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Effect of bio-regulators and plant growth promoting bacteria on growth attributes of Indian bean (*Lablab purpureus* L. var. typicus)

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Abstract
A field experiment was carried out to know the effect of bio-regulators and plant growth promoting bacteria (PGPB) on growth, yield and quality of Indian bean (*Lablab purpureus* L. var. typicus)" during *kharif* season 2017 at Horticulture Farm, S.K.N. College of Agriculture, Jobner (Jaipur).The experiment consisted of twenty treatment combinations including five bio-regulators (control, brassinoids 0.5 ppm, brassinoids 1.0 ppm, salicylic acid 100 ppm and salicylic acid 150 ppm) and four plant growth promoting bacteria (control, *Rhizobium*, *Pseudomonas* and *Rhizobium* + *Pseudomonas*). Experiment laid out in randomized block design with three replications. The results of the study clearly indicated that application of brassinoids 1.0 ppm to the Indian bean significantly increased the plant height (77.56 cm), number of branches per plant (9.82), dry matter accumulation(90.50,161.72 and 215.0 g/m row length) at 45, 60 and 75 days after sowing, respectively, CGR (26.38 and 19.73 g/m^2/day) at 45-60 and 60-75 days after sowing, chlorophyll content in leaves (1.942 mg/g) and leaf area (3093 cm^2) as compared to control. Similarly, seed inoculation with *Rhizobium* + *Pseudomonas* also significantly increased the plant height (76.70 cm), number of branches (10.80), dry matter accumulation (92.17,161.51 and 218.76 g/m row length) at 45, 60 and 75 days after sowing, respectively, CGR (25.68 and 21.20 g/m^2/day) at 45-60 and 60-75 days after sowing, chlorophyll content in leaves (1.931 mg/g) and leaf area (3027 cm^2) than control (no inoculation).

Keywords: Brassinoids, growth, Indian bean, *Pseudomonas fluorescens*, *Rhizobium phaseoli* and salicylic acid

1. Introduction
Indian bean or Dolichos bean (*Lablab purpureus* L. var. typicus) belongsto the family fabaceae (2n=22). There are two type of cultivated species of Indian bean *viz*, *Lablab purpureus* var. typicus which is vegetable type, cultivated for its soft and edible pods and *Lablab purpureus* var. lignosus is the field bean, cultivated for dry seeds as pulse.The pods of Indian bean are important source of protein, minerals and dietary fibre. Its mature dark coloured seeds contains trypsin inhibitor, which break down into water soluble cyanogenic. The nutritional composition of edible green pods contain 86 percent moisture, 2 percent fibre, 4 percent protein, 7.10 percent carbohydrate, 48 Kcal energy, 68mg phosphorus, 1mg iron, 210mg Ca, 668 IU vitamin-A, 0.08mg thiamine, 0.11mg riboflavin, 0.75mg niacin and 9.3mg vitamin C (Gopalan *et al.*, 2004) [5]. The growth hormones and bio-regulators not only regulate the growth of plant species, which play an important role in root induction and growth of plants but also play important role in DNA replication, cell division, controlling of microgenesis, senescence and resistant to environmental stresses (Kaur-Sawhney *et al.*,2003) [6]. Brassinosteroids improve the resistance power in the plants against environmental stresses *viz*., water stress, salinity stress, low and high temperature stress (Rao *et al*., 2002) [18] and crop productivity (Vardhini *et al*., 2006) [24]. Salicylic acid plays an important role in the regulation of some physiological processes in plants and positively affects growth and development, ion uptake, transport, photosynthesis, and membrane permeability (Simaei *et al*., 2012) [23]. Use of Plant Growth Promoting Bacteria (PGPB) can have a great importance for increasing fertilizer use efficiency and crop productivity.

Reduced application rates of chemical fertilizers through inoculation with plant growth-promoting rhizobacteria were supplementing 75% of the recommended fertilizer rate with inoculants produced statistically equivalent plant growth, yield and nutrient (nitrogen and phosphorus) uptake to the full fertilizer rate without inoculants (Adesemoye *et al*., 2009) [1]. Thus, the present experiment was conducted to study the effect of bio-regulators and plant growth promoting bacteria on growth attributes of Indian bean.

Materials and methods

The experiment was conducted at Horticulture Farm, S.K.N. College of Agriculture, Jobner (Jaipur) during *Kharif* season 2016-2017. This region falls under agro-climatic zone-IIIA (Semi-Arid Eastern Plains) in Rajasthan state of India.The experiment was laid out in Randomized Block Design having twenty treatment combinations including five bio-regulators (B_0-control, B_1-brassinoids 0.5 ppm, B_2-brassinoids 1.0 ppm, B_3-salicylic acid 100 ppm and B_4-salicylic acid 150 ppm) and four plant growth promoting bacteria (P_0-control, P_1-*Rhizobium*, P_2-*Pseudomonas and* P_3-*Rhizobium* + *Pseudomonas*)with three replications. Bio-regulators was sprayed as foliar application at 30 and 45 DAS as per treatment combinations. The process of inoculation was preceded by seed treatment with fungicide then seed inoculation with *Rhizobium phaseoli* and *Pseudomonas fluorescens* before sowing by putting seeds in 20% sucrose solution and then inoculated with @ 10 g/kg of seeds by putting the uniform coating of chalk form powder on seeds and were allowed to air dry in shade. The seeds were sown on the same day after inoculation. The seeds of control plot treated with sucrose solution only. The crop geometry was kept at 60 x 30 cm in a plot of 2.8 m × 1.4 m (4.32 m^2) size. All the cultural operations were followed which were necessary to raise the good crop. The observations like plant height (cm), number of branches per plant, dry matter accumulation(g/m), CGR at 45-60 and 60-75(g/m^2/day)days after sowing, chlorophyll content in leaves (mg) and leaf area (cm^2) were recorded. CGR was calculated by Radford, 1967[15] method. chlorophyll content was measured by using the method of Arnon (1949) [3] with slight modifications. The data obtained from the trial were subjected to statistical analysis and the results were documented, analysed and presented in tabular form.

Results and Discussion

Effect of bio-regulators

An appraisal of data in table 1 and 2 reveals that growth parameters was significantly influenced by the application of different bio-regulators at different stages of Indian bean crop. The maximum plant height (77.56 cm) at final harvesting stage, number of branches per plant **(**9.82) at 60 DAS, dry matter accumulation 90.50 g, 161.72 g and 215 g at 45, 60 and 75 DAS,CGR (26.38) at 45 to 60 DAS and (19.73) at 60 to 75 DAS, total chlorophyll content in leaves (1.942 mg/g)and leaf area (3093 cm^2) at 60 DAS were recorded under treatment B_2 (Brassinoids @ 1.0 ppm) and minimum under control. The treatment B_2 where brassinoids @ 1.0 ppm was applied observed as significantly superior over control but remained statistically at par with treatment B_1 (Brassinoids @ 0.5 ppm), B_3 (Salicylic acid @ 100 ppm) and B_4 (Salicylic acid @ 150 ppm) in case of plant height, dry matter accumulation at 45, 60 and 75 DAS and CGR at 45 to 60 DAS and 60 to 75 DAS. However, in case of leaf area the treatment B_4 (Salicylic acid @ 150 ppm) remained statistically at par with treatment B_2.This might be due to the stimulating effect of brassinosteroids in cell division and cell elongation. The reason can also be attributed to the synergistic effects of brassinosteroid with the available endogenous auxin as reported by Meudt *et al*., (1983) [10]. The increase in growth attributes also supported by Vardhini and Rao (2001) [25]. Brassinolide promoted shoot growth and increased the shoot height of *Sportina patens* cultured callus (Lu *et al*., 2003) [9]. The increase in chlorophyll content by brassinoide treatment was reported in groundnut by Prakash *et al*., (2006) [12] and by salicylic acid in soybean by Sharma and Kaur (2003) [22]. The increase in chlorophyll content was enhanced by these bio-regulators because the chlorophyllase enzyme which is responsible for chlorophyll depletion might have been inhibited leading to higher accumulation of chlorophyll (Paricha *et al*., 1977) [11]. The increase in leaf area per plant with brassinoide treatment also revealed by Prakash *et al*., (2008) [13] and Choudhary (2017) [4]. The increase in leaf area might also be due to activities of meristematic tissues of plant, increase in number and size of cells, which ultimately increased photosynthetic surface area and vegetative growth of plants (Ramraj *et al*., 1997) [17].

Effect of plant growth promoting bacteria (PGPB)

An appraisal of data in table 1 and 2also reveals that growth parameters were significantly influenced by the inoculation of plant growth promoting bacteria at sowing time of Indian bean crop. The maximum plant height of (76.70 cm) at final harvesting stage, number of branches per plant **(**10.80) at 60 DAS, dry matter accumulation as 92.17 g, 161.51 g and 218.76 g at 45, 60 and 75 DAS,CGR (25.68g/m^2/day) at 45 to 60 DAS and (21.20 g/m^2/day) at 60 to 75 DAS, total chlorophyll content in leaves (1.931 mg/g)and leaf area (3027 cm^2) at 60 DAS were recorded under treatment P_3 (inoculation with *Rhizobium phaseoli* + *Pseudomonas fluorescens*) and minimum under control and remained statistically at par with treatment P_1 (inoculation with *Rhizobium*) and P_2 (inoculation with *Pseudomonas*) in case of plant height, dry matter accumulation at 60 DAS and CGR at 45 to 60 DAS. However, in case of leaf area the treatment P_1 (inoculation with *Rhizobium*) remained statistically at par with treatment P_3.

Inoculation of seed with symbiotic nitrogen fixers might have increased the concentration of an efficient and healthy strain of *Rhizobium* in rhizosphere, which in turn resulted in greater fixation of atmospheric nitrogen in soil by the plants and consequently resulting into higher growth (Prasad and Maurya, 1989) [14]. PGPB promote plant growth through production of phytohormones, siderophores, antibiotics, enzymes and /or fungicidal compounds (Saleim *et al*., 2011) [21]. Many PGPB have shown the role of rhizosphere as an ecosystem and has gained importance in the functioning of biosphere (Ahmed and Khan, 2011)[2]. Various bacterial species *viz*., *Pseudomonas*, *Azospirillium*, *Azotobacter* and *Bacillusetc*. have been reported to enhance plant growth (Kumar *et al*., 2012) [7], germination and seedling vigour in tomato (Rathaur *et al*., 2012) [19] and in soyabean (Kumar *et al*., 2012) [7]. *Fluorescent pseudomonads*, a group of PGPB are the most studied once which help in soil health maintenance and are metabolically and functionally most diverse (Lata *et al*., 2000) [8]. Presence of *fluorescent pseudomonad* inoculants in combination with microbial

fertilizer play an effective role in stimulating plant yield and growth (Rokhzadi *et al*., 2008) [20]. Another widespread characteristic among the rhizosphere bacteria is the ACC deaminase activity, whose regulation is a principal mechanism by which bacteria exert beneficial effects on plants under biotic and abiotic stress (Rama *et al*., 2013)[16].

Table 1: Effect of Bio-regulators and PGPB on growth attributes of Indian bean

Treatment combinations	Characters				
	Plant height (cm) at final harvesting stage	Number of branches per plant at 60 DAS	Crop Dry Matter Accumulation (g/m row length) at 45 DAS	60 DAS	75 DAS
Bio-regulators					
B_0	69.13	5.54	74.00	128.20	169.80
B_1	74.71	8.76	89.70	160.74	213.00
B_2	77.56	9.82	90.50	161.72	215.00
B_3	75.95	9.29	88.40	157.00	210.00
B_4	77.06	9.34	89.50	158.77	212.00
S.Em+	1.11	0.13	1.17	2.07	2.78
CD at 0.05%	3.17	0.37	3.35	5.94	7.97
PGPB					
P_0	73.15	6.00	76.17	137.31	181.56
P_1	75.47	8.80	89.17	157.71	208.76
P_2	74.21	8.60	88.17	156.61	206.76
P_3	76.70	10.80	92.17	161.51	218.76
S.Em+	0.99	0.12	1.05	1.85	2.49
CD at 0.05%	2.84	0.33	3.00	5.31	7.12

Table 2: Effect of Bio-regulators and PGPB on growth attributes of Indian bean

Treatment combinations	Characters			
	Total Chlorophyll (mg/g)	Leaf area (cm^2)	Crop Growth Rate (g/m^2/day) at 45 to 60 DAS	60 to 75 DAS
Bio-regulators				
B_0	1.519	2483	20.07	15.41
B_1	1.859	2593	26.31	19.35
B_2	1.942	3093	26.38	19.73
B_3	1.810	2969	25.41	19.63
B_4	1.833	3056	25.66	19.71
S.Em+	0.027	37	0.33	0.26
CD at 0.05%	1.519	2483	0.96	0.75
PGPB				
P_0	1.680	2488	22.65	16.39
P_1	1.820	2974	25.39	18.91
P_2	1.740	2865	25.35	18.57
P_3	1.931	3027	25.68	21.20
S.Em+	0.024	33	0.30	0.23
CD at 0.05%	0.070	94	0.86	0.67

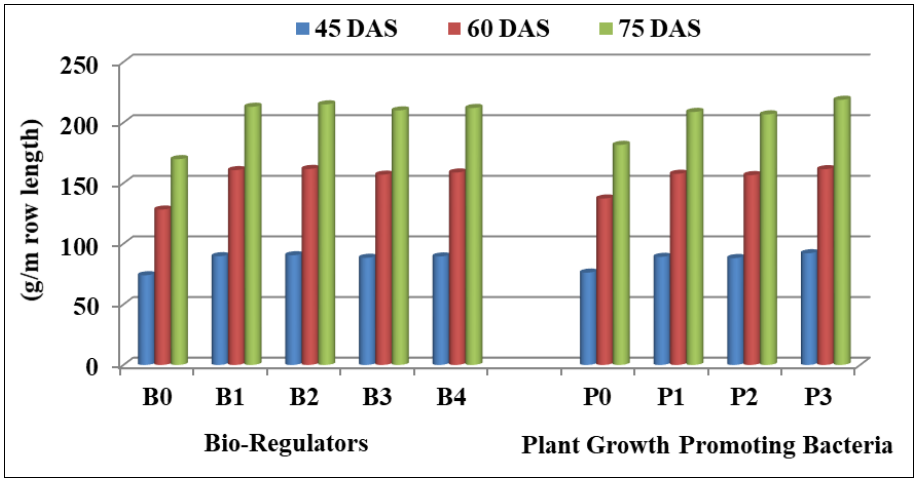

Fig 1: Effect of bio-regulators and plant growth promoting bacteria on crop dry matter accumulation of Indian bean

Conclusion

On the basis of results of one year experiment, it may be concluded that the application of bio-regulator as brassinoids @ 1.0 ppm and seed inoculation by plant growth promoting bacteria *Rhizobium* + *Pseudomonas* were found most suitable in terms of growth attributes which being at

par to brassinoids 0.5 ppm and seed inoculation with *Rhizobium* and *Pseudomonas*, respectively. Thus, applications of brassinoids 0.5 ppm and *Rhizobium phaseoli* + *Pseudomonas fluoresens* to Indian bean crop is recommended.

References

1. Adesemoye AO. Torbert HA. Kloepper JW. Plant growth-promoting rhizobacteria allow reduced application rates of chemical fertilizers. Microbial Ecology. 2009;58:921-929.
2. Ahmed M, Khan MS. Functional aspects of plants growth promoting rhizobacteria: recent advancements. Insight Microbiology. 2011;1:9-54.
3. Arnon DI. Copper enzymes in isolated chloroplast I polyphenol oxidase in Beta vulgaris. Plant Physiology. 1949;24:1-5.
4. Choudhary KK. Effect of brassinolide on physiological aspects, growth and yield of wheat (*Triticum aestivum* L.) under salt stress. M.Sc. (Ag.) thesis, submitted to S. K. N. Agriculture University, Jobner, Jaipur; c2017.
5. Gopalan C, Rama Sastri BV, Balasubramanian SC. Nutritive Value of Indian Food, National Institute of Nutrition, ICMR, Hyderabad; c2004.
6. Kaur-Sawhney R, Tiburico FA, Altabella T, Galston AW. Polyamines in plants. An overview. Journal of Cell and Molecular Biology. 2003;2:1-12.
7. Kumar A, Kumar A, Devi S, Patil S, Payal C, Sushila Negi S. Isolation, screening and characterization of bacteria from rhizospheric soils for different plant growth promotion (PGP) activities: an *In vitro* study. Recent Research in Science and Technology. 2012;4:01-05.
8. Lata AK, Sexena KV, Tilak BR. Biofertilizers to augment soil fertility and crop production, in soil fertility and crop production (Ed. K.R. Krishna) science Publishers, USA; c2000. p. 297-312.
9. Lu Z, Huang M, Ge DP, Yang YH, Cai X, Qin, NP, *et al*. Effect of brassinolide on callus growth and regeneration in *Spartina patens* (Poaceae). Plant Cell Tissue and Organ Culture. 2003;73:87-89.
10. Meudt WJ, Thompson MJ, Benvet HW. Investigations on the mechanism of the brassinosteroid response III. Techniques for potential enhancement of crop production. 10th Proceedings of Plant Growth Regulation Society Annals; c1983. p. 312-318.
11. Paricha PC, Ghosh BK, Sahoo NC. Further studies on the significance of cycocel in enhancing drought resistance in rice. Science and Culture. 1977;43:230-231.
12. Prakash D, Arima M, Mohan A. Ultrahigh-temperature metamorphism in the palni hills, South India: Insights from feldspar thermometry and phase equilibria. International Geology Review. 2006;48:619-638.
13. Prakash M, Suganthi S, Gokulakrishnan J, Sabesan T. Effect of homobrassinolide on growth, physiology and biochemical aspects of sesame. Karnataka Journal of Agricultural Science. 2008;20:110-112.
14. Prasad RN, Maurya AN. Note on effect of rhizobium at different levels of phosphorus on growth, nodulation and yield of garden pea (*Pisum sativum* L.) cv. Arkel. Progressive Horticulture. 1989;21:208-212.
15. Radford PJ. Growth analysis formulae – their use and abuse. Crop Science. 1967;7:171-175.
16. Rama D, Lakkineni VK, Bose P, Ali S, Annapurna K. Mitigation of salt stress in wheat seedlings by halotolerant bacteria isolated from saline habitats. Springer Plus. 2013;2:6.
17. Ramraj VM, Vyas BN, Godrej NB, Mistry KB. Swami BN. Singh N. Effects of 28-homobrassinolide on yields of wheat, rice, groundnut, mustard, potato and cotton. Journal of Agricultural Science. 1997;128:405-413.
18. Rao SSR, Vardhini BV, Sujatha E, Anuradha S. Brassinostroids: A new class of phytohormones. Current Science. 2002;82:1239-1245.
19. Rathaur P, Raja W, Ramteke PW, John SA. Effect of UV-B tolerant plant growth promoting rhizobacteria (PGPR) on seed germination and growth of *Withania somnifera*. Advance Applied Science Research. 2012;3:1399-1404.
20. Rokhzadi A, Asgharzadeh A, Darvish F, Nour-Mohammadi G, Majidi E. Influence of plant growth promoting rhizobacteria on dry matter accumulation of chickpea (*Cicer arietinum* L.) under field conditions. Journal of Engineering and Applied Science (JEAS). 2008;3:253-257.
21. Seleim MAA, Saead KMH, Abd-EI-Moneem, Abo-EL-Yousr KAM. Biological control of bacterial wilt of tomato by plant growth promoting rhizobacteria. Plant Pathology. 2011;10:146-153.
22. Sharma K, Kaur S. Effect of exogenous application of brassinolide and salicylic acid on certain physiological and biochemical aspects og green gram (*Vigna radiata* L.). Indian Agriculturist. 2003;47:79-84.
23. Simaei M, Khavari-Nejad RA, Bernard F. Exogenous application of salicylic acid and nitric oxide on the ionic contents and enzymatic activities in NaCl-stressed soybean plants. American Journal of Plant Sciences. 2012;3:1495-1503.
24. Vardhini B, Anuradha S, Rao SR. Brassinosteroids – new class of plant hormone with potential to improve crop productivity. Indian Journal of Plant Physiology. 2006;11:1-12.
25. Vardhini BV, Rao SSR. Effect of brassinosteroidson growth and yield of tomato (*Lycopersicon esculentum* Mill) under field conditions. Indian Journal of Plant Physiology. 2001;6:326-328.