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Original Research Article

Assessment of Various Sources of Nutrients on Growth, Yield and Yield Components of Bottle Gourd [*Lagenaria siceraria* L.]

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A B S T R A C T

Bottle gourd is an important vegetable crop grown for its green tender fruits, which are used as a vegetable in a variety of ways. It is rich in vitamins, calcium, potassium and other minerals. The present investigation was conducted during spring- summer seasons of 2013 and 2014 to find out the assessment of various sources of nutrients on growth, yield and yield components of bottle gourd [*Lagenaria siceraria* L.]. The experimental material for the present investigation was comprised of sixteen treatments with three replications. The results revealed that the plants received 100% RDF of NPK + FYM @ 10 t ha^{-1} + Vermicompost @ 5 t ha^{-1} + Poultry manure @ 2.5 t ha^{-1} had a beneficial effect on bottle gourd viz., maximum vine length (82.96 cm), number of branches $plant^{-1}$ (6.33), minimum days taken for first male (43.39) as well as female flower initiation (49.87) that appeared at earliest node for first male and female flower (17.72 and 19.96, respectively). INM packages on Maximum fruit length (22.71 cm), fruit girth (8.68 cm), minimum pedicle length (7.58 cm), maximum fruit weight (568.43 g) and fruit yield ha^{-1} (463.31 q) was found in same treatment. Organic manures alone or in combination with inorganic fertilizer significantly influence vegetative growth of bottle gourd plants and substantially improves the fruit yield of the bottle gourd cultivars.

Keywords

Bottle gourd, Vermicompost, Poultry manure, FYM, Vine length

Introduction

The importance of vegetables in human nutrition is well known. Vegetables are rich and comparatively cheaper source of vitamins and minerals. Cucurbit vegetables are fair source of thiamine and riboflavin. Bottle gourd is the leading vegetable crop of India, the higher yield and maximum returns make it the most preferred vegetable crop of Indian farmers. Bottle gourd (*Legenaria siceraria* L.) belongs to the family cucurbitaceae and locally known as 'Lauki' is an important gourd having wide range of uses and is largely cultivated in the tropics and subtropics for as vegetable, sweets, raita and pickles. It has cooling effect and prevents constipation and has diuretic and cardio-tonic properties. From nutritional point of view, bottle gourd can be considered as nutrition rich fruit vegetable. No doubt modern agriculture is based on the use of inorganic manures, which play a major role for producing higher yield in per unit area. These are commonly used by most of the farmers because of quick availability of nutrient to the plant and easy available in market. Organic manures increase the organic matter in the soil. They provide organic acids that help dissolve soil nutrients

and make them available for the plants. Application of organic manures improves the soil fertility, soil structure and moisture holding capacity. Integrated plant nutrient management is one of the recent methods of supplying nutrients to the plants by organic as well as inorganic means together to fulfill the nutrient requirements. At the same time the main aim of integrated plant nutrient management is to minimize the use of chemical fertilizers without sacrificing the yield. Composts, vermicomposts, poultry manures, Farmyard manure (FYM) etc. are bulky organic manures, although supply low quality of major nutrients, but have potential to supply all essential nutrients for longer periods (Kale *et al.,* 1998). Integrated plant nutrient management (IPNM) is the best approach for obtaining potential crop yield with less expenditure. The optimum dose of nitrogen, phosphorus, and potassium vary greatly cultivar, geographical location and the environmental factors. These factors will have marked effect on the growth and yield parameters of bottle gourd. A judicious use of organic manures, chemical fertilizers and bio-fertilizers may be effective not only in sustaining crop productivity and soil health, but also in supplementing chemical fertilizers, requirements of the crops (Bahadur *et al.,* 2006 and Pandey *et al.,* 2009).

Materials and Methods

The present experiment was conducted at progressive farmer's field located at Village- Khajua, Post- Mahsanw, Dist. - Rewa (M.P.) during spring- summer seasons of 2013 and 2014. The experiment was comprised of sixteen treatments with various combinations of nutrient management, applied to bottle gourd variety Pusa Naveen, included different level of applications of inorganic fertilizers, Organic manure (FYM, vermicompost and poultry manure) and bio-fertilizers (*Azospirillum*) as mentioned in Tables. The experiment was laid out in randomized block design (R.B.D.) with 3 replications of each treatment. Bottle gourd seeds were sown in the field at a spacing of 2.0 m × 0.5 m in plots of 4.0 m × 3.0 m size. Normal cultural practices and plant protection measures were followed during the cultivation process. Five plants were selected at random from each plot of each treatment as representative sample for recording the data. The pooled mean values of each treatment in each replication for individual observation were calculated.

Results and Discussion

The results of the mean data in respect of growth (vine length and number of branch plant^{-1}), flowering (number of nodes to first male flower appears, as well as female flower and days taken to male and female flower initiation), yield and yield attributes as influenced by various treatment combinations are presented in Table 1, 2 and 3.

Effect of different nutrient management on growth characters of bottle gourd

Integrated nutrient management treatments rendered their significant effect on all the vegetative growth characters (Table 1). Significantly highest vine length (82.96 cm) and higher number of branches plant^{-1} (6.33) were recorded in 100% RDF of NPK + FYM @ 10 t ha^{-1} + Vermicompost @ 5 t ha^{-1} + Poultry manure @ 2.5 t ha^{-1} (Treatment, T_{11}) as against lowest vine length (42.42 cm) and number of branches plant^{-1} (2.81) recorded with *Azospirillum* @ 2 kg ha^{-1} (Treatment, T_{16}). NPK, FYM, vermicompost and poultry manure mixture portably stimulates the root growth through efficient translocation of growth promoting substances synthesized in plant followed by

enhanced nutrients absorption. Rate of various physiological and biochemical processes enhanced due to development of large photosynthetic areas comprising of wider leaf area and higher weight of branch was observed. The phenomena of increase in growth parameter might be due to better photosynthetic activities in wide photosynthetic area (Sarhan *et al.,* 2011).

Effect of different nutrient management on flowering characters of bottle gourd

The first male flower recorded at earliest node (17.72) and earliest female flowering node (19.96) were recorded by application of 100% RDF of NPK + FYM @ 10 t ha^{-1} + Vermicompost @ 5 t ha^{-1} + Poultry manure @ 2.5 t ha^{-1} which was significantly superior to all the other treatments. Significantly minimum days taken for first male flower (43.39 days) and first female flower anthesis (49.87 days) were recorded in same treatment.

The delay in initiation of first male and female flower was noted at 23.68 and 27.43 nodes, respectively as well as maximum days taken for first male and female flower appearance (56.69 and 58.20 days, respectively) were with application of *Azospirillum* @ 2 kg ha^{-1} (Table 2). The possible reason for above might be due to fact that balance dose of NPK and FYM + vermicompost + poultry manure (Rajput and Pandey, 2004). The reduction in days to male and female flower initiation was due to stimulating effect of phosphorus on growth hormones which induce early flowering (Singh and Asrey, 2005). On the other hand, plants of the plots with addition of manure and bio-fertilizers along with inorganic fertilizers took comparatively lesser days for initiation of male and female flowers and minimum number of nodes at which first male and female flower appeared. Similar kind of result has been revealed in a study on integrated nutrient management in cucumber by Bindyia *et al.,* (2006) where they observed that combined application of vermicompost (2 tha^{-1}) + ½ RD of NPK (50:30:30 Kg ha^{-1}) + Azotobacter and PSB each at 5 Kg ha^{-1} showed earliness and took lesser number of days for 50% flowering.

Early flowering may be due to integration effect as vermicompost have soil microbes, nitrogen-fixing bacteria, phosphate solubilizing bacteria and growth hormones like auxine, gibberlines and cytokinins which influence and enhance efficiency of nitrogen greater than that of chemical fertilizer which influence early flowering and earliest node to flowering (Nirmala and Vadivel, 1999).

The present results are in accordance with the findings of Prasad *et al.,* (2009) and Suresh Kumar and Karuppaiah (2008) in bitter gourd and Singh and Teena Rani (2012) in bottle gourd. From these reports, it is evident that the results of the present investigation are well supported by the findings of the earlier research workers.

Effect of different nutrient management on yield attributing characters of bottle gourd

The yield attributing characters like fruit length and girth, pedicle length, fruit weight and fruit yield have been presented in Table 3. Result showed significantly higher yield attributes of bottle gourd towards higher fruit length (22.71 cm) and girth (8.68 cm) and lowest pedicel length (7.58 cm) in the application of T_{11} (100% RDF of NPK + FYM @ 10 t ha^{-1} + Vermicompost @ 5 t ha^{-1} + Poultry manure @ 2.5 t ha^{-1}). Minimum results of yield attributing characters were obtained in the plots those received *Azospirillum* @ 2 kg ha^{-1}.

Table.1 Assessment of various sources of nutrients on growth characters at 45 days after sowing (DAS) of bottle gourd

Sr. No.	Treatments	Vine Length (cm)	Number of branch plant^{-1}
T_1:	Normal dose of NPK 120: 60: 60 kg ha^{-1}	60.63	3.55
T_2:	FYM @ 20 t ha^{-1}	65.63	3.65
T_3:	Vermicompost @ 10 t ha^{-1}	62.41	3.94
T_4:	Poultry manure @ 5 t ha^{-1}	62.51	3.73
T_5:	50% RDF of NPK + FYM @ 20 t ha^{-1}	68.75	3.68
T_6:	100% RDF of NPK + FYM @10 t ha^{-1} + vermicompost @ 5 t ha^{-1}	76.83	5.06
T_7:	50% RDF of NPK + vermicompost @ 2.5 t ha^{-1} + poultry manure @ 1.25 t ha^{-1}	64.11	3.84
T_8:	100% RDF of NPK + FYM @ 5 t ha^{-1} + Azospirillum @ 1 kg ha^{-1}	66.71	4.26
T_9:	100% RDF of NPK + FYM @ 5 t ha^{-1} + vermicompost @ 10 t ha^{-1}	79.93	5.25
T_{10}:	100% RDF of NPK + FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1} + Azospirillum @ 1 kg ha^{-1}	72.60	4.74
T_{11}:	100% RDF of NPK + FYM @10 t ha^{-1} + vermicompost @ 5 t ha^{-1} + poultry manure @ 2.5 t ha^{-1}	82.96	6.33
T_{12}:	100% RDF of NPK + FYM @ 5 t ha^{-1} + vermicompost @ 2.5t ha^{-1} + poultry manure @ 1.25 t ha^{-1}	73.81	4.87
T_{13}:	50% RDF of NPK + vermicompost @ 10 t ha^{-1}	61.93	4.54
T_{14}:	100% RDF of NPK + vermicompost @ 5 t ha^{-1}	71.38	4.60
T_{15}:	100% RDF of NPK + vermicompost @ 2.5 t ha^{-1}	67.78	4.40
T_{16}:	Azospirillum @ 2 kg ha^{-1}	42.42	2.81
	SEm	1.77	0.16
	CD (P=0.05)	5.14	0.48

Table.2 Assessment of various sources of nutrients on flowering characters of bottle gourd

Sr. No.	Treatments	First male flower initiation (days)	First female flower initiation (days)	Nodes to first male flower initiation	Nodes to first female flower initiation
T_1:	Normal dose of NPK 120: 60: 60 kg ha^{-1}	53.93	54.72	22.42	24.92
T_2:	FYM @ 20 t ha^{-1}	53.38	53.97	22.34	24.54
T_3:	Vermicompost @ 10 t ha^{-1}	52.23	52.95	21.68	23.59
T_4:	Poultry manure @ 5 t ha^{-1}	53.03	53.44	22.35	24.22
T_5:	50% RDF of NPK + FYM @ 20 t ha^{-1}	51.32	53.66	23.01	24.29
T_6:	100% RDF of NPK + FYM @10 t ha^{-1} + vermicompost @ 5 t ha^{-1}	46.95	51.27	20.85	21.99
T_7:	50% RDF of NPK + vermicompost @ 2.5 t ha^{-1} + poultry manure @ 1.25 t ha^{-1}	54.43	53.25	22.24	24.00
T_8:	100% RDF of NPK + FYM @ 5 t ha^{-1} + Azospirillum @ 1 kg ha^{-1}	51.04	52.55	22.40	23.42
T_9:	100% RDF of NPK + FYM @ 5 t ha^{-1} + vermicompost @ 10 t ha^{-1}	44.14	50.95	19.23	21.39
T_{10}:	100% RDF of NPK + FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1} + Azospirillum @ 1 kg ha^{-1}	44.23	51.69	21.24	22.62
T_{11}:	100% RDF of NPK + FYM @10 t ha^{-1} + vermicompost @ 5 t ha^{-1} + poultry manure @ 2.5 t ha^{-1}	43.39	49.87	17.72	19.96
T_{12}:	100% RDF of NPK + FYM @ 5 t ha^{-1} + vermicompost @ 2.5t ha^{-1} + poultry manure @ 1.25 t ha^{-1}	49.52	51.54	20.72	22.19
T_{13}:	50% RDF of NPK + vermicompost @ 10 t ha^{-1}	51.63	52.09	21.54	23.14
T_{14}:	100% RDF of NPK + vermicompost @ 5 t ha^{-1}	50.62	51.84	21.40	22.86
T_{15}:	100% RDF of NPK + vermicompost @ 2.5 t ha^{-1}	51.46	52.38	21.71	23.17
T_{16}:	Azospirillum @ 2 kg ha^{-1}	56.69	58.20	23.68	27.43
	SEm	1.02	0.73	0.64	0.42
	CD (P=0.05)	2.96	2.13	1.87	1.21

Table.3 Assessment of various sources of nutrients on yield of bottle gourd

Sr. No.	Treatments	Fruit length (cm)	Fruit girth (cm)	Pedicle Length (cm)	Fruit weight (g)	Fruit yield (q ha-1)
T_1:	Normal dose of NPK 120: 60: 60 kg ha^{-1}	16.66	6.58	12.19	429.24	134.80
T_2:	FYM @ 20 t ha^{-1}	16.95	7.66	11.93	442.39	146.99
T_3:	Vermicompost @ 10 t ha^{-1}	18.16	8.07	11.42	474.46	208.11
T_4:	Poultry manure @ 5 t ha^{-1}	17.44	7.98	11.92	460.28	163.69
T_5:	50% RDF of NPK + FYM @ 20 t ha^{-1}	17.26	7.79	11.99	457.10	157.85
T_6:	100% RDF of NPK + FYM @10 t ha^{-1} + vermicompost @ 5 t ha^{-1}	20.08	8.29	8.89	518.56	337.49
T_7:	50% RDF of NPK + vermicompost @ 2.5 t ha^{-1} + poultry manure @ 1.25 t ha^{-1}	17.70	8.00	11.58	466.33	167.82
T_8:	100% RDF of NPK + FYM @ 5 t ha^{-1} + Azospirillum @ 1 kg ha^{-1}	18.49	8.12	11.26	478.29	210.81
T_9:	100% RDF of NPK + FYM @ 5 t ha^{-1} + vermicompost @ 10 t ha^{-1}	22.39	8.51	8.10	543.47	377.72
T_{10}:	100% RDF of NPK + FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1} + Azospirillum @ 1 kg ha^{-1}	21.24	8.48	9.80	504.54	245.00
T_{11}:	100% RDF of NPK + FYM @10 t ha^{-1} + vermicompost @ 5 t ha^{-1} + poultry manure @ 2.5 t ha^{-1}	22.71	8.68	7.58	568.43	463.31
T_{12}:	100% RDF of NPK + FYM @ 5 t ha^{-1} + vermicompost @ 2.5t ha^{-1} + poultry manure @ 1.25 t ha^{-1}	20.77	8.35	9.12	502.47	260.18
T_{13}:	50% RDF of NPK + vermicompost @ 10 t ha^{-1}	19.31	8.00	10.60	491.19	233.08
T_{14}:	100% RDF of NPK + vermicompost @ 5 t ha^{-1}	19.33	8.27	10.48	499.94	237.28
T_{15}:	100% RDF of NPK + vermicompost @ 2.5 t ha^{-1}	18.48	8.14	9.99	485.83	219.23
T_{16}:	Azospirillum @ 2 kg ha^{-1}	13.86	5.59	12.57	326.42	114.11
	SEm	0.41	0.22	0.11	7.24	8.51
	CD (P=0.05)	1.18	0.64	0.33	21.04	24.74

The higher yield attributes found is due to luxurious supply of nitrogen, phosphorus, potash, vermicompost, FYM and poultry manure and their effect absorption which the various physiological and metabolic processed especially protein metabolism.

The translocation of these nutrients to the fruiting nodes results in higher fruiting and fruit development. Similar findings with respect to nitrogen and phosphors on yield attributes were also reported by Naik and Srinivas (1992) and Mani *et al.*, (1999). In

application of inorganic sources of nutrients in combination with FYM, vermicompost and poultry manure lead the plant growth favorably with the production of more carbohydrates.

In this situation, flow of assimilates to sink was high and might be the reason of higher fruit length. Besides, more length and girth of fruit under T_{11} exercised positively on fruit weight (Anjanappa *et al.,* 2012 and Dushyant *et al.,* 2014). Thus, the results of the present experiment are in a good agreement with the above-mentioned findings.

Effect of different nutrient management on yield of bottle gourd

Fertility levels had significant response on yield of fruits. The application of 100% RDF of NPK + FYM @ 10 t ha^{-1} + Vermicompost @ 5 t ha^{-1} + Poultry manure @ 2.5 t ha^{-1} produced highest fruit weight (568.43 g) and fruit yield (463.31 q ha^{-1}) (Table 3). The fruit yield depends mainly on the length of fruit, diameter of fruit, volume of fruit and average weight of fruit. The highly suitability of INM treatment imparts favorable yield attributes may because of favorable soil environment under this treatment (Bahadur *et al.,* 2006). Higher yield of bottle gourd in the present study is also related to the influence of combined effect of organic and inorganic fertilizers. Besides, quick availability of plant nutrient from inorganic sources, balanced C/N ratio, enhanced the synthesis of photosynthates and production of hormone like substances IAA, GA, amino acids and vitamins resulted in quantitative yield might be due to its additive effect on vegetative growth of the crop ultimately affecting the yield (Nayak *et al.,* 2016). The present results are in accordance with the findings of Pulak Bhunia *et al.,* (2009) and Thriveni *et al.,* (2015) in bitter gourd, Kameswari and Narayanamma (2011) in ridge gourd and Tirupathi *et al.,* (2014) in spinach and Padmakshi *et al.,* (2017) in bottle gourd.

Integrated nutrient management treatments rendered their significant effect on almost all the growth, flowering characters and yield attributing characters as well as fruit yield of bottle gourd cv. Pusa Naveen. Treatment consisted of 100% RDF of NPK + FYM @ 10 t ha^{-1} + Vermicompost @ 5 t ha^{-1} + Poultry manure @ 2.5 t ha^{-1} recorded maximum performances with respect to almost all the characters. Treatment (*Azospirillum* @2 kg ha^{-1}) was the lowest performer for the results of the said characters. So, keeping view on yield sustainability, balance in ecosystem, soil health improvement and good health of human beings it may be suggested that vegetable growers may supplement through the judicious and efficient use of inorganic fertilizers or FYM, vermicompost and poultry manure, alone or in combinations

References

Anjanappa, M., Venkatesha, J. and Suresh Kumara, B., 2012. Growth, yield and quality attributes of cucumber (Cv. Hassan local) as influenced by integrated nutrient management grown under protected condition. Veg. Sci., 39(1): 47-50.

Bahadur, A., Singh, J., Singh, K.P. and Rai, M., 2006. Plant growth, yield and quality attributes in garden pea as influenced by use of organic amendments and biofertilizers. Ind. J. Hort., 63(4): 464-66.

Bindiya, Y., Reddy, I.P., Srihari, D., Reddy, R.S. and Narayanamma, M., 2006. Effect of different sources of nutrition on soil health, bacterial population and yield of cucumber. J. Res. ANGRAU, 34: 12-17.

Dushyant Maji, S., Kumar, S., Maurya, A. K. and Meena, K. R., 2014. Efficacy of organic manures on growth, yield and biomolecules of stevia (*Stevia rebaudiana* Bertoni). J. Crop and Weed, 10: 107-10.

Kale, L.V., Bhandarkar, M. and Brunner, R., 1998. Load Balancing in Parallel

Molecular Dynamics. In Fifth International Symposium on Solving Irregularly Structured Problems in Parallel.

Kameswari, P.L. and Narayanamma, M., 2011. Influence of integrated nutrient management in ridge gourd (*Luffa acutangula* L.). J. Res. ANGRAU, 39(3): 16-20.

Mani, R., Kamerya, P.R. and Fageria, M. S., 1999. Effect of nitrogen and phosphorus on growth and yield of okra var. Parbhani Kranti. Haryana J. Hort. Sci., 28 (1-2): 128-129.

Naik, L. B. and Srinivash, K., 1992. Influence of nitrogen and phosphorus fertilization on seed crop of okra (*Hibiscus esculentus*). Ind. J. Agronomy, 37 (4): 769-771.

Nayak, D.A., Pradhan, M., Mohanty, S., Parida, A.K. and Mahapatra, P., 2016. Effect of integrated nutrient management on productivity and profitability of pointed gourd (*Trichosanthes dioica* Roxb.). J. Crop and Weed, 12(1): 25-31.

Nirmala, R. and Vadivel, E., 1999. Organic manure and biofertilizers on growth and productivity of cucumber. South Ind. J. Hort., 47(1-6): 252-254.

Padmakshi Thakur, J. Singh, S.K. Nair and Sasmita Priyadarsini Dash, 2017. Correlation and Path Analysis in Bottle Gourd [*Lagenaria siceraria* (Mol.) Standl.]. Int. J. Curr. Microbiol. App. Sci., 6(12): 1478-1485.

Pandey, S. K., Singh, A. B., Singh, R. and Singh, M. C., 2009. Effect of organic manures and bio-fertilizers on biomass distribution, growth and yield of okra. Veg. Sci., 36(3): 415-17.

Prasad, P.H., Mandal, A.R., Sarkar, A., Thapa, U. and Mality, T.K., 2009. Effect of biofertilizer and nitrogen on growth and yield attributes of bitter gourd (*Momordica charantia* L.). Proceedings, International Conference on Horticulture-2009. Pp. 738-740.

Pulak Bhunia Mandai, A.R., 2009. Influence of irrigation levels and nutrient management on growth and yield of bitter gourd (*Momordica charantia* L.) under West Bengal condition. Indian Agriculturist, 53(3/4): 91-96.

Rajput, R. L. and Pandey, R. N., 2004. Effect of method of application of bio-fertilizers on yield of pea. Legume Research, 27(1): 75-76.

Sarhan Taha, Z., Ghurbat H. Mohammed and Jiyan A. Teli., 2011. Effect of bio and organic fertilizers on growth, yield and fruit quality of summer squash. Sarhad J. Agric., 27(3): 2011.

Singh, R. and Asrey, R., 2005. Integrated nutrient management in tomato (*Solanum lycopersicum* L.) under semiarid region of Punjab. Veg. Sci., 32(2): 194-195.

Singh, Vijay Kumar and Teena Rani, V.K., 2012. Effect of integrated nutrient management on economics in bottle-gourd (*Lagenaria siceraria* L.). Environment and Ecology, 30(4A): 1410-1412.

Sureshkumar, R. and Karuppaiah, P., 2008. Effect of integrated nutrient management on growth and yield of bitter gourd (*Momordica charantia* L.) type Mithipagal. Plant Archives. 8(2): 867-868.

Thriveni, V., Mishra, H.N., Pattanayak, S.K., Sahoo, G.S., and Thomson, T., 2015. Effect of inorganic, organic fertilizers and biofertilizers on growth, flowering, yield and quality attributes of bitter gourd (*Momordica charantia* L.). Int. J. Farm Sci., 5(1): 24-29.

Tirupathi Rao H., Sumathi, S., Subhash Reddy, R. and Padmaja, S., 2014. Influence of FYM and VAM on yield, nutrient content and antioxidant activity of spinach (*Beta vulgaris*) grown under water stress conditions. Asian J. Microbiol. Biotech. Environmental Sci., 16(4): 805-809.