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Effect of fertility levels and weed management on number of nodules and yield of lentil

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Abstract

An experiment was conducted during the *Rabi* season of 2012-13 and 2013-14 to examine the effects of fertility levels and weed management practices on Nodules formation and yield of lentil (*Lens culinaris* Medikus). The experiment was laid out in split-plot design comprising six main plot treatments *viz.* Control (F₀), 100% RDF (F₁), 75% RDF + 2% urea spray at pre-flowering and pod initiation stage (F₂), 75% RDF + Plantgro 9 kg/ha at 35, 50 and 65 DAS as foliar spray (F₃), 100% RDF + 2% urea spray at pre-flowering and pod initiation stage (F₄), 100% RDF+ Plantgro 9 kg/ha at 35, 50 and 65 DAS as foliar spray (F₅) and four sub-plot treatments *viz.* unweeded (W₀), weed free (W₁), pendimethalin 1 kg a.i./ha (W₂), imazethapyr 37.5 g a.i./ha (W₃). The number of nodules plant⁻¹ were recorded at 30, 60 and 90 DAS. It was observed that the number of nodules varied significantly due to varying fertility levels and weed management treatments. A close inspection of the data revealed that 100% RDF +Plantgro 9 kg ha⁻¹ recorded significantly highest nodule number plant⁻¹ followed by 100% RDF + 2% urea spray as compared to rest of the treatments during both the years of study. Application of 75% RDF +Plantgro 9 kg ha⁻¹ recorded significantly highest grain yield (1243 and 1323 kg ha⁻¹) followed by 100% RDF + 2% urea spray (1105 and 1168 kg ha⁻¹) as compared to rest of the treatments during both the years of study.

Keywords: Fertility level, lentil, nodules, weed management, yield

Introduction

At the global level, though India's share in lentil production is quite large (30%), yet the production (0.95 mt) and productivity level (633.33 kg/ha) in the country is substantially low (FAOSTAT, 2014). The low average yield might be due to poor level of crop management, growing lentil on marginal lands with low fertilizer inputs and inadequate weed management. Foliar application is regarded as a preferred solution when the quick supply of nutrients is hindered or the soil conditions are conducive for the absorption of nutrients (Salisbury and Ross, 1995)^[6]. Urea is the most suitable nitrogen source for foliar application due to its low salt index and high solubility in comparison to other nitrogen sources Plant GRO MAGIC is a fertilizer product which is a multi nutrient water soluble fertilizer (57.1% total nutrients) and includes nitrogen, phosphorus and potassium as primary nutrients. It has been found that weeds reduce yield of lentil to the extent of 73% (Phogat *et al.*, 2003)^[5] and under high densities of weeds losses can reach even up to 100%. Weed infestation in lentil is high due to its slow initial growth, short stature and shallow root system. The most effective method of controlling weeds in lentil is hand weeding. But, this technique is feasible only on small farms and under sufficient labour availability. The use of herbicides as an alternative to hand weeding can be feasible and more economical than hand weeding. Pre- emergence herbicides like pendimethalin effective only for a period of initial 30 days and at later stages, crop gets infested with weeds. Therefore, the use of post-emergence herbicide needs to be advocated in lentil. There is a need to develop most effective and economical fertilizer management and weed control practices for obtaining higher yield as well as profitability. Keeping these facts in view, the present experiment was designed to determine the best suitable fertilizer and weed management technique for lentil crop.

Materials and methods

Field experiment was conducted during the winter season of 2012-13 and 2013-14 at dryland research farm of Banaras Hindu University, Varanasi (U.P.) to examine the performance of lentil under varying fertility levels and weed management treatments. The experimental site is located at 25°18' North latitude, 83°03' East longitude and at altitude of 76.60 meter above the mean sea level (MSL) in the Northern Gangetic Alluvial Plain. A composite representative soil sample was collected and was analysed for physicochemical properties. The soil was clay loam in texture with pH 7.31 (1:25 soil and water ratio), 0.37% organic carbon (Walkley and Black,

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1937), 212.50 kg/ha available nitrogen (Subbiah and Asija, 1956), 25.17 kg/ha available phosphorus (Olsen *et al.*, 1954) and 234.15 kg/ha potassium (Jackson, 1973) before the start of the experiment. The experiment was replicated thrice in split-plot design with six fertility levels *viz.* Control (F₀), 100% RDF (F₁), 75% RDF + 2% urea spray at pre-flowering and pod initiation (F₂), 75% RDF + Plantgro 9 kg/ha at 35, 50 and 65 DAS as foliar spray (F₃), 100% RDF + 2% urea spray at pre-flowering at pod initiation (F₄), 100% RDF + Plantgro 9 kg/ha at 35, 50 and 65 DAS as foliar spray (F₅) and four weed management practices *viz.*, Unweeded (W₀), weed free (W₁), pendimethalin 1.0 kg/ha (W₂), imazethapyr 37.5 g/ha (W₃). A uniform dose of 20, 40, 30 kg N, P₂O₅, K₂O/ha was applied to different plots as per the treatment requirements through urea, Single super phosphate and Muriate of potash respectively. Full dose of recommended fertilizers were applied as basal before sowing. Lentil variety HUL-57 (Malviya- Vishwanath) was sown on 23 November in 2013 and 21 November in 2014, respectively using a seed rate of 40 kg/ha at row spacing of 25 x 5 cm and following all standard package and practices. Hand weeding was done with the help of khurpi at an interval of 25 days or whenever weeds were observed in weed free plots. Pendimethalin was applied as pre-emergence using Knapsack sprayer fitted with flat fan nozzle by mixing 500 litres of water/ha. Post-emergence herbicide Imazethapyr was applied at 2-4 leaf stage of weed. Number of nodules in each of the five uprooted plants were counted and the mean values were taken for expressing number of nodules plant⁻¹ at 30, 60 and at 90 DAS. After the death of a batch of nodules, fresh nodules developed. While counting, care was taken to exclude the dead nodules for the fact that only live and active nodules are effective in symbiotic association with the leguminous plants. After threshing each plot separately, the grains were cleaned and weight was recorded in kg per plot. It was standardized to 12-14% moisture and then weight was converted into kg ha⁻¹.

Result and discussion

Number of nodules plant⁻¹

The number of nodules plant⁻¹ were recorded at 30, 60 and 90 DAS and the data is presented in Table 1. It was observed that the number of nodules varied significantly due to varying fertility levels and weed management treatments. A close inspection of the data revealed that 100% RDF + Plantgro 9 kg ha⁻¹ recorded significantly highest nodule number plant⁻¹ followed by 100% RDF + 2% urea spray as compared to rest of the treatments during both the years of study. Thereafter, application of 75% RDF + Plantgro 9 kg ha⁻¹ recorded highest number of nodules plant⁻¹ followed by 75% RDF + 2% urea spray as compared to alone recommended dose of fertilizers and control during both the years of study. However, all the fertility level treatments were significantly superior to control which recorded lowest nodule number plant⁻¹ during both the years of experimentation. That significant variations due to varying weed management treatments was observed with respect to nodule number plant⁻¹. It is clear from the data that among weed management treatment weed free recorded significantly highest number of nodules plant⁻¹. Among herbicidal treatments, at initial stages *i.e.* at 30 DAS pre-emergence application of Pendimethalin 1.0 kg ha⁻¹ recorded highest number of nodules plant⁻¹. At later stages *i.e.* at 60 DAS and thereafter post-emergence application of Imazethapyr 37.5 g ha⁻¹ recorded highest number of nodules plant⁻¹. All the treatments remained significantly superior to unweeded control during both the years in recording highest nodule number plant⁻¹. Nodules plant⁻¹ was varied significantly due to varying levels of fertility. Nitrogen is an essential constituent of all living matter including proteins, amino acids, nucleic acids, nucleotides, enzymes, alkaloids, vitamins, This might be due to the synergistic effect of nitrogen, phosphorus and potassium application which might have enhanced root activities and root nodulation of plants. Similar results were obtained by Shivran and Ahlawat (2000a) [7], Chandel *et al.* (2002) [1] and Jagdale *et al.* (2005) [2].

Table 1: Effect of fertility levels and weed management on nodule number plant⁻¹ at different stages of observation in lentil

Treatment	30 DAS		60 DAS		90 DAS	
	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14
A. Fertility levels						
F ₀ Control (No fertilizer)	4.77	4.95	3.35	3.52	1.68	1.84
F ₁ 100% RDF	5.38	5.61	3.62	3.83	1.99	2.19
F ₂ 75% RDF+ 2% urea spray at pre-flowering and pod initiation	6.55	6.80	5.14	5.37	2.17	2.37
F ₃ 75% RDF + Plantgro 9 kg ha ⁻¹ at 35, 50, 65 DAS as foliar spray	6.91	7.16	5.79	6.03	2.43	2.64
F ₄ 100% RDF + 2% urea spray at pre-flowering and pod initiation	7.32	7.57	6.91	7.16	3.00	3.21
F ₅ 100% RDF + Plantgro 9 kg ha ⁻¹ at 35, 50, 65 DAS as foliar spray	8.33	8.60	8.12	8.38	3.46	3.67
SEm ±	0.12	0.12	0.11	0.12	0.05	0.05
CD (P = 0.05)	0.37	0.39	0.35	0.36	0.14	0.14
B. Weed management						
W ₀ Unweeded	5.76	5.99	4.82	5.04	1.91	2.11
W ₁ Weed free	7.28	7.52	6.25	6.48	3.03	3.23
W ₂ Pendimethalin 1.0 kg ha ⁻¹	6.80	7.04	5.27	5.50	2.27	2.47
W ₃ Imazethapyr 37.5 g ha ⁻¹	6.33	6.56	5.61	5.84	2.61	2.81
SEm ±	0.07	0.07	0.06	0.07	0.03	0.03
CD (P = 0.05)	0.21	0.21	0.18	0.19	0.08	0.08

Grain yield

An investigation of the data is presented in Table 2, on grain yield revealed that marked variation in grain yield was observed due to varying fertility levels. An inspection of the data revealed that application of 75% RDF + Plantgro 9 kg ha⁻¹ recorded significantly highest grain yield (1243 and 1323 kg ha⁻¹) followed by 100% RDF + 2% urea spray (1105 and 1168 kg ha⁻¹) as compared to rest of the treatments during both the

years of study. 75% RDF + Plantgro 9 kg ha⁻¹ treatment recorded a higher yield increase of 49.93% and 36.11% compared to control during 2012-13 and 2013-2014 respectively. Thereafter, application of 100% followed by 75% RDF + 2% urea spray remained comparable to each other but significantly better than 100% RDF + Plantgro 9 kg ha⁻¹ during both the years of study. However, all the fertility level treatments were significantly superior to control which

recorded lowest grain yield during both the years of experimentation.

Among herbicidal treatments, post-emergence application of Imazethapyr 37.5 g ha⁻¹ recorded highest grain yield (1069 kg ha⁻¹). This treatment recorded yield increase of 20.51% and 8.5% compared to unweeded control during

2012-13 and 2013-14 respectively. All the herbicidal treatments remained significantly superior to unweeded control during both the years in recording highest grain yield. These results are in conformity with Meena *et al.* (2013)^[3] and Singh *et al.* (2014)^[8].

Table 2: Effect of fertility levels and weed management on yield (kg ha⁻¹) in lentil

Treatment	Grain yield (kg ha ⁻¹)	
	2012-13	2013-14
A. Fertility levels		
F ₀ Control (No fertilizer)	829	972
F ₁ 100% RDF	1048	1146
F ₂ 75% RDF+ 2% urea spray at pre-flowering and pod initiation	1001	1054
F ₃ 75% RDF + Plantgro 9 kg ha ⁻¹ at 35, 50, 65 DAS as foliar spray	1243	1323
F ₄ 100% RDF + 2% urea spray at pre-flowering and pod initiation	1105	1168
F ₅ 100% RDF + Plantgro 9 kg ha ⁻¹ at 35, 50, 65 DAS as foliar spray	1000	1057
SEm ±	29	30
CD (P = 0.05)	91	95
B. Weed management		
W ₀ Unweeded	887	1020
W ₁ Weed free	1187	1275
W ₂ Pendimethalin 1.0 kg ha ⁻¹	1007	1078
W ₃ Imazethapyr 37.5 g ha ⁻¹	1069	1107
SEm ±	16	10
CD (P = 0.05)	47	33

Conclusion

The highest value of grain yield of lentil was observed under 75% RDF + Plantgro 9 kg ha⁻¹ next followed by 100% RDF + 2% urea spray. Among herbicidal treatments, application of Imazethapyr 37.5 g ha⁻¹ at 40 DAS was the best treatment with respect to grain yield. Based on two-year experimental findings, it is recommended that application of 100% RDF + 2% urea spray accompanied with Imazethapyr 37.5 g ha⁻¹ at 40 DAS be practiced to achieve higher yield and net returns of lentil under agro-climatic condition of Varanasi.

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