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Effect of integrated nutrient management on cowpea

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Abstract : A field experiment was conducted during 2010-11 at the field of Horticulture farm, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharastra) to evaluate the effect of 16 treatments *i.e.* various sources of nutrient on growth parameter, yield attributes, nutrient uptake, and soil nutrient status of cowpea (*Vigna unquiculata* L.) variety 'pusa komol'. As regards the growth parameters the plant height , number of leaves and branches per plant were significantly increased to a greater extent by the treatment 75 per cent RDF + Vermicompost +*Rhizobium* + PSB as compared to RDF alone.In respect of yield per hectare and over all yield contributing factors, such as number of pods, diameter and length of pods, the treatment of 75 per cent RDF + Vermicompost + *Rhizobium* + PSB was found significant over control and RDF alone. It indicates a saving of 25 per cent chemical fertilizer. Nitrogen status in soil after harvest was found significant in treatment RDF + *Rhizobium* + PSB and phosphorus status in soil after harvest was found significant in treatment 75 per cent RDF + vermicompost + *Rhizobium* + PSB. Maximum nitrogen and phosphorus uptake by plant was found significant in treatment 75 per cent RDF + Vermicompost + *Rhizobium* + PSB. Thus their was increase in soil fertility level by using biofertilizer, FYM, vermicompost along with chemical fertilizer as compared to chemical fertilizers alone.

Key words : Cowpea, *Rhizobium*, Phasphate solubalizing bacteria, FYM, Vermicompost

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Cowpea is one of the most important leguminous vegetable crop. Leguminous crops play an important role in Indian Agriculture. They have unique ability of biological nitrogen fixation, deep root system, mobilization of insoluble soil nutrient and bringing qualitative changes in soil. Cowpea (*Vigna unquiculata* L.) belongs to the family leguminoceae and having chromosome number 2n=22 with genus *Vigna*. It is originated form Central Africa and mainly cultivated in Asia, Africa, Central and South America. The countries like Bangladesh, China, India and Indonesia are the major cowpea growing countries in Asia. In India it is grown in the states like Rajasthan and adjoining a part of Himachal Pradesh have a good acreage under this crop.

There is worldwide consensus that sole dependence on chemical input based agriculture is not suitable in long run and only integrated plant nutrient system (IPNS) involving a combination of fertilizer, organic manures and bio-fertilizers are essential to sustain crop production, preserve soil health and biodiversity. Integrated effort are required to boost up the yield of cowpea in order to supply a balanced diet to increasing population of our country.

RESEARCH METHODS

A field experiment was carried out during year 2010-11 at the field of Horticulture farm, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment was laid out in a Randomized Block Design with three replications. There were 16 treatments *viz.*, T_1- RDF 25:50 kg ha^{-1} NP, T_2- 2.5 t ha^{-1} FYM, T_3- 1.65 t ha^{-1} vermicompost , T_4- 2.5 t ha^{-1} FYM + 2.4 kg ha^{-1} *Rhizobium* +2.5 kg ha^{-1} PSB, T_5- 1.65 t ha^{-1} vermicompost + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB, T_6- 75 per cent RDF + 0.62 t ha^{-1} FYM + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB, T_7- 75 per cent RDF + 0.41 t ha^{-1} vermicompost + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB , T_8- 50 per cent RDF + 1.25 t ha^{-1} FYM + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB, T_9- 50 per cent RDF + 0.82 t ha^{-1} vermicompost + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB, T_{10}- 25 per cent RDF + 1.87 t ha^{-1} FYM + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB, T_{11}- 25 per cent RDF + 1.23 t ha^{-1} vermicompost + 2.4 kg ha^{-1}

Rhizobium + 2.5 kg ha^{-1} PSB, T_{12}- 25: 50 kg ha^{-1} NP(RDF) + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB, T_{13}- 75 per cent RDF + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB , T_{14}- 50 per cent RDF + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB, T_{15}- 25 per cent RDF + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB, T_{16}- Control. Sowing of seed was done in *Kharif* season. Quantity of organic and inorganic fertilizers to be applied to the cowpea was calculated as per treatments. Quantity of nitrogen added through urea, phosphorus added through single super phosphate. FYM and vermicompost was applied as per the treatments. Soil application of *Rhizobium*, PSB were given as per the treatments. Five plants per treatment were selected randomly to record observations.

RESEARCH FINDINGS AND DISCUSSION

The results obtained from the present investigation are summarized below :

Effect of integrated nutrient management on growth parameters:

Table 1 revealed that maximum height of plant (69.73 cm) was achieved with treatment 75 per cent RDF + 0.41 t ha^{-1} vermicompost + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB (T_7) and minimum height of plant (49.74 cm) was found in treatment control (T_{16}). No. of branches (9.36) at subsequent stages of plant growth was also recorded maximum with treatment 75 per cent RDF + 0.41 t ha^{-1} vermicompost + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB (T_7). Similarly number of leaves (76.46), internodal length (3.22 cm) were achieved maximum in treatment T_7. This might be due to the property of nitrogen to enhance the vegetative growth, since nitrogen as a major component of protoplasm helps in photosynthesis and enhances metabolic rate, cell division and cell elongation which allow the plant grow faster. Phosphorus enhances the elongation, leaf expansion and helps in cell elongation. Similar results were also obtained by Gondalia *et al.* (1988), Dubey and Nemdeo (1994), Chittapur *et al.* (1994), Pawar and Power (1998) and Sharma *et al.* (2009).

Table 1 : Effect of integrated nutrient management on growth parameters

Treatments	Plant height (cm)	Number of branches / plant	Number of leaves / plant	Internodal length (cm)
T_1	62.18	8.32	68.00	2.87
T_2	54.28	6.89	62.08	2.53
T_3	56.83	6.72	60.80	2.57
T_4	54.54	7.25	65.10	2.64
T_5	53.55	6.88	64.13	2.74
T_6	63.14	8.05	68.56	3.14
T_7	69.73	9.36	76.46	3.22
T_8	60.90	8.25	66.86	2.46
T_9	62.66	8.29	67.71	3.05
T_{10}	55.35	7.46	62.57	2.84
T_{11}	57.37	7.89	66.38	2.88
T_{12}	65.46	8.14	68.77	2.94
T_{13}	62.66	8.08	68.56	2.83
T_{14}	60.65	7.98	67.31	2.94
T_{15}	56.18	7.64	61.30	2.67
T_{16}	49.74	5.66	51.85	2.18
'F' test	Sig	Sig	Sig	NS
S.E. $\pm$	2.09	0.31	2.39	0.19
C.D.(P=0.05)	6.04	0.92	6.90	

NS=Non-significant

Effect of integrated nutrient management on yield and yield attributes:

Table 2 revealed that maximum number of pods per plant (33.47) was achieved in treatment 75 per cent RDF + 0.41 t ha^{-1} vermicompost + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB (T_7) followed by treatment 75 per cent RDF + 0.62 t ha^{-1} FYM + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB (T_6), (31.47 pods per plant). Length of pod (22.98 cm) was achieved maximum with treatment T_7 and lowest length of pod (16.92 cm) was found in treatment T_{16} (control). Simillarly diameter of pod (0.76 cm) was highest in treatment 75 per cent RDF + 0.41 t ha^{-1} vermicompost + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB (T_7). Regarding pod yield per plot, treatment T_7 produced maximum (1.21 kg) yield of green pod per plot and lowest yield (0.56 kg) was per plot was observed in treatment T_{16} (control). Simillarly pod yield per hectare (100.13 q) was observed in treatment 75 per cent RDF + 0.41 t ha^{-1} vermicompost + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB (T_7) and lowest yield (46.63 q) was found in treatment T_{16} (control). This might be due to the fact that, an application of vermicompost and biofertilizers resulted in better growth, increases number of branches and pods per plant and which ultimately resulted into the maximum pod yield per hectare. Phosphorus plays vital role in the productive phase of crop. It enhances carbohydrate synthesis and the rate of metabolic activities though increased leaf area and its efficient utilization in protein synthesis resulting in more number of pods per plant. Similar finding were also reported by Pujari *et al.* (1998), Jadhav and Andhale (2009) and Sharma *et al.* (2009).

Effect of integrated nutrient management on soil nutrient status and nutrient uptake by plant:

Table 3 revealed that observation of available

Table 2 : Effect of integrated nutrient management on yield and yield attributes

Treatments	Total no. of pod/plant	Length of pod (cm)	Diameter of pod (cm)	Pod yield /plot (kg)	Pod yield /ha (q)
T_1	29.17	20.97	0.65	0.96	79.56
T_2	19.28	17.61	0.53	0.64	52.67
T_3	20.20	17.95	0.56	0.65	54.04
T_4	23.23	18.48	0.60	0.73	60.63
T_5	23.34	19.08	0.61	0.75	62.00
T_6	31.47	21.16	0.70	0.96	79.01
T_7	33.47	22.98	0.76	1.21	100.13
T_8	28.62	20.75	0.65	0.94	77.36
T_9	28.96	20.83	0.67	0.95	78.73
T_{10}	23.72	20.12	0.60	0.76	63.10
T_{11}	26.01	20.63	0.62	0.85	70.23
T_{12}	30.48	21.13	0.70	0.97	79.83
T_{13}	30.09	21.10	0.69	0.91	75.17
T_{14}	26.93	19.85	0.62	0.86	71.05
T_{15}	22.92	19.40	0.59	0.75	62.27
T_{16}	17.78	16.92	0.52	0.56	46.63
'F' test	Sig	Sig	Sig	Sig	Sig
S.E. ±	0.51	0.50	0.01	0.05	4.64
C.D. (P=0.05)	1.47	1.46	0.05	0.16	13.41

nitrogen content in soil after harvest were found significant. Maximum nitrogen (261.66 kg / ha) was recorded in treatment 25: 50 kg ha^{-1} NP(RDF) + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB (T_{12}) which was significantly superior over all other remaining treatments. Treatment T_{16} (control) recorded lowest available nitrogen (216.33 kg / ha) in soil after harvest. From the data presented, it was noticed that *Rhizobium*, PSB in combination with fertilizer doses recorded increase in nitrogen status of soil after harvest, as compared to their respective fertilizer doses alone. Similar type of results of increase in nitrogen status of soil were recorded by earlier workers (Sairam, 1989; Sharma and Namdeo, 1999). Maximum phosphorus (32.98 kg / ha) was

Table 3 : Effect of integrated nutrient management on soil nutrient status and nutrient uptake by plant

Treatments	Soil nutrient status (kg/ha)		Nutrient uptake by plant (kg/ha)	
	Available nitrogen	Available phosphorus	Nitrogen	Phosphorus
T_1	240.26	27.13	77.73	17.28
T_2	218.66	25.13	57.33	11.68
T_3	219.29	25.52	58.17	11.86
T_4	220.21	26.07	59.77	12.33
T_5	220.37	26.20	61.12	12.74
T_6	241.00	29.80	79.19	18.65
T_7	241.80	32.98	83.39	21.15
T_8	235.55	28.00	72.81	14.40
T_9	238.00	29.43	74.46	14.49
T_{10}	230.41	27.47	63.44	13.25
T_{11}	232.26	27.63	67.93	13.68
T_{12}	261.66	29.65	79.14	18.38
T_{13}	229.75	29.77	78.15	17.30
T_{14}	221.85	27.93	71.63	14.07
T_{15}	221.15	26.80	61.83	13.02
T_{16}	216.33	20.08	47.97	10.10
'F' test	Sig	Sig	Sig	Sig
S.E. ±	6.38	0.86	1.80	0.77
C.D. (P=0.05)	18.42	2.48	5.20	2.24

recorded in treatment 75 per cent RDF + 0.41 t ha^{-1} vermicompost + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB (T_7) which was significantly superior over all other remaining treatments. Treatment T_{16} (control) recorded lowest available phosphorus (20.08 kg / ha) in soil after harvest. Treatments of biofertilizer in combination with chemical fertilizers recorded more increase in available phosphorus in soil after harvest as compared to corresponding doses of fertilizer alone. Sharma and Namdeo (1999) reported increase in phosphorus status of soil with fluctuating trends by using *Rhizobium* and PSB. Regarding maximum nitrogen uptake (83.39 kg / ha) by plant was found in treatment 75 per cent RDF + 0.41 t ha^{-1} vermicompost + 2.4 kg ha^{-1} *Rhizobium* + 2.5 kg ha^{-1} PSB (T_7). Lowest uptake of nitrogen (47.97 kg / ha) by plant was recorded in T_{16} (control). Maximum phosphorus uptake (21.15 kg / ha) by plant was recorded in treatment T_7. Lowest uptake of phosphorus (10.10 kg / ha) by plant was recorded in treatment $T_{16.}$ It might be due to improvement in nutrient content in soil solution in available forms which resulted in more uptake of phosphorus. Similar results were also recorded by Aishwanath and Dravid (2002).

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