International Journal of Environment and Climate Change

Volume 13, Issue 8, Page 2032-2036, 2023; Article no.IJECC.100920
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

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

Doney Pragna [a++*], Rajesh Singh [a#] and Thakur Indu [a†]

[a] Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i82160

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/100920

Original Research Article

Received: 02/04/2023
Accepted: 04/06/2023
Published: 21/06/2023

ABSTRACT

A field experiment was conducted during *Rabi* 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 experiment was laid out in Randomized Block Design comprising of two factors *viz*., Sulphur (20, 30, 40 kg/ha), Iron (control, 0.3%, 0.5%) and a 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). Application of Sulphur and foliar application of Iron significantly influenced the yield and economics over control. Results revealed that yield attributes like more number of pods per plant (162.40), more number of seeds per pod (2.53), higher seed yield (1556.19 kg/ha) and higher stover yield (2868.3 kg/ha) were recorded with application of Sulphur 40 kg/ha + Iron 0.5%. Maximum gross returns (85590.45

[++] *M.Sc Scholar;*
[#] *Associate Professor;*
[†] *Ph.D Scholar;*
**Corresponding author: E-mail: dpragna342@gmail.com;*

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.) belongs to family Leguminosae. It is typically produced in marginal soils with low fertility status during the rabi season [1]. 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 [2]. "Lentil contains about 11% water, 25% protein and 60% carbohydrates" [3]. "Due to its low cellulose content, lentil straw is also regarded as animal feed" [4]. "However, the vegetative parts of lentils can be utilised as green manure" [5]. "It is North India's third-largest pulse crop" [6]. In India it is cultivated in area of 14.24 lakh ha with the production of 12.17 lakh tonnes 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 [7].

"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" [8]. "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" [9].

Keeping in view the above facts, the present experiment was undertaken to study the performance of Sulphur and foliar application of Iron on yield attributes and yield of lentil and to work out the economics of different treatment combinations.

2. MATERIALS AND METHODS

A field experiment was conducted during *Rabi* 2022 at the Crop Research Farm, Department of Agronomy, Naini Agricultural 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), organic carbon (0.112%), available N (278.93 kg/ha), available P (10.8 kg/ha), and available K (206.4 kg/ha). The experiment was laid out in Randomized Block Design comprising of two factors *viz*., Sulphur (20, 30, 40 kg/ha), Iron (control, 0.3%, 0.5%) and a 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 sowing was done on 1st December, 2022 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. Five 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 [10].

3. RESULTS AND DISCUSSION

3.1 Yield Attributes and Yield

3.1.1 Number of pods per plant

The data showed in Table 1 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., [11]. 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. [12].

3.1.2 Number of seeds per pod

The data showed in Table 1 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 showed in Table 1 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 [13]. 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., [14].

3.1.5 Stover yield (kg/ha)

The data showed in Table 1 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].

3.2 Economics

The data showed in Table 2 revealed that 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 Benefit: cost ratio (B:C ratio) (2.04) was observed in treatment T_9 [Sulphur 40 kg/ha + Iron 0.5%] and the 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 (*Lens culinaris* L.)

S. No	Treatment combinations	No. of Pods/ plant	No. of seeds/ pod	Test weight	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index
1	Sulphur 20 kg/ha + Control	155.47	1.20	17.85	1018.89	1861.9	35.37
2	Sulphur 20 kg/ha + Iron 0.3%	158.13	1.73	20.35	1159.63	2170.3	34.83
3	Sulphur 20 kg/ha + Iron 0.5%	159.27	1.93	20.46	1266.90	2314.6	35.41
4	Sulphur 30 kg/ha + Control	156.80	1.33	18.13	1047.80	1955.1	34.88
5	Sulphur 30 kg/ha + Iron 0.3%	159.53	2.00	20.78	1361.79	2455.8	35.68
6	Sulphur 30 kg/ha + Iron 0.5%	160.87	2.07	20.85	1434.81	2599.3	35.57
7	Sulphur 40 kg/ha + Control	157.40	1.53	20.16	1136.40	2032.7	35.87
8	Sulphur 40 kg/ha + Iron 0.3%	161.80	2.33	20.99	1515.27	2755.5	35.50
9	Sulphur 40 kg/ha + Iron 0.5%	162.40	2.53	21.07	1556.19	2868.3	35.17
10	Control (20-40-20 NPK kg/ha)	151.33	1.07	17.52	966.85	1753.0	35.55
	F-test	S	S	NS	S	S	NS
	SEm(±)	0.32	0.08	0.97	14.39	39.84	0.44
	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 (*Lens culinaris* L.)

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

4. 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.

ACKNOWLEDGEMENT

I express my gratitude to my advisor Dr. Rajesh Singh and all the faculty members of the Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, (U.P) India for providing necessary facilities to undertake the studies.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Sahay N, Singh SP, Sharma VK. Effect of cobalt and potassium application on growth, yield and nutrient uptake in lentil (*Lens culinaris* L.). Legume Research. 2013;36(3):259-262.
2. Omer FA. Efficiency of nitrogen-fixing nodules developed on roots of broadbean, chickpea and lentil plants grow in pots. J. Duhok Univ. (Agri. and Vet. Sciences). 2009;12(2):169-174.
3. Singh G, Wade LJ, Singh BB, Singh RK, Singh VP. Nutrient management in semi- deep water (30-50 cm) rice (*Oryza sativa*) and its effect on succeeding lentil (*Lens culinaris*) crop. Indian Journal of Agronomy. 2001;46(1): 12–16.
4. Erskine W, Rihawe S, Capper BS. Variation in lentil straw quality. Animal Feed Science and Technology. 1990;28: 61–69.

5. Kara K. Field crops. Ataturk University, Faculty of Agricultural Engineering, Erzurum, Turkey. 2008;191:307.
6. Singh SS, Singh AK, Sundaram PK. Agrotechnological options for upscaling agricultural productivity in eastern indogangetic plains under impending climate change situations: A review: Journal of Agrisearch. 2014;1(2):55-65.
7. Yadav S, Verma R, Yadav K. Effect of sulphur and iron on chlorophyll content, leghaemoglobin content, soil properties and optimum dose of sulphur for groundnut (*Arachis hypogea* L.). International Journal of Current Microbiology and Applied Sciences. 2019; 8(6): 291-297.
8. Poonia T, Bhunia SR, Choudhary R. Effect of iron fertilization on growth, yield and economics of groundnut (*Arachis hypogaea* L.). International Journal of Economic Plants. 2022;9(1):038-044.
9. Hanwate GR, Giri SN, Yelvikar NV. Effect of foliar application of micronutrients on nutrient uptake by soybean crop. International Journal of Pure & Applied Bioscience. 2018;6:261−265.
10. Gomez KA, Gomez AA. Three or more factor experiment. (In:) Statistical Procedure for Agricultural Research 2nd Ed. 1976;139-141.
11. Sahu S, Shankar T, Maitra S, Adhikary R, Mondal T, Duvvada SK. Impact of phosphorus and sulphur on the growth and productivity of green gram (*Vigna radiata*). Research on Crops. 2021;22(4):785-791.
12. Barla S, Sahoo HK, Patra BP, Biswasi S, Kumari K, Ojha RK. Effect of zinc and Iron on growth and productivity of summer Mung bean. International Journal of Environment and Climate Change. 2022; 12(4):119-124.
13. Das NR, Misra RS. Effect of sulphur and variety on yield of summer groundnut in West Bengal. Indian Journal of Agriculture. 1991;36:604-605.
14. Anitha S, Sreenivasan, Purushothaman SM. Response of cowpea [*Vigna ungiculata* L. Walp] to foliar nutrition of Zinc and Iron in the oxisols of Kerala. Legume Research. 2005;28(4):294-296.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/100920