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Growth and yield parameters of Pea (*Pisum sativum* L.) as influenced by different priming treatments

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Abstract
Current study was conducted at the experimental farm, Department of Agriculture, Sant Baba Bhag Singh University, Jalandhar, Punjab, during the Rabi season of 2022-23. The Randomized block design was used with seven treatments replicated thrice. Various priming agents *viz.*, water (hydropriming), rhizobium inoculants, KNO_3, GA_3, H_2O_2 and neem leaf powder, at different concentrations were used to treat the seed for 8 hours. Findings unveiled that growth parameters *viz.*, days to emergence, plant height and number of branches per plant, days to flower initiation, days to 50% flowering and number of flowers per plant were recorded maximum with the application of treatment (T_4) i.e., seed priming with GA_3 @ 100 ppm, followed by treatment (T_3) i.e. seed priming with KNO_3 @ 3% (30gm). Similarly, yield attributes viz., number of pods, number of seeds per pod and seed yield per plant, pod yield per plot, maximum average yield also had maximum reported values in treatment T_4 followed by T_3.

Keywords: Priming, Seed, Garden Pea, Yield, Growth

Introduction

Seed is a crucial component in crop production and successful plant establishment depends upon optimal seed germination. The proportion of seed germination, emergence, and seedling vigour has decreased in recent years as a result of several environmental and abiotic stresses, which eventually leads to a low crop yield. Various physiological and environmental factors can help the germination of seeds. There are non-physiological methods for improving seed performance and overcoming environmental restrictions (Dawood, 2018) [5]. Seed priming is a low-cost, high-impact hydration strategy used to promote seed germination. It is a pre-sowing procedure that induces some physiological changes which promote better seed germination. Seeds go through a physiological process during priming process, such as regulated hydration and drying, which results in an accelerated and better pre-germinative metabolic process for quick germination (Ghassemi *et al.*, 2012) [6]. Seed priming has the potential to synchronize seed germination and promote emergence. These techniques have several advantages, including the reduction of fertilizer consumption, increased crop output through synchronized seed germination and the induction of systemic resistance in plants, which is both cost-effective and environmentally acceptable (Dalil, 2014) [4]. Nowadays, farmers are employing a variety of priming strategies at the field level *viz.*, hydro, osmo, chemo and hormonal priming (Thapa *et al*., 2020) [13].
Priming is a method for increasing the rate and consistency of germination. It improves crop health and establishment, ultimately increasing production in vegetable crops. As a result, good crop stand is achieved in various crops, including pea, after seed priming (Mal *et al*., 2019) [9]. The primary goal of seed priming is to boost germination percentage, improve field emergence, decrease mean germination time and promote seedling or plant growth even in adverse environmental condition.

Materials and Methods

The present study was carried out during rabi season of 2022-2023 at the experimental farm of Sant Baba Bhag Singh University, Jalandhar. The experimental site is at an elevation of 249 meters above mean sea level in the central plains of Punjab. The location's geographical coordinates are 760 3311.5 E longitude and 310 2520.4 N latitude.

It represents sub-humid mid-hill region of Punjab characterized by a sub-tropical climate.

The experiment was set up in a randomized block design with three replications. 21 sub plots were made, each measuring 3m x 3m. Data was recorded on the characters *viz*., days to emergence, plant height, number of branches per plant, days to flower initiation, days to 50% flowering, number of flowers per plant, number of pods per plant, number of seeds per pod, seed yield per plot and average yield.

Table 1: Experimental details

Design	RBD (Randomized Block Design)
Replication	3
Total number of treatments	7
Total number of plots	21
Gross plot size	3 m x 3 m
Spacing	30 cm x 10 cm
Seed priming date	10th November, 2022
Seed priming duration	8 hours
Seed sowing	13th November, 2022
Crop	Garden Pea (*Pisum sativum* L.)
Variety	Punjab-89

Table 2: Treatments details

Treatments	Detail
To	100% un-primed seeds
T_1	Hydro priming of seeds with distilled water for 8 hrs.
T_2	Seed priming with liquid Rhizobium inoculant @ 3 ml for 8 hrs.
T_3	Seed priming with KNO3 @ 3% (30gm) for 8 hrs.
T_4	Seed priming with GA3 @ 100 ppm for 8 hrs.
T_5	Seed priming with Hydrogen peroxide @ 20 mm for 8 hrs.
T_6	Seed priming with neem leaf powder @ 30gm for 8 hrs.

It is a vigorous medium dwarf that produces a large number of pods that are well-filled. Average yield is 60 q/acre.

In order to ensure that all of the seeds are evenly soaked, prepared solutions of KNO_3 at 3% (30gm), liquid rhizobium inoculant at 3ml, GA_3 at 100 ppm, hydrogen peroxide at 20 mM, and neem leaf powder at 30gm were added to the containers at the same time. For hydro priming, distilled water was used. Seeds were kept in these solutions at room temperature for 8 hours. After eight hours, seeds were taken out, rinsed three times with distilled water and dried in shade. Shade dried seeds were then sown in the field.

The experimental design followed for statistical analysis, was used according to F test results. The critical difference (CD) was determined to find out significant treatments.

Results and Discussion

Table 3 represents the data for various characters under study. Plants took least number of days in treatment T_4 (5.19) i.e. seeds treated with GA_3 (Table 3), followed by T_3 (7.27), where seeds were treated with KNO_3 and T_1 (7.95) i.e. hydropriming. Maximum value (15.57) for this character was noted in T_0 (control). Similar findings were reported by Mazed *et al*., (2015) [10] in chickpea, Carver *et al*., (2014) [3] in Pigeon pea and Brocklehurst *et al*., (1983) [2] in celery. This could be because of the seed's rapid metabolism and the increased moisture content.

Plant height at 30 DAS was maximum in treatment T_4 (13.66 cm) i.e., seeds treated with GA_3 (100ppm) followed by T_3 (11.51 cm) i.e., seeds treated with KNO_3 @ 30 gm and T_1 (9.96 cm), whereas minimum in unprimed seeds T_0 (4.38 cm). At 60 DAS, the tallest plants were observed in treatment T_4 (49.57 cm) which was statistically at par with treatment T_3 (45.83 cm) followed by T_1 (44.09 cm) i.e., seeds primed with distilled water. Shortest plants (30.14 cm) were observed in T_0 control. At 90 DAS, the maximum value was observed in T_4 (92.15 cm) followed by T_3 (86.06 cm) and T_1 (83.63 cm). The better root and shoot growth from GA_3 primed seeds could be the reason for the increase in plant height. These outcomes are similar to those of Jagdish (1993) [7] in tomato & chilli and Nalini *et al*., (2001) [11] in onion.

Data on the number of branches at 30 DAS was highest for treatment T_4 (6.97) followed by treatment T_3 (5.06) and T_1 (4.71). The minimum number of branches were observed in unprimed seeds T_0 (1.30). At 60 DAS, the most number of branches were found in T_4 (13.20), which was followed by T_3 (10.53). At 90 DAS also maximum was recorded in T_4 (17.43), followed by T_3 (16.47), while minimum in T_0 (8.63). It can be assumed that as a result of cell enlargement and increase in regular cell division, the meristematic tissues of the plant produce a greater number of branches. These results are in line with Mazed *et al*., (2015) [10] in chickpea.

The findings of the study revealed that number of days required for initial flowering varied significantly between treatments. Least number of days required for flower initiation was observed in T_4 (48.17), followed by T_3 (50.86) and T_1 (52.18) while the maximum number of days were recorded for T_0 (60.58) with untreated seeds. In many plant species, including the garden pea, the function of GA_3 is that of regulating and stimulating the activities of sub-apical meristems and inducing flowering. Similar findings were presented by Lee (1990) [8] in groundnut.

The minimum days to 50 percent flowering were taken by T_4 (57.25), which was followed by T_3 (59.72) and T_1 (62.19) whereas the greatest number of days were taken by untreated seed T_0 (70.58). The reason behind earliness in flowering could be quick cell division. These findings match with those of Mazed *et al*., (2015) [10] in chickpea and Pushpalatha (2008) [12] in bhendi.

The maximum number of flowers per plant (23.92) were produced by T_4, followed by T_3 (21.9) and T_1 (19.78). Minimum number of flowers per plant was found in T0

(15.09) with unprimed seeds. It might be because GA_3 induced more branches, which provided better chances of flower bud development. Similar reports were presented by Lee (1990) [8] in groundnut.

Most number of pods per plant were found in treatment T_4 (19.82), followed by T_3 (17.71) and T_1 (16.22). Minimum pods were observed in unprimed seeds in treatment T_0 (10.01). This might be explained by the fact that priming with GA_3 resulted in more flowers per plant, and subsequently more pods. Similar findings were reported by Mazed *et al*., (2015) [10] in chickpea, Lee (1990) [8] in groundnut and Pushpalatha (2008) [12] in bhendi.

The maximum number of seeds per pod were recorded in treatment T_4 (10.62), followed by treatment T_3 (9.02) and T_1 (8.17). Pods with the least seeds were recorded in T_0 (5.14). A greater seed set could have resulted from positive influence of GA_3 on flowering, pollination, and fertilization, increasing the number of seeds produced per pod. These results are in agreement with those of Arslan and Cuplan (2017) [1].

The highest pod yield per plot was recorded in T_4 (3.06 kg) followed by T_3 (2.23 kg) and T_1 (2.06 kg) while lowest pod yield per plot was recorded in unprimed seeds treatment i.e. T_0 (0.72 kg). These findings were in agreement with those of Mazed *et al*., (2015) [10] in chickpea and Pushpalatha (2008) [12] in bhendi.

Maximum yield (69.00 q/ha) was observed in T_4 (seeds were primed with GA_3), followed by T_3 (56.66 q/ha) and T_1 (51.66 q/ha) with seeds primed with KNO_3 and distilled water, respectively. Minimum yield was found in T_0 (18.16 q/ha) with unprimed seeds. Increase in yield-related traits, such as the average number of pods per plant, number of seeds per pod, and average yield per plot could be attributed to GA_3 priming. Similar outcomes were suggested by Mazed *et al*., (2015) [10] in chickpea, Pushpalatha (2008) [12] in bhendi and Tiwari *et al*., (2014) [14] in Pigeon pea.

Table 3: Effect of different treatments on growth and yield parameters

Treatments	**Days to emergence**	**Plant height (cm)**			**Branches/ plant**			**Days to flower initiation**	**Days to 50% flowering**	**Number of flowers per plant**	**Number of pods per plant**	**Number of seeds per pod**	**Pod yield per plot (Kg)**	**Average yield (q/ha)**
		30 DAS	**60 DAS**	**90 DAS**	**30 DAS**	**60 DAS**	**90 DAS**							
To (unprimed seeds)	15.57	4.38	30.14	62.69	1.30	2.61	8.63	60.58	70.58	15.09	10.01	5.14	0.72	18.16
T_1 (hydropriming with distilled water for 8 hrs.)	7.95	9.96	44.09	83.63	4.71	9.38	14.18	52.18	62.19	19.78	16.22	8.17	2.06	51.66
T_2 (seed priming with rhizobium inoculants @ 30 ml for 8 hrs.)	8.17	9.05	40.44	78.24	3.37	7.56	12.38	54.53	65.06	18.87	14.90	7.47	2.00	50.00
T_3 (seed priming with KNO3 @ 30 gm for 8 hrs.)	7.27	11.51	45.83	86.06	5.06	10.53	16.47	50.86	59.72	21.9	17.71	9.02	2.23	56.66
T_4 (seed priming with GA3@100ppm for 8 hrs.)	5.19	13.66	49.57	92.15	6.97	13.20	17.43	48.17	57.25	23.92	19.82	10.62	3.06	69.00
T_5 (seed priming with Hydrogen peroxide @ 20 Mm for 8 hrs.)	9.53	8.11	38.87	76.36	2.50	5.09	11.7	56.62	66.97	17.6	13.25	6.77	1.90	47.50
T_6 (seed priming with neem leaf powder @ 30 gm for 8 hrs.)	10.98	6.31	35.17	72.27	1.58	4.33	10.84	57.72	67.81	16.85	11.53	6.17	1.71	42.91
CD (0.05)	1.24	0.82	1.50	2.06	0.32	1.31	1.57	1.09	1.30	1.00	1.12	0.87	0.24	3.33

Conclusion

Based on results discussed above it can be concluded that among all the treatments studied, treatment T_4 i.e. seed priming with GA_3 @ 100 ppm for 8 hours proved to be the best in terms of all growth and yield parameters under study, while T_3 i.e. seed priming with KNO_3 @ 3% (30gm) for 8 hours was the second-best treatment for these characters followed by T_1 i.e., hydro priming with distilled water. Gibberellic acid produced best results due to the characteristic influences it has on growth and development of plants. Hence, these best performing treatments could be suggested for improving pea production, after further testing at different locations and farmer fields.

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