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Effect of Integrated Nutrient Management (INM) on Growth, Phonological characters and Yield of Tomato (*Lycopersicon esculentum* Mill.) cv. Arka Rakshak

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Abstract
An experiment was conducted to find out the suitable organic, inorganic nutrients and biofertilizers or their combinations for integrated nutrient management in tomato at the Horticulture Research Farm, College of Agriculture, Indore (M.P) during kharif season of 2019-20. The experiment comprised of total eight treatments combinations of organic and inorganic nutrients and control. The experiment was laid out in randomized completely block design with three replications. Application of RDF treatment T_2-100% RDF (100:50:50 NPK respectively) recorded significantly best performance over plant height (114.03 cm) phonological parameters like minimum days taken into first flowering (41.67), days taken to 50% flowering (54.43), days to first fruit picking (82.07), fresh weight of plant (169.12 g) and dry weight of plant (57.22 g). Similarly, treatment T_8 (RDF 75% + 25% [Neem cake (6.25%) + Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%)] + PSB + Azotobacter,) recorded superior performance over other treatment for growth and yield parameters like maximum number of branches per plant (25.67), number of leaves per plant (77.93), leaf area (360.58 cm^2) at harvest stage, and maximum number of fruit per plant (44.13), polar diameter (5.52 cm), equatorial diameter (4.93 cm), fresh weight of fruit (65.89 g), dry weight of fruit (3.64 g), fruit yield (19.40 kg/plot) and fruit yield (269.44 q/ha). The minimum values of all parameters were recorded under control.

Keywords: Tomato, INM, growth, phonological characters, yield

Introduction
Tomato (*Lycopersicon esculentum* Mill.) is one of the most important vegetable crops grown all over the world due to its wider adaptability to various agro-climate conditions. India ranks second in area and production of tomato in the world. Tomato belongs to the family of solanaceae with chromosome number 2n= 24 and is the most popular and third most consumed vegetable in the world next to potato and sweet potato (FAO, 2002) [4]. More than 90% of the vitamin C in human diets is supplied by fruits and vegetables (of which tomato is the most important) (Vallejo *et al*., 2002) [19]. Tomato fruits contain high amount of ascorbic acid and lycopene (Tindall, 1983) [18]. It is a very remunerative crop for small and marginal farmers. There are various types of flavoring compounds found in tomato fruits, which enrich the taste. The pulp and juice are digestible, a promoter of gastric secretion and blood purifier. Cultivated tomato is generally accepted to have originated in the tropical America since all related species of tomato are native to the Andean region and form where it spread to other parts of the world in the 16th century and became popular in India within the last 9 decades. The leading tomato growing states in India are U.P., Karnataka, M.H., Haryana, Punjab and Bihar. It is cultivated in 0.769 M ha area with the production of 19.66 Mt in India (NHB, 2018-19) [1].

For tomato nutrition management is one of the most important factors which govern the tomato production. It is a heavy feeder of macro-nutrient (N.P.K.) and therefore should be applied in right doses in right time and suitable method so that better growth and development is attained that will ensure higher fruit yield. Nitrogen, phosphorus and potassium are essential for tomato production, and the recommended balanced rates of fertilization include twice as much N as P and K Generally, Solanaceous vegetables require large quantity of major nutrients in addition to secondary nutrients such as Calcium and Sulphur for better growth, fruit and seed yield. Adequate supply of nutrients increases fruit quality, fruit size, keeping quality, colour, taste and acidity (Maji and Ghosh, 2006) [8].

Organic fertilizers contain relatively low concentrations of nutrients as compared to chemical one, but they perform important functions which the chemical fertilizers do not do. The use of organic fertilizers and their proper management may reduce the need for chemical fertilizers thus allowing the small farmers to save in part the cost of production. FYM refers to the decomposed mixture of dung and urine of farm animals along with litter and left over material from roughages or fodder fed to the cattle. Neemcake is used for controlling nematodes and other soil born organism. It is very useful organic manure and it is directly or indirectly helpful in increasing the production of crops. Vermicompost provides excellent soil structure, porosity, aeration, drainage, water retention capacity and prevent soil degradation (Pal *et al*., 2015) [12]. Integrated nutrient management is an advanced concept of modern agriculture. It is a holistic, approach that considers application of organic, inorganic and bio-fertilizers as a source of plant nutrients in an integrated way. Their judicious management will maximize the use of organic input while, it will minimize the use of chemical fertilizers and nutrient losses. Addition of organic material maintains and improves soil quality and crop productivity. It contributes to better farm waste management, minimizing environmental pollution improving soil productivity, and the production of safe food and feed. Application of chemical fertilizers provides a good yield but soil properties are badly affected. Keeping in mind the bad impact of chemical fertilizers use only, the concept of integrated nutrient management is taken under consideration to obtain 3 a higher yield and good quality. Organic manures such as cow dung; poultry manure and crop residues and vermicompost were used as alternatives for the inorganic fertilizers but no conclusive results were obtained to ascertain which among these organic sources of nutrition gave a higher yield of tomato (Ali *et al*., 2014) [2]. So an experiment has been conducted by combining different organic and inorganic fertilizers in a frame which is rare in the field of tomato research. The research has been performed using tomato as a test crop because it is one of the most popular, nutritious and widely grown vegetable. The nutrient needed for tomato crop should be supplied through organic, inorganic source and bio-fertilizers.

Materials and Methods

The experiment was conducted in the Research Farm, Department of Horticulture, College of Agriculture, Indore (M.P.) during kharif season of 2019-20. The experiment site Indore is situated in Malwa plateau region in the Western part of the state of Madhya Pradesh at an altitude of 555.5 meters above mean sea level (MSL). It is located at latitude 22.43^0N and longitude of 75.66^0E. It has subtropical climate having a temperature range of 29 °C to 41 °C and 7 °C to 23 °C in summer and winter season, respectively and relative humidity 30 - 85%. In this area, most of the rainfall is received during Mid-June to early October, while winter rains are occasional and uncertain. The annual rainfall is 941 mm. The south–west monsoon is responsible for the major precipitation. The land topography of the experimental site was almost uniform with an adequate surface drainage. The experiment was laid out in randomized completely block design with three replications and eight treatments. Details of treatments used in the study were T_1 – Control, T_2 -100% RDF(100:50:50 kg/ha N: P: K, respectively), T_3- Neem cake 50% + Vermicompost 50% + PSB + Azotobacter, T_4- Neem cake 50% + Poultry manure 50% + PSB + Azotobacter, T_5- Neem cake 50% + FYM 50% + PSB + Azotobacter, T_6- Neem cake 25% + Vermicompost 25% + FYM 25% + Poultry manure 25% + PSB + Azotobacter, T_7- RDF 50% + 50% (Neem cake 12.5% + Vermicompost 12.5% + FYM 12.5%+ Poultry manure 12.5%) + PSB + Azotobacter, T_8- RDF 75% + 25% (Neem cake 6.25% + Vermicompost 6.25% + FYM 6.25%+ Poultry manure 6.25%) + PSB + Azotobacter. The 30 days old seedlings of tomato (cv. Arka rakshak) with a spacing of 60cm X 60 cm to plant transplanted in the plots in the afternoon hours immediately followed by irrigation for proper establishment of the seedlings. Observations were recorded on growth and yield parameters. The N, P and K were given in the form urea, single super phosphate and muriate of potash, respectively. Full dose of P and K and half dose of N were applied at the time of transplanting and remaining half dose of N was given in two equal splits 30 and 60 days after transplanting. Organic manures *viz.,* Neem cake, FYM, poultry manure and vermicompost were incorporated as per treatment in respective plots 20 days before to transplanting. Bio fertilizers (Azotobacter and *Phosphorus solubilizing bacteria*) were inoculated to seedling prior to transplanting by dipping the seedlings bio fertilizers solution @ 2 kg ha^{-1}. The data so generated were statistically analyzed.

Results and Discussion

Effect of different treatments of INM on Morphological characters of tomato

Observations on plant height, number of branches per plant, number of leaves per plant and leaf area were recorded at different stages of growth (at 20, 40, 60, 80 DAT (days after transplanting) and at harvest). The data presented in Table-1 demonstrates that the significantly maximum plant height 37.73, 46.39, 72.70, 94.09 and 114.03 were recorded in treatment T_2 (100% RDF) at all DAT and at harvest, followed by T_8 (RDF 75% + 25% [Neem cake (6.25%) +Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%)] + PSB + Azotobacter) valued (36.47, 45.01, 71.47, 92.18, 111.80) all DAT and at harvesting stage, respectively. While the minimum plant height (29.37, 35.17, 62, 81.63 and 101.87) was observed in treatment T_1 (control.) at all DAT and at harvesting respectively. This may be due to Urea is a rich source of N for increasing vegetative growth of plants as compared to organic fertilizer sources but the combined use of these sources was found more effective. The finding is also in agreement with the findings of Khan *et al*. (2017) [7]. The enhancement of plant height with 100% inorganic fertilizers at 60 DAT may be due to the direct effect of higher amount of inorganic nitrogen, which is an integral part of protein and chlorophyll molecules Chattarjje *et al*. (2014) [3].

The significantly maximum number of branches per plant i.e. (1.62, 3.40, 6.37, 14.47 and 25.67), maximum leaves per plant (6.40, 16.40, 51.96, 69.93 and 77.93) and leaf area (cm^2) per plant (171.25, 207.10, 289.01, 334.26 and 360.58) were found under the treatment T_8 (RDF 75% + 25% [Neem cake (6.25%) + Vermicompost (6.25%) + FYM (6.25%) +Poultry manure (6.25%)] + PSB + Azotobacter) followed by T_2 (100% RDF) at all DAT and at harvest (Table-1&2). This might be due to the fact that the application of NPK, FYM and vermicompost provided adequate N which is associated with high photosynthetic activity and vigorous vegetative growth. Combination of organic and inorganic fertilizers significantly increased the number of leaves Prativa and

Bhattarai (2011) [14]. Islam *et al*. (2013) [6] stated that the number of leaves plant^{-1} was higher in the treatment where full doses of chemical fertilizers were applied and almost same number of the leaves was observed where chemical and organic fertilizers were applied in integrated pattern might be due to sufficient nutrient throughout the growth period. The enlarged leaf area might be due to combined application of inorganic and bio fertilizers might be attributed to synthesis of metabolically active enzymes as well as production and translocation of the metabolites due to synergistic effects of particularly zinc aids in the formation of auxin, a growth promoting compound which is directly involved in cell division and cell elongation. The results are in the close agreement with Gosavi *et al*. (2010) [5] and Siddaling *et al*. (2017) [17].

Effect of different treatments of INM on phonological parameters of tomato.

The data clearly indicated (Table-3) that the treatments effect significantly influenced the number of flower cluster per plant. The significantly maximum number of flowers was recorded in the treatment T_8 (RDF 75% + 25% [Neem cake (6.25%) + Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%)] + PSB + Azotobacter). valued 29.80 followed by T_2 (100% RDF) valued 28.42 both were at par with each other. The minimum number of flower cluster was noted in treatment T_1 (control) valued 22.48. Higher number of fruit clusters per plant, number of fruits per plant and average fruit weight may be due to increased growth components of tomato plant at RDF and organic manure along with bio fertilizer. This might have helped in producing higher amount of carbohydrates which might have Tran located from source (leaf) to reproductive parts (sink) resulting in more number of fruit clusters, fruits and average fruit weight. The similar result reported by Singh *et al*. (2017) [16].

The data clearly indicated (Table-3) that the treatments effect were significantly effect on days to first flowering, days taken to 50% flowering, days to first fruit picking, fresh weight of plant and dry weight of plant. The significantly minimum days taken into first flowering (41.67), days taken to 50% flowering (54.43), days to first fruit picking (82.07), fresh weight of plant (169.12 g) and dry weight of plant (57.22 g) were recorded in the treatment T_2 (100% RDF) followed by T_8 (RDF 75% + 25% [Neem cake (6.25%) + Vermicompost (6.25%) + FYM (6.25%) +Poultry manure (6.25%)] + PSB + Azotobacter). The maximum days to first flowering (45.13), days taken to 50% flowering (58.20) and days to first fruit picking (85.93), fresh weight of plant (117.10 g) and dry weight of plant (42.52 g) were recorded in treatment T_1 (control). This might be due to the fact that nitrogen in plants increased cell division and cell differentiation. Thus, plant remained in vegetative phase and resulted in imbalance between C:N ration, Thus delayed flowering at higher nitrogen level. The findings are in agreement with findings of Parmar *et al*. (2019) [13]. The higher fruit set may also be due to higher percentage of productive flowers (Premshekhar and Rajshree 2009) [15].

Effect of different treatments of INM on yield parameters of tomato

The results revealed (Table-4) significant effect of organic and inorganic treatments. Significantly, highest polar diameter of fruit (5.52 cm), equatorial diameter of fruit (4.93 cm), fresh weight of fruit (65.89 g), dry weight of fruit (3.64 g), fruit yield per plot (19.40 kg/plot) and fruit yield per ha (269.44q/ha) were recorded in the treatment T_8 (RDF 75% + 25% [Neem cake (6.25%) + Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%)] + PSB + Azotobacter). While the minimum value of polar diameter of fruit (4.68cm), equatorial diameter of fruit (4.17cm), fresh weight of fruit (51.47g), dry weight of fruit (2.37g), fruit yield per plot (12.60kg/plot) and fruit yield per ha (175 q/ha) were recorded in treatment T_1 (control). Increase in length and size of the fruits may be also due to complementary action of phosphorous and potassium which helps in synthesize the auxins which are responsible for the cell elongation by increasing the cell permeability to water and osmotic solutes of the cells. Besides, auxins are also responsible for inducing the synthesis of specific DNA dependent new m-RNA and specific enzymatic proteins causes increased cell plasticity and extension resulting ultimately in cell enlargement. Besides, increase in the fruit size might be due to the higher uptake of nutrients and more food material synthesis by plant when treated with biofertilizers. Farm Yard Manure is storehouses of the nutrients in soil, which enhance the fruit length (cm) fruit diameter and fruit weight (g). The similar results reported by Mudasir *et al*. (2012) [11] and Siddaling *et al*. (2017) [17]. The yield per hectare is ultimate response due to number of branches, number of fruits, yield per plant and such other associated characters. The performance of this treatment is a combined effect of all the positive function of different treatments present individually. This result conformity with the findings has by Meena *et al*. (2017) [9]. The organic manures provide prolonged and better availability of nutrients during crop growth period. There are many reports indicating increased fruit yield due to the application of organic manures along with inorganic fertilizers. The present results are in close conformity with the results of Mohit *et al*. (2019) [10].

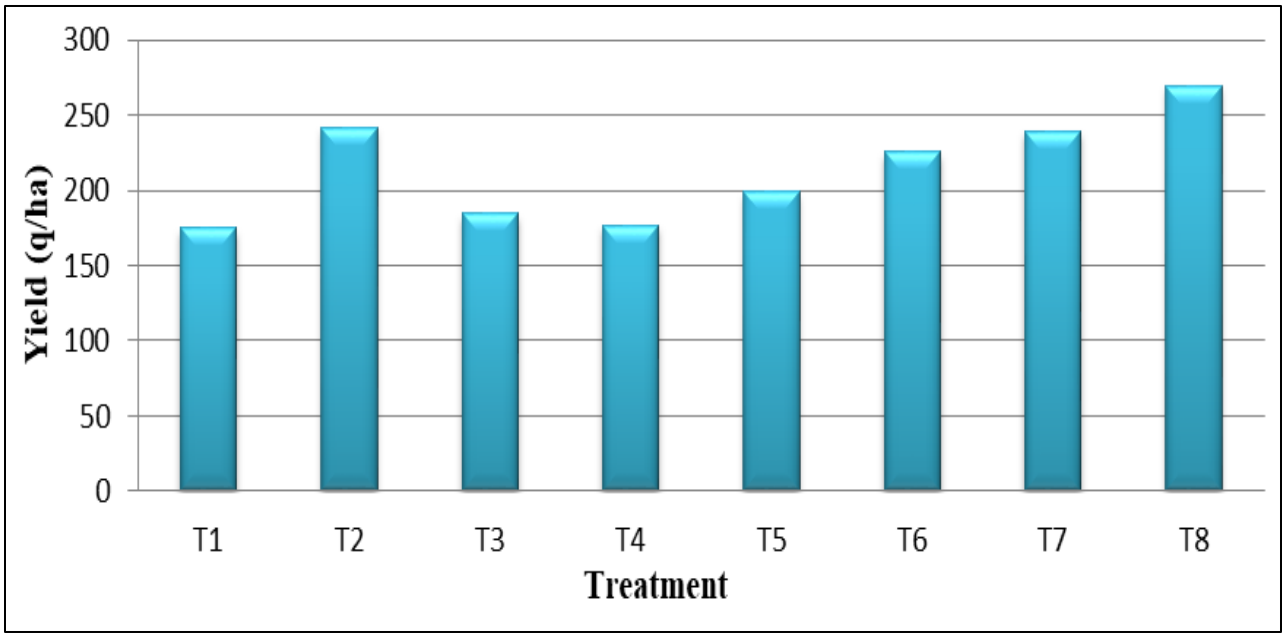

Fig 1: Effect of INM on fruit yield of tomato

Table 1: Effect of Integrated nutrient management on plant height and number of branches per plant in tomato.

Treatments	Plant height (cm)					Number of branches / plant				
	20 DAT	40 DAT	60 DAT	80 DAT	At harvest	20 DAT	40 DAT	60 DAT	80 DAT	At harvest
T_1	29.37	35.17	62.00	81.63	101.87	1.26	2.70	5.60	10.18	14.26
T_2	37.73	46.39	72.70	94.09	114.03	1.57	3.33	6.33	13.33	22.01
T_3	32.40	38.98	65.87	86.61	105.72	1.37	2.95	5.77	11.00	18.51
T_4	32.23	38.50	63.87	86.45	103.87	1.28	2.73	5.63	10.73	15.87
T_5	34.20	39.32	67.43	89.81	107.47	1.41	2.87	5.80	11.60	18.93
T_6	35.57	40.94	70.70	90.54	110.77	1.51	3.07	6.00	12.40	19.35
T_7	35.93	41.98	70.87	91.26	110.87	1.52	3.13	6.15	13.07	20.96
T_8	36.47	45.01	71.47	92.18	111.80	1.62	3.40	6.37	14.47	25.67
S.Em±	1.59	2.11	1.16	2.34	2.23	0.07	0.15	0.17	0.88	1.90
CD at 5%	4.83	6.42	3.51	7.12	6.79	0.23	0.46	0.54	2.67	5.77

Table 2: Effect of Integrated nutrient management on number of leaves per plant and leaf area (cm^2) per plant in tomato

Treatments	Number of leaves per plant					Leaf area (cm^2) per plant				
	20 DAT	40 DAT	60 DAT	80 DAT	At harvest	20 DAT	40 DAT	60 DAT	80 DAT	At harvest
T_1	5.27	13.36	37.20	55.93	64.63	68.34	86.57	130.72	149.61	159.62
T_2	6.30	15.45	50.07	67.33	77.47	166.50	199.80	277.61	325.35	336.56
T_3	5.40	13.87	37.60	59.00	71.60	106.66	147.84	181.23	222.70	244.07
T_4	5.33	13.60	37.52	58.33	69.47	89.30	108.48	165.35	173.36	186.70
T_5	5.73	14.33	41.07	62.67	71.93	123.20	128.35	197.75	259.86	259.81
T_6	5.93	14.73	42.82	64.00	73.33	138.72	162.46	239.91	284.39	299.17
T_7	6.13	15.13	49.38	65.23	74.93	153.15	184.79	258.33	314.41	319.95
T_8	6.40	16.40	51.96	69.93	77.93	171.25	207.10	289.01	334.26	360.58
S.Em±	0.24	0.43	3.23	1.94	2.57	7.53	9.45	12.75	16.12	11.48
CD at 5%	0.73	1.33	9.81	5.90	7.80	22.84	28.67	38.69	48.92	34.83

Table 3: Effect of Integrated nutrient management on phonological parameters of tomato

Treatments	Number of flower cluster/ plant	Days to first flowering	Days to 50% flowering	Days to first fruit picking	Fresh weight of plant (g)	Dry weight of plant (g)
T_1	22.48	45.13	58.20	85.93	117.10	42.52
T_2	28.42	41.67	54.43	82.07	169.12	57.22
T_3	24.74	44.00	57.60	84.33	138.76	49.04
T_4	22.97	44.40	58.00	85.17	124.01	45.04
T_5	26.19	43.53	56.40	83.60	145.00	52.05
T_6	27.19	43.67	57.53	84.27	129.76	46.36
T_7	28.27	42.47	56.27	83.57	155.44	53.50
T_8	29.80	41.93	55.73	83.00	165.15	56.91
S.Em±	0.83	0.52	0.53	0.65	4.41	2.76
CD at 5%	2.54	1.59	1.61	1.97	13.38	8.39

Table 4: Effect of Integrated nutrient management on yield parameters of tomato

Treatments	Number of fruit/plant	Polar diameter (cm)	Equatorial diameter (cm)	Fresh weight of fruit (g)	Dry weight of fruit (g)	Fruit Yield (kg/plot)	Fruit yield (q/ha)
T_1	40.93	4.68	4.17	51.47	2.37	12.60	175.00
T_2	44.07	5.38	4.84	62.47	3.38	17.43	242.08
T_3	41.80	4.84	4.27	52.89	2.60	13.30	184.73
T_4	42.00	4.71	4.21	52.51	2.52	12.73	176.80
T_5	43.53	5.01	4.33	57.44	2.80	14.37	199.33
T_6	43.33	5.18	4.57	54.27	2.72	16.27	225.93
T_7	43.00	5.42	4.73	59.05	2.99	17.23	239.30
T_8	44.13	5.52	4.93	65.89	3.64	19.40	269.44
S.Em±	0.49	0.09	0.15	2.85	0.16	0.56	7.85
CD at 5%	1.50	0.29	0.45	8.67	0.49	1.71	23.83

Conclusions

Result of present study thus clearly indicated that different treatments significantly influenced the growth, yield and quality of fruit and soil quality in tomato (Arka Rakshak). It may be concluded from the findings of the present study that among the different treatments of tomato, treatment T_8 (RDF 75% + 25% [Neem cake (6.25%) + Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%)] + PSB + Azotobacter,) recorded superior performance over other treatment for growth and yield. Among the different treatments T_2-100% RDF (100:50:50 NPK respectively), showed superior in phonological parameters of tomato crop.

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References

1. Anonymous. Indian Horticulture Data base. National Horticultural Board, Govt. of India, Gurgaon, India; c2018.
2. Ali MB, Lakun HI, Abubakar W, Mohammed YS. Performance of tomato as influenced by organic manure and sowing date in Samaru, Zaria. Int. J Agron. Agric. Res. 2014;5(5):104-110.
3. Chatterjee R, Bandyopadhyay S, Jana JC. Impact of organic amendments and inorganic fertilizers on production potential, nitrogen use efficiency and nitrogen balance in tomato (*Lycopersicon esculentum* Mill.). Int. J Sci. Res. Knowl. 2014;2(5):233–240.
4. FAO. FAO production year book. Basic Data Unit of Statistics Division, FAO, Italy, 2002;54:139-141.
5. Gosavi PU, Kambale AB, Pandure BS. Effect of organic and biofertilizer on quality of tomato fruits. The Asian J. Hort. 2010;5:376-378.
6. Islam MR, Chauwdhary MAH, Saha BK, Hasan MM. Integrated nutrient management on soil fertility. growth and yield of tomato. J Bangladesh Agril. Univ. 2013;11(1):33–40.
7. Khan AA, Bibi H, Ali Z, Sharif M, Shah SA, Ibadullah H *et al*. Effect of compost and inorganic fertilizers on yield and quality of tomato. Academia Journal of Agricultural Research 2017;5(10):287-293.
8. Maji S, Ghosh SN. Effect of different levels of nitrogen on some growth parameters of pummelo [*Citrus grandis* (L.), *C.maxima* (Merill)]. The Horticulture J. 2006;19(3):185-86.
9. Meena ML, Gehlot VS, Meena DC, Kishor S, Kishor S, Kumar S. *et al*. Impact of biofertilizers on growth, yield and quality of tomato (*Lycopersicon esculentum* Mill.) cv. Pusa Sheetal. J Pharmocogn. Phytochem. 2017;6(4):1579-1583.
10. Mohit KM, Singh MK, Singh SP, Naresh RK. Effect of Integrated Use of Organic and Inorganic Sources of Nutrients on Growth, Yield Quality and Profitability of Tomato (*Lycopersicon Esculentum* Mill.) Var. Pusa Rohini. Int. J. Agri. cult. Stat. Sci. 2019;15(1):57-66.
11. Mudasir MM, Chattoo S, Faheema AP, Parry FA. Influence of organic and inorganic nutrients on growth and yield attributes of tomato. The Asian J Hort. 2009;7(2):337- 339.
12. Pal A, Majhi S, Govind KR, Kumar S, Meena D. Efficacy of various sources of nutrients on growth, flowering, yield and quality of tomato (*Solanum lycopersicum*) cv. Azad T-6. The Bioscan. 2015;10(1):473-477.
13. Parmar U, Tembhre D, Das MP, Pradhan J. Effect of integrated nutrient management on growth development and yield traits of tomato (*Solanum lycopersicon* L.). J Pharmocogn. Phytochem. 2019;8(3):2764-2768.
14. Prativa KC, Bhattarai BP. Effect of integrated nutrient management on the growth, yield and soil nutrient status in tomato. Nepal Journal of Science and Technology. 2011;2:23-28.
15. Premsekhar M, Rajashree V. Influence of bio-fertilizers on the growth characters, yield attributes, yield and quality of tomato: Am.-Eurasian J Sustain. Agric. 2009;3(1):68-70.
16. 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 Pharmocogn. Phytochem. 2017;6(5):1793-1795.
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. Tindall HD. Vegetables in the Tropics. Macmillan Education Ltd. Houndmills Hampshire; c1983. p. 533.
19. Vallejo F, Tomas-Barberan FA, Garcia-Viguera C. Potential bioactive compounds in health promotion from broccoli cultivars grown in Spain. J Sci. Food Agric. 2002;82:1293-1297.