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Effect of integrated nutrients management on yield and economics of cowpea (*Vigna unguiculata* (L.) Walp.) under rainfed conditions

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ABSTRACT

A field experiment was conducted at Centre of Excellence for Reseach on Pulses, S.D. Agricultural University, Sardarkrushinagar during rainy season of 2005, 2006 and 2007 on "Effect of integrated nutrients management on yield and economics of cowpea". Results revealed that application of 10 kg N + 20 kg P_2O_5 per ha alongwith *Rhizobium* + PSB inoculation significantly increased seed yield over application of 20 kg N + 40 kg P_2O_5 per ha but was at par with application of 10 kg N + 20 kg P_2O_5 per ha alongwith PSB, which indicated that *Rhizobium* + PSB or only PSB inoculation saved 50 per cent nitrogen and phosphorus as chemical fertilizers. Seed inoculation with *Rhizobium* + PSB inoculation or PSB alone in combination with 10 kg N + 20 kg P_2O_5 or 20 kg N + 40 kg P_2O_5 per ha improved significantly all the parameters governing the seed yield *viz.*, number of pods per plant. number of seeds per pod and 100-seed weight. The highest BCR value of 3.01 was recorded with the application of 10 kg N + 20 kg P_2O_5 per ha along with *Rhizobium* and PSB inoculation followed by application of 10 kg N + 20 kg P_2O_5 per ha alongwith PSB inoculation.

Key words : Cowpea, rhizobium, PSB, net return.

Cowpea is an important legume crop and it has manifold uses such as vegetable, pulses, green manuring and fodder crop. Its productivity remains lower inspite of higher potential of the crop. The factors behind the low yield are poor management and imbalance use of nutrients *viz.*, nitrogen and phosphorus. Nitrogen being a major constituent of protein and chlorophyll, It must be adequately and timely supplied to the crop. P is required for better root growth, nodulation and nitrogen fixation and supplied as inorganic fertilizers. The use efficiency of P fertilizer is generally low (20-30%) and therefore enhancing of applied fertilizers (Jain and Trivedi, 2005). PSB hold promise in the present scenario of escalating price of phosphatic fertilizers in the country. A positive response of PSB inoculation has also reported by Srivastava and Ahlawat (1995) in pea. Besides minerals nutrition, biofertilizers play an important role in the cowpea production as these are eco-friendly, low cost, non-bulky agricultural inputs. *Rhizobium* have an enormous potential to fix atmospheric N_2 while, PSB have capacity to solubilize and mobilize P present in the non-available form in the soil. Therefore, there is need to evolve integrated nutrient supply system by judicious combination of chemical and biofertilizers. Therefore, present study was undertaken to study the effect of integrated nutrients management on yield and economics of cowpea.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* 2005 to *kharif* 2007 at Centre of Excellence for Reseach on Pulses, S. D. Agricultural University, Sardarkrushinagar (Gujarat) on "Effect of integrated nutrient management on yield and economics of cowpea." The soil was loamy sand having low in organic carbon (0.21%), medium available phosphorus (42 kg/ha) and high available potassium (254 kg/ha) with pH 7.6. Both the bio-fertilizers were prepared as peat based inoculants for this study. The treatment details are T_1: Control,

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T_2: *Rhizobium* inoculation, T_3: PSB inoculation, T_4: *Rhizobium* and PSB inoculation, T_5: 10 + 20 NP kg/ ha, T_6: 10 + 20 NP kg/ha + *Rhizobium* inoculation T_7: 10 + 20 NP kg/ha + PSB inoculation, T_8: 10 + 20 NP kg/ ha + *Rhizobium* and PSB inoculation, T_9: 20 + 40 NP kg/ha, T_{10}: 20 + 40 NP kg/ha + *Rhizobium* inoculation, T_{11}: 20 + 40 NP kg/ha + PSB inoculation, T_{12}: 20 + 40 NP kg/ha + *Rhizobium* and PSB inoculations. The experiment was conducted in randomized block design with four replications. Cowpea variety Gujarat Cowpea-5(GC-5) was sown in first fortnight of July during all the years of experimentation with 45 cm row spacing. Rainfall was received 527 mm, 1103 mm and 704 mm during *kharif* 2005, 2006 and 2007, respectively.

RESULTS AND DISCUSSION

Growth and yield attributes

On the basis of pooled, the results showed favourable response to integrated nutrient management in terms of number of pods per plant, number of seeds per pods, 100- seed weight, number of branches per plant and plant height (Table -1). The number of pods per plant and number of seeds per pod were significantly higher in treatment T_{12} and were found at par with treatments T_{11}, T_{10}, T_8 and T_7. Treatment T_{12} recorded significantly higher number of branches per plant and 100-seed weight as compared to control, T_2 and T_5 but was at par with rest of the treatments. Plant height was at par and significantly higher in treatment T_{12}.

Table 1 Effect of bio-fertilizers at different fertility levels on growth and yield attributes of cowpea

Treatments	Pods / plant	Seeds/ pod	100- seed weight (g)	Plant height (cm)	Branches/ plant
T_1 : Control	11.5	11.1	6.49	54.7	1.92
T_2 : *Rhizobium* inoculation	13.0	11.7	7.18	61.7	2.67
T_3 : PSB inoculation	14.5	12.0	7.59	65.3	3.18
T_4 : *Rhizobium* and PSB inoculation	15.2	12.2	7.48	64.7	3.18
T_5 : 10 + 20 NP kg/ha	13.7	11.8	7.26	64.1	3.00
T_6 : 10 + 20 NP kg/ha + *Rhizobium* inoculation	14.6	12.2	7.40	65.7	3.13
T_7 : 10 + 20 NP kg/ha + PSB inoculation	16.9	12.9	7.62	69.3	3.58
T_8 : 10 + 20 NP kg/ ha + *Rhizobium* and PSB inoculation	17.5	13.0	7.62	69.3	3.51
T_9 : 20 + 40 NP kg/ha	15.6	12.3	7.55	68.4	3.25
T_{10}: 20 + 40 NP kg/ha + *Rhizobium* inoculation	16.7	12.8	7.52	68.8	3.47
T_{11}: 20 + 40 NP kg/ha + PSB inoculation	18.5	12.9	7.83	70.2	3.37
T_{12}: 20 + 40 NP kg/ha + *Rhizobium* and PSB inoculation	18.6	13.2	7.86	71.4	3.68
S. Em. +	0.75	0.22	0.20	2.01	0.22
C. D. at 5 %	2.0	0.62	0.55	5.9	0.66
C. V. (%)	16.6	6.7	8.9	10.1	17.7

Table 2 Productivity and economics of cowpea under different treatments

Treatments	Seed yield(kg/ha)				Straw yield (kg/ha)	Gross income (₹/ha)	Cost (₹/ha)	Net return (₹/ha)	BCR
	2005	2006	2007	Pooled					
T_1: Control	600	863	1056	840	1767	14854	4884	9970	2.04
T_2: *Rhizobium* inoculation	712	945	1140	932	2001	16514	4934	11580	2.35
T_3: PSB inoculation	800	1018	1311	1043	2267	18502	4945	13517	2.73
T_4: *Rhizobium* and PSB inoculation	832	1053	1301	1062	2419	18927	4967	13960	2.81
T_5: 10 + 20 NP kg/ha	769	1065	1143	992	2125	17572	5445	12127	2.23
T_6: 10 + 20 NP kg/ha + *Rhizobium* inoculation	836	1127	1254	1072	2366	19045	5495	13550	2.47
T_7: 10 + 20 NP kg/ha + PSB inoculation	911	1293	1438	1214	2717	21598	5506	16092	2.92
T_8: 10 + 20 NP kg/ ha + *Rhizobium* and PSB inoculation	946	1307	1482	1245	2780	22144	5528	16616	3.01
T_9: 20 + 40 NP kg/ha	858	1177	1309	1115	2494	19836	6006	13830	2.30
T_{10}: 20 + 40 NP kg/ha + *Rhizobium* inoculation	897	1204	1426	1175	2685	20948	6056	14892	2.46
T_{11}: 20 + 40 NP kg/ha + PSB inoculation	921	1454	1467	1281	2862	22786	6067	16719	2.76
T_{12}: 20 + 40 NP kg/ha + *Rhizobium* and PSB inoculation	959	1461	1499	1306	3010	23304	6089	17215	2.82
S. Em. ±	64	78	93	44	106				
C. D. at 5 %	185	224	264	123	298				
C. V. (%)	15.5	13.5	14.0	14.4	16.2				

Input Price: *Rhizobium*: ₹ 10 per packet Urea: ₹ 5 per kg
PSB: ₹ 15 per packet Market Price: Seed; ₹16 per kg
DAP: ₹ 9.50 per kg Straw ₹ 0.8 per kg

T_{11}, T_{10}, T_9, T_8, T_7 and T_6 as compared to rest of the treatments. Significant increase in yield attributes, yield and harvest index of mungbean due to *Rhizobium* inoculation have been reported by Shukla and Dixit (1996). Raut *et al.* (2004) reported that seed dressing with *Rhizobium* + PSB micro-organisms in combination with half or full dose of RDF improved significantly all the parameters governing the yield in soybean at Nagpur.

Seed yield

The results presented in Table 2 indicated that the seed yield differences were found significant due to various treatments during individual years as well as in pooled data. An application of 20 kg N + 40 kg P_2O_5 per ha alongwith seed inoculation of *Rhizobium* and PSB recorded maximum seed yield in cowpea during all the individual years as well as in their pooled data. However, its seed yield was at par with the seed yields of the treatments T_{11}, T_{10}, T_9, T_8, T_7 and T_6 during the years 2005 and 2007. But it was remained at par with T_{11}, T_8 and T_7 during the year 2006 and in pooled data of three years.

On the pooled basis, seed yield increased in the treatments of T_{12}, T_{11}, T_8 and T_7 to the tune of 55, 53, 48, and 45 per cent, respectively as compared to

control. The seed yield increased in these treatments may be due to increase in yield attributing characters *viz.*, number of pods per plant, number of seeds per pod and 100-seed weight which were significantly higher in these treatments. These results indicated that the dual inoculation of *Rhizobium* and PSB has the ability to save about 50 per cent of inorganic N and P fertilizer in this crop. *Rhizobium* inoculation fixed nitrogen through root nodules of plant, whereas, PSB solubilizes native phosphorous and increasing availability to the plants. Thus, combined inoculation of seeds with *Rhizobium* and PSB improved N and P status of soil which ultimately increased N and P uptake and enhancement of growth, yield attributes and seed yield. Similar results have been reported in blackgram (Surendra *et al.*, 1993) and in clusterbean at Hisar (Haryana) (Rawat *et al., 2008*). Prabakaran *et al.*, (1999) reported that the dual inoculation of *Rhizobium* and PSB with 50 per cent of P_2O_5 per ha gave a comparable yield with 100 per cent P_2O_5 per ha alone in horsegram at Vamaban (Tamil Nadu) on red lateritic soil.

Straw yield

On the basis of pooled analysis (Table 2), significantly higher straw yield of cowpea was registered with an application of 20 kg N + 40 kg P_2O_5 per ha alongwith *Rhizobium* and PSB inoculations than that registered in the rest of the treatments, however, its straw yield was at par with the straw yield obtained from T_{11}, T_7 and T_8. Higher straw yield in these treatments was clearly reflected by growth characters *viz.*, plant height and number of branches per plant. Singh and Pareek (2003) reported that seed inoculation with bio-fertilizers proved superior to no inoculation with respect to straw yield of mungbean at Jobner (Rajasthan) on loamy sand soil.

Economics

Looking to the economics, an application of 10 kg N + 20 kg P_2O_5 per ha alongwith *Rhizobium* and PSB inoculation recorded the highest BCR value of 3.01 (net return of Rs. 16616 per ha) followed by the application of 10 kg N + 20 kg P_2O_5 per ha along with PSB inoculation (BCR 2.92 and net return Rs. 16092/ ha), 20 kg N and 40 kg P_2O_5 per ha along with *Rhizobium* + PSB inoculation (BCR 2.82 and net return Rs. 17215/ha) and 20 kg N + 40 kg P_2O_5 per ha alongwith PSB inoculation (BCR 2.76 and net return Rs. 16719/ha).Rajput and Pandey (2004) reported that 50% NPK with *Rhizobium* and PSB mixed with 25 kg FYM recorded the highest additional return over control with the BCR value of 3.73 in Pea at Morena(MP) and sowing in sandy loam soil.

REFERENCES

Jain P.C. and Trivedi S.K. 2005. Response of Soybean(*Glycine max*(L.)Merrill) to phosphorus and bio fertilizers. *Legume Research*, **28**(1): 30-33.

Prabakaran, J., Balachandar, P., Nagarajan, P. and Dhanakodi, C. V. 1999. Effect of dual inoculation of *Rhizobium* and phoshobacteria at different levels of phosphorus in horsegram. *Legume Research*, **22**(2): 137-38.

Rajput R.L. and Pandey R.N. 2004 Effect of method of application of bio fertilizers on yield of Pea (*Pisum sativum*). *Legume Research*, **27**(1): 75-76.

Raut Sneha S, Chore, C. N. Deotale, R. D, Waghmare, H. U. and Hatmode, C. N. 2004. Response of seed dressing with Biofertilizers and nutrient on chemical, Bio-chemical, yield and yield attributing parameters of soybean. *Journal of Soils and Crops*. **14**(1): 66-70.

Rawat, G. S., Mahendra, Singh and Bhodoria, R. R. S.2008. Performance of early maturing guar [(*Cyamopsis tetragonoloba* L.) Taub] variety to bio-fertilizers under different fertility levels. National Symposium on Enhancing productivity, Nutritional Security and Export Potential through Arid legumes held at CARRI, Jodhpur on 28-30 June pp. 63.

Shukla, S. K. and Dixit,. R. S. 1996. Effect of *Rhizobium* inoculation, plant protection and phosphorous on growth and yield of summer greengram (*Phaseolus radiata*). *Indian Journal of Agronomy*, **41**: 64-65

Singh, B. and Pareek, R. G. 2003. Effect of phosphorous and bio-fertilizers on growth and yield of mungbean. *Indian Journal of Pulses Research*, **16**(1): 31-33

Srivastava, T. K. and Ahlawat, I.P.S.1995.Responce of pea (*Pisum sativum*) to phosphorus, molybdenum and biofertilizers. *Indian Journal of Agronomy*, **40**: 630-635.

Surendra, S. T., Pattan, M. A., Gupta, K. P. and Khandkar, U. R. 1993. Effect of phosphate solubility bacteria at different levels of phosphorus on blackgram (*Phaseolus mungo*). *Indian Journal of Agronomy*, **38**: 131-133.