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Effect of microbial inoculants on soil quality, growth and yield of pea plant

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ABSTRACT

The research work was conducted to study the effect of eight treatments of biofertilizers i.e. control, *Rhizobium*, *Phosphate solubilizing bacteria* (PSB), *Azotobacter*, PSB + *Azotobacter*, *Rhizobium* + *Azotobacter*, *Rhizobium* + PSB and *Rhizobium* + PSB + *Azotobacter* on soil quality, growth and yield attributes of pea plant. The soil characteristics like moisture content, organic carbon, available nitrogen, phosphorous content were significantly improved in T_8 treatment. Based on the mean performance, plants treated with microbial consortium of *Rhizobium* + PSB + *Azotobacter* (T_8) showed significantly highest shoot, plant height, plant biomass, pod length, number of seeds per pod and weight of seeds. From the present research work, it has been proved that the application of biofertilizers seems to be beneficial for improved growth and yield of pea plant.

Key words: *Azotobacter, Rhizobium, PSB, Soil quality, Biofertilizers*

Introduction

The excessive use of chemical fertilizers and pesticides accelerates soil acidification resulting in contamination of ground water. Chemicals also weakens the roots of plants and making them susceptible to unwanted diseases (Chun-Li *et al*., 2014). Long term use of chemical fertilizers can change the soil pH, upset beneficial microbial ecosystems, increase pest infection. The use of organic media or microbial inoculants offers a valuable alternative over chemical fertilizers due to their good water holding capacity, proper aeration and nutrient absorption. Biofertilizers when applied through seed or soil treatment, promote growth by increasing the supply or availability of nutrients to the host plant (Moinuddin *et al*., 2014). The present research work aims to see the effect of application of various bacterial inoculants alone and in combination on the quality of soil and growth and yield of pea plant.

Methodology

The experimental site selected was Agriculture Research Farm of Mata Gujri College, Sri Fatehgarh Sahib. Each replication consisted of eight treatments (Table 1). The selected crop was *Pisum sativum.* The experimental area was divided into small experimental plots to accommodate 8 treatments and 3 replications.

Seed treatment

100g of jaggery was dissolved in 100 mL of water. *Rhizobium*, *Azotobacter*, *PSB* culture was thoroughly mixed for slurry preparation in above solution. Seeds were dipped in this solution so that uniform coating is made. After 15 minute seeds were removed and kept for drying under shade and then

used for sowing. The seeds were sown in rows, with a row to row distance of 20 cm and a plant to plant distance of 10 cm at the depth of 3-5 cm. Garden pea was harvested at edible maturity stage by picking the green pods manually. Three pickings were taken during the experimental period. The observational data recorded on all the parameters was subjected to statistical analysis at 5 per cent level of significance. The standard error of mean (SEm) and critical differences (C.D.) for comparing the means of any two treatments were computed.

Results and Discussion

Soil pH, moisture content, organic carbon, available nitrogen, phosphorous

The results revealed that the soil pH within various treatments decreased with the addition of biofertilizers at harvest as compared to control (pH 7.77) as shown in Table 1. Addition of microbial inoculants may increase the content of organic acids through their secretions thus lowering the soil pH. The results were in accordance with findings of Jaipaul *et al*.,(2011) who found that soil pH decreased significantly with the addition of farm yard manure along with biofertilizers. Moisture content, organic carbon was observed more in treatment T_8, 0.61%, 0.29% respectively. High microbial biomass production and high rhizo deposits of carbonaceous materials through root exudates may be reason for higher organic carbon (Franzluebbers *et al*., 1995). Higher amount of nitrogen and phosphorous was recorded in the T_8 treated plants, 394.08 kg/ ha and 41.07 kg/ha respectively and least 284.33 kg/ha and 21.29 kg/ha in T_1. Significant increase was observed in nitrogen in case of safflower seed inoculation with *Azotobacter* and *Azospirillum* (Naseri and Mirzaei, 2010).

Growth parameters (Shoot Length, Plant biomass and Plant height)

The shoot length increased continuously from 30 days of sowing to harvest in all the treatments (Fig 1). Amongst all the treatments, T_8 treated plants showed significantly highest shoot length compared to other treatments at all the four stages of plant growth, i.e. 14.40 cm, 30.47 cm, 45.93 cm, and 75.10 cm respectively. Plots treated with T_8 treatment showed plant biomass of 17.33 g and 51.00 g and plant height of 41.47 cm and 77.33 cm at 60 DAS and 120 DAS respectively as compared to other treatments (Fig. 2, 3).

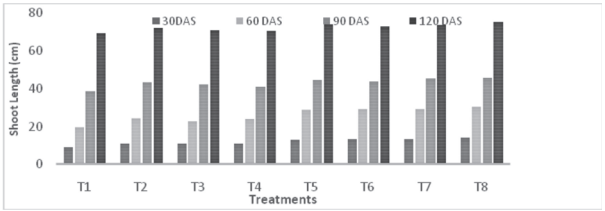

Fig. 1. Shoot length of pea plant influenced by various treatments

Afzal and Bano, (2008) revealed that single and dual inoculation with biofertilizer significantly increased shoot weight. Rather *et al*., (2010) reported highest growth in plant height (45.26 cm) with inoculation of *Rhizobium*, *Azotobacter* and PSB.

Yield Parameters

Different yield parameters of pea plant such as pod

Table 1. Effect of biofertilizer treatments on characteristics of soil

Treatments	Details	pH	Moisture Content (%)	Organic Carbon (%)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)
T_1	Control	7.77	0.46	0.12	284.33	21.29
T_2	*Rhizobium*	7.53	0.48	0.17	309.41	26.88
T_3	*PSB*	7.84	0.54	0.13	291.64	28.52
T_4	*Azotobacter*	7.76	0.57	0.25	300.01	26.46
T_5	PSB + *Azotobacter*	7.20	0.55	0.15	321.96	34.16
T_6	*Rhizobium* + *Azotobacter*	7.64	0.58	0.20	359.59	30.11
T_7	*Rhizobium* + PSB	7.57	0.47	0.22	381.54	38.08
T_8	*Rhizobium* + PSB + *Azotobacter*	7.34	0.61	0.29	394.08	41.07
	SE(m)	0.28	0.03	0.01	9.63	3.72
	CD	0.84	0.09	0.04	29.22	11.30

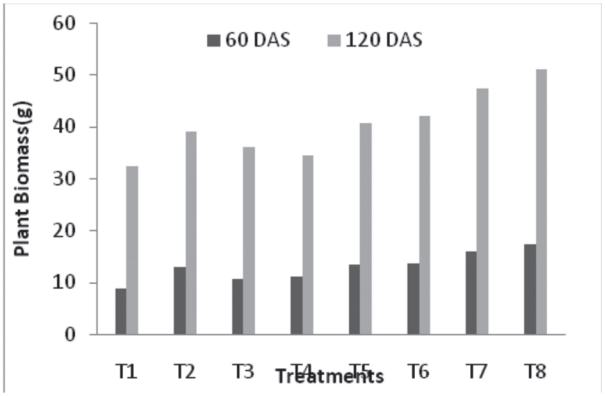

Fig. 2. Plant Biomass of pea plant influenced by various treatments

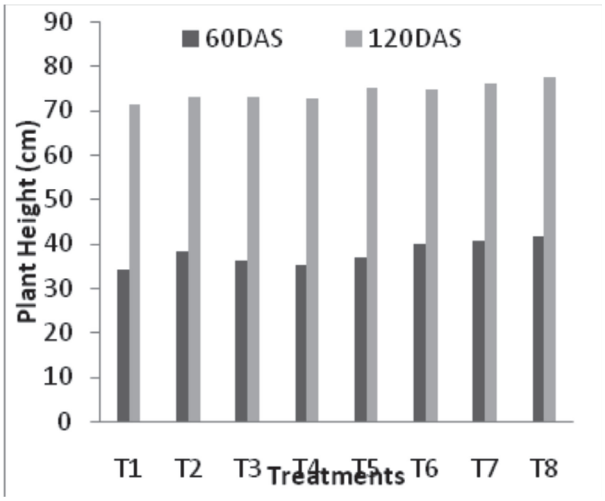

Fig. 3: Plant height of pea plant influenced by various treatments

length, number of seeds per pod and weight of 100 seeds were recorded at harvest (Table 2). T_8treated plants recorded significantly highest pod length of 9.93 cm and average number of seeds 8.73 and weight of seeds as 39.29g at harvest while treatment T_1 recorded the least pod length of 8.21cm, lowest average number of seeds 6.00 and lowest weight as 32.94g. The positive increase in relation to yield attributes might be caused due to superior rate of carbohydrate manufacturing in reproductive parts of the plant. Mishra *et al*., (2010) showed number of grains per pod was highest 5.67 at combined inoculation of *Rhizobium* + PSB + PGPR. Al-shakankery *et al*., (2014) noticed significant increase in the weight of 100 grains of maize plant with different concentrations of biofertilizers.

Table 2. Mean data of yield parameters influenced by various treatments

Treatment no.	Yield Parameters		
	Pod Length (cm)	No. of seeds	Wt. of 100 seeds (g)
T_1	8.21	6.00	32.94
T_2	8.92	6.40	34.21
T_3	8.63	6.27	33.39
T_4	8.58	6.33	33.00
T_5	9.57	8.07	34.50
T_6	9.27	8.20	35.27
T_7	9.89	8.47	38.92
T_8	9.93	8.73	39.29

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