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Varietal Efficacy of Lentil on Nitrogen uptake under Tripura Condition

Anandika Kar[1], Utpal Giri[1*], Debashish Sen[1], Niladri Paul[1] and Vinodakumar S. Naik[2]
[1]*College of Agriculture Tripura, Lembucherra, Tripura (799 210), India*
[2]*Multi Technology Testing Centre & Vocational Training Centre, Central Agricultural University, College of Fisheries, Tripura, Lembucherra, Tripura (799 210), India*
*Corresponding email: utpalgiricat2014@gmail.com
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ABSTRACT

For millions of people, lentil (*Lens culinaris* Medik. sub sp. *culinaris*) is considered to be a staple and a nutrient-dense diet. At the experimental farm of College of Agriculture Tripura, a field experiment was carried out to study the varietal efficacy of nitrogen uptake by lentil crop under Tripura condition. A complete randomised block design was employed to evaluate sixteen different lentil types and the results were reproduced three times. The IPL-534 (27.47 kg ha^{-1}) variety reported the maximum nitrogen uptake closely followed by BARI Masoor-5 (23.45 kg ha^{-1}) and the minimum nitrogen uptake was recorded by $C_{23}E_{21}$ variety (4.48 kg ha^{-1}). The maximum available nitrogen was found in soil of Moitri variety and ILL-10893 variety (376.3 kg ha^{-1}) closely followed by BARI Masoor-7 variety, $C_{23}E_{21}$ variety and L4717 variety (351.2 kg ha^{-1}) whereas the minimum available nitrogen were found in the soil of IPL-534 variety (225.7 kg ha^{-1}). The highest uptake of nitrogen from soil was recorded by IPL-534 variety as well as it also recorded the least expected nitrogen. Hence, nitrogen availability in soil was also significantly affected by different varieties of lentil. Though, the IPL-534 variety shows the greater efficacy of nitrogen among all the varieties that were tested. Hence, nitrogen budget states that some of the varieties have experienced an overall net gain in nitrogen, whereas the remaining varieties experienced an overall net loss in nitrogen.

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INTRODUCTION

Lentil (*Lens culinaris* Medik. sub sp. *culinaris*), belonging to the family Fabaceae, subfamily Papilionaceae, is a self-pollinated crop and it is divided into two sub-species, including macro-sperma and micro-sperma. Lentils are widely consumed by humans throughout India among the many pulse species. Due to the high protein content of their seed, lentils are essential to the food and nutritional security of millions of people, especially those in low-income Indian households. With a mean protein content of 28.3% that ranges from 15.9 to 31.4%, lentil seeds are an essential source of protein (Grusak, 2009). Like many other pulses, lentils are a valuable rotation crop that improves soil fertility and offers additional environmental benefits to production systems. Lentils are tailored to the local climate and soil fertility conditions in addition to fixing nitrogen from the atmosphere and providing residual nitrogen in the soil for the next harvest (Wang *et al*., 2012). In nodules on their roots, legumes or lentils, develop symbiotic associations with rhizobia bacteria that can fix nitrogen gas into a form that plants can use. Rhizobia inoculation can enhance the probability and magnitude of nitrogen fixation and nodulation in legumes. Because of this mechanism, farmers who wish to apply less nitrogen fertiliser to their soil may find lentils to be a desirable alternative.

Since Tripura imports about 90% of its lentils and is also one of the major lentil-consuming states in India, the state must give priority to pulse production in order to meet its protein demands and become self-sufficient. Lentils have a great chance of raising both cropping intensity and farm income in Tripura, where a sizable portion of the upland, moisture-deficient region is left fallow following *Kharif* rainfed crops (Das *et al*., 2014). Growing mostly on residual soil moisture, lentils are a significant pulse crop and a major source of vegetable protein (Singh *et al*., 2011). As a pulse crop, lentil also increases soil fertility and is a great crop rotation choice. There are a number of obstacles to lentil farming in Tripura, including acidic soil, a small window of time following rice harvest for seed and flower dropping, and poor pod setting in crops that are planted later. Thus, the aim of this study was to investigate how well lentils absorbed nitrogen in Tripura conditions.

MATERIALS AND METHODS

Experimental Site

At 2021-22, a field experiment was carried out at the experimental farm of the College of Agriculture, Lembucherra, Tripura, India (23°56' N lat. and 91°10' E long., 160 msl). The experimental field's soil (*Typic Kandihumults*) is sandy clay loam, and the baseline soil sample had 326 kg ha^{-1} of accessible nitrogen (N) and 1.8 g kg^{-1} SOC. The soil's pH was 5.2, meaning it was acidic (the ratio of soil to water was 1:2.6) (Giri *et al*., 2021). Figure 1 elaborated the weekly meteorological data recorded during the period of experiment.

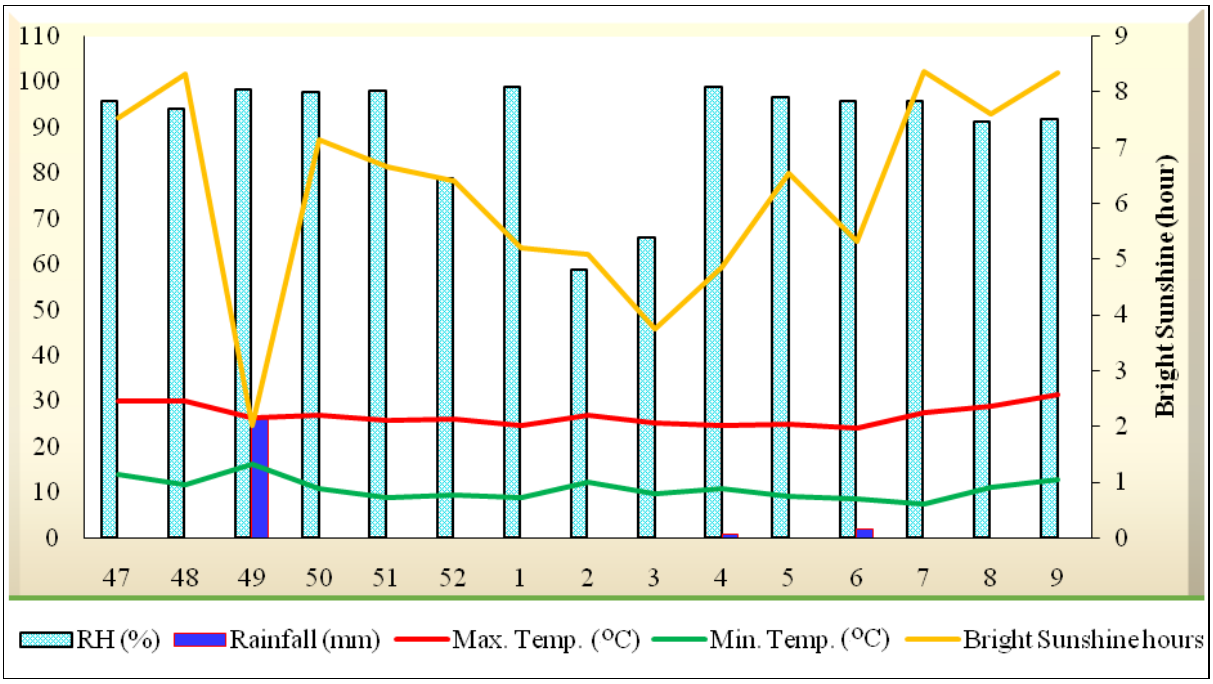

Figure 1: Weekly meteorological data recorded during the period of experiment

Experimental Design and Crop Management

The sixteen lentil varieties were gathered from Bidhan Chandra Krishi ViswaVidyalaya (BCKV), Kalyani, West Bengal and the International Centre for Agricultural Research in the Dry Areas (ICARDA), Syria. The spacing between lentil seeds was 30 cm × 10 cm (R-R × P-P). Three replications of the 16 cultivars' tests were conducted using a complete randomised block design (CRBD). Full dose of the recommended NPK as basal were applied (20:40:40 NPK respectively) along with 5 ton of FYM as the organic source of nitrogen and as the soil of the experimental field is highly acidic, it has been observed that there has been very little or no nodule formation. Consequently, foliar sprays of 2% urea were administered at 35 DAS to make up for the N requirement and a second foliar spray of 0.5% borax and 0.1% ammonium molybdate was sprayed immediately after blooming at 36 DAS. Additionally, shortly after blooming at 48 DAS, a second spray of 0.5% borax and 0.1% ammonium molybdate was sprayed.

Available Nitrogen (N) Content in Soil and Plant

The soil's available nitrogen content was calculated in kg ha^{-1} using Jackson's (1967) modified Kjeldahl method. The proportion of available nitrogen in the soil and plants was also ascertained and the crop's nitrogen uptake was computed in kg ha^{-1}.

Nitrogen Budgeting

Nitrogen budgets provide information about how crop inputs and outputs are balanced. To put it briefly, Kumar *et al*. (2022) contrast the nutrients that crops absorb with those that are applied to the soil. All nutrient inputs on a farm as well as those taken off the land are considered in a nutrient budget.

Statistical Analysis

The analysis of variance technique was employed to statistically analyse the experimental data related to each study parameter and the "F" test was used to determine the significance of the results, as described by Gomez and Gomez (1984). To assess differences between treatment means, the critical difference (CD) and standard error of means (SEm±) at 5% probability (p=0.05) were calculated for each parameter under study.

RESULTS AND DISCUSSION

The maximum nitrogen uptake was done by IPL-534 (27.47 kg ha^{-1}) variety closely followed by BARI Masoor-5 (23.45 kg ha^{-1}). The minimum nitrogen uptake was recorded by $C_{23}E_{21}$ variety (4.48 kg ha^{-1}). This might be due to the photosynthetic ability, greater nutrient absorption ability and to some extent, genetic factors (Table 1). The maximum available nitrogen was found in soil of Moitri variety and ILL-10893 variety (376.3 kg ha^{-1}) closely followed by BARI Masoor-7 variety, $C_{23}E_{21}$ variety and L4717 variety (351.2 kg ha^{-1}) whereas the minimum available nitrogen were found in the soil of IPL-534 variety (225.7 kg ha^{-1}). This might be due to the greater uptake of nutrients by the particular varieties and there might also be some leaching loss if the uptake is less as well as the available nitrogen being less. Similar types of findings were reported by Vinodakumar *et al.* (2017) and Kumar *et al.* (2022).

Table 1: Effect of varieties of lentil on plant nitrogen uptake and available nitrogen in soil (kg ha^{-1})

Treatment	Total N (uptake)	Available N
BARI Masoor-5	23.45	275.90
BARI Masoor-7	5.91	351.20
$C_{23}E_{21}$	4.48	351.20
ILL10802	9.20	301.00
ILL10893	8.24	376.30
IPL 220	8.39	301.00
L4717	4.67	351.20
L4727	8.56	275.90
ILL10961	11.10	351.20
BINA-7	11.26	250.80
BINA-8	20.31	301.00
BINA-9	12.96	301.00
BINA-10	8.03	275.90
IPL534	27.47	225.70
ILL-10803	17.72	250.80
Moitri (Check)	10.18	376.30
SE_m (±)	1.77	2.49
CD at 5%	5.34	7.50
CV (%)	25.51	1.40

The varieties $C_{23}E_{21}$ and L4717 showed the maximum expected nitrogen content among the other varieties closely followed by BARI Maroor-7. IPL-534 variety showed the least expected nitrogen content and it removed the highest quantity of nitrogen from soil. The highest actual nitrogen balance based on soil status was recorded by Moitri and ILL10893 variety followed by BARI Masoor-7, $C_{23}E_{21}$ and L4717 variety and lowest was recorded by IPL-534 (Table 2). Few varieties showed an overall net gain in nitrogen whereas the rest of the varieties recorded net loss in nitrogen. The net gain in nitrogen might be due to the seed treatment with *Rhizobium leguminosarum* and the fixation of nitrogen by the soil microbes that have been treated. The net loss in nitrogen might be due to the greater uptake of the variety and soil loss through leaching, runoff, *etc*.

Table 2: Effect of lentil varieties on available nitrogen balance (kg ha^{-1}) in soil

Treatment	Initial soil N status	N added through		Total quantity of N added	Total quantity of N removed by crops	Expected N	Actual N	Net Gain or Loss
		Organic	Inorganic					
BARI Masoor-5	326.1	25	30	55	23.5	357.7	275.9	-50.17
BARI Masoor-7	326.1	25	30	55	5.92	375.2	351.2	25.09
$C_{23}E_{21}$	326.1	25	30	55	4.49	376.7	351.2	25.09
ILL10802	326.1	25	30	55	9.20	371.9	301.0	-25.08
ILL10893	326.1	25	30	55	8.24	372.9	376.3	50.18
IPL 220	326.1	25	30	55	8.39	372.8	301.0	-25.08
L4717	326.1	25	30	55	4.67	376.5	351.2	25.09
L4727	326.1	25	30	55	8.56	372.6	275.9	-50.17
ILL10961	326.1	25	30	55	11.1	370.0	351.2	25.09
BINA-7	326.1	25	30	55	11.3	369.9	250.8	-75.26
BINA-8	326.1	25	30	55	20.3	360.8	301.0	-25.08
BINA-9	326.1	25	30	55	13.0	368.2	301.0	-25.08
BINA-10	326.1	25	30	55	8.04	373.1	275.9	-50.17
IPL534	326.1	25	30	55	27.5	353.7	225.7	-100.3
ILL-10803	326.1	25	30	55	17.7	363.4	250.8	25.09
Moitri (Check)	326.1	25	30	55	10.2	371.0	376.3	50.18

[Not statistically analysed; N: Nitrogen]

CONCLUSION

The experimental study indicates that there is potential for growing high-yielding lentil cultivars in Tripura's highland environment. The highest uptake of nitrogen from soil was recorded by IPL-534 variety as well as it also recorded the least expected nitrogen. However, it also recorded the less actual nitrogen content of soil (available nitrogen), this might be due to the highest nitrogen uptake by this variety, but the nitrogen budget study states that there was an overall loss in nitrogen; it means that there might be some leaching loss. Hence, this variety performed well and also shows the greater efficacy of nitrogen uptake among the other varieties. However, to find high-yielding, short-duration varieties that are appropriate for this state, more lines or varieties from various institutes should be tested.

Conflict of Interest

The authors declare no conflict of interest.

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