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Effect of fertility levels and bio-fertilizers on growth and yield attribute of field pea (*Pisum sativum*) in South Eastern plain Zone of Rajasthan

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Abstracts:

A field experiment entitled "Effect of fertility levels and bio-fertilizers on growth and yield attribute of fieldpea (*Pisum sativum*) in South Eastern plain zone of Rajasthan" have been conducted on clay loam soil of Research Farm, Department of Agronomy, Career Point University, Kotaduring rabi 2023-2024. The treatments comprising four fertility levels (F0: Control, F2: 50% RDF, F3: 75% RDF and F2: 100% RDF) and four bio-fertilizer levels (B0: Control, B1: Rhizobium, U2: PSB and B3: Rhizobium + PSB assigned respectively to plots and those were replicated three times in FRBD. For such experiment field pea was used. Results revealed that under 100% RDF and rhizobium + PSB crop was obtained highest value of growth parameters (plant height, number of primary branches plant^{-1}, periodic dry matter accumulation, yield attributes viz., number of pod plant^{-1}, number of grains pod^{-1} and 100g weight of grains.

Key words: Field pea, Rhizobium, Bio-fertilizer, Fertility

I Introduction:

Field pea (Pisum sativum) is a crucial leguminous crop, known for its high nutritional value and significant role in sustainable agriculture through nitrogen fixation. In the South Eastern Plain Zone of Rajasthan, optimizing the growth and yield of field peas is essential to enhance food security and promote sustainable farming practices. The region's unique climatic and

soil conditions present both challenges and opportunities for field pea cultivation, necessitating tailored agronomic strategies. Soil fertility and the use of bio-fertilizers are critical components that influence the growth and yield of field peas. Soil fertility levels, which refer to the availability of essential nutrients, are fundamental in determining the plant's developmental success and productivity. Ensuring optimal nutrient availability through appropriate fertility management can lead to improved plant growth, higher yields, and better-quality produce. Bio-fertilizers, which consist of beneficial microorganisms such as nitrogen-fixing bacteria, phosphate-solubilizing bacteria, and mycorrhizal fungi, play a vital role in sustainable agriculture. These bio-fertilizers enhance nutrient availability, improve soil health, and promote robust plant growth by facilitating nutrient uptake and stimulating root development. In the context of the South Eastern Plain Zone of Rajasthan, bio-fertilizers offer a sustainable solution to maintain soil fertility and achieve high crop yields, especially in challenging environmental conditions.

The interplay between different fertility levels and bio-fertilizers in influencing the growth and yield attributes of field peas is a significant area of research. Understanding how these factors interact can help develop integrated nutrient management strategies that maximize crop productivity while maintaining soil health. This is particularly important for the South Eastern Plain Zone of Rajasthan, where sustainable farming practices are essential for the long-term sustainability of agriculture. This study aims to investigate the effects of varying fertility levels and bio-fertilizers on the growth and yield attributes of field pea in the South Eastern Plain Zone of Rajasthan. By evaluating different combinations of fertility treatments and bio-fertilizers, this research seeks to identify the most effective strategies for enhancing field pea productivity in this region. The findings will provide valuable insights for farmers, agronomists, and policymakers, contributing to the development of sustainable and efficient agricultural practices for field pea cultivation in Rajasthan.

II Literature Review:

Field pea [*Pisum sativum* (L.)] or matar is one of the important cool season's crops of the India cultivated over an area of about 0.64 mha with a production of about 0.88m tonnes. (FAO 2021). In Rajasthan the area occupied by field pea was 14 thousand hectares and the production was 35 thousand tonnes during 2020-21 (Anonymous 2021).

Pea is commonly used in human diet throughout the world and it is rich in protein (21-25 %), carbohydrates, vitamin A and C, calcium, phosphorous and has high levels of

amino acids lysin and tryptophan (Bhat *et al*. 2013). It provides variety of vegetarian dishes and hence it is liked throughout the world. Unripe pods are used as green vegetable and dry seeds are used for dal and chat after boiling. It contains protein (19.2-22.5%), fat (1.8%), carbohydrate (60- 65%), calcium (64 mg), iron (4.8 mg), riboflavin (0.15 mg), thiamine (0.72 mg) and niacin (2.4 mg).

Field pea is highly responsive to nitrogenous fertilizer application especially in early stage. Nitrogen promotes the leaf, stem and other vegetative growth. It also increases the protein content in pea. It is an integral constituent of proteins and chlorophyll and is present in many other compounds of great physiological importance in plant metabolism, such as nucleotides, phosphatised, alkaloids, enzymes, hormones, vitamins etc. It imparts dark-green colour to plants, hastens rapid early growth and improves capacity to fix atmospheric nitrogen symbiotically. Nitrogen application to legumes at lower doses in the initial stage is essential for vigorous start. Growing of pulses without application of phosphatic fertilizer is an important factor for low yield. An adequate supply of phosphorus has been reported by various workers to be beneficial for better growth and yield, better quality in legumes (Sammauria *et al*., 2009). It acts as a structural component of membrane system of cells, chloroplasts and mitochondria. It is a constituent of energy phosphates like ADP and ATP, nucleic acid, nucleo proteins, purines, pyrimidine, nucleotides and several co-enzymes. It is involved in the basic reaction of photosynthesis. It plays an important role in cell division, carbohydrate break down for energy release, transfer of inherited characteristics and hastening the maturity of plants. Use of bio-fertilizers plays an important role in increasing fertilizers use efficiency. When the seeds of pulses are inoculated with Rhizobium and sown in such soils, it increases their number in the rhizosphere, thereby increasing the amount of microbiologically fixed nitrogen for the plant growth.

III Methodology:

Materials and methods : The field experiment was conducted at Research Farm, Career Point University, Kota(Rajasthan) which is situated at 29° 10´ N latitude and 75° 46´ E longitude with an elevation of 215.2 m above mean sea level in Rajasthan state of India. Effect of fertility levels and bio-fertilizers on growth and yield attribute of field pea (*Pisum sativum*) in South Eastern plain zone of Rajasthan" have been conducted on clay loam soil of Research Farm, Department of Agronomy, Career Point University, Kota during Rabi 2023-2024. The treatments comprising four fertility levels (F0: Control, F2: 50% RDF, F3: 75%

RDF and F2: 100% RDF) and four bio-fertilizer levels (B0: Control, B1: Rhizobium, U2: PSB and B3: Rhizobium + PSB assigned respectively to plots and those were replicated three times in FRBD. For such experiment field pea was used. Observation was recorded as growth and yield attributes of field pea.

IV Result and Discussion

Effect of fertility Growth Parameters Fertility levels had significant effect on plant height, number of primary branches plant^{-1} and periodic dry matter accumulation. The maximum plant height (18.10, 25.63, 42.76 and 55.90cm), number of primary branches plant^{-1}(1.35, 1.83, 2.45 and 2.91),dry matter accumulation (0.449, 5.05, 15.30 and 23.41 g plant^{-1}) at 30, 60, 90 DAS and at harvest was recorded under the application of 100% RDF and minimum was recorded under control (no fertilizer)(Table 1). Water is an elementary constituent of plant protoplasm and their adequate supplies enhance cell division and as well as cell elongation. Therefore, optimum availability of fertilizer with 100% RDF to field pea might have improved the photosynthetic area of plants that cumulatively contributed to higher growth parameters. All the treatments resulted in increasing available nutrient in soil over control. These results are in agreement with those of Zhao *et al*., (2009), Yadav and Kumar (2009) and Chesti and Ali (2012).

Yield Attributes

The analysis of data indicates that different fertility levels had significant effect on yield attributes *viz*., number of pod plant^{-1}, number of grains pod^{-1} and 100g weight of grains. The maximum number of pod plant^{-1} (21.52), number of grains pod^{-1} (5.12) and 100g weight of grains (15.68 g) were registered under 100% RDF (Table 2).An overall increase in yield attributes and yield of field pea crop due to combined application of chemical fertilizers with bio-fertilizers have also been reported by Mishra *et al*. (2010), Rajput and Kushwah (2005), Bhat *et al*. (2013), Erman *et al*. (2009), Negi *et al*. (2006), Dass *et al*. (2005) and Kumari *et al* (2012).

Effect of bio-fertilizer

Growth Parameters

An analysis of data indicated that various bio-fertilizer levels caused significant increment in the growth parameters of field pea *i.e*., plant height, number of primary branches plant^{-1} and periodic dry matter accumulation. The maximum plant height (15.48, 23.01, 40.14 and 53.28cm), number of primary branches plant^{-1}(1.26, 1.65, 2.28 and 2.73),dry matter

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accumulation (0.430, 4.84, 14.70 and 22.50 g plant^{-1}) at 30, 60, 90 DAS and at harvest was recorded under the application of Rhizobium + PSB but statistically higher over control (Table 1). Different studies have shown that bio-fertilizer application affects crop growth, plant metabolism and physiology. Increased nodulation under Rhizobium + PSB inoculation might be to due to close association of both the microbial population and their activities resulting in improving soil fertility status. These finding are similar to the results obtained by Singh *et al*., (2012), Khandelwal *et al*., (2012) and Kumari *et al*., (2012).

Yield Attributes

Bio-fertilizer application caused a significant increase in yield attributes *viz*., number of pod plant^{-1}, number of grains pod^{-1} and 100g weight of grains. The maximum number of pod plant^{-1} (20.55), number of grains pod^{-1} (4.71) and 100g weight of grains (15.23 g) were registered under rhizobium + PSB as compare to control (Table 2).Rhizobium or PSB application may enhance crop yield by several indirect action such as decreased shading due to greater leaf erectness. Erectness of leaves as a result of Rhizobium or PSB application could account for about 10 per cent in the photosynthesis, there by indirectly increasing yield. Similar results were also noticed by Sharma *et al.* (1999).

Table 1. Effect of fertility level and bio-fertilizer on number of pods plant^{-1}, number of grains pod^{-1} and 100 grain weight and grain yield

Treatment	Number of pods plant^{-1}	Number of grains pod^{-1}	100 grain wt. (g)
Fertility level			
Control	14.04	3.36	13.89
50 % RDF	15.81	3.75	14.27
75 % RDF	17.96	4.31	14.83
100 % RDF	21.52	5.12	15.64
SEm±	**0.454**	**0.148**	**0.148**
CD (P=0.05)	**1.311**	**0.426**	**0.426**
Bio-fertilizer level			
Control	11.84	3.01	13.53
Rhizobium	17.91	4.32	14.84
PSB	19.03	4.50	15.02
Rhizobium + PSB	20.55	4.71	15.23
SEm±	**0.454**	**0.148**	**0.148**
CD (P=0.05)	**1.311**	**0.426**	**0.426**

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Table 2. Effect of fertility level and bio-fertilizer on plant height, number of primary branches plant^{-1} and dry matter accumulation at 30, 60, 90 DAS and at harvest.

Treatment	Plant height (cm)				Number of primary branches plant^{-1}				Dry matter accumulation (g plant^{-1})			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
Fertility level												
Control	9.73	17.27	34.39	47.53	0.49	0.88	1.50	1.96	0.382	4.12	11.75	17.60
50 % RDF	12.20	19.74	36.86	50.00	0.81	1.39	2.01	2.47	0.408	4.42	13.06	19.66
75 % RDF	15.85	23.53	40.51	53.65	1.07	1.58	2.21	2.66	0.434	4.76	14.10	21.66
100 % RDF	18.10	25.63	42.76	55.90	1.35	1.83	2.45	2.91	0.449	5.08	15.30	23.41
SEm±	**0.640**	**0.636**	**0.640**	**0.640**	**0.054**	**0.064**	**0.064**	**0.064**	**0.003**	**0.074**	**0.246**	**0.227**
CD (P=0.05)	**1.848**	**1.836**	**1.848**	**1.848**	**0.15**	**0.184**	**0.184**	**0.184**	**0.010**	**0.213**	**0.711**	**0.657**
Bio-fertilizer level												
Control	11.83	19.39	36.49	49.63	0.39	0.90	1.53	1.98	0.397	4.24	11.73	17.70
Rhizobium	13.82	21.48	38.48	51.63	0.99	1.51	2.14	2.59	0.415	4.55	13.34	20.18
PSB	14.75	22.29	39.41	52.55	1.08	1.61	2.24	2.69	0.427	4.78	14.43	21.95
Rhizobium + PSB	15.48	23.01	40.14	53.28	1.26	1.65	2.28	2.73	0.430	4.84	14.70	22.50
SEm±	**0.640**	**0.636**	**0.640**	**0.640**	**0.054**	**0.064**	**0.064**	**0.064**	**0.003**	**0.074**	**0.246**	**0.227**
CD (P=0.05)	**1.848**	**1.836**	**1.848**	**1.848**	**0.15**	**0.184**	**0.184**	**0.184**	**0.010**	**0.213**	**0.711**	**0.657**

V Conclusion:

On the basis of one year investigation titled "Effect of fertility levels and bio-fertilizers on growth and yield of field pea (*Pisum sativum*) in South Eastern plain zone of Rajasthan" it can be concluded that, maximum growth and yield attribute was recorded under 150 kg ha^{-1} and rhizobium + PSB compared to other treatments.

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