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Effect of bio-fertilizers on growth, yield and economics of field pea (*Pisum sativum* L.)

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ABSTRACT

A field experiment was conducted at Research Farm of A.S. (P.G.) College, Lakhoati, Bulandshahr (U.P.) to find the out the effect of bio-fertilizers {*Rhizobium, Azotobacter* and phosphate solubilising bacteria (PSB)} application on growth, yield and economics of field pea (*Pisum sativum* L.). The Co-inoculation of all the three bio-fertilizers *i.e. Rhizobium*, Azotobacter and PSB produced significantly higher growth characters as compared to absolute control and when inoculated them individually. The treatment T_8 comprising *Rhizobium* + *Azotobacter* + PSB gave highest growth in terms of plant height (45.26 cm), number of leaves/ plant (13.33), number of branches/ plant (4.20), number of nodules/ plant (38.46), fresh weight and dry weight of nodules (562.34 and 122.62 mg, respectively). The yield attributes like pod length, number of pods/ plant, number of seeds/ pod and 1000 grain weight (g) and yield of grain and straw of pea increased by co-inoculation of bio-fertilizers and were highest for the treatment in which *Rhizobium*, *Azotobacter* and PSB were co-inoculated. More over the co-inoculation of *Rhizobium* and PSB also gave beneficial results in respect to other treatments. However, single inoculation of *Rhizobium*, *Azotobacter* and PSB produced promising results compared to control. In economic consideration, it was found that co-inoculation of *Rhizobium*, *Azotobacter* and PSB gave highest net income (Rs. 17363.6/ha) and Benefit: cost ratio (1.90) as compared to other treatments.

Key words : Pea, *Rhozobium*, *Azotobacter*, PSB, Growth, Yield, Economics

INTRODUCTION

In order to meet out the nutritional demand of the increasing population, efforts are being made at the national and international level to increase the per hectare production. Fertilizers being vital agricultural inputs to increase the production but the main drawbacks in the use and manufacture of chemical fertilizers *viz.*, energy crises and inavailability of indigenous materials like neptha, sulphur etc at the national level and hazardous effect of chemical fertilizers on our health and environment. All these things have led to the research of alternative renewable source of nutrients to the crop through fertilizers of biological origin (bio-fertilizers). All the bio-fertilizers are safe, low cost and easy in application. Bio-fertilizer application has shown bright results in case of leguminous crops, especially exclusive results have been obtained in case of pea. Considering the above facts, present investigation was carried to find out the effect of bio-fertilizers on growth, yield and economics of pea.

MATERIALS AND METHODS

A field experiment was carried out during the *Rabi* season of 2002 on the Research Farm of A.S. (P.G.) College, Lakhoati, Bulandshahr (U.P.). The soil of the experimental field was well drained sandy loam, slightly alkaline in reaction (pH 7.7), having E.Ce.-0.03 dSm^{-1}, organic carbon- 2.95g/kg soil, available N, P and K as 197.0, 13.0 and 113.0 kg/ha, respectively. The soil was low in available N and organic carbon and medium in available P and K. Eight treatments consisted of three bio-fertilizers *viz.*, *Rhizobium*, *Azotobacter* and PSB applied singly as well as in co-inoculation along with one absolute control were replicated thrice and laid out in factorial Randomized Block Design. Bio-fertilizers *viz.*, *Rhizobium*, *Azotobacter* and PSB were applied through seed treatment. For each kg of seed slurry was prepared by mixing and warming 200g of bio-fertilizer culture in 200ml water containing 50g Jaggery. The seeds were then put in the slurry and removed after 15-20 minutes and spread in shade for 20-30 minutes and then sown in the prepared field.

RESULTS AND DISCUSSION

The results of the present investigation (Table 1) showed that the application of bio-fertilizers significantly improved all the growth characters over control. Consequently, significant results were obtained in case of co-inoculation cases. The highest growth in terms of plant height (45.26cm), number of leaves/ plant (13.33), number of branches/ plant (4.20), number of nodules/ plant (38.46), fresh weight (562.34 mg) and dry weight (122.62 mg) were recorded with treatment in which *Rhizobium*, *Azotobacter* and PSB were co-inoculated followed by the results produced by the co-inoculation of *Rhizobium* and PSB. This might be due to symbiotic and non-symbiotic

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Table 1: Effect of bio-fertilizers on growth parameters of field pea

Treatments	Plant height (cm)	No. of leaves plant^{-1}	No. of branches plant^{-1}	No. of nodules plant^{-1}	Fresh wt. of nodules plant^{-1} (mg)	Dry weight of nodules plant^{-1} (mg)
T_1: Control	38.28	10.24	2.08	34.53	374.65	84.37
T_2: PSB	39.46	11.44	2.80	34.55	396.31	88.54
T_3: Azotobacter	38.77	10.82	2.40	34.63	394.68	86.32
T_4: Azotobacter + PSB	42.27	11.64	3.50	36.23	402.17	102.47
T_5: Rhizobium	41.44	11.55	2.80	36.13	410.23	96.40
T_6: Rhozobium + PSB	43.30	12.83	3.90	38.25	492.39	118.43
T_7: Rhizobium + Azobacter	42.07	11.82	3.15	36.25	480.58	116.43
T_8: Rhizobium +Azotobacter + PSB	45.26	13.33	4.20	38.46	562.34	122.62
C.D. (P = 0.05)	0.22	0.19	0.70	0.25	0.52	0.33

Table 2: Effect of bio-fertilizers on yield attributes, yield and economics of field pea

Treatments	Yield attributes				Yield q/ha		Economics	
	Pod length (cm)	No. of pods plant^{-1}	No. of seeds Pod^{-1}	1000 – Grains weight (g)	Grain	Straw	Net income (Rs/in)	B:C ratio
T_1	4.07	10.72	4.14	98.53	9.46	15.36	4718.8	0.58
T_2	4.77	11.53	4.94	103.83	12.12	18.10	7909.0	0.94
T_3	4.66	11.36	4.14	103.13	11.17	16.80	6695.0	0.80
T_4	5.10	13.50	5.76	105.25	13.80	18.30	9829.0	1.13
T_5	5.00	13.30	4.68	104.10	13.10	18.20	9126.0	1.08
T_6	5.70	15.12	6.46	109.45	17.30	22.10	14473.0	1.60
T_7	5.45	14.10	5.43	108.60	15.20	20.90	11637.0	1.32
T_8	9.95	16.60	6.98	112.10	19.80	25.12	17363.6	1.90
C.D. (P=0.05)	0.68	0.78	0.77	2.23	2.60	2.67		

nitrogen fixation by *Azotobacter* and by increasing the availability of phosphorous to the plant by PSB on one hand and on the other hand countering the ill effects of excessive nitrogen in the soil, thereby helping in improving the aforesaid characters. The results are in conformity with the finding of Patel *et al*. (1998) and Khoja *et al.* (2002). The yield attributes and yield showed a significant improvement over control due to co-inoculation cases of *Rhizobium*, *Azobacter* and PSB. The highest yield attributes *i.e.* pod length (9.95cm), number of pods/ plant (16.60), number of seeds/pod length (6.98), 1000 grain weight (112.10g) and yield of grains and straw (19.80 and 25.12 q/ha), respectively were produced by the treatments (T_8) in which *Rhizobium*, *Azotobacter* and PSB were co-inoculated together (Table 2). The positive increase in relation to yield attributes and yield might be caused due to superior rate of carbohydrate manufacturing in reproductive parts of the plant and also sustainable increase in no. of pods and seed weight per plant. Singh *et al.* (1992) and Kundu (1988) also found the similar observations. The co-inoculation of *Rhizobium*, *Azotobacter* and PSB gave significantly maximum net return (Rs. 17363.6/ha) and B:C ratio (1.90) as compared to control and other treatments.

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