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Effect of bio fertilizer with conjoined use of organic and inorganic fertilizer on yield and economics of short duration pigeon pea (*Cajanus cajan* L.)

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Abstract
The results of experiment from pooled table revealed that treatment F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) in fertility level and B7 (Rhyzobium + PSB + PGPR) in bio fertilizer recorded significant high Yield attributes (pods/plant, seeds/pod, grains/plant, grain weight/plant and 1000-grain weight) The grain, straw, stick and biological yield increased by F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) 15.34, 47.61, 22.45 and 84.81 in fertility level and B7 (Rhyzobium + PSB + PGPR) 15.13, 49.61, 22.48 and 87.26 in case of bio fertilizer, respectively. Maximum gross and net returns was found in F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) Rs.106729.93, Rs.79260.3 in fertility level and B7 (Rhyzobium + PSB + PGPR) Rs.105523.66, Rs.74606.5 in bio fertilizer benefit: cost ratio maximum found in F3 (40:90:40 kg NPK/ha +1t/ha VC+ 3t/ha FYM) (3.90) in fertility level and B4 (Rhyzobium + PSB) (3.74) in bio fertilizer.

Keywords: bio fertilizer, inorganic fertilizer, pigeon pea.

Introduction
Pulses occupied an area of about 68.31 million hector contributing 57.32 metric tonnes of production to the world food basket. India is the largest producer (25%), importer (20%) and consumer of pulses in the world. Current requirement of pulses in India is 17 million tonnes whereas the present production is 15.19 million tonnes. India shared 35.2 per cent of area and 27.65 per cent of global pulses production (Chaturvedi and Ali, 2012). ulses are highly responsive to phosphorus, potosh and miner nutrients. Phosphorus is an important plant nutrient and it effects seed germination, cell devision, flowering, fruiting, synthesis of fat, starch and infact most biochemical activities it also induces root prolification and nodulation. Some hetrotropic bacteria are known to have ability to solublize phosphorus from insoluble sources, about 15-20 kgP2 O5 then per season Pigeon pea [Cajanus cajan (L.) Millsp., Family-Fabaceae], is one of the major pulse crops of the tropics and sub-tropics, grown in approximately 50m countries in Asia, Africa and the Americas, mostly as an intercrop with cereals. It is commonly known as pigeon pea, red gram, tur, arhar, tuvarica, Congobean, thogari or gandul in India. India is the largest producer 2.76 mt with 3.6 million ha area, Pigeon pea pods are consumed as green vegetable in many countries. The solubilisation effect of phosphobacterins is generally due to the production of organic acids that lower the soil pH and bring about the dissolution of bound forms of phosphate. It is reported that PSB culture increased yield up to 200-500 kg/ha PGPR represent a wide variety of soil bacteria which, when grown in association with a host plant, result in stimulation of host growth. PGPR modes include fixing N, increasing the availability of nutrients in the rhizosphere, Sulphur is increasingly used as a component of fertilizers. The most important form of sulphur for fertilizer is the mineral calcium sulphate. Zinc (Zn) is one among the seven Micronutrient elements that is indispensable for plant growth. Its presence activates a series of enzymes responsible for maintaining the course and tempo of several vital growth events. Zinc asserts in protein synthesis and production of auxins (growth promoting chemicals). Therefore, a low zinc supply encourages protein deficiency and dwarfism in plants.

Experimental methods
The experiment was conducted at Students Instructional Farm, Department of Agronomy Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The experiment was carried out in randomized block design with three replications he experiment comprised of 32 treatment combinations of 4 sources of fertility level F0 (Control), F1 (20:30:20 kg NPK/ha + 3t/ha VC + 9t/ha FYM) F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) F3 (40:90:40 kg NPK/ha + 1t/ha VC + 3t/ha FYM) and 8 bio fertilizer B0 (Control) B1 (Rhyzobium) B2

(PSB) B3 (PGPR) B4 (Rhyzobium + PSB) B5 (Rhyzobium + PGPR) B6 (PSB + PGPR) B7 (Rhyzobium + PSB + PGPR).Recommended dose of Zn and S (20 and 15 kg/ha) are applied in all treatment as common dose. The variety of Pigeon pea UPAS120 seed was sown @ 15 kg ha 60 cm X 20cm spacing. Extra crop plant was thinned out at 30 days after sowing by hand to maintain proper recommended plant to plant spacing one irrigation was given at 42 day stage of the crop

Experimental Results and Analysis

The results obtained from the present study have been discussed in detail under following

Yield analysis

The grain yield of pigeon pea (Table 1) differed significantly due to various treatments under study. It could be seen that the grain yield (15.69 q ha-1) was maximize with the application of F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) respectively in fertility level, Significantly maximize grain yield (15.13 q ha-1) of pigeon pea was obtained with the application of B7 (Rhyzobium + PSB + PGPR) then rest of the Treatments, The differences in straw yield of pigeon pea was significant due to various treatments under study. From the data summarized that treatment F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) has significantly straw yield was maximize (48.61 q ha-1) compared to all other treatments in fertility level, significantly straw yield was maximize B7 (Rhyzobium + PSB + PGPR) (49.61 q ha-1) as compare to rest of the treatments in bio fertilizer under investigation. From the data summarized that the maximize stick yield (22.79 q ha-1) of pigeon pea was recorded in fertility level with the application of F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) In case of bio fertilizer level the maximum stick yield of pigeon pea was obtained with the application of B7 (Rhyzobium + PSB + PGPR) (22.48 q ha-1) to rest of the treatments. The highest Biological yield was recorded with the application of F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) 87.12 q ha-1 which was tatistically at par with F1 (20:30:20 kg NPK/ha + 3t/ha VC + 9t/ha FYM) Significantly treatment B7 (Rhyzobium + PSB + PGPR) 87.26 q ha-1 was prodused maximum biological yield in case of bio fertilizer and B0 (control) 71.34 q ha-1 was found lowest biological yield in bio fertilizer level as compared to all other treatment. Application of F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) was recorded highest harvest index 18.00 this was statistically at par with F1 (20:30:20 kg NPK/ha + 3t/ha VC + 9t/ha FYM) and F3 (40:90:40 kg NPK/ha + 1t/ha VC + 3t/ha FYM) during both the year in fertility level. While lower harvest index value 13.95 was recorded by treatment F0 (control) In case of bio fertilizer harvest index is non-significant, highest harvest index 17.03 was found in B7 (Rhyzobium + PSB + PGPR)

Table 1: Effect of bio- fertilizer with conjoined use of organic and inorganic fertilizer on yield

Treatment	Grains yield	Straw yield	Stick yield	Test weight (g)	Biological yield	Harvest index
Fertility level						
F0	7.94	7.94	15.65	60.63	57.14	13.95
F1	15.49	15.49	22.59	62.87	85.85	17.99
F2	15.69	15.69	22.79	63.00	87.12	18.00
F3	15.34	15.34	22.45	62.72	84.81	17.95
SEM±	0.04	0.04	0.10	0.08	0.44	0.07
CD (P=0.05)	0.14	0.14	0.33	0..26	1.36	0.23
Bio-fertilizers						
B0	12.14	39.80	19.29	60.50	71.34	16.77
B1	13.46	43.65	20.68	62.27	77.83	17.03
B2	13.13	42.63	20.35	61.95	76.11	17.00
B3	12.76	41.50	19.99	61.65	74.26	16.95
B4	14.38	46.98	21.68	63.11	82.8	17.02
B5	14.15	46.18	21.43	62.82	81.83	16.98
B6	13.80	45.03	21.08	62.56	79.41	16.99
B7	15.13	49.61	22.48	63.51	87.26	17.03
SEM±	0.16	0.34	0.24	0.18	0.67	0.15
CD(P=0.05)	0.44	0.94	0.69	0.51	1.86	NS

Economic analysis

Data presented in table 2 cost of cultivation, grass monetary return, net monetary return and benefit-cost ratio is presented Perusal of the data shown that maximum cost of cultivation was recorded (Rs.36700) with application of F1 (20:30:20 kg NPK/ha +3t/ha VC+ 9t/ha FYM) This was closely followed by F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) in fertility level, while the minimum cost of cultivation (Rs.17374) was recorded with F0 (control) Cost of cultivation data recorded maximum (Rs.30926) with application of B7 (Rhyzobium + PSB + PGPR) in bio fertilizer then rest of the treatment and B0 (control) (Rs.25871) was found lowest cost of cultivation The gross returns of pigeon pea differed significantly due to various treatments. It could be seen from data (Table 4.38) and Fig. 4.11 that F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) gave maximum gross monetary returns of Rs. 109153.08. This was closely followed by F1 (20:30:20 kg NPK/ha +3t/ha VC+ 9t/ha FYM) in fertility level. The minimum gross return was recorded with F0 (control) (Rs.56688.97) in fertility level. The significantly maximum gross monetary returns of Rs. 105523.66 was found in bio fertilizer in B7 (Rhyzobium + PSB + PGPR) then rest of the treatments and lowest gross monetary returns was found significantly in B0 (control) (Rs.85095.07) in bio fertilizer.The maximum net monetary returns in pooled data was recorded of Rs. 79260 with F2 (30:60:30 kg NPK/ha +2t/ha VC+ 6t/ha FYM) which was significantly more than rest of the treatments. This was closely followed by F1 and F3 both the years of experiment in fertility level. Whereas, minimum net return was recorded with F0 (control) Rs.39313.8 in fertility level In case of bio fertilizer maximum net monetary returns was recorded in B7 (Rhyzobium + PSB + PGPR) Rs. 74606.5 in bio fertilizer level which was significantly more than rest of the treatments in bio fertilizer

and maximum net monetary returns was lowest found in B0 (control) Rs. 59225.4 in bio fertilizer level The maximum benefit cost ratio was obtained (3.90) with F2 (40:90:40 kg NPK/ha +1t/ha VC+ 3t/ha FYM) than all other the treatments, in fertility level. This was closely followed by F1 and F3. Whereas, minimum benefit cost ratio was registered in F0 (control) 2.91 the maximum benefit cost ratio was obtained in B4 (Rhyzobium + PSB) 3.74 significantly in bio fertilizer level then rest of the treatments. The lowest b:c ratio was found in B0 (control) 3.02

Table 2: Effect of bio- fertilizer with conjoined use of organic and inorganic fertilizer on economics

	Cost of cultivation	Gross income	Net income	b:c ratio
Fertility level				
F0	17374	56688.97	39313.8	2.91
F1	36700	107758.63	79260.3	3.29
F2	32073	109153.08	79260.3	3.41
F3	27446	106729.93	71565.2	3.90
SEM±		155.30	134.92	0.01
CD (P=0.05)		478.52	415.71	0.03
Bio-fertilizers				
B0	25871	85095.07	59225.4	3.02
B1	25950	93900.92	67950.6	3.68
B2	26997	91624.30	64626.8	3.45
B3	29720	89123.52	60403.2	3.33
B4	27076	100316.34	73240.0	3.74
B5	29800	98703.69	68903.4	3.27
B6	30846	96315.03	65464.5	3.12
B7	30926	105523.66	74606.5	3.40
SEM±		223.34	185.11	0.01
CD(P=0.05)		622.14	515.65	0.04

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