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Research Article

INFLUENCE OF INTEGRATED NUTRIENT MANAGEMENT ON YIELD, SECONDARY NUTRIENTS CONTENT AND UPTAKE OF BITTER GOURD (*Momordica charantia L.)*

THRIVENI VANGAPANDU[1*], MISHRA H.N.[2], MANDAL PURANDAR[3], CHHURIA SWARNAPRABHA[4] AND BISWAL MONALISHA[5]

[1,2]Department of Vegetable Science, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar, 751003 Odisha
[3]Department of Soil Science, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar, 751003 Odisha
[4]Department of Fruit science, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar, 751003 Odisha
[5]Department of Floriculture and Landscaping, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar, 751003 Odisha
*Corresponding Author: Email-trivenihort.13@gmail.com

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Abstract- An experiment was conducted at All India Net work project on Biodiversity and Bio-fertilizers Department of Soil Science, OUAT, Bhubaneswar during kharif season, 2013 to find out the influence of "Integrated nutrient management on of on yield, secondary nutrients content and uptake of bitter gourd" (*Momordica charantia L.,)* under Bhubaneswar condition. Experimental factors includes T_1-Absolute control, T_2-50% recommended dose of fertilizers, T_3- 50% NPK+ Vermicompost (@2.5 t ha^{-1}), T_4 - 50% NPK+ VC+ Bio fertilizers (Azotobacter, Azospirillum and PSB @ 4kg ha^{-1}), T_5-75%NPK, 75%NPK +VC(T_6),75%NPK+VC+BF(T_7), 100%NPK(T_8), 100% NPK+VC(T_9), 100%NPK+ VC+BF(T10). Vermicompost (2.5t/ha) and Bio fertilizer mixture were (*i.e.*, Azotobacter, Azospirillum, PSB @ 1:1:1 ratio) applied @ 4kg/ha three times *i.e.*, at the time of sowing, at 30DAS and 45DAS replicated three times in RBD. Among different tratments100% NPK+ Vermicompost+ Bio-fertilizers (*Azotobacter, Azospirillum & Phosphate Solubilizing bacteria*) (T_{10}) was recorded maximum yield (4036 kg/ha) and yield/plant (1514g/plant). However, same treatment obtained highest Ca concentration (by vine0.82%, than by fruit 0.26%), and uptake of Calcium by shoots (12.7 kg/ha) than by fruit (7.91kg/ha), Magnesium content (by vine 0.80%, by fruit 0.41%). and uptake by shoots (15.4kg/ha) than by fruit (1.47 kg/ha) followed by T_7 of the crop.

Keywords-Bitter Gourd NPK, Vermicompost, Bio-fertilizers, Nutrient uptake.

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Introduction

Bitter gourd is important vegetable among cultivated cucurbits, which was identified as a potent vegetable for export purpose by APEDA due to its rich nutritional and hypoglycemic properties. In India it occupies about 9,205M ha with an annual production of 162,187 million tonnes [2]. In Odisha cultivated an area of 11407 ha with 111762 MT production and having 9.71t/ha productivity [3]. It is rich in Vit. C and minerals such as N, P, K, Ca, Mg, and Fe. Application of indiscriminate doses of chemical fertilizers without organic manures or biofertilizers causes damage to the soil health in terms of physical and chemical properties of soil, decreasing of soil microbial activities. Application of inorganics integration with organic manures and biofertilizers were found best in obtaining optimum uptake of nutrients in cucumber [1]. As very little information is available on the combined effect of organic, inorganic and biofetilizers on bitter gourd. Hence, this study aimed to investigate the "Influence of Integrated Nutrient Management on yield, secondary nutrients content and uptake of bitter gourd" (*Momordica charantia L.*).

Materials and Methods

This experiment was carried out at College of Agriculture at All India Net work project on Biodiversity and Bio-fertilizers, OUAT, Bhubaneswar to study the influence of integrated use of in organics, organic manures and bio fertilizers on yield secondary nutrients content and uptake of bitter gourd(*Momordica charantia* L.) Cv. Prachi. The field was sandy loam having pH 6.5 and the plot size 2.2X2.5cm with a spacing of 1m X50cm.The experiment was laid out in a randomized block design with three replications involving 10 treatments as fallows. Fertilizer and manural doses were calculated as per the soil test report.

T_1-Absolute control, T_2- 50% recommended dose of fertilizers, T_3- 50% NPK+ Vermicompost(@2.5 t ha^{-1}), T_4 - 50% NPK+ VC+ Bio fertilizers (Azotobacter, Azospirillum and PSB @ 4kg ha^{-1}), T_5-75%NPK, 75%NPK + VC(T_6),75%NPK +VC+BF(T_7),100% NPK(T_8),100%NPK+ VC(T_9),100% NPK+ VC+BF(T10). Vermicompost (2.5t/ha) and Bio fertilizer mixture were (i.e., *Azotobacter, Azospirillum,* PSB @ 1:1:1 ratio) applied @ 4kg/ha three times i.e., at the time of sowing, at 30das and 45das, respectively. At the time of sowing seed, 1/3 of nitrogen, ½ of potassium and full dose of phosphorous applied as per the treatments in basins and mixed well in the soil as a basal application.

Half of remaining N (out of ¾ total) of nitrogen and rest part of K_2O (1/2) were applied as a first top dressing at 15 days after sowing. The remaining N was applied as second top dressing at 30 days after sowing. The recommended dose of fertilizers N, P_2O_5, K_2O and So_4 @ 150:50:100:50 Kg ha^{-1} were applied in the form of Navrathna (19-19-0-13), Urea and Muriate of Potash (MOP). Cultivar in this study was bejo F1 hybrid Prachi. Regular weeding, earthing up, irrigation and plant protection measures were followed. In each plot five plants were selected randomly and tagged for observations. Thechemical analysis Ca and Mg of fruit as well as vine were ground separately into powder by using mill. These were digested separately following di acid digestion method and estimated by EDTA complex metric titration method. Nutrient uptake through plant(vine) and fruit was

calculated after multiplying the nutrient concentration of individual nutrient with dry matter yield (vine and fruit) due to respective treatment and then added to get total nutrient uptake. The results were expressed in the unit of kg ha^{-1}. The observations on growth yield economics and plant nutrient content mean data were analyzed by using RBD statistic method [5].

Results & Discussion

Fruit yield/plant (g)

The results of the present experiment indicated that among the treatments integrated application of 100% NPK with VC and Bio fertilizers(@ 4kg/ha T_{10} recorded increased in optimum yield per plant (1514g) fallowed by T_7 (1420 g) as well as lowest yield was obtained with T_1(358 g).Among ten treatment combinations tested, T_{10} (agro inputs with optimum doses of inorganics) produced best of all performances (15% more fruits per plant and 15% higher per ha^{-1} yield compared to that of with 100% inorganic dose, [Table-1].The increasing yield per plant might be due to better nutrient supply by specific combination of INM treatment. Use of Vermicompost not only improves the soil aeration, nutrient status also biological properties (food source for microbial population and their activity. [10,1,6,9] also reported similar results in cucumber.

Fruit Yield (kg ha^{-1})

The fruit yield of bitter gourd due to various treatments varied between 1303kg ha^{-1} and 4036kgha^{-} , highest due to combined use of incremental dose of inorganics with VC and BF inT_{10} and lowest due to without application (control). Compared to the yield of 3523 kg ha^{-1} due to optimum inorganic dose there was 22 per cent and 8 per cent yield loss due to application of half RDF and 75%RDF respectively. Further integration of vermi compost application @ 2.5 t/ha, increasing the fruit yield by 6.4 per cent,5.2 per cent and 4.6per cent compared over respective yields due to 50,75 and 100% RDF respectively.

Again, the fruit yield increased 17, 11 and 10 per cent by the integration bio-fertilizer application with combined application of in organics 50%, 75% and 100% STD respectively. With the combined use of organic nutrients and bio fertilizers the fruit yield increased at a decreasing rate with the incremental doses of inorganic nutrients. Similar results were also obtained by [9][1] in cucumber at GKVK, Banglore and [4]in Gerkins at Hyderabad.

The results of the mean data of the experiment on secondary nutrient uptake by different parts of the plant [Table-1], total uptake and nutrient recovery by the plant were presented in [Table-2] influenced by integrated nutrient management during *Kharif* season 2013.

Table-1 *Influence of graded doses of inorganics integrated with Vermicompost and bio fertilizers on yield and nutrient content of bitter gourd.*

Sl .No.	Treatments	Yield/plant(g)	Fruit yield (kg ha^{-1})	Ca concentration (%)		Mg concentration (%)	
				Fruit	Vine	Fruit	Vine
1	T_1- Absolute control	358	1303	0.12	0.68	0.38	0.77
2	T_2 - 50%NPK	860	2760	0.27	0.69	0.33	0.65
3	T_3 - 50%NPK+VC	908	2937	0.18	0.61	0.35	0.69
4	T_4 - 50%NPK+VC+BF	1258	3430	0.17	0.57	0.36	0.73
5	T_5 - 75%NPK	1215	3230	0.20	0.62	0.30	0.52
6	T_6 - 75%NPK+VC	1276	3396	0.23	0.62	0.33	0.66
7	T_7 - 75%NPK+VC+BF	1420	3773	0.24	0.76	0.37	0.75
8	T_8 - 100%NPK	1261	3523	0.22	0.72	0.30	0.50
9	T_9 - 100%NPK+VC	1360	3683	0.25	0.73	0.35	0.70
10	T_{10} - 100%NPK+VC+BF	1514	4036	0.26	0.82	0.41	0.80
Mean		**1146**	**3208**	**0.21**	**0.68**	**0.35**	**0.67**
CD(0.05)		**201.42**	**623.04**	**1.19**	**0.09**	**0.17**	**0.23**
CV (%)		**10.24**	**11.32**	**11.90**	**8.03**	**11.05**	**19.7**

Secondary Nutrient concentration and uptake by different plant parts:

Calcium:

The concentration of Calcium in the fruit of bitter gourd ranged from0.12 to 0.28 percent and in vine ranged between 0.57 and 0.82 percent [Table-1], The maximum Ca concentration was found in the vine than in the fruit. However, there was a marked impact of integrated application on Ca and Mg uptake by bitter gourd. Plants were applied with 100%RDF+ Vermicompost + bio-fertilizers (Azotobacter, Azospirillum and PSB @4kg/ha) (T_{10}) recorded maximum Calcium uptake through the vine (15.70 kg/ha) than through the fruit (7.90 kg/ha) which was on par with T_7 (15.2 kg/ha) fallowed by T_9 (100% NPK+VC) (13.80kg/ha by vine and by fruit 7.30, 7.90 kg/ha) while lowest uptake was obtained with absolute control 4.0kg/ha by vine and by fruit 1.10 kg/ha (T1-with no fertilization), respectively.

Table-2 *Uptake of different nutrients in different parts of bitter gourd under the influence of graded doses of inorganics integrated with Vermicompost and bio fertilizers*

Sl.No.	Treatments	Ca uptake (kg/ha)			Mg Uptake (kg ha^{-1})		
		Fruit	Vine	Total	Fruit	Vine	Total
1	T_1- Absolute control	1.1	4.0	5.2	0.36	4.45	4.82
2	T_2 - 50%NPK	4.2	5.8	11.4	0.67	5.54	6.22
3	T_3 - 50%NPK+VC	4.6	7.7	12.0	0.82	8.72	9.54
4	T_4 - 50%NPK+VC+BF	5.5	8.3	12.8	0.97	10.6	11.6
5	T_5 - 75%NPK	5.4	10.0	15.4	0.81	8.36	9.20
6	T_6 - 75%NPK+VC	6.3	10.8	17.2	0.91	11.5	12.4
7	T_7 - 75%NPK+VC+BF	7.3	15.2	22.5	1.12	14.0	15.1
8	T_8 - 100%NPK	7.8	12.4	20.2	0.91	9.04	9.9
9	T_9 - 100%NPK+VC	7.9	13.8	22.0	1.11	13.3	14.4
10	T_{10} -100%NPK+VC+BF	7.9	15.7	23.3	1.47	15.4	16.8
Mean		**5.82**	**10.19**	**16.05**	**0.92**	**10.08**	**9.99**
CD (0.05)		**1.2**	**2.8**	**2.64**	**0.17**	**2.9**	**2.84**
CV (%)		**11.9**	**16.3**	**9.61**	**11.0**	**16.9**	**15.1**

Magnesium:

Data pertaining to magnesium concentration and uptake (kg/ha) by different plant parts of bitter gourd as influenced by integrated nutrient management differed significantly among treatments. The concentration of magnesium in bitter gourd fruit was less (ranging from0.30 to 0.41%) than the vine (ranging from 0.50 to 0.80 %) has been presented in [Table-1&2].

During Kharif plants treated with 100% RDF+ VC+BF (T10) recorded maximum Mg uptake by vine (15.4 kg/ha) fallowed by 100% RDF + VC +BF (T_7) (14.00 kg/ha) and T_9(13.30kg/ha), whereas least magnesium uptake (4.45 kg/ha) was recorded in treatment without fertilization (T_1), with regard to fruit T_{10} recorded the optimum total Mg uptake (16.80 kg/ha) which was on par T_7(15.10kg/ha). however, the lowest uptake (4.82 kg/ha) was registered with absolute control (T_1). These findings were supported with results [1] in cucumber at GKVK, Bangalore, [4] in Gherkin at Hyderabad, [8] in potato.

Integrated application of inorganic nutrients with organic input source and bifertilizers through their impact on physical, chemical and biological properties of soil, nutrient supplying capacity has influences the biomass production, yield and nutrient use efficiency. Vermicompost is organic manure; it is not only improves the aeration, water holding capacity, micro nutrients, cation exchange capacity but also provides food for the soil microbes. Application of biofertilizers not only enhances the crop production but also improves soil fertility through nutrient fixation (*Aztobacter, Azospirillum*), solubilization (Phosphate Solubilizing bacteria) and in addition also releases GRs like IAA, GA, Cytokinins and other growth promoting substances, which influences cell elongation in ordered to give good root growth, root density, root volume, root cat ion exchanging capacity, there by enhances the dry matter production of the crop. Hence it was directly influence the yield and nutrient uptake of the crop.

All the above findings supported integrated nutrient management including application of optimum soil test based fertilizer application correcting deficient of soil nutrients, sufficient organics and consortia of micro-organisms, like *Aztobacter, Azospirillum* and PSM for increased productivity produce as well as nutrient per cent and uptake of the crop.

Conclusion:

Among all treatment combinations 100% integration with vermicompost and biofertilizer T10 the best for maximum yield (4036 kg/ha) and yield/plant, calcium and magnesium content of the crop.

Application of research:

The integrated use of vermicompost and biofertilizers in combination with chemical fertilizers results in solubulization of plant nutrients and was found significant in improving the crop growth, dry matter production as well as nutrient use efficiency, which leads to enhanced crop yield and uptake of calcium and magnesium by the crop. Mixing of organic, inorganic and biofertilizers not only reduces the nutrient losses but also improves the fertilizer use efficiency thus improving the soil nutrient availability.

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Conflict of Interest: None declared

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