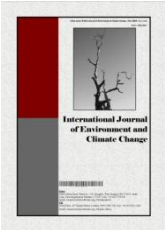

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Comparative Study of Biofertilizer and Plant Extracts on Growth, Yield and Yield Attributing Traits of Field Pea (*Pisum sativum*)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The field experiment was conducted to comparative analyze the effect of biofertilizer and plant extracts on growth, yield and yield attributing traits of field pea (*Pisum Sativum* L.)" was conducted during Rabi 2021 at field experimental centre, Department of Genetics and Plant Breeding, SHUATS, Prayagraj, (U.P). The soil of 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 are as follows, TO- Control, T1, T2, T3, - Rhizobium at the rate of 5%, 8%, 10%, T4, T5, T6 – Vermi wash at the rate of 5%, 8%, 10%, T7, T8, T9 – Neem leaf extract at the rate of 5%, 10%, 15% and T10, T11, T12 – Tulsi leaf extract at the rate of 5%, 10%, 15% respectively. The experiment results revealed that seeds treated with rhizobium at the rate of 8% gave better than other treatments viz, field emergence (87.47%), plant height (95.71 cm), days to 50% flowering (40.60), number of branches per plant (8.87), number of pods per plant (13.53), number of seeds per pod (8.47), seed yield per plant (24.88 g), seed yield per plot (746.50 g), biological yield (33.73 kg/ha), harvest index (73.48%) were recorded significantly higher compared to other treatments.

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Keywords: Rhizobium; vermiwash; neem leaf extract; tulsi leaf extract; seed priming.

1. INTRODUCTION

The field pea is one of the oldest domesticated crops, cultivated for at least 7,000 years. Field peas are now grown in many countries for both human consumption and stock feed. It is a climbing annual legume with weak, viny, and relatively succulent stems. Vines often are 4 to 5 feet (120 to 150 cm) long, but when grown alone, field pea's weak stems prevent it from growing more than 1.5 to 2 feet (45 to 60 cm) tall. Leaves have two leaflets and a tendril. Flowers are white, pink, or purple. Pods carry seeds that are large (4,000 seeds/lb), nearly spherical, and white, gray, green, or brown. The root system is relatively shallow and small and nodulated. The field pea is a cool-season legume crop that is grown on over 25 million acres worldwide. Field peas or "dry peas" are marketed as a dry, shelled product for either human or livestock food, unlike the garden pea, which is marketed as a fresh or canned vegetable. Peas contain symbiotic bacteria called Rhizobia within root nodules of their Root system (in most of the legume crops). These rhizobium bacteria have the special ability to fix N2 from atmospheric, molecular nitrogen (N2) into Ammonia (NH3) [1-10].

To overcome most of the micronutrient deficiencies in plant grown in nutrient deficient soils, seeds treated with rhizobium shows maximum germinability and vigour index. Now a days seeds treated with biofertilizers shows best results producing high yield and enhance plant growth (Maurya et al. 2021). It also acts as a plant growth promoter by mechanisms of tolerance of abiotic stresses. Vermiwash is a liquid extract produced from vermicompost in a medium where earthworms are richly populated. It comprises a massive decomposer bacteria count, mucus, vitamins, different bioavailable minerals, hormones, enzymes, different antimicrobial peptides, etc. Seeds primed with Vermiwash results in highest field emergence and better yield in various field crops (Manjunadh et al. 2021). It acts as a plant growth promoter. Rhizobium biofertilizer contains symbiotic rhizobium bacteria which is the most important nitrogen-fixing organism. These organisms have the ability to drive atmospheric nitrogen and provide it to plants. It is recommended for crops such as groundnut, soybean, red-gram, greengram, black-gram, lentil, cowpea, field pea, bengal-gram and fodder legumes, etc. They are the most efficient biofertilizer as per the quantity of atmospheric nitrogen fixed. Vermiwash is nutrient rich liquid manure, extracted from vermicomposts riches with a greater number of earthworms feeding on organic waste material and plant residues. It is non-toxic and eco-friendly, which arrests bacterial growth and forms as a protective layer for their survival and growth. Vermiwash contains N, P, K, Ca & hormones such as auxin, cytokinin, some other secretions and many useful microbes like heterotrophic bacteria, fungi etc. Neem leaf extract is a powerful insecticide which contains a pivotal insecticidal ingredient called Azadirachtin which repells the insects by inhibiting feeding and by disrupting their growth, metamorphosis and reproduction. Azadirachtin affects insect physiology by mimicking a natural hormone. It has been shown to affect egg production and hatching rates. In larvae, azadirachtin can inhibit molting, preventing them from developing into pupae. Tulsi leaf extract is an anti fungal agent and an insecticide but it shows least inhibition over control against fungi such as *Aspergillus niger, Alternaria alternata, Penicillium rubrum*, and *Fusarium moniliformae*. But neem leaf extract was more effective than tulsi leaf extract. By knowing the useful effects of biofertilizer and plant extracts on the plant growth, the present is conducted to know the best seed priming method in field pea [11-20].

2. MATERIALS AND METHODS

The present research was conducted to study the effect of presowing seed treatments (seed priming) on growth and yield of field pea. The seed priming especially bio-priming with plant extracts and rhizobium were used to find out suitable seed priming method for field pea. For this purpose, 13 priming treatments including control on Field pea seeds were used to study under filed conditions during Rabi, 2021-22. The treatments were T0–Control, T1-Rhizobium (5%), T2- Rhizobium (8%), T3- Rhizobium (10%), T4-Vermiwash (5%), T5- Vermiwash (8%), T6-Vermiwash (10%), T7-Neem leaf extract (5%), T8-Neem leaf extract (10%), T9-Neem leaf extract (15%), T10-Tulasi leaf extract-(5%), T11-Tulasi leaf extract-(10%), T12-Tulasi leaf extract-(15%). The mustard seeds were primed with above different priming agents in above different concentrations and intensities for a given duration. After priming seeds were dried to initial moisture content at room temperature. After that

Table 1. Mean performance of different treatments for pre harvest characters in field pea *(Pisum sativum*)

Treatments	Concentrations (%)	Rate of field emergence	Plant Height (cm)	Days to 50% flowering	Days to maturity	Number of branches
Control	-	1850	74.85	44.6	107.56	5.53
Rhizobium	5%	2053	89.66	44.07	106.48	6.47
Rhizobium	8%	2309	95.71	40.6	101.43	8.87
Rhizobium	10%	2114	82.78	43.1	105.66	6.73
Vermiwash	5%	2083	86.01	43.27	107.1	6.13
Vermiwash	8%	2136	85.68	43.23	106.12	6.67
Vermiwash	10%	2237	87.27	42.93	106.92	6.13
Neem leaf extract	5%	2201	83.38	45.2	104.31	7.13
Neem leaf extract	10%	2272	92.54	41.4	102.83	7.8
Neem leaf extract	15%	1945	88.62	43.2	107.43	5.73
Tulsi leaf extract	5%	2020	85.63	45	106.76	6.33
Tulsi leaf extract	10%	1898	84.73	44.27	103.79	7.27
Tulsi leaf extract	15%	1991	82.37	43	105.02	6.93
F Test			S	S	S	S
S.EM (±)			0.54	0.41	1.21	0.14
CD (p=0.05)			1.59	1.2	3.54	0.42

Table 2. Mean performance of different treatments for yield parameters in field pea (*Pisum sativum)*

Treatments	Concentrations	Numbers of pods per plant	Number of seeds per pod	Seed yield per plant (gm)	Seed yield per plot (gm)	Biological yield	Harvest Index
Control	-	10.8	5.87	13.25	397.4	24.28	55.1
Rhizobium	5%	11.4	7	17.09	512.57	25.86	66.47
Rhizobium	8%	13.53	8.47	24.88	746.5	33.73	73.48
Rhizobium	10%	13	7.2	20.9	627.09	30.37	64.62
Vermiwash	5%	11.47	6.47	19.95	598.37	29.49	68.42
Vermiwash	8%	11.67	7.6	18.12	543.56	28.84	63.03
Vermiwash	10%	12.6	7.2	19.41	582.29	29.36	66.46
Neem leaf extract	5%	11.47	7.6	16.96	508.78	26.66	68.84
Neem leaf extract	10%	13.2	8	22.09	662.83	32.33	68.99
Neem leaf extract	15%	13.17	6.07	16.07	482.07	27.43	58.16
Tulsi leaf extract	5%	12.2	7.33	16.24	487.14	26.74	61.12
Tulsi leaf extract	10%	12.87	7.87	21.86	655.93	30.88	70.77
Tulsi leaf extract	15%	12.87	6.87	18.21	546.27	28.44	64.15
F Test		S	S	S	S	S	S
S.EM (±)		0.16	0.16	0.57	16.97	1. 01	2.22
CD (p=0.05)		0.45	0.46	1.65	49.55	2.95	6.49

the primed seeds were used to grow under field conditions. Field experiment was laid out in randomized block design (RBD) with three replications during Rabi 2021-22. Data were recorded for 10 characters i.e.

Pre-harvest characters viz., Field emergence percentage, Plant height (60 DAS), number of primary branches (at harvest), 50% of flowering and Days to maturity [21-30].

2.1 Yield Parameters

Number of pods/plant, number of seeds/pod, seed yield/plant (gm), seed yield/plot (gm), biological yield (gm), harvest index (%). Analysis of variance for the data revealed that significance mean sum of squares due to seed priming treatments were observed for all the characters under study viz., Field emergence percentage, Plant height (60, at harvest), number of primary branches (at harvest), 50% of flowering and Days to maturity, number of pods/plant, number of seeds/pod, seed yield/plant (gm), seed yield/plot (gm), biological yield (gm), harvest index (%). which were highly significant at 5% level of significance indicating presence of good amount of variability among the treatments for these characters [31-39].

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

Seed treatment is a technique to decrease the emergence time, produce uniform emergence time, better algometric (changes in growth of plant parts over time) attributes and provide requisite stand in many horticultural and field crops. Various pre-hydration or priming treatments have been employed to increase the speed and synchrony of seed germination. The treatments showed significant effect of pre-sowing seed treatment on field emergence. The higher mean performance of field emergence was observed in the treatment using rhizobium with the concentration of 8% (2309), followed by treatment of seeds with neem leaf extract with 10% concentration (2272), and the plant height was observed highest in the treatment using Rhizobium @ 8% (95.71cm) followed by treatment with neem leaf extract @10% (92.54) .In the performance with the parameter 50% flowering, treatment with Rhizobium @ 8% showed significant value (40.6) which is followed by the seed treatment using neem leaf extract @ 10% (41.4) and days to pod maturity was observed highest in the seed treatment using Rhizobium @ 8% (101.43) , followed by the treatment using neem leaf extract @ 10% (102.83) and in the consideration of parameter, number of primary branches seed treatment by using Rhizobium @ 8% shown effective results with the mean value range of 8.87 which is followed by the treatment of seeds with neem leaf extract @ 10% (7.8). Based on the above observations seed treatment by using Rhizobium @ 8% shown considerable results in the growth parameters on comparison with the other treatments.

3.2 Yield Attributes

The mean performance of number of pods/plant was recorded highest in the seed treatment using Rhizobium @ 8% concentration with the mean value range of (13.53 pods) which is followed by treating of seeds with neem leaf extract @ 10% concentration (13.2) and in the case of number of seeds per pod the treatment of seeds with the treatment using Rhizobium @ 8% shown the highest mean performance (8.47) which is followed by seed treatment using Neem leaf extract @ 10% (8). The parameter of seed yield per plant when taken under consideration, the seed treatment using Rhizobium @ 8% recorded the higher mean performance (24.88), followed by treating of seeds with Neem leaf extract @ 10% (22.09) and seed yield per plot was recorded higher in the treatment of seeds with Rhizobium @ 8% (746.5) which is followed by treating of seeds with Neem leaf extract @ 10% (662.83).In the parameter of biological yield higher values were recorded in the treatment of Rhizobium @ 8% (33.73), followed by seed treatment using Neem leaf extract @ 10% concentration (32.33). On considering the harvest index the treatment using Rhizobium @ 8% recorded the higher mean value (73.48) and it was followed by treatment using Neem leaf extract @ 10% (68.99).These recorded mean performances are comparatively higher than the control used and the treatment of seeds with the Rhizobium @ 8% recorded significant results in the yield attributes of the plant.

4. CONCLUSION

It is concluded that seeds treated with Rhizobium @ 8% was found to be more desirable for producing significantly higher seed yield per plant (24.88 g), seed yield per plot (746.50 g). Findings are based on research done in one season in Prayagraj (Allahabad) U.P. These

recommendations are based on Three months experimentation and therefore further investigation is needed to arrive at valid recommendation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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