Print ISSN : 0972-8813
e-ISSN : 2582-2780

[Vol. 21(2) May-August 2023]

Pantnagar Journal of Research

(Formerly International Journal of Basic and Applied Agricultural Research ISSN : 2349-8765)

G.B. Pant University of Agriculture & Technology, Pantnagar

PANTNAGAR JOURNAL OF RESEARCH

Vol. 21(2) May-August, 2023

CONTENTS

Performance of Integrated Nutrient Management for yield and Net Income of lentil (*Lens culinaris Medik*)

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ABSTRACT: The purpose of the one-season field trial was to examine how integrated nutrient management affected the growth, yield and net income of the lentil crop. It was carried out at the Agriculture Research Block of the SGRR University (SAS-SGRRU), Dehradun, Uttarakhand, during the *Rabi* season of 2021–2022. Eight treatments viz: Control (T_1); N:P:K @ 15:20:0 kg ha^{-1} (T_2); N:P:K @ 15:20:20 kg ha^{-1} (T_3); N:P:K @ 15:40:20 kg ha^{-1} (T_4); N:P:K @ 15:40:20 kg ha^{-1} + Rhizobium (T_5); N:P:K @ 15:20:20 kg ha^{-1} + Rhizobium + PSB (T_6); N:P:K:S:Zn @15:40:10:8.5:10.5 kg ha^{-1} (T_7) and N:P:K:S:Zn @15:40:0:17:21 kg ha^{-1} (T_8), each replicated three times, were used in the RBD design. The soil of the experimental field was sandy loam with low levels of organic carbon, phosphorus, and potassium that were readily available. It may be advised to increase production and monitory benefit of lentil in valley areas of Dehradun, Uttarakhand, by applying N: P: K @ 15:20:20 kg ha^{-1} + Rhizobium + PSB because these treatments considerably increased grain yield, straw yield, harvest index, net income, and B: C ratio.

Key words: Farm yard manure, Integrated Nutrient Management, lentil, NPK, Rhizobium

For low-income Indian farmers, pulses are the most cost-effective source of protein and are crucial to a vegetarian diet. Through the fixation of nitrogen from the atmosphere, the addition of biomass to the soil, and the secretion of growth-promoting substances, these are also known to improve soil fertility and raise the production potential of subsequent crops. Lentil (*Lens culinaris*), one of the most important pulse crops, makes up around 6% of India's total pulse acreage and production (Ram and Punia, 2018). It produces 1.56 million tonnes with a productivity of 1,032 kg per hectare across an area of 1.51 million hectares (Directorate of Economics and Statistics, 2020). India produces 68 % of the world's lentils, making it the largest producer in the world. The second and third-largest producers are Canada and Turkey, respectively. Uttar Pradesh, Bihar, and Madhya Pradesh are the three states that produce the most lentils in India. Lentil production and acreage rank fourth and fifth, respectively, among all pulses. The issues with India's post-green revolution era include decreased growth rates, declining factor productivity, stagnant or even declining production and productivity. Poor nutrient management, which led to nutrient shortages and disturbed the natural equilibrium of nutrient components in soils, was a contributing factor in these restrictions. However, cultivating HYV with balanced fertilization that uses micronutrients offers a lot of possibilities and a strong chance of increasing lentil productivity. Both micronutrients like zinc and macronutrients like nitrogen, phosphorous, potassium, and sulphur help the crop thrive. Despite the fact that INM has become more significant during the past ten years in regions where chemical fertilizers are used with organic fertilizers. Additionally, using organic and bio fertilizers is occasionally important because synthetic fertilizers are so expensive. As a result, INM that uses both chemical and organic fertilizers can increase soil fertility sustainably because it not only enhances the physio-chemical characteristics of the soil but also boosts nutrient usage efficiency. Bio-fertilizers like PSB and Rhizobium, which provide plant nutrients, should be used more frequently to increase soil fertility while maintaining the ecological balance. These issues can be resolved by using reasonably priced organic fertilizers to increase soil fertility, soil health, and crop yields without having a negative impact on the environment. They can be used alone,

in combination with other organic resources, or in substitution of inorganic fertilizers.

Thus, the main goal of this one-season field experiment was to identify the most efficient, long-lasting, and financially viable nutrient management options for increasing lentil crop yield in Uttarakhand's Western Himalayan region.

MATERIALS AND METHODS

A one-season field trial was conducted in the *Rabi* season of 2021–2022 at the agricultural research block of the SGRR University, Dehradun, Uttarakhand, which is located in the northwest region of Uttarakhand at an altitude of 450 metres above mean sea level and in between 29° 58' and 31° 2' 30'' North latitude and 77° 34' 45'' and 78° 18' 30'' east longitude. During the trial year, the highest and lowest recorded summer temperatures were 36° C and 16° C, respectively, and the lowest and highest recorded winter temperatures were 23.4 C and 5.2 C, respectively. 1440 mm of precipitation fell on average per year. The soil of the experimental field had a sandy loam texture, was slightly acidic (7.26), contained low levels of organic carbon (0.42 %) and nitrogen (225.3 kg ha^{-1}), medium levels of phosphorus (16.1 kg ha^{-1}), and high levels of potassium (236.3 kg ha^{-1}). The experiment was laid out in RBD with three replications and eight treatments viz: Control (T_1); N:P:K @ 15:20:0 kg ha^{-1} (T_2); N:P:K @ 15:20:20 kg ha^{-1} (T_3); N:P:K @ 15:40:20 kg ha^{-1} (T_4); N:P:K @ 15:40:20 kg ha^{-1} + Rhizobium (T_5); N:P:K @ 15:20:20 kg ha^{-1} + Rhizobium + PSB (T_6); N:P:K:S:Zn @15:40:10:8.5:10.5 kg ha^{-1} (T_7) and N:P:K:S:Zn @15:40:0:17:21 kg ha^{-1} (T_8). The field was fully ploughed twice with a tractor-drawn harrow at the ideal soil moisture level, and then harrowed just once after that. The PL-9 variety was sown on November 12th, 2021, using the line sowing method with a seed rate of 60 kg ha^{-1} following row to row spacing of 15 cm. Urea, DAP, MOP, and zinc sulphate were employed, respectively, to apply nitrogen, phosphorus, potash, sulphur and zinc during field preparation. When preparing the field, liquid PSB was administered to the soil and Rhizobium was used to treat the seeds. 40 to 45 days after sowing, the first irrigation was applied. When the grain hardened and had a moisture level of 19–20 %, the crop was harvested. The crop was physically picked with a sickle, and the grains were separated after 3–4 days of sun drying. Five randomly selected plants from each plot were used as the basis for the observation of growth and yield. Using a one-meter row length, plants were cut down to the ground in each plot so that dry weight measurements could be taken at 30, 60, 90, and harvest. To attain a constant weight, samples were first air dried in the sun after being dried in an oven at 65°C. The materials were weighed to determine their dry weight after drying.

RESULTS AND DISCUSSION

The findings demonstrated that various integrated nutrient management techniques had a significant influence on the productivity and development of the lentil crop. The application of N:P:K @ 15:20:20 kg ha^{-1} + Rhizobium + PSB resulted in the greatest number of pods per plant, seeds per pod, grain yield, straw yield, harvest index, and net return when compared to rest of the nutrient management techniques. The use of biofertilizer encourages the growth and development of the crop and enhances nutrition by changing all of the physical, chemical, and biological properties of the soil. By adding PSB to the soil, which also affects the nutrient pool in the soil in the crop's favor, the growth rate of the lentil crop was sped up. Furthermore, comparable results were found by Podder *et al.*, 1989; Hossain, 2018 and Hossain and Suman, 2005.

The soil application of PSB had a substantial impact on plant growth because of the improved nutrient availability and the addition of other plant growth-promoting bacteria after the increased availability of macro and micronutrients as well as phosphorus in the soil Jat and Ahlawat (2004). But T_8, when zinc and sulphur were administered, identically revealed improvement in these parameters, which are closely in line with the conclusions of Laghari *et al.* (2010). The crucial roles that nitrogen, phosphorus and potassium play in a number of physiological and metabolic processes that increased

Table 1: Yield attributing parameters as influenced by various treatments

Treatments	Pods/ plant	seeds/plant (No.)	100 seeds weight (g)	Grain yield (kg/ha)	Straw Yield Kg/ha	Biological Yield Kg/ha	Harvest Index
T_1	42.98	78.82	3.60	586.92	646.10	1245.08	47.60
T_2	70.82	108.52	4.42	682.64	754.31	1455.86	47.50
T_3	71.52	124.21	4.58	696.93	790.23	1496.26	46.86
T_4	73.64	136.32	4.68	728.18	829.12	1558.50	46.75
T_5	76.27	152.76	4.96	957.12	1082.45	2039.57	46.92
T_6	85.12	172.41	5.32	1096.21	1841.31	2937.52	54.29
T_7	78.12	160.14	5.10	972.01	1046.92	2018.93	48.14
T_8	79.32	169.74	5.17	1011.22	1760.42	2771.64	36.48
S.Em ±	0.769	0.883	0.737	0.910	0.793	0.846	0.717
C.D. at 5%	2.354	19.05	N/A	27.87	24.30	25.83	2.196

Table 2: Net return and B: C Ratio as influenced by various treatments

Treatments	Cost of cultivation (Rs.)	Gross return (Rs.)	Net Return (Rs.)	B: C ratio
T_1	35655	93907	58252	1.61
T_2	36895	109222	72327	1.97
T_3	36950	111508	74558	2.07
T_4	37125	116508	79383	2.15
T_5	38000	153139	115139	3.20
T_6	39650	175393	135743	3.45
T_7	40125	155521	115396	2.76
T_8	41675	161795	120120	2.81
S.Em ±	63.5	145.6	105.5	0.115
C.D. at 5%	750	4459.2	10750	0.35

the crop's net absorption rate are well known. These findings concur strongly with those of Tomar *et al.*, 2016; Gupta and Namdeo, 1997; Pathak *et al.*, 2003; Rajput and Pandey, 2004; Rajput and Kushwah, 2005; Pal *et al.*, 2015 and Nema *et al.*,1984.

CONCLUSION

Based on one season field research, it can be concluded that different nutrient management strategies had a significant impact on the growth, production, yield and net benefits of the lentil crop. It may be advised to apply NPK (15:20:20 kg ha^{-1}) along with seed treatment with Rhizobium and soil application of PSB for enhancing grain yield and net income in the Western Himalayan areas of Uttarakhand.

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Received: May 30, 2023
Accepted: August 4, 2023