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M Rakesh
M.Sc. Student, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India

Rajesh Singh
Assistant Professor, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India

Ekta Singh
Ph.D., Scholar, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India

Corresponding Author:
M Rakesh
M.Sc. Student, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India

Influence of nitrogen and foliar spray of iron on yield and economics of safflower (*Carthamus tinctorius* L.)

M Rakesh, Rajesh Singh and Ekta Singh

Abstract
A Field experiment was conducted during *rabi* 2020-21 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.3), low in organic carbon (0.57%), available N (230 kg/ha), available P (32.10 kg/ha) and available K (235 kg/ha). The treatments consist of four levels of Nitrogen soil application and three levels of Iron foliar spray. The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice. It is concluded that application of 50 kg/ha N + 0.6% iron foliar spray recorded significantly higher grain yield (1427.7 kg/ha), gross return (74,745 ₹/ha), net return (50,184 ₹/ha) and benefit cost ratio (2.04). These findings are based on one season; therefore, further trail may be required for further confirmation.

Keywords: Nitrogen, iron foliar spray, grain yield and economics

Introduction
Oil consumption has been increased due to increasing population and capitation consumption recently. Certainly, one of the most attentions is to cultivate oil seeds, such as safflower, because of its importance in human nutrition. Improvement of oil seeds quality and quantity has formed an important part of cultivation in different counties (Weiss, 2000) [5].
Oil seeds have an important role in nutritionally demands of mankind, animal feeding and medicine (Singh, 2007) [3]. Nutrient management is one of the critical inputs in achieving high productivity of safflower. Nitrogen is a crucial element for development of crop. Nitrogen plays a major role in increasing the photosynthetic surface and in turn increases the translocation of photosynthates to sink and results in increasing the productivity. Nitrogen combined with high concentration of chlorophyll utilizes the sunlight as an energy source to carryout essential plant functions including nutrient uptake. Iron helps in the formation of chlorophyll, and it helps in absorption of other nutrient elements. The deficiency of secondary and micronutrients is wide spread in many parts of the country due to cultivation of high yielding varieties and intensive agriculture. Rational application of elements as they have becoming a factor for obtaining higher yields of several oil seed crops including safflower. Therefore, keeping in view of the said facts above, safflower crop yields can be enhanced through nutrient management, for which the present investigation was initiated.

Materials and Methods
Field experiment was conducted during *rabi* 2020-21 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.3), low in organic carbon (0.57%), available N (230 kg/ha), available P (32.10 kg/ha) and available K (235 kg/ha). The treatments consist of four levels of Nitrogen soil application and three levels of Iron foliar spray. The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice.

Results
Yield attributes
Data in table 1 tabulated that the significantly higher number of capsules per plant was observed in 50 kg/ha N + 0.6% iron foliar spray (22.18). Which was statistically at par with the application of 50 kg/ha N + 0.5% iron foliar spray (21.08), 50 kg/ha N + 0.3% iron foliar spray (21.40), 40 kg/ha N + 0.6% iron foliar spray (20.90) and 40 kg/ha N + 0.5% iron foliar spray (19.95). Similar result was reported by Zareii *et al.* (2014) [6].

Higher number of seeds per capsule and test weight (g) was observed in 50 kg/ha N + 0.5% iron foliar spray (17.60), 50 kg/ha N + 0.6% iron foliar spray (36.89 g) respectively, but there was no significant difference among the treatments.

Table 1: Influence of Nitrogen and Iron applications on yield attributes of safflower

S. No	Treatments	No. capsules/plant	No. Seeds/capsule	Test weight (g)
1.	30 kg/ha N + 0.3% iron foliar spray	17.80	16.06	36.56
2.	30 kg/ha N + 0.5% iron foliar spray	18.08	16.46	36.75
3.	30 kg/ha N + 0.6% iron foliar spray	18.71	17.03	36.52
4.	40 kg/ha N + 0.3% iron foliar spray	19.40	16.59	36.91
5.	40 kg/ha N + 0.5% iron foliar spray	19.95	17.16	36.72
6.	40 kg/ha N + 0.6% iron foliar spray	20.90	17.05	36.79
7.	50 kg/ha N + 0.3% iron foliar spray	21.40	17.32	36.7
8.	50 kg/ha N + 0.5% iron foliar spray	21.08	17.60	36.82
9.	50 kg/ha N + 0.6% iron foliar spray	22.18	17.47	36.89
	F test	S	NS	NS
	S.Em (±)	0.82	0.39	0.18
	CD (p=0.05)	2.46	-	-

Yield

Data in table 2 tabulated that significantly higher grain yield was observed in 50 kg/ha N + 0.6% iron foliar spray (1427.6 kg/ha). Which was statistically at par with 50 kg/ha N + 0.5% iron foliar spray (1423.6 kg/ha) and 50 kg/ha N + 0.3% iron foliar spray (1403.2 kg/ha). Seed yield is the function of several yields attributing characters *viz*., number of capsule per plant, number of seeds capsule and 100 seed weight. Cumulative effect of all the yield attributing characters due to adequate nutrition of nitrogen might have resulted in the production of higher seed yield reported by Tomar (2012) [4]. The significantly higher stover yield was observed in 50 kg/ha N + 0.6% iron foliar spray (3695.2 kg/ha). Which is statistically at par with the application of 50 kg/ha N + 0.5% iron foliar spray (3642.3 kg/ha) 50 kg/ha N + 0.3% iron foliar spray (3566.1 kg/ha) and 40 kg/ha N + 0.6% iron foliar spray (3563.2 kg/ha). The increase in stalk yield is due to increase in respiration and photosynthesis, indirectly affected on source and sink relation by application of Iron reported by Ravi *et al*. (2008) [2]. Higher plant height, branches per plant, resulting from the application of higher doses of nitrogen reported by Nathan *et al*. (2017) [1]. The higher harvest index was observed in 50 kg/ha N + 0.3% iron foliar spray (28.43). But there is no significant difference among the treatments.

Table 2: Influence of Nitrogen and Iron applications on yield of safflower

S. No	Treatments	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Harvest Index (%)
1.	30 kg/ha N + 0.3% iron foliar spray	1202.3	3279.3	26.46
2.	30 kg/ha N + 0.5% iron foliar spray	1250.6	3228.6	27.00
3.	30 kg/ha N + 0.6% iron foliar spray	1275.3	3326.7	27.92
4.	40 kg/ha N + 0.3% iron foliar spray	1280.2	3461.6	27.36
5.	40 kg/ha N + 0.5% iron foliar spray	1341.0	3469.1	28.19
6.	40 kg/ha N + 0.6% iron foliar spray	1355.0	3563.2	27.21
7.	50 kg/ha N + 0.3% iron foliar spray	1403.2	3566.1	28.43
8.	50 kg/ha N + 0.5% iron foliar spray	1423.6	3642.3	28.14
9.	50 kg/ha N + 0.6% iron foliar spray	1427.7	3695.2	28.00
	F test	S	S	NS
	S.Em (±)	35.19	69.79	0.76
	CD (p=0.05)	105.5	209.23	1.08

Economics

Data in table 3 tabulated Experimental results revealed that maximum cost of cultivation (24,574.5 ₹/ha) and gross return (74,745 ₹/ha) and net return (50,184 ₹/ha) is found in with the application of 50 kg/ha N + 0.6% iron foliar spray. Higher B:C ratio is found in with the application of 50 kg/ha N + 0.6% iron foliar spray (2.04) respectively.

Table 3: Influence of Nitrogen and Iron applications on economics of safflower

S. No	Treatments	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
1.	30 kg/ha N + 0.3% iron foliar spray	23,861.97	61,426	37,564	1.57
2.	30 kg/ha N + 0.5% iron foliar spray	24,181.97	65,034	40,853	1.68
3.	30 kg/ha N + 0.6% iron foliar spray	24,341.97	62,871	41,768	1.71
4.	40 kg/ha N + 0.3% iron foliar spray	23,978.28	68,050	44,072	1.83
5.	40 kg/ha N + 0.5% iron foliar spray	24,298.28	70,910	46,612	2.00
6.	40 kg/ha N + 0.6% iron foliar spray	24,458.28	69,420	38,361	1.83
7.	50 kg/ha N + 0.3% iron foliar spray	24,094.50	71,240	47,146	1.95
8.	50 kg/ha N + 0.5% iron foliar spray	24,414.50	74,204	49,790	2.03
9.	50 kg/ha N + 0.6% iron foliar spray	24,574.50	74,745	50,184	2.04

Conclusion

It is concluded that application of 50 kg/ha N + 0.6% iron foliar spray recorded significantly higher grain yield (1427.7 kg/ha), gross return (74,745 ₹/ha), net return (50,184 ₹/ha)

and benefit cost ratio (2.04). These findings are based on one season; therefore, further trail may be required for further confirmation.

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