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Effect of Organic manures and Bio-stimulants on the Yield of Snake gourd (*Trichosanthes cucumerina* L.)

R. SURIYA AND P. MADHANAKUMARI

Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar - 608002

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ABSTRACT

A field experiment was conducted to identify the influences of organic manures and bio-stimuants on the yield of snake gourd (Trichosanthes cucumerina L.) during kharif season of 2021. The organic manures like farm yard manure, vermicompost and phosphobacteria were applied as basal form, whereas bio-stimulants like seaweed extract and effective microorganism were foliar sprayed on three stages i.e. 20, 35 and 50 days after sowing. Maximum values of yield parameters viz., number of fruits vine^{-1} (20.32), fruit length (39.46 cm), fruit girth (15.21 cm), single fruit weight (490.26 g), fruit yield vine^{-1} (9.94 kg), fruit yield ha^{-1} (24.82 t/ha), net income (Rs. 316343.14) and B:C ratio (3.43) were recorded under the treatment of vermicompost (5t ha^{-1}) + seaweed extract (3ml/litre) + RDF. The RDF + phosphobacteria (2kg ha^{-1}) + effective microorganisms (1:500) proved next best treatment in respect of these parameters. Among all the treatments, vermicompost and seaweed extract proved superior to others in respect of yield attributes. The minimum values of all these characters were recorded under control. The use of organic manures proved to be eco-friendly in snake gourd cultivation for sustainable yield and fruit quality as well as for improving soil health.

Keywords: Snake gourd, organic manures, bio-stimulants, yield, cost economics.

INTRODUCTION

Snake gourd (*Trichosanthes cucumerina* L.) is an important annual cucurbit vegetable, belongs to the family Cucurbitaceae. The immature fruits are used as vegetable and are a good source of minerals like Calcium, Magnesium, Phosphorus, fibres and other nutrients to make the food wholesome and healthy (Rahman *et al.*, 2002). The traditional method of farming and less use of organic manure reduces the quality of snake gourd. For increasing the productivity economical fertilizer package need to be formulated which can provide all the essential elements through both organic and inorganic sources to get good quality fruits, produce with higher production, keeping the production cost at sustainable level of an average farmer. Intensive use of only chemical fertilizers to achieve high production has created various problems. Organic matter plays a key role to achieve sustainability on agricultural production due to high water holding capacity, cation exchange capacity and beneficial effect on the physical, chemical and biological characteristics of soil. It also adds organic matter to the soil which may improve soil structure, aeration, soil moisture holding capacity and water infiltration (Sundararasu, 2017). Bio-stimulants stimulate endogenous plant defense response to both biotic and abiotic stress factors. Vermicompost is one of the most promising alternatives to costly chemical fertilizer and it has a higher level of available nutrients like nitrate or ammonium nitrogen, exchangeable phosphorous and soluble potassium, calcium and magnesium derived from wastes (Meenakumari and Shekhar, 2012). Farm yard manure improves the soil structure, porosity, aeration, drainage, water retention capacity and prevents the soil degradation (Singh *et al.*, 2018). Being a bio-fertilizer, phosphobacteria enriches the diversity of soil microbes and maintains the soil fertility. Seaweed extracts (SWE) contain a wide variety of plant growth-promoting substances such as auxins, cytokinins, betaines, gibberellins, and organic substances, including amino acids, micronutrients, and trace elements that improve crop yield and quality (Trejo *et al.*, 2018). EM acts as a supreme in soil microbes which encourages other microbes to follow it and suppress the activity of smaller group of negative or opportunistic microbes (Joshi *et al.*, 2019). Thus, an experiment was conducted to study the role of above organic manures and bio-stimulants in combination with inorganic fertilizers on yield of snake gourd.

Corresponding author E-mail: suriyarajass14@gmail.com

MATERIALS AND METHODS

The field experiment was conducted at Sithalavai village, Krishnarayapuram taluk, Karur district of Tamil Nadu during kharif season of 2021. The field area consists of red soil with excellent water holding capacity. It has a pH of about 7.52 and electrical conductivity of 0.25 dSm^{-1}. The experimental area was laid out in randomized block design with nine treatments and three replications. The treatments comprised of T_1 - RDF + FYM (12.5t ha^{-1}), T_2 - RDF + FYM (12.5t ha^{-1}) + Effective microorganisms (1:500), T_3 - RDF + FYM (12.5t ha^{-1}) + Seaweed extract (3ml/litre), T_4 - RDF + Vermicompost (5t ha^{-1}), T_5 - RDF + Vermicompost (5t ha^{-1}) + Effective microorganisms (1:500), T_6 - RDF + Vermicompost (5 t ha^{-1}) + Seaweed extract (3 ml/litre), T_7 - RDF + Phosphobacteria (2 kg ha^{-1}), T_8 - RDF + Phosphobacteria (2 kg ha^{-1}) + Effective microorganisms (1:500) and T_9 - RDF + Phosphobacteria (2 kg ha^{-1}) + Seaweed extract (3ml/litre). The organic manures were incorporated into soil before sowing and the foliar application of bio-stimulants was applied at 20, 35 and 50 days after sowing. The recommended dose of fertilizers 60 kg N + 40 Kg P + 40 kg Kha^{-1} were applied as basal. Snake gourd variety selected for study was Co-2. The seeds were sown at a distance of 2 x 1.5 m. The cultural operations *viz.,* field preparation, application of manures and fertilizers, Staking and trellising, Irrigation and plant protection were carried out as per the requirement of the crop. The observations on fruits $vine^{-1}$, fruit length, fruit girth, single fruit weight, fruit yield $vine^{-1}$, fruit yield ha^{-1}, net returns and B: C ratio were recorded at harvest. The data was recorded by taking five plants from each plot which was selected randomly. The statistical analysis of data was done by using DSAASTAT. For treatments showing significance, critical differences were worked out at five percent probability level. Net income was obtained by deducting all costs from gross income. B: C ratio was calculated by dividing the gross income with total cost of cultivation.

RESULTS AND DISCUSSION

The number of fruits per vine (20.32 fruits) was found to be maximum in T_6 (RDF + Vermicompost + Seaweed extract) followed by T_8 (RDF + Phosphobacteria + Effective microorganisms (1:500) with 18.76 fruits and least value (13.32 fruits) was noted in T_1 (RDF + FYM - control) in Table 1. The length and girth of fruits per vine was recorded to be maximum in T_6 (RDF + Vermicompost + Seaweed extract) with 39.46 cm and 15.21 cm, respectively. This is followed by T_8 (RDF + Phosphobacteria + Effective microorganisms (1:500) with 37.43 cm and 12.91 cm respectively. The least value was recorded in T_1 (RDF + FYM - control) with 26.98 cm and 7.72 cm respectively. The highest fruit weight (490.26 g/ fruit) was found to be maximum in T_6 (RDF + Vermicompost + Seaweed extract), followed by T_8 (RDF + Phosphobacteria + Effective microorganisms (1:500) with 473.36 g /fruit weight and least weight was noted in T_1 (RDF + FYM - control) with 301.27 g.

Table 1: Effect of organic manures and biostimulants on yield parameters of snake gourd

Tr. No	Treatment details	Number of fruits/vine	Fruit length (cm)	Fruit girth (cm)	Single fruit weight (g)
T_1	Control - RDF + FYM (12.5t ha^{-1})	13.32	26.98	7.72	301.27
T_2	RDF + FYM (12.5t ha^{-1}) + EM (1:500)	15.01	31.42	9.64	361.76
T_3	RDF + FYM (12.5t ha^{-1}) + SWE (3ml/litre)	16.06	33.81	10.65	394.22
T_4	RDF + VC (5t ha^{-1})	15.34	31.50	9.90	363.25
T_5	RDF + VC (5t ha^{-1}) + EM (1:500)	16.54	33.97	10.95	396.79
T_6	RDF + VC (5t ha^{-1}) + SWE(3ml/litre)	20.32	39.46	15.21	490.26
T_7	RDF + PSB (2kg ha^{-1})	14.27	28.79	8.43	340.97
T_8	RDF + PSB (2kg ha^{-1}) + EM(1:500)	18.76	37.43	12.91	473.36
T_9	RDF + PSB (2kg ha^{-1}) + SWE(3ml/litre)	17.83	35.29	11.16	432.57
S.ED		0.31	0.63	0.20	7.58
CD (p=0.05)		0.65	1.34	0.43	16.07

FYM-Farmyard Manure; EM-Effective Microorganism; SWE - Seaweed extract; VC - Vermicompost; PSB - Phosphobacteria

The maximum amount of fruit yield per vine (9.94 kg) was found highest in case of T_6 (RDF + Vermicompost + Seaweed extract) followed by T_8 (RDF + Phosphobacteria + Effective microorganisms (1:500) with 8.85 kg (Table 2). The least amount of fruit yield (4.23 kg) was noted in treatment T_1 (RDF + FYM - control). The highest fruit yield (24.82 t ha^{-1}) was found in the treatment T_6 (RDF + Vermicompost + Seaweed extract) followed by T_8 (RDF + Phosphobacteria + Effective microorganisms (1:500)) with 22.15 t ha^{-1}. The lowest fruit yield (10.57 t ha^{-1}) was recorded in T_1 (RDF + FYM - control).

Table 2: Fruit yield and cost economics of snake gourd as influenced by organic manures and biostimulants

Tr. No	Treatment details	Fruit yield/vine (kg)	Fruit yield (t/ha)	Net income (Rs. ha^{-1})	Benefit cost ratio (BCR)
T_1	Control - RDF + FYM (12.5t ha^{-1})	4.23	10.57	77853.76	1.96
T_2	RDF + FYM (12.5t ha^{-1}) + EM (1:500)	5.45	13.60	137970.24	2.29
T_3	RDF + FYM (12.5t ha^{-1}) + SWE (3ml/litre)	6.27	15.65	171240.38	2.55
T_4	RDF + VC (5t ha^{-1})	5.52	13.79	143600.77	2.37
T_5	RDF + VC (5t ha^{-1}) + EM (1:500)	6.58	16.47	183000.04	2.61
T_6	RDF + VC (5t ha^{-1}) + SWE(3ml/litre)	9.94	24.82	316343.14	3.43
T_7	RDF + PSB (2kg ha^{-1})	4.79	11.94	115374.38	2.15
T_8	RDF + PSB (2kg ha^{-1}) + EM(1:500)	8.85	22.15	269678.24	3.09
T_9	RDF + PSB (2kg ha^{-1}) + SWE(3ml/litre)	7.69	19.32	223561.32	2.80
S.ED		0.13	0.32	-	-
CD (p=0.05)		0.27	0.69	-	-

FYM - Farmyard Manure; EM-Effective Microorganism; SWE-Seaweed extract; VC- Vermicompost; PSB – Phosphobacteria

Yield is a complex phenomenon which is controlled by the interaction of morphological and physiological parameters and it can also be manipulated by genetic factors or cultural operations. Organic manures and bio-stimulants have been found to produce positive effect on the yield characters of snake gourd. The increased number of fruits per vine might be due to the increased nutrient availability from the organic manures especially by the application of vermicompost with inorganic nutrients might have increased the various endogenous hormonal level in the plant tissue (Sureshkumar *et al.*, 2016). Dudhat and Patel (2020) reported that this might be due to combined effect of organic manures, inorganic fertilizers and bio-fertilizers which favourably influenced translocation of nutrient to the fruiting nodes results in higher fruiting. Similar findings were also reported by Moharana *et al.* (2017) in cucumber and Mahalakshmi and Madhanakumari (2021) in taro. The increase in number of fruits and fruit weight may be attributed to the increase in the number of cells as well as elongation of individual cells, which might be rendered possible through better translocation of soluble ions under optimum levels of nutrients. Further, Battacharyya *et al.* (2015) reports that sea weed extract and vermicompost help the soil to create an environment suitable for root growth by increasing microbial diversity and improving biological activities like respiration, nitrogen mobilization and mineralization of mineral nutrients. These findings are parallel to studies reported by Khanuma *et al.* (2021) in squash. The effect of cytokinin and high amount of potassium in seaweed extract may be the reason for the increase in length and girth of the fruits. Uma Maheshwari (2017) stated that increased fruit girth by application of seaweed extract is due to the accumulation of protein and carbohydrates and it also improved the root system which is influenced by endogenous auxins and presence of magnesium. The translocation of these nutrients to the fruiting nodes results in higher fruiting and fruit development. These results are in consonance with the experimental findings of Kharga *et al.* (2019) in cucumber. The highest fruit weight might be due to accelerated mobility of photosynthate from the source to the sink as influenced by the growth hormones released or synthesized due to the organic sources of fertilizers (Aisha *et al.*, 2014). The yield characters were increased due to presence of R.

plant growth regulators (IAA, gibberllins, kinetin and zeatin). The growth promoting substance and osmo protectant betanins in the extract contains potassium, calcium, magnesium, iron, manganese zinc, copper, and vitamins in the available form. One of the probable reasons behind improved fruit characteristics may be due to the production and translocation of adequate amount of photosynthates from leaves to the reproductive organs Kharga *et al.* (2019). These results are in consonance with the experimental findings of Ghasem *et al.* (2014) and Moharana *et al.* (2017) in cucumber. These results are in conformity with findings of Thriveni *et al.* (2017) in bitter gourd, Ghayal *et al.* (2018) in cucumber. The increased yield and yield characters may be due to the presence of macro and micro nutrients in sea weed extract. It may also be due to presence of stimulators such as auxins, gibberellins and cytokinin, trace elements like (iron, calcium, zinc, cobalt, molybdenum, manganese, and nickel), vitamins and amino acids. Application of sea weed extract stimulate different aspects of plant growth like development of root system, absorption of mineral, enlargement of shoot, increased rate of photosynthesis and crop yield.

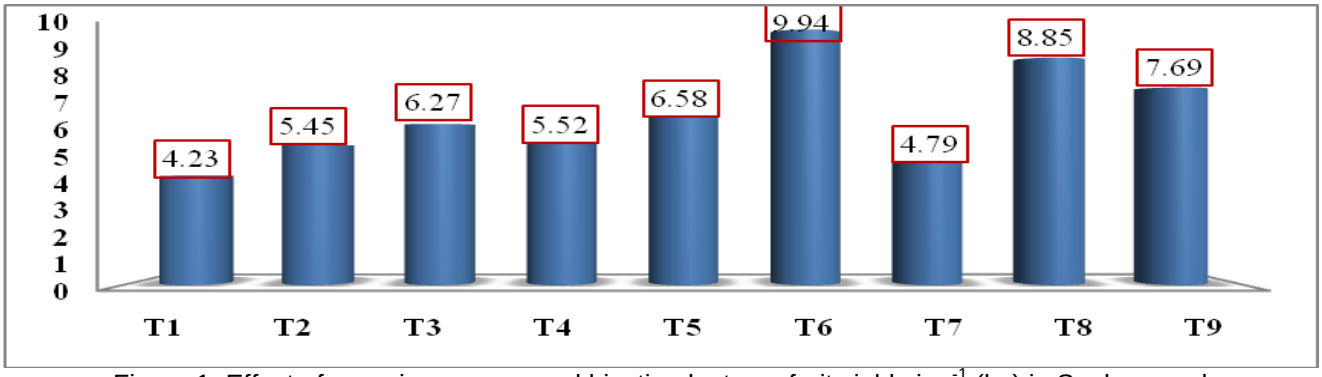

Figure 1: Effect of organic manures and biostimulants on fruit yield vine^{-1} (kg) in Snake gourd

Cost economics

The net income (Rs. 3,16,343.1) and BCR (3.43) was found to be maximum in treatment receiving vermicompost + seaweed extract along with recommended dose of fertilizers. This was followed by RDF + Phosphobacteria + Effective microorganisms (1:500)) with net income of Rs. 2,69,678.2 and BCR of 3.09 and the least value was noted under control - RDF + FYM with net income of Rs. 77,853.7 and BCR of 1.96. Cost benefit (Table 2) of farmers was greatest when organic manures and bio-stimulants were used as a growth promoter and proved as the cheapest along with higher net returns. Application of vermicompost and seaweed extract increased the overall growth as well as the yield characters due to various active compounds. Similarly, effective microorganisms also have the capacity to improve the yield due to the presence of macro and micro elements, hormones and bioactive compounds.

CONCLUSION

Organic manures and seaweed extract played an important role in enhancing the yield and net returns of snake gourd. With abundant distribution and great regeneration potential, the vermicompost and seaweed extract seems to be a feasible substitute to synthetic fertilizers. If vermicompost and seaweed extract are used for organic farming, our dependence on chemical fertilizers can be reduced. This can be further recommended to farmers for increasing the yield and enhancing the productivity of the crop thereby improving the livelihood of farmers.

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