International Journal of Horticulture and Food Science 2022; 4(1): 176-180

E-ISSN: 2663-1067
P-ISSN: 2663-1075
https://www.hortijournal.com
IJHFS 2022; 4(1): 176-180
Received: 13-01-2022
Accepted: 14-02-2022

Amruta Katti
M.Sc. Scholar, Department of Vegetable Sciences, College of Horticulture, Bagalkot, Karnataka, India

Rudresh DL
Assistant Professor, Department of Agricultural Microbiology, College of Horticulture, Bagalkot, Karnataka, India

RS Jawadagi
Professor and Head, Department of Vegetable Science, College of Horticulture, Bagalkot, Karnataka, India

Shashikanth Evoor
Assistant Professor, Department of Vegetable Science, College of Horticulture, Bagalkot, Karnataka, India

Sanjeevraddi G Reddi
Assistant Professor, Department of Agronomy, College of Horticulture, Bagalkot, Karnataka, India

Corresponding Author:
Amruta Katti
M.Sc. Scholar, Department of Vegetable Sciences, College of Horticulture, Bagalkot, Karnataka, India

Plant growth promoting microbial consortia for enhancing growth and yield attributes of Brinjal (*Solanum melongena* L.)

Amruta Katti, Rudresh DL, RS Jawadagi, Shashikanth Evoor, Sanjeevraddi G Reddi

DOI: https://doi.org/10.33545/26631067.2022.v4.i1c.138

Abstract
Combinations of plant growth promoting microorganisms were evaluated under pot culture to test their ability to enhance growth and yield attributes of Brinjal during rabi 2020 at the Department of Vegetable Science, College of Horticulture, Bagalkot, (UHS, Bagalkot), Karnataka, India. The pot experiment was laid out in a completely randomized design with sixteen treatments and three replications. The experiment results showed that combination of VAM + *Azotobacter* + *Trichoderma harzianum* to be the best PGPR consortia for enhancing the growth and yield attributes of brinjal followed by VAM+PSB. The treatment combination containing VAM + *Azotobacter* + *Trichoderma harzianum* showed the maximum plant height (22.56, 46.16 and 62.76 cm), highest number of branches per plant (4.00, 10.66 and 13.33), more number of leaves per plant (61.33, 102.33 and 126.33) at 30, 60 and 90 days after transplanting respectively and the treatment also recorded maximum root length (59.86 cm) and fruit yield per plant (615.93 g/plant), shoot fresh and dry weight (268.70 g and 54.20 g respectively), root fresh and dry weight (237.43 g and 55.36 g), nutrients in soil (495.00: 66.73: 402.80 NPK kg/ha.) and nutrient uptake of brinjal plant (461.66: 196.66: 523.33 NPK kg/ha) at 90 days after transplanting.

Keywords: Brinjal, VAM, PGPR, *Azotobacter, Trichoderma harzianum*, PSB

1. Introduction
Brinjal (*Solanum melongena* L.) is one of the most important vegetable crop grown in tropical and subtropical regions of the world. It belongs to the family solanaceae and is native to Indo-Burma region. It is often described as a poor man's cusp because its popularity among small and marginal farmers and low income consumers. (Devi *et al.*, 2019) [4]. India is the world's second largest producer of brinjal. Brinjal fruits are widely used in various culinary preparations like sliced bhaji, stuffed curry, bharta, chutney, vangibath and pickles. It is good for the patients suffering from asthma, diabetes, cardiovascular disease, cholera and bronchitis.

It is known that increased dependence on agro-chemicals including fertilizers has led to several ill effects on the environment and decreased soil fertility. On the other hand use of biofertilizers is becoming popular now a days for its cheap cost and it also decreases the adverse effects of chemical fertilizers on soil and environment (Verma, 1995) [21].

Plant growth promoting rhizobacteria are beneficial microorganisms that promote the growth of the plant by various ways like, converting the unavailable form of nutrients into available form by various methods (Kumar *et al.,* 2019) [8]. A small dose of plant growth promoting microorganism/ biofertilizer is sufficient to produce desirable results, because each gram of biofertilizer formulation contains at least 10 million viable cells of a specific strain (Pathak *et al.,* 2017) [12].

Generally, solanaceous crops require large quantity of nutrients like nitrogen, phosphorus, potassium, calcium and sulphur for better growth, fruit and seed yield. They are known to improve soil fertility, crop growth, yield as well as productivity (Singh *et al*., 2020) [18]. The application of PGPR's in combination is known to give compounded benefit on plant growth and yield compared to individual application.

Therefore the present investigation was aimed at identification of best consortia of PGPR's for enhancing seedling establishment, growth and yield of brinjal.

2. Material and Methods

An experiment was carried out during winter season of 2020 at College of Horticulture, Bagalkot (University of Horticultural Sciences, Bagalkot). The mahy super 10 hybrid seeds were used in experiment. The experiment was laid out in completely randomized design with sixteen treatment combinations and three replications. The treatments consists of T_1 -100 % RDF (control), T_2 - 100 % RDF + VAM, T_3 -100 % RDF + *Azotobacter*, T_4 -100 % RDF + PSB, T_5 -100 % RDF + *Trichoderma harzianum,* T_6-100 % RDF + *Pseudomonas fluorescens,* T_7-100 % RDF+ VAM +*Azotobacter,* T_8 -100 % RDF +VAM +*Azotobacter* + PSB, T_9 -100 % RDF +VAM + *Azotobacter* + *Trichoderma harzianum,* T_{10} -100 % RDF + VAM + *Azotobacter* + *Pseudomonas fluorescens,* T_{11} -100 % RDF + VAM + PSB, T_{12} - 100 % RDF + VAM + PSB +*Trichoderma harzianum,* T_{13} -100 % RDF + VAM + PSB+ *Pseudomonas fluorescens,* T_{14} -100 % RDF + VAM + *Azotobacter* + PSB + *Trichoderma harzianum,* T_{15} -100 % RDF + VAM + *Azotobacter* + PSB + *Pseudomonas fluorescens,* T_{16} -100 % RDF + VAM + *Azotobacter* + PSB + *Pseudomonas fluorescens* + *Trichoderma harzianum.* The plastic pots of 20kg were filled with the potting mixture containing 3:1 proportion of soil and Farm Yard Manure. Two grams of the inoculum/formulation from each of the PGPR strains as per the treatment requirement was mixed per kilograms of sieved non sterile field soil at the time of transplanting. Two seedlings were transplanted in individual pots. Three pots / replication were maintained for individual treatments. The Brinjal crop was first established in nursery and then transplanted to main field at 30 days after sowing. Full dose of phosphorus and potassium were applied as basal during transplanting and fifty per cent of nitrogen was applied as basal and remaining half was top dressed at 30 DAT. All other cultural practices were followed as per recommendation. Careful observations were taken with respect growth and yield parameters which plant height (cm), number of branches, number leaves per plant, Root length (cm), Shoot and root biomass weight (g) Plant nutrient uptake (N, P, K) and available soil nutrients.

3. Results and Discussion

3.1 Growth parameters

Effects of plant growth promoting microorganisms on plant height, total number of branches / plant, number of leaves / plant under pot culture is presented in the table 1.

The treatment T_9 (VAM + *Azotobacter* + *Trichoderma harzianum*), had recorded maximum plant height of 22.56, 46.16 and 62.76 cm at 30, 60 and 90 DAT respectively, number of branches/plant (4.00, 10.66 and 13.33 at 30, 60 and 90 DAT respectively) and number of leaves/plant (61.33, 102.33 and 126.33 at 30, 60 and 90 DAT respectively).

This might be due to application of *Azotobacter* which helps in the nitrogen fixation and production of plant hormones like IAA, GA_3 and cytokinins (Kumar *et al.*, 2019; Ashraf *et al.*, 2020) [8, 2] like substances which are known to increase the cell division and cell elongation resulting in the better plant growth. Similar findings were reported by, Shubha *et al.* (2019) [16], Nandihalli *et al.* (2018) [10], Ghanti *et al.* (2009) [5] and Siddaling *et al*. (2017) [17].

3.2 Root length and fruit yield

The maximum root length was observed in the treatment combination of VAM + *Azotobacter* + *Trichoderma harzianum* (T_9) with 59.86 cm (Table 2).This might be due to better establishment of beneficial microorganisms in the rhizosphere of plants, which might have released the plant growth regulators like auxin particularly indole acetic acid which is involved in growth of the roots in the plant rhizosphere. These results are in agreement with the Sarma *et al.* (2011) [15] and Kumar *et al.* (2017) [12].

The maximum fruit yield per plant was observed in the treatment combination of VAM + *Azotobacter* + *Trichoderma harzianum* (T_9) with 615.93 g/plant (Table 2). This might be due higher absorption of N, P and K (Rai *et al.*, 2017) [13] from the soil. As, N is the chief constituent of protein, essential for protoplasm formation, which leads to cell enlargement, cell division and ultimately resulting in increased plant growth, height of plant, branches, flowers and fruits produced per plant. Increased foliage might have resulted in production of more photosynthates enhancing the yield. The present findings are in accordance with Devi *et al.* (2019) [4] and Singh and Sharma (2019) [19].

3.3 Shoot and root biomass

Maximum shoot fresh weight (268.70 g) and dry weight (54.20 g) was observed in treatment T_9 (VAM + *Azotobacter* + *Trichoderma harzianum*) (Table 2.) This might be due to the application of microbial consortia and chemical fertilizers which enhance the availability of nutrients, phosphorus, plant growth substances (Kumar *et al.*, 2019; Ashraf *et al.*, 2020) [8, 2]. Nitrogen fixing and phosphorus solubilizing microorganism secrete certain organic acids and biochemical compounds which are growth promoting in nature (Ashraf *et al.*,2020) [2]. Similar results were also reported by Kumar *et al.* (2017) [12] and Roshni *et al.* (2019) [19].

Maximum root fresh weight (237.43 g) and dry weight (55.36 g) was observed in treatment T_9 (VAM + *Azotobacter* + *Trichoderma harzianum*) (Table 2). This might be attributed to enhanced soil nutrient availability through better microbial activity and releasing the nutrients from the soil and helping by VAM in absorption of ample nutrients and its utilization by the plants. Application of bio fertilizers might have enhanced growth promoting substances secreted by the microbial inoculants and also arbuscular mycorrhizae might have played an important role in better root proliferation (Ashraf *et al.*, 2020) [2]. The phosphorus acquisition has been improved through approaches aimed at increasing citrate synthesis or exudation from plant cell. There are evidences to show that exudation of citrate and malate (Molla *et al*., 2012) [9] from root effectively solubilize unavailable phosphorus sources accompanied by extensive root hair growth that increases the root surface by greater than 100 folds thus resulted in increase of root length, spread and fresh and dry weight of a plant as stated by Kumar *et al.* (2017) [12] and Roshni *et al.* (2019) [14].

3.4 Plant nutrient uptake

Data in the Table 3 revealed that highest nitrogen, phosphorous and potassium uptake was found in treatment T_9 (VAM + *Azotobacter* + *Trichoderma harzianum*) with

461.66, 196.66 and 523.33 kg/ha respectively. This might be due to more uptake of nitrogen may be due to expanded root surface area through increased root growth and root hair development. The growth of bacteria and presence of mycorrhizal fungi around plant rhizosphere is known to increase the surface area of roots for explorations of nutrients particularly phosphorus (Khan *et al.*, 2009) [6]. The exudation of citrate and malate from roots effectively solubilizes unavailable phosphorus sources accompanied by extensive root hair. These biofertilizers were able to increase mobility and enhance absorption of P which might have increased the uptake of P. Similar results were observed by Kumar *et al.* (2017) [12].

3.5 Available soil nutrients

The highest nitrogen, phosphorus and potassium availability in soil was observed in treatment T_9 (VAM + *Azotobacter* + *Trichoderma harzianum*) (495.00, 66.73 and 402.80 kg / ha respectively.) (Table -3).This might be due to balanced C/N ratio, more decomposition, enhanced biomass addition which contains humus (source of plant nutrients), production of organic acids (Molla *et al.*, 2012) [9] which made insoluble forms of nutrients into available forms. Enhanced nutrient availability might also be attributed to nitrogen fixation and phosphorus solubilization by *Azotobacter* and *Trichoderma harzianum* respectively, which might have led to increase in nitrogen and phosphorus availability in the rhizosphere (Bagyaraj *et al.*, 1992) [3]. Besides, improved soil properties (physical, chemical and biological) might also be responsible for enhanced nutrient availability. Similar results were reported by Kumar *et al.* (2017) [12] and Vimera *et al.* (2012) [22].

Table 1: Plant height (cm), total number of branches per plant, number of leaves per plant of brinjal at different growth stages as influenced by different plant growth promoting microorganism.

Treatments	Plant height (cm)			Total number of branches per plant			Number of leaves per plant		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
T_1 – Control	18.30	35.40	49.66	2.00	6.00	9.00	40.00	83.33	97.66
T_2 – VAM	21.00	37.30	51.93	3.00	8.66	10.00	45.33	83.66	108.33
T_3 – *Azotobacter*	19.30	37.23	53.16	2.66	7.33	10.66	51.33	89.66	111.66
T_4 – PSB	19.36	38.93	53.53	3.00	9.00	10.33	46.00	90.33	113.00
T_5 - *Trichoderma harzianum*	19.70	37.13	51.10	3.00	7.66	10.66	47.33	91.00	115.66
T_6 - *Pseudomonas fluorescens*	19.33	37.10	49.96	3.00	9.66	10.33	45.33	91.00	111.00
T_7 - VAM + *Azotobacter*	21.66	39.06	53.46	3.00	9.66	11.66	47.66	86.66	105.33
T_8 - VAM + *Azotobacter* + PSB	20.63	37.73	53.20	3.00	8.33	12.00	43.66	90.33	104.33
T_9 - VAM + *Azotobacter* + T.H	22.56	46.16	62.76	4.00	10.66	13.33	61.33	102.33	126.33
T_{10} - VAM + *Azotobacter* + P.F	20.46	39.53	52.03	3.00	7.66	12.33	57.00	89.33	116.00
T_{11} - VAM + PSB	22.00	46.03	58.83	4.00	10.00	13.00	58.00	97.33	120.33
T_{12} - VAM + PSB + T.H	22.10	44.33	59.90	3.33	10.00	12.66	59.33	95.33	114.00
T_{13} - VAM + PSB + P.F	19.46	37.80	53.06	3.33	9.00	11.66	50.00	89.00	111.66
T_{14} - VAM + *Azotobacter* + PSB + T.H	21.23	37.46	53.33	2.00	7.00	12.00	46.33	91.00	112.33
T_{15} - VAM + *Azotobacter* + PSB + P.F	22.06	42.50	57.23	3.66	10.00	12.66	58.66	94.00	121.66
T_{16} - VAM + *Azotobacter* + PSB + P.F + T.H	20.56	36.93	51.16	3.00	8.66	12.00	46.66	88.33	114.33
S.Em ±	0.56	1.08	1.54	0.14	0.25	0.33	1.29	1.55	2.42
CD at 5%	1.63	3.11	4.44	0.41	0.72	0.96	3.73	4.47	6.98

Note: DAT: Days After Transplanting
PSB: *Bacillus megaterium* - UHSBB11
VAM: *Vesicular Arbuscular Fungi* (*Glomus fasiculatum*)
T.H: *Trichoderma harzianum*-UHSBTH15
Azotobacter: *Azotobacter chroococcum* - UHSBB6
P.F: *Pseudomonas fluorescens*-UHSBPF1

Table 2: Effects of plant growth promoting microorganisms on root length (cm), fruit yield per plant (g), shoot and root biomass weight under pot culture

Treatments	Root length (cm)	Fruit yield / plant (g)	Shoot biomass		Root biomass	
			Shoot fresh Weight (g)	Shoot dry weight(g)	Root fresh weight (g)	Root dry weight(g)
T_1 - Control	42.96	339.33	183.53	37.30	133.70	26.50
T_2 - VAM	50.06	383.10	219.33	47.10	143.00	29.13
T_3 - *Azotobacter*	46.00	481.83	218.53	44.03	141.83	32.16
T_4 - PSB	49.03	435.00	207.50	43.50	140.83	34.63
T_5 - *Trichoderma harzianum*	44.06	360.00	199.20	43.26	156.93	26.90
T_6 - *Pseudomonas fluorescens*	46.13	408.33	209.60	44.00	140.13	26.96
T_7 - VAM + *Azotobacter*	45.53	544.23	211.76	45.50	157.13	31.66
T_8 - VAM + *Azotobacter* + PSB	45.33	459.00	230.13	47.73	175.56	38.36
T_9 - VAM + *Azotobacter* + T.H	59.86	615.93	268.70	54.20	237.43	55.36
T_{10} - VAM + *Azotobacter* + P.F	48.83	412.33	224.10	45.53	163.80	41.06
T_{11} - VAM + PSB	54.33	589.66	255.50	52.73	199.80	54.96
T_{12} - VAM + PSB + T.H	51.63	564.00	246.06	50.10	180.43	48.06
T_{13} - VAM + PSB + P.F	44.26	558.16	224.90	48.73	134.66	45.33
T_{14} - VAM + *Azotobacter* + PSB + T.H	44.40	450.00	213.53	46.00	163.80	45.16
T_{15} - VAM + *Azotobacter* + PSB + P.F	50.83	562.50	234.56	49.33	181.76	52.10

T_{16} - VAM + *Azotobacter* + PSB + P.F + T.H	48.63	441.66	191.10	40.76	168.06	43.83
S.Em ±	1.16	11.61	4.61	0.92	3.42	0.78
CD at 5%	3.36	33.44	13.30	2.65	9.85	2.24

Note: DAT: Days After Transplanting
PSB: *Bacillus megaterium* - UHSBB11
VAM: *Vesicular Arbuscular Fungi* (*Glomus fasiculatum*)
T.H: *Trichoderma harzianum*-UHSBTH15
Azotobacter: *Azotobacter chroococcum* - UHSBB6 P.F: *Pseudomonas fluorescens*-UHSBPF1

Table 3: Effects of plant growth promoting microorganisms on plant nutrient uptake and available soil nutrients under pot culture

Treatments	Plant nutrient uptake			Available soil nutrients		
	Nitrogen uptake (kg/ha)	Phosphorus uptake (kg/ha)	Potassium uptake (kg/ha)	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
T_1 - Control	170.00	65.01	319.33	272.65	42.00	280.00
T_2 - VAM	198.27	86.55	340.00	325.56	54.33	315.00
T_3 - *Azotobacter*	234.76	105.31	406.66	410.43	50.33	289.00
T_4 - PSB	248.07	90.634	323.33	367.20	44.66	343.33
T_5 - *Trichoderma harzianum*	203.02	80.70	381.66	343.33	45.53	345.70
T_6 - *Pseudomonas fluorescens*	153.14	89.58	425.00	333.69	55.66	372.56
T_7 - VAM + *Azotobacter*	265.05	111.85	418.33	366.67	49.70	364.00
T_8 - VAM + *Azotobacter* + PSB	286.19	97.75	385.00	387.16	57.10	370.33
T_9 - VAM + *Azotobacter* + T.H	461.66	196.66	523.33	495.00	66.73	402.80
T_{10} - VAM + *Azotobacter* + P.F	238.10	101.13	410.00	430.86	60.23	385.00
T_{11} - VAM + PSB	340.00	158.00	486.66	485.20	65.82	397.33
T_{12} - VAM + PSB + T.H	331.66	137.31	441.66	473.67	62.99	391.66
T_{13} - VAM + PSB + P.F	323.33	127.70	403.33	325.04	52.80	361.66
T_{14} - VAM + *Azotobacter* + PSB + T.H	254.71	98.82	408.66	471.10	53.50	349.00
T_{15} - VAM + *Azotobacter* + PSB + P.F	338.10	144.91	441.66	478.91	64.33	394.46
T_{16} - VAM + *Azotobacter* + PSB + P.F + T.H	281.65	90.41	412.66	347.64	52.33	376.33
S.Em ±	10.52	3.61	11.33	11.05	2.48	12.51
CD at 5%	30.32	10.40	32.64	31.85	7.14	36.02

Note: DAT: Days After Transplanting
PSB: *Bacillus megaterium* - UHSBB11
VAM: *Vesicular Arbuscular Fungi* (*Glomus fasiculatum*)
T.H: *Trichoderma harzianum*-UHSBTH15
Azotobacter: *Azotobacter chroococcum* - UHSBB6 P.F: *Pseudomonas fluorescens*-UHSBPF1

Conclusion

The present investigation was aimed at identifying the best combination of beneficial microorganisms for getting good growth and yield of brinjal crop. The beneficial microorganisms helps in maintaining good soil health for longer time and enhances nutrient availability in soil and ultimately helps in getting better crop yields. From the investigation, we can conclude that the treatment combination of VAM + *Azotobacter* + *Trichoderma harzianum* to be the best PGPR consortia for enhancing growth and yield attributes of brinjal.

References

1. Annonymous, National Horticultural Board, Ministery of Agriculture and Farmers Welfare, Govt. of India. 2020.
2. Ashraf MT, Mufti S, Jan U, Anayat R, Nisar F, Ahmad N. Role of biofertilizers in vegetable crop production: A review. Int. J. Chem. Stud. 2020;8(6):2810-2814.
3. Bagyaraj DJ. Vesicular arbuscular mycorrhiza: application in agriculture. Methods in Microbio. 1992;24:359-373.
4. Devi KL, Chettri S, Sharma APM, Jhajharia D, Singh RK. Effect of biofertilizers and biocontrol agents on growth and yield in off season brinjal under low cost polyhouse. Curr. Appl. Sci. Tech. 2019;34(5):1-5.
5. Ghanti S, Sharangi AB. Effect of bio-fertilizers on growth, yield and quality of onion cv. sukhsagar. J. Crop Weed. 2009;5(1):120-123.
6. Khan S, Chattopadhyay N. Effect of inorganic and biofertilizers on chilli. J. Crop Weed. 2009;5(1):191-196.
7. Kumar GA. Effect of biofertilizers in combination with inorganic nutrients on growth, yield and quality of cauliflower (*Brassica oleracea var. botrytis* L.), M.Sc. (Hort.) Thesis, University of Horticultural Sciences, West godavari (India). 2017.
8. Kumar M, Kumar K. Role of Bio-fertilizers in vegetables production: A review. J. Pharmacogn. Phytochem. 2019;8(1):328-334.
9. Molla AH, Haque MM, Haque MA, Ilias GNM. Trichoderma-enriched biofertilizer enhances production and nutritional quality of tomato (*Lycopersicon esculentum* Mill.) and minimizes NPK fertilizer use. Agric. Res. 2012;1(3):265-272.
10. Nandihalli SY. Effect of partial substitution of chemical fertilizers with fym and bio-fertilizer consortia in okra [Abelmoschus esculentus (L.) Moench], M.Sc. (Hort.) Thesis, University of Horticultural Sciences, Bagalkot (India). 2018.
11. Panse NG, Sukhatme PV. Statistical for Agricultural Workers, Indian Council of Agricultural Research Publication, New Delhi, India. 1961.
12. Pathak DV, Kumar M, Rani K. Biofertilizer application in horticultural crops. In Microorganisms for Green Revolution. Springer, Singapore. 2017, 215-227.
13. Rai A, Nabti E. Plant growth-promoting bacteria: Importance in vegetable production. Microbial

Strategies for Vegetable Production. Springer, Cham, 2017, 23-48.
14. Roshni P, Narasimha Murthy DK, Salomi DR. Studies on biofertilizers and inorganics on growth and yield of carrot. J. pharmacogn. Phytochem. 2019;8(2):1559-1562.
15. Sarma I, Phookan DB, Boruah S. Effect of organic manures and biofertilizers on yield and economics of cabbage, Brassica oleracea var. capitata. J. Eco-friendly Agric. 2011;6(1):6-9.
16. Shubha AS, Srinivasa V, Devaraju SM, Nandish MS, Yogaraju M, Shanwaz A. Effect of integrated nutrient management on microbial density, yield and quality attributes in potato under hill zone of Karnataka. Int. J. Chem. Studies. 2019;7(1):2146-2149.
17. Siddaling N, Kempegowda K, Raghavendra H. Effect of integrated nutrient management on growth and yield of tomato (Solanum lycopersicum L.) var. Arka Rakshak. Int. J Plant Soil Sci. 2017;16(2):1-7.
18. Singh A, Prasad VM, Srivastva R, Bahadur V. Effect of integrated nutrient management on growth, yield and quality of okra (Abelmoschus esculentus L. Moench) cv. Kashi Pragati. J. Pharmacogn. Phytochem. 2020;9(2):1978-1984.
19. Singh P, Sharma DP. Response of Trichoderma viridae and plant growth promoting rhizobactera (PGPR) on growth and yield of chilli cv. Arka Lohit. J. Pharmacogn. Phytochem. 2019;8(4):1495-1497,
20. Singh RK, Dixit PS, Singh MK. Effect of bio fertilizers and organic manures on growth, yield and quality of tomato (Lycopersicon esculentum Mill.) cv. Arka Vikas. J. Pharmacogn. Phytochem. 2017;6(5):1793-1795.
21. Verma A. Ecophysiology and application of Arbuscular Mycorrizal fungi in arid soil In Mycorrhiza, edited by a Varma and B Hock. 1995.
22. Vimera K, Kanaujia SP, Singh VB, Singh PK. Integrated nutrient management for quality production of king chilli (Capsicum chinense Jackquin) in an acid alfisol. J. Indian Soc. Soil Sci. 2012;60(1):45-49.