
Botany and Senior Scientist
Plant Breeding, Pulses
Research Unit, Dr. Panjabrao
Deshmukh Krishi Vidyapeeth,
Akola, Maharashtra, India

Corresponding Author:**Sangita U Fatak**

Oilseeds Research Unit, Dr.
Panjabrao Deshmukh
Krishi Vidyapeeth, Akola,
Maharashtra, India

Studies on heterosis for seed yield and yield contributing traits in sunflower (*Helianthus annuus* L.)

Sangita U Fatak¹, SJ Gahukar², RB Ghorade³, HP Meena⁴, VL Gawande⁵

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i10Sg.10339>

ABSTRACT

A Line x Tester analysis was carried out by using 16 parents and their resulting 60 hybrids along with four checks (LSFH-171, PDKVSH 952, PDKV Suraj and DRSH-1) of sunflower to estimate heterosis in the inheritance of majority of yield and its contributing traits. The experiment was conducted in randomized block design with three replications at the Oilseeds Research Unit, Dr. PDKV, Akola, Agricultural Research Station, Dr. PDKV, Ekarjuna and Oilseeds Research Station, MPKV, Jalgaon during Kharif-2024 seasons. Overall, the results demonstrated substantial heterotic variability among the hybrids for most traits. HA 288A × AKSFI-22-3 showed the greatest and most consistent negative heterosis for earliness, while HA 288A × PB 1208 showed pronounced negative heterosis for plant height. CMS 138A × AKSFI-22-4 was notable for head diameter, HA 228A × PB 1575 for 100-seed weight, HA 288A × PB 1100 for volume weight, and HA 228A × PB 1103 for reduced hull content. For the principal economic trait, seed yield per plant, HA 302A × PB 1100 exhibited the strongest and most consistent heterotic response, recording 61.25% average heterosis, 52.77% heterobeltiosis, and standard heterosis of 20.34, 10.91, 4.56 and 6.95% over LSFH 171, PDKVSH 952, PDKV Suraj and DRSH 1, respectively.

Keywords: Heterosis, Heterobeltiosis, Standard heterosis

Introduction

Sunflower (*Helianthus annuus* L., $2n = 2x = 34$) is an important oilseed crop after groundnut, soybean, rapeseed and mustard belonging to family Asteraceae, native to the Southern part of USA and Mexico. The genus *Helianthus* is named from the Greek word Helios meaning 'Sun' and anthus meaning 'Flower'. The genus name associates the characteristic heliotropism exhibited during the flowering period.

India is the 4th largest oilseed producing country in the world after USA, China and Brazil. However, it is the 3rd largest consumer and 2nd largest importer of edible oils (DVVOF, 2017) and enjoys a distinct position in terms of diversity in annual oilseed crops. After cytoplasmic male sterile (CMS) lines and fertility restorer lines were discovered, population breeding was switched to heterosis breeding. Commercial sunflower farming started in India in the 1970s with the selection of imported open-pollinated populations. Classical cytoplasmic male sterility (PET-1) discovered by [Leclercq \(1969\)](#) [1] and a few restorer lines are being utilized for commercial hybrid seed production in sunflowers over the world since 1972. The utilization of a single source of male sterility results in a high level of vulnerability to biotic and abiotic stresses.

A heterotic cross combination is more likely to produce an F₁ with a wide range of variation in segregating generations the more unlike the parents. The numerous CMS and restorer lines aim to produce superior hybrids with increased oil content and seed output as well as improved heterosis and stability. Exploring heterosis is a strategy for boosting sunflower productivity and output. High-yielding hybrids have rapidly surpassed open-pollinated cultivars in sunflower production, which was previously dominated by them.

However, many hybrids failed to pique the interest of the agricultural community as profitable crops due to poor seed filling, low yield levels, low oil content, and vulnerability to disease and insects. These events might occur as a result of the interaction between Genotype and Environment. The decision was made to look for high heterotic stable crosses as a result. Numerous candidate genotypes are typically evaluated in a variety of conditions for critical yield-related variables prior to the selection of approved genotypes. The genotype's performance in terms of yield and yield contributing potential was significantly influenced by location, seasonal variation, and their interactions.

Materials and methods

The present research conducted at Oilseeds Research Unit, Akola, Agricultural Research Station, Ekarjuna and Oilseeds Research Unit, Jalgaon during Kharif-2024 seasons. Crossing programme adopting using line × tester mating design ([Kempthorne, 1957](#)) [2] and the parental material consisting of four CMS lines (HA 288A, HA 228A, HA 302A, CMS 17A, CMS 138A, AKSF 10-1-1A) and ten testers (PB 1208, PB 1210, PB

1100, PB 1103, PB 1575, PB 898, AKSFI-22-1, AKSFI-22-2, AKSFI-22-3 and AKSFI-22-4). The resultant 60 hybrids along with their 16 parents and four checks viz. LSFH-171, PDKVSH 952, PDKV Suraj and DRSH-1 were evaluated in randomized block design. Each plot consisted of one row of 3.0 meter length with a spacing of 60 cm between rows and 30 cm between plants. Observations were recorded in each entry on randomly selected three plants for importance yield contributing characters viz. days to 50% flowering, days to maturity, plant height, head diameter (cm), 100 seed weight (g), volume weight (g/100 ml), seed filling (%), hull content (%) and seed yield per plant (g).

Results and discussion

Pooled location wise (Akola, Ekarjuna and Jalgaon) analysis of variance was carried out for seed yield and its components. The results are presented in Table 1. Pooled locationwise (Akola, Ekarjuna and Jalgaon) analysis of variance for *Kharif* 2024 revealed significant ge-

netic and environmental variation for seed yield and its component traits. The mean sum of squares due to parents and hybrids were highly significant for all the characters, indicating substantial variability among the genotypes. The parents vs. hybrids effect was also highly significant for most traits, except volume weight, demonstrating considerable divergence between parental and hybrid performance. Significant environment $\times$ genotype interactions were observed for most characters, except hull content and seed yield, indicating differential response of genotypes across environments. Environment $\times$ parent interactions were significant for the majority of traits, whereas environment $\times$ hybrid interactions were significant for most characters, except hull content and seed yield. The environment $\times$ parent vs. hybrid interaction was significant for nearly all characters, except volume weight. Overall, the pooled analysis demonstrated the presence of substantial genetic variability along with significant environmental influence and genotype $\times$ environment interaction, suggesting differential expression and environmental responsiveness of parents and hybrids for seed yield and its component traits.

Table 1. Pooled locationwise (Akola, Ekarjuna and Jalgaon) analysis of variance across the season (*Kharif* 2024)

Source of Variation	d.f.	Days to 50% flowering	Days to maturity	Plant height	Head diameter	100 seed weight
Mean sum of Squares						
Environments	2	1730.63 **	1004.43 **	1094.36 **	60.28 **	11.32 **
Genotypes	75	67.77 **	33.80 **	4517.27 **	2.93 **	5.68 **
Parents	15	45.827 **	24.41 **	2370.94 **	3.06 **	6.32 **
Hybrids	59	45.89 **	31.59 **	4983.57 **	2.87 **	4.67 **
Parent vs Hybrids	1	1683.96 **	305.29 **	9200.99 **	4.59 **	55.47 **
Environment x Genotypes	150	13.02 **	23.65 **	90.46 **	0.22 **	0.21
Environment x Parents	30	11.40 **	13.00 **	4.033	0.30 **	0.02
Environment x Hybrids	118	10.26 **	26.24 **	111.76**	0.19 *	0.25 *
Environment x Parent vs Hybrids	2	200.63 **	30.36 **	130.31**	0.55 *	1.03 **
Error	450	1.89	3.11	12.64	0.14	0.19

2. Pooled location wise (Akola, Ekarjuna and Jalgaon) average heterosis, heterobeltiosis and standard heterosis across season (*Kharif* 2024)

Table 1. cont...

Source of Variation	d.f.	Volume weight	Seed filling	Hull content	Seed yield
Mean sum of Squares					
Environments	2	189.13 **	62.72 **	55.00 **	422.04**
Genotypes	75	90.69 **	957.33 **	29.32 **	379.29**
Parents	15	134.68 **	89.41 **	25.53 **	199.39 **
Hybrids	59	80.96**	916.71**	27.97 **	423.56 **
Parent vs Hybrids	1	4.96	16373.01 **	165.87 **	465.93 **
Environment x Genotypes	150	2.96 **	47.39 **	1.03	9.33
Environment x Parents	30	0.65	11.61 **	0.04	0.03
Environment x Hybrids	118	3.51 **	56.12 **	0.84	10.23
Environment x Parent vs Hybrids	2	5.44	69.40 **	27.14 **	95.85 **
Error	450	2.11	5.13	1.78	12.17

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

The heterosis range of all characters given in Table 2. The maximum average heterosis, heterobeltiosis and standard heterosis was estimated for all characters is given in Table 3. The heterosis analysis

conducted during *Kharif*-2024 revealed considerable variation among the hybrids for seed yield and its component traits. The character-wise results are summarized below.

Table 2. Pooled locationwise (Akola, Ekarjuna and Jalgaon) heterosis range of heterosis (%) for various traits across the seasons (*Kharif* 2024)

Character	H1 (%)	H2 (%)	H3 (%)	H4 (%)	H5 (%)	H6 (%)
Days to 50% flowering	-14.83 to 3.64	-17.82 to 3.45	-9.06 to 7.84	-14.49 to 1.39	-16.01 to -0.41	-16.75 to -1.29

(continued on next page)

Character	H ₁ (%)	H ₂ (%)	H ₃ (%)	H ₄ (%)	H ₅ (%)	H ₆ (%)
Days to maturity	-7.90 to 3.15	-8.63 to 3.13	-1.58 to 8.95	-7.16 to 2.77	-9.35 to 0.35	-14.29 to -5.12
Plant height	-33.56 to 28.54	-38.36 to 25.67	-21.06 to 43.90	-42.83 to 4.21	-45.75 to -1.11	-46.18 to -1.89
Head diameter	-8.52 to 12.43	-9.89 to 12.00	-8.33 to 6.49	-12.38 to 1.79	-12.46 to 1.70	-11.77 to 2.50
100-seed weight	-27.06 to 59.94	-32.10 to 39.35	-27.24 to 36.19	-34.65 to 22.32	-39.57 to 13.12	-36.07 to 19.67
Volume weight	-19.12 to 18.75	-25.78 to 14.83	-8.81 to 27.01	-13.39 to 20.64	-16.61 to 16.15	-18.54 to 13.46
Seed filling	-42.38 to 4.40	-44.29 to 2.31	-44.25 to -1.30	-45.83 to -4.10	-44.23 to -1.27	-44.08 to -1.01
Hull content	-21.51 to 26.08	-28.22 to 19.74	-28.40 to 10.04	-32.10 to 13.12	-29.86 to 12.61	-26.40 to 22.01
Seed yield	-32.04 to 61.25	-38.14 to 52.77	-46.42 to 20.34	-50.62 to 10.91	-53.44 to 4.56	-52.38 to 6.95

H₁- Mid Parent, H₂ Better Parent, H₃- LSFH 171 (C), H₄- PDKVSH 952 (C), H₅- PDKV Suraj (C), H₆-DRSH 1 (C)

H₁- Mid Parent, H₂ Better Parent, H₃- LSFH 171 (C), H₄- PDKVSH 952 (C), H₅- PDKV Suraj (C), H₆-DRSH 1 (C)

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

For days to 50% flowering forty-eight hybrids exhibited significant negative average heterosis, ranging from -14.83 to 3.64%. The highest negative average heterosis was recorded by HA 288A × AKSFI-22-3 (-14.83%), followed by AKSF 10-1-1A × AKSFI-22-1 (-14.08%) and HA 228A × AKSFI-22-3 (-14.00%). Fifty-two hybrids showed significant negative heterobeltiosis, ranging from -17.82 to 3.45%, with HA 288A × AKSFI-22-3 (-17.82%) being the highest. Standard heterosis over LSFH 171, PDKVSH 952, PDKV Suraj and DRSH 1 ranged from -9.06 to 7.84%, -14.49 to 1.39%, -16.01 to -0.41% and -16.75 to -1.29%, respectively. The highest negative heterosis was recorded by HA 288A × AKSFI-22-3 over all four checks, with values of -9.06, -14.49, -16.01 and -16.75%, respectively.

For days to maturity thirty-three hybrids showed significant negative average heterosis, ranging from -7.90 to 3.15%, with HA 228A × AKSFI-22-3 (-7.90%) recording the highest negative value. Heterobeltiosis ranged from -8.63 to 3.13%, with the same hybrid recording the highest negative heterobeltiosis (-8.63%). Standard heterosis over PDKVSH 952, PDKV Suraj and DRSH 1 ranged from -7.16 to 2.77%, -9.35 to 0.35% and -14.29 to -5.12%, respectively. HA 228A × AKSFI-22-3 recorded the highest negative standard het-

erosis of -7.16, -9.35 and -14.29%, respectively. No hybrid showed significant negative standard heterosis over LSFH 171.

For plant height thirty-nine hybrids exhibited significant negative average heterosis, ranging from -33.56 to 28.54%. HA 288A × PB 898 (-33.56%) recorded the highest negative average heterosis. Forty-four hybrids showed significant negative heterobeltiosis, ranging from -38.36 to 25.67%, with HA 288A × PB 1208 (-38.36%) recording the highest value. Standard heterosis over LSFH 171, PDKVSH 952, PDKV Suraj and DRSH 1 ranged from -21.06 to 43.90%, -42.83 to 4.21%, -45.75 to -1.11% and -46.18 to -1.89%, respectively. HA 288A × PB 1208 recorded the highest negative standard heterosis over these checks, with values of -21.06, -42.83, -45.75 and -46.18%, respectively.

For head diameter thirty-one hybrids showed significant positive average heterosis, ranging from -8.52 to 12.43%. CMS 138A × AKSFI-22-4 (12.43%) recorded the highest average heterosis, followed by CMS 17A × AKSFI-22-4 (12.25%). Fifteen hybrids exhibited significant positive heterobeltiosis, ranging from -9.89 to 12.00%, with CMS 17A × AKSFI-22-4 (12.00%) recording the highest value. Standard heterosis over LSFH 171 ranged from -8.33 to 6.49%, with HA 302A × AKSFI-22-2 (6.49%) recording the highest value. No hybrid showed significant positive standard heterosis over PDKVSH 952 or PDKV Suraj, where the maximum values were 1.79 and 1.70%, respectively. Four hybrids showed significant positive heterosis over DRSH 1, with HA 302A × AKSFI-22-2 (2.50%) recording the highest value.

Table 3. Pooled locationwise (Akola, Ekarjuna and Jalgaon) maximum heterosis in desirable direction for various traits across the seasons (Kharif 2024)

Character	Hybrids	Maximum Average heterosis (H ₁), heterobeltiosis (H ₂) and standard heterosis (H ₃), (H ₄), (H ₅) and (H ₆)
Days to 50% flowering	HA 288A × AKSFI-22-3	H ₁ = -14.83 **
	HA 288A × AKSFI-22-3	H ₂ = -17.82 **
	HA 288A × AKSFI-22-3	H ₃ = -9.06 **
	HA 288A × AKSFI-22-3	H ₄ = -14.49 **
	HA 288A × AKSFI-22-3	H ₅ = -16.01 **
	HA 288A × AKSFI-22-3	H ₆ = -16.75 **

(continued on next page)

Days to maturity	HA 228A × AKSFI-22-3	$H1 = -7.90^{**}$
	HA 228A × AKSFI-22-3	$H2 = -8.63^{**}$
	HA 228A × AKSFI-22-3	$H3 = -1.58$
	HA 228A × AKSFI-22-3	$H4 = -7.16^{**}$
	HA 228A × AKSFI-22-3	$H5 = -9.35^{**}$
	HA 228A × AKSFI-22-3	$H6 = -14.29^{**}$
Plant height	HA 288A × PB 898	$H1 = -33.56^{**}$
	HA 288A × PB 1208	$H2 = -38.36^{**}$
	HA 288A × PB 1208	$H3 = -21.06^{**}$
	HA 288A × PB 1208	$H4 = -42.83^{**}$
	HA 288A × PB 1208	$H5 = -45.75^{**}$
	HA 288A × PB 1208	$H6 = -46.18^{**}$
Head diameter	CMS 138A × AKSFI-22-4	$H1 = 12.43^{**}$
	CMS 17A × AKSFI-22-4	$H2 = 12.00^{**}$
	HA 302A × AKSFI-22-2	$H3 = 6.49^{**}$
	HA 302A × AKSFI-22-2	$H4 = 1.79$
	HA 302A × AKSFI-22-2	$H5 = 1.70$
	HA 302A × AKSFI-22-2	$H6 = 2.50^{*}$

(continued on next page)

100-seed weight	HA 302A × PB 1208	$H1 = 59.94^{**}$
	HA 302A × PB 1208	$H2 = 39.35^{**}$
	HA 228A × PB 1575	$H3 = 36.19^{**}$
	HA 228A × PB 1575	$H4 = 22.32^{**}$
	HA 228A × PB 1575	$H5 = 13.12^{**}$
	HA 228A × PB 1575	$H6 = 19.67^{**}$
Volume weight	AKSF 10-1-1A × AKSFI-22-2	$H1 = 18.75^{**}$
	CMS 138A × AKSFI-22-1	$H2 = 14.83^{**}$
	HA 288A × PB 1100	$H3 = 27.01^{**}$
	HA 288A × PB 1100	$H4 = 20.64^{**}$
	HA 288A × PB 1100	$H5 = 16.15^{**}$
	HA 288A × PB 1100	$H6 = 13.46^{**}$
Seed filling %	HA 288A × AKSFI-22-2	$H1 = 4.40^{**}$
	HA 288A × AKSFI-22-2	$H2 = 2.31$
	AKSF 10-1-1A × AKSFI-22-4	$H3 = -1.30$
	AKSF 10-1-1A × AKSFI-22-4	$H4 = -4.10^{**}$
	AKSF 10-1-1A × AKSFI-22-4	$H5 = -1.27$
	AKSF 10-1-1A × AKSFI-22-4	$H6 = -1.01$

(continued on next page)

Hull content	HA 228A × PB 1103	$H1 = -21.51^{**}$
	HA 228A × PB 1103	$H2 = -28.22^{**}$
	HA 228A × PB 1103	$H3 = -28.40^{**}$
	HA 228A × PB 1103	$H4 = -32.10^{**}$
	HA 228A × PB 1103	$H5 = -29.86^{**}$
	HA 228A × PB 1103	$H6 = -26.40^{**}$
Seed yield	HA 302A × PB 1100	$H1 = 61.25^{**}$
	HA 302A × PB 1100	$H2 = 52.77^{**}$
	HA 302A × PB 1100	$H3 = 20.34^{**}$
	HA 302A × PB 1100	$H4 = 10.91^{**}$
	HA 302A × PB 1100	$H5 = 4.56$
	HA 302A × PB 1100	$H6 = 6.95^{*}$

For 100-seed weight forty-two hybrids exhibited significant positive average heterosis, ranging from -27.06 to 59.94%. HA 302A × PB 1208 (59.94%) recorded the highest average heterosis. Twenty-five hybrids showed significant positive heterobeltiosis, ranging from -32.10 to 39.35%, with HA 302A × PB 1208 (39.35%) recording the highest value. Standard heterosis over LSFH 171, PDKVSH 952, PDKV Suraj and DRSB 1 ranged from -27.24 to 36.19%, -34.65 to 22.32%, -39.57 to 13.12% and -36.07 to 19.67%, respectively. HA 228A × PB 1575 consistently recorded the highest positive standard heterosis, with values of 36.19, 22.32, 13.12 and 19.67%, respectively.

For volume weight twenty hybrids showed significant positive average heterosis, with values ranging from -19.12 to 18.75%. The highest positive average heterosis was recorded by AKSF 10-1-1A × AKSFI-22-2 (18.75%). Ten hybrids exhibited significant positive heterobeltiosis, ranging from -25.78 to 14.83%, with CMS 138A × AKSFI-22-1 (14.83%) recording the highest value. Standard heterosis over LSFH 171, PDKVSH 952, PDKV Suraj and DRSB 1 ranged from -8.81 to 27.01%, -13.39 to 20.64%, -16.61 to 16.15% and -18.54 to 13.46%, respectively. HA 288A × PB 1100 recorded the highest positive heterosis over all four checks, with values of 27.01, 20.64, 16.15 and 13.46%, respectively.

For seed filling percentage average heterosis ranged from -42.38 to 4.40%, with only two hybrids showing significant positive heterosis.

HA 288A × AKSFI-22-2 (4.40%) recorded the highest value, followed by AKSF 10-1-1A × AKSFI-22-4 (2.12%). Heterobeltiosis ranged from -44.29 to 2.31%, with only one hybrid showing significant positive heterobeltiosis. Standard heterosis over LSFH 171, PDKVSH 952, PDKV Suraj and DRSB 1 ranged from -44.25 to -1.30%, -45.83 to -4.10%, -44.23 to -1.27% and -44.08 to -1.01%, respectively. No hybrid showed significant positive standard heterosis over any of the four checks, indicating limited heterotic expression for seed filling percentage. Lakshman *et al.* (2020) [3]; Pole *et al.* (2020) [4]; Rajane *et al.* (2022) [5]; Shinde *et al.* (2023) [6]; Sharron *et al.* (2024) [7] also reported high positive heterosis for volume weight and seed filling percentage.

For hull content since lower hull content is desirable, negative heterosis was considered favourable. Average heterosis ranged from -21.51 to 26.08%, with significant negative heterosis in nine hybrids. HA 228A × PB 1103 (-21.51%) recorded the highest negative average heterosis. Heterobeltiosis ranged from -28.22 to 19.74%, with HA 228A × PB 1103 (-28.22%) recording the highest negative value. Standard heterosis over LSFH 171, PDKVSH 952, PDKV Suraj and DRSB 1 ranged from -28.40 to 10.04%, -32.10 to 13.12%, -29.86 to 12.61% and -26.40 to 22.01%, respectively. HA 228A × PB 1103 recorded the highest negative heterosis over all four checks, with values of -28.40, -32.10, -29.86 and -26.40%, respectively. Shinde *et al.* (2023) [6]; Sharron *et al.* (2024) [7] also recorded lowest hull content.

For seed yield per plant average heterosis ranged from -32.04 to 61.25%, with thirteen hybrids showing significant positive heterosis. HA 302A × PB 1100 (61.25%) recorded the highest average heterosis, followed by CMS 138A × PB 1100 (37.49%) and HA 288A × PB 1100 (32.38%). Heterobeltiosis ranged from -38.14 to 52.77%, with HA 302A × PB 1100 (52.77%) recording the highest positive value. Standard heterosis over LSFH 171 ranged from -46.42 to 20.34%, with HA 302A × PB 1100 (20.34%) recording the highest value. Over PDKVSH 952, heterosis ranged from -50.62 to 10.91%, with HA 302A × PB 1100 (10.91%) being the highest. Over PDKV Suraj, the range was -53.44 to 4.56%, with no significant positive heterosis. Over DRSH 1, the range was -52.38 to 6.95%, and HA 302A × PB 1100 (6.95%) was the only hybrid showing significant positive heterosis.

Conclusion

Overall, the results demonstrated substantial heterotic variability among the hybrids for most traits. HA 288A × AKSFI-22-3 showed the greatest and most consistent negative heterosis for earliness, while HA 288A × PB 1208 showed pronounced negative heterosis for plant height. CMS 138A × AKSFI-22-4 was notable for head diameter, HA 228A × PB 1575 for 100-seed weight, HA 288A × PB 1100 for volume weight, and HA 228A × PB 1103 for reduced hull content. For the principal economic trait, seed yield per plant, HA 302A × PB 1100 exhibited the strongest and most consistent heterotic response, recording 61.25% average heterosis, 52.77% heterobeltiosis, and standard heterosis of 20.34, 10.91, 4.56 and 6.95% over LSFH 171, PDKVSH 952, PDKV Suraj and DRSH 1, respectively.

References

1. Leclercq P. Line sterile cytoplasmique chezk tournesol. Ann. Amelior Planta. 1969;19:99-106.

2. Kempthorne O. An introduction to Genetic Statistics. The Iowa University Press; 1957:18-23.
3. Lakshman SS, Chakrabarty NR, Ghodke MK, Kole PC. Heterosis study in sunflower (*Helianthus annuus* L.). Euro. J. Exp. Bio. 2020;10(1):1-14.
4. Pole SP, Kalpande HV, Toprope VN, Zate DK. Heterotic behaviour of sunflower hybrids in different environments. J Pharmacogn Phytochem. 2020;9(6):426-430.
5. Rajane AR, Nichal SS, Fatak SU, Vaidya ER, Sasane PR, Kale PP. Heterotic Performance of F1 Hybrids for Yield, its Components and Oil Content of Sunflower (*Helianthus annuus* L.). Biological Forum – An Int. J. 2022;14(2a):276-285.
6. Shinde JV, Ghodke MK, Chaudhari BD, Gaiwal KB. Heterosis for seed yield and yield contributing traits in Sunflower (*Helianthus annuus* L.). J. Oilseeds Res. 2023;39(Special Issue):344-345.
7. Sharron KB, Sasikala R, Kalaiyarasi R, Harish S, Vanitha K. Assessment of Combining Ability and Heterosis for Seed Yield and its Attributes in Sunflower (*Helianthus annuus* L.). Plant Science Today. 2024.

How to cite this article: Fatak SU, Gahukar S, Ghorade R, Meena H, Gawande V. Studies on heterosis for seed yield and yield contributing traits in sunflower (*Helianthus annuus* L.). *International Journal of Advanced Biochemistry Research*. 2026;SP-10(10):544-550. doi: <https://www.doi.org/10.33545/26174693.2026.v10.i10Sg.10339>