

Influence of bio-fertilizers on growth and yield of pea (*Pisum sativum* L.)

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Abstract

The field experiment entitled “Influence of bio-fertilizers on growth and yield of pea (*Pisum sativum* L.)” was carried out at the “Campus for Research and Advanced Studies, G.S.S.D.G.S. Khalsa College, Patiala” during the Rabi season of 2021-2022. The experiment was laid out in randomized block design with comprising of eight treatments and three replications. The results revealed that influence of bio-fertilizers were significantly superior in growth and yield characters. All the growth parameters like plant height (107.64 cm), number of leaves plant⁻¹ (108.65), number of branches plant⁻¹ (21.68), number of flowers plant⁻¹ (15.69) were significantly maximum in treatment T₈ - (PSB 100 ml kg⁻¹ seed + *Azotobacter* 100 ml kg⁻¹ seed + *Rhizobium* 100 ml kg⁻¹ seed) and yield parameters number of pods plant⁻¹ (15.54), number of seeds pod⁻¹ (9.78), pod length (9.18 cm) and total yield (172.53 q ha⁻¹) was reported in T₈ - PSB 100 ml kg⁻¹ seed + *Azotobacter* 100 ml kg⁻¹ seed + *Rhizobium* 100 ml kg⁻¹ seed.

Keywords: Pea, *Rhizobium*, *Azotobacter*, PSB

Introduction

The Pea (*Pisum sativum* L.) is a popular vegetable crop that is produced all over the world. It is mostly grown as a cool-season crop in North Indian plains and as a summer vegetable in the hills. It has chromosome number 2n = 14 and belongs to the leguminosae (Fabaceae) family. According to Hakim, The Mediterranean region, western and central Asia and Ethiopia have been in dictated as centre of origin (Hakim *et al.* 2015).

India is the world's second-largest pea producer, accounting for 21% of global output. Punjab is India's fifth largest pea producer, accounting for 6.7% of total production. With a total area of 563 thousand hectares and an annual yield of 5703 thousand tonnes, it is Punjab's second most important vegetable crop (NHB 2020).

It requires temperature of 18-22 °C for optimum germination. It can germinate even at 4-5°C and can tolerate mild frost. At temperature of 25 °C and above, the percentage of seed germination decreases. It has high digestible proteins, carbohydrates, lipids, minerals (Ca, P, and Mg), and vitamins A, B, and C. High-quality starch and protein is extracted from dry pea seeds. Because they contain few anti-nutritional elements, dry seeds are used as a

protein source (Mishra 2014).

Rhizobium inoculation increased root nodulation through improved root development and increased nutrient availability. *Azotobacter*, PSB, and *Azospirillum* bio fertilizers fix atmospheric nitrogen and solubilize phosphorous to increase soil fertility and biological activity. Inoculation with PSB bio-fertilizer can increases crop yield by 10% to 30%. (Tilak and Annapurna 1993).

Materials and Methods

The experiment was performed during winter season of 2021-2022 at the Campus for Research and Advanced Studies, G.S.S.D.G.S. Khalsa College, Patiala (Punjab). The field experiment was carried out with 8 treatments and 3 replications laid out in Randomized Block Design consisting of T₁ - Control, T₂ - *Azotobacter* 100 ml kg⁻¹ seed, T₃ - *Rhizobium* 100 ml kg⁻¹seed, T₄ - PSB 100 ml kg⁻¹seed, T₅ - *Azotobacter* 100 ml kg⁻¹seed + PSB 100 ml kg⁻¹seed, T₆ - *Azotobacter* 100 ml kg⁻¹ seed + *Rhizobium* 100 ml kg⁻¹ seed, T₇ - PSB 100 ml kg⁻¹ seed + *Rhizobium* 100 ml kg⁻¹ seed, T₈ - PSB 100 ml kg⁻¹ seed + *Azotobacter* 100 ml kg⁻¹ seed + *Rhizobium* 100 ml kg⁻¹ seed. The experiment was laid out in randomized

block design with three replications. All these treatments were applied to Punjab-89 variety of pea. The gross and net plot size were $1.5 \times 3.0 \text{ m} = 4.5 \text{ m}^2$ and $1.7 \times 3.2 \text{ m} = 5.44 \text{ m}^2$ respectively. Pea crop was sown on 8th November, 2021 with a spacing of 10 cm x 30 cm. The crop was harvested on 20 February, 2022. Growth attributes were recorded at various stages starting from 30 DAS followed by 60 DAS followed by 90 DAS and at harvest which consists plant height (cm), number of leaves plant⁻¹, number of branches plant⁻¹, number of flowers plant⁻¹. Similarly, all yield parameters including number of pods plant⁻¹, number of seeds pod⁻¹, pod length (cm), total yield (q ha⁻¹) at harvest by standard methods.

Results and Discussion

Growth parameters

The results of various growth parameters of pea such as plant height (cm), number of leaves plant⁻¹, number of branches plant⁻¹, number of flowers plant⁻¹ were significantly enhanced by each one of the treatment. The different combination of bio fertilizers showed an improved growth characteristic over the rest of the treatments. The highest plant height (107.64 cm), number of leaves plant⁻¹ (108.65), number of branches plant⁻¹ (21.68), number of flowers plant⁻¹ (15.69) were observed with the application of T₈ - PSB 100 ml kg⁻¹ seed + *Azotobacter* 100 ml kg⁻¹ seed + *Rhizobium* 100 ml kg⁻¹ seed. The maximum growth parameters were induced by bio-fertilizers because they increased the symbiotic and non-symbiotic nitrogen fixation by *Azotobacter* and *Rhizobium*.

Increasing the availability of phosphorous to the plant by PSB and countering the ill effects of excessive nitrogen in the soil, thereby helping in improving plant growth. (Kothyari *et al.* (2017), Khan *et al.* (2017), Jyoti *et al.* (2016), Qureshi *et al.* (2015) in pea.

Yield parameters

The different bio-fertilizers also influenced the yield contributing characteristics of pea. The number of pods plant⁻¹ (15.54), number of seeds pod⁻¹ (9.78), pod length (9.18 cm) and total yield (172.53 q ha⁻¹) was reported in T₈ - PSB 100 ml kg⁻¹ seed + *Azotobacter* 100 ml kg⁻¹ seed + *Rhizobium* 100 ml kg⁻¹ seed and the minimum results were obtained from the control treatment. The findings showed that various combinations of the biofertilizer considerably boosted the yield parameters of treatments, application of PSB + *Azotobacter* + *Rhizobium* were resulted significantly better chemical properties, microbial populations and enzymatic activity followed by 100% RDF after harvest of pea. (Singh *et al.* (2015), Varsha *et al.* (2015), Zaghoul *et al.* (2015), Sharma *et al.* (2009) in pea.

Conclusion

From the above investigation, it can be concluded that application of PSB 100 ml kg⁻¹ seed + *Azotobacter* 100 ml kg⁻¹ seed + *Rhizobium* 100 ml kg⁻¹ seed resulted in higher production of pea. In term of growth and yield this might be due to symbiotic and non-symbiotic nitrogen fixation by *Azotobacter* and *Rhizobium*. Increasing the availability of phosphorous to the plant by PSB on one hand and on the other hand

Table 1: Effect of biofertilizers on growth parameters of pea

Treatment	Plant Height (cm)	No. of Leaves plant ⁻¹	No. of Branches plant ⁻¹	No. of Flowers plant ⁻¹
T ₁ :Control	85.24	99.59	15.99	7.65
T ₂ : <i>Azotobacter</i> 100 ml kg ⁻¹ seed	90.51	102.10	17.52	9.62
T ₃ : <i>Rhizobium</i> 100 ml kg ⁻¹ seed	93.43	103.30	18.08	10.01
T ₄ :PSB 100 ml kg ⁻¹ seed	95.31	105.04	19.16	12.54
T ₅ : <i>Azotobacter</i> 100 ml kg ⁻¹ seed + PSB 100 ml kg ⁻¹ seed	97.95	104.32	18.67	11.15
T ₆ : <i>Azotobacter</i> 100 ml kg ⁻¹ seed + <i>Rhizobium</i> 100 ml kg ⁻¹ seed	97.59	106.05	18.37	12.04
T ₇ :PSB 100 ml kg ⁻¹ seed + <i>Rhizobium</i> 100 ml kg ⁻¹ seed	105.43	107.13	20.52	14.27
T ₈ :PSB 100 ml kg ⁻¹ seed + <i>Azotobacter</i> 100 ml kg ⁻¹ seed + <i>Rhizobium</i> 100 ml kg ⁻¹ seed	107.64	108.65	21.68	15.69
SE (m) ±	0.98	0.71	0.61	0.75
CD (5%)	2.21	1.62	1.39	1.70

Table 2: Effect of bio-fertilizers on yield parameters of pea

Treatment	Number of pods plant ⁻¹	Number of seeds pod ⁻¹	Pod length (cm)	Green pod yield q ha ⁻¹
T ₁ :Control	8.62	5.61	5.12	90.50
T ₂ : <i>Azotobacter</i> 100 ml kg ⁻¹ seed	10.33	6.12	5.85	113.55
T ₃ : <i>Rhizobium</i> 100 ml kg ⁻¹ seed	11.53	5.78	6.06	126.48
T ₄ :PSB 100 ml kg ⁻¹ seed	10.59	7.16	7.35	117.53
T ₅ : <i>Azotobacter</i> 100 ml kg ⁻¹ seed + PSB 100 ml kg ⁻¹ seed	13.46	7.26	8.02	152.66
T ₆ : <i>Azotobacter</i> 100 ml kg ⁻¹ seed + <i>Rhizobium</i> 100 ml kg ⁻¹ seed	12.7	6.51	7.38	142.25
T ₇ :PSB 100 ml kg ⁻¹ seed + <i>Rhizobium</i> 100 ml kg ⁻¹ seed	14.34	8.42	8.17	169.31
T ₈ :PSB 100 ml kg ⁻¹ seed + <i>Azotobacter</i> 100 ml kg ⁻¹ seed + <i>Rhizobium</i> 100 ml kg ⁻¹ seed	15.54	9.78	9.18	172.53
SE (m) ±	0.69	0.64	0.49	1.42
CD (5%)	1.57	1.46	1.12	3.21

countering the ill effects of excessive nitrogen in the soil, thereby helping in improving the yield of crop. The application of bio-fertilizers not only improves plant characteristics but also the soil's health by sustaining its fertility and supplying it with nutrients, as well as relieving farmer's economic burden.

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