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Evaluation of Nutrient Management Strategies to Increase the Performance of Lentils in the Doon Valley Agro-Ecosystem

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The study examines the impact of integrated nutrient management (INM) on the growth, yield and economic performance of lentil (*Lens culinaris* L.) in doon valley area, Dehradun. The Rabi season of 202425 was the test period that was carried out at the Crop Research Farm of Dev Bhoomi Uttarakhand University in a 10-treatment and 3-replication Randomized Block Design. The treatments were different mixtures of organic (FYM, vermicompost) and inorganic fertilizers (RDF). The findings showed that there were great variation of treatments in all the growth and yield attributes. The FYM, when mixed with 75% of RDF + vermicompost gave the best results in terms of tallest plants, highest nodulation, maximum pods per plant, and better grain and straw yield. The net highest was also a 75 percent RDF + vermicompost which is economically the best. The analysis finds that combined nutrient management strategies result in complementary productivity and profitability and sustainable soil health.

Keywords: Fertilization, Productivity, Sustainability, Profitability, Agroecosystem

Introduction

Lentil (*Lens culinaris* L.) is one of the oldest and most commonly grown legumes known to have seeds which are rich in protein, dietary fiber, vitamins, and minerals. Being a cool-season crop, it has a significant role in sustainable farming systems, in particular, owing to its ability to fix nitrogen biologically by means of symbiosis with Rhizobium bacteria. Although it is able to repair the nitrogen content in the atmosphere, the production of lentils needs other supplementary nutrients so that it could achieve maximum yields.

Over the past decades, the overuse of chemical fertilizers in India has caused a number of ecological issues which include soil erosion, nutrient imbalance, ineffectiveness in using nitrogen and water pollution. Extensive use of inorganic fertilizers has undermined the structure of the soils, the level of organic matter and long-term yield. On the other hand, organic sources of nutrients like farmyard manure (FYM) and vermicompost enhance the physical activity of microorganisms in the soil, its aeration, moisture well-being, and slow pace of nutrient release. Nonetheless, organic sources are in most cases insufficient to satisfy the nutrient requirements of contemporary farming.

Integrated Nutrient Management (INM) that involves the combination of organic and inorganic sources of nutrients has developed as a viable solution to enhance the fertility of soil, health, and safety of crop. The reasoning behind INM is that the fast-nutrient delivery of fertilizers would be coupled with long-term soil health of organic inputs. Therefore, INM will be able to boost the lentil performance and reduce negative impact on the environment.

This research was conducted, considering the inadequate information on the nutrient dosage standardization at the Dehradun region to determine the effect of varying nutrient blends on growth, yield characteristics, yield, and economic gains of lentil.

Literature Review

Past studies have emphasized the need to have a balance in the management of nutrients in legumes. Too much fertilizer application has been linked to acidic soil, lack of balance in nutrients and low crop production (Ojeniyi, 2002). These organic amendments (e.g., FYM) are very effective in enhancing the physical characteristics of soil, the abundance of microorganisms, and the productivity of crops (Khan et al., 2010; Chandra et al., 2021). Vermicompost increases the soil porosity, nutrient level, and biologic activity which has led to good crop production in comparison to the use of the chemical fertilizer (Parthasarathi et al., 2008).

Rhizobium and phosphate-solubilizing bacteria (PSB) can also be considered biofertilizers that help to improve nutrient absorption, nodulation, and yield qualities of lentil (Tiwari et al., 2018). Research on INM highlights that combined application of fertilizers and organic additions enhance the yield of grain, soil quality, microbial biomass, and financial gains (Shareef et al., 2021; Singh et al., 2018).

Various researchers arrive at the conclusion that INM practices are more successful than single fertilizer administration or organic ones, as they yield better results in terms of yield, profit and soil quality.

Methodology

The experiment was carried at the Crop Research Farm of Dev Bhoomi Uttarakhand University, Dehradun in Rabi season which is situated at 30.38 o N latitude and 77.93 o E longitude, and the altitude of the place is about 639 m. It was sandy loam and moderately fertile soil.

Table 1. Plant Height at Different Growth Stages

Treatment	30 DAS	60 DAS	90 DAS	Harvest
100% RDF	14.1	28.8	39.8	40.2
75% RDF	13.1	27.0	36.7	36.8
50% RDF	12.0	24.9	34.0	34.9
75% RDF + FYM	14.6	30.3	40.9	41.1
50% RDF + FYM	13.2	28.0	38.3	39.1
75% RDF + VC	14.7	30.9	42.2	42.8
50% RDF + VC	13.3	28.4	39.0	40.1
75% RDF + FYM + VC	15.2	32.8	44.0	44.9
50% RDF + FYM + VC	14.9	32.2	43.0	43.8
Control	11.2	21.8	30.8	31.1

Table 2. Number of Pods per Plant

Treatment	Pods/Plant
100% RDF	44.1
75% RDF	42.3
50% RDF	39.4
75% RDF + FYM	48.9
50% RDF + FYM	45.7
75% RDF + VC	49.4
50% RDF + VC	46.3
75% RDF + FYM + VC	52.1
50% RDF + FYM + VC	50.7
Control	33.2

Table 3. Grain Yield of Lentil

Treatment	Grain Yield (kg/ha)
100% RDF	1650

75% RDF	1500
50% RDF	1350
75% RDF + FYM	1800
50% RDF + FYM	1600
75% RDF + VC	1900
50% RDF + VC	1750
75% RDF + FYM + VC	2075
50% RDF + FYM + VC	1990
Control	900

Table 4. Economic Performance of Lentil Under INM Treatments

Treatment	Gross Return (₹/ha)	Net Return (₹/ha)	B:C Ratio
100% RDF	82500	45500	2.23
75% RDF	75000	40500	2.17
50% RDF	67500	35000	2.07
75% RDF + FYM	90000	51000	2.3
50% RDF + FYM	80000	46000	2.25
75% RDF + VC	95000	88508	2.75
50% RDF + VC	87500	54000	2.28
75% RDF + FYM + VC	103750	62000	2.4
50% RDF + FYM + VC	99500	59000	2.36
Control	45000	12000	1.4

Randomized Block Design (RBD) was employed in the study with 10 treatments and 3 repetitions. The various doses of RDF (Recommended Dose of Fertilizer), FYM and vermicompost were applied as different combinations of the treatments. The variety used was Pant Masoor-9 and sowing was done at a distance of 30 x 10 cm spacing. The cultural practices such as irrigation, weeding, seed treatment and harvesting were the same in all plots. Parameters related to growth (plant height, branches, nodules) and yield (pods/plant, grains/ pod, test weight), as well as yields (grain and straw) were noted. The economic analysis involved calculation of gross returns, net returns and benefit-cost ratio. ANOVA was used to test the difference in RBD using statistical analysis.

Results And Discussion

There had been significant differences in all the treatments on growth, yield, and economic parameters. Combined nutrient interventions led to excellent vegetative development and reproduction.

Growth Parameters: The highest growth of the plants, the highest number of branches and the highest nodulation was measured under 75 percent RDF + FYM + vermicompost. This is credited to the increased activity of the microbes, mineralization of the nutrients and balanced supply of nutrients.

Yield Attributes: Both treatments with FYM and vermicompost had the highest number of pods per plant, grains per pod and test weight.

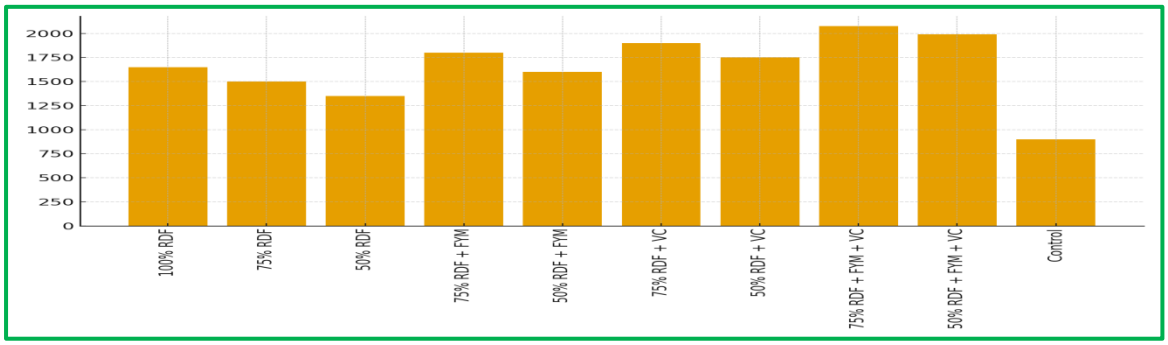

Figure 1. Grain Yield Across Treatments

Grain and Straw Yield: The best result of grain yield (2075 kg/ha) and straw yield were attained under the integrated treatment T8 (75% RDF + FYM + vermicompost). The lowest yields were at the control.

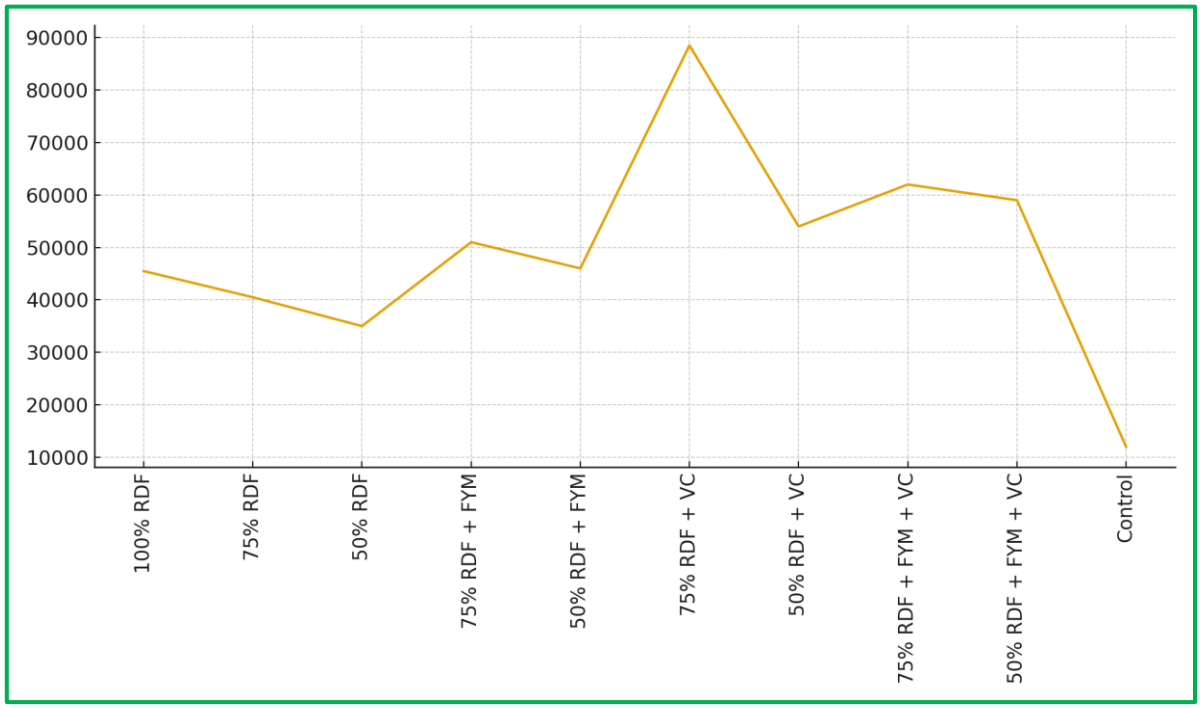

Figure 2. Net Returns Across INM Treatments

Economics: T8, etc. T8 gave the highest biological yield but T6 (75% RDF + vermicompost) gave the highest net return (₹88,508/ha) which implies that it is cheaper and has a relatively high yield. The B:C ratio was the highest with 100% RDF.

Conclusion and Summary

The research paper comes to a conclusion that, integrated nutrient management is important in improving the lentil productivity within the Doon Valley. The mixture of 75% RDF + FYM + vermicompost always worked better in the aspects of growth and yield qualities. RDF + vermicompost 75 yielded the highest net revenue because it had lesser input cost. Thus, the practices of INM can be used as the sustainable and lucrative way of lentils growing in the analogous agro-ecological areas.The research paper comes to a conclusion that, integrated nutrient management is important in improving the lentil productivity within the Doon Valley. The mixture of 75% RDF + FYM + vermicompost always worked better in the aspects of growth and yield qualities. RDF + vermicompost 75 yielded the highest net revenue because it had lesser input cost. Thus, the practices of INM can be used as the sustainable and lucrative way of lentils growing in the analogous agro-ecological areas.

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