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EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON YIELD, QUALITY AND NUTRIENTS UPTAKE OF LENTIL

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ABSTRACT

A field experiment was conducted during winter seasons of 2011-12 and 2012-13 at Rewa to study the effect of organic and inorganic sources of nutrients on growth, yield, and quality and nutrients uptake of lentil. Amongst the organic sources of nutrients, FYM (5 t ha^{-1}) addition recorded maximum growth parameters, yield and yield attributes, net income and grain protein. Thus, FYM produced maximum (12.24 q ha^{-1}) grain having 24.3 % protein with net income of *Rs 25115 ha^{-1} and B:C ratio (1.99) Application of 100% RDF ($N_{20}P_{40}K_{20}$) raised all the parameters and grain yield (12.57 q ha^{-1})strow yiel (15.049 q ha-^{1})with grain protein 24.4% and net income of Rs 26257 ha^{-1} (B:C ratio 2.04). Application of FYM recorded significantly higher N, P, K and S uptake in grain and straw over other organic manures tested. Similarly, the nutrients uptake in grain and straw was significantly higher due to $N_{20}P_{40}K_{20}$ over other NPK levels. The maximum total uptake of N (63.3 kg ha^{-1}), P (7.6 kg ha^{-1}), K (30.5 kg ha^{-1}) and S (6.3 kg ha^{-1}) by lentil was noted with 20 kg N+40kg P_2O_5+20kg K_2O ha-^{1} and lowest at control.*

Key words: Organic, inorganic sources, nutrients, lentil, growth, yield, quality, uptake

INTRODUCTION

The indiscriminate use of chemical fertilizers without organic manures is known to degrade physico-chemical as well as biological properties of the soil i.e. soil environment and soil health. On the other hand, the use of different type of organics improves soil properties; its health and fertilizer use efficiency, mitigates short supply of micronutrients, stimulates the proliferation of diverse group of soil microorganisms and improves the ecological balance of rhizosphere. Farmyard manure is well known as a store house of plant nutrients. Poultry manure is a good source of nutrients and each tonne of deep litter contain 29.40 kg nitrogen, 20.41 kg phosphorus and 20.41 kg potassium together with 6.8 kg magnesium, 6.8 kg sodium and 24.21 kg calcium (Channabasavanna and Biradar, 2002). Vermicompost being a rich source of macro and micronutrients and vitamins, plant growth regulators and beneficial microflora appeared to be the best organic source in maintaining soil fertility on sustainable basis towards an eco-friendly environment (Edwards and Arancon, 2004). Vermicompost application to different field crops has been known to reduce the requirement of chemical fertilizers without any reduction in crop yield (Giraddi, 2000). Similarly, FYM, poultry manure and farm-compost etc. are known for being the store house of plant nutrients with great variation in their nutrient contents and their release pattern after decomposition. Looking to the poor fertility condition of the intensively cropped lands where lentil is generally grown, addition of organics is important for securing sustainable yield potential. Since, the information was scanty on these aspects; the present research work was undertaken using lentil as test crop.

MATERIALS AND METHODS

A field experiment was conducted during rabi seasons of 2011-12 and 2012-13 at the Private Agriculture-Research Farm, Beena-Semaria Road, Rewa (M.P.). The soil of the experimental field was sandy-loam having pH 6.9 to 7.2, electrical conductivity 0.15 to 0.17 dS m^{-1}, organic carbon 5.6 to 6.0 g kg^{-1}, available N, 295 to 309 kg ha^{-1}, available P_2O_5 15.4 to 16.1 kg ha^{-1} and available K_2O 389 to 392 kg ha^{-1}. The rainfall received during the winter months was 161.2 and 98.6 mm in first and second year, respectively. The treatments comprised five organic sources (FYM, vermicompost, poultry manure, farm compost and Rhizobium + PSB biofertilizers) and five levels of NPK fertilizers (0, 25, 50, 75 and 100% RDF ($N_{20}P_{40}K_{20}$). The experiment was laid out in randomized block design with three replications. Lentil var. Jawahar Lentil-1 was sown during 1st week of November @ 35 kg seed ha^{-1} in rows 30 cm apart in both the years. As per treatments, N, P and K were applied through urea, single superphosphate and muriate of potash, respectively. Before sowing, the seeds were first treated with thirum fungicide @ 3 g kg^{-1} seed. Seeds were inoculated with Rhizobium and PSB each @ 20 g kg^{-1} seed as per recommended procedure. Lentil was grown as per package of practices. Lentil was

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harvested on 22 February, 2012 and 3 March, 2013 yield attributs and yields (grain and straw) were recorded at harvest. Grain and straw samples were analysed for their N, P, K and S content by adopting standard procedures (Jackson, 1973). The protein content in grain was determined by multiplying the per cent N content in grain with 6.25. The nutrients uptake per hectare was calculated by multiplying the seed or straw yield with the per cent nutrient content in seed or straw.

RESULTS AND DISCUSSION

Growth and yield attributes

Amongst the organic sources, FYM (5 t ha^{-1}) resulted in maximum growth and yield attributes over other organics. There were 66.1 pods $plant^{-1}$, 1.5 seeds pod^{-1}, 29.2 g test weight and 6.0 g seed weight $plant^{-1}$ with 5 t FYM ha^{-1} treatments (Table 1). However, this was followed by vermicompost and poultry manure. Biofertilizers recorded the lowest performance for these parameters. The significantly higher yield attributes from FYM may be owing to maximum dry matter production (104.3 g/m^2). The significant variation in growth and yield attributes due to different organics might be owing to variation in their nutrient contents, decomposition of organic residues, C: N ratio, nutrient release pattern, climate and soil characteristics (Dhama, 2003 and Sanwal *et al.*, 2007). The lowest performance of biofertilizers on growth and yield components might be owing to the fact that their activities facilitated to supply only nitrogen and phosphorus to the plants. Application of 100% RDF ($N_{20}P_{40}K_{20}$) resulted in significantly higher growth and yield attributes and gave maximum values of pods (73.7), seeds pod^{-1} (1.7), 1000-seed weight (30.1 g) and seed weight (6.1 g) $plant^{-1}$. The increased supply of NPK might have increased multi-role activities in plant and soil which, in turn, resulted in greater accumulation of carbohydrates, protein and their translocation to the reproductive organs i.e. yield components. The results corroborate the finding of Pathak *et al.* (2003), Patel *et al.* (2012) and Singh *et al.* (2013).

Table 1: Growth and yield parameters of lentil as influenced by organic and inorganic sources of nutrients (Pooled for two years)

Treatments	Plant height (cm)	Branches/ plant (90 DAS)	Dry matter (g/m^2) 60 DAS	Pods/ plant	Seeds/ pod	1000-grain weight (g)	Seed weight/ plant (g)
Organic sources							
5 t FYM ha^{-1}	33.45	15.89	104.32	66.18	1.56	29.28	6.07
2 t VC ha^{-1}	32.95	15.89	99.97	61.50	1.50	28.47	5.86
3 t PM ha^{-1}	33.12	15.79	96.16	61.48	1.51	27.94	5.75
5 t Compost ha^{-1}	33.12	15.61	91.12	55.87	1.48	27.45	5.59
Biofertilizers	32.87	15.55	87.12	49.80	1.47	27.15	5.49
C.D. (P=0.05)	0.31	0.20	5.73	1.55	0.03	0.26	0.025
Inorganic sources							
0 % ($N_0P_0K_0$)	32.06	14.97	78.24	39.74	1.35	25.96	5.24
25 % ($N_5P_{10}K_5$)	32.62	15.36	88.29	51.04	1.43	27.10	5.51
50 % ($N_{10}P_{20}K_{10}$)	33.16	15.74	99.21	61.67	1.48	28.05	5.83
75% ($N_{15}P_{30}K_{15}$)	33.62	16.10	103.81	68.69	1.56	29.10	6.01
100% ($N_{20}P_{40}K_{20}$)	34.04	16.57	109.44	73.71	1.71	30.10	6.18
C.D. (P=0.05)	0.31	0.20	5.73	1.55	0.03	0.26	0.025

VC: Vermicompost, PM: Poultry Manure

Seed yield, quality and net income

Among different organics, FYM (5 t ha^{-1}) gave significantly higher grain yield (12.24 q ha^{-1}), harvest index (47.47 %) as well as protein yield (297.8 kg ha^{-1}), but grain protein remained unchanged due to various organic manures (Table 2). On the other hands, straw yield was not affected significantly with organic sources of nutrients. The maximum grain and straw yield as a result of maximum yield attributes under FYM application brought about maximum protein yield as well as net income (`. 25115 $ha^{-1}$). Application of 100% NPK resulted in significant increase in grain and straw yield (12.57 q $ha^{-1}$,15.04 q $ha^{-1}$ ) harvest index (45.4%) and protein yield (307.7 kg $ha^{-1}$). The net income was upto `. 26257 ha^{-1}. The grain and straw yield was the resultant of coordinated interplay of growth and development characters. Thus, the productivity and quality parameters were based on the cumulative effect of the genetic ability and production efficiency of the lentil genotype, its fertility management and the existing agro-climatic conditions. All these favourable situations might have resulted in greater accumulation of carbohydrates, protein and their

translocation to the reproductive organs which, in turn, increased the yield components and the yield. The combined application of FYM + 100% NPK further encouraged grain yield, protein yield and net income synergistically over their separate applications. The results are in accordance with those of Hakeem *et al.* (2007), Shah and Namdeo (2009), Patel *et al.* (2012), Dhuppar *et al.* (2013) and Singh *et al.* (2013).

Table 2: Yield, quality and economics of lentil as affected by various treatments (mean of Two years)

Treatments	Grain yield (q ha^{-1})	Straw yield (q $ha^{-1)}$	Harvest index (%)	Net income (Rs. ha^{-1})	B:C ratio	Grain protein (%)	Protein yield (kg ha^{-1})
Organic sources							
5 t FYM ha^{-1}	12.24	13.55	47.47	25115	1.99	24.27	297.8
2 t VC ha^{-1}	10.59	14.00	43.01	17565	1.67	24.14	256.3
3 t PM ha^{-1}	10.06	14.13	41.52	15481	1.59	24.08	243.1
5 t Compost ha^{-1}	9.19	14.22	39.13	13010	1.52	23.90	220.3
Biofertilizers	9.02	14.50	38.20	16326	1.77	23.88	215.9
C.D. (P=0.05)	0.09	NS	1.80	-	-	NS	4.13
Inorganic sources							
0 % ($N_0P_0K_0$)	7.98	10.62	42.75	8911	1.38	23.60	188.6
25 % ($N_5P_{10}K_5$)	9.27	14.73	38.45	14125	1.58	23.88	221.7
50 % ($N_{10}P_{20}K_{10}$)	10.34	14.92	40.80	18069	1.74	24.05	249.1
75% ($N_{15}P_{30}K_{15}$)	10.94	15.07	41.89	20136	1.81	24.29	266.3
100% ($N_{20}P_{40}K_{20}$)	12.57	15.04	45.42	26257	2.04	24.44	307.7
C.D. (P=0.05)	0.09	1.45	1.80	-	-	0.35	4.13

Uptake of nutrients

Amongst the organic sources of nutrients, FYM (5 t ha^{-1}) recorded significantly higher nutrient uptake by lentil grain and straw (Table 3). The maximum uptake of N by grain and straw was 47.6 and 12.2 kg ha^{-1}, P uptake 4.3 and 2.4 kg ha^{-1}, K-uptake 11.2 and 14.9 kg ha^{-1} and S uptake 1.1 and 4.0 kg ha^{-1}, respectively. The maximum increase in the uptake of nutrients may be owing to maximum increase in grain and straw yields as well as nutrient contents in grain and straw due to FYM application. These results commemorated with the findings of Gedam *et al.* (2008) and Singh *et al.* (2013).

Table 3: Uptake of nutrients by lentil grain and straw as influenced by organic and inorganic sources of nutrients (mean of 2 years)

Treatments	Nitrogen (kg ha^{-1})		Phosphorus (kg ha^{-1})		Potassium (kg ha^{-1})		Sulphur (kg ha^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Organic sources								
5 t FYM ha^{-1}	47.64	12.29	4.32	2.46	11.29	14.99	1.12	4.06
2 t VC ha^{-1}	40.99	12.44	3.50	2.43	9.58	15.32	0.96	4.14
3 t PM ha^{-1}	38.88	12.57	3.37	2.20	9.01	15.34	0.89	4.07
5 t Compost ha^{-1}	35.25	12.49	2.99	2.18	8.20	15.46	0.81	4.08
Biofertilizers	34.53	12.67	2.93	2.22	8.00	15.53	0.76	4.11
CD (P=0.05)	1.08	NS	0.05	0.05	0.34	0.27	0.014	NS
Inorganic sources								
0 % ($N_0P_0K_0$)	30.18	8.75	2.37	1.42	6.76	9.86	0.65	2.52
25 % ($N_5P_{10}K_5$)	35.46	12.63	2.86	2.17	7.99	14.21	0.78	3.84
50 % ($N_{10}P_{20}K_{10}$)	39.86	13.08	3.39	2.44	9.21	16.11	0.92	4.26
75% ($N_{15}P_{30}K_{15}$)	42.60	13.94	3.83	2.56	10.18	17.85	1.01	4.76
100% ($N_{20}P_{40}K_{20}$)	49.20	14.10	4.69	2.91	11.95	18.60	1.18	5.08
CD (P=0.05)	1.08	0.31	0.05	0.05	0.34	0.27	0.014	0.13

NS= Non-significant

The increasing doses of NPK upto 100% enhanced the uptake of nutrients significantly over control. The highest N-uptake by grain and straw was 49.2 and 14.1 kg ha^{-1}, P-uptake 4.6 and 2.9 kg ha^{-1}, K-uptake 11.9 and 18.6 kg ha^{-1} and S-uptake 1.1 and 5.0 kg ha^{-1}, respectively. The maximum uptake of nutrients at 100% fertility level may be as a result of increased grain and straw yields as well as per cent

nutrient contents in grain and straw. The present results agree with the findings of Tiwari *et al.* (2006) and Patel *et al.* (2012). The lentil crop producing 18.60 q ha-^{1} total biomass in $N_0P_0K_0$ treatment removed 38.9 kg N, 3.7 kg P, 16.6 kg K and 3.1 kg S ha^{-1}. However, this removal of nutrients was enhanced significantly under 100% RDF ($N_{20}P_{40}K_{20}$). The total crop biomass production at this fertility level was upto 27.61 q ha^{-1}, which removed 63.3 kg N, 7.6 kg P, 30.5 kg K and 6.2 kg S ha^{-1}.

The results summarized that 5 t FYM ha-^{1} alongwith 20 kgN+40kg P_2O_5+20kg K_2O ha-^{1} chemical fertilizer came out the most beneficial fertility level for the lentil growers of this region.

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