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Effect of Vermicompost and Bio-Fertilizers on Yield and Economics of Organic Lentil (*Lens culinaris Medik)*

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ABSTRACT: A field research was carried out during Rabi Season of 2020-2021 at crop research farm of SHUATS, U.P., India. The experiment was done on Effect of levels of vermicompost and bio-fertilizers on economics and yield of lentil. It consists of 3 Levels of Vermicompost @ (75 %- 3.75 t/ha, 100 %-5t/ha, 125 % -6.25t/ha) and Bio-fertilizers (Rhizobium & PGPR)@ 20g/kg (Seed treatment) and was carried out through Randomized Block Design (RBD) with 3 replications. Variety used was K-73. Among all the treatments the plot treated with Vermicompost@125% + Rhizobium + PGPR has produced significantly highest Seed yield (2520 kg/ha) and Harvest index (33.4) and also fetched highest Gross returns (201600.00 INR/ha), Net returns (144110.00 INR/ha) and Benefit Cost ratio (2:5) when compared to the control. Description of the study indicates that while technology induced farming uses the excessive use chemicals, fertilizers, pesticides, and weedicides in agriculture has caused problem to all living beings on earth. Organic farming has emerged as the only answer bring sustainability to agriculture.

Keywords: Bio-fertilizers, Benefit cost Ratio, PGPR (*Psuedomonas fluorescence*)

INTRODUCTION

Pulses have been considered the most important barebones of cropping systems. Their inference in the agricultural manufacturing system lies in the fact that they are natural nitrogen fixers and help maintain soil fertility.Lentil is one of the prime pulse crops cultivated in semi-arid region of the world, Lentil crop broadly grown in India during Rabi season. Particularly in Indian sub-continent and the dry areas of Middle East. India being first in area and second in production of lentil (Singh, 2021).

Bio-fertilizers are living Microorganisms of Bacterial, Fungal and Algal origin. They solubilize the insoluble forms of phosphates like Tricalcium, Iron and alumnium phosphates into accessible forms. They scavenge phosphate from soil layers and produce hormones and antimetabolites which promote root growth (Kumar and Chandra 2008; Biswas *et al.,* 2015).

Rhizobium is comparatively more effective and widely used Bio-fertilizer. Effective nodulation of leguminous crop by rhizobium largely depends on the obtain ability of a well-matched stain for a particular legume. Rhizobium population in the soil is hooked on the presence of legumes crops in field (Chala, 2017; Singh *et al.*, 2016).

The mechanisms of PGPR embrace adaptable hormonal and nutritional balance, encourage resistance against plant pathogens, and solubilizing nutrients for easy uptake by plants. There are several types of plant growth promoting rhizobacteria among them Pseudomonas fluorescence act as both plant growth regulator and bio control agent (Deshmukh *et al.,* 2015).

Pseudomonas fluorescens is an aerobic, gram-negative, ubiquitous organism that was well altered to grow in the rhizosphere. This rhizobacterium holds many characters to act as Bio Control agent and to promote plant growth ability. In the plant rhizosphere, it produces a wide spectrum of bioactive metabolites, that is antibiotics, siderophores, volatiles, and growth-promoting substances which resists aggressively with other microorganisms and adapts to environmental stresses. In addition, pseudomonads are responsible for the *natural suppressive* of some soil stomached pathogens (Khanna *et al.,* 2006; Kumar and Chandra 2008).

MATERIALS AND METHODS

The experiment was conducted during the *Rabi* season 2020-2021, at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.) which is located at 25° 30″ 42N latitude, 81° 60″ 56″ E longitude and 98 m altitude above the mean sea level. During *Rabi* season 2021 on sandy loam soil, having nearly neutral in soil reaction (pH 7.7), organic carbon (0.44), available nitrogen (171.48 kg/ha K), available phosphorus (27 kg/ha) and available potassium (291.2 kg/ha). The climate of the region is semi- arid sub-tropical. Treatments consists of with T_1-CONTROL, T_2-75% Vermicompost + Rhizobium, T_3-75%

Vermicompost + PGPR, T_4-75% Vermicompost + Rhizobium + PGPR, T_5-100% Vermicompost + Rhizobium, T_6-100% Vermicompost + PGPR, T_7-100% Vermicompost + Rhizobium + PGPR, T_8-125% Vermicompost + Rhizobium, T_9-125% Vermicompost + PGPR, T_{10}-125% Vermicompost + Rhizobium + PGPR.

A. Chemical analysis of soil

Composite soil samples are collected before layout of the experiment to determine the initial soil properties. The soil samples are collected from 0-15 cm depth and were dried under shade, powdered with wooden pestle and mortar, passed through 2 mm sieve and were analysed for organic carbon by rapid titration method by Nelson (1975). Available nitrogen was estimated by alkaline permanganate method by Nelson (1975). Available nitrogen was estimated by alkaline permanganate method and available phosphorus by Olsen,s method as outlined by Jackson (1967), available potassium was determined by using the flame photometer normal ammonium acetate solution and estimating by using flame photometer (ELICO Model) as outlined by Jackson (1973) and available $ZnSO_4$ was estimated by Atomic Absorption Spectrophotometer method.

RESULTS AND DISCUSSIONS

A. Yield

It is revealed from data present in Table 1. The Maximum grain yield (2.53 t/ha) and straw yield (5.59 t/ha) was found in the treatment Vermicompost @125 % + Rhizobium + PGPR which was superior over all the treatments except with the application of treatment with Vermicompost @100% + Rhizobium + PGPR in both parameters grain yield (2049 t/ha) and straw yield (5706 t/ha) this may be due to the stimulatory effect in cell division, cell elongation and background of cell structure and also higher dose of vermicompost may be responsible for increased leaf area and chlorophyll content causing higher photosynthesis and assimilation, metabolic activities responsible for overall reproductive phase and ultimately increased the seed yield (Khan *et al.,* 2006; Ahmadpour and Hosseizadeh 2017; Chavan *et al.,* 2010).

B. Economics

It is revealed from the data present in Table 2. The cost of cultivation of organic lentil crop was recorded numerically higher (₹57490) value for the treatment of application Vermicompost @ 125 % (6t/ha) + Rhizobium + PGPR and numerically minimum cost of cultivation was recorded with the application of Control (₹ 13700).

Table 1: Effect of Vermicompost and Biofertilizers on yield of organic Lentil.

Treatments	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1. CONTROL	550.0	5482.7	33.4
2. Vermicompost@75% + Rhizobium	1596.3	5223.0	34.2
3. Vermicompost@75% + PGPR	1615.0	5558.7	37.5
4. Vermicompost@75% + Rhizobium + PGPR	1969.7	5534.0	35.7
5. Vermicompost @100% + Rhizobium	1866.0	5541.7	37.6
6. Vermicompost@100% + PGPR	1893.3	5247.0	34.9
7. Vermicompost@100% + Rhizobium + PGPR	2049.0	5706.7	29.5
8. Vermicompost@125% + Rhizobium	1965.3	5486.0	35.9
9. Vermicompost @125% + PGPR	1749.3	4672.7	37.7
10. Vermicompost@125% + Rhizobium + PGPR	2520.3	5959.3	38.4
F- test	S	S	S
S. EM (±)	**22.7**	**33.73**	**0.73**
C. D. (P = 0.05)	**65.7**	**97.43**	**2.13**

Table: 2 Effect of Vermicompost and Biofertilizers on Economics of Organic lentil.

Treatments	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net Returns (INR /ha)	B:C Ratio
1. CONTROL	13100	44000	30900	2.3
2. Vermicompost@75% + Rhizobium	39670	127680	88010	2.3
3. Vermicompost @75% + PGPR	39670	129200	89530	2.2
4. Vermicompost @75% + Rhizobium + PGPR	39990	139994	99954	2.4
5. Vermicompost @100% + Rhizobium	48420	150880	102460	2.1
6. Vermicompost@100% + PGPR	48420	151680	103260	2.1
7. Vermicompost@100% + Rhizobium + PGPR	48740	163920	115180	2.3
8. Vermicompost@125 % + Rhizobium	57170	157224	100054	1.7
9. Vermicompost @125 % + PGPR	57170	157576	100406	1.7
10. Vermicompost @125% + Rhizobium + PGPR	57490	201600	144110	2.5

Numerically higher gross returns (₹ 2,01,600). Net returns (`1,44,110) and B:C ratio (2.5) were obtained with the application of Vermicompost @125 % + Rhizobium + PGPR while the cost of organic fertilizers was relatively high.

CONCLUSION

It is concluded from the above discussion that application of Vermicompost @125(6.5 t/ha) + Bio-fertilizers (Rhizobium + PGPR @ 20g/kg seed treated plots in Lentil was observed to be the best, that recorded significantly higher seed yield. It also drew the maximum Gross return, Net return, and benefit cost ratio as compared to other treatment combinations.

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