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Effect of seed priming on growth, seed yield and Vigour of French bean (*Phaseolus vulgaris* L.) under organic condition

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Abstract
To examine the effect of seed priming on growth, seed yield and vigour of French bean(*Phaseolus vulgaris* L.) under organic condition, results revealed that the application of priming with 1% KNO_3 for 12 hours recorded significantly highest plant height (36.59cm), number of primary branches per plant (4.63), number of secondary branches per plant (7.69 cm), pod length (11.48 cm), number of pods per plant (35.45), number of seeds per pod (7.13), seed yield per plant (13.10 g), seed yield (18.43 q ha^{-1}), 100 seed weight (38.13 g), germination percentage (87.91%), root length (14.83 cm), shoot length (19.57 cm.) and seed vigour index (3024.10),respectively in comparison to other treatments while, the lowest plant height, number of primary branches per plant, number of secondary branches per plant, pod length, number of pods per plant, number of seeds per pod, seed yield per plant, seed yield, 100 seed weight, germination percentage, root length , shoot length and seed vigour index (29.34 cm, 3.70, 5.19, 8.07cm, 27.52, 4.95, 9.56 g, 11.08 q ha^{-1}, 32.59 g, 82.80%, 8.68 cm, 13.47 cm and 1834.02, respectively) were recorded in control.

Keywords: French bean, priming, growth, yield and seed quality

Introduction
The French bean (kidney bean, snap bean, haricot bean and navy bean) is most important leguminous crop grown for the tender vegetable, shelled green beans and dry beans (rajma). Among all the beans, it is the most extensively short duration having rich nutritive values. It is a valuable source of protein, vitamins and minerals. It's dry seed contains 21.1 per cent protein, 69.9 per cent carbohydrates, 1.7 per cent fat, 381 mg calcium, 425 mg phosphorous and 12.4 mg iron per 100 g of edible part (Ali and Kushwaha 1987) [2].
French bean mainly grown in Andhra Pradesh, Bihar, Gujarat, Haryana, Himanchal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Uttrakhand, Uttar Pradesh and Tamil Nadu, having an area of 230078 ha with annual production of 647965 tonnes with a productivity of 28163 kg/ha (Anonymous, 2019) [3].
Seed priming is a technique to controlled hydration process followed by re-drying that allows seed to imbibe water and begin internal biological processes necessary for germination, but which does not allow the seed to actually germinate. On the other hand, seed priming the amount of water absorption is controlled so as necessary metabolic activities occurred for germination but radical emergence is prohibited. Now-a-days, various seed priming techniques have been developed by seed scientists, including hydro priming (soaking in water), halo priming (soaking in inorganic salt solutions), osmo-priming (soaking in solutions of different organic osmotic), thermo priming (treatment of seed with low or high temperatures), solid matrix priming (treatment of seed with solid matrices) and bio priming (hydration using biological compounds Seed priming has been successfully demonstrated to improve germination and emergence in seeds of many crops, particularly seeds of vegetables and small seeded grasses. Harris *et al*. (1999) [16] demonstrated that seed priming (soaking seeds overnight in water) markedly improved establishment and early vigour of upland rice, maize and chickpea, resulting in faster development, earlier flowering and maturity and higher yields.

Material and Methods
A field experiment was carried out at Organic Research Farm, Institute of Agricultural Sciences, Bundelkhand University, Jhansi during 2020-21, to evaluate the impact of seed priming on growth, seed yield and vigour of French bean (*Phaseolus vulgaris* L.) under

organic condition cv. Utkarsh (IPR98-5). The soil of experimental plots was red soil, (pH 7.2), low in organic carbon (0.63%), available nitrogen (326 kg/ha), available phosphorus (4.5 kg P_2O_5/ha) and medium in available potassium (87.0 kg K_2O/ha) content by adopting randomized block design having three replications.

Eight treatments were taken in consideration *viz.* T_1- (Priming with water for 6 hours),
T_2- (Priming with water for 12 hours),
T_3-(Priming with 10 ppm GA_3 for 6 hours),
T_4- (Priming with 10 ppm GA_3 for 12 hours),
T_5- (Priming with 1% KCL for 6 hours),
T_6-(Priming with 1% KCL for 12 hours),
T_7-(Priming with 1% KNO_3 for 6 hours) and
T_8- (Priming with 1% KNO_3 for 12 hours).

The seeds were immersed inside water for 6 hours and 12 hours. Socked seeds were air dried. In case of GA_3 10 ppm, HNO_3, KCL, solution was prepared and same procedure was adopted for treatment of the seeds. Thereafter, seeds were removed and the seeds were dried at 25 ^{0}C for 24 hours in the laboratory to maintain original moisture level. The crop was sown 30x10 cm row to row and plant to plant spacing by using recommended seed rate of 60 kg ha-1. Agronomic practices were applied as per schedule. Various observation of growth character *viz*. plant height (cm), number of primary branches per plant, number of primary branches per plant, yield and yield attributing characters like pod length(cm), number of pods per plant, number of seed per pod, seed yield per plant (g), seed yield (q ha^{-1}) and 100 seed weight (cm), seed quality parameters *viz.* germination percentage(%), root length(cm), shoot length(cm) and seedling vigour index were recorded as per schedule.

Result and Discussion

A significant enhancement were noted in various growth parameters are presented in Table-1. The maximum plant height (36.59 cm) was recorded in treatment T8 priming with 1% KNO_3 for 12 hours followed by (T7) 1% KNO_3 for 6 hours (35.99 cm), (T6) 1% KCL for 12 hours (33.81cm), priming with 1% KCL for 6 hours (33.38 cm), (T5) priming with water for 12 hours (31.77 cm). However, minimum plant height (29.34 cm) was noticed in control (T1) priming with water for 6 hours. Sharma *et al.* (2009) [14] and Gupta and Singh (2012) [8] have also reported increased height of plants with seed soaking treatments.

The number of primary branches per plant and number of secondary branches per plant were found maximum with application of priming with 1% KNO_3 for 12 hours (4.63 and 7.69) as compared to priming with water for 6 hours (3.70 and 5.19) followed by priming with 1% KNO_3 for 6 hours (4.42 and 6.67), while, minimum number of primary branches per plant and number of secondary branches per plant recorded in (T1) priming with water for 6 hours (3.70 and 5.19).

it might be due application of priming techniques increased imbibational processes of seed by enhancing metabolism, increased the efficiency of hydrolyzing enzymes, by maintaining the concentration of growth inhibitors and growth promoters which encourages faster germination lead to more accumulation of photosynthetic compounds. Growth hormones, metabolic enzymes and secondary metabolites lead to increased cell division and cell enlargement and defence mechanism of plant resulting Increased height, growth, number of branching in the plants due to application of seed priming. Similar finding were also reported by Isvand *et al.* (2012) [10].

Application of priming with 1% KNO_3 for 12 hours recorded the highest pod length (11.48 cm), number of pods per plant (35.45) and number of seeds per pod (7.13) as compared to priming with water for 6 hours (8.07cm, 27.52 and 4.95). Other treatment combination were found at par with priming with 1% KNO_3 for 12 hours (10.67 cm, 34.51 and 7.08) and priming with 1% KNO_3 for 6 hours (10.29 cm, 32.63 and 6.82). The increase in number of pods per plant and number of seeds per pod may be attributed to priming treatment**.** The results were also corroborated with Das and Jana (2015) and Prajapati *et al.* (2017) [13].

The highest seed yield per plant (13.10 g) and seed yield (18.43 q ha^{-1}) were recorded in priming with 1% KNO_3 for 12 hours, which was found at par with the application of priming with 1% KCL for 12 hours (13.00 g and 16.18 q ha^{-1}), while lowest seed yield per plant (9.56 g) and seed yield (11.08 q ha^{-1}) were reported in priming with water for 6 hours.

A significant enhancement were noticed in 100-seed weight (38.13 g) was recorded in treatment (T8) with the application of priming with 1% KNO_3 for 12 hours. While, the minimum 100-seed weight (32.59 g) was observed in control. Narayanan *et al.* (2016) [12] and Kunghatkar *et al.* (2018) [11] were also found similar results.

The maximum germination percentage (87.91%), root length (14.83 cm) and shoot length (19.57 cm) were recorded in priming with 1% KNO_3 for 12 hours which was at par with priming with 1% KNO_3 for 12 hours. The minimum germination percentage (82.80%), root length (8.68 cm) and shoot length (13.47 cm) were reported in priming with water for 6 hours.

The higher seed vigour index (3024.10) was recorded in priming with 1% KNO_3 for 12 hours followed by priming with 1% KCL for 12 hours (2784.54). The treatment T1 showed poor performance in vigour index (1834.02). These findings were also confirmed by Choudhary *et al.* (2008), Ghobadi *et al.* (2012) [6] and Ghobadi *et al.* (2017) [15].

Increased in growth, yield and yield attributing characters might be due to seeds treated with priming increase the quick sprouting lead to faster gernination resulting early emergence, better crop stand, faster growth, longer vegetative growth period. Plants height and better tillering by sprouted/ pre germinated and pre-sowing seed soaking.

Increased seed quality parameters might be due to the priming treatment increased higher seed weight, produced more number of grains, heavier and bold seeds contributing to better seed quality.

Table 1: Impact of seed priming on growth, seed yield and vigour of French bean(*Phaseolus vulgaris* L.) under organic condition.

Treatment	Plant height (cm.)	number of primary branches per plant	number of primary branches per plant	Pod length (g)	Number of pods per plant	Number of seeds per pod	Seed yield per plants (g)	Seed yield (qha^{-1})	100 seed weight (g)	Germination (%)	Root length (cm)	Shoot length (cm)	Seed vigour index
T_1	29.34	3.70	5.19	8.07	27.52	4.95	9.56	11.08	32.59	82.80	8.68	13.47	1834.02
T_2	31.77	4.02	5.79	8.83	30.65	5.14	10.85	12.76	33.14	84.67	11.53	16.33	2358.91
T_3	30.78	3.83	5.52	8.12	29.12	5.05	10.48	11.92	32.95	82.88	9.74	14.55	2013.16
T_4	31.47	4.01	5.56	9.35	32.35	5.38	11.16	13.89	34.27	83.66	10.22	14.99	2109.07
T_5	33.38	4.21	6.12	9.49	32.63	6.64	11.81	14.37	34.89	83.92	10.92	15.59	2224.72
T_6	33.81	4.23	6.31	10.67	34.51	7.08	13.00	16.18	36.90	86.80	13.61	18.47	2784.54
T_7	35.99	4.42	6.67	10.29	33.37	6.82	12.81	15.11	36.19	85.41	12.51	17.41	2555.47
T_8	36.59	4.63	7.69	11.48	35.45	7.13	13.10	18.43	38.13	87.91	14.83	19.57	3024.10
S.Em±	0.67	0.11	0.33	0.41	1.28	0.35	0.43	0.61	0.88	0.85	0.46	0.96	1.98
CD at 5%	2.05	0.35	1.01	1.25	3.93	1.06	1.31	1.87	2.67	2.56	1.39	2.91	5.97

*T_1- (Priming with water for 6 hours), T_2- (Priming with water for 12 hours), T_3-(Priming with 10 ppm GA_3 for 6 hours), T_4- (Priming with 10 ppm GA_3 for 12 hours), T_5- (Priming with 1% KCL for 6 hours), T_6-(Priming with 1% KCL for 12 hours), T_7- (Priming with 1% KNO_3 for 6 hours) and T_8- (Priming with 1% KNO_3 for 12 hours)

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