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EFFECT OF WATER-SOLUBLE FERTILIZERS AND BIO STIMULANTS ON GROWTH AND YIELD OF POLE BEAN (*PHASEOLUS VULGARIS* L.) UNDER PROTECTED CONDITION

Kavya K.A.[1]*, Srinivasa V.[1], Umamaheswarappa P.[1], Narayana S. Mavarkar[2] and Ravi C.S.
[1]Department of Vegetable Science, College of Horticulture, Mudigere-577 132, Karnataka, India.
[2]K.S.N.U.A.H.S., Iruvakki, Shivamogga-577412, Karnataka, India
[3]Department of Plantation, Spices, Medicinal, Aromatic Crops. (PSMAC),
College of Horticulture Mudigere-577132, Karnataka, India
*Corresponding author E-mail: kavyaka@uahs.edu.in
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ABSTRACT

An experiment was conducted to study the "Effect of water-soluble fertilizers and bio stimulants on growth and yield of pole bean (*Phaseolus vulgaris* L.) under protected condition" at department of vegetable science, College of Horticulture, Mudigere during the year 2023-24. The study was laid out in Randomized Complete Block Design with twelve treatments and three replications. The treatments comprised of water-soluble fertilizers (*viz*., 1 % 19:19:19, 0.5 % monoammonium phosphate and 0.5% potassium nitrate) and bio stimulants (*viz*., 0.5 % humic acid, 0.5 % sea weed extract and 3 % panchagavya) along with RDF. Among different treatment combinations, foliar application of monoammonium phosphate and potassium nitrate each @ 0.5 per cent with 0.5 per cent humic acid, 0.5 per cent seaweed extract and 3 per cent panchagavya along with RDF (T_{12}) recorded significantly maximum plant height (580.00 cm), number of primary branches (7.20), secondary branches (8.53), number of leaves (154.00), leaf area per plant (5807.01 cm^2), leaf area index (2.15), total dry matter production (55.79 g) and minimum days to flower bud initiation (35.00 days) and days to 50 per cent flowering (41.07 days). Same treatment also recorded significantly maximum number of pods (55.28), pod length (19.84 cm), pod girth (2.37 cm), pod weight (14.96 g), pod yield per plant (621.74 g) and pod yield per 1000m^2 (2.30 t) over control.

Keywords **:** Water-Soluble Fertilizers, Bio Stimulants, Growth and Yield, Pole Bean (*Phaseolus vulgaris* L.)

Introduction

French bean (*Phaseolus vulgaris* L.), native to Central and South America, is a versatile vegetable species cultivated for its pods, seeds, and foliage. It is a self-pollinated, diploid, annual herbaceous plant with three growth habits: bush, semi-pole, and pole types. French beans have dark green to light green leaves, hairy growth, and tap roots, with pods that are slender, 10-25 cm long, and straight or curved. Pole beans, a trailing type, grow up to 10 feet tall, require support, and yield two to three times more than bush beans. Pole beans are promoted for their high yield potential, crop rotation benefits, and intercropping suitability, offering improved yield steadiness over bush beans (Neethu *et al*., 2022).

Water-soluble fertilizers provide essential nutrients to plants through precise irrigation and foliar applications, promoting healthy growth and increased yields. Foliar application bypasses soil complexities, ensuring efficient fertilizer use and improved crop quality, particularly in crops like french beans. Key water-soluble fertilizers, such as potassium nitrate, 19:19:19 and monoammonium phosphate facilitate rapid nutrient utilization and better absorption (Gowda, 2022).

Bio stimulants, including humic acids, seaweed extracts, panchagavya and beneficial microorganisms, enhance plant growth and development beyond traditional nutrient supply by stimulating natural processes. These substances improve nutrient use efficiency, stress tolerance, and overall plant health, leading to better root growth, photosynthesis, and crop quality in vegetables like French beans. Integrating bio stimulants with water-soluble fertilizers offers a sustainable agriculture approach, optimizing plant growth and productivity through synergistic effects (Rupan, 2019).

Material and Methods

The present investigation was carried out during Rabi 2023-24, at College of Horticulture, Mudigere. The experiment was laid out in Randomized Complete Block Design with 12 treatment combinations replicated thrice under naturally ventilated polyhouse. The seeds were sown at a distance of 60 cm between row to row and 45 cm between plants. All the recommended cultural operations were followed and observations were recorded in five randomly selected plants per replication of all the treatments. Well decomposed FYM @ 25 tonnes per hectare was applied at the time of land preparation. The recommended dose 150:75:75 kg NPK per ha was applied in the form of urea, single super phosphate and muriate of potash, respectively. The treatments include T_1- RDF(Control), T_2-19:19:19 @ 1%, T_3- MAP 0.5% + KNO_3 0.5%, T_4-19:19:19 @ 1% + Humic acid 0.5%, T_5-19:19:19 @ 1% + Sea weed extract 0.5%, T_6-19:19:19 @ 1% + Panchagavya 3%, T_7- MAP 0.5% + KNO_3 0.5% + Humic acid 0.5%, T_8- MAP 0.5% + KNO_3 0.5% + Sea weed extract 0.5%, T_9- MAP 0.5% + KNO_3 0.5% + Panchagavya 3%, T_{10}- Humic acid 0.5% + Sea weed extract 0.5% + Panchagavya 3%, T_{11}-19:19:19 @1% + Humic acid 0.5% + Sea weed extract 0.5% + Panchagavya 3% and T_{12}- MAP 0.5% + KNO_3 0.5% + Humic acid 0.5% + Sea weed extract 0.5% + Panchagavya 3%.The foliar application of treatments was done at 15, 30, 45 days after sowing and growth parameters were recorded at 30, 45, 60 and 75 days after sowing. Yield parameters were recorded as and when harvesting was done. Analysis of variance was performed following the statistical method described by Panse and Sukhatme (1967) and significance of differences among treatment means were calculated at 5% level of significance.

Results and Discussion

The data on growth parameters as influenced by foliar application of water-soluble fertilizers and bio stimulants are presented in Table 1.

Table 1 : Effect of water-soluble fertilizers and bio stimulants on growth parameters of pole bean (*Phaseolus vulgaris* L.)

Treatments	plant height (cm)	primary branches per plant	secondary branches per plant	number of leaves per plant	leaf area plant^{-1} (cm^2)	leaf area index	dry matter production (g/plant)
T_1	469.78	5.80	6.60	134.40	3819.67	1.41	43.23
T_2	483.00	6.13	7.07	136.00	4012.62	1.49	45.13
T_3	490.74	6.33	7.13	137.41	4090.64	1.52	46.21
T_4	520.67	6.40	7.33	140.75	4365.11	1.62	48.14
T_5	549.74	6.53	7.80	143.00	4752.76	1.76	50.34
T_6	531.00	6.40	7.33	140.00	4333.42	1.60	48.49
T_7	543.67	6.60	7.73	144.67	4724.01	1.75	50.59
T_8	554.33	6.87	8.20	148.44	5474.27	2.03	53.38
T_9	550.00	6.80	8.00	147.00	5207.78	1.93	52.54
T_{10}	544.00	6.73	7.93	145.43	5058.76	1.87	52.14
T_{11}	564.75	6.93	8.40	151.09	5614.19	2.08	54.10
T_{12}	580.00	7.20	8.53	154.00	5807.01	2.15	55.79
S. Em±	**5.07**	**0.08**	**0.12**	**1.86**	**63.88**	**0.02**	**0.48**
CD @ 5%	**15.26**	**0.27**	**0.36**	**5.45**	**187.35**	**0.07**	**1.41**

The results recorded that, the treatment T_{12} (MAP 0.5% + KNO_3 0.5% + Humic acid 0.5% + Sea weed extract 0.5% + Panchagavya 3%) has shown the highest plant height (580.00 cm) whereas lowest was observed in control (469.78 cm). The plant height was progressively increased as the age of crop advanced up to harvest due to more availability of essential nutrients at critical growth stages by the application of water-soluble nutrients directly to the foliage. Biostimulants like humic acid, seaweed extract and panchagavya rich in natural growth hormones, boosts cell division, cell elongation, adds beneficial microorganisms and growth-promoting substances further increasing height. Similar findings were noticed

by Gowda (2022), Mandaliya *et al*. (2022) and Bhawariya (2022).

A similar trend was observed regarding the number of primary and secondary branches (7.20 and 8.53), was observed with application of MAP 0.5% + KNO_3 0.5% + Humic acid 0.5% + Sea weed extract 0.5% + Panchagavya 3% (T_{12}) as compared to RDF. The possible reason could be that the foliar application of the water-soluble fertilizers and biostimulants increases metabolic activity process *viz.*, photosynthesis and symbiotic biological N_2 fixation. It also increases chlorophyll and N, P, K content and K concentration increased number of branches was also reported in Gowda (2022) on chilli. Similar findings were also reported by Mandaliya *et al*. (2022) and Bhawariya (2022).

Maximum number of leaves per plant (154.00), leaf area per plant (5807.01 cm^2), leaf area index (2.15) and dry matter production (55.79 g/plant) was recorded in treatment T_{12} (MAP 0.5% + KNO_3 0.5% + Humic acid 0.5% + Sea weed extract 0.5% + Panchagavya 3%). Foliar nutrition and bio stimulant application enhanced nitrogen uptake, boosting chlorophyll content and photosynthesis, stimulating rapid cell division and elongation and increasing the number of leaves per plant. Higher leaf number per plant drove increased leaf area, progressively boosting Leaf Area Index (LAI). Similar findings were documented by Krishnan *et al*. (2014), Sahana *et al.* (2018), Mandaliya *et al*. (2022) in cowpea and Baldaniya *et al.* (2023). The higher total dry matter accumulation was associated with the higher number of leaves, which in turn led to maximum leaf area, resulting in higher assimilatory surface area for absorption of foliar applied nutrients, resulting in the higher accumulation of photosynthates. Similar findings were observed by Gowda (2022) and Baldaniya *et al* (2023). While the lowest growth parameters were recorded with the control treatment (RDF). This might be due to a lack of availability of nutrients at critical crop growth stages.

Flowering parameters

The data on number of days taken for initiation of flowering, 50 per cent flowering, days to first picking, number of clusters per plant and number of flowers per cluster are presented in the Table 2.

Combined application of MAP @ 0.5 % + KNO_3 @ 0.5 % + Humic acid 0.5% + Sea weed extract 0.5% + Panchagavya 3% (T_{12}) took minimum days for initiation of flower bud, 50 per cent flowering and days taken for first picking (35.80, 41.07 and 46.37 days, respectively) on the contrary, RDF took maximum days. Optimized plant nutrition and hormone activity, facilitated by foliar applications and bio stimulants, accelerate flowering initiation and uniformity in beans.

A significantly higher number of clusters per plant and flowers per cluster observed in (T_{12}) MAP @ 0.5 % + KNO_3 @ 0.5 % + Humic acid 0.5 % + Sea weed extract 0.5 % + Panchagavya 3 % (17.20 and 4.53) and lowest recorded in RDF. Foliar treatments and biostimulants supply essential nutrients and bioactive compounds to leaves, promoting optimal photosynthesis, nutrient uptake, and hormonal balance, resulting in increased flowering, improved plant vigor, and enhanced stress tolerance. Similar findings were observed in Udayakumar *et al.* (2019) in french bean and Mandaliya *et al*. (2022) in cowpea.

Yield parameters

The data on yield parameters as influenced by water soluble fertilizers and bio stimulants are presented in Table 3.

For number of pickings, pod length, pod girth significant differences were observed in the treatments. The treatment which received MAP @ 0.5 % + KNO_3 @ 0.5 % + Humic acid 0.5% + Sea weed extract 0.5% + Panchagavya 3% (T_{12}) gives maximum number of pickings (11.73), pod length (19.84 cm) and pod girth (2.37 cm) as compared to RDF (T_1). It boosts nutrient absorption, plant growth, and stress resistance, resulting in earlier flowering, higher yields, and better-quality pole bean produce.

Similar trend was noticed with respected to pod weight (14.96 g) and number of pods per plant (55.28). The maximum number of pods per plant was attributed to increased branching and pickings, supported by improved soil fertility and productivity from water-soluble fertilizers and bio stimulants. These applications also boosted pod weight by enhancing water absorption, metabolite synthesis, photosynthesis, and stress tolerance, resulting in longer, thicker pods with increased average weight. Similar results were also reported by Swarnam *et al.* (2018), Gowda (2022), Dodiya *et al.* (2024) and Sindha *et al.* (2024).

Different treatments showed significant effect on pod yield production in pole bean. Pod yield per plant (621.74 g), pod yield per plot (9.95 kg) and pod yield per 1000 m^2 (2.30 t/ha) were significantly higher with the inoculation of MAP 0.5 @ % + KNO_3 @ 0.5 % + Humic acid 0.5 % + Sea weed extract 0.5 % + Panchagavya 3 % (T_{12}). The superior yield performance of pole beans was attributed to balanced nutrition, eliminating nutrient stress throughout growth stages, and enhanced reproductive parameters. The presence of growth-promoting substances (auxin, gibberellins, cytokinin) in humic acid, sea weed

extract, and panchagavya optimized photosynthesis, nutrient uptake, and stress tolerance, ultimately boosting pod yield per plant and overall crop productivity. The results are in agreement with the earlier findings by Rupan (2019), Gowda (2022) and Sindha *et al.* (2024).

Table 2 : Effect of water-soluble fertilizers and bio stimulants on flowering parameters of pole bean (*Phaseolus vulgaris* L.)

Treatments	Days to flower bud initiation	Days to 50 per cent flowering	Days taken for first picking	Number of clusters per plant	Number of flowers per cluster
T_1	44.73	48.73	55.87	13.20	3.47
T_2	42.87	47.93	54.60	13.53	3.67
T_3	42.47	47.67	54.07	13.73	3.87
T_4	40.93	46.60	53.07	14.00	3.93
T_5	38.40	43.40	49.93	14.47	4.20
T_6	41.13	44.60	52.40	13.93	4.13
T_7	39.27	43.53	51.00	14.33	4.20
T_8	36.73	42.27	48.53	15.27	4.27
T_9	38.27	42.40	49.00	14.93	4.27
T_{10}	37.93	43.00	49.07	14.87	4.20
T_{11}	36.07	42.20	48.23	16.13	4.33
T_{12}	35.00	41.07	46.37	17.20	4.53
S. Em±	**0.51**	**0.55**	**0.68**	**0.13**	**0.06**
CD @ 5%	**1.51**	**1.63**	**2.01**	**0.38**	**0.17**

Table 3 : Effect of water-soluble fertilizers and bio stimulants on pod yield parameters of pole bean (*Phaseolus vulgaris* L.)

Treatments	Number of pickings	Pod length (cm)	pod girth (cm)	Pod weight (g)	Number of pods per plant	Pod yield per plant (g)	Pod yield per plot (kg)	Pod yield 1000 m^2 (t)
T_1	7.60	15.20	1.79	10.86	36.04	400.08	6.40	1.48
T_2	8.20	15.65	1.86	11.73	38.85	419.76	6.72	1.55
T_3	8.60	15.80	1.92	11.83	39.52	427.96	6.85	1.59
T_4	9.13	16.62	2.02	12.21	42.24	449.02	7.18	1.66
T_5	10.33	17.33	2.21	12.97	45.80	479.91	7.68	1.78
T_6	9.33	16.72	2.12	12.52	42.93	440.98	7.06	1.63
T_7	10.40	17.20	2.16	12.76	46.40	487.97	7.81	1.81
T_8	11.07	18.47	2.23	13.52	50.17	549.83	8.80	2.04
T_9	10.87	18.23	2.25	13.85	48.80	532.49	8.52	1.97
T_{10}	10.53	17.76	2.20	13.63	48.32	526.62	8.43	1.95
T_{11}	11.20	18.63	2.26	13.95	52.10	578.10	9.25	2.14
T_{12}	11.73	19.84	2.37	14.96	55.28	621.74	9.95	2.30
S. Em±	**0.13**	**0.36**	**0.03**	**0.15**	**1.03**	**7.93**	**0.13**	**0.03**
CD @ 5%	**0.37**	**1.06**	**0.10**	**0.45**	**3.03**	**23.25**	**0.37**	**0.09**

Conclusion

From the present study it may be concluded that the treatment T_{12} *i.e.* application of MAP @ 0.5 % + KNO_3 @ 0.5 % + Humic acid 0.5 % + Sea weed extract 0.5 % + Panchagavya 3 % at 30, 45, 60 and 75 DAS with RDF registered proved to be superior to other treatments in regarding all vegetative, flowering and yield parameters like plant height, number of primary and secondary branches, number of leaves, leaf area, leaf area index and dry matter production, number of clusters per plant, number of flowers per cluster, pod length, girth, weight, number of pods per plant, number of pickings, pod yield per plant, pod

yield per plot and pod yield per 1000 m^2. Earliness in flowering also observed in treatment T_{12}.

References

Baldaniya, J. K., Panchal, B. H., Rathod, M. B. and Macwan, S.J. (2023). Effect of bio stimulants on growth and quality of broccoli (*Brassica oleracea* var. *italica*) cv. Pusa KTS-1. *Pharm Innov,* **12**(5): 667-670.

Bhawariya, A., Pareek, N. K., Sunda, S. L., Rakesh, S. and Rathore, B. S. (2022). Effect of foliar application of organics and fertilizers on growth yield and economics of cluster bean (*Cyamopsis tetragonoloba* L. Taub.). *Biol. Forum-A Int. J*., **14**(1): 608-613.

Dodiya, S., Pisal, R., Chaudhary, K., and Gohil, V. (2024). Agronomic study on cowpea growth and yield influenced by PGRs and foliar nutrition. *J. Pharm. Innov.,* **12** (12): 2757-2761.

Gowda, D. (2022). Influence of water soluble fertilizers and PGPR on growth, yield and quality of green chilli (*capsicum annuum* L.) Under Hill Zone of Karnataka. *M.Sc. (Agri) thesis*, KSN Univ. Agric. And Horti. Sci., Shivamogga, Karnataka (India)

Krishnan, A., Indiresh, K. M. and Anjanappa, M. (2014), Effect of water-soluble fertilizers on growth and yield of tomato (*Solanum lycopersicum* L.). *J. Trop Agric*., **52**(2): 154-157.

Mandaliya, J. V., Desai, K. C., Patel, C. R., Gondaliya, B. R. and Solanki, P. P. (2022). Response of vegetable cowpea (*Vigna unguiculata* L. Walp.) to different bio stimulants. *Pharma innov*., **11**(4): 216-221.

Neethu, T. M., Adivappar, N., Srinivasa, V. and Girijesh. G. K. (2022). Effect of spacing and fertigation on growth and yield parameters of french bean (*Phaseolus vulgaris* L.) under protected cultivation. *Legume Res*., **45**(6):742-748.

Panse, V. G. and Sukhatme, P. V. (1957). The application of genetics to plant breeding. IV. The inheritance of quantitative characters and plant breeding. *J. Genet*., **40**: 283-302.

Rupan, D. (2019). Effect of panchagavya, humic acid, sea weed extract and brassinolide on growth and yield of bitter gourd (*Momordica charantia* L.). *M.Sc (Agri) thesis*, Odisha Uni. Agric. Tech., Bhubaneswar, India.

Sindha, P. M., Patel, H, H., Patel, J, N., Bambhaniya, S. M. and Vaishnav, M.D. (2024). Effect of nutrient management on cowpea [*Vigna unguiculata* (L.) Walp]. *Int J Plant Soil Sci*, **36**(4): 257-265.

Swarnam, T. P., Velmurugan, A., Jaisankar, I. and Roy, N. (2018). Effect of foliar application of panchagavya on yield and quality characteristics of eggplant (*Solanum melongena* L.). *Adv. Life Sci*., **5**(7): 2278-4705.

Udayakumar, Ramesh, G., Patil, S., Pampanna, Y. and Anand, N. (2019). Effect of fertigation and foliar application of nutrients on yield and quality of french bean (*Phaseolus vulgaris* L.). *Int. J. Curr. Microbiol. App. Sci.*, **8**(9): 812-821.