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HETEROSIS AND HETEROBELTIOSIS STUDIES ON *HELIANTHUS ANNUUS* (Linn)

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Heterosis and heterobeltiosis were estimated for seed yield and five other characters in nine hybrids of sunflower derived from crosses between four females and seven males. The differences in yield and other characters over hybrids and parents were significant (P<O.Ol). Two hybrids, CMS-232 x RHA-229 and HO-lA x RHP-44 surpassed their male and female parents and rest of the crosses for seed yield per plot. It was found that manifestion of negative heterosis was more frequent than positive heterosis and heterobeltiosis for most of crosses. The significant and positive heterosis effects were maximum for head diameter followed by seed yield and plant height. The hybrids CMS-232 x RHA-229 and HO-lA x RHP-44, may be included in the future breeding programme of sunflower.

Key words: *Helianthus annuus* (Linn), heterobeltiosis, heterosis

INTRODUCTION

Sunflower, *Helianthus annuus* (Linn), is one of the most important oilseed crops grown in Pakistan. It is grown as non-traditional oilseed crop because no systematic research work has been done on evolution of high yielding, early maturing, abiotic and biotic stress resistant varieties of this crop in Sindh as well as in other provinces of Pakistan.

Exploration of hybrid vigour in economic crop plants is being taken up to increase production to cope with demand. Shrinivasa (1982) found significant and positive heterosis for plant height, head diameter and yield per plant. Significant and positive heterotic effects for yield and its related characters were also found by Burlov *et al.* (1982); Gupta and Khana (1982) and Pathak *et al.(1983),* while Borodu-lina *et al.(198U* and Reddy *et al. (1985)* reported heterosis and heterobeltiosis for capitula diameter, days to flowering and yield. Days to maturity, head diameter and yield also showed significant heterosis and heterobeltiosis in sunflower (Singh *et al.,* 1984 and Kukosh., 1985). Keeping the above in view, the present experiment was conducted to assess the heterosis and heterobeltiosis in *Helianthue annuus* (Linn) Fr hybrids for yield and some other important characters.

MATERIALS AND METHODS

Nine crosses (CMS-232 x RHA-229, HO-lA x RHP-44, CMS-232 x RHA-857, HO-lA x RHA-298, CMS-850 x RHA-856, HO-lA x RHA-268, CMS-OIP X RHA-206, CMS-OIP x RHA-299, and CMS-232 x RHP-44) derived from four females (CMS-232, CMS-850, CMS-OIP and HO-lA) and seven males RHA-229, RHA-298, RHA-857, RHA-856, RHA-268 and 206 and RHP-44) were planted during spring, 1995 at the National Oilseed Development Project, Agricultural Research Institute, Tandojam in a randomized complete block design using two replications. The distance between row to row and plant to plant was 45 and 22.5 cm, respectively having a net plot area of 3' x 5 meter. The recommended fertilizer dose (100-50 kg NPlha) was applied prior to sowing as urea and single superphosphate. Required cultural operations were adopted in all the plots throughout the growing period. For recording observations on days to initial flowering, days to complete flowering, days to maturity, plant height, and head diameter, ten plants were selected randomly from each plot of respective hybrids and their male and female parents tagged, while at harvest seed yield/plot was obtained from each plot and weighed. The data collected were subjected to analysis of variance and LSD test following Steel and Torri (1980). Heterosis and heterobeltiosis were calculated according to Fonseca and Patterson (1968). To test significance of heterosis and heterobeltiosis 't' test was applied (Wynne *et al., 1970).*

RESULTS AND DISCUSSION

Performance of Fr Hybrids: It is evident from Table 1 that differences in days to initial flowering, days to complete flowering, days to maturity, plant height, head diameter and seed yield between genotypes were highly significant (Pcu:O'l). It was further observed that' Fl hybrid (CMS-232 x RHA-299) was found superior and gave maximum seed yield compared to its female and male parents as well as rest of the hybrids developed. This increase in seed yield seems to be associated with wider ear head. The cross HO-lA x RHP-44 also surpassed male and female parents in respect to seed yield. These results demonstrated that out of nine Fr hybrids, two were outstanding when compared to their male and female parents, therefore, these genotypes could be used in future sunflower breeding strategies for introduction of new high yielding varieties.

Heterosis and Heterobeltiosis: As far as hybrid vigour or heterosis is concerned (Table 2), it was found that of nine crosses, only one cross (HO-lA x RHP-44) showed highly significant and positive heterotic effect for head diameter and seed yield, while five hybrids showed negative heterobeltiosis effect for this character. These results explain that Fl hybrid (HO-lA x RHP-298) surpasses its female and male parents regarding days to initial flowering showing positive heterotic effect for this trait. A perusal of Table 3 also indicated that estimates for heterobeltiosis were significant and positive for five crosses and the cross HO-lA x RHP-44 showed the best performance followed by CMS-232 x RHP-229 and CMS-850 x RHA-856.

In case of days to complete flowering and maturity almost similar trend was observed for the manifestation of heterotic effects for these traits. These results reveal that the hybrid HO-lA x RHP-

Table 1. Analysis of variance for seed yield and some other characters in Fr hybrids and male and female parents of *Helianthus annuus* (Linn)

Source of varlation	DF	Days to initial flowering	Days to complete flowering	Days to maturity	Plant height (cm)	Head diameter (cm)	Seed yield per plot (g)
Genotypes	19	8.802 **	33.706 **	55.739 .,	937.901*	7.995 .,	144783.516"*
Replication	1	0.571	0.036	0.036	20.571	0.839	2414.516
Error	19	1,418	1,420	0.882	66.110	1,108	8568.132
Standard error		1,191	1,192	0.939	8.131	1,053	92.564
LSD at P<0.05		2.596	2.598	2.047	17.725	2.295	201,790
.LSD at P<O.Ol		3.633	3.636	2.864	24.800	3.212	282.320

** Significant at P<O.Ol percent level of probability.

Table 2. Estimates of heterosis in Fr hybrids of *Helianthus annuus* (Linn)

Fi hybrtds	Days to initial flowering	Days to complete flowering	Days to maturity	Plant height (cm)	Head diameter (cm)	Seed yield per plot (g)
CMS-232 X RHA-299	1,03	3.57 •	3.26 **	1,53	3.65 **	4,499 ••
HO-lA X RHP-44	-6.66 *.	-4.110 **	-8.13 **	1,21	33.89 **	16.66 ••
CMS-232 X RHA-857	-2.058	-0.813	-1,80 "	-7.51	8.66 **	14.83 .*
HO-lA X RHA-298	5.05 *	9.560 "*	5.19 **	-21,42	32.15 **	12.82 **
CMS-850 X RHA-856	-9.25 *.	-4.110 .*	-10.50 **	-2,48	2.87 "	12.32 .-
HO-lA X RHA-268	-4.115 **	-1,500 "	-3.65 "	-9.17	-35.37 **	-1,59
CMS-OIP X RHA-206	-0.97	0.000	-12.56 •	14.77 **	12.90 **	-9,49
CMS-IOP X RHA-299	2.97	1,030	-1,50 *	-1,03	4.75 *	-13.58 -
CMS-232X RHP-44	-5.55	-2.740	-10.61 "	-21,96 *"	-12.10 *.	-20.70 ••

*Significant at P< 0.05 percent level of probability; ** significant at P<O.Ol percent level of probability.

Table 3. Estimates of heterobeltiosis in Fr hybrids of *Helianthus annuus* (Lirm)

Fr hybr'ids	Days to initial flowering	Days to complete flowering	Days to maturity	Plant height (cm)	Head diameter (cm)	Seed yield per plot (g)
CMS-232 X RHA-299	-3.920 "	-2.817 •	-3.012 "	-4.340	2.150	3.743 ••
HO-lA X RHP-44	-9.501 ••	-9.859 ••	-28.614 **	-0.348	10.330 ••	12.560 ••
CMS-232 X RHA-857	-3.563 **	-2.817 *	-6.024 ••	-2.609 *	-2.151	0.153
HO-lA X RHA-298	1,188	5.634 *.	1,506	-25.100 *•.	0.672	0.917
CMS-850 X RHA-856	-15.510	-11.268 **	-28.614 **	-4.830	1,344	1,220
HO-lA X RHA-268	-7.126 **	-7.042 ••	-16.566 ••	-1,913	1,344	-11,409
CMS-OIP X RHA-206	-4.751 **	-7.250 **	-22.590 **	-8,400	5.570	-7.570
CMS-IOP X RHA-299	-3.563 **	0.000	-19.578 **	-2.957 *	2.350 •	-34.800 ••
CMS-232 X RHP-44	-7.126 **	-5.634 **	27.108**	-25.'360••	-9.740	-25.610 **

*Significant at P< 0.05 percent level of probability; ** significant at P<O.Olpercent level of probability.

44 surpasses its better parent followed by CMS-232 x RHA-299, while the rest were almost recessive over their superior parent. These results further demonstrated that most of the Fr, hybrids took less days to initial and complete flowering compared to their mid as well as better parent, and could safely be included in future sunflower breeding programme. Work conducted earlier by Borodu-lina *et al.* (1981), Chaudhry and Anand (1984) and Reddy *et al.* (1985) also indicated significant heterotic effect for days to flowering. It was also noted from the estimates of heterobeltiosis that all the Fi hybrids except one (HO-lA x RHA-298), reduced number of days to crop maturity as compared to their better parent (Table 3). These results also explain that eight Fl hybrids were found to be early maturing than mid parent, while seven took lesser days to maturity than superior parents. This breeding material could be exploited to develop early maturing strains of sunflower, urgently needed to provide a chance for growing of subsequent crops. These results are supported by the findings of Singh *et al.* (1984) and Kukosh (1985) who also reported significant heterotic effect for days to maturity.

An examination of Tables 2 and 3 showed that Fl hybrid CMS-232 x RHP-44 had negative and significant heterotic effect on plant height. The heterobeltiosis effects were negative for all crosses in which four were significant (Table 3). These results are in· accordance with the findings of Shrinivasa (1982). He found significant heterosis for plant height in sunflower. The data in Table 2 show that most of the hybrids, displayed positive heterosis for head diameter. The heterobeltiosis estimate reveals that Fl hybrids, HO-lA x RHA-44 and CMS-OIP x RHA-299, had maximum positive and significant negative effect respectively over their better parents, while the rest except one were either positive or negative, but were non-significant. Research conducted earlier by Shrinivasa (1982), Chaudhry and Anand (1984) and Kukosh (1985) also showed significant heterosis for head diameter in sunflower.

It was observed that five crosses out of nine had positive and significant heterotic influence on seed yield, whereas two had significant negative heterosis for yield. This explained that six hybrids surpassed significantly their mid parent, while three did not (Table 2). The heterobeltiosis estimate (Table 3) indicated that two crosses Le. CMS-232 x RHA-298 and HO-lA x RHP-44 were found significantly superior to their better parent, however, rest of the hybrids developed, showed no significant heterobeltiotic effect for seed yield. The present results are in line with those reported by Shrinivasa (1982), Gupta and Khana (1982), Chaudhry and Anand (1984) and Kukosh (1985). They also reported significant heterosis for yield.

It may be concluded that of hybrids developed, eight were early maturing, four were dwarf, one showed greater size of ear head and five gave maximum yield over superior parents. It is suggested that these high yielding, short-statured and early maturing hybrids should be included in future sunflower breeding strategies to develop new varieties of sunflower.

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