Effect of seed treatment with Biofertilizers and Plant Growth Regulators on the growth and yield attributing characters of Field Pea (*Pisum sativum* L.)

ABSTRACT

India is one of the largest producers of Field pea in the world and stands at the 5th place in the list of major pea producers next to Russia. A field experiment was conducted during *Rabi* 2021 at Crop Research Farm, Department of Genetics and Plant Breeding, SHUATS, Prayagraj (U.P). The experiment was placed in a randomized blocking design and consisted of 13 treatments and 3 replicates. The experimental results revealed that viz: Field emergence (%), plant height @ 30, 60 and 90 DAS, Days to 50% flowering, number of branches per plant, days to maturity. biological yield (gm), were recorded significantly highest in the treatment of T_9: Gibberellic acid 100 ppm @12 hrs and yield parameters like Number pods per plant, Numbers of seeds per pod, Seed yield per plant (gm), Seed yield per plot (gm), Biological yield (gm), Seed index (gm) and Harvest index (%) were recorded significantly highest in the treatment of (T_3) Rhizobium 30g @12 hrs as compared to the other treatment. It is clearly concluded from the research that T_3: (Rhizobium 30g @12 hrs) significantly produced more yield. Hence the seed treatment of Rhizobium 30g @12 hrs could be recommended for the field pea.

Key words: Biofertilizers; field pea; gibberellic acid; NAA.

INTRODUCTION

"Pulses are referred to as poor man's meat, belong to the family Leguminosae and subfamily Papilionoideae They provide 22-24 percent protein and the seeds are considered easily digestible and the increasing demand of protein rich raw material for animal feed or intermediary product for human nutrition, there is raising interest in these crops as a protein" source Santalla *et al*.[16].

"Field pea (*Pisum sativum* L.) is a popular pulse crop of India. India is the second largest producer of peas in the world after Russia. Peas are rich in protein, carbohydrates, vitamins A and C, calcium and phosphorus. It is represented as one of the worlds most seasoned cultivated crop" Zohary[18]. It is originated from the Middle East and first cultivated roughly 10,000 years ago Mithen,[11]. Commonly there are two kinds of peas developed in India i.e, grain and vegetable type. It is cultivated for seeds, feed, silage and green manure. It is one of the sixth major pulses crops cultivated globally and the second highest yielding grain legumes next to the extensive bean *(Vicia Faba* L.*).*

"Field Pea is an important grain legume in Asia and being a rich and cheap source of protein can help people improve the nutritional quality of their diets. It provides a nutritious meal rich in protein as 100 grams of dried grains contain 1.8 grams of fat, 62.1 grams of carbohydrates, 22.5 grams of protein, 0.15 grams of riboflavin, 0.72 mg of thiamine, 2.4 mg of niacin, 64 mg of calcium and 4.8 mg of iron" Masood Ali *et al.*[10]. "More specifically, the field pea is naturally rich in iron and zinc and, thus, can address two of the most common micronutrient deficiencies in the world" Amarakoon *et al*.[1]. "Despite the possibility of high consumption of field peas to help reduce hidden hunger, little progress has been made to increase production and yields have lagged behind those of grain" Amarakoon *et al.* [1]. According to FAO statistics, The Indian Field pea production contributes to around 7% in the world's total pea production. In India the state of Uttar Pradesh is ranked first in both area and production, it is followed by Madhya Pradesh and Jharkhand, where Rajasthan is ranked first in terms of productivity followed by Punjab and Jharkhand. The lowest production was seen in Maharashtra followed by Chhattisgarh.

"Among various fertilizers, bio-fertilizers are important sources of nutrients. Biofertilizer application has shown bright results in case of leguminous crops especially exclusive results have been obtained in case of pea" Rao *et al.*[14]. "Rhizobium inoculation increased Root nodulation through improved root growth and availability of more nutrients, resulting in vigorous plant growth and dry matter production resulting in the formation of improved flowering, fruit and pods and ultimately having a beneficial effect on seed yield" Sardana *et al*.[17]. Rhizobium and PSB are of great importance because of their important role

in N2-determination and P-solubility. Among various biofertilizers Rhizobium is of paramount importance. Rhizobium fixes atmospheric nitrogen in symbiosis with legumes.

"The phytohormones can be use either as plant sprays or as seed treatments has brought spectacular results in both the yield and quality of many vegetable crops. The effects of plant growth regulators were influenced by light, temperature, moisture, nutrients and other environmental factors. The efficiency of plant growth regulators varies under different concentrations, methods of application and time of application. Some plant growth regulators like gibberellic acid promote the cell elongation and are responsible for expansion, cell division in shoot elongation, flowering and seed germination and hasten the maturity of the plant**.** Naphthalene acetic acid (NAA) is another plant growth regulator and an important synthetic auxin used in plants. Auxins have a wide variety of plants and other growth regulators' effects on theirs. Various effects of application of NAA in acceleration of rooting, control of flowering, prevention of fruit drop and increase in fruit formation have been observed in different plants" Prakash and Ganesan, [13].

Sudden increase in area of peas in recent years has created an acute shortage supply of seeds and there is more difference between the production and total demand of seeds. Hence, to boost up the seed yield per unit area and to standardize the practice to be used for the higher production of pea seeds, the present investigation was undertaken on effect of Biofertilizers and plant growth regulators on growth and yield of field pea (*Pisum sativum* L.)

2. MATERIALS AND METHODS

The research work was conducted at the experimental farm of Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Prayagraj during the year 2021-2022. The experiment were carried out in Randomized block design with 13 treatments included Bio-fertilizers, (Phosphorus Solubilizing Bacteria, Rhizobium) and plant growth regulators (GA3 and NAA). The following observations were recorded for each treatment on five randomly selected plants in each replication on field emergence, plant height, number of primary branches, days to 50% flowering, days to maturity, number of pods per plant, number of seeds per pod, seed yield per plant, seed yield per plot, biological yield, seed index

and harvest index. The Pea variety Azad pea-3 was selected for this research trial. The gross area of field is about 131m^2 and net area 39m^2 respectively. Fertilizer was used at the time of sowing. Seeds were sown in the line sowing method, with a distance of 30 cm row and 10 cm plant to plant for row-to-row spacing, respectively. The recommended doses of nitrogen, phosphorus, and potash were applied in all plots except for the control. An optimum dose of nitrogen (25 kg N ha^{-1}) was applied, half of which was given at the time of seed sowing along with the full dose of phosphorus (60 kg ha^{-1}) and potassium (40kg ha^{-1}) and the remaining half dose of nitrogen was applied as top dressing. Recommended seed rate of 60-80 kg/ha. The following treatment combinations were used in this research work are given below.

Treatment Details

T0 Control

T1 Rhizobium 10g for 12hrs

T2 Rhizobium 20g for 12hrs

T3 Rhizobium 30g for 12hrs

T4 PSB 10g for 12hrs

T5 PSB 20g for 12hrs

T6 PSB 30g for 12hrs

T7 GA3 50ppm for 12hrs

T8 GA3 75ppm for 12hrs

T9 GA3 100ppm for 12hrs

T10 NAA 10ppm for 12hrs

T11 NAA 15ppm for 12hrs

T12 NAA 20ppm for 12hrs

2.2 Statistical Analysis

The data recorded were different characteristics were subjected to statistical analysis by adopting Fishers the method of analysis of varianc (ANOVA) as described by Gomez and Gomez. [4].. Critical difference (CD) values were calculated the 'F' test was found significant at 5% level.

3. RESULTS AND DISCUSSION

Growth, yield and yield attributes showed significant variations with different concentrations of Bio-fertilizers and Plant growth regulators.

Effect on growth parameters

Hence, a study was formulated to evaluate the effect of seed treatment with Biofertilizers and Plant Growth Regulators on the growth and yield attributing characters of Field Pea. Field pea variety AP-3 were treated with various seed treatment i.e., Rhizobium @ 10g, 20g, 30g at 12 hours, PSB @10g, 20g, 30g at 12 hours, Gibberellic acid @ 50ppm, 75ppm, 100ppm at 12 hours, NAA @ 10ppm, 15ppm, 20ppm at 12 hours. The treated seeds were evaluated on their seed qualities and productivity using untreated seeds as control. The improvement in growth parameters due to the action of growth hormone and yield. The above treated seeds were also evaluated under field condition the growth, yield and yield characters were observed pre sowing seed treatment. In Table 1, Gibberellic acid @100 ppm at 12 hours recorded highest values for the growth traits Field emergence, plant height (90 DAS), Number of branches, biological yield which were (81.00%, 117.24cm, 5.13, 26.92g). The early days to maturity and days to 50% flowering was recorded in Gibberellic acid @ 100 ppm at 12 hours (92.40 and 45.13). Increase in field emergence may be due to the higher metabolic activity before sowing due to pre-sowing seed treatment that caused seeds gets ready for germination as soon as sown. The above results obtained were in line with different scientists conducted the research in different crops, similar results were observed by Kumar and Sundareswaran, [9] GA3 effectively increased the vegetative growth of pea plant, this is due to that GA3 can promote the cell division and cell elongation; Similar results were found by Kalariya *et al.* [7], Kropi *et al.*[8] revealed that morphological characters with respect to plant height (93.70 cm), number of leaves per plant (53.10) and number of branches per plant (6.90) were significantly improved by GA3 treatment at 100 ppm (T3). The variation in the number of branches may be due to vigorous growth of plants due to priming.

Devi *et al.* [3] obtained similar results in terms of maturity when seeds were treated with 5 ppm GA3.

Effect on yield and yield attributes

In case of Number of seeds per pod of pea the significantly maximum increase occurs by T_3 (Rhizobium @ 30 gm 12hrs) exhibited maximum number of seeds per pod (6.80), followed by T_2 with (Rhizobium @ 20gm 12hrs) (5.80) and Minimum value was obtained in T_0 with control (4.33). Similar findings have been reported by Mrudula *et al.* [6] showed that the various treatments Rhizobium @ 5g (7.83) recorded the highest number of seeds per plant followed by Rhizobium @ 3g (7.7) and PSB @ 5g (7.6) respectively**.** In case of pods per plant of peas It is clear from Table 2 that the considerable maximum increase in pods per plant T_3 (Rhizobium @ 30 g 12 hrs) exhibited higher mean value for number of pods per plant (10.40), followed by T_2 (Rhizobium @ 20 g 12 hrs) (10.13) and Minimum value was obtained in T_0 with control (6.13). Similar findings have been reported by Khan *et al.* [5] showed that the maximum number of pods per plant (16.00), number of seeds per pod, (6.45) were recorded under treatment T_8 (100% RDF + Rhizobium 30g/kg seed). In case of Seed yield per plant of pea it is evident from table 2 that significantly maximum increase in Seed yield per plant occurs by the T_3 with application of (Rhizobium @ 30g 12 hrs) exhibited maximum seed yield per plant (18.33 gm), followed by T_2 with of (Rhizobium @ 20g 12 hrs) (18.07gm) and Minimum value was obtained in T_0 with control (10.27 gm). Similar observations were reported by Salah Uddin *et al.* [15] showed that most of the growth and yield component of mungbean viz. plant height, branch per plant, number of nodules per plant, total dry matter per plant, pods per plant, seed per plant, seed per pod, weight of 1000-seeds, seed yield and straw yield were significantly influence by the bio-fertilizer (Brady rhyzobium inoculums) treatment. It also obtained highest number of pods per plant, seed yield per plant, 1000 seed weight and seed yield. In case of Seed yield per plot of pea it is evident from table 2 that significantly maximum increase in Seed yield per plot occurs by the T_3 with application of (Rhizobium @ 30g 12 hrs) exhibited highest seed yield per plot (580.00 g), followed by T_2 with of (Rhizobium @ 20g 12 hrs) (544.33gm) and Minimum value was obtained in T_0 with control (366.33 gm). Similar results were obtained by Panday *et al.* [12] reported on pea plant that, Generally, rhizobium inoculation increased root nodulation through improved root growth and availability of more nutrients, which led to vigorous plant growth and

dry matter production resulting in better flowering and pod formation ultimately had beneficial effects on seed yield. In the case of the pea seed index it is clear from Table 2 that the considerable maximum increase in seed index occurs by the treatment (T3- Rhizobium @30g), which exhibits a higher seed index (23.8 g), followed by Rhizobium @20 g T2 with 12hrs (23.1 gm) and Minimum value was obtained in T_0 with control (21.8 gm). Similar results were reported by Dekhane *et al.* [2]reported on pea plant, that Seed index and number of nodules were significantly increased with Rhizobium inoculation compared with the un-inoculated one. In case of Harvest index (%) it is evident from table 2 that T_3 (Rhizobium @ 30 g 12 hrs) showed significantly maximum in Harvest index (81.21%) than control respectively with the above-mentioned characters.

4. CONCLUSION

It was concluded from the present study that the seeds of Field pea (Variety- AP 3) were treated with Biofertilizer and Plant growth regulators. The treatment Rhizobium (T_3- 30g for 12 hours) resulted in better in yield and yield attributes and it gives maximum seed yield per plots (580g) compare to other treatment. Hence the treatment Rhizobium @ 30g 12 hrs was recommended. These recommendations are based on four months experimentation and therefore further investigation is needed to arrive at valid recommendation.

Table 1 **Mean performance of different treatments for Pre-harvest characters in Field pea**

Treatment	Treatments	Field emergence (%)	Plant height at 30 DAS (cm)	Plant heightat 60DAS (cm)	Plant heightat 90 DAS (cm)	Days to 50% flowering	Number of branches	Days to maturity
T0	Control	67.00	13.59	56.88	67.04	50.07	2.87	98.50
T1	Rhizobium 10g 12hrs	72.00	17.09	63.89	75.03	46.73	4.00	95.50
T2	Rhizobium 20g 12hrs	73.67	17.68	65.20	77.06	46.67	4.07	92.97
T3	Rhizobium 30g 12hrs	74.67	17.92	65.71	78.68	46.07	4.27	92.97
T4	PSB 10g 12hrs	71.00	17.92	62.28	71.74	48.87	3.60	98.13
T5	PSB 20g 12hrs	71.33	17.05	63.05	73.56	47.73	3.67	97.33
T6	PSB 30g12hrs	71.33	18.24	63.40	74.74	46.73	3.87	97.30
T7	GA3 50ppm 12hrs	75.00	58.75	84.62	104.11	45.33	4.93	92.90
T8	GA3 75ppm 12hrs	76.67	63.31	86.38	108.31	45.20	5.07	92.90
T9	GA3 100ppm 12hrs	81.00	65.12	88.32	117.24	45.13	5.13	92.40
T10	NAA 10ppm 12hrs	69.33	20.12	57.06	67.20	49.73	3.07	98.50
T11	NAA 15ppm 12hrs	70.33	20.72	58.33	70.40	49.40	3.27	98.30
T12	NAA 20ppm 12hrs	71.00	19.71	61.64	71.20	49.07	3.47	98.23
Mean		72.64	28.25	67.48	81.30	47.44	3.94	92.4
SEm		1.33	2.73	1.85	4.26	0.08	0.06	0.17
SEd		1.88	3.86	2.61	6.02	0.12	0.09	0.24
CD(p=5 %)		3.89	7.96	5.40	12.44	0.25	0.20	0.51
CV		3.17	16.73	4.74	9.08	0.32	3.02	0.31

Table 2 **Mean performance of different treatments for post-harvest characters in Field pea**

Treatment	Treatments	Numbers of pods per plant	Numbers of seeds per pod	Seed yield per plant (gm)	Seed yield per plot (gm)	Biological yield (gm)	Seed index (gm)	Harvest index (%)
T0	Control	6.13	4.33	10.27	366.33	18.20	21.8	59.98
T1	Rhizobium 10g 12hrs	9.07	5.33	16.93	520.00	21.43	22.1	75.22
T2	Rhizobium 20g 12hrs	10.13	5.80	18.07	544.33	23.57	23.1	80.63
T3	Rhizobium 30g 12hrs	10.40	6.80	18.33	580.00	24.37	23.8	81.21
T4	PSB 10g 12hrs	8.53	5.27	15.00	492.33	19.13	22.1	74.43
T5	PSB 20g 12hrs	8.93	5.33	16.07	504.00	20.51	22.1	75.56
T6	PSB 30g12hrs	9.13	5.47	17.73	527.66	22.13	22.8	79.80
T7	GA3 50ppm 12hrs	7.20	4.87	14.07	441.00	25.70	22.0	76.15
T8	GA3 75ppm 12hrs	7.93	4.87	14.67	452.66	26.23	22.0	78.65
T9	GA3 100ppm 12hrs	8.40	5.20	14.73	469.33	26.92	22.1	76.33
T10	NAA 10ppm 12hrs	6.67	4.60	12.80	371.66	24.10	21.9	50.54
T11	NAA 15ppm 12hrs	6.87	4.80	13.27	419.00	24.47	21.9	51.94
T12	NAA 20ppm 12hrs	6.87	4.87	13.60	432.33	24.27	21.9	52.68
Mean		8.17	5.19	15.04	470.82	23.16	22.3	70.24
SEm		0.12	0.14	0.12	3.12	0.20	0.13	0.50
SEd		0.17	0.20	0.17	4.14	0.29	0.18	0.71
CD(p=5 %)		0.36	0.43	0.36	9.11	1.60	0.38	1.46
CV		2.67	4.94	1.45	1.14	1.64	1.03	1.23

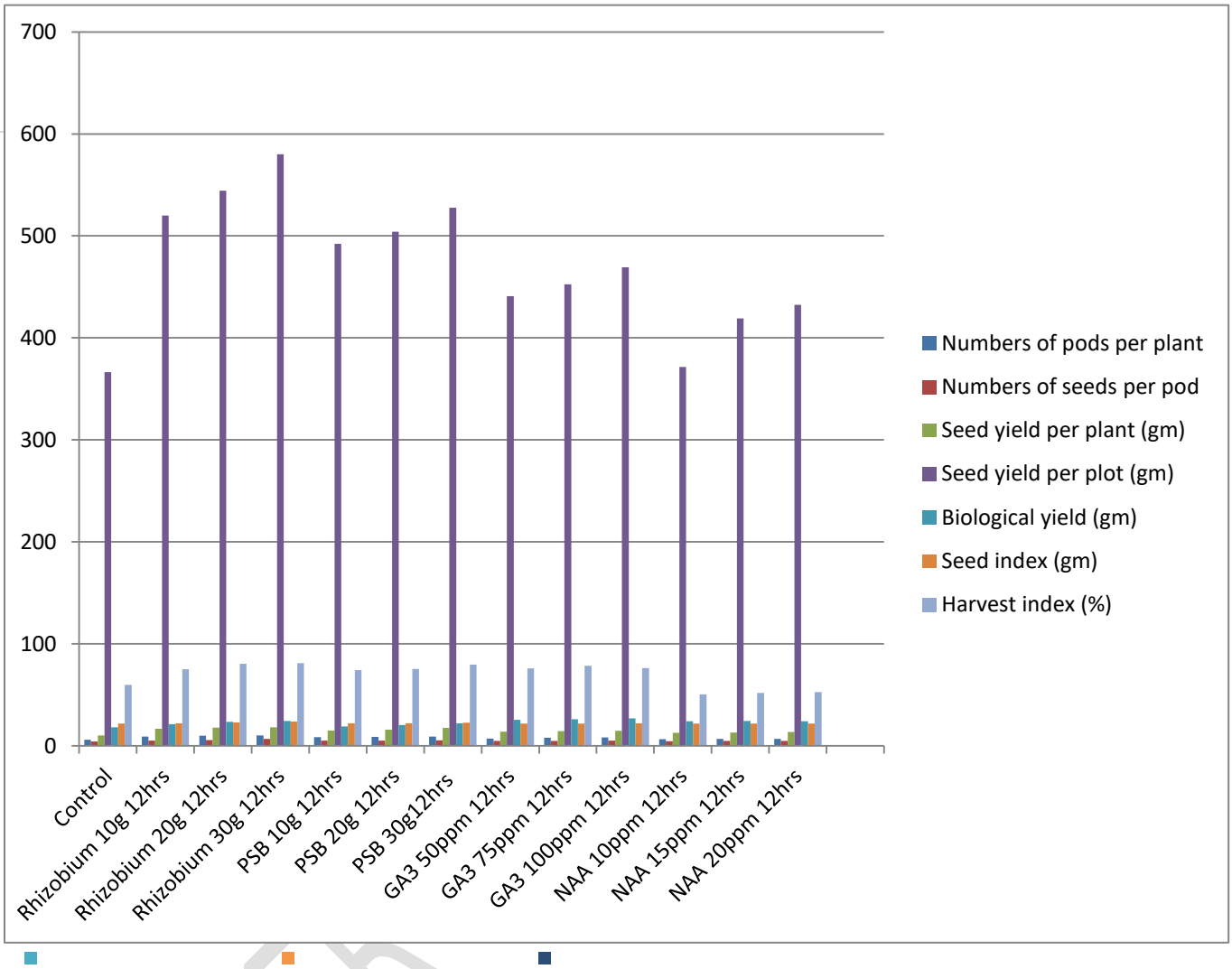

Fig 1 Bar diagram representing the performance of different treatments for post-harvest characters in Field pea

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