International Journal of Agricultural Sciences
Volume **10** | Issue 1| January, 2014 | 175-178

RESEARCH PAPER

Effect of integrated nutrient management on growth, physiological parameters and productivity of lentil (*Lens culinaris* Medik.)

DASHRATH SINGH* AND R.P. SINGH[1]
Department of Agronomy, Central Institute of Agricultural Engineering, BHOPAL (M.P.) INDIA
(Email : agriandashrath@yahoo.com)

Abstract : A field experiment was conducted during *Rabi* season at All India Co-ordinated Research Project on MULLaRP (mungbean, urdbean, lentil, lathyrus, rajmash and pea) Department of Agronomy, R.A.K. College of Agriculture, Sehore (M.P.) during 2007-2008, with the objective of studying the effect of INM practices on growth(plant height and branches), physiological parameters (leaf area, LAI, NAR, CGR) and seed yield of lentil. The results of the study could be concluded that all the growth, physiological characters of lentil were improved 11.2 to 52.0 % Leaf area, 18.7 to 43.7 % LAI at 60 DAS and 1.8 to 64.8 CGR, 11.1 to 88.8 % NAR at 45-60 DAS, 29.7 to 50.9 % root nodule at 60 DAS and 16.5 to 43.7 % yield as compared to control due to balance use of NPKS @ 20:40:20:20 kg/ha + FYM @ 5 t/ha. Further it was suggested that the INM is best option to improve the seed yield of lentil.

Key Words : Integrated nutrient management, *Rhizobium*, NAR, LAI, Branches, Yield

View Point Article : Singh, Dashrath and Singh, R.P. (2014). Effect of integrated nutrient management on growth, physiological parameters and productivity of lentil (*Lens culinaris* Medik.). *Internat. J. agric. Sci.*, **10** (1): 175-178.

Article History : Received : 23.04.2013**; Revised :** 07.10.2013**; Accepted :** 05.11.2013

INTRODUCTION

Lentil (*Lens culinaris* Medik.) is an important *Rabi* pulse crop extensively grown in India. In an area of 1.48 million ha with a production of 1.03 million tons (during 2009-10). As a leguminous crop; it utilizes atmospheric nitrogen to meet its partial nitrogen requirement and thus occupies an important place in crop rotations in different parts of the country. The yield level of lentil is generally low because it is less cared crop and mostly grown in poor soils under rain fed conditions without manures and fertilizers. Regular depletion of nutrient resources of soils has led to emergence of several nutrients deficiencies in many crops including lentil. This is because the greater is the production the higher and faster are the rates of nutrient exhaustion from the soil.

Environmental awareness necessitating a shift in nutrient management strategy towards soil fertility maintenance based on natural recourse conservation, biological nitrogen fixation and input efficiency, often referred to as integrated nutrient management. The concept dose not preclude the use of fertilizer but empasis laid on use against the alternative in terms of direct and long term environmental cost in meeting the demand for food, fibre, forage and fuel for human being.

Although the integrated nutrient management (INM) has assumed greater significance over the past decade, work on lentil, as a whole is scattered. Besides, the prohibitive cost of chemical fertilizers often compels to use organic and bio-fertilizers. Therefore, INM involving inorganic, biological and organic sources has potential to improve soil fertility on a sustainable basis, since it supplies several nutrients besides increasing nutrient use efficiency and improving physio-chemical properties of soil. Hence, there is a need

*** Author for correspondence**
[1]Department of Agronomy, R.A.K. College of Agriculture, SEHORE (M.P.) INDIA

to study the effect of combined use of inorganic, organic and bio-fertilizers on productivity of lentil.

The beneficial effect of FYM, vermicompost, *Rhizobium* and PSB culture on crop yield and soil productivity is the result of its usefulness as a store house of plant nutrients. Improved soil aeration and root development reduced evaporation and increased biological activities in the rhizosphere. Therefore, the addition of FYM, vermicompost, *Rhizobium* and PSB culture to the poor fertile soils along with optimum dose of chemical fertilizers is most essential.

With this back draw, an experiment was conducted at RAK College of Agriculture with the objective of studying the effect of INM practices on productivity of lentil.

MATERIAL AND METHODS

A field experiment was conducted during *Rabi* season at All India Co-ordinated Research Project on MULLaRP (mungbean, urdbean, lentil, lathyrus, rajmash and rea) Department of Agronomy, R.A.K. College of Agriculture, Sehore (M.P.) during 2007-2008. The soils of the experimental area were clayey loam in texture with slight alkalinity (pH 7.5) in reaction. The available nitrogen, phosphorus, potash and organic carbon were 200, 15.0, 290 kg/ha and 0.42 %, respectively. The experiment was laid out in a Randomized Block Design with 10 treatments with three replications. The treatments were T_1-Control, T_2-NPKS (20:17:20:20 kg/ha), T_3-FYM @ 5 t/ha, T_4-Vermicompost @2 t/ha., T_5-NPKS (20:17:20:20 kg/ha) + FYM @ 5 t/ha, T_6-NPKS (20:17:20:20 kg/ha) + vermicompost @2 t/ha, T_7-*Rhizobium* culture + PSB, T_8-NPKS (20:17:20:20 kg/ha) + *Rhizobium* culture + PSB, T_9-FYM @ 5 t/ha + *Rhizobium* culture + PSB, T_{10}-Vermicompost @2 t/ha + *Rhizobium* culture + PSB. Sulphur was applied through gypsum and broadcasted uniformly as per the treatment. Phosphorus was applied through DAP as per treatment and potash (20 kg/ha through muriate of potash) was applied as basal dose at the time of sowing. The lentil variety JL-3 was sown at 30x10 cm spacing. Seed inoculation was done with *Rhizobium* and phosphate solubilizing bacteria (PSB). The observations on number of pods per plant, number of seeds per pod, grain, straw and biological yield were recorded at maturity. The data were statistically analyzed by Microsoft Excel.

RESULTS AND DISCUSSION

The results of the present study have been presented and discussed under the following headings:

Growth parameters:

The plant height and number of branches at different stages lies depicted in Table 1. Both the parameters were significantly improved at maturity. It was also observed that

Table 1: Branches, plant height, leaf area, leaf area index, NAR and CGR of lentil as influenced by various INM treatments

Sl. No.	Treatments	Branches / plant	Height (cm)	Leaf area (cm^2)			Leaf area index			NAR ($mg/cm^2/day$)		CGR ($g/m^2/day$)	
				30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 - 45 DAS	45- 60 DAS	30-45 DAS	45-60 DAS
T_1	Control	3.48	21.52	15.26	25.12	51.82	0.05	0.07	0.16	0.003	0.0009	0.66	0.54
T_2	NPKS @ 20:40:2020 kg/ha kg/ha	4.62	29.88	20	29.46	65.02	0.07	0.1	0.21	0.004	0.001	1.06	0.65
T_3	FYM @ 5 t/ha	4.47	29.79	18.94	28.08	59.09	0.06	0.1	0.2	0.0039	0.0012	0.98	0.6
T_4	Vermicompost @ 2 t/ha	4.41	29.56	18.99	27.58	58.06	0.06	0.1	0.19	0.0037	0.0012	0.91	0.59
T_5	NPKS @ 20:40:2020 kg/ha + FYM @ 5 t/ha	5.63	32.73	24.24	34.04	78.8	0.08	0.11	0.23	0.0047	0.0017	1.44	0.89
T_6	NPKS @ 20:40:2020 kg/ha + Vermicompost @ 2 t/ha	5.47	32.50	22	33.7	70.58	0.07	0.11	0.22	0.0046	0.0016	1.38	0.85
T_7	*Rhizobium* + PSB	4.30	29.24	18.63	27.17	57.66	0.06	0.09	0.19	0.0036	0.0015	0.89	0.55
T_8	NPKS @ 20:40:2020 kg/ha + *Rhizobium* + PSB	5.26	32.51	21.21	32.09	69.07	0.07	0.11	0.22	0.0041	0.0015	1.18	0.7
T_9	FYM @ 5 t/ha + *Rhizobium* + PSB	4.87	30.19	20.73	30.52	66.17	0.07	0.1	0.21	0.0039	0.0014	1.09	0.71
T_{10}	Vermicompost @2 t/ha + *Rhizobium* +PSB	5.23	31.20	21	31.37	68.33	0.07	0.1	0.22	0.004	0.0015	1.16	0.77
	S.E.±	0.22	1.44	0.89	0.41	1.8	0.003	0.005	0.1	0.0002	0.0001	0.05	0.031
	C.D. (P=0.05)	0.63	4.15	2.58	1.19	5.22	0.009	0.014	0.028	0.0006	0.0002	0.27	0.091

the significant improvement of plant height was observed in the INM treatment (T_5). The plant height and number of branches varied from 32.7 to 61.7% and 35.2 to 51.3 % over control. Among the INM systems the above mentiat parameters were in the order of T_5, T_6, T_8 and T_{10}.

The leaf area and leaf area index are the most important plant physiological parameters to evaluate the canopy growth performance. It was observed that both the parameters were significantly improved in the sequence at all these stages. At 60 DAS, the leaf area index and leaf area were maximum and highest value was observed in T_5 treatment followed by T_6 and T_8. The leaf area and leaf area index varied from 11.2 to 52.0 % leaf area and 18.7 to 43.7 % LAI over control in the best treatment (Table 1).

The dry matter accumulation and it represented as NAR and CGR. These parameters have been estimated at 45 and 60 days after sowing of crop. In this experiment it was observed that both NAR and CGR were consistently decreased with advancement of time. However, it was relatively greater in T_5 followed by T_6 and T_{10}. This study clearly indicated that INM is the best management option than chemical fertilizer (Table 1).

The factors which are responsible for growth (branches per plant, plant height, leaf area, NAR, CGR and seed yield) were augmented significantly due to increased supply of nutrients from integrated nutrient management treatments receiving NPKS @ 20:40:20:20 kg/ha with FYM @ 5 t/ha. This was found to be significantly superior over control. This was followed by integrated nutrient management treatments NPKS @ 20:40:20:20 kg/ha + vermicompost @ 2 t/ha and then NPKS @ 20:40:20:20 kg/ha + *Rhizobium* + PSB, respectively with respect to growth, nodulation and physiological attributes. The organic sources like FYM or vermicompost are the store house of plant nutrients which might have improved the physico chemical as well as biological properties of the soil to enhance crop growth. On the other hand, for the soils applied with only chemical fertilizers are deprived of all these advantages necessary for more accumulation of carbohydrates, and their translocation to the reproductive organs, increased the plant height number of branches per plant, leaf area, NAR and CGR. These results are in conformity with the findings of Singh *et al.* (2005), Ahmed *et al.* (2006), Zeidan, (2007), Mohammadjanloo *et al.* (2009), Giri and Joshi (2010) and Sinha *et al.* (2010).

Yield and yield attributing parameters:

The factors which are directly responsible for ultimate grain production *viz.*, number of pods per plant, number of seeds per pod and test weight were augmented significantly due to increased supply of nutrients from integrated nutrient management treatments having NPKS @ 20:40:20:20 kg/ha + FYM @ 5 t/ha. This integrated nutrient management treatment was found significantly superior to rest of the treatments except the integrated nutrient management treatment having NPKS @ 20:40:20:20 kg/ha + vermicompost @ 2 t/ha and then NPKS @ 20:40:20:20 kg/ha + *Rhizobium* + PSB. This was followed by integrated nutrient management treatments NPKS @ 20:40:20:20 kg/ha + vermicompost @ 2 t/ha and then NPKS @ 20:40:20:20 kg/ha + *Rhizobium* + PSB, respectively with respect to yield and yield-attributing parameters. The organic sources like FYM or vermicompost are the store house of plant nutrients which might have improved the physico chemical as well as biological properties of the soil to enhance crop yield. On the other hand, for the soils applied with only chemical fertilizers are deprived of all these advantages necessary for more production of functioning leaves, greater accumulation of carbohydrates, protein and their translocation to the reproductive organs, which in turn increased the number of pods per plant and other associated yield attributing parameters (Table 2). These results are in conformity with the findings of Krishna Reddy and Ahlawat (2001), Singh *et*

Table 2 : Yield attributes and yields of lentil as influenced by various INM treatments

Sr. No.	Treatments	Pods/ Plant	Seeds/ pod	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index
1.	Control	37.99	1.28	1.70	745	1450	2195	33.98
2.	NPKS @ 20:40:20:20 kg/ha	77.53	1.79	2.91	984	1728	2712	36.27
3.	FYM @ 5 t/ha	68.80	1.47	2.58	917	1671	2589	35.44
4.	Vermicompost @ 2 t/ha	55.60	1.45	2.49	914	1629	2542	35.92
5.	NPKS @ 20:40:20:20 kg/ha + FYM @ 5 t/ha	84.07	2.19	3.30	1071	1839	2910	36.83
6.	NPKS @ 20:40:20:20 kg/ha + Vermicompost @ 2 t/ha	78.33	2.12	3.18	1040	1801	2840	36.74
7.	Rhizobium + PSB	49.00	1.37	2.37	868	1617	2485	34.93
8.	NPKS @ 20:40:20:20 kg/ha + *Rhizobium* + PSB	77.87	1.93	3.03	1009	1758	2768	36.46
9.	FYM @ 5 t/ha + *Rhizobium* + PSB	73.27	1.64	2.84	928	1712	2640	35.20
10.	Vermicompost @ 2 t/ha + *Rhizobium* +PSB	69.73	1.55	2.71	921	1693	2615	35.27
	S.E. ±	3.02	0.06	0.12	20.07	42.17	93.80	0.62
	C.D. (P=0.05)	8.72	0.18	0.36	27.98	121.78	270.88	1.81

al. (2003), Togay *et al.* (2008), Kumar *et al*. (2010), Dekhane *et al.* (2011) and Sharma and Verma (2011).

The significant increases in straw and biological yield due to various integrated nutrient management treatments NPKS @ 20:40:20:20 kg/ha + FYM @ 5 t/ha, NPKS @ 20:40:20:20 kg/ha + vermicompost @ 2 t/ha and NPKS @ 20:40:20:20 kg/ha + *Rhizobium* + PSB, may be mainly due to similar increases in vegetative growth characters *viz.*, plant height and branches particularly only pods per plant as a result of such treatments. The significant differences in harvest index under these treatments might be because of the proportionately equally higher grain production over its straw yield as reported by Singh *et al.* (2003), Kumar and Kumar (2006), Togay *et al.* (2008) and Akhtar *et al.* (2009),

Summary:

It can be concluded that the all physiological parameters (leaf area, leaf area index, net assimilation ratio and crop growth rate), productive parameters as seeds/pod, pods/plant, test weight and seed yield of lentil was found significant as compared to control. The productivity of lentil was improved by 44% due to NPKS @ 20:40:20:20 kg/ha + FYM @ 5 t/ha over control and 8.8% over only chemical fertilization.

REFERENCES

Ahmed, Z.I., Anjum, M.S and Rauf, C.A. (2006). Effect of *Rhizobium* inoculation on growth and nodule formation of green gram. *Internat. J. Agric. Biol.*, **8**(2) : 235–237.

Akhtar, M.S. and Siddiqui, Z.A. (2009). Effects of phosphate solubilizing microorganisms and *Rhizobium* sp. on the growth, nodulation, yield and root-rot disease complex of chickpea under field condition. *African J. Biotechnol.*, **8** (15) : 3489-3496.

Dekhane, S.S., Khafi, H.R., Raj, A.D. and Parmar, R.M. (2011). Effect of bio fertilizer and fertility levels on yield, protein content and nutrient uptake of cowpea (*Vigna unguiculata* L.) *Legume Res.*, **34** (1) : 51 – 54.

Giri, N. and Joshi, N.C. (2010). Growth and yield response of chick pea (*Cicer arietinum*) to seed inoculation with *Rhizobium* sp. *Nature & Sci.*, **8**(9) :232-236.

Krishna Reddy, S.V. and Ahlawat, I.P.S. (2001). Dry matter accumulation and nutrient uptake in lentil (*Lens culinaris* Medikus) in relation to cultivars, phosphorus, zinc and bio-fertilizers. *Res. Crops*, **2** (1): 21-24.

Kumar, Anil, Reena, Nandan, Brij, Kumar, Jai and Jamwal B.S. (2010). Response of large seeded lentil to seed rate, phosphorus and FYM application in sub-tropical kandi-belt of Jammu and Kashmir. *J. Food Legumes*, **23**(1): 44- 46.

Kumar, S. and Kumar, R. (2006). Effect of farm yard manure, phosphorus levels and biofertilizer on productivity of lentil. *Crop Res.*, **31** (3): 370-372.

Mohammadjanloo, A.M., Gholipouri, A., Tobeh, A., and. Mostafeai, H. (2009). Study of effects of different levels of nitrogen and potassium on yield and yield components of rain-fed Lentil. *Plant Ecophysiol.*, **1** (**2**) : 91-94

Sharma, R. and Verma, M.L. (2011). Effect of *Rhizobium*, farm yard manure and chemical fertilizers on sustainable production and profitability of rajmash (*Phaseolus vulgaris* L.) and soil fertility in dry temperate region of North- western Himalayas. *Legume Res.*, **34** (4): 251 – 258.

Singh, O.N., Sharma, M. and Dash, R. (2003). Effect of seed rate, phosphorus and FYM application on growth and yield of bold seeded lentil. *Indian J. Pulse Res.*, **16** (2):116-118.

Singh, M.S. (2005). Effect of *Rhizobium*, FYM and chemical fertilizers on legume crops and nutrient status of soil - a review. *Agric. Rev.*, **26** (4): 309 – 312.

Sinha, J., Biswas, C.K. Ghosh, A. and Saha, A. (2010). Efficacy of vermicompost against fertilizers on *Cicer* and *Pisum* and on population diversity of N_2 fixing bacteria. *J. Environ. Bio.*, **31** (3) : 287-292.

Togay, Y., Togay, N. and Dogan, Y. (2008). Research on the effect of phosphorus and molybdenum applications on the yield and yield parameters in lentil (*Lens culinaris* Medic.). *African J. Biotechnol.*, **7** (9): 1256-1260.

Zeidan, M.S. (2007). Effect of organic manure and phosphorus fertilizers on growth, yield and quality of lentil plants in sandy soil. *Res. J. Agric. & Biol. Sci.*, **3**(6): 748-752.