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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH, YIELD AND FERTILITY LEVEL IN LENTIL

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ABSTRACT
A field experiment was conducted at Krishi Vigyan Kendra, Begusarai as well as in farmer's field at different four locations to study the effect of various nutrients through different sources either alone or in combination on different yield attributes and yield of lentil. Application of 150% RDF showed highest numerical value of plant height (41.8cm), number of branches per plant (9.7), nodules number per plant (19.9), nodules dry weight per plant (44.3mg) and number of pods per plant (99.38). The treatment with the application of vermicompost @ 1t per ha + 50% RDF stood at second and statistically similar to 150% RDF in respect of having the plant height (40.2cm), number of branches per plant(9.2), number of nodules per plant(19.7), nodules dry weight per plant(44mg) and number of pods per plant(96.61). The number of grains per pod was not influenced significantly by different treatments where as all, the tested treatments were signifisuperior over the control in respect of having 1000 grains weight. The maximum grain yield of lentil was obtained at 150% RDF but statistically similar with the application of vermicompost@1t/ha + 50%RDF at the five locations. Application of chemical fertilizer @150% RDF or vermicompost @1t/ha + 50%RDF could be beneficial for sustainable agriculture.

INTRODUCTION

Lentil (*Lens culinaris* Medik) is primarily a rabi season pulse crop of India. It is also called poor man's meat because lentil seed contains 22-34.6% protein (Adsule *et al.*, 1989). It is cultivated in 1.51 million ha area with an annual production of 0.95 million tons. It is mainly cultivated in Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Jharkhand, Bihar and west Bengal with 85%-90% of total area and production of Lentil. (Dixit *et al.*, 2011). Nutrient management play a pivotal role that greatly affect the growth and yield of lentil. The basic idea of present investigation is to evolve an integrated nutrient management module to increase growth, Yield and fertility level for lentil crop particularly under changing climates. To maintain reasonable health of the Indian soils, each and every field is to be manured with at least 7 to 10 tons of organic fertilizer with this assumptions there is a need for about 850 to 1200 million tones of organic fertilizer (Singh and Singh, 2014). Organic manure being less expensive, easily available and ecofriendly are expected to improve soil fertility, crop yield and quality (Singh *et al.*, 2007). However, so far, information about the activity of vermicompost and poultry manure of the soils in Begusarai is scarce. The present study was undertaken with the objective to find out the effectiveness of vermicompost and poultry manure in combination with chemical fertilizer on yield attributes and yield of lentil.

MATERIALS AND METHODS

Five multi-locational field experiments were conducted during rabi season of 2012-13 and 2013-14 at the experimental area of Krishi Vigyan Kendra, Khodawandpur as well as farmer's field at Cheriya Bariyarpur, Bakhri, Begusarai and Matihani. The soil is sandy loam at all the locations. Eight treatments of different fertility level (T_1 = control, T_2 = 50% RDF, T_3 = 100% RDF and T_4 = 150% RDF, T_5 = Poltry manure@2t/ha, T_6 = vermicompost@2t/ha, T_7 = Poultry manure @1t/ha + 50%RDF , T_8 = vermicompost@1t/ha + 50% RDF) were tested against different yield attributes and yield of lentil crop. The recommended dose of fertilizer for lentil was 20 Kg N, 45 Kg P_2O_5, 20 Kg K_2O and 20 Kg S per ha. The entire fertilizer dose was applied at the time of sowing. Nitrogen and Phosphorus were applied in the form of Diammonium Phosphate. The entire quantity of organic manures was applied on dry weight basis. The chemical nutrient content of both the manure and different parameters of experimental field is given in Table 1 and Table 2, shows the soils were low in organic carbon, available phosphorus were medium at all the locations while available nitrogen and available potash were low in Cheriya Bariyarpur and Matihani and available potash were also low in Begusarai. The treatments were evaluated in split plot design with three replications. Lentil variety Hul-57 was shown on 25 October, 2012 and 30 October, 2013 in furrow at 25 cm row spacing using a seed rate 35 kg/ha at all the locations. All recommended practices were followed to raise a good crop. At Krishi Vigyan Kendra, Khodawandpur, height of plant, number of branches per plant, nodules number per plant, nodules dry weight per plant, pods per plant, grains per pod, 1000 grain weight and grain yield were recorded at harvest where as at other locations data on only grain yield was recorded. The crop was harvested after 120-125 days of sowing. Soil samples were collected from different locations of the experimental plots to a depth of 15 cm with the help of screw type auger. The collected soil samples were mixed and reduced into 500g and then dried under shade, ground and

sieved through 2mm sieve size. These soil samples were analyzed for pH, organic carbon, available nitrogen, phosphors and potassium (Jackson, 1973). Statistical analysis was done through procedure prescribed by (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

The results showed (Table 3) that plant height increased with increasing fertility level and the pooled analysis of plant height was recorded maximum (41.8 cm) at 150% RDF but found statistically at par with the application of vermicompost @ 1t/ha + 50% RDF(40.2cm) and 100% RDF(40.1cm) though the numerical value of plant height (40.2 cm) was observed more with combined application of vermicompost 1t/ha + 50% RDF in compared to 100% RDF(40.1cm). The pooled analysis for the branches per plant was also recorded maximum (9.7) at 150% RDF but statistically similar (9.2) with application of vermicompost@ 1t/ha + 50%RDF. The application of various nutrients through different sources either alone or in combination resulted in significantly higher plant height and number of branches per plant over control. The maximum plant height and number of branches per plant at 150% RDF might be due to synergistic effect of N,P,K and S which is known to enhance chlorophyll content, cell division shoot growth and photosynthetic rate. The similar results were also reported by Arpana *et al.*, (2002). The plant height and branches per plant were recorded more with the application of vermicompost@1t/ha + 50% RDF in compared to 100% RDF. The reason for better growth and development with the application of vermicompost@1t/ha + 50%RDF might be due to increased availability of nitrogen and phosphorous to the plant initially through chemical fertilizer and then through vermicompost in cropping season. These results of the study are also in agreement with the finding of Pillai *et al.*, (1985).

Table 1: Nutrient Content (%) of organic manures

Manures	Year	N	P_2O_5	K_2O
Vermicompost	2012	1.17	0.83	0.87
	2013	1.12	0.86	0.81
Poultry manure	2012	1.19	0.96	1.26
	2013	1.07	0.85	1.27

Table 2: pH, organic carbon (%), available N, P_2O_5 and K_2O (Kg/ha) of the soils of experimental field at different locations

Parameters	Locations				
	Khodawandpur	Cheriya Bariyarpur	Bakhri	Begusarai	Matihani
pH	7.8	8.0	7.9	8.0	7.9
Organic Carbon	0.49	0.37	0.41	0.29	0.33
N	196	145	172	152	140
P_2O_5	47	33	41	29	26
K_2O	152	89	89	94	91

Table 3: Effect of organic sources and chemical fertilizers on plant height, number of branches and nodule parameters at Khodawandpur

Treatments	Plant height (cm)			Number of branches/plant			Nodules/Plant			Nodule dry Weight(mg/plant)		
	2012-13	2013-14	Mean	2012-13	2013-14	Mean	2012-13	2013-14	Mean	2012-13	2013-14	Mean
T_1	30.8	30.2	30.5	6.6	6.1	6.4	13.1	13.9	13.5	30.0	30.8	30.4
T_2	35.8	35.6	35.7	7.4	7.2	7.3	15.5	15.8	15.7	35.7	36.4	36.1
T_3	39.8	40.4	40.1	8.2	8.7	8.5	17.6	17.4	17.5	39.5	38.9	39.2
T_4	41.4	42.3	41.8	9.6	9.8	9.7	20.2	19.6	19.9	44.8	43.7	44.3
T_5	34.5	35.1	34.9	7.2	6.9	7.1	15.0	15.3	15.2	35.4	36.0	35.7
T_6	35.0	35.4	35.2	7.4	7.0	7.2	16.9	16.4	16.6	36.6	36.8	36.7
T_7	37.1	37.5	37.3	7.8	8.2	8.0	18.0	18.2	18.1	38.8	39.0	38.9
T_8	40.5	40.6	40.2	9.1	9.3	9.2	20.0	19.4	19.7	44.6	43.4	44.0
SEm	0.82	0.58	0.67	0.24	0.27	0.22	0.83	0.57	0.70	0.94	1.18	0.98
CD (0.05)	2.10	1.74	1.81	0.68	0.71	0.63	2.26	1.71	2.14	2.72	3.01	2.81

Table 4: Effect of organic sources and chemical fertilizers on yield attributes pods/plant, Grains/pod and 1000 grains weight/plant at Khodawandpur

Treatments	Pods/Plant			Grains/pod			1000 grains weight(g)		
	2012-13	2013-14	Mean	2012-13	2013-14	Mean	2012-13	2013-14	Mean
T_1	83.94	83.43	83.69	1.41	1.39	1.40	17.10	17.20	17.15
T_2	89.72	89.25	89.48	1.52	1.54	1.53	18.70	18.74	18.72
T_3	95.69	95.81	95.83	1.64	1.66	1.65	18.96	18.94	18.95
T_4	99.82	98.94	99.38	1.68	1.72	1.70	20.60	20.12	20.36
T_5	88.23	88.56	88.39	1.47	1.47	1.47	18.32	18.36	18.34
T_6	89.37	89.11	89.24	1.49	1.53	1.52	18.35	18.42	18.38
T_7	94.85	94.56	94.71	1.62	1.64	1.63	18.90	18.88	18.89
T_8	96.88	96.34	96.61	1.67	1.65	1.66	19.40	19.94	19.67
SEm	1.64	1.46	1.51	0.03	0.07	0.05	0.61	0.68	0.63
CD (0.05)	5.03	4.71	4.89	NS	NS	NS	1.71	1.85	1.76

Table 5: Effect of organic sources and chemical fertilizers on grain yield at different locations

Treatments	Grain yield (Kg/ha)														
	Khodawandpur			Cheriyabariyarpur			Bakhri			Begusarai			Matihani		
	2012-13	2013-14	Mean	2012-13	2013-14	Mean	2012-13	2013-14	Mean	2012-13	2013-14	Mean	2012-13	2013-14	Mean
T_1	948	1060	1004	1076	1068	1072	1008	975	992	947	921	934	904	930	917
T_2	1212	1196	1204	1347	1302	1325	1263	1278	1271	1258	1312	1285	1214	1184	1199
T_3	1414	1468	1441	1370	1436	1403	1407	1386	1370	1445	1345	1395	1389	1377	1383
T_4	1598	1609	1604	1525	1586	1556	1522	1551	1525	1554	1626	1590	1576	1548	1562
T_5	1167	1125	1196	1300	1310	1305	1213	1222	1300	1208	1170	1189	1150	1172	1161
T_6	1182	1247	1215	1318	1320	1319	1242	1550	1318	1189	1208	1199	1187	1194	1191
T_7	1342	1378	1360	1362	1343	1353	1348	1206	1362	1287	1318	1303	1304	1275	1290
T_8	1514	1487	1501	1382	1458	1420	1487	1442	1382	1450	1482	1466	1398	1416	1407
SEm	59	34	53	48	40	44	32	56	51	28	56	63	65	42	54
CD (0.05)	176	127	152	144	132	138	120	159	147	106	164	172	181	134	167

The application of various nutrients through different sources either alone or in combination resulted in significantly higher nodule number and nodule dry weight as compared to control (Table 3). The application of chemical fertilizer @ 150% RDF recorded maximum number of nodule (19.9) and nodule dry weight (44.3 mg) but at par and almost similar with the application of vermicompost @ 1t/ha+50%RDF having the nodule number (19.4) and nodule dry weight (44 mg) whereas these two treatments were found significantly superior over the rest of treatments including the application of 100% RDF and combined use of poultry manures @ 1t/ha + 50% RDF. The maximum nodule number and nodule dry weight at 150% RDF might be due to enhanced synergistic effect of N, P, K, and S. The application of vermicompost @ 1t/ha +50% RDF having the number of nodule number and nodule dry weight almost similar to the application of 150% RDF because vermicompost is rich in organic matter vitamins, amino acids, vitamins, growth regulators and also contains nitrogen fixing bacteria, phosphorous solublizing bacteria along with actinomycetes and due to these ingredients, vermicompost may enhanced phosphorous, nitrogen and other nutrients availability with better exploitation of greater soil volume for nodulation. The results of the present study are in conformity with earlier reports of Meena *et al*,. (2013)

The data (Table 4) recorded during 2012-13 and 2013-14 crop seasons, indicated that all the treatments organic manures, chemical fertilizer alone or in combination resulted with significant increase in pods per plant and 1000 grains weight as compared to control but yield attribute grains per pod was not influenced significantly by different treatments over the check. The highest number of pods per plant (99.82) was recorded with the application of chemical fertilizer @ 150% RDF but significantly at par with the application of vermicompost @ 1t/ha +50% RDF (96.88), chemical fertilizer@ 100 % RDF (95.69) and poultry manures @ 1t/ha + 50% RDF (94.85) during the year 2012-13. The analysis of yield attribute grains/pod was not influenced significantly by different treatments over the control though the treatments of different fertility level were at par to each other but found significantly superior over the control in respect of thousand grains weight. The effect of tested treatments at different fertility levels for increasing pods per plant, number of grains per pod and thousand grains weight of lentil in the second year 2013-14 followed the same trend as in the first year (2012-13). The number of pods per plant and thousand grains weight were recorded numerically maximum at 150% RDF might be due to direct role of seed growth and indirect help in osmotic imbalance present during final stage of grain filling. These results were corroborated with those reported by Malik *et al*., (1991) and Singh *et al*., (2007). The application of vermicompost@1t/ha+50% RDF stood at second position but statistically similar to 150% RDF in respect of number of pods/plant and 1000 grains weight though the sole application of vermicompost@2t/ha was found less effective which might be also due to combined and synergistic effect. Moreover vermicompost is highly hygroscopic in nature and contains high amount of organic matter which increase the moisture retention of the soil and improves dissolution of nutrients particularly phosphorus. Singh *et al*., (2010) reported similar results in lentil and found maximum value of pods per plant

under the combination of organic manures and recommended dose of fertilizer. Choudhary *et al*.(2011) recorded maximum number of pods per plant and grain test weight in mungbeen under the combination of vermicompost@ 0.7 t/ha + 50% RDF.

It is revealed from the Table 5 that all the treatments (organic manures, chemical fertilizer and combination of both) significantly influenced on grain yield of lentil at all the five locations. All the locations, though application of 150% RDF resulted in highest grain yield yet it was at par with the application of vermicompost 1t/ha +50% RDF at all the locations during both the years 'obviously the trend observed for the yield attributes perpetuated to build up the final outcome in terms of yield. The finding is supported by Gwal *et al*. (1995). The increase in grain yield with fertilizer application might be due to more plant height, number of branches per plant, nodule number, and nodule dry weight, pods per plant, grains per pod and 1000 grains weight as grain yield is known to have positive association with these characters (Lavanya and Toms, 2009). Integrated nutrient management enhances the yield potential of crops over and above achievable yield with recommended fertilizers and hence could sustain high yields in various cropping system (Sharma *et al.,* 2013). The application of either organic manure or chemical fertilizer alone could not produce comparable yields to that obtained in case of their combined use at all the five locations except increase RDF@150%. Thus it may be concluded that the application of chemical fertilizer @150%RDF or vermicompost@1t/ha + 50% RDF is expected to be the most promising treatment.

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