Environment & Ecology 35 (4C) : 3343—3348, October—December 2017
Website: environmentandecology.com ISSN 0970-0420

Assessment of Various Sources of Nutrients on Sustainable Production of Bottle Gourd (*Lagenaria siceraria* Standl.)

Satish Singh Baghel, U. S. Bose, Rajesh Singh, S. S. Singh

Received 10 March 2017 ; Accepted 12 April 2017 ; Published online 2 May 2017

Abstract The present investigation was conducted on bottle gourd during spring-summer seasons of 2013 and 2014, to find out the evaluation of integrated nutrient management for sustainable production of bottle gourd (*Lagenaria siceraria* L.). The experimental material for the present investigation was comprised of sixteen treatments with three replications with spacing of 2.0 m × 0.5 m and of 4.0 m × 3.0 m of plot size. The cultivar used in this study was Pusa Naveen. The physico-chemical analysis of soil showed that the soil of experimental site was predominantly sandy clay in texture. The chemical fertilizers alone or in combination with organic fertilizers were applied according to the planed layout. The organic manure were applied 15 days prior to seed sowing whereas, the inorganic fertilizers were applied as per the layout plan. 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 (47.62 cm), number of nodes $branch^{-1}$ (4.65), maximum length of internodes (4.61), maximum no. of branches $plant^{-1}$ (5.82). INM packages on minimum days were taken to fruit set (1.90) as well as horticultural maturity (7.35) and fruit yield ha^{-1} (463.31 q) was found in the same treatment. Organic manures alone or in combination with inorganic fertilizer significantly hances vegetative growth of bottle gourd plants and substantially improves the fruit yield of the bottle gourd cultivars.

Keywords Bottle gourd, Vermicompost, *Azospirillum*, Bio-fertilizer, FYM.

S. S. Baghel*, U. S. Bose
JNKVV, College of Agriculture, Rewa 486001, MP, India

R. Singh
JNKVV, KVK, Rewa 486001, MP, India

S. S. Singh
MGCGVV, Chitrakoot, Satna 485334, MP, India
e-mail: rewahortic@gmail.com
*Correspondence

Introduction

Bottle gourd (*Legenaria siceraria* L.) is popular vegetable belongs to the family Cucurbitaceae. It is preferably grown for its edible tender fruits in almost all parts of the world. The importance of vegetables in human nutrition is well known. Vegetables are rich and comparatively cheaper source of vitamins and minerals, which constitute an important component in human nutrition. Besides the nutritional value of vegetables, increased interest in being bestowed on the functional and therapeutic benefits of vegetables in human health. Vegetable consumption in sufficient quantities provides taste, palatability and increases appetite and provides fair amount of fibers. 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 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. It contains considerable amount of water 96.1 g, carbohydrates 2.5 g, protein 0.2 g, fat 0.1 g, minerals 0.5 g , fiber 0.6 g, riboflavin 0.023 mg, vitamin A 10 IU, Vitamin c 11 mg, calcium 16 mg, Iron 0.4 mg, phosphorus 14 mg and energy 12 K cal per 100 g of edible fruit. Externally the pulp is applied as poultice and cooling application to the saved head delirium and also rubbed on the flat of the feat and hands to diminish the effect of heat. It helps against constipation, cough night blindness and function as antidote against certain poisons.

Application of heavy doses of chemical fertilizers without organic manures or biofertilizers causes deterioration of soil health in terms of physical and chemical, properties of soil, declining of soil microbial activities, reduction in soil humus, increased pollution of soil, water and air. But today, 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) are bulky organic manures, although supply low quality of major nutrients, but have potential to supply all essential nutrients for longer periods [1—3]. Hence, integrated nutrient management is the need of the hour.

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 [4, 5].

(The authors acknowledged the contributions of Dr. A. K. Singh and Dr. T. K. Singh for donating their time, critical evaluation, constructive comments and invaluable assistance toward the improvement of this very manuscript. We are thankful to Dr. Rakesh Sahu for his technical help in carrying out the experiment and his assistance in the statistical analysis of the obtained data).

Materials and Methods

The present experiment was conducted at progressive farmers field located at Village-Khajua, Post-Mahsanw, Dist-Rewa (MP) 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 biofertilizers (*Azospirillum*) as mentioned in Tables. The experiment was laid out in randomized block design (RBD) 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.

Table 1. Effect of integrated nutrient management on growth characters at 30 days after sowing (DAS) of bottle gourd.

Sl. No.	Treatments	Vine length (cm)	Number of nodes branch^{-1}	Length of inter-nodes	No. of branches plant^{-1}
T_1 :	Normal dose of NPK 120 : 60 : 60 kg ha^{-1}	30.40	1.92	2.91	1.41
T_2 :	FYM @ 20 t ha^{-1}	30.60	1.98	2.94	1.44
T_3 :	Vermicompost @ 10 t ha^{-1}	34.30	2.50	3.23	1.95
T_4 :	Poultry manure @ 5 t ha^{-1}	31.90	2.11	3.32	1.69
T_5 :	50% RDF of NPK + FYM @ 20 t ha^{-1}	31.18	2.04	3.06	1.58
T_6 :	100% RDF of NPK + FYM @ 10 t ha^{-1}+ Vermicompost @ 5 t ha^{-1}	43.03	4.08	4.14	3.35
T_7 :	50% RDF of NPK + Vermicompost @ 2.5 t ha^{-1}+ Poultry manure @ 1.25 t ha^{-1}	33.29	2.30	3.18	1.85
T_8 :	100% RDF of NPK + FYM @ 5 t ha^{-1} + *Azospirillum* @ 1 kg ha^{-1}	35.48	2.61	3.30	2.05
T_9 :	100% RDF of NPK + FYM @ 5 t ha^{-1}+ Vermicompost @ 10 t ha^{-1}	45.59	4.41	5.86	4.44
T_{10} :	100% RDF of NPK + FYM @ 5 t ha^{-1}+ Vermicompost @ 2.5 t ha^{-1} + *Azospirillum* @ 1 kg ha^{-1}	42.08	3.11	3.76	2.66
T_{11} :	100% RDF of NPK+FYM @ 10 t ha^{-1} + Vermicompost @ 5 t ha^{-1}+ Poultry manure @ 2.5 t ha^{-1}	47.62	4.65	4.61	5.82
T_{12} :	100% RDF of NPK + FYM @ 5 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} +Poultry manure @ 1.25 t ha^{-1}	40.91	3.17	3.53	2.94
T_{13} :	50% RDF of NPK + Vermicompost @ 10 t ha^{-1}	37.76	2.83	3.66	2.43
T_{14} :	100% RDF of NPK + Vermicompost @ 5 t ha^{-1}	39.15	2.95	3.90	2.57
T_{15} :	100% RDF of NPK + Vermicompost @ 2.5 t ha^{-1}	36.53	2.74	3.37	2.29
T_{16} :	*Azospirillum* @ 2 kg ha^{-1}	20.89	1.88	2.36	1.39
	SEm	1.35	0.10	0.13	0.17
	CD (p = 0.05)	3.94	0.29	0.39	0.50

Results and Discussion

The results of the mean data in respect of growth (vine length, number of nodes branch^{-1}, length of internodes and no. of branches plant^{-1}), flowering characters (number of nodes to first male flower appears, as well as female flower), yield and yield attributes as influenced by various treatment combinations are presented in Tables 1 and 2.

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 (47.62 cm), maximum number of nodes branch^{-1} (4.65), maximum length of internodes (4.61 cm) and maximum no. of branches plant^{-1} (5.82) 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 (20.89 cm) and minimum number of nodes branch^{-1} (1.88), lowest length of internodes (2.36 cm) and minimum no. of branches plant^{-1} (1.39) 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

Table 2. Effect of integrated nutrient management on flowering and yield characters of bottle gourd.

Sl. No.	Treatments	Days to fruit set	Days to horticultural maturity	Fruit yield (q ha^{-1})
T_1 :	Normal dose of NPK 120 : 60 : 60 kg ha^{-1}	3.22	9.95	134.80
T_2 :	FYM @ 20 t ha^{-1}	3.17	9.78	146.99
T_3 :	Vermicompost @ 10 t ha^{-1}	2.96	9.11	208.11
T_4 :	Poultry manure @ 5 t ha^{-1}	3.18	9.46	163.69
T_5 :	50% RDF of NPK + FYM @ 20 t ha^{-1}	3.14	9.65	157.85
T_6 :	100% RDF of NPK + FYM @ 10 t ha^{-1}+ Vermicompost @ 5 t ha^{-1}	2.52	8.68	337.49
T_7 :	50% RDF of NPK + Vermicompost @ 2.5 t ha^{-1}+ Poultry manure @ 1.25 t ha^{-1}	3.00	9.21	167.82
T_8 :	100% RDF of NPK + FYM @ 5 t ha^{-1} +*Azospirillum* @ 1 kg ha^{-1}	2.93	9.00	210.81
T_9 :	100% RDF of NPK + FYM @ 5 t ha^{-1}+Vermicompost @ 10 t ha^{-1}	2.20	8.43	377.72
T_{10} :	100% RDF of NPK + FYM @ 5 t ha^{-1}+Vermicompost @ 2.5 t ha^{-1} *Azospirillum* @ 1 kg ha^{-1}	2.65	8.89	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}	1.90	7.35	463.31
T_{12} :	100% RDF of NPK + FYM @ 5 t ha^{-1} +Vermicompost @ 2.5 t ha^{-1} + Poultry manure @ 1.25 t ha^{-1}	2.73	8.85	260.18
T_{13} :	50% RDF of NPK + Vermicompost @ 10 t ha^{-1}	2.84	8.94	233.08
T_{14} :	100% RDF of NPK + Vermicompost @ 5 t ha^{-1}	2.80	8.91	237.28
T_{15} :	100% RDF of NPK + Vermicompost @ 2.5 t ha^{-1}	2.89	8.97	219.23
T_{16} :	*Azospirillum* @ 2 kg ha^{-1}	5.07	9.99	114.11
	SEm	0.13	0.17	8.51
	CD (p = 0.05)	0.37	0.48	24.74

parameter might be due to better photosynthetic activities in wide photosynthetic area [3, 6—10].

Vine length, number of nodes branch^{-1}, length of internodes and number of branches plant^{-1} is a main and key trait that affects the number of fruits. More branches under higher N levels with T_{11} were mainly associated with a total vine length that ultimately affects the branches in a vine. The finding is agreement to that increasing N level produced a greater vine length and number of branches compared to lower doses [11]. These beneficial effects of various sources of nutrients were also reported in pumpkin [12], cucumber [13] and ridge gourd [14].

The bottle gourd growth parameters were strongly influenced by the combined application of organic manure and fertilizer and yield highest with the combination. The bottle gourd plant had enough nutrients for rapid growth and development considering the composition of the organic manure which was incorporated into the soil during land preparation. It was observed that the higher the nutrients applied, the higher the values of these traits per plant. The vigorus growth in bottle gourd which was experienced during the growing period as evidenced in the growth parameters was in the literatures [15] that nutrients from mineral fertilizers enhanced the establishment of crops while those from the mineralization of organic matter promoted yield when manures and fertilizers were combined.

Effect of different nutrient management on fruit characters of bottle gourd

The fruit characters have been presented in Table 2. A significant favorable change were recorded to minimum days taken to fruit set (1.90) as well as horticultural maturity (7.35) with the application of 100% RDF of NPK+FYM @ 10 t ha^{-1} +Vermicompost @ 5 t ha^{-1} + Poultry manure @ 2.5 t ha^{-1} (Treatment, T_{11}). The possible reason for above might be due to fact that application of balanced dose of NPK and FYM +Vermicompost + Poultry manure. The reduction in days to fruit set and horticultural maturity was due to stimulating effect of phosphorus on growth hor-

mones, which induce early flowering. Nitrogen and phosphorus are being important constituents of nucleotides, proteins, chlorophyll and enzyme, involved in various metabolic processes, which had direct impact on vegetative and reproductive phase of the plant [16]. The present results are in accordance with the findings in cucumber [17] and bottle gourd [18]. Another probable reason may be due to better nutritional status of the plants, which was favored by the treatments. Increased production of leaves might help to elaborate more photosynthates and induce flowering stimulates, thus effecting early initiation of flower bud. The delay in fruit set and horticultural maturity (5.07 and 9.99 days, respectively) as well as minimum fruit yield ha^{-1} (114.11 q ha^{-1}) with application of *Azospirillum* @ 2 kg ha^{-1} (Treatment, T_{16}).

Effect of different nutrient management on yield of bottle gourd

The highest fruit yield (463.31 q ha^{-1}) was recorded with 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}). It 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 phosphorus on yield attributes in the literatures [19]. Minimum results of fruit yield was obtained in the plots those received *Azospirillum* @ 2 kg ha^{-1} (Treatment, T_{16}).

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 [17]. Yield is the manifestation of morphological, physiological, biochemical and growth parameters and is considered to result from the trapping and conversion of solar energy efficiency. Yield is polygenic in nature and is influenced by several factors (internal and external) throughout the crop growth period.

In the present study, the treatment with organics along with RDF, recorded significantly higher fruit yield. The reasons for increased fruit yield in bottle gourd was attributed to the increased solubilization effect and availability of nutrients by the addition of organic manure and increased physiological activity leading to the buildup of sufficient food reserves for the developing sinks and better portioning towards the developing fruits. Similar results were also reported in the literatures [20] in pumpkin.

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. The present results are in accordance with the findings in the literatures in summer squash [8], cucumber [17], bottle gourd [7, 18], in ridge gourd [19] and bitter gourd [21]. Thus, the results of the present experiment are in a good agreement with the above mentioned findings.

Conclusion

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} was found the best IPNM treatment for spring-summer bottle gourd production under Northern plains of India. 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 inor-

ganic fertilizers or FYM, vermicompost and poultry manure, alone or in combinations.

References

1. Goverdhan M, Ramanjaneyulu AV (2015) Impact of organic amendments and mulch materials on productivity and economics of rainfed groundnut grown on alfisols. Environ Ecol 33 : 795—799.
2. Karbauskiene E (2000) Influence of vermicompost upon the yield and quality of fennel. Sodininkysteir-Darzinin Kyste 19 : 73—81.
3. Bhadoria PBS, Prakash YS, Amitava R, Rakshit A (2002) Importance of organic manures in improv ing quality of rice and okra. Environ Ecol 20 : 628—633.
4. Pandey SK, Singh AB, Singh R, Singh MC (2009) Effect of organic manures and bio-fertilizers on biomass distribution, growth and yield of okra. Veg Sci 36 : 415—417.
5. Mishra M, Patosjashi AK (1995) Effect of biofertilization in okra (*Abelimaschus esculentus* L.). Environ Ecol 13 : 732—733.
6. Sarhan TZ (2008) Effect of biological fertilizers, animal residues and urea on growth and yield of potato plant cv Desiree (*Solanum tuberosom* L.). PhD Dissert. Hort Sci & Landscape Design (Vegetable). Univ of Mosul, College of Agric & For, Iraq.
7. Singh Vijay Kumar, Teena Rani VK (2012) Effect of integrated nutrient management on economics in bottle-gourd (*Lagenaria siceraria* L.). Environ Ecol 30 : 1410—1412.
8. Sarhan Taha Z, Ghurbat H Mohammed, Jiyan A Teli (2011) Effect of bio and organic fertilizers on growth, yield and fruit quality of summer squash. Sarhad J Agric 27 : 2011.
9. Umamaheswarappa P, Krishnappa KS, Murthy PV, Marthu NA (2004) Uptake of NPK by plant and leaf chlorophyll content of bottle gourd cv Arka Bahar. Environ Ecol 22 : 653—656.
10. Bairwa LN, Fageria MS (2008) Effects of zinc and integrated use of nitrogen on seed production of bottle gourd var Pusa Naveen. Ind J Hort 65 : 506—508.
11. Singh DN, Chhonkar VS (1996) Effect of nitrogen, phosphorus, potassium and spacing on growth and yield of muskmelon (*Cucumis melo* L.). Indus J Hort 24 : 265—269.
12. Oloyede FM, Agbaje GO, Obisesan IO (2013) Analysis of pumpkin (*Cucurbita pepo* Linn.) biomass yield and its components as affected by nitrogen, phosphorus and potassium (NPK) fertilizer rates. Afr J Agric Res 8 : 4686—4692.
13. Azarmi Rasool, Mousa Torabi Giglou Hajieghrari Behzad (2009) The effect of sheep-manure vermicompost on quantitative and qualitative properties of cucumber (*Cucumis sativus* L.) grown in the greenhouse. Afr J Biotechnol 8 : 4953—4957.
14. Hilli JS, Vyakarnahal BS, Biradar DP, Ravi Hunje (2009) Influence of method of trailing and fertilizer levels on seed yield of ridgegourd (*Luffa acutangula* L. Roxb). Karnataka J Agric Sci 22 : 47—52.
15. Eifediyi EK, Remison SU (2010) Growth and yield of cucumber (*Cucumis sativus* L.) as Influenced by farmyard manure and inorganic fertilizer. J Pl Breed and Crop Sci 2 : 216—220.
16. Singh R, Asrey R (2005) Integrated nutrient management in tomato (*Solanum lycopersicum* L.) under semiarid region of Punjab. Veg Sci 32 : 194—195.
17. Anjanappa M, Venkatesha J, 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 : 47—50.
18. Leghari MH, Mugheri AA, Sheikh SA, Wahocho NA (2014) Response of nitrogen levels on the growth and yield of bottle gourd varieties. Int J Agron and Agric Res (IJAAR) 5 : 86—92.
19. Kameswari PL, Narayanamma M (2011) Influence of integrated nutrient management in ridge gourd (*Luffa acutangula* L.). J Res ANGRAU 39 : 16—20.
20. Alekar AN, Hirve PS, Deshmukh GN, Kharde RP (2015) Study the effect of integrated nutrient management on yield and nutrient uptake in pumpkin. J Hort 2 : 1—3.
21. Thriveni V, Mishra HN, Pattanayak SK, Sahoo GS, 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 : 24—29.