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Effect of integrated nutrient management on growth and quality of bitter gourd (*Momordica charantia* L.)

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Abstract
The present investigation entitled effect of integrated nutrient management on growth and quality of bitter gourd (*Momordica charantia* L.) was carried out during *Kharif* 2018 at College farm, College of Horticulture, S. D. Agricultural University, Jagudan, Dist. Mehsana, Gujarat. The experiment was laid out in Randomized Block Design with three replications with fourteen treatments under study. Treatments were evaluated with respect to growth and quality parameters of bitter gourd. Treatment 75% RDN through vermicompost + 25% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha (T_{11}) was found significantly higher as compare other treatments. The growth parameters *viz.*, maximum vine length (186.70 cm) at 45 DAS and (511.33 cm) at 90 DAS and number of branches per plant (12.87) at 90 DAS were recorded with treatment given by 75% RDN through vermicompost + 25% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha (T_{11}).

Keywords: Bitter gourd, INM, Urea, SSP, MOP, FYM, Neem cake, *Azotobacter*, PSB, Vermicompost, Growth and Quality

Introduction

Bitter gourd (*Momordica charantia* L.) also known as bitter melon belongs to family Cucurbitaceae is native to China or India. The vegetable *Momordica charantia* L., Cucurbitaceae, is known variously as bitter gourd, balsam pear, bitter melon, bitter cucumber and African cucumber (Heiser, 1979) [8]. Bitter gourd (*Momordica charantia* L.) is one of the commercially important cucurbitaceous vegetable crops extensively grown throughout the country for its nutritive value and medicinal properties. The fruits are prepared for consumption in many ways and are quite commonly used as fried, boiled and stuffed forms. It is highly cross pollinated crop and it is a climbing vine. (Behera *et al*. 2010) [4]. Although it has many culinary uses, especially in South India, South East and East Asia, it is also grown as an ornamental and is used extensively in folk medicine (Heiser, 1979) [8].

India is regarded as a horticultural paradise (Saravaiya and Patel, 2005) [19], with a vast array of vegetables being cultivated in our country. Bitter gourd is considered as one of the most popular and priced fruit vegetable among cucurbits. It is cultivated in many tropical countries as a source of both vegetable and medicine. It contains over 60 phytomedicines (Raman and Lau, 1996) [18] having medicinal properties and actions against nearly 30 human diseases, including cancer, diabetes and AIDS (Ng *et al*. 1992, Basch *et al*. 2003 and Kole *et al*. 2013) [14, 3, 11]. The bitterness of bitter gourd is due to the cucurbitacin-like alkaloid momordicine and tri terpene glycosides (Momordicoside K and L) (Jeffrey 1980, Okabe *et al*. 1982) [9, 15]. Bitter gourd fruits are a good source of carbohydrates, proteins, vitamins, and minerals and have the highest nutritive value among cucurbits (Desai and Musmade, 1998) [7]. The vitamin C content of Chinese bitter gourd varies significantly (440-780 mg/kg edible portion). Considerable variation in nutrients, including protein, carbohydrates, iron, zinc, calcium, magnesium, phosphorous and ascorbic acid has been observed in bitter gourd (Kale *et al.* 1991) [1]. Moreover, the crude protein content (11.4 - 20.9 g/kg) of bitter gourd fruits is higher than that of tomato and cucumber (Xiang *et al*. 2000) [24].

Integrated nutrient supply system has become an accepted strategy to bring about improvement in soil fertility and protecting the environment. It involves the integrated use of mineral fertilizers in combination with organic manures and microbial inoculants to sustain optimum yield to maintain and to improve the soil fertility (Abrol and Katyal, 1990) [1]. Organic farming is the pathway that leads to achieve sustainability in horticultural production.

Farm yard manure (FYM) is the principle source of organic matter in our country and its application helps in proper supply of nutrition and maintaining soil health. It supplies all the essential plant nutrients, which improve the physico-chemical properties, increases water holding capacity and encourages the soil microbial activities.

Vermicompost is adopted as organic manure produced by use of Earthworm. It modifies soil physical, chemical and biochemical properties.

Neem cake is the by product obtained in the process of cold pressing of neem tree fruits and kernels and the solvent extraction process for neem oil cake. It is a potential source of organic manure. Neem cake also protects plant roots from nematodes, soil grubs and white ants probably due to its residual limonoid content. It also reduces alkalinity in soil, as it produces organic acids on decomposition. Being totally natural, it is compatible with soil microbes, improves rhizosphere micro flora and hence ensures fertility of soil. Neem cake improves the organic matter content of the soil, helping improve soil texture, water holding capacity, and soil aeration for better root development.

Biofertilizer is a substance which contains living microorganism which when applied to seeds, plant surface or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Chemical fertilizers directly increase soil fertility by adding nutrients. However, biofertilizer add nutrients through the natural processes of fixing atmospheric nitrogen, solubilizing phosphorus and stimulating plant growth through the synthesis of growth promoting substances.

Materials and Methods

Experiment was carried out in *Kharif* season 2018 under field condition at the College of Horticulture, S. D. Agricultural University, Jagudan, Dist. Mehsana, Gujarat.

Phule Green Gold is one of the high yielding variety. Its fruits are dark green in colour with tubercules and having average length about 25 to 30 cm. The pure seeds were obtained from MPKV, Rahuri

The experiment was laid out in Randomized Block Design with three replications and fourteen treatments under study *viz*., $T_{1:}$ 100% RDF (100: 50: 50: NPK kg/ha), $T_{2:}$ 100% RDN through urea, $T_{3:}$ 75% RDN through FYM + 25% N through urea, $T_{4:}$ 50% RDN through FYM + 50% N through urea, $T_{5:}$ 75% RDN through vermicompost + 25% N through urea, $T_{6:}$ 50% RDN through vermicompost + 50% N through urea, $T_{7:}$ 75% RDN through neem cake + 25% N through urea, $T_{8:}$ 50% RDN through neem cake + 50% N through urea, $T_{9:}$ 75% RDN through FYM + 25% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha, $T_{10:}$ 50% RDN through FYM + 50% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha, $T_{11:}$ 75% RDN through vermicompost + 25% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha, $T_{12:}$ 50% RDN through vermicompost + 50% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha, $T_{13:}$ 75% RDN through neem cake + 25% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha, $T_{14:}$ 50% RDN through neem cake + 50% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha.

Dose of organic manures (FYM, Vermicompost and Neem cake) for nitrogen as per treatments were applied at the time of sowing whereas, treatments having chemical fertilizers (Urea, SSP and MOP) as a source of NPK, full dose of phosphorus and potassium and half dose of nitrogen applied at the time of sowing and remaining nitrogen was applied as top dressing at 30 DAS. The biofertilizers namely *Azotobacter* and PSB were applied along with organic manures. Whereas, treatments having chemical fertilizers as a source of N, P, K, full dose of P & K and half dose of N applied at basal and remaining N was applied as top dressing at 30 DAS.

Results and Discussion

Growth Parameters

Effect of integrated nutrient management on vine length at 45 and 90 days after sowing (cm)

The data pertaining to the effect of integrated nutrient management on vine length at 45 and 90 days after sowing are presented in Table.

Maximum vine length at 45 DAS (186.70 cm) and 90 DAS (511.33 cm) was observed with treatment 75% RDN through vermicompost + 25% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha (T_{11}) which was statistically at par with treatment $T_{12,}$ T_5, $T_{6,}$ T_{13} and T_{14}, whereas the minimum vine length at 45 DAS (140.18 cm) and 90 DAS (390.04 cm) was recorded with the treatment 100% RDN through urea (T_2).

These might be due to the application of organic manures along with biofertilizers are necessary to increase the content of organic matter, maintain the nutrients balance and improve the physical and chemical properties of the soil. The positive effect of organic manures on growth parameters obtained in this study was supported by Thriveni *et al.* (2015) [23] in bitter gourd, Das *et al.* (2015) [6], Singh *et al.* (2017) [20] and Patle *et al.* (2018) [16] in bottle gourd, Singh *et al.* (2018) [21, 22] in cucumber and Nayak *et al.* (2016) [13] in pointed gourd.

Effect of integrated nutrient management on number of branches at 90 DAS

Data regarding to the effect of integrated nutrient management on number of branches at 90 DAS is presented in Table.

Significantly the maximum number of branches at 90 DAS (12.87) was observed with treatment 75% RDN through vermicompost + 25% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha (T_{11}), whereas the minimum number of branches at 90 DAS (9.30) was recorded with the treatment 100% RDN through urea (T_2). These might be due to organic manure and biofertilizer improves water holding capacity, availability of nutrient and micronutrients. These findings are in the accordance with the result of Thriveni *et al.* (2015) [23] in bitter gourd, Das *et al.* (2015) [6], Singh *et al.* (2017) [20] and Singh *et al.* (2018) [21, 22] in bottle gourd, Anjanappa *et al.* (2012) [2] and Singh *et al.* (2018) [21, 22] in cucumber, Nayak *et al.* (2016) [13] in pointed gourd and Bindiya *et al.* (2012) [5] in gherkin.

Quality parameter

Effect of integrated nutrient management on fruit volume (cm^3)

The effect of integrated nutrient management on fruit volume (cm^3) is presented in Table. Data revealed that fruit volume was found significant.

Maximum fruit volume (125.56 cm^3) was observed with treatment 75% RDN through vermicompost + 25% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha (T_{11}) which was statistically at par with treatment T_5 and T_{12}, whereas the minimum fruit volume (106.72 cm^3) was recorded with the treatment 100% RDN through urea (T_2). This parameter positively increased with incremental use of inorganic use of vermicompost either alone or with biofertilizers. Similar observations were also noted by Mulani *et al.* (2007) [12] and Prasad *et al.* (2009) [17] in bitter gourd.

Table 1: Effect of integrated nutrient management on growth and quality parameters

Tr. No.	Treatments detail	Vine length at 45 DAS (cm)	Vine length at 90 DAS (cm)	Number of branches at 90 DAS	Fruit volume (cm^3)
T_1	100% RDF (100: 50: 50: NPK kg/ha)	142.93	412.53	9.59	107.11
T_2	100% RDN through urea	140.18	390.04	9.30	106.72
T_3	75% RDN through FYM + 25% N through urea	144.87	419.01	9.67	108.69
T_4	50% RDN through FYM + 50% N through urea	143.64	418.40	9.66	108.24
T_5	75% RDN through vermicompost + 25% N through urea	173.50	482.70	10.23	119.93
T_6	50% RDN through vermicompost + 50% N through urea	170.26	474.00	10.21	117.14
T_7	75% RDN through neem cake + 25% N through urea	158.20	443.82	10.13	114.64
T_8	50% RDN through neem cake + 50% N through urea	157.25	440.63	10.07	110.25
T_9	75% RDN through FYM + 25% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha	154.24	428.52	10.06	109.83
T_{10}	50% RDN through FYM + 50% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha	149.32	421.61	9.79	108.94
T_{11}	75% RDN through vermicompost + 25% N through urea + *Azotobacter*@ 2.5 lit/ha + PSB @ 2.5 lit/ha	186.70	511.33	12.87	125.56
T_{12}	50% RDN through vermicompost + 50% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha	179.82	497.63	10.29	120.12
T_{13}	75% RDN through neem cake + 25% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha	164.64	474.75	10.19	116.44
T_{14}	50% RDN through neem cake + 50% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha	158.34	464.28	10.13	115.46
	S.Em. ±	7.45	19.79	0.48	2.79
	C.D. (P = 0.05)	21.64	57.52	1.41	8.10
	C.V.%	8.12	7.64	8.25	4.25

Conclusion

From the foregoing discussion, it could be concluded that application of 75% RDN through vermicompost + 25% N through urea + *Azotobacter* @ 2.5 lit/ha + PSB @ 2.5 lit/ha (T_{11}) in *Kharif* bitter gourd is beneficial for better growth, good quality and improvement of nutrient status of the soil.

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