Influence of Pre Sowing Seed Treatments with Biofertilizers and Plant Growth Regulators on Growth, Yield and Yield Attributing traits of Field pea (*Pisum sativum* L.) var. RACHNA

ABSTRACT

The field experiment was conducted during Rabi Season 2021-22 at field experimental centre at Genetics and Plant Breeding Naini Agricultural Institute, SHUATS, Prayagraj, (U.P). The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with thirteen treatments including control which were replicated thrice. The treatments were as follows, T_O- Control, T_1, T_2, T_3- Rhizobium - 10%, 15%, 20%, T_4, T_5, T_6-Azospirullum – 5%, 10%, 15%, and T_7, T_8, T_9-Gibberellic acid (GA_3)-50ppm, 75ppm, 100 ppm, T_{10}, T_{11}, T_{12}- NAA -10 ppm, 15ppm, 20ppm respectively. The experiment results revealed that seeds treated with T_9-Gibberellic Acid-100% ppm gave better results followed by T3-Rhizobium@ 20 % and T12-NAA @20 ppm than other treatments viz, Field emergence (80.06), Plant height (94.75cm), Days to 50% flowering (68.71), Days to Maturity (120.98), number of branches per plant (7.24), number of pods per plant (20.86), number of seeds per pod g), Seed index (23.91), Harvest index (34.24 %)

were recorded significantly higher compared to other treatments.

Key words: Field pea, Rhizobium, Azospirullum, GA_3, NAA.

INTRODUCTION:

Besides serving as an important source of protein for a large portion of the global population, pulses contribute to healthy soils and climate change mitigation through their nitrogen fixing properties. Stagnant productivity coupled with declining availability has created substantial demand supply gap, forcing heavy import bill on the exchequer and affecting nutritional security of majority of the population for whom pulses are the one of the cheapest sources of protein. India is the world's top producer of pulses (25 percent of total output), consumer of pulses (27 percent of total consumption), and importer of pulses (14 percent). Around 20% of the area is planted with food grains, and pulses produce between 7% and 10% of all the food grains grown in the nation.. Though pulses are grown in both Kharif and Rabi seasons, Rabi pulses contribute more than 60 per cent of the total production. While the production of pulses climbed from 8.41 million ha to 19.27 million ha during the same period, representing an increase of nearly 100%, the area under pulses increased from 19 million hectares in 1950–51 to 25 million ha in 2013–14, suggesting an increase of 31%. The total area, production and productivity of pea in India in 2017-18 was 540.48 thousand Ha, 5422.14 thousand MT and 10.0 MT/ ha respectively.

Field pea is an annual cool season grain legume or pulse crop and majorly grown in rabi season and third most popular rabi pulse of India after chickpea and lentil. Pea is a commonly grown leguminous vegetable in the world with Botanical name *Pisum sativum* L. Family Leguminaceae, Chromosome no 2n=14, origin South West Asia

In India, the field pea (*Pisum sativum*) is a widely grown pulse crop. After Russia, India is the world's second-largest producer of peas. Protein, carbs, vitamins A and C, calcium, and phosphorus are all abundant in pea. It is frequently used in human diets around the world and has high levels of tryptophan and lysine, two amino acids that are relatively low in cereal grains. It also contains a low amount of fibre, about 21–25 percent protein, 62.1 percent carbohydrates, and 1.8 percent fat, making it an excellent livestock feed. It is crucial for advancing sustainable agriculture in addition to sustaining soil fertility through nitrogen fixation in association with symbiotic Rhizobium present in their root nodules. Thus apart from meeting its own nitrogen requirement, pea crop is known to add 50-60 kg residual nitrogen ha-1in soil **(Erman *et al*., 2009)**

Field pea can be cultivated on a variety of soil types, from light sandy loams to heavy clays, but any soil must have sufficient drainage because field pea cannot stand up to wet or soggy conditions. The ideal pH range for soil is 5.5 to 6.5. Field peas are primarily consumed by humans or fed to cattle. The stems of the annual herbaceous field pea can reach a length of 2 to 4 feet. A leaf is made up of one to three pairs of leaflets and a branching tendril at the end. The leaves are a light green colour with a whitish bloom. The plant matures into a prostrate vine.

Field pea (*Pisum sativum* L.), is found in Asia, Africa, Europe, North America, and Australia. The top countries for field pea production are China, the Russian Federation, Ukraine, India, France, Canada, and the United States, with a combined contribution of about 75% to the global production of 90–95 million tonnes. In terms of production, India is ranked fifth, behind the Russian Federation, Ukraine, China, and Canada. Field pea grows on 0.62 million hectares in India and produces 0.56 million tonnes of food annually with an average productivity of 906 kilos per hectare (Prasad, 2004).

Pea is an important pulse crop grown in India. India is the fifth-largest producer in the world. United States, China, France, and the United Kingdom are further important pea growers. Uttar Pradesh, Bihar, Haryana, Punjab, Himachal Pradesh, Orissa, and Karnataka are the principal pea-growing states in India. With a yield of 0.71 million tonnes, it is grown on 0.78 million hectares in India. (2010 annual report) The Gujarat state produces pulse crops on around 7.84 lakh ha and 6.02 lakh tonnes of land, respectively (DoA, 2011).

OBJECTIVES

To evaluate the influence of pre-sowing seed treatments with biofertilizers and plant growth regulators on growth, yield and yield Attributing traits of Field Pea (*Pisum sativum*. L).

MATERIALS AND METHODS:

Variety Details: Rachana: Developed from **(ICAR-IIPR Kanpur)**, U.P., it is resistant to powdery mildew. The crop takes 120-130 days to mature and may produce 22-30 q/ha seeds which are round and white.

The present research was made to identify the effect of seed Pre-Sowing treatments of different kinds on seed quality parameters of Field pea and to find out suitable seed pre sowing method for Field pea. The experiment was conducted in *Rabi* season and laid out in Randomized Block Design (RBD) with thirteen treatments including control which were replicated thrice. The treatments were as follows, T_0- Control, (T_1, T_2, T_3, - Rhizobium – 10%, 15%, 20%), (T_4, T_5, T_6, – Azospirullum – 5%, 10%, 15%,), (T_7, T_8, T_9,– GA_3 – 50ppm, 75ppm, 100ppm) (T_{10}, T_{11}, T_{12}-NAA - 10ppm,15ppm,20ppm) respectively.

Methodology:

Mode of Action of Rhizobium: Rhizobium are known to form colonies on the root surface stimulating biological nitrogen fixation and providing nitrogen to the leguminous crops and hence considered as a significant process for improving yield and soil fertility. Rhizobium-mediated symbiotic nitrogen-fixing systems can fix a significant quantity of nitrogen by acclimatizing with varied ecological conditions.

Mode of Action of Azospirillum: Under certain environmental and soil conditions, Azospirillum can positively influence plant growth, crop yields and N-content of the plant. Azospirillum is thought to stimulate plant growth through a number of methods, including biological nitrogen fixation and auxin synthesis. However, the role of biological nitrogen fixing in this plant response has frequently been disputed. Additionally, azospirilla do not significantly excrete ammonium during diazotrophic development. Other factors, such as the synthesis of chemicals that encourage plant development and an increase in the rate of mineral uptake by plant roots, have also been considered to explain the improvement in plant output and may even be more significant in determining the plant response.

Mode of Action of GA_3: Gibberellins (GAs) are plant hormones that regulate various developmental processes, including stem elongation, germination, dormancy, flowering, flower development, and leaf and fruit senescence. GAs are one of the longest-known classes of plant hormone**.**

Mode of Action of NAA: NAA is a synthetic plant hormone in the auxin family, NAA has been shown to greatly increase cellulose fiber formation in plants when paired with another phytohormone called gibberellic acid. Being a member of the auxin family, it is also known to prevent premature fruit thinning and dropping off stems.

RESULTS AND DISCUSSION:

Pre – harvest observations:

Plant height: the seeds treated with GA_3 (100ppm) in T_9 varied significantly and recorded higher plant height among other treatments with 98.11 cm and statistically at par values are observed in T_3 Rhizobium (96.92 cm) followed by T_{12} NAA and the lowest was observed in control with 91.15 cm. The increase in plant height could be attributed to enhancement of cell division and cell elongation in the growing portion of plants (Pandita et al., 1980). Same was reported by **Tsegay *et al.* (2018)** in pigeon pea .

Days to 50% flowering: T_9 seeds treated with GA_3 (100 ppm) flowered earlier than other treatments (63.40 DAS) and T_3 Rhizobium performed at par with T_9 (66.67 DAS) followed by T_{12} NAA. The highest days to 50 % flowering was observed in control (T_0) with 73.73 DAS. Since, GA3 is known to initiate early flowering by inhibiting the abscisic acid functioning (Saeed et al., 2013; Sajid et al., 2016), enhancing nutrients uptake, carbohydrates filling in sinks, balancing C/N ratio in leaves and by activating the hydrolyzing enzymes (Cardoso et al., 2012; Ali et al., 2019) same was reported by **Sisodia *et al*. (2018)** in safflower.

Number of branches: the seeds treated with GA_3 (100ppm) in T_9 varied significantly more number branches per plant were observed in T_9 with 8.00 branches and T_3 Rhizobium with 7.60 branches per plant is statistically on par with T_9 followed by T_{12} NAA. The lowest number of branches per plant was observed in control with 6.73 branches. This could be due to rapid cell division and cell elongation in growing portion of plants and increased uptake of nutrients which might have resulted in maximum plant height, leading to the production of more number of branches **Thejeshwini *et al.* (2019)** in onion.

Days to maturity: significantly early maturity was observed in T_9 in seeds treated with GA_3 (100ppm) at 117.86 days to maturity and T_3 Rhizobium performed statistically on par with T_9 (119.53) followed by T_{12} NAA and the higher number of days to maturity was observed in control (123.73). The crop has matured sooner than the other treatments because this might be due to early flowering results in early maturity of plants reported by **Gangaraju *et al*. (2019)** in black gram cultivars (Rashmi and DU-1).

YIELD ATTRIBUTES:

Number of pods per plant:
the seed treatments varied significantly among them. The seeds treated with GA_3@100ppm in T_9 was significantly higher among all other treatments with 23.53 pods and T_3 Rhizobium was statistically at par with T_9 with 22.73 Pods followed by T_{12} NAA. The lowest number pods were obtained in control with 18.60 pods. This might be due to the fact that GA, at higher concentrations recorded increased number of branches and fruiting points, which lead to better utilization of sunlight and higher current photosynthesis which resulted developing more number of pods per plant similar results were reported by **Sumeet *et al. (*2018*)*** Pusa Pragati garden pea variety.

Number of seeds per pod: Significantly higher number seeds per pod were obtained in T_9 GA_3 @ 100ppm (5.33) and statistically at par values were observed in T3 with 5.13 seeds per pod. The control had performed lowest of all treatments with 3.66 seeds per pod. reported that that the foliar application of plant growth regulators (Kinetin, GA_3 and NAA) positively affected growth and seed yield parameters such as plant height, number of primary branches, days to flowering, number of pods/plants, number of seeds/pod and 100-seed weight which ultimately contributed to increased growth, yield and seed quality parameters on the Among the three growth regulators, GA3 gave the best results, particularly at 75 ppm for seed yield and quality parameters.

Seed yield per plant: T_9 @ GA_3 100 ppm had performed better and is significantly higher (23.36g) over all other treatments and statistically at par values were obtained in T_3 22.33 g and the lowest seed yield was observed in control with 15.73 g.

Seed yield per plot: The seeds treated with GA_3 @100ppm in T_9 were significantly higher among all other treatments with 334.03g and T_3 was statistically at par with T_9 (322.03g). The lowest seed yield per plot was obtained in control with 193.34g. By increasing the number of seeds per pod and the number of pods per plant, this might be due to increase in number of pods per plant and high photosynthetic rate during seed development. The similar findings were reported by Similar findings were reported by **R. V. Sathavahana** and **L. Edwin (2022**) in **lentil,Mazed et al. (2015)** in chickpea, **Moosavi et al. (2014)** in soybean, **Setareh Rastin et al. (2013)** in red bean, **Rao et al., (2012).**

CONCLUSION:

It is concluded that seeds treated with Gibberellic Acid(GA_3) @ 100ppm were found to be more desirable for producing significantly higher seed yield per plant (23.36g), seed yield per plot (334.03g). Findings are based on research done in one season in Prayagraj (Allahabad) U.P. Further trials may be required before considering it as the recommendation.

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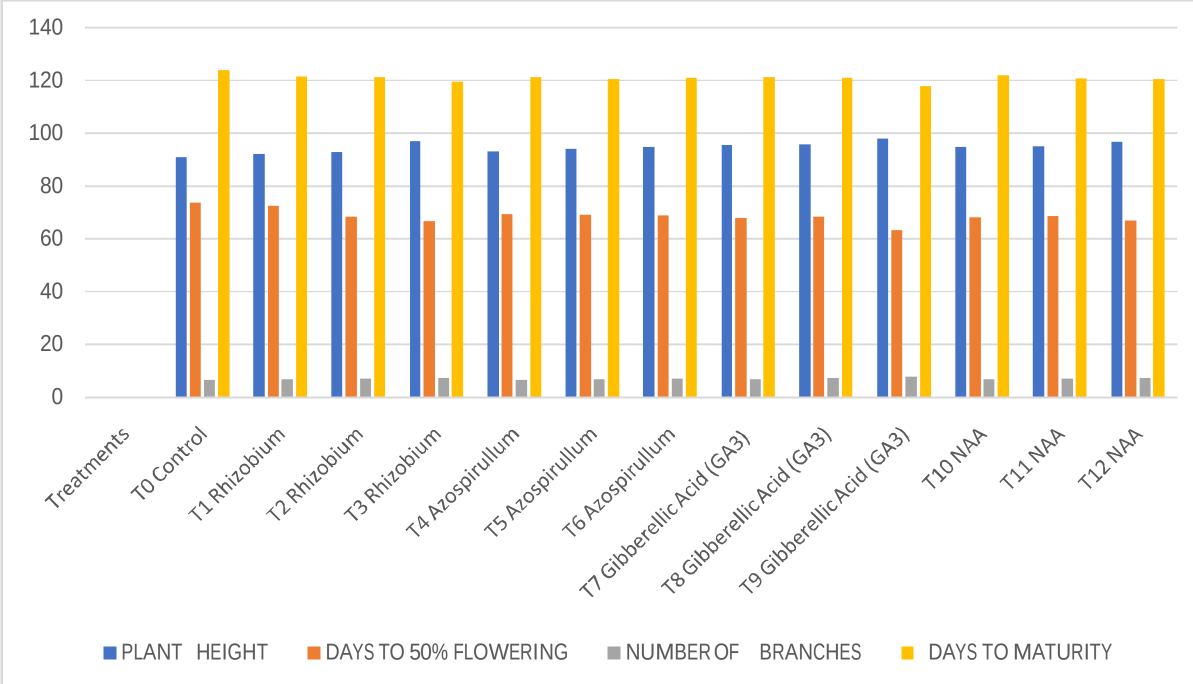
Table 1: **Influence of Rhizobium, Azospirullum, Gibberellic Acid(GA_3),NAA on plant height, days to 50 % flowering, number of branches, days to maturity.**

	TREATMENT	PLANT HEIGHT	DAYS TO 50% FLOWERING	NUMBER OF BRANCHES	DAYS TO MATURITY
T0	Control	91.15	73.73	6.73	123.73
T1	Rhizobium	92.21	72.66	7.00	121.46
T2	Rhizobium	92.88	68.46	7.26	121.40
T3	Rhizobium	96.92	66.66	7.60	119.53
T4	Azospirullum	93.05	69.53	6.86	121.26
T5	Azospirullum	94.23	69.26	7.13	120.60
T6	Azospirullum	95.00	68.93	7.33	121.00
T7	Gibberellic Acid (GA_3)	95.71	68	7.07	121.33
T8	Gibberellic Acid (GA_3)	95.79	68.46	7.40	121.20
T9	Gibberellic Acid (GA_3)	98.11	63.4	8.00	117.86
T10	NAA	94.94	68.4	7.06	121.93
T11	NAA	95.13	68.73	7.33	120.80
T12	NAA	96.70	67.06	7.40	120.66
	Grand Mean	94.75	68.56	7.24	120.98
	S. Em (±)	0.58	0.56	0.44	0.19
	CD (p=0.05)	1.70	1.62	0.63	0.55
	CV	1.07	1.40	4.47	1.28

Figure 1: Bar Graph showing the Influence of Rhizobium, Azospirullum, Gibberellic Acid(GA3),NAA on plant height, days to 50 % flowering, number of branches, days to maturity.

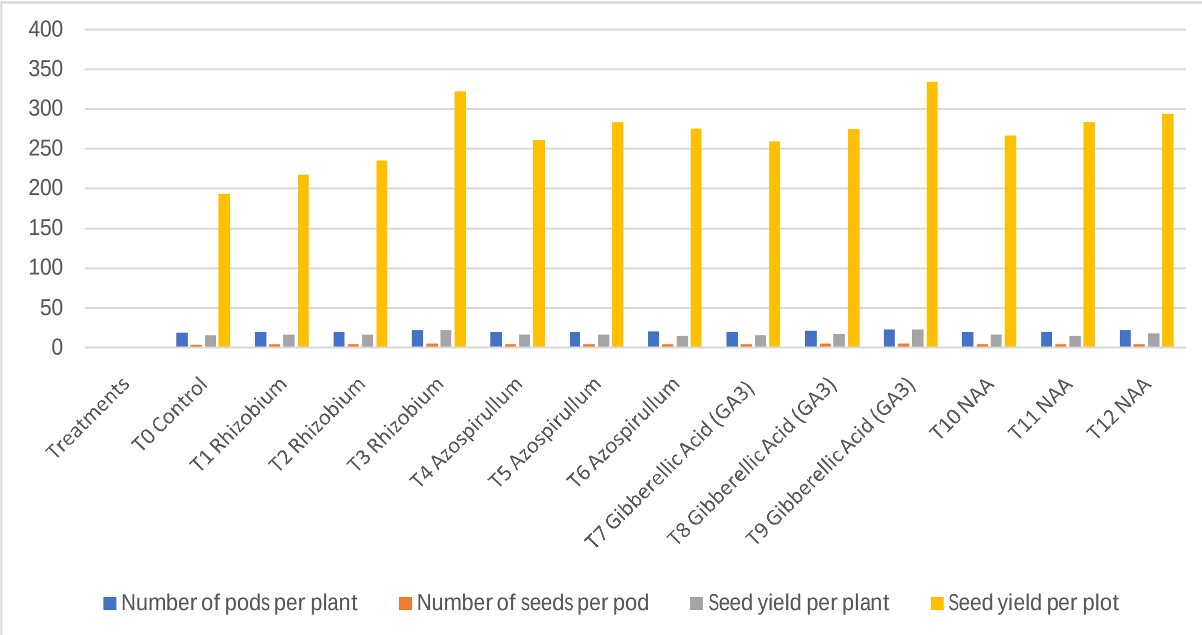


140
120
100
80
60
40
20
0
Treatments
T0 Control
T1 Rhizobium
T2 Rhizobium
T3 Rhizobium
T4 Azospirullum
T5 Azospirullum
T6 Azospirullum
T7 Gibberellic Acid (GA3)
T8 Gibberellic Acid (GA3)
T9 Gibberellic Acid (GA3)
T10 NAA
T11 NAA
T12 NAA
PLANT HEIGHT
DAYS TO 50% FLOWERING
NUMBER OF BRANCHES
DAYS TO MATURITY

Table 2 **: Influence of Rhizobium, Azospirullum, Gibberellic Acid(GA_3),NAA on number of pods per plant, number of seeds per pod, seed yield per plant, seed yield per plot..**

	TREATMENT	Number of pods per plant	Number of seeds per pod	Seed yield per plant	Seed yield per plot
T0	Control	**18.6**	**3.66**	15.73	193.34
T1	Rhizobium	19.73	4.33	16.43	218.10
T2	Rhizobium	20.67	4.2	16.46	236.07
T3	Rhizobium	**22.73**	**5.13**	22.33	322.03
T4	Azospirullum	19.46	4.53	16.8	261.60
T5	Azospirullum	20.20	4.4	16.36	283.57
T6	Azospirullum	21.46	4.6	15.4	275.63
T7	Gibberellic Acid (GA_3)	20.46	4.6	16	260.03
T8	Gibberellic Acid (GA_3)	21.73	5	17.5	275.60
T9	Gibberellic Acid (GA_3)	**23.53**	**5.3**	23.36	334.03
T10	NAA	19.80	4.2	16.7	267.10
T11	NAA	20.33	4.4	15.36	283.90
T12	NAA	22.53	4.8	18.33	293.97
	Grand Mean	20.86	4.55	17.44	269.61
	S. Em (±)	0.36	0.13	0.40	4.55
	CD (p=0.05)	1.06	0.39	1.18	13.28
	CV	3.02	5.04	4.11	2.92

Figure 2: Bar Graph showing the Influence of Rhizobium, Azospirullum, Gibberellic Acid(GA3),NAA on number of pods per plant, number of seeds per pod, seed yield per plant, seed yield per plot


400
350
300
250
200
150
100
50
0
Treatments
T0 Control
T1 Rhizobium
T2 Rhizobium
T3 Rhizobium
T4 Azospirullum
T5 Azospirullum
T6 Azospirullum
T7 Gibberellic Acid (GA3)
T8 Gibberellic Acid (GA3)
T9 Gibberellic Acid (GA3)
T10 NAA
T11 NAA
T12 NAA
Number of pods per plant
Number of seeds per pod
Seed yield per plant
Seed yield per plot