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Effect of different bio-fertilizer and fertility level on growth, quality and yield attributes of cowpea (*Vigna unguiculata* L. Walp)

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Abstract
A study was conducted during rabi season of 2019-20 on sandy loam soil to effect of different bio-fertilizers and fertility level on growth, quality and yield attributes of cowpea. As treatments used combination of RDF, bio-fertilizer and organic manure. Results indicated that application of 75% RDF with organic manure (FYM and VC @2t/ha) and combination of bio-fertilizers (Rhizobium, PSB, Azotobacter and Azospirillum @ 2kg/ha) significantly increases the parameters *viz*. plant height, percent emergence, no. of leaves, no. of branches, root length, number of pods/plant, number of seeds/pod, pod length, chlorophyll content and protein content, among all the treatments the application of Rhizobium+ FYM + Azotobacter + Azospirillum + PSB +75% RDF was found most effective as showed significant difference under different levels of fertility and bio-fertilizers application. The next effective treatment was Rhizobium+ Vermicompost + Azotobacter + Azospirillum + PSB +75% RDF, Rhizobium+ Vermicompost + FYM +75% RDF, Rhizobium + Azospirillum + PSB + 75% RDF. The other treatments of Rhizobium + Vermicompost + 75% RDF, Rhizobium + FYM + 75% RDF and Rhizobium + 75% RDF were intermittent, however, much better than the un-inoculated control. These treatments though were at par with each other in most of the parameters like percent emergence, number of leaves, number of branches, number of pods/plant, number of seeds/pod, pod length, chlorophyll content and protein content etc.

Keywords: Cowpea, biofertilizer, vermicompost and rhizobium

Introduction
Cowpea (*Vigna unguiculata* L.) is commonly known as lobia is one of the important summer pulse crop grown for grain, forage and green manuring. The crop gives such a heavy vegetative growth and covers the ground so well that it checks the soil erosion in problem areas and can later be ploughed down for green manure. It has considerable promise as an alternative pulse crop. Cowpea is responsive to fertilizer application and organic manure. Among the various constraints to low productivity of cowpea, inadequate use of fertilizers and lack of improved package of practices are important. Nitrogen plays an important role in various metabolic process of plant. Nitrogen is an essential constituent of protein and chlorophyll and is present in many other compounds helps in plant metabolism. Phosphorus is an essential constituent of nucleic acids and stimulates root growth as well as increase nodule activity in plant. The seed of pulses is inoculated with Rhizobium and others bio-fertilizers with an objective of increasing their number in the rhizospheric soil, so that there is substantial increase in the microbiologically fixed nitrogen and make available nutrient for the plant growth. The inoculation of seeds with suitable Rhizobium culture increased the green pod yield over un-inoculated control (Vaisya *et al*., 1983) [10]. The association of Rhizobium and pulse plants helps in improving fertility of soil and is a cost effective method of nitrogen fertilization in legumes. FYM & Vermicompost is used as organic matter. Agricultural residues, animal wastes, dairy and poultry wastes, food industry wastes, sludge can all be recycled to give vermicompost and FYM. In recent years, use of FYM and vermicompost has been advocated in integrated nutrient management system in field crops (Shroff and Devathali, 1992) [9]. An objective the present study on effect of different bio-fertilizer and fertility levels on growth, quality and yield of cowpea.

Materials and Methods
A field experiment was conducted during rabi season of 2019-20 at the horticultural research farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) under RBD with three

replications. The soil was loamy sand in texture, neutal in reaction (pH 7.4), low in organic carbon (0.62%), low available nitrogen (133.80 kg/ha), medium available phosphorus (16.81 kg P2O5 /ha) and high in potassium (303.11 kg K2O/ha) content. The experiment consisted four fertility levels (control, 100% RDF, 75% RDF and 50%RDF) and four different bio-fertilizers (Rhizobium, PSB, Azotobacter and Azospirrilum), and two organic manure (FYM & Vermicompost @2 t/ha) thereby, making ten treatment combinations. Fertilizers were applied as per treatment through DAP, MOP and urea at the time of sowing as basal dose. The cowpea cv. Kashi kanchan was sown on 28th of December 2019 using seed rate of 20 kg/ha with a row spacing of 30 cm. The crop was harvested on 11th March 2020. Five irrigations were applied during growing season. Intercultural operations *viz*., thinning, hoeing and weeding were followed after 20 days of sowing to maintain recommended spacing and weed control. For weed management pendimethalin 1.0 kg a.i./ha was applied as pre-emergence to control the weeds in early stages of the crop. Growth parameters observation was recorded at 60DAS. Fully mature and develop pods from randomly selected five plants from each plot were plucked and number of seeds were counted. The average number of pods and seeds/plants was worked out, than after each net plot area was recorded in kg/plot and then converted to kg/ha.

Results and Discussion

Effect of fertility levels Results revealed that application of Rhizobium+ FYM + Azotobacter + Azospirillum + PSB +75% RDF significantly increases the parameters *viz*. plant height, % emergence, no. of leaves, no. of branches, root length, number of pods/plant, number of seeds/pod, pod length, chlorophyll content and protein content and remained at par with the application of Rhizobium+ Vermicompost + Azotobacter + Azospirillum + PSB + 75% RDF, Rhizobium + Azospirillum + PSB + 75% RDF over the rest of treatments and over control (Table 1 & 2). However, the test weight differ significantly under different fertility levels. This may be attributed primarily to the beneficial effect of fertility on overall physical condition of the soil. The reason for better growth and development in the above treatments might be due to increased availability of nitrogen and phosphorus to the plant initially through fertilizers and then through different bio-fertilizer increased microbial population in the rhizosphere soil and nodulation through symbiotic association of rhizobium with cowpea crop.

The effect of RDF and biofertilizers both of them on root nodule was significant. As the phosphorus plays an important role in nodule initiation, root proliferation and in addition of PSB increases the availability of soluble phosphate and enhances the root growth while Rhizobium increases nodulation by increasing nitrogen content by biological nitrogen fixation and formation of enzymes which leads to increases nodulation. Since the fertility being a store house of almost all the plant nutrient required for proper growth and development of plants, its addition the in soil enhanced availability of these nutrients. The efficiency of inorganic fertilizer is much pronounced when it is combined with organic manures (FYM and vermicompost). The increased vegetative growth and the balanced C: N ratio might have increased the synthesis of carbohydrates, which ultimately promoted yield (Kumar *et al*., 2003; More *et al*., 2008; Sammauria *et al*., 2009; Choudhary and Yadav, 2011) [5, 7, 8, 2].

Effect of biofertilizers Results further indicated that inoculation of seed with Rhizobium, PSB, azotobacter and azospirillum significantly higher the plant height, % emergence, no. of leaves, no. of branches, root length, number of pods/plant, number of seeds/pod, pod length, chlorophyll content and protein content over the rest of treatments (Table 1 & 2). Rhizobium and PSB might have improved both nitrogen and available phosphorus in rhizosphere as they are symbiotic nitrogen fixers and phosphorus solubilizers, respectively. Thus, the increased availability of nitrogen due to Rhizobium coupled with phosphors due to PSB might open the door for increased utilization of others nutrient also and have resulted in more increase in growth in comparison to Rhizobium and PSB inoculations (Kausale *et al*., 2009; Kumawat *et al*., 2010) [3, 6]. However, the test weight slightly significant differences observed under different levels of bio-fertilizers. The available P was low in loamy sand soil; PSB might have helped in reducing P fixation by its effect and also solubilized the unavailable form of P leading to more uptake of nutrient and reflected in better yield attributes (Bansal, 2009; Khandelwal *et al*., 2012) [1, 4].

Table 1: Effect of biofertilizer and fertility level on growth attribute of cowpea

Treatment	Pt.ht. (cm.)	No. of branches / plant	No. of leaves/plant	Root length (cm.)	% emergence
Control (0% RDF)	37.31	7.30	10.45	12.02	77.01
Control (100% RDF)	50.32	11.05	12.80	16.01	80.98
Rhizobium + 75% RDF	45.26	11.02	11.83	16.04	89.93
Rhizobium + 50% RDF	42.17	8.09	11.03	13.23	78.34
Rhizobium + Azospirillum + PSB + 75% RDF	49.98	10.15	13.66	19.69	89.91
Rhizobium + Vermicompost + 75% RDF	48.25	10.65	12.33	14.87	91.79
Rhizobium + FYM + 75% RDF	52.04	11.34	12.52	17.02	91.66
Rhizobium + Vermicompost + FYM +75% RDF	54.01	11.85	13.88	17.15	91.36
Rhizobium + Vermicompost + Azotobacter + Azospirillum + PSB + 75% RDF	53.19	12.88	13.60	19.85	92.66
Rhizobium+ FYM + Azotobacter + Azospirillum + PSB +75% RDF	57.23	13.60	14.10	20.7	92.79
SEmt	2.24	0.07	0.27	0.11	0.28
CD (P=0.05)	6.66	0.21	0.81	0.32	0.83
CV (%)	7.92	1.14	3.76	1.14	0.55

Table 2: Effect of bio-fertilizer and fertility level on yield and quality attribute of cowpea

Treatment	Number of pods/plant	Number of seeds/pod	Pod length (cm.)	Chlorophyll content	Protein content (mg/g)	Test weight (g)
Control (0% RDF)	8.00	8.508	20.42	33.93	579.23	86.11
Control (100% RDF)	10.20	11.864	27.78	40.54	613.34	87.33
Rhizobium + 75% RDF	10.00	12.985	28.01	40.98	601.43	87.13
Rhizobium + 50% RDF	9.70	10.77	24.82	33.96	509.77	86.66
Rhizobium + Azospirillum + PSB + 75% RDF	11.40	10.65	28.06	36.31	517.24	87.45
Rhizobium + Vermicompost + 75% RDF	11.01	11.23	28.72	39.62	601.06	86.73
Rhizobium + FYM +75% RDF	10.90	11.54	26.70	37.98	530.58	86.67
Rhizobium+ Vermicompost + FYM +75% RDF	10.60	11.87	28.64	39.66	614.33	86.91
Rhizobium + Vermicompost + Azotobacter + Azospirillum + PSB + 75% RDF	11.80	11.21	27.58	38.59	601.66	88.01
Rhizobium + FYM + Azotobacter + Azospirillum + PSB + 75% RDF	12.00	12.63	29.26	45.70	633.66	88.06
SEmt	0.39	0.18	0.12	0.18	5.08	0.38
CD (P=0.05)	1.16	0.53	0.35	0.54	15.11	0.18
CV (%)	6.38	2.74	0.75	0.81	1.52	0.26

Conclusion

Microbial population increase by application of 75% RDF along with inoculation of Rhizobium + PSB +Azotobacter + Azospirillum and FYM application showed significant effect as compared to other combination of isolates, organic manure over control and 100% RDF alone. which increase the dehydrogenates activity and population of beneficial microbial in the rhizosphere soil of cowpea crop and number of root nodules and effective nodules due to enhance the proliferation of root growth, enzymatic activities and plays important role in nutrient content by improving nutrient availability in soil which ultimately increases growth, yield and quality of crop and fulfill the requirement of rest nutrient for proper growth & development of crop.

Thus it can be concluded that the application of 75% RDF along with biofertilizer *viz*. Rhizobium + PSB +Azotobacter + Azospirillum inoculation and organic manure FYM is better as compared to 100% RDF alone to sustain soil fertility and to maintain soil health for the future crop planning.

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