Environment & Ecology 27 (1) : 185—189, 2009
 ISSN 0970-0420

Performance of Sunflower as a Function of Sowing Dates and Planting Techniques

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Abstract

Sunflower has emerged as an important oilseed crop of the country. To study the performance of sunflower as a function of sowing dates and planting techniques a field experiment was conducted for two years keeping five sowing dates and six planting techniques in split plot design. It was observed that early sowing on 21 December or 30 December gave significantly higher seed and oil yield than all the other dates of sowing. The reduction in seed yield with delay in sowing was found to be sequential. Among planting techniques ridge sowing and flat sowing covered with polythene mulch produced significantly higher seed yield than other methods of sowing. However, oil content increased, but oil yield decreased with delay in sowing. Oil content and protein content of sunflower did not differ significantly under different planting techniques.

Key words : Sunflower, Sowing date, Sowing method, Seed yield, Oil yield.

Sunflower is the second most important oil crop next to soybean containing oil of high quality due to its high linoleic acid which is suitable for making products like margarine (1). The meal, obtained after oil extraction contains about 40% protein which is valuable source of proteins for animals and humans. Sunflower is grown in India on about 1.7 million hectares but its average yield is low (549 kg/ha) as compared with world average of 1,219 kg/ha (3). Major reasons for its low yield is that despite an energy rich crop, it is not grown on recommended time with suitable planting methods and is mostly grown on poor soils. Its seeds are rich source of high quality edible oil which has non-cholesterol and anti-cholesterol properties. Being photo insensitive crop, it can be grown throughout the years but under Punjab conditions sowing of sunflower has been recommended during spring season. Generally sunflower is grown after potato, toria, cotton and increases the economic returns of the farmers. However, sunflower matures late in mid-June when sown in early February thereby delays the sowing of succeeding crops. Sunflower when sown in early December may face low temperature resulting in delayed emergence, late maturity and lower seed yield. These problems may, possibly be over come with the help of agronomic manipulations like sowing of sunflower on southern side of east-west laid ridges, mulching, seed soaking. However, these aspects have not been much addressed in India and particularly, under Punjab conditions where sunflower is an important oilseed crop. In view of the foregoing considerations an experiment was conducted to investigate the effects of sowing dates and planting techniques.

Methods

A field experiment was conducted at the research farm of Department of Agronomy, Punjab Agricultural University, Ludhiana for two years. The soil of the experimental field was loamy sand with pH 7.8, EC 0.2 mmhos/cm, organic carbon 0.29% (4), available nitrogen 120 kg/ha (5), P 15 kg/ha (6) and K 149 kg/ha (7). There were five dates of sowing which were kept in main plots and six planting techniques which were kept in sub-plots. The experiment was laid out in split plot design with three replications. The treatment details for the experiment are as follows.

Table 1. Seed yield of sunflower as influenced by sowing dates and planting techniques

Treatments	Seed yield		Final plant height (cm)		Stem diameter (cm)		1000 seed weight (g)		No. of filled seeds/heads	Days to	
	Ist year	IInd year	Ist year	IInd year	Ist year	IInd year	Ist year	IInd year	IInd year	Flowering	Maturity
Sowing Date											
Dec 21	25.2	–	144	–	–		48.1	–	–	–	–
Dec 30	23.9	30.1	144	148	2.46		47.1	53.5	1261	97	135
Jan 15	21.1	28.0	145	156	2.41		44.8	52.3	1221	89	124
Jan 30	18.7	25.0	147	162	2.35		42.0	49.8	1219	85	116
Feb 15	17.9	23.6	147	174	2.33		42.0	45.0	1175	72	109
Mar 02	–	22.5	–	176	2.24		–	39.4	1138	89	110
CD (5%)	2.49	0.95	NS	NS	0.11		2.90	3.30	NS	–	–
Planting Techniques											
Ridge sowing	24.2	27.6	151	168	2.48		51.2	53.4	1337	89	117
Flat sowing	19.3	23.4	143	160	2.26		41.0	43.3	1030	87	119
Flat sowing + water sowing	20.2	24.2	144	161	2.27		42.6	45.5	1148	89	120
Falt sowing + CaCl2 soaking	20.2	25.2	144	160	2.35		41.6	47.1	1184	90	120
Flat sowing + polythene mulch	23.0	28.6	147	162	2.40		49.2	51.9	1290	88	119
Flat sowing + FYM on seed rows	21.5	26.1	144	167	2.40		43.9	49.2	1228	89	120
CD (5%)	1.94	1.08	4.6	NS	0.07		2.68	4.05	89.3	–	–
Interaction	NS	NS	NS	NS	NS		NS	NS	NS	–	–

Main plots Sowing dates		Sub plots Planting techniques
First year	Second year	T_1 Ridge sowing
D_1 21 Dec	30 Dec	T_2 Flat sowing
D_2 30 Dec	15 Jan	T_3 Flat sowing with seeds soaked in water
D_3 15 Jan	30 Jan	
D_4 30 Jan	15 Feb	T_4 Flat sowing with seed soaked in 1% $CaCl_2$
D_5 15 Feb	2 Mar	T_5 Flat sowing covered with polythene mulch
		T_6 Flat sowing covered with farm manure yard

In T_1 the crop was sown on the southern side of the east-west laid ridges at 60 × 30 cm spacing. The ridges were formed after applying full dose of N and P fertilizers to soil. In T_3 and T_4 seeds were soaked in water and 1% $CaCl_2$ solution in volume equal to 75% of volume of seeds for 12 hours, respectively. These seeds were dried in shade before sowing. In T_6 the seed rows were covered with farm yard manure at 5 q/ha. In T_5 transparent polythene sheet was used to cover the plot after sowing and was removed 3 days after emergence. In T_1 two seeds per hill were dibbled at a depth of 5 cm on the southern slope of east-west laid ridges. Hybrid sunflower (MSFH-8) was sown keeping row to row spacing of 60 cm and plant to plant of 30 cm. Full dose of 60 kg N and 30 kg P_2O_5/ha in the form of urea and single super phosphate were applied before sowing. The crop was irrigated as and when required depending upon rainfall. The crop was sprayed against insects and pests with recommended chemicals.

Nitrogen content of the seeds was determined by Kjeldahl method after digesting the seeds in conc H_2SO_4 at 350 C. Protein content of seeds was estimated by multiplying the N content with a factor of 6.25. Oil content of sunflower seeds was estimated by wide line nuclear magnetic resonance spectroscopy and oil yield (kg/ha) was obtained as a product of oil content (%) and seed yield (kg/ha). Soil temperature was recorded from a depth of 5 cm at 0730 and 1430 hours everyday with a soil temperature probe

Table 2. Heat unit requirement for different phenophases of sunflower under different dates of sowing.

Sowing date	Emergence	Star stage	Bud stage	50% flowering	Physiological maturity	Harvesting
Dec 21	108	816	932	1254	1806	2136
Dec 30	100	800	918	1209	1825	2151
Jan 15	105	823	931	1232	1814	2140
Jan 30	106	813	928	1287	1859	2179
Feb 15	102	809	923	1271	1824	2154
Mean	104.2	812.2	926.4	1250.6	1825.6	2152

from sowing to crop emergence stage. Heat units were worked out for different growth stages by taking daily mean air temperature minus base temperature of 5 C.

Results and Discussion

Response of Sunflower to Sowing Dates

The dates of sowing were not similar during both the years; hence different parameters have been presented and discussed separately for each year. Over all, the seed yield was better during second years due to favorable weather conditions.

The seed yield of sunflower was significantly influenced by sowing dates during both the years. Table 1 shows that early sowing of 21 December in the first year and 30 December in second year of study produced the highest seed yield and was significantly better than all the latter sowing dates. The reduction in seed yield with each delay in sowing was sequential and works out to be 5.6, 16.6, 26.0 and 29.1% during first year and 7.2, 16.9, 21.7 and 25.4% during second year, respectively, as compared to first sowing date. This decrease in seed yield may be attributed to shorter vegetative and reproductive periods which might have resulted in lesser synthesis and translocation of photosynthates towards sink. Chhabra et al. (8) also reported that seed yield of sunflower was higher where duration of the crop was more. Late sowing experienced high temperature during reproductive stage which might have reduced translocation of photosynthates resulting in low seed yield. Higher seed yield obtained from early sowing was supported by yield contributing characters like test weight, seed weight and number of filled seeds per head and stem diameter (Table 1). Ujjinaiah et al. (9) also reported that early sowing favored the yield contributing characters and seed yield of sunflower and vice-versa. Although the changes in plant height recorded at harvest remained non-significant in different dates of sowing yet numerically there was an increase in plant height with delay in sowing. This may be attributed to accelerated plant growth due to high temperature experienced by the late sown crop. However, reverse was true in stem diameter recorded at harvest in the second year which decreased sequentially with delay in sowing. It was maximum (2.46 cm) in 30 December sown crop and minimum (2.24 cm) in 2 March sown crop. Increase in plant height with delay in sowing might have reduced the stem diameter. It was found that early sown crop took more days for emergence. During first year, crop sown on 21 December took 1, 4, 5 and 8 days more for emergence than 30 December, 15 January, 30 January and 2 March, respectively. This may be due to lower soil temperature experienced during early sowing as evident from the data on soil temperature (Table 2). Early sown crop took more days for maturity than late sown crop (Table 1). This might be due to higher temperature experienced by the late sown crop which accelerated emergence and later on hastened maturity.

Data on heat unit requirement for different phenophases showed that December 30 sowing date took lesser heat units for emergence, star, bud and 50% flowering stages, whereas more heat units were taken by December 21 sowing for emergence, bud stage and physiological maturity and January 15 for star stage and January 30 for 50% flowering stage (Table 3). This depends upon the corresponding variation in the atmospheric temperature since base temperature was taken 5 C. Over all, there was not great variation in the heat unit requirement for different stages. Heat unit requirement calculations can help in predicting the different stages of sunflower when sown on different sowing dates to adjust the agronomic management practices accordingly.

Response of Sunflower to Planting Techniques

The seed yield of sunflower was significantly influenced by planting techniques during both the years. Seed yield obtained from ridge sowing and flat sowing covered with polythene mulch were at par

Table 3. Mean soil temperature as influenced by sowing dates and planting techniques during seedling emergence. M : Morning temperature recorded at 0730 h, E : Evening temperature recorded at 1430 h.

	Sowing dates									
	Dec 21		Dec 30		Jan 15		Jan 30		Feb 15	
	1st Year									
Planting Techniques	M	E	M	E	M	E	M	E	M	E
Ridge sowing	9.0	26.0	6.0	21.0	3.0	26.0	9.0	28.0	11.0	30.0
Flat sowing	8.0	21.0	9.0	19.0	5.0	23.0	10.0	25.0	12.0	26.0
Flat sowing + polythene mulch	11.0	24.0	11.0	21.0	7.0	24.2	12.0	28.0	13.0	28.0
Flat sowing + FYM on seed rows	8.0	21.0	9.0	19.0	5.0	23.0	10.0	25.0	12.0	26.0
	2nd Year									
	Dec 30		Jan 15		Jan 30		Feb 15		Mar 2	
Planting Techniques	M	E	M	E	M	E	M	E	M	E
Ridge sowing	9.0	30.0	8.0	20.0	18.0		8.0	29.0	10.0	34.0
Flat sowing	11.0	23.0	9.0	24.0	11.0		10.0	25.0	14.0	30.0
Flat sowing + polythene mulch	12.0	27.0	10.0	26.0	13.0		11.0	30.0	15.0	32.0
Flat sowing + FYM on seed rows	11.0	23.0	10.0	23.0	11.0		10.0	24.0	13.0	30.0

with each other and significantly superior than all other treatments. The increase in seed yield in ridge sowing and flat sowing covered with polythene mulch over flat sowing was 25.5 and 18.0% during first year and 19.4 and 22.2% during second year, respectively. The increase in seed yield in these two planting techniques got support from yield contributing characters like head diameter and tesdt weight (Table 1). Minimum days for emergence were taken by flat sowing covered with polythene mulch treatment where as maximum days were taken by the flat sowing treatment (Table 1). This might be due to higher temperature maintained by polythene mulch particularly during night and on the southern slope of east-west laid ridges (Table 3) during noon. Plant height and stem diameter were maximum under ridge sowing followed by flat sowing covered with polythene mulch during both the years which may be due to more availability of plant nutrients. Sawhney et al. (10) also reported higher grain yield from ridge sown winter maize crop than flat sowing and higher soil temperature at base of the southern slope of the east-west laid ridges.

Effect on Quality Parameters

Contrary to seed yield of sunflower, oil content increased with the delay in sowing and the oil content obtained from 30 January and 15 February sowings was significantly higher than 21 December and 30 December sowings during first year. This might be due to higher temperature and more sunshine hours during reproductive phase which might have helped in more/higher synthesis of oil in late sowing. Izquierdo et al. (11) observed a strong effect of temperature during the period from flowering to 400 degree days after flowering than during other periods. Temperature affects total activity of oleate desaturase, the enzyme that catalyzes the conversion of oleic to loinoleic acid. Increase in night temperature resulted in a strong increment of oil content (12). It was also observed that the optimum sowing date for grain yield could be different than the sowing date that results in the best oil yield. In the present study also oil yield, decreased with delay in sowing which is due to decrease in seed yield with delay in sowing. Oil yield was maximum in 21 December sown crop which was 32% more than 15 February sown crop (Table 4). There was a decrease in protein content with delay in sowing. This may be due to more oil content which shows inverse relation with protein content. Protein content, oil content and oil yield of sunflower remained statistically unaffected by different planting techniques.

Table 4. Protein content, oil content and oil yield as influenced by sowing dates and planting techniques during seedling emergence.

	Protein content (%)	Oil content (%)	Oil yield (kg/ha)
Sowing Date			
Dec 21	18.9	35.2	89.6
Dec 30	18.4	35.5	848.6
Jan 15	18.0	36.4	767.7
Jan 30	17.8	37.1	693.8
Feb 15	16.9	37.6	674.5
CD (5%)	0.75	0.84	–
Planting Techniques			
Ridge sowing	18.6	36.1	871.8
Flat sowing	17.7	36.5	702.6
Flat sowing + water sowing	18.0	36.4	735.3
Flat sowing + CaCl2 soaking	17.9	36.5	737.7
Falt sowing + polythene mulch	18.2	36.3	834.2
Flat sowing + FYM on seed rows	17.7	36.4	784.1
CD (5%)	NS	NS	–
Interaction	NS	NS	–

However, highest oil yield of sunflower was obtained from ridge sowing (872 kg/ha) followed by flat sowing covered with polythene mulch treatment (834 kg/ha) which may be due to higher seed yield in these treatments.

Conclusion

It can therefore be concluded that early sowing (21 or 30 December) was favorable for achieving higher seed and oil yield of sunflower. Although early sown crop took more number of days to mature but vacated the field for timely sowing of succeeding crop. Seed yield from ridge sowing and flat sowing covered with polythene mulch was significantly superior to all other planting techniques tested.

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