

Evaluation of the Effect of Rhizobium Inoculation and Phosphorus, Grain Yield and Nodulation Behaviour of *Lens culinaris*

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Abstract

Effect of Rhizobium inoculation on Lentil was evaluated at Adaptive Research Farm Karor on sandy loam soil during winter-2000-01 and 2001-02. Masoor-93 variety was used as a medium. The treatments were control, inoculation alone, 57 kg P₂O₅/ha + 22 kg N/ha, 57 kg P₂O₅/ha + 22kg N/ha + inoculation, 28 kg P₂O₅/ha +11 kg N/ha + inoculation and 28 kg P₂O₅/ha +11 kg N/ha. The treatment comprising of 57 kg P₂O₅ + 22 kg N/ha + inoculation produced significantly the highest grain yield/ha, number of nodules/plant and net return as compared to other treatments. All other treatments also differ significantly from one another during both the years.

Key words: Lentil, Phosphorus, Nitrogen, Inoculation, Grain yield, Net return.

Introduction

Lentil is a major crop of rain fed areas, but its actual yield is very low than potential yield because of many factors. The most important one is the use of less quantity of recommended fertilizers by virtue of their high cost. Lentil crop is blessed with the ability of N-fixation. This N-fixation ability can be increased by 14-46% with Rhizobium Inoculation. Similarly experiments conducted at various locations depicted a positive response of Rhizobium inoculation application. Kumar and Agarwal, 1993 reported that seed yield of lentil was increased from 1.84 to 1.96 t/ha with inoculation, from 1.88 to 1.92 t/ha with N application. It has been estimated that application of inoculation plays a vital role for successful lentil crop cultivation to enhance number of nodules/plant; Kumar *et al* (1993) conducted an experiment on a loam soil. Lentil was uninoculated and inoculated with Rhizobium and given 0 or 20 Kg N and 25, 50, 75 or 100 Kg P₂O₅/ha.

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Percentage germination 15 days after sowing was increased by inoculation from 71.4 to 78.3%. N application @ 20 kg N/ha significantly increased plant DM and P₂O₅ upto 50 kg/ha, also significantly increased plant DW. Inoculation increased seed weight/plant, 1000-seed weight, seed yield and seed protein content. Keeping the above consistence results in view, the present study was designed to evaluate the effect of Rhizobium inoculation and phosphorus on the grain of lentil.

Materials and Methods

The experiment was laid out from 2000-2001 and 2001-02 on lentil varieties Masoor-93 at Adaptive Research Farm Karor. The physico-chemical analysis of the soil during the experiment period is given as:

Physico chemical analysis of the soil

	2000	2001	2000	2001
Depth (cm)	0-15	0-15	15-30	15-30
Ec (dsm)	1.90	1.85	2.15	2.08
pH	8.20	8.15	8.20	8.31
O.M (%)	1.30	1.13	1.40	1.37
P ₂ O ₅	12.40	11.75	12.80	12.91
K ₂ O(ppm)	260	252	280	284

The complete dose of fertilizer application for N and P was given in the form of urea and triple super phosphate at sowing time.

Experimental design used was Randomized complete Block (RCBD) with three replications having plot size of 4.5x9.5m. All other Agronomic practices were remained same for all treatments. The data obtained were analyzed using computer package MSTAT-C, and LSD test at 5% level of probability was used to compare the treatment means (Steel and Torrie, 1984).

Results and Discussion

The data on the grain yield of lentil (Table-1) indicated that the application of Rhizobium inoculation+ 57 kg P₂O₅/ha+22 kg N/ha produced significantly higher grain yield over control and other treatments, followed by the treatment where 57 kg P₂O₅/ha + 22 kg N/ha fertilizer was applied without seed inoculation, during both the years.

Table 1: Grain yield as affected by different treatments

Treatments	2000-01	2001-02
Control	1056 d	899 f
Inoculation alone	1085 cd	1159 d
57 KgP ₂ O ₅ /ha+22kg N/ha	1249 b	1561 b
57 KgP ₂ O ₅ /ha+22kg N/ha + inoculation	1357 a	1713 a
28 KgP ₂ O ₅ /ha+11kg N/ha + inoculation	1150 c	1244 c
28 KgP ₂ O ₅ /ha+11kg N/ha	1077 d	1031 e
Lsd (5% Probability level)	74.93	42.55

These results were also in conformity with Dziauba & Mirosław, (1994). Experiments were conducted with three varieties and 2 strains of *R. leguminosarum* Var. *Viciae* during 1989-91. Inoculation increased or reduced yield depending on the year and variety. The greatest fall in the yield relative to the un-inoculated control during the three years of study was 39.2% and the greatest rise was 315.5%. Azad *et al.* (1991) HAS reported that LENS *Culinaris* Cv. L 9-12 was inoculated or not inoculated with Rhizobium and given 0, 20, 40 or 60 Kg P/ha. Grain yield was increased by P irrespective of Rhizobium inoculation, Rhizobium inoculation increased yield (1.56 t/ha) was with 60 kg P/ha and Rhizobium inoculation. Singh *et al.* 2000 reported that Lentil cv. K 75 were given 0-90 kg S/ha, 0-38.7 kg P/ha and were inoculated or not inoculated with Rhizobium. Yield increased with S up to 60 kg/ha and 25.8 kg/ha P and was increased from 1.73 to 1.95 t/ha by inoculation. Singh *et al.* (1991) stated that Lentil cv K 75 were given 0-90 kg P₂O₅/ha, O or 20 kg N/ha and were seed inoculated or not inoculated with Rhizobium. Seed yield was 896, 968, 1182 and 1008 kg/ha with 0, 30, 60 & 90 kg P₂O₅/ha and was highest with 20 kg N combined with seed inoculation.

Nodulation behaviour

The data on Number of Nodules/plant (Table 2) depicted that number of nodules/plant were significantly higher in the treatment where inoculation was applied to the seed with 57 kg P₂O₅/ha + 22 kg

Table 3: Economic analysis of Rhizobium inoculation and phosphorus on grain yield and nodulation behaviour of *L. culinaris*.

Treatments	Av. Of two years yield (kg/hg)	Gross income (Rs.)	Exp. (Rs.)	Net income (Rs)	Additional Exp. (Rs.)	Value of increased yield (Rs.)	VCR
Control	977.5	19550	3700	15850	-	-	-
Inoculation alone	1122.0	22440	3800	18720	100	2890	1:28.9
57 KgP ₂ O ₅ /ha+22kg N/ha	1405.0	28100	5816	22284	2116	8550	1:4.04
57 KgP ₂ O ₅ /ha+22kg N/ha + inoculation	1535.0	30700	5916	24864	2216	11150	1:5.03
28 KgP ₂ O ₅ /ha+11kg N/ha + inoculation	1197.0	23940	4858	19162	1158	4390	1:3.79
28 KgP ₂ O ₅ /ha+11kg N/ha	1054.0	21080	4758	16322	1058	1530	1:3.79

Cost of P₂O₅ = Rs. 30/kg; Cost of N = Rs. 18.47/kg; Cost of lentil = Rs. 20/kg

Value cost ratio = Value of increased yield / Additional expenditure

References

N/ha. In both the years of study followed 57 kg P₂O₅/ha + 22 kg N/ha with out inoculation. Significantly, the lowest number of nodules was recorded in control. It can be concluded from the results that the Rhizobium inoculation and phosphorus application has positive impact on number of nodule/plant.

These results were in confirmation with those of Yadav *et al.* (1992), who stated that total number of nodules/plant was increased with Rhizobium inoculation. Moreover, Roy and Rehman (1992) reported that two lentil cultivars were grown (Lentil-5 & L-81124) & inoculation treatment were, non inoculation with Rhizobium strain RLC-140 & inoculation + 20 kg N/ha. Lentil-5 produced more nodules/plant and had higher LAI & seed yields but L-81124 produced more DM. Chandra, R (1991) conducted field trials & registered that Lentil cv .PL 406 gave seed yields of 1.05 & 1.16, 1.29 & 1.24 t/ha with no inoculation increased nodule number & DM. Shah *et al.* 2000, stated that Lentil cv. Masoor-93 grown in rain fed area of Swat River Valley & seed was inoculated with Rhizobium *leguminosarum* obtained from Australia, Tarnab and NARC Islamabad.

Table 2: Number of nodules as effected by different treatments.

Treatments	2000-01	2001-02
Control	15.0 e	16.0 e
Inoculation alone	20.0 c	22.0 c
57 KgP ₂ O ₅ /ha+22kg N/ha	25.0 b	23.7 b
57 KgP ₂ O ₅ /ha+22kg N/ha + inoculation	28.0 a	29.3 a
28 KgP ₂ O ₅ /ha+11kg N/ha + inoculation	20.0 c	19.0 d
28 KgP ₂ O ₅ /ha+11kg N/ha	18.0 d	18.0 d
Lsd (5% Probability level)	1.21	1.47

Economic analysis

The economics of the treatments was calculated and it is investigated that the net return was maximum of the treatment comprising of 57 kg P₂O₅/ha+22 kg N/ha+ inoculation as shown in the Table 3.

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