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Influence of irrigation and nitrogen on safflower (*Carthamus tinctorius*)

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Safflower (*Carthamus tinctorius* L.) is one of the most suitable oilseed crops for drylands owing to its deep root-system and spiny nature of leaves. However, high-yielding, spineless varieties of safflower have been developed to make this crop widely adaptable. Since most of the information available on irrigation and nutrient management aspects of safflower pertains to spiny varieties, it becomes imperative to study the effect of irrigation and doses and time of nitrogen application on recently developed spineless varieties of safflower.

An experiment was conducted during the winter season (*rabi*) of 1990–91 and 1991–92 at New Delhi. The soil was sandy loam, low in organic carbon (0.42%) and medium in available phosphorus (18.0 kg P/ha) and potassium (213 kg K/ha), with pH 7.8. Bulk density, field capacity and wilting point of soil up to 30 cm depth was 1.51 g/cc, 19 and 7% respectively.

The treatments comprising 4 levels of irrigation (no irrigation, 1 irrigation at rosette termination, 1 at flowering and 2 irrigations, 1 each at resette termination and flowering stages) formed the main plots. Five treatments of nitrogen, viz. 2 doses (40 and 80 kg/ha) in combination with 2 stages of its application (sole at sowing and half at sowing + half at first irrigation) along with 1 absolute control, were assigned to subplots. Thus 20 treatment combinations were tested in split-plot design, replicated 3 times. Spineless variety 'JSI 7' of safflower was sown at the distance of 45 cm on 6 and 11 November and harvested on 9 and 4 May in respective years. In the 2 years, first irrigation was applied on 21 December and 7 January, i.e. 45 and 57 days after sowing, respectively. In the respective seasons second irrigation was applied on 19 and 25 March, i.e. 133 and 134 days. During 2 respective seasons a total rainfall of 99.3 mm in 7 splits and 59.5 mm in 5 splits was recorded.

Safflower responded to irrigation and showed improvement in seed yield (Table 1). However, results were significant during

Table 1. Effect of irrigation and doses and time of N application on seed yield of safflower

Treatment	Seed yield (q/ha)	
	1990–91	1991–92
Irrigation		
No irrigation	14.1	22.0
1 irrigation (rosette termination)	14.0	24.1
1 irrigation (flowering)	15.6	23.8
2 irrigations 1 each at rossette termination + flowering	14.9	26.6
CD (P = 0.05)	NS	2.1
N application		
0	12.1	20.6
40 kg/ha, sole	13.7	22.8
80 kg/ha, sole	15.8	24.8
40 kg/ha, split	15.6	25.1
80 kg/ha, split	16.2	26.0
CD (P = 0.05)	1.5	2.2

1991–92. One irrigation at rosette-termination stage increased the seed yield significantly over no irrigation. Irrigation at rosette termination and flowering remained at par for seed yield. Two irrigations applied at both the stages further increased the seed yield during 1991–92. Rains which coincided with these critical stages might have nullified the irrigation effect, whereas rainfall during 1991–92 was negligible and showed its ineffectiveness.

Application of N significantly influenced the seed yield in both the seasons. During 1990–91 a significant increase was recorded up to 80 kg N/ha, whereas during 1991–92 yield increased significantly only up to 40 kg/ha. Split application of 40 kg N/ha increased the seed yield significantly over its sole application at the sowing. Split application of both 40 and 80 kg N/ha remained at par for seed yield. On an average, 40 and 80 kg N/ha applied as sole at sowing increased the seed yield by 11.6 and 23.3% over the control, whereas split application of 40 kg N/ha increased the yield by 25.7%. It indicates that split application of 40 kg N/ha gave 12.6% higher yield than its sole application.

Response of safflower to N under sole and split applications showed that response to sole application at sowing was linear in both years. The equations worked out for the response in 2 years were $Y = 12.05 + 0.0438\ X$ and $20.47 + 0.055\ x$ respectively.

Unlike sole application, split application showed quadratic response and the equations worked out were $Y = 12.10 + 0.1338\ X - 0.0010\ X^2$ and $20.60 + 0.1575\ X - 0.0011X^2$ respectively. Under split application, doses of 62.3 and 67.4 kg N/ha were worked out to be economically optimum during 1990–91 and 1991–92 respectively. Response at respective economic optimum doses were 4.45 and 5.62 q/ha. Response per kg N and return per rupee invested were 7.15 kg and Rs 6.74 during 1990–91 and 8.34 kg and Rs 8.03 during 1991–92 respectively.