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Short communication

EFFECT OF FERTILIZER AND BIO-FERTILIZERS ON GROWTH, YIELD AND ECONOMICS OF COWPEA

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Cowpea (*Vigna unguiculata* (L.) Walp) is an important pulse crop grown mainly in *Kharif* season under rainfed condition. It is grown for grain, fodder, vegetable and green manuring purposes. It has about 24.6 % protein and rich source of calcium and iron. Cowpea is short duration, high yielding and quick growing crop and provided quick and thick cover on the ground thus helping in conservation of soil. It is grown as alternative crop in dry land farming. Use of biofertilizers can have a greater importance in increasing fertilizer use efficiency. The seed inoculation with *Rhizobium* increased number of rhizosphere, so that there is substantial increase in the microbiologically fixed nitrogen for the plant growth. Seed of pulses when inoculated with phosphate solubilizing bacteria secret acidic substances which act as solubilizer to unavailable soil phosphorus. These biofertilizers may increase yield of crops by 10-30 per cent.

A field experiment was conducted during *kharif*, 2006 at Jobner, Rajasthan. The soil was loamy sand in texture, having 8.1 pH, 1.20 dSm^{-1} electrical conductivity, 1.3 g kg^{-1} organic carbon, 130 kg ha^{-1} available nitrogen, 16 kg ha^{-1} available phosphorus and 151 kg ha^{-1} available potassium. The experiment consisted of 16 treatment combinations i.e. four fertility levels (0, 50, 75, and 100% RDF) and four biofertilizers (control, *Rhizobium*, PSB, *Rhizo*bium + PSB) was laid out in randomized block design and with three replications. Cowpea (RC-101) crop was sown during mid of July and harvested in second week of September, 2006. The sources of nutrients were urea and diammonium phosphate for N and P, respectively, Seed was inoculated with *Rhizobium* and PSB culture using 12 gram culture per kg seed as per treatments before sowing. Intercultural operations *viz.*, thinning, hoeing and weeding were done after 20 days of sowing to maintain recommended spacing, proper aeration and weed control. For weed management pendimethalin 1.0 kg a.i. per ha was applied as pre-emergence to control the weeds in early stage of the crop. Five plants were selected randomly from each plot, and used for measurement of plant height at 40 DAS and at harvest. The five plants randomly selected in each plot for height measurement were used to record the number of branches per plant at 40 DAS and at harvest and their average values were computed. Dry matter production was recorded at 40 DAS and at harvest. For this, plants from one metre row length were uprooted randomly from rows of each plot. After removal of root portion, the samples were first air dried for some days and finally dried in an electric oven at 70 ^{0}C till constant weight. The weight was recorded and expressed as average dry matter per metre row length. After threshing and winnowing the

Table 1: Effect of fertilizers and Biofertilizers on growth, yield and economics of cowpea

Treatments	Plant height		Branches/ plant		Dry matter (g)		Seed yield ($q\ ha^{-1}$)	Straw yield ($q\ ha^{-1}$)	Net return ($Rs\ ha^{-1}$)	B:C ratio
	40 DAS	At harvest	40 DAS	At harvest	40 DAS	At harvest				
Fertilizers (N and P_2O_5 kg ha^{-1})										
Control	37.6	50.8	5.89	7.19	63.96	93.83	7.37	15.73	10725	1.55
50 % RDF	41.0	55.3	6.50	8.04	69.73	102.25	7.85	17.73	12239	1.77
75 % RDF	44.4	59.9	7.09	8.74	75.48	110.71	8.85	19.20	14551	2.10
100 % RDF	45.6	61.6	7.49	9.26	77.63	113.87	9.24	20.20	15533	2.25
CD(P=0.05)	3.36	4.36	0.55	0.68	5.61	8.23	0.40	1.34	865	0.12
Biofertilizers										
Control	38.3	52.0	5.80	7.14	65.50	95.50	7.40	16.29	11566	1.80
Rhizobium	43.6	57.8	7.03	8.66	74.60	108.80	8.50	18.76	13817	2.02
PSB	41.7	56.4	6.67	8.22	70.10	104.00	8.12	17.68	12636	1.79
PSB+Rhizobium	45.2	61.6	7.48	9.21	76.60	112.36	9.20	20.12	15030	2.06
CD(P=0.05)	3.36	4.36	0.55	0.68	5.61	8.23	0.40	1.34	865	0.12

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weight of seeds for each net plot area was recorded in kg per plot and then converted in to qha^{-1}.

Data (Table 1) revealed that application of 75 % RDF (15 kg N+30 kg P_2O_5 ha^{-1}) showed significantly higher plant height, branches per plant and dry matter accumulation over control and 50 % RDF. The combined use of *Rhizobium* + PSB proved significantly superior over both sole inoculation either *Rhizobium* or PSB. However, seed inoculation by any strain significantly increased all parameters over no inoculation. The increases in grain and stover yield were 24.3, 8.23 and 13.3 % in grain yield and 23.5, 7.2 and 13.8 % in straw yield over control, Successive increase in fertility levels up to 15 kg ha^{-1} and 30kg P_2O_5 ha^{-1} significantly improved the growth attributes viz. the plant height, branches per plant and dry matter accumulation of cowpea. The application of 100 % RDF (20 kg N and 40kg P_2O_5 ha^{-1}) significantly improved the net returns as compared to 75% RDF (15kg N and 30kg P_2O_5 ha^{-1}), 50% RDF (10 kg N and 20 kg P_2O_5 ha^{-1}) and without fertilizers, and a significant increase of Rs 4808 and Rs. 3294 and Rs. 982, respectively over control, 50% RDF (10kg N and 20 kg P_2O_5 ha^{-1}) and 75 % RDF. The individual as well as combined inoculation of seeds with PSB and *Rhizobium* recorded significantly higher net returns over without inoculation. PSB + *Rhizobium* fetched the net return of Rs 15030 and represented an increase of Rs 3464, 1213 and 2391over control, *Rhizobium* and PSB, respectively. The increases in seed and straw yield with increased rates of nitrogen might be due to better nutritional status of the crop in nitrogen deficient soil as evidenced by increased N content and uptake. The increased supply of nitrogen and its higher uptake by plant might have stimulated the rate of various physiological processes in plant and led to increased growth and yield. These findings corroborate the closely related to the results of Patel *et al.* (2004) Sharma and Dayal (2005). Thus, application of phosphorus might have resulted in increased higher plant height, dry matter accumulation, number of branches per plant, seed yield and straw yield. These findings corroborate the results of Sharma and Jat (2003) and Nadeem *et al.* (2004). Inoculation of seed with symbiotic nitrogen fixers might have increased the concentration of an efficient and healthy strain of *Rhizobium* in rhizosphere, which in turn resulted in greater fixation of atmospheric nitrogen in soil for use by the plants and consequently resulting in to higher growth. Yadav and Malik (2005) and Choudhaty *et al.* (2013) reported similar results. Inoculation of seeds with PSB also recorded significantly higher values of growth parameters and yield of cowpea. It is obvious because of the fact that PSB produces organic acids like gluconic, succinic, lactic, oxalic, citric and α-ketogloconic acid which render the insoluble phosphate to soluble one and also synthesizes growth promoting substances which augment plant growth. PSB + *Rhizobium* might have improved both nitrogen and available phosphorus in rhizosphere as they are symbiotic nitrogen fixers and phosphate solubilizers, respectively. The combined inoculation of nitrogen fixer and PSB benefits the plant more than either group of organisms alone and might have added advantages in the degraded agro ecosystem. (Basu *et al.* 2006 and Farhad *et al.* 2010).

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