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Effect of vermiwash on growth and yielding pattern of selected vegetable crop Chilli, *Capsicum annuum*)

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Abstract

Present study to evaluate the growth and yielding pattern of chilli plant by the application of vermiwash and also physico-chemical nutrients properties of vermiwash applied soil were analysed. Significant results was observed in in total organic carbon, total potassium, total calcium and magnesium. Number of leaves and plant height were significantly observed at 50:50 ratio. Growth and yielding pattern of chilli was significantly observed in 50:50 ratio. This vermiwash may be very much useful to improve the yield of chilli.

Keywords: vermiwash, Chilli, yield, organic carbon, physico-chemical.

Introduction

The agriculture development strategy for India in the 21st century must be through increasing productivity of the land under cultivation, with reduced costs of production and higher use efficiency of inputs with no harm to the environmental quality. The prime requisite is the promotion of health of the soil – plant – environment system to be free from economic exploitation under overuse and abuse of the input as if with impurity. In today's era, heavy doses of chemical fertilizers and pesticides are being used by the farmers to get a better yield of various field crops. These chemical fertilizers and pesticides decreased soil fertility and caused health problems to the consumers. Due to adverse effects of chemical fertilizers, interest has been stimulated for the use of organic manures (Follet *et al*., 1981). The use of organic matter such as animal manures, human waste, food wastes, yard wastes, sewage sludge's and composts has long been recognized in agriculture as beneficial for plant growth and yield and the maintenance of soil fertility.

The new approaches to the use of organic amendments in farming have proven to be effective means of improving soil structure, enhancing soil fertility and increasing crop yields. Organic matters are excellent source of plant-available nutrients and their addition to soil could maintain high microbial populations and activities.

Earthworms play a vital role in plant growth and productivity. It is a quite possible to effect quick change over for sustainable agriculture by harnessing brand new vermicompost technology to the soil. In recent times, the commercial vermin culturists have started promoting a product called vermiwash. This vermiwash would have enzymes, secretions of earthworms which would stimulate the growth and yield of agricultural crops and even develop resistance in crops receiving this spray. Such a preparation would certainly have the soluble plant nutrients apart from

some organic acids and mucus of earthworms and microbes (Shivsubramanian and Ganeshkumar, 2004).

Vermiwash is a very good plant tonic which can be used for foliar spray. It is the liquid extract collected after the passage of water through the different layers of worm culture unit. The decoction contains excretory product of earthworm secretions of the worm. The coelomic fluid oozing through the dorsal pores, mucus, enzymes secreted by the worm and the microorganisms, plant nutrients, vitamins and plant growth promoting substances. The coelomic fluid of earthworm is called as vermiwash. Recently vermiwash production has drawn the attention of commercial vermiculturists, because of rich organic composition. Long tubular body of earthworm contains coelomic fluid secreted by the body itself that always keeps the body functions. Concentration of nutrients like auxins, cytokinins, bacteria, fungi, calcium, phosphorous, potassium etc. present in vermiwash, depends on the raw material, which is used in the production of vermicompost. Vermiwash plays an important role in the plant growth and development, contribute to initiation of rooting,root growth , plant development, promotion growth rate and improvement in crop production increasing the soil organic matter and increase in nutrient content which are readily available for the plants, resulting in good crop yield. Vermiwash and vermiprotein for wide use in agro-ecosystem, aquaculture and poultry. Kobatke (1954) reported that the coelomic fluid from earthworm body had antibacterial properties. Studies on effect of spraying of vermiwash on vegetables indicated that quality and quantity of yield were improved markedly.

Materials and Methods

Maintenance of earthworm

About 100 earthworms were taken out of the vermicompost bed kept in the vermicompost containing cow dung and leaf litter. The vermicompost was kept moist by adding good amount of water to it. The temperature was maintained at 25 ^{0}C and the soil moisture was also maintained.

Preparation of vermiwash

Preparation of vermiwash (V/W) was prepared by the method standardized by Ismail (1997). A plastic tub of dimensions 100 x 100 x 100 cm was fitted with a plastic gate-valve to facilitate drainage of eluates. The tub was filled to a height of 25 cm with gravel (2- 4" size) above which was placed a layer of coarse sand (30 cm) and garden soil (30 cm). Above the soil, a layer of shade dried and powdered cow dung was added. This was gently moistened with distilled water and the excess of water was drained off. The unit was moistened every day (80% moisture). To this, 250 adult earthworms (*L. mauritii*) were released. After sixteen days, elutes were collected daily by slowly sprinkling five liters of distilled water from the top. The water slowly percolated through the compost and drilospheres, carrying with it nutrients from freshly formed castings, as well as washings from the drilospheres through the filter unit. Collected elutes were stored at 4^{o}C and used for analyses the physico-chemical nutrient composition.

Analysis of Vermiwash

The vermiwash, collected by above method, was analyzed for organic carbon, nitrogen, potassium, sodium, calcium, magnesium, copper and zinc by AAS according to the standard methods given in APHA.

The C: N ratio will be calculated by using the following formula.

$$\text{C: N ratio} = \frac{\text{Organic carbon content of the sample}}{\text{Total Nitrogen content of the sample}} \times 100$$

Concentration of vermiwash

Vermiwash + water (V/V), 40:60% , 50:50% and 60:40% were used for foliar spray to selected vegetable crop.

Selected vegetable crop

Chilli (*Capsicum annuum*) was cultivated in two plots of 5m x 5m, hence there were 6 replicates for the crop maintained (Two plots x Three seasons = 6 replicates), method was followed by Ansari (2008).

Measurements of Plant Growth Parameters

Plant height and length of inter node (cm) was recorded using a measuring tape. Count the number of leaves and number of branches. Leaf surface was measured by using of Leaf Area Meter (Systronics 211).

Statistical Analyses

Data on all parameters were subjected to statistical analyses. All data were expressed as mean and standard error. The differences between groups were statistically analyzed by analysis of variance (ANOVA). The level of significance was set at $P<0.05$.

Results and Discussion

Physico-chemical nutrients properties of vermiwash applied soil were analysed and presented table 1. Significant results was observed in total organic carbon, total potassium, total calcium and magnesium. Growth and yielding pattern of chilli plant by the application of vermiwash in the 0 day sapling was recorded and presented in table 2. Number of leaves and plant height were significantly observed at 50:50 ratio. Whereas, number of flowers, number of fruits and weight fruits were not significant. Followed by Growth and yielding pattern of chilli plant by the application of vermiwash in the 30 day was recorded and presented in table 3. Number of leaves and plant height were significantly observed at 50:50 ratio. Whereas, number of flowers, number of fruits and weight fruits were not significant. Followed by Growth and yielding pattern of chilli plant by the application vermiwash in the 60 day was recorded and presented in table 4. Number of leaves ,plant height, number of flowers and number of fruits were significantly observed at 50:50 ratio. Followed by growth and yielding pattern of chilli plant by the application vermiwash in the 90 day was recorded and presented in table 5. Number of leaves, plant height, number of flowers, number of fruits and weight of fruits were significantly observed at 50:50 ratio.

Table 1: Analysis of physico-chemical nutrients of vermiwash

S. No.	Name of the parameter	Different concentration of vermiwash		
		40:60	50:50	60:40
1	pH	6.41±0.15	7.11±0.15	7.11±0.21
2	Electrical conductivity (dSm^{-1})	0.52±0.00	0.43±0.01	0.58±0.01
3	Total Organic carbon (%)	3.13±0.43	3.43±0.06	3.19±0.05
4	Total Nitrogen (%)	1.52±0.06	1.78±0.18	1.71±0.09
5	Total Phosphorous (%)	1.29±0.06	1.56±0.05	1.51±0.13
6	Total Potassium (%)	2.11±0.07	3.52±0.02	2.92±0.04
7	Total Sodium (%)	3.05±0.04	3.23±0.02	2.72±0.06
8	Total sulphur (%)	2.24±0.03	2.34±0.06	2.44±0.12
9	Total Calcium (%)	2.41±0.03	3.64±0.07	3.24±0.02
10	Total Magnesium (%)	2.78±0.04	3.29±0.02	3.16±0.04
11	C:N ratio	1:3	1:3	1:3

#Mean and standard deviations were obtained from 3 replicates

Table 2: Growth and yielding pattern of chilli plant by using vermiwash (in 0^{th} day 30^{th} day sapling)

Vermiwash	No. of leaves	Plant height (cm)	Number of flowers	Number of fruits	Weight of the fruits
Control	$7±0.83^{a}$	$11±3.57^{a}$	$0±0.00^{a}$	$0±0.00^{a}$	$0±0.00^{a}$
40:60	$9±1.04^{a}$	$13±2.73^{a}$	$0±0.00^{a}$	$0±0.00^{a}$	$0±0.00^{a}$
50:50	$9±1.84^{b}$	$15±1.92^{b}$	$0±0.00^{a}$	$0±0.00^{a}$	$0±0.00^{a}$
60:40	$8±0.74^{a}$	$14±2.95^{a}$	$0±0.00^{a}$	$0±0.00^{a}$	$0±0.00^{a}$

Mean and standard deviations were obtained from 5 individuals

Table 3: Growth and yielding pattern of chilli plant by using vermiwash (in 30th day)

Vermiwash	No. of leaves	Plant height (cm)	Number of flowers	Number of fruits	Weight of the fruits
Control	24±4.83[a]	20±7.34[a]	0±0.00[a]	0±0.00[a]	0±0.00[a]
40:60	25±6.04[a]	20±8.03[a]	0±0.00[a]	0±0.00[a]	0±0.00[a]
50:50	29±4.62[c]	26±4.92[ab]	0±0.00[a]	0±0.00[a]	0±0.00[a]
60:40	27±7.27[ab]	21±5.83[ab]	0±0.00[a]	0±0.00[a]	0±0.00[a]

Mean and standard deviations were obtained from 5 individuals

Table 4: Growth and yielding pattern of chilli plant by using vermiwash (in 60th day)

Vermiwash	No. of leaves	Plant height (cm)	Number of flowers	Number of fruits	Weight of the fruits
Control	44±8.74[a]	55±8.35[a]	7±3.13[a]	3±2.93[a]	0±0.00[a]
40:60	48±11.02[b]	57±6.92[b]	8±3.13[a]	4±1.43[a]	0±0.00[a]
50:50	53±12.68[c]	62±5.84[c]	14±1.85[b]	8±2.34[b]	0±0.00[a]
60:40	49±10.95[c]	57±7.31[b]	9±4.32[ab]	7±1.04[b]	0±0.00[a]

Mean and standard deviations were obtained from 5 individuals

Table 5: Growth and yielding pattern of chilli plant by using vermiwash (in 90th day)

Vermiwash	No. of leaves	Plant height (cm)	Number of flowers	Number of fruits	Weight of the fruits (g)
Control	81±4.72[a]	82±7.50[a]	39±2.73[a]	26±3.05[a]	1067±6.81[a]
40:60	92±6.09[b]	85±3.32[c]	32±1.85[b]	21±2.25[b]	1329±5.36[b]
50:50	104±4.18[c]	97±5.84[c]	43±4.90[d]	31±3.13[bc]	1517±8.05[c]
60:40	91±8.11[a]	88±4.95[b]	37±2.58[c]	23±1.25[b]	1316±5.47[b]

Mean and standard deviations were obtained from 5 individuals

The growing concern for an ecologically sound agricultural system without pesticides has added new dimensions to the economics of bio dynamics. Reliance on organic matter sources is a central feature of organic agriculture. It involves the harnessing of soil organisms like bacteria, earthworms and other micro fauna in recycling organic wastes like straw, grass, leaves twigs, weeds etc. and their transformation to produce slow release nutrients as needed by the crop (Cacco *et al*., 1984).

In the present investigation, Physico-chemical analysis of vermiwash were showed significant level in all ratio. These findings are agreed with recent reports, Manyuchi (2013) reported that the vermicompost and vermiwash had a neutral pH, particularly the electrical conductivity was 21% higher in the vermicompost. The nitrogen and potassium content was 57% and 79.6% richer in the vermicompost respectively compared to the vermiwash. However, the vermiwash was 84% richer in phosphorous as compared to vermicompost. Furthermore, the vermiwash was 89.1% and 97.6% richer in Ca and Mg respectively and was 97.8% richer in Na salts compared to the vermicompost. The earthworms also enhance the nitrogen levels of the substrate by adding their excretory products,mucus, body fluid, enzymes and even through decaying tissues of dead worms in vermicomposting sub-system (Suthar, 2007c).(Atiyeh *et al*, 2001); and Klock (1997) reported that electrical conductivity of planting media substituted with vermicomposts increased in the range of 1.3 to 2.8 times over those untreated control. Since most of the mineral nitrogen in vermicompost is usually in the nitrate form (Atiyeh *et al*., 2001; Orozco *et al*., 1996; Benetiz, 1999), it was not surprising that amounts of nitrates in the planting media increased with the increasing vermicompost concentrations.

The P content also a direct action of earthworm gut enzymes and indirectly by stimulation of the microflora (Satchell and Martein, 1984) due to bacterial and faecal phosphate activity of earthworms that probably lead towards mineralization and mobilization of phosphorus (Edwards and Lofty, 1972). Other micronutrient elements which are required by plants in very low concentrations for adequate growth and reproduction. Despite of their low concentrations within the plant tissues and organs, micronutrients are of equal important to macronutrients for the nutrition of plants that are essential for the growth and development (Kirkby and Romheld, 2004).

The earthworms also enhance the nitrogen levels of the substrate by adding their excretory products,mucus, body fluid, enzymes and even through decaying tissues of dead worms in vermicomposting sub-system (Suthar, 2007c). The observed pattern for nitrogen enhancement in casts appears to be related with quality of the substrate used for worm feed. Flegel and Schreder (2000) demonstrated a significant correlations of the enzymes activities (dehydrogenases, acid and alkaline phosphomonesterase; indicating microbial decomposition in worm's gut) in the earthworm casts with their organic C and total nitrogen content. They observed that activities of these enzymes were influenced by the food, which affects the specific nutrient status of the casts (Oyedele *et al*., 2005). It is also suggested that the chemistry of plant residues can also influence the decomposition and mineralization rate in vermicomposting system.

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