__Original Research Article__

Effect of Sulphur and foliar application of Iron on Yield and Economics of Lentil (*Lens culinaris* L.)

ABSTRACT

A field experiment was conducted during *Rabi* season of 2022 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, (U.P) India to study the Effect of Sulphur and foliar application of Iron on Yield and Economics of Lentil. The treatments consist of 3 levels of Sulphur (20, 30, 40 kg/ha) and 2 levels of Iron (control, 0.3%, 0.5%) and Control (20-40-20 NPK kg/ha). There were 10 treatments each replicated thrice. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.9), Organic carbon (0.112%), available N (278.93 kg/ha), available P (10.8 kg/ha), and available K (206.4 kg/ha). Results revealed that yield attributes like more no of pods per plant (162.40), more no of seeds per pod (2.53), higher seed yield (1556.19 kg/ha) and higher stover yield (2868.3 kg/ha) were significantly influenced with application of Sulphur 40 kg/ha + Iron 0.5%. Maximum gross returns (85590.45 INR/ha), net returns (57460.45 INR/ha) and benefit cost ratio (2.04) were also recorded in same treatment T_9 (Sulphur 40 kg/ha + Iron 0.5%).

Keywords: *Lentil, Sulphur, Iron, Yield attributes, Yield and Economics.*

1. INTRODUCTION

Lentil (*Lens culinaris* L.) is typically produced in marginal soils with low fertility status during the rabi season **(Sahay *et al.* 2013)**. It is India's most important pulse crop. Due to its deep root structure, it is best suited for rain-fed environments. Due to the large number of efficient nodules in their roots which supply nitrogen to the soil, it also contributes positively to boosting the fertility of the soil **(Omer, 2009)**. Lentil contains about 11% water, 25% protein and 60% carbohydrates **(Singh, 2001)**. Due to its low cellulose content, lentil straw is also regarded as animal feed **(Erskine *et al.* 1990).** However, the vegetative parts of lentils can be utilised as green manure **(Kara, 2008).** It is North India's third-largest pulse crop **(Singh *et al.* 2014)**. In India it is cultivated in area of 14.24 lakh ha with the production of 12.17 lakh tones and productivity of 855 kg/ha.

Sulphur plays a crucial and unique role in the synthesis of proteins, chlorophyll, and oil content as well as sulfur-containing amino acids like methionine (20%) and cysteine (27%). Additionally, it is associated to the production of vitamins (such as biotin and thiamine) and the coenzyme-A metabolism of carbohydrates, proteins, and lipids. Sulphur is also known to promote nodulation in legumes where it aids in N fixation and is linked to crops with spurious nutritional value **(Yadav *et al*. 2019)**.

Despite not being a component of chlorophyll, iron is involved in its synthesis. Various metabolically active substances, including cytochromes (B, B6, C1, and A3), heme and non-heme enzymes, and other functional metal proteins like ferrodoxin and haemoglobin, possess iron as a component. Well known role of Iron is its catalytic role in biological oxidation-reduction and other metabolic processes in plants, such as oxidative photophosphorylation during cell respiration. It is also known to play a role in the metabolism of carbohydrates **(Poonia *et al.* 2018)**. Foliar application of micronutrients is more advantageous than soil application because the application rate of the nutrient is relatively lower and nutrient absorption is higher. Moreover, foliar treatment is always a suitable substitute when roots are unable to supply vital nutrients **(Hanwate *et al*. 2018)**.

Keeping in view the above facts, the present experiment was undertaken to find out **"Effect of Sulphur and foliar application of Iron on Yield and Economics of Lentil (Lens culinaris L.)".**

2. MATERIAL AND METHODS

A field experiment was conducted during *Rabi* season 2022 at the Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.). The farm is located at 25.57° N latitude, 87.19° E longitude and at an altitude of 98m above mean sea level. The soil of experimental plot was sandy loam texture, nearly neutral in soil reaction (pH 6.9), low in organic carbon (0.112%). The experiment was laid out in Randomized Block Design comprising of 3 levels of Sulphur (20, 30, 40 kg/ha), 2 levels of Iron (control, 0.3%, 0.5%)

and Control (20-40-20 NPK kg/ha). There were 10 treatments each replicated thrice. The treatments consist of T_1-Sulphur 20 kg/ha + Control, T_2-Sulphur 20 kg/ha + Iron 0.3%, T_3-Sulphur 20 kg/ha + Iron 0.5%, T_4-Sulphur 30 kg/ha + Control, T_5-Sulphur 30 kg/ha + Iron 0.3%, T_6-Sulphur 30 kg/ha + Iron 0.5%, T_7-Sulphur 40 kg/ha + Control, T_8-Sulphur 40 kg/ha + Iron 0.3%, T_9-Sulphur 40 kg/ha + Iron 0.5% and T_{10}-Control (20-40-20 NPK kg/ha). The field was levelled properly and the seeds are sown with seed rate 40-45 kg/ha and at the spacing of 30 cm x 10 cm in line sowing. The lentil variety taken to carry out the experiment was PL-406. Recommended dose of fertilizers 20-40-20 NPK kg/ha were applied as basal dose and Sulphur was added to soil just before sowing. Foliar application of Iron was done at pre-flowering and pod formation stage. Thinning and gap filling operations were done at 10 days after sowing. The experimental plots were kept weed free throughout the crop growing period. 5 plants were randomly selected and tagged for recording observations. The observations were recorded for number of pods per plant, number of seeds per pod, seed yield (kg/ha), stover yield (kg/ha). The data were subjected to statistical analysis by analysis of variance method **(Gomez and Gomez, 1976).**

3. RESULTS AND DISCUSSION

3.1 YIELD ATTRIBUTES AND YIELD

3.1.1 Number of pods per plant

The data revealed that significantly, more number of pods per plant (162.40) were recorded in treatment T_9 [Sulphur 40 kg/ha + Iron 0.5%], however treatment T_8 [Sulphur 40 kg/ha + Iron 0.3%] was found to be statistically at par with treatment T_9.

Sulphur was found to boost yield attributes when balanced nutrients were applied because the element is known to help plants to form reproductive organs, which result in the development of pods and seeds and led to an increase in yield attributing parameters in lentil. Similar results were previously reported by **Sahu *et al.* (2021).** Foliar application of iron during the flowering and pod-formation stages, which helps in efficient photosynthate transfer from source to sink and results in a higher number of pods and seeds per pod, might have led to further increase. Similar results were previously reported by **Barla *et al*. (2022).**

3.1.2 Number of seeds per pod

The data revealed that significantly, more number of seeds per pods (2.53) were recorded in treatment T_9 [Sulphur 40 kg/ha + Iron 0.5%], however treatment T_8 [Sulphur 40 kg/ha + Iron 0.3%] was found to be statistically at par with treatment T_9.

3.1.3 Test weight (g)

The data revealed that there was no significant difference between treatments. However maximum test weight (21.07 g) was recorded in treatment T_9 [Sulphur 40 kg/ha + Iron 0.5%] whereas, minimum test weight (20.99 g) was recorded in treatment T_2 [Sulphur 20 kg/ha + Iron 0.3%].

3.1.4 Seed yield (kg/ha)

The data revealed that significantly higher seed yield (1556.19 kg/ha) was recorded in treatment T_9 [Sulphur 40 kg/ha + Iron 0.5%], however treatment T_8 [Sulphur 40 kg/ha + Iron 0.3%] was found to be statistically at par with treatment T_9.

Sulphur has been discovered to be a crucial component for increased pulse production because it is a component of proteins, sulpholipids, enzymes, and other compounds. Similar findings were reported by **Das and Misra (1991)**. The application of iron, which aids in photosynthesis, assimilates nutrients for transportation to sinks, and boosts carbohydrate synthesis, may have led to the further increase. This, in turn, increases seed yield and stover yield. Similar findings were reported by **Anitha *et al.* (2005)**.

3.1.5 Stover yield (kg/ha)

The data revealed that significantly higher stover yield (2868.3 kg/ha) was recorded in treatment T_9 [Sulphur 40 kg/ha + Iron 0.5%], however treatment T_8 [Sulphur 40 kg/ha + Iron 0.3%] was found to be statistically at par with treatment T_9.

3.1.6 Harvest index (%)

The data revealed that there was no significant difference between treatments. However higher harvest index (35.87%) was recorded in treatment T_7 [Sulphur 40 kg/ha + Control] whereas, lesser harvest index (34.88%) was recorded in treatment T_4 [Sulphur 30 kg/ha + Control].

ECONOMICS

Highest cost of cultivation (28130.00 INR/ha) was observed in treatment T_9 [Sulphur 40 kg/ha + Iron 0.5%] and lowest was observed in treatment T_{10} [20-40-20 NPK kg/ha]. Gross returns varied due to the application of different levels of Sulphur and Iron in lentil. Higher gross returns (85590.45 INR/ha) were observed in treatment T_9 [Sulphur 40 kg/ha + Iron 0.5%] and lowest (53176.75 INR/ha) were observed in treatment T_{10} [20-40-20 NPK kg/ha]. Higher net returns (57460.45 INR/ha) were observed in treatment T_9 [Sulphur 40 kg/ha + Iron 0.5%] and lower were observed in treatment T_{10} [20-40-20 NPK kg/ha]. Highest B:C ratio (2.04) was observed in treatment T_9 [Sulphur 40 kg/ha + Iron 0.5%] and lowest B:C ratio (1.08) was observed in treatment T_{10} [20-40-20 NPK kg/ha].

Table 1. Effect of Sulphur and foliar application of Iron on yield attributes and yield of Lentil.

S.No	Treatment combinations	No. of Pods/plant	No. of seeds/pod	Seed yield (kg/ha)	Stover yield (kg/ha)
1	Sulphur 20kg/ha + Control	155.47	1.20	1018.89	1861.9
2	Sulphur 20kg/ha + Iron 0.3%	158.13	1.73	1159.63	2170.3
3	Sulphur 20kg/ha + Iron 0.5%	159.27	1.93	1266.90	2314.6
4	Sulphur 30kg/ha + Control	156.80	1.33	1047.80	1955.1
5	Sulphur 30kg/ha + Iron 0.3%	159.53	2.00	1361.79	2455.8
6	Sulphur 30kg/ha + Iron 0.5%	160.87	2.07	1434.81	2599.3
7	Sulphur 40kg/ha + Control	157.40	1.53	1136.40	2032.7
8	Sulphur 40kg/ha + Iron 0.3%	161.80	2.33	1515.27	2755.5
9	Sulphur 40kg/ha + Iron 0.5%	162.40	2.53	1556.19	2868.3
10	Control (20-40-20 NPK kg/ha)	151.33	1.07	966.85	1753.0
	F-test	S	S	S	S
	SEm (±)	0.32	0.08	14.39	39.84
	CD (p=0.05)	0.94	0.25	42.78	118.40

Table 2. Effect of Sulphur and foliar application of Iron on Economics of Lentil.

S.No	Treatment combinations	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C Ratio
1	Sulphur 20 kg/ha + Control	26708.00	56038.95	29330.95	1.09
2	Sulphur 20 kg/ha + Iron 0.3%	26810.00	63779.65	36969.65	1.37
3	Sulphur 20 kg/ha + Iron 0.5%	26878.00	69679.50	42801.50	1.59
4	Sulphur 30 kg/ha + Control	27338.00	57629.00	30291.00	1.10
5	Sulphur 30 kg/ha + Iron 0.3%	27440.00	74898.45	47458.45	1.72
6	Sulphur 30 kg/ha + Iron 0.5%	27508.00	78914.55	51406.55	1.86
7	Sulphur 40 kg/ha + Control	27968.00	62502.00	34534.00	1.23
8	Sulphur 40 kg/ha + Iron 0.3%	28070.00	83339.85	55269.85	1.96
9	Sulphur 40 kg/ha + Iron 0.5%	28130.00	85590.45	57460.45	2.04
10	Control (20-40-20 NPK kg/ha)	25448.00	53176.75	27728.75	1.08

CONCLUSION

This study concluded that application of Sulphur 40 kg/ha in combination with Iron 0.5% as foliar spray has performed positively and improved yield attributes, yield of lentil and also proven economically profitable. Since the findings are based on one season, further trails are needed to confirm the results.

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