Original research article

Effect of Nitrogen and Zinc on growth and yield of Lentil

ABSTRACT

A field experiment titled "Effect of Nitrogen and Zinc on Growth and Yield of Lentil" was conducted during *Rabi* season of 2022-23 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 Response of Nitrogen and Boron on growth and yield of Lentil. The treatment combinations are T_1: Nitrogen 10 kg/ha+ Zinc 8.0 kg/ha, T_2: Nitrogen 10 kg/ha + Zinc 10 kg/ha, T_3: Nitrogen 10 kg/ha + Zinc 12 kg/ha, T_4: Nitrogen 20 kg/ha + Zinc 8.0 kg/ha, T_5: Nitrogen 20 kg/ha + Zinc 10 kg/ha, T_6: Nitrogen 20 kg/ha + Zinc 12 kg/ha, T_7: Nitrogen 30 kg/ha + Zinc 8.0 kg/ha, T_8: Nitrogen 30 kg/ha + Zinc 10 kg/ha, T_9: Nitrogen 30 kg/ha + Zinc 12 kg/ha, T_{10}: Control (RDF: 20:40:20 kg/ha) are used. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.8), low in organic carbon (0.35%). Results obtained that the higher plant height (34.01 cm), higher number of nodules (9.20), higher plant dry weight (14.73 g/plant), higher number of pods/plant (153.60), higher number of seeds/pod (1.87), higher 1000 seed weight (21.51 g), higher seed yield (1.61 t/ha) and higher stover yield (3.13 t/ha) were significantly influenced with application of Nitrogen 30 kg/ha + Zinc 12 kg/ha. Higher gross return (INR 96,480/ha), higher net return (INR 64,094/ha) and higher B:C ratio (2.98) were also recorded in treatment 9 (Nitrogen 30 kg/ha + Zinc 12 kg/ha).

Keywords: *Lentil, nitrogen, zinc, growth parameters, yield attributes and Economics*

Introduction

Lentil is a legume crop and plays a great role in crop rotation for maintaining soil fertility and through root nodules, lentil can fix atmospheric nitrogen by symbiotic rhizobia therefore fertilizers and soil fertility has a major role for obtaining higher yield of vegetable protein asfar as an Indian dietary is concerned. The lysine rich protein of pulses has been reported by **Zafar *et.al*. (2003)**. “Lentil is an excellent source of easily digestible protein, lower in anti-nutritional factors i.e.,hemagglutinins, oligosaccharides and flavones compared to other legumes. The seeds are eaten as dal and the flour can be mixed with cereal flour and used in cakes, breads and some baby foods. Its seed is a rich source of minerals and vitamins as human food, while the straw servesas high-value animal feed” **(Tomar *et.al*. 2000).**

“Zinc plays a greater role during reproductive phase especially during fertilization Remarkably pollen grain contains zinc in very high quantity. At the time of fertilization most of zinc is diverted to seed only” **(Jenik and Kathryn 2014).**

“Growing lentil without fertilizer application or at a very low rate is considered a major factor for low yield” **(Sharar *et.al*. 2003).** “The other reasons such as lack of quality optimum seed rate, using local varieties as planting material, appropriate time of sowing, lack of judicious fertilizer application and specially decrease of organic matter in soil” **(Datta *et.al*. 2013).**

“Lentil maturity, like other annual crops, is initiated by leaf senescence. Leaf senescence is triggered by plant hormones, drought, and insufficient supply of nutrients, especially N” (**Lim *et.al.* 2007). “**Eighty percent of the fixed nitrogen comes from symbiotic associations with grain legumes (pulses) and the rest from free-living or associative systems” **(Graham *et.al.* 1984). “**In indeterminate crops, N remobilization from shoots and roots to seeds is low, therefore, yield may suffer from late season N deficiency” **((Munier-Jolain et.al. 1996 ; Whitehead *et.al.* 2000).**

Materials and Methods

The experiment was conducted during rabi 2022-23. "The experiment was conducted in Randomized Block Design (RBD) which includes ten treatments that are replicated thrice and was laid out with the different treatments allocated randomly in each replication. The soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 7.8) with low level of organic carbon (0.35%), available N (225 Kg/ha), P (13.6 kg/ha) and higher level of K (215.4 kg/ha) and the treatment combinations are as follows T_1: Nitrogen 10 kg/ha+ Zinc 8.0 kg/ha, T_2: Nitrogen 10 kg/ha + Zinc 10 kg/ha, T_3: Nitrogen 10 kg/ha + Zinc 12 kg/ha, T_4: Nitrogen 20 kg/ha + Zinc 8.0 kg/ha, T_5: Nitrogen 20 kg/ha + Zinc 10 kg/ha, T_6: Nitrogen 20 kg/ha + Zinc 12 kg/ha, T_7: Nitrogen 30 kg/ha + Zinc 8.0 kg/ha, T_8: Nitrogen 30 kg/ha + Zinc 10 kg/ha, T_9: Nitrogen 30 kg/ha + Zinc 12 kg/ha, T_{10}: Control (RDF: 20:40:20 kg/ha) are used" (Malavath and Debbarma, 2022).

Result and discussion

1.Growth Parameters:

1.1 Plant Height

The plant height of crop which was recorded at 20, 40, 60 and at 80 DAS. Five plants were selected randomly from each plot and tagged. The height of the plant was measured from the base of the plant up to the tip. The height was measured in cm. The significantly higher plant height (34.01 cm) was recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha. Significant and higher plant height was recorded may be sowing to nitrogen application in the soil might be due to nitrogen have favoured rapid growth and enlargement of tissues. Similar results were obtained by Fatima. Further, increase in plant height may be due to with the application of zinc activation of several enzymes which are zinc dependent viz. carbonic anhydrase, ribulose bis phosphate carboxylase, aldolase fructose 1 to 6 bis phosphatase, starch synthetase and sucrose synthetase. Zinc is known to produce the growth hormones and precursor of auxins i.e., tryptophan (**Pramanik and Bera (2012) and Debnath (2018).**

1.2 No of nodules/plants

The significantly superior number of nodules (9.20) were recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha. The increase of number of root nodules with increasing levels of Zn might be due to the fact that Zn helps to improve more nodulation and leghemoglobin formation. Proper nutrition of plants with S increases the amount of glucose flowering to the roots and ATP biosynthesis. These are in conformity with the present findings of **Valenciano *et.al.* (2011) and Singh *et.al.* (2012).**

1.3 Plant dry weight (gm^2/plant)

The significantly higher plant dry weight (14.73 g) was recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha).This might be due to nitrogen promote hasten growth in terms of higher plant height, a greater number of leaves/plant and greater number of branches/plant. Similar results were reported by **Balai *et.al*. (2017).** "And Furthur increase in dry weight might be due to application of Zinc. It is an important element for the synthesis of tryptophan, which is the pioneer for the synthesis of IAA (Indole acetic acid), a growth hormone, involved in stem elongation" **(Patel *et al*. 2007)**

Yield Parameters:

2.1 Number of Pods/plant

The significant and higher number of pods/plant (153.60) was recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha, which was significantly superior over rest of the treatments. However, treatment 8 with application of Nitrogen 30 kg/ha and Zinc 10 kg/ha, was found to be statistically at par with treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha.

"Significant and higher number of pods/plants was recorded with application of nitrogen (30 kg/ha) has shown the most effective in increasing the quantity of pods/plant, it might have show`s a favourable influence on soil chemical characteristics, particularly near the rhizosphere. As a result, all of these variables may produce an increase in nutrient absorption from the soil, resulting in increase in total number of pods/plant, either directly or indirectly". **Naik and Debbarma (2022).**

2.2 Number of seeds/pod

The significant and higher number of seeds/pod (1.87) was recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha, which was significantly superior over rest of the treatments. However, treatment 8 with application of Nitrogen 30 kg/ha and Zinc 10 kg/ha, was statistically at par with treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha.

"Significant and higher number of seeds/pod was recorded with the application of Nitrogen (30 kg/ha), might be due to the balanced application of nitrogen also, contributed to increase in plant growth which in turns increased the fruit bearing branches, seed setting and seed development". **Malik *et.al.* (2003).**

2.3Test Weight (g)

The significant and higher test weight (21.51 g) was recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha, which was significantly superior over rest of the treatments. However, treatment 8 with application of Nitrogen 30 kg/ha and Zinc 10 kg/ha, was statistically at par with treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha.

The significant and higher test weight (21.51 g) was recorded with the application of nitrogen 30kg/ha. Improved growth characters might have also resulted into the improved source sink relationship and sink size. Application of nitrogen can significantly increase the number of pods per plant by influencing the soil chemical characteristics and nutrient absorption from the soil **Moniruzzaman *et.al.* (2020).**

2.3 Seed Yield (t/ha)

The significant and higher seed yield (1.90 t/ha) was recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha, which was significantly superior over rest of the treatments. However, treatment 8 with application of Nitrogen 30 kg/ha and Zinc 10 kg/ha, was found to be statistically at par with treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha.

"Significant and higher seed yield was with application of nitrogen which might have improved in different yield contributing characters due to higher nitrogen level". **Fatima *et.al*. (2013).**

2.4 Stover Yield (t/ha)

The significant and higher stover yield (3.13 t/ha) was recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha, which was significantly superior over rest of the treatments. However, treatment 8 with application of Nitrogen 30 kg/ha and Zinc 10 kg/ha, was statistically at par with treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha.

The significant and higher stover yield (3.13 t/ha) was recorded with the application of Nitrogen and zinc. Zinc plays a major role in photosynthesis, enzymes activation, fertilization and translocation of assimilates which are responsible for the increase in stover yield**.**

3. Economical Analysis

3.1 Cost of cultivation (INR/ha)

Higher Cost of cultivation (32,386.00 INR/ha) was recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha.

3.2 Gross returns (INR/ha)

Higher Gross returns (96,480.00 INR/ha) was recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha.

3.3 Net returns (INR/ha)

Higher Net returns (64,094.00 INR/ha) was recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha.

3.4 Benefit Cost ratio (B: C)

Higher Benefit Cost ratio (2.98) was recorded in treatment 9 with application of Nitrogen 30 kg/ha and Zinc 12 kg/ha.

CONCLUSION

Based on experimental finding on Lentil it is concluded with the application of Nitrogen 30 kg/ha and Zinc 12 kg/ha (Treatment-9) recorded higher growth, yield and benefit cost ratio (2.98), which may be more beneficial for farmers.

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Table 1: Effect of nitrogen and zinc on on Growth Attributes of Lentil.

S. No.	Treatments	Plant height (cm)	Number of nodules	Dry weight (g)
1.	Nitrogen 10 kg/ha+ Zinc kg/ha	27.97	26.44	12.48
2.	Nitrogen 10 kg/ha + Zinc 10 kg/ha	28.88	26.27	12.51
3.	Nitrogen 10 kg/ha + Zinc 12 kg/ha	30.18	27.55	12.78
4.	Nitrogen 20 kg/ha + Zinc 8 kg/ha	30.90	28.47	13.04
5.	Nitrogen 20 kg/ha + Zinc 10 kg/ha	32.04	28.45	13.10
6.	Nitrogen 20 kg/ha + Zinc 12 kg/ha	33.14	29.44	13.46
7.	Nitrogen 30 kg/ha + Zinc 8 kg/ha	31.91	29.77	14.11
8.	Nitrogen 30 kg/ha + Zinc 10 kg/ha	33.44	30.55	14.31
9.	Nitrogen 30 kg/ha + Zinc 12 kg/ha	34.01	32.04	14.73
10.	Control (RDF: 20:40:20 kg/ha)	30.07	28.87	12.90
SEm±		0.58	0.41	0.18
CD (P=0.05)		1.71	1.21	0.55

Table 2: Effect of Nitrogen and Zinc on yield attributes and yield of Lentil.

S. No.	Treatments	Pods/plant	Seeds/pod	Test weight (g)	Seed yield (t/ha)	Stover yield (t/ha)
1.	Nitrogen 10 kg/ha+ Zinc 8 kg/ha	124.23	1.33	17.38	1.34	2.40
2.	Nitrogen 10 kg/ha + Zinc 10 kg/ha	130.93	1.37	17.58	1.10	2.34
3.	Nitrogen 10 kg/ha + Zinc 12 kg/ha	129.63	1.55	17.70	1.17	2.55
4.	Nitrogen 20 kg/ha + Zinc 8 kg/ha	131.83	1.55	18.08	1.22	2.39
5.	Nitrogen 20 kg/ha + Zinc 10 kg/ha	136.13	1.57	18.27	1.26	2.80
6.	Nitrogen 20 kg/ha + Zinc 12 kg/ha	138.50	1.58	18.49	1.35	2.99
7.	Nitrogen 30 kg/ha + Zinc 8 kg/ha	142.83	1.67	19.56	1.43	2.77
8.	Nitrogen 30 kg/ha + Zinc 10 kg/ha	145.21	1.74	20.23	1.52	3.10
9.	Nitrogen 30 kg/ha + Zinc 12 kg/ha	153.60	1.87	21.51	1.61	3.13
10.	Control (RDF: 20:40:20 kg/ha)	135.73	1.45	17.61	1.15	2.42
	SEm±	1.90	0.05	0.27	0.04	0.06
	CD (P=0.05)	5.63	0.15	0.81	0.12	0.19

Table 3 Effect of Nitrogen and Zinc on yield attributes and yield of Lentil, Economical Analysis.

S.no	Treatments	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C Ratio
1	Nitrogen 10 kg/ha+ Zinc 8 kg/ha	30,791.00	62,400.00	31,609.00	1.03
2	Nitrogen 10 kg/ha + Zinc 10 kg/ha	31,351.00	65,700.00	34,349.00	1.10
3	Nitrogen 10 kg/ha + Zinc 12 kg/ha	31,951.00	70,140.00	38,189.00	1.20
4	Nitrogen 20 kg/ha + Zinc 8 kg/ha	31,008.00	73,380.00	42,372.00	1.37
5	Nitrogen 20 kg/ha + Zinc 10 kg/ha	31,568.00	85,560.00	53,992.00	1.71
6	Nitrogen 20 kg/ha + Zinc 12 kg/ha	32,168.00	81,180.00	49,012.00	1.52
7	Nitrogen 30 kg/ha + Zinc 8 kg/ha	31,226.00	86,040.00	54,814.00	2.76
8	Nitrogen 30 kg/ha + Zinc 10 kg/ha	31,786.00	91,020.00	59,234.00	2.86
9	Nitrogen 30 kg/ha + Zinc 12 kg/ha	32,386.00	96,480.00	64,094.00	2.98
10	Control (RDF: 20:40:20 kg/ha)	29,454.00	86,760.00	39,306.00	1.34