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Effect of pre-sowing treatments on germination and growth of French bean (*Phaseolus vulgaris* L.)

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Abstract

The experiment was laid out to study the effect of pre-sowing treatments with growth regulators viz. Indole acetic acid (IAA), Salicylic acid (SA) and Gibberellin acid (GA₃) with different concentrations like 50 ppm and 100 ppm on physiological and growth attributes of French bean. The seeds treated with growth regulators for 8 hrs. And 12 hrs. Duration along with three replications of treatments. The experimental approaches like plot size 2.5×2.5 m, spacing 45×15 cm and ridge & furrow planting method used and transplanting followed. The significantly maximum germination percentage (95.95%) recorded with 100 ppm concentration of IAA in this seeds soaked for 12 hrs. (T₆) which was better over control (87.17%). The maximum change in seed diameter (0.86 cm) was noticed in T₆ i.e. seeds treated with IAA 100 ppm concentration and soaked for 12 hrs. And minimum recorded in control (0 cm). The better length of radical (9.03 cm) when seeds treated with 100 ppm concentration of GA₃ and soaked for 12 hrs. (T₄). The minimum days taken to emergence (5.11 days) occurred with T₆ i.e. seeds treated with 100 ppm IAA and soaked for 12 hrs. Over control. The results revealed that significant change in growth attributes of French bean like maximum plant height (66.46 cm), number of branches per plant (7.85), minimum days taken to 50% flowering (31.15 days) recorded when seeds treated with 100 ppm GA₃ and soaked for 12 hrs. (T₄) over control or water treated seeds.

Keywords: French bean, growth regulators, pre-sowing, germination and growth

Introduction

French bean (*Phaseolus vulgaris* L.) belongs to Fabaceae family which is one of the most important source of protein and energy (Rathod *et al.* 2015) ^[1]. It is cultivated in worldwide and contributes nearly 30% of food legumes total production (Vasishtha and Srivastava 2012) ^[2]. It is a rich source of nutrient and minerals viz., protein content 17.5-28.7% in dry seeds and 1.0-2.5% in green pods, 3.2-5.0% mineral matter, 4.2-6.3% crude fiber, 1.2-2.0% crude fat and 340-450 K cal energy, 0.16 mg iron, 1.76 mg calcium and 3.43 mg zinc per 100 g of the edible part (Sardana *et al.* 2000) ^[3]. It is a native crop of Central and South America. The cultivation of French bean was started 7000 years ago by the Indian tribes in Mexico and Peru. The pole and bush type of varieties were popular in worldwide. French bean is the most important and predominantly cultivated as green vegetable and pulse crop. It is widely cultivated in the temperate, sub-tropical and tropical regions. The optimum mean temperature for French bean is 20-25 °C for its growth and better productivity. Extreme high temperature interfere pod filling, while low temperature is unfavourable for vegetative growth (Dhakal *et al.* 2020) ^[4]. India is leading producer of dry seed followed by Brazil and Myanmar conversely, the production of green beans is extreme in China followed by Indonesia and Turkey. In India the productivity of seeds is about 2-2.5 t/hac by contributing the states viz. Maharashtra, Punjab and Andhra Pradesh. The production and dissemination of quality seed is one of the indispensable factors to achieve anticipated yields in addition to optimum quality of cultivar. The quality of seed alone is known to account for at least 10-15% increase in productivity. The unavailability of quality seeds is one of the major problem, to overcome this by using "value-added" techniques like pre-sowing treatment, priming, seed coating. The pre-sowing treatment may be either with growth regulators, bio-fertilizers, salts and may with organic or inorganic substances to improve the seed quality as well plant growth (Laloo *et al.* 2020) ^[5]. Pre-sowing techniques are used to improve germination, to reduce the time between sowing and emergence in the field especially under adverse environments (Gupta *et al.* 2008) ^[6].

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Plant growth regulators can improve the physiological efficiency including photosynthetic ability and thereby helping in effective flower formation, fruit and seed development and ultimately enhance productivity of the crops (Kumar *et al.* 2018) [7]. Plant growth regulators enhance the physiological, morphological and biochemical activities which results better establishment of plant. Keeping these things in view the experiment was conducted to know the effect of pre-sowing treatments on germination and growth of French bean.

Materials and Methods

The present investigation entitled effect of pre-sowing treatments on germination and growth of French bean was carried out in 2018-2019 at Vegetable Research Farm of

Khalsa College, Amritsar. The experiment was carried out to study the effect of SA, IAA and GA₃ with different concentrations *i.e.* 50 and 100 ppm for 8 hours and 12 hours on germination and growth of French bean. The treated seeds of Arka Komal variety was sown in plug trays heaving soil-less growing media (cocopeat, perlite and vermiculite) used in ratio 3:1:1. After 30-35 days when 2-3 leaves occur the seedlings were ready then transplanted in second week of February in field. The total treatments were eight and replicated thrice times and transplanting done at space 45×15 cm in ridge and furrow method of 2.5×2.5 m sized plot of each treatment and made three rows of plants in each treatment. From each plot five plants were randomly selected to take the observations from each treatment to analyse the germination and growth attributes of French bean.

Table 1: The experiment comprised of the following treatments

Treatments	Concentration and soaking duration
T ₁	SA 50 ppm for 8 hrs.
T ₂	SA 100 ppm for 12 hrs.
T ₃	GA ₃ 50 ppm for 8 hrs.
T ₄	GA ₃ 100 ppm for 12 hrs.
T ₅	IAA 50 ppm for 8 hrs.
T ₆	IAA 100 ppm for 12 hrs.
T ₇	Water for 24 hrs.
T ₈	Control

Result and Discussion

Maximum change in seed diameter was recorded in T₆ which is at par with T₄ and T₂. This was happened due to the permeability of seed coat to growth regulators and water which results swelling of seed. The Halirimana (2015) [8] in French bean and Lalitha *et al.* (2016) [9] in horse gram revealed the same results. The maximum radical length was found in T₄ which was at par with T₆ and T₂. This was may be happened due to growth regulator like GA₃ and IAA permote cell division and cell elongation and also help to breakdown the seed dormancy. These same results were also recorded in horse gram by Lalitha *et al.* (2016) [9]. The significant variation in germination percentage was observed with T₆ which was at par with T₄ and T₂. This was may be due to pre-sowing treatment with growth regulators can increase the seed vigour, enhance cell elongation and cell division and growth regulators also enhance synthesis of enzyme protein that

stimulate the germination process given by Chauhan *et al.* (2010) [10] in mung bean. Bassi *et al.* (2011) [11] revealed the similar results in soybean and Yadav & Singh (2014) [12] in mung bean recorded that seed treated with IAA and GA₃ have better result than the non-treated seed. The early emergence observed in T₆ followed by T₄ and T₂ but maximum days taken by control one. The reason behind this was pre-sowing treatment can repair and build up the nucleic acid, increase synthesis of proteins as well as the repairing of membranes (McDonald MB 2000) [13]. Soaking also enhance the activities of antioxidative enzyme in treated seeds. Due to readily available food during germination, soaked seeds are better able to complete the process of germination in a short time and cope with environmental stresses (Ghassemi-Golezani 2014) [14]. Bharadwaj *et al.* (2017) [15] revealed the same results that IAA can permote germination and early germination occur in mung bean by seed treatment.

Table 2: Effect of pre-sowing treatments on germination and growth of French bean (*Phaseolus vulgaris* L.)

Treatments	Change in seed diameter (cm)	Germination percentage (%)	Days taken to emergence	Length of radical (cm)	Plant height (cm)	Number of branches per plant	Days taken to 50% flowering (days)
T ₁	0.55	90.78	10.83	5.14	61.38	5.20	38.94
T ₂	0.72	93.85	7.86	7.37	64.89	6.61	34.73
T ₃	0.56	91.47	9.49	6.85	63.45	6.34	35.69
T ₄	0.83	94.18	6.31	9.03	66.46	7.85	31.15
T ₅	0.60	92.41	8.21	5.69	62.37	5.44	36.09
T ₆	0.86	95.95	5.11	8.01	65.96	7.64	33.35
T ₇	0.54	89.15	11.39	4.98	60.94	5.09	40.78
T ₈	0	87.14	12.90	0	55.42	4.59	45.09
CD	0.09	1.77	1.51	1.36	1.44	0.72	0.98

The maximum plant height was recorded with T₄ treatment and minimum plant height was recorded in T₈. Maximum number of branches per plant occur with treatment T₄ which was at par with T₆ and T₂. The minimum days to 50% flowering observed in T₄ and maximum time recorded in T₈. Thomson *et al.* (2015) [16] revealed that the GA₃ effectively increased the vegetative growth of pea plant, this is due to that

GA₃ can permote the cell division and cell elongation. This observation agrees with Noori (2014) [17] who found out that gibberellic acid is the most important growth stimulating plant growth regulator that is used for cell elongation and thus promotes plant growth and development in legumes. Plant growth substances are well known which enhance the source-sink relationship and stimulate the translocation of photo-

assimilates to sink, thereby help in effective flower formation, fruit and seed development and ultimately enhancing the productivity of crops (Amanullah *et al.* 2010) ^[18]. The Taiz & Zeiger (2010) ^[19] describe that growth regulators can enhance the vegetative as well as reproductive growth of plants. GA₃ play a major role in all growth processes like seed germination and development, seed germination rate, stimulating stem and root growth and early flowering given by Yamaguchi (2008) ^[20]. The IAA and GA₃ both increase the growth attributes like shoot, number of pods and plant height by seed treatment reported by El Karamany *et al.* (2019) ^[21]. Mervat *et al.* (2013) ^[22] reported the similar results in Faba bean and explain that the growth regulators can enhance the formation of photosynthetic products which improves the plant growth.

Conclusion

The findings of our study illustrated that the pre-sowing treatment with IAA, SA and GA₃ with different concentrations (*i.e.* 50 and 100 ppm) for different time durations (8 and 12 hrs.) were beneficial for germination and growth of French bean. The better physiological characters was recorded with T₆ (IAA 100 ppm and soaked for 12 hrs.) and superior establishment of plant occurred with T₄ (GA₃ 100 ppm and seeds soaked for 12 hrs.). The variations also occur with concentration and seed treatment duration but better over control (untreated seeds).

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