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EFFECTS OF DIFFERENT SEED RATES AND SOWING DATES ON THE YIELD OF SAFFLOWER (*Carthamus tinctorius L.*)

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The results of the field experiments in safflower conducted in deep black soils under rainfed conditions at Jalgaon (Maharashtra) during the *Kharif* seasons of 1977-78 to 1979-80 showed that the differences in grain yield due to seed rates were significant while the differences in yield due to sowing dates were not significant. Irrespective of seasons, sowing safflower at seed rates ranging from 5.0 to 12.5 kg/ha resulted in marginal variation in its yield. The first fortnight of October was found to be the best period for sowing of safflower in Jalgaon region of Maharashtra.

Safflower *(Carthamus tinctorius L.)* a drought resistant crop, is mostly grown rainfed in the peninsular region of India. The average seed yield in the country is considerably low (325 kg/ha) as compared to other countries viz. U.S.A. (2012 kg/ha) and Mexico (1316 kg/ha). Among the various causes responsible for low yields of safflower, poor agronomic management is a prime factor.

A properly managed safflower crop can yield 1.5 tonnes/ha in the drylands of north-west India (De *et al.* 1974). Sounda *et al.* (1977)

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recommended a population of 1.28 lakh plants/ha and fertilization upto 80 kg. N/ha for partially irrigated lands. For dryland cropping, however a balance has to be maintained between the moisture available in the soil profile at sowing and the population pressure that stored water can sustain (Arnon 1972; Patil and De, 1978). Since safflower is sown on conserved or residual moisture, the optimum seeding time would be governed not only by the amount of moisture held in the soil profile but also by the temperature prevailing at the time of sowing. The seed rate used for sowing to maintain the optimum plants is also an important factor in maximising the production. The present study was, therefore, taken up to optimise these two factors for maximising the production.

MATERIALS AND METHODS

An experiment was laidout in a factorial randomised block design replicated three times at the Agricultural Research Station, Jalgaon (India) during 1977-78 to 1979-80 under rainfed conditions. Treatments comprised of 4 levels of seeding rates *viz.* 5, 7.5, 10 and 12.5 kg/na and three sowing dates *viz.* 15th September, 1st October and 15th October. The safflower variety 'Tara' was used and it was sown at 45 cm. apart. The final yield was recorded from an uniform net area of 7.40 x 3.60 m^2. All plots received 50 kg N + 10 kg $P_2 O_5$ /ha applied in the field at the time of seeding during all the years. The crop was sown behind a manually drawn marker, care being taken to put the seeds in the moist zone, especially on the second and third dates since the soil moisture had receded considerably by then. No thinning was done in all the treatments. The crop was taken on *Kharif* fallow. The soil of the experimental site was deep black cotton with pH of 8.2, medium in nitrogen and phosphorus and rich in potash in all the three years.

Total rainfall from September to February received was 271.8, 129.8 and 246.0 mm with 24, 23 & 23 rainy days in 1977-78, 1978-79 and 1979-80 respectively. The maximum temperatures were very high in the month of October in all the years.

RESULTS AND DISCUSSION

Effect of seeding rates:

The differences in the yield due to seeding rates were found to be significant during all the years and also on pooling the results for three years (Table 1). A seed rate of 5 kg/ha gave the lowest yield which was significantly inferior to the rest of seed rates while seed rates of 7.5, 10 and 12.5 kg/ha yielded on par. A seed rate of 7.5 kg/ha recorded the highest yield. Irrespective of seasons, sowing safflower at seed rates ranging from 7.5 to 12.5 kg/ha resulted in marginal variation in the yields of safflower. A seed rate of 7.5 kg/ha gave the highest yield but there was a very marginal difference in the yield obtained from a seed rate of 10 kg/ha. Leaving margin for both high and low moisture conditions, a seed rate of 10 kg/ha would be sufficient for safflower grown in drylands, when the crop is to be taken after *kharif* fallow.

Table 1. Influence of different levels of seeding rates and seasons on the yield of safflower

Seed rate (kg/ha)	Seed yield (kg/ha)			
	1977	1978	1979	Pooled
5.0	901	595	534	677
7.5	1085	761	693	846
10.0	1055	781	683	840
12.5	995	779	622	798
Mean	1009	729	633	—
S. E. ±	42.79	37.54	41.26	24.32
C. D. at 5%	125.49	108.26	104.76	68.42

Interaction - seeding rates x seasons.

S. E. ± 42.00

C. D. at 5% 118.31

Table 2. Effect of various sowing dates and seasons on the yield of safflower.

Sowing dates	Seed yield (kg/ha)			
	1977	1978	1979	Pooled
15th September	796	746	278	607
1st October	1261	742	463	822
15th October	975	699	1159	884
Mean	1011	729	633	—
S. E. ±	35.7	31.3	48.1	143.2
C. D. at 5%	104.8		149.8	—

interaction - Sowing dates x seasons - N. S.

At Varanasi, a 10 kg seed rate/ha was reported to give the highest yield (Anonymous, 1982). Girase *et al.* (1980) also reported the increase in the yield with the increase in the plant density. Montilla (1968) reported the highest yield of 1450 kg/ha obtained with the highest plant density. Seed yield was maximum at a population density of 166,000 plants/ha. However, a plant density of 111,000 plants/ha was most conducive for obtaining high seed yield and biological yield. (Ganga Saran *et al.* 1980).

It would be seen from Table 3 that the height of a plant was found to increase with the increase in the seed rate. The number of primary branches/plant, number of capitula/plant and number of seeds/capitulum were higher when a seed rate of 5 kg/ha was used and they were observed to be reduced with increase in the seed rate. Girase *et al.* (1980) also reported the similar observations except 1000 grain weight which was reported to be not influenced by different plant densities whereas it was slightly decreased with the increase in the seed rate in our observations.

In the present studies, the interaction between season x seed rates was found to be significant and seed rates x sowing dates was observed to be not significant. Interaction between seed rates x sowing dates x season was not significant.

Table 3. The mean yield components of safflower as influenced by different treatments (Average of 3 years i.e. 1977-78 to 1979-80)

Treatments	Mean height per plant at harvest (cm)	Mean No. of Primary branches/ plant at harvest	Mean No. of capitulum/ plant	Mean No. of seeds/ capitulum	1000 grain wt (g)	Plant stand/ha at harvest (in thousands)
I) Seeding rates kg/ha						
1. 5.00	59.6	12.23	33.2	21.69	48.83	47.02
2. 7.5	62.8	11.14	29.7	21.65	48.65	72.46
3. 10.5	60.3	9.36	23.4	20.64	48.13	95.37
4. 12.5	62.8	8.43	20.3	20.01	46.88	110.10
Mean	61.4	10.29	26.6	20.99	48.12	—
S. E. ±	1.21	0.41	0.79	1.22	0.78	—
C. D. at 5%	—	1.34	2.58	—	—	—
II) Sowing dates						
1. 15th September	61.9	9.75	19.7	19.27	46.71	113.36
2. 1st October	62.3	10.70	29.6	23.57	48.29	86.46
3. 15th October	62.19	10.66	26.5	22.14	47.92	78.31
Mean	62.1	10.37	25.3	21.66	47.64	—
S. E. ±	0.92	0.54	2.73	2.14	0.85	—
C. D. at 5%	—	—	6.16	—	—	—

Effect of sowing dates :

The differences in yield due to sowing dates were significant for two seasons out of three. This might be due to the variation in the seasons. The second sowing date i. e. 1st October recorded the highest yields than other two sowing dates during 1977 - 78 and 1978 - 79. Fifteenth October sowing proved distinctly significantly superior to 1st October and 15th September sowings in the year 1979-80. Such unusual trends were observed because during 1978 only 129.8 mm rainfall was received as against 271.8 mm in 1977 and 246.0 mm in 1979 during crop season. During 1977, 1st October sowing gave significantly higher yield of 1261 kg/ha. This was due to the better establishment of the crop as the rainfall of 35.02 mm was received in the first week of October, while the crop sown on 15th October suffered due to subsequent moisture stress during the early crop growth period in 1977 and 1978 whereas it recorded significantly highest yield of 1159 kg/ha during 1979. This was due to the rainfall of 17.06 mm received on 14th October and 22.08 mm on 22nd October which ensured the proper germination and better establishment of the crop during early corp growth period. The early sowings on 15th September and 1st October suffered from *alternaria* leaf spot during all the seasons in general and 1979 in particular which resulted in the low yields. The sowing time had very significant effect on the yield of safflower. Irrespective of seasons and seeding rates, the first fortnight of October seems to be the best period for sowing of safflower in this region provided sufficient moisture is available in the soil at seeding. This however, needs further confirmation in the light of the variation in the season and rainfall. Girase *et al.* (1975) also reported that the safflower sown on 1st October had most favourable effects in respect of yield & yield components, whereas at Rajendranagar (Anon. 1979) the highest yield (971 kg/ha) was obtained when the crop was sown on 12th October and the yield decreased with later sowings. Ganga Saran *et al.* (1980) reported that the sowing of safflower in the second week of October at an optimum temperature of 26° C was most conducive for obtaining high seed yield and biological yield as well as high harvest index.

It could be seen from Table 3 that the yield components like number of primary branches/plant, number of capitula/plant, number of seeds/capitulum and 1000 grain weight were highest when the crop was sown on 1st October. These observations are similar to those observed by Girase *et al* (1975).

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ASSOCIATION STUDIES IN *TRITICALE*

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Correlation and path coefficient analyses were carried out in 63 strains of *triticale* for grain yield and its components. Grain yield / plant showed significantly positive association with tillers/plant, grains/main spike and spikelets/main spike, while length of main spike and 100-grain weight though had positive association but of low magnitude. Plant height had negative correlation with yield. Path coefficient analysis revealed that tillers/plant, grains/main spike and 100-grain weight had positive direct effects on grain yield/plant. Spikelets/main spike and spike length also showed positive direct effect on grain yield/plant but of low magnitude. Therefore, due stress must be laid on number of tillers/plant, number of grains/main spike, 100-grain weight, number of spikelets/main spike and length of main spike during the selection for higher yield in *triticale*.

The primary *triticales* synthesized by doubling the chromosomes of the f_1 hybrids between *Triticum aestivum* and *Secale cereale* are very low in yield as compared to wheat and barley which is primarily due to shrivelled endosperm and poor seed set. The secondary *triticales* produced by selection also did not prove better and hence further improvement may be achieved through hybridization and selection for which a clear picture of the interrelationship between yield and its components is

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