Original Research Article

Influence of Bio fertilizers and Zinc on growth and yield of Lentil (*Lens culinaris* L.)

Abstract

The field experiment conducted at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj,(U.P), during the *rabi* season of 2021-22. To study the **"Influence of bio fertilizers and zinc on growth and yield of lentil *(Lens culinaris* L.)".**The soil in the experimental plot was sandy loam in texture, pH (7.2),low in organic carbon (0.82%),available N (274.48kg/ha), available P (26.80kg/ha) and available K (230.24kg/ha).The layout experiment was done in Randomized block designs with nine no. of treatments which has been replicated thrice. The bio fertilizers (rhizobium, psb and vam) @ 25g/kg seeds and three levels of zinc (4,5,6 kg/ha).Growth and yield parameters like plant height ,no.of nodules plant^{-1},dry weight, pods plant^{-1},no. of seeds/pod ,test weight, seed yield ,Stover yield ,harvest index were collected from this experiment .Results revealed that significantly higher plant height (35.24cm),dry weight (25.64) ,no. nodules (8.33/plant),pods/plant (160.32),seeds/pod(1.89),seed yield(1.79 t/ha),Stover yield(2.60 t/ha). Maximum gross return (91290.00 INR/ha), net returns (62405.65 INR/ha),and benefit cost (2.16) were obtained highest in the treatment combination of Rhizobium at 25g/kg seeds + Zinc at 6kg/ha.

Keywords : Economics ,Bio fertilizers Rhizobium, PSB,VAM, Zinc

Introduction

The lentil (Lens culinaris or Lens esculenta) is an edible legume. It is about 40 cm (16 inch) tall, and the seeds grow in pods, usually with two seeds in each. Lentil is a self-pollinated crop with very low percentage of natural out crossing .It belongs to the family Leguminosae, sub family papillionaceae.. Lentil is also known as a "poor mans" meat because of its rich protein content **(Bhatty,1984).**It contain about water 11%, protein 22 to 25%and carbohydrates 43.4-74.9g, fat 0.3-3.5g. It is also rich in iron, calcium, phosphorus and magnesium, niacin and high lysine and tryptophan content **(Erskine *et al.*2009)** .A significant amount of vitamin A and B is also provided by lentil **(Zafar *et al*. 2003).**

Lentil is the fifth most important pulse crop in india. India ranked first in area and second the production with 39.79% and 22.79% of world are and production respectively. Canada rank first in production (41.16%) due to very high level of productivity(1633kg/ha) as compared to india (611kg/ha)

Bio fertilizers are gaining importance as they are ecofriendly, non-hazardous and non-toxic.Use of biofertilizers for the betterment of the crops and even for the health of soil.Biofertilizers can be a very good complimentary to the chemical pesticides as they not only kill the harmful insects but also the benefical insect such as pollinators.Rhizobium inoculation is essential for all the pulse crops to increase the yield of pulses. Rhizosphere, seed inoculation of legumes with an efficient rhizobial strain is necessary.Its is a biofertilizers which increase symbiotic nitrogen fixation and ultimately it increase the yield. The presence of efficient and specific strains of rhizobium in the rhizosphere is one of the most important requirement for proper establishment an growth of grain legume plant **(Gyaneshwar *et al*. 2002).**

Microorganisms belongs to PSB can produce bioactive molecules and organic acids as inoculants in soil increase the phosphorous uptake by the plants and also improve the crop yield particularly of pulse crop **(A.K Bera *et al*.2013)**. The ability of phosphate solubilizing bacteria to convert insoluble form into soluble one.

The word mycorrhiza is given to a mutualistic association between a fungus (Myco) and the roots (rhizo of the plants). The hyphae of fungus are able to take up nutrients such as phosphorous, zinc, copper and transport to host plant, thereby improving plant nutrition. vam produce moisture requirement and increase the drought resistance of the crops. They improve soil structure, enhance plant health and vigor and minimize stress caused by pathogenic fungi, weed& pollution from heavy metals**.(Chen *et al*.2005)**

Zinc regulates auxin concentration in plants and helps in the synthesis of protein, chlorophyll etc**.(Singh *et al.*2003)** 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 Barton 2005, Pandey and Gautam 2009).** Zinc deficiency occurs plant growth and development by reduce enzyme activity, disturbing ribosomal stabilization, and decreasing the rate of protein. It induces reducing flowers ovule infertility, low seed set and yield reduction.

MATERIALS AND METHODS

The experiment was carried out during *RABI* season of 2021 at the CRF (Crop Research Farm) SHIATS, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The crop Research Farm is situated at 25.750 N latitude, 87.190 E longitude and at an altitude of 98m above mean sea level. This area is situated on the right side of the river Yamuna and by the opposite side of Prayagraj City. After completing presowing irrigation the field will be ploughed and after levelling up.KLS-0903(Krishi) variety was sown 40-45kg/ha.seed inoculated by Rhizobium,PSB,VAM.(20:40:20kg/ha) NPK proportion was added to soil at time of sowing.In order to minimize weed competition hoeing cum weeding was done 20days after sowing. To main uniform plant stand at an intra-row spacing of

20cm,extra plant were thinned out .weeding and hoeing done with khurfi 30&45 days after sowing to facilitate aeration and removing the weeds.Neem oil 5% was sprayed to control insect pest particularly aphids.The crop was harvested at physiological maturity of the crops.Threshing of the crop was done after proper sun drying.

RESULT AND DISCUSSION

A)Growth attributes

It is noticed table 1. the influence of biofertilizers and Zinc on growth and yield of lentil the result revealed that maximum plant height (35.24cm), no. of nodules/plant (25.64),Plant dry weight(8.33/plant)was observed with application of Rhizobium 25g/kg seeds + 6kg/ha $Znso_4$ as compared to other treatments statistically at par to Rhizobium25g/kg seeds + 5kg/ha $ZnSo_4$.Rhizobium is higher in nitrogen fixation ultimately increases crop yield. Rhizobium increases root nodulation activity due to enzymatic activity and nitrogen fixation which ultimately increase nodulation. An enhanced growth and higher dry matter accumulation due to application of zinc. Zinc produce the growth hormones and precusor of auxins i.e. tryptophan **P.Debnath *et al.* (2018) (Narinder singh *et al.* (2016)**

Yield attributes

It is noticed table 2 the influence of Biofertilizers and Zinc on growth and yield of lentil the result revealed that higher no. of pods/plant (160.32),no.of seeds/ pod(1.89) ,seed yield(1.76t/ha), stover yield(2.60t/ha) was observed with application of Rhizobium 25g/kg seeds +6kg/ha $ZnSo_4$ compared to other treatments statistically at par to PSB 25g/kg seeds + 6 kg/ha $ZnSo_4$. effect of rhizobium may be due to better availability of nitrogen to plants it will play an important role in increasing the crop production. Zinc in chlorophyll content higher value of auxin content which helps in increased growth and yield of the crop. **Shahid Rasool, Janardhan Singh (2016) and Akhilesh Kumar Upadhyay *et al.* (2013)**

Economics

It is noticed table 3 the influence of Biofertilizers and Zinc on growth and yield of lentil the result revealed that higher cost of cultivation, gross return and net return increased with Rhizobium and Zinc. Application of Rhizobium at 25g/kg seeds +6kg/ha $ZnSo_4$ recorded highest gross return (91290.00 INR/ha), net returns (62405.65 INR/ha) and B:C ratio (2.16) This was attributed to increase in grain and straw yield as comparatively less cost than additional income under these treaments.**Shahid Rasool, Janardhan Singh (2016)**

Table 1. Influence of Biofertilizers and zinc on growth parameters of Lentil

Treatments	Plant height (cm)	No.of nodules/plant	Plant dry weight (g/plant)	Crop growth rate ($g/m^2/day$)	Relative growth rate (g/g/day)
1. Rhizobium 25g/kg seeds + 4 Kg/ha $ZnSO_4$	34.82	7.663	25.36	9.93	0.0140
2 Rhizobium 25g/kg seeds + 5 Kg/ha $ZnSO_4$	35.15	8.00	25.55	9.96	0.0140
3.Rhizobium 25g/kg seeds + 6 Kg/ha $ZnSO_4$	35.24	8.333	25.64	10.00	0.0140
4. PSB 25g/kg seeds + 4 Kg/ha $ZnSO_4$	32.78	6.67	24.12	9.63	0.0143
5. PSB 25g/kg seeds + 5 Kg/ha $ZnSO_4$	33.02	7.00	24.26	9.73	0.0140
6. PSB 25g/kg seeds + 6 Kg/ha $ZnSO_4$	33.28	7.333	24.48	9.63	0.0143
7. VAM 25g/kg seeds + 4Kg/ha $ZnSO_4$	30.88	6.00	22.92	10.03	0.0153
8. VAM 25g/kg seeds + 5Kg/ha $ZnSO_4$	31.20	6.33	23.16	10.13	0.0150
9. VAM 25g/kg seeds + 6Kg/ha $ZnSO_4$	31.46	6.663	23.34	10.20	0.0150
F test	S	S	S	S	S
SEm (±)	0.03	0.30	0.03	0.08	0.001
CD (5%)	0.09	0.89	0.09	0.25	0.00

Table 2 Influence of Biofertilizers and Zinc on yield parameters of lentil

Treatments	No.of pods/plant	No.of Seeds/pod	Test weight (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1. Rhizobium 25g/kg seeds + 4 Kg/ha ZnSO4	155.84	1.49	18.84	1.58	2.32	40.51
2 Rhizobium 25g/kg seeds + 5 Kg/ha ZnSO4	157.76	1.71	18.82	1.68	2.46	40.58
3.Rhizobium 25g/kg seeds + 6 Kg/ha ZnSO4	160.32	1.89	18.82	1.79	2.60	40.77
4. PSB 25g/kg seeds + 4 Kg/ha ZnSO4	155.62	1.39	18.86	1.55	2.28	40.47

5. PSB 25g/kg seeds + 5 Kg/ha ZnSO4	157.42	1.66	18.84	1.65	2.43	40.44
6. PSB 25g/kg seeds + 6 Kg/ha ZnSO4	160.20	1.85	18.84	1.76	2.56	40.74
7. VAM 25g/kg seeds + 4Kg/ha ZnSO4	155.34	1.28	18.93	1.51	2.24	40.26
8. VAM 25g/kg seeds + 5Kg/ha ZnSO4	156.64	1.56	18.88	1.62	2.41	40.20
9. VAM 25g/kg seeds + 6Kg/ha ZnSO4	159.44	1.82	18.82	1.71	2.51	40.52
F test	S	S	NS	S	S	NS
SEm (±)	0.04	0.02	0.03	0.02	0.02	1.08
CD (5%)	0.12	0.07	-	0.06	0.06	-

Table 3. Influence of Biofertilizers and zinc on Economics of lentil

S. No	Treatments	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
1	Rhizobium 25g/kg seeds + 4 Kg/ha $ZnSO_4$	28610.35	80580.00	51969.65	1.82
2	Rhizobium 25g/kg seeds + 5 Kg/ha $ZnSO_4$	28747.35	85680.00	56932.65	1.98
3	Rhizobium 25g/kg seeds + 6 Kg/ha $ZnSO_4$	28884.35	91290.00	62405.65	2.16
4	PSB 25g/kg seeds + 4 Kg/ha $ZnSO_4$	28538.35	79050.00	50511.65	1.77
5	PSB 25g/kg seeds + 5 Kg/ha $ZnSO_4$	28675.35	84150.00	55474.65	1.93
6	PSB 25g/kg seeds + 6 Kg/ha $ZnSO_4$	28812.35	89760.00	60947.65	2.12
7	VAM 25g/kg seeds + 4Kg/ha $ZnSO_4$	28502.35	77010.00	48507.65	1.70
8	VAM 25g/kg seeds + 5Kg/ha $ZnSO_4$	28639.35	82620.00	53980.65	1.88
9	VAM 25g/kg seeds + 6 Kg/ha $ZnSO_4$	28776.35	87210.00	58433.65	2.03

Conclusion

From the present study it can be concluded that for better crop growth and productivity of lentil, the seeds must be inoculated with rhizobium at 25g/kg seeds and crop must be fertilized with 6kg/ha $ZnSo_4$ was found more helpful for farmers to get better yield in lentil.

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