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Effects of sowing dates on yield and yield components of hybrid sunflower (*Helianthus annuus* L) in non traditional areas of West Bengal

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Sunflower (*Helianthus annuus* L) is the second important source of vegetable oil in the world, after soybean. In India it is mostly grown in the states of Karnataka, Maharastra, Andhra Pradesh and Tamil Nadu with potential scope of growing in non traditional areas like West Bengal. In West Bengal sunflower is second important oilseed crop after rapeseed mustard during rabi (winter) season. Sunflower being a photoperiod neutral crop has wide scope to bring additional areas of rice fallows. Bange *et al.* (1997) investigated the effect of sowing date on sunflower yield performance and found changes in yield reduction with date of planting. Correct time of sowing, not only influences yield but also the kernel husk ratio. Seed weight tends to decrease with delayed sowing and greatest loss in the kernel. However, sowing outside the optimum time may be necessary to have a particular grade of oil (Weiss, 2000). The present study aimed at to quantify the sowing time variations with respect to yield and yield components of sunflower hybrids under five date of sowing in non traditional areas.

The experiment was laid out in 2008-09 at Pulses and Oilseeds Research Station, Berhampore, West Bengal with three hybrids namely PAC 1091, KBSH 44 and KBSH 1 received from Directorate of Oilseed Research, Hyderabad and planted on November 15, November 30, December 15, December 30 and January 15. The experimental design was laid out in a factorial set up with randomized complete blocks having three replications with plot size of 4.5m x 4.2m. The row to row distance was 60 cm. and plant to plant distance was maintained at 30 cm. Uniform dose of fertilizer @ 60 kg N, 90 kg P_2O_5 and 60 kg K_2O per hectare was applied. Sunflower seeds were planted by putting three seeds per hill and after emergence one plant per hill was maintained. Observations were recorded on ten randomly selected plants from each plot of all replications to record data on the following characters *viz.*, plant height (cm.), head diameter (cm.), seed filling(%), 100 seed weight (g) and oil content (%). Observations on 50% flowering (days), maturity (days) and seed yield (kg ha^{-1}) were taken on plot basis. The mean values were subjected to statistical analysis using M-STATC computer programme.

The statistical analysis revealed that head diameter showed a decreasing trend with delayed date of sowing (Table 1). Sowing on November 30 exhibited maximum head diameter (16.8 cm). The effects on head diameter were much more pronounced in case of last two sowing dates. The reasons of smaller head could be related to low plant vigour with early flowering and maturity. Similar results were reported by Paul and Thompson (1982), who concluded that smaller plants with less stem girth would give smaller heads. The interaction between hybrids and sowing also revealed similar trends, with November 30 sowing date had maximum head diameter with all three hybrids (Table 2).

Plant height of three hybrids showed that November 15 had highest plant height followed by that sown on November 30. There was reduction of plant height with delayed sowing dates (Table 1). Interaction effects also showed highest plant height with November 15 and November 30 sowing dates (Table 2). Days to 50% flowering and days to maturity revealed that November 15 and November 30 date of sowing, delayed flowering and maturity while delayed sowing resulted early flowering and maturity of all the hybrids (Table 1). Interaction effects (Table 2) also showed similar trend of flowering and maturity of the hybrids.Seed filling percentage and 100 seed weight plays a remarkable role in determining the grain yield. Earlier sowing showed maximum seed filling percentage and 100 seed weight (Table 1). The maximum seed filling percentage (92.7) and 100 seed weight (5.5 g) was in the case of November 30 sowing date followed by November 15 date of sowing (89.0% and 5g, respectively). The lowest value was recorded in case of January 15 date of sowing. This may be due to less head diameter and early flowering and maturity of the hybrids. Earlier sowing produced larger heads those ultimately encouraged higher seed filling % and 100 seed weight. Similar results were observed by La Vega and Hall (2002) who opined failures in seed set with delayed sowing was due to lack of fertilization or embryo abortion in the central portion of the floral disc.

Short Communication

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Table 1: Mean comparison of main effects of measured characters

Treatments	Seed yield (kg ha^{-1})	Head diameter (cm)	Oil content (%)	Plant height (cm)	50% flowering (days)	Maturity (days)	Seed filling (%)	100 seed wt. (g)
Sowing dates								
November 15	1664	16.8	37.8	184.1	83	115	89.0	5.0
November 30	2003	18.4	37.1	181.6	80	112	92.7	5.5
December 15	1106	14.4	35.1	167.9	70	102	82.1	3.8
December 30	838	10.9	32.4	143.5	58	93	81.4	3.2
January 15	678	9.0	34.0	117.1	57	89	80.0	3.1
LSD(0.05)	**248.8**	**0.62**	**0.52**	**6.48**	**0.97**	**0.66**	**1.64**	**0.28**
Varieties								
PAC 1091	1273	14.0	35.4	128.9	70	102	84.1	3.9
KBSH 44	1361	14.0	34.8	176.3	72	104	85.9	4.5
KBSH 1	1139	13.7	35.6	171.2	67	100	85.1	4.0
LSD(0.05)	**192.8**	**0.48**	**0.40**	**5.02**	**0.75**	**0.51**	**1.27**	**0.22**

Table 2: Mean comparison of interaction effects of measured characters

Treatments		Seed yield (kg ha^{-1})	Head diameter (cm)	Oil content (%)	Plant height (cm)	50% flowering (days)	Maturity (days)	Seed filling (%)	100 seed wt. (g)
November 15	PAC 1091	1362	17.2	37.8	148.3	83	113	87.2	4.8
	KBSH 44	1762	17.7	36.8	209.3	87	117	90.2	5.7
	KBSH 1	1869	15.5	38.9	194.6	81	113	90.0	4.5
November 30	PAC 1091	2235	19.1	37.7	140.3	80	110	93.0	5.1
	KBSH 44	2266	18.7	37.2	202.3	84	115	94.0	6.0
	KBSH 1	1508	17.3	36.4	202.0	77	110	91.0	5.4
December 15	PAC 1091	1166	13.8	35.9	134.6	70	102	81.0	3.6
	KBSH 44	1170	15.3	34.0	182.3	72	105	83.0	4.2
	KBSH 1	980	14.1	35.3	186.6	68	100	82.7	3.5
December 30	PAC 1091	883	10.6	32.0	117.0	59	94	79.4	2.7
	KBSH 44	950	10.1	32.6	164.3	60	94	82.5	3.5
	KBSH 1	680	11.9	32.6	149.0	56	90	82.4	3.5
January 15	PAC 1091	718	9.1	33.8	104.3	56	90	80.2	3.0
	KBSH 44	658	8.2	33.4	123.3	59	90	79.8	3.0
	KBSH 1	656	9.5	34.9	123.6	55	85	79.6	3.2
LSD (0.05)		**431.0**	**1.08**	**0.9**	**11.22**	**1.67**	**1.15**	**2.83**	**0.48**

Final seed yield is the major character which is influenced by individual yield components. Table-1 showed that maximum seed yield was November 30 sowing date followed by November 15 sowing date. Interaction effect (Table 2) revealed that PAC 1091 and KBSH 44 produced maximum seed yield with November 30 sowing date and KBSH 1 produced maximum seed yield with November 15 sowing date. These results are in confirmatory with those of Austin (1993) who reported significant differences in seed yield of different hybrids with different date of sowing. Late sown crops produced smaller plants, smaller heads, less number of seeds, low 100 seed weight and early flowering and maturity which ultimately translated into less seed yield compared to early sowings. La Vega and Hall (2002), Shahbaz *et al.* (2005) concluded that late planting dates affect negatively sunflower yield through reduction in all components.

Oil content (%) of sunflower seed was remarkably reduced for delayed sowing (Andrade 1995, Bange *et al.* 1997). The present investigation also showed similar trends of low oil yield with maximum oil content (%) at November 15 showing date (Table 2). Terminal stresses are likely to affect oil concentration simply through changes in the rate and duration of embryo and oil increases (Hall *et al* 1985) *i.e.*, a shortening of the grain filling period would result in a greater proportion of pericarp.

The results of present research work and analyses revealed differential interaction of sowing dates with different sunflower hybrids. This is consistent with earlier reports showing that late planting dates affect negatively sunflower yields through reductions in all its components. It is therefore suggested that November 30 sowing date is ideal for sunflower for getting maximum yield under Gangetic West Bengal condition.

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