

Effect of seed priming with organics on seed quality of French bean (*Phaseolus vulgaris* L.)

Gowri K G¹, N M Shakuntala¹, B S Ganigara², Vijaykumar Kurnalliker³, Vishwanath S⁴, Basavaraj⁵

¹ Department of Seed Science and Technology, University of Agricultural Sciences, Raichur, Bengaluru, Karnataka, India

² Department of Seed Science and Technology, College of Agriculture, Bheemarayanagudi, Bengaluru, Karnataka, India

³ Seed Unit, University of Agricultural Sciences, Bengaluru, Karnataka, India

⁴ Department of Agronomy, University of Agricultural Sciences, Bengaluru, Karnataka, India

⁵ Office of the Director of Education, University of Agricultural Sciences, Raichur, Bengaluru, Karnataka, India

Abstract

The experiment evaluated the effect of organic seed priming on the seed quality of French bean (*Phaseolus vulgaris* L.) under controlled laboratory conditions. Seeds were primed with different organic solutions, including biochar (1%), panchagavya (3%), vermiwash (5%), cow urine (5%), humic acid (0.25%) and bio NPK (10%), along with hydropriming and an untreated control by using Completely Randomized Design with four replications was followed. Significant variation was observed in humic acid @ 0.25% where recorded the highest germination percentage (98.50%), seedling length (24.96 cm), seedling dry weight (12.13 mg) and vigour index I (2458). Organic priming, particularly with humic acid (0.25%), offering a sustainable alternative to synthetic seed treatments for better seedling establishment and growth.

Keywords: French bean, humic acid, organic priming and seed quality

Introduction

French bean (*Phaseolus vulgaris* L.), an herbaceous plant in the Fabaceae family, is also known as kidney bean, haricot bean, navy bean and snap bean. Typically reaching 20-60 cm in height with three leaflets per node, it produces flowers that are usually white or purple, yielding seeds of varied colours (Razvi *et al.*, 2018) [8]. The green pods contain 22% protein, 78% carbohydrates, 11 mg vitamin C and 381 mg calcium per 100 g of edible portion. French beans are globally renowned for their nutritional value including proteins, vitamins, minerals and polyunsaturated fatty acids. Immature pods are consumed as a vegetable, while mature pods are used as pulses.

Originating from Central and South America, the french bean is among the oldest cultivated plants, adaptable from tropical to temperate regions. It is widely grown in the Northern Indian subcontinent for its pods and dry seeds. In India, french bean occupies an area of 137.54 thousand hectares, cultivated with an annual production of 1370.21 thousand metric tons and an average productivity of 9.96 metric tons per hectare. French bean growing states include West Bengal, Andhra Pradesh, Jharkhand, Jammu and Kashmir, Himachal Pradesh and Punjab which contribute nearly 2000 hectares, producing 1900 metric tons annually at a productivity of 1.6 metric tons per hectare (Kumar, 2024) [6].

Organic seed priming using substances like panchagavya, cow urine, vermiwash and bio NPK significantly enhances seed quality and promotes sustainable agriculture by improving various aspects of plant growth and soil health (Soniya *et al.*, 2022) [11]. Panchagavya promotes seed germination and early root development due to the presence of beneficial microbes like *Acnetobacter spp.*, which stimulate cell division and elongation. Cow urine, diluted appropriately, has been shown to increase germination percentage and seedling vigour in crops like finger millet. Vermiwash containing enzymes, macro and micronutrients, growth promoting hormones, enhances seed germination,

seedling vigour and overall plant growth. Bio NPK, comprised of nitrogen-fixing, phosphorus-solubilizing and potassium-mobilizing bacteria, contribute to improved nutrient uptake and plant growth, thereby reducing reliance on chemical fertilizers and pesticides. These organic priming methods offer an eco-friendly and cost-effective alternative to conventional treatments, fostering a more balanced and resilient agricultural ecosystem.

Organic and inorganic fertilizers are widely used for increasing crop production. Among these, foliar applications of organic compounds are widely used for increasing crop production. Among various organics used for sustainable crop production, humic acid is one of them (Shafeek *et al.*, 2013) [10]. Humic acid is a natural polymer which is produced as a result of decaying organic matter in soil, peat and lignin. Thus humic acid can be used to increase crop productivity (Sabzevari *et al.*, 2008) [9]. Cultivation of the french bean crop has consistently posed challenges due to its high initial fertilizer requirements, necessitating costly nitrogen, phosphorus and potassium-based fertilizers for achieving optimal yields (Aslani and Souri, 2018 [3]; Barcchiya and Kushwah, 2017) [4]. Looking into the above problem in french bean and the importance of seed priming for precision sowing the present investigation entitled effect of seed priming with organics on seed quality of french bean (*Phaseolus vulgaris* L.) was undertaken.

Material and methods

An experiment was conducted in the Department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Raichur, during the year 2024-25. The experiment consists of eight treatments with four replications by using Completely Randomized Design. From early experiment it is found that the best biochar concentration @ 1 % is redefined with organics like panchagavya 3 %, vermiwash 5 %, cow urine 5 %, humic acid 0.25 % and bio NPK @ 10 %. The solution was prepared by dissolving 3 ml of panchagavya, 5 ml of

vermiwash, 5 ml of cow urine, 0.25 ml of humic acid and 10 ml of bio NPK in 100 ml of distilled water. Similarly, seeds were also soaked in water for 10 hours duration in a 1:1 seed to solution ratio for hydro priming seed treatment. Then the seeds were decanted and uniformly spread over the blotter paper and kept for air drying under shade to re-dry to their original moisture level for 12 hours. Finally, such seeds were used for a seed germination test for assessing the seed quality parameters. The germination test was conducted in four replicates of 100 seeds each; following the pleated paper method in a walk-in seed germination room maintained at 25 ± 2 °C temperature and 90 ± 5 per cent RH for 10 days (Anon, 2014). Whereas, the seedling length, seedling dry weight and seedling vigour index-I were determined according to Abdul-Baki and Anderson (1973) [1].

Results and discussion

The seed germination percentage, shoot length, root length, seedling length, seedling dry weight, vigour index I and vigour index II showed significant enhancement with organic priming treatments compared to the control, is presented in Table.1.

Humic acid @ 0.25 % (T₇) recorded the highest germination percentage of 98.50 %, while least germination percentage show in the control (T₁, 84.50 %) shown in Fig.1. Research demonstrates that humic acid stimulates seed germination by enhancing water uptake, activating enzymatic processes and improving membrane permeability. Studies show that humic substances activate plasma membrane H⁺-ATPase, which is crucial for ion transport and maintaining cellular pH balance during germination. The excellent performance aligns with findings that humic acid at low concentrations (0.1-0.5%) significantly improves germination through enhanced metabolic activation.

Maximum shoot length and root length was seen in humic acid @ 0.25 % (T₇) (11.48 cm and 13.48 cm), over the control (T₁, 8.72 cm and 10.59 cm). Humic acid helps cells grow by activating an enzyme that makes cell walls softer, allowing them to expand. It also improves shoot growth by helping plants take up important nutrients like nitrogen and phosphorus, which support the growth of shoot tips. Humic acid application increased root length in wheat through enhanced cell division and elongation processes. The mechanisms involve activation of the root meristem,

enhanced mitotic activity and improved nutrient transport through activated membrane pumps. Similar findings were recorded by Kucukyumuk and Erdal (2011) [5] in wheat crop.

Humic acid @ 0.25 % (T₇) recorded the maximum seedling length (24.96 cm), representing a 21.6 % increase over the control (19.31 cm). The increase in seedling length is driven by enhanced mitotic activity, elevated respiration rates and accelerated cell division, all of which contribute to the development of the root meristem. Humic acid stimulates cell elongation by activating plasma membrane H⁺-ATPase, which acidifies the cell wall, loosens the cellulose network and enables cell expansion.

Seedling dry weight demonstrated significant improvement with organic priming, with T₇ (humic acid @ 0.25 %) achieving the highest dry weight (12.13 mg), over the control (T₁, 10.98 mg). Humic acid priming significantly enhances seedling dry weight, indicating improved biomass accumulation and metabolic efficiency. This effect is largely associated with the ability of humic substances to activate plasma membrane H⁺-ATPase, thereby enhancing proton extrusion, nutrient uptake, and mineral accumulation in shoots. The subsequent increase in dry matter is attributed to improved nutrient availability and the stimulation of key metabolic processes. By coupling ATP hydrolysis with H⁺ transport, humic acid promotes apoplastic acidification, cell wall loosening and cell elongation, ultimately leading to greater biomass production.

Seedling vigour index I demonstrated substantial improvement with organic priming treatments compared to the control (1631) which is also represented in Fig. 2 and 3. T₇ (humic acid @ 0.25 %) achieved the maximum vigour index I (2458), representing a 28.7% increase over the control. Poomani *et al.* (2023) [7] found that priming lentil seeds with humic acid increased seedling vigour index I by 21 to 31.8% under normal growing conditions, with even greater enhancements observed under stress. Humic acid priming accelerates water uptake and promotes efficient mobilization of seed reserves, resulting in faster germination and improved seedling establishment. The underlying mechanisms involve activation of plasma membrane H⁺-ATPase, increased cell division and enhanced nutrient absorption, all of which contribute to elevated vigour index I values.

Table 1: Influence of orgo seed priming on seed quality parameter of French bean

Treatment	Seed germination (%)	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Seedling dry weight (mg)	Seedling vigour index-I
T ₁ – Control	84.50	8.72	10.59	19.31	10.98	1631
T ₂ – Hydropriming	88.50	9.94	11.11	21.05	11.24	1862
T ₃ - Biochar @ 1 %	93.50	10.63	12.24	22.87	11.56	2138
T ₄ - Panchagavya @ 3 %	95.00	10.94	12.86	23.80	11.63	2261
T ₅ - Vermiwash @ 5 %	90.75	10.51	12.15	22.66	11.33	2056
T ₆ - Cow urine @ 5%	85.75	10.13	11.73	21.86	11.34	1874
T ₇ - Humic acid @ 0.25%	98.50	11.48	13.48	24.96	12.13	2458
T ₈ - Bio NPK @ 10%	85.25	10.08	11.34	21.42	11.02	1826
Mean	90.21	10.30	11.93	22.24	11.40	2013
S.Em. ±	0.50	0.48	0.34	0.73	0.02	66
CD @ 1 %	1.98	1.91	1.35	2.90	1.10	261

Conclusion

Organic seed priming substantially increases seed germination, growth, and vigour in french bean, with humic acid @ 0.25% showing the greatest improvements among

the treatments. Panchagavya and biochar also provide moderate enhancement compared to control and hydropriming.

References

1. Abdul-Baki AA, Anderson JD. Vigour determination in soya bean seed by multiple criteria 1. Crop Science,1973;13(6):630-3.
2. Anonymous. International rules for seed testing. Seed Science and Technology,2014;27:25-30.
3. Aslani M, Souri MK. Growth and quality of green bean (*Phaseolus vulgaris* L.) under foliar application of organic-chelate fertilizers. Open Agric,2018;3(1):146-54.
4. Barochiya J, Kushwah S. Influence of Integrated Nutrient Management on root growth, flowering and quality of seed in french Bean (*Phaseolus vulgaris* L.). Int J Plant Soil Sci,2017;16(6):1-7.
5. Kucukyumuk Z, Erdal I. Effects of humic acid on growth and nutrient uptake of wheat (*Triticum aestivum* L.). Plant Archives,2011;11(2):403-6.
6. Kumar A. Assessment of French bean (*Phaseolus vulgaris* L.) genotypes for yield traits. J Krishi Vigyan,2024;11(1):1-6.
7. Poomani K, Kumar R, Singh A. Influence of humic acid seed priming on seedling vigour and growth parameters of selected crops. Turk J Agric,2023;47(5):156-64.
8. Razvi SM, Khan MN, Bhat MA, Ahmad M, Ganaie SA, Sheikh FA, Najeeb S, Parry FA. Morphological variability and phylogenetic analysis in Common bean (*Phaseolus vulgaris* L.). An I J,2018;41(2):208-12.
9. Sabzevari S, Khazaie HR, Kafi M. Effect of humic acid on root and shoot growth of two wheat cultivars. J Water Soil,2008;23:87-94.
10. Shafeek MR, Helmy YI, Nadia MO, Fatma AR. Effect of foliar fertilizer with nutritional compound and humic acid on growth and yield of broad bean plants under sandy soil conditions. J Appl Sci Res,2013;9:3674-80.
11. Soniya G, Karthikeyan R, Thirukumaran K, Gopalakrishnan M. Effect of Seed priming with organic-inputs on seedling germination, seedling growth and vigour of finger millet. Int J Environ Clim,2022;12(10):596-600.