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IMPACT OF VERMITECHNOLOGY AND CHEMICAL FERTILIZER ON GROWTH, YIELD AND NUTRIENTS IN TOMATO

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Abstract: **Vermitechnology technology contains bio-oxidation and balance of organic matter through contact between earthworms and microbes. Although microorganisms are primarily responsible for the biochemical decomposition of organic matter, earthworms play an important role in the process by fragmenting and conditioning the substrate, increasing the surface area for the growth of microorganisms, and altering their natural movement. These days fertilizers have become important to modern agriculture to feed a growing population. In modern agriculture, chemical fertilisers are widely used to improve crop yields. The increase in the yield of crops largely depends on the type of fertiliser that is used to supplement the essential plant nutrients. In order to reposition plant soil nutrients consumed through previous plant growth with the ultimate goal of increasing productivity and economic profit, fertiliser application is necessary. There is a great deal of attention today on the impact on the soil environment of the increased use of chemical fertilisers. In agriculture, not only soil quality but also the survival of the soil organisms that live there have been observed the effect of the use of chemical fertilizer. Eelworms are an important element of the soil fauna and are participating, directly or indirectly through the formation of humus and various soil processes, in biodegradation and stabilisation in a number of soil environments. Vermitechnology is beneficial for plant health, growth, soil fertility, plant yield and human health which produces safe and more nutritious food. For this experiment 25 pots were selected to grow tomato (Solanum Lycopersicon) plant. 5 treatments which were applied in the experiment were namely vermicompost, vermiwash, vermitea, chemical fertilizer and control. Per treatment 5 pots were use. Vermiwash and vermitea were prepared by the investigator and vermicompost and chemical fertilizer were purchased from the market. The results also advocate that vermiwash, vermitea and vermicompost positively influence growth, yield, quality. The maximum fruit weight were recorded in vermiwash, followed by vermitea fertilized plant. Vermiwash, vermitea and vermicompost were found significantly superior for number of fruits, maximum fruit diameter over chemical fertilizer and control. Vermitechnology treated plants produced fruit containing significantly higher amount of vitamin C. Soil treated with vermiwash, vermitea and vermicompost were found better in ph, organic carbon, available phosphorus and potassium.**

Keywords: *Vermitechnology, Vermiwash, Vermitea, vermicompost*

I INTRODUCTION

Earthworms are an essential waste nutrient that plays a crucial role in organic matter and soil metabolism's decomposition process. They are known as soil health indicators. The complex process of partial organic matter decomposition and mixing with mucus and intestines enhances the fertility of the soil. The soil is affected by forming the atmosphere which contributes to the porosity of the soil. For plant growth and productivity, the positive role of earthworms is very important. Includes a worm technology that has been developed because of the importance of the earthworm. Use of surface and earthworms in soil management and fertilization. The production of vermicompost and vermicompost, which have proven to be an essential ingredient for plant growth and productivity, can therefore optimally recover bio waste through the processing of cyclone composts.

The present study is an effort to introduce a clear picture of the existing situation about use of vermitechnology in the production of organic vegetable.

The regular use of chemical fertilizers leads to risks of certain diseases, and the biggest problem facing the use of chemical fertilizers is cancer, goiter, birth defects, high blood pressure, testicular cancer and abdominal cancer.

Organic (Virus Technology) VS. Chemical fertilizers

Innovative and cost effective technology turns organic waste into a worthwhile product by using viral technology. The soil and water, plant growth and increased productivity benefit from Earthworm fertilisers. Chemical fertiliser is hot as it is charged with fire and energy, while natural organic fertilisers are cool and nutritious like breast milk. Because of its humus content, high porosity, its capacity to hold and drain more water than chemical fertilisers, organic fertilisers have a high growth promoter value. Karl et al (2009) The increased requirements for organic food is mainly explained by the concern of consumers with regard to food safety and quality, and their perception that organic food is safer and healthier than conventional foods when comparing nutrients and contaminants between organic and conventional vegetables and potatoes. They found that organic plants and potatoes are significantly better than conventional plants for nutrients and pollutants. Organic fertilisers are now proven to be a gigantic step towards achieving "social, economic and environmental" global sustainability to "replace" chemical fertilisers for producing "safe organic foods".

Effects on soil physical properties

Two main activities of earthworm are highly influenced by its structure: ingestion of the soil, a partial breakdown of organic substance; and an intimate mixing of these fractions. It penetrates the earth and takes the earth to the surface. Earthworms contribute to soil aggregation, improve soil aeration and porosity through these processes (Edwards and Bohlen, 1996). Despite earthworms, Earthworms contribute mainly to soil accumulation by manufacturing moles.

Burrows can also help to achieve overall stability since they are often covered with guided clay and humic materials (Lachnicht and Hendrix, 2001). Most workers have agreed that earthworm moles are made of more stable pools of water than soil and that their activity impacts both water drainage from the ground and soil's capacity to retain moisture (Edwards and Bohlen, 1996; Lachnicht and Hendrix, 2001).

Effect on chemical properties of soil

The effect on the chemical of the soil leads to the mineralisation of the organic matter and therefore the release of nutrients from plants in the available forms (Edwards and Bohlen, 1996). In its moles, that break up to form fine particles, the organic matter passing through the gut of the earthworm is present, so that a greater organic field is microbially degraded (Martin, 1991). Earthworms have important effects in many ecosystems on nutrient cycling (Edwards and Bohlin, 1996). These typical bases are based on four scales (Lavel and Martin, 1992), in earthworm intestines, newly sedimented moles, outdated moles and the long-term formation of the entire soil profile. Earthworms provide nutrients as nitrogen waste (Ismail, 2005). They contain replaceable phosphorus, potassium and manganese exchangeable and total replaceable calcium. Earthworms favour nitrification because the bacteria are increasing and soil ventilation. Maybe the most important effect of earthworms is the stimulation of microbial activity in the moulds that encourage dissolved nitrogen to become a microbial protein, thereby reducing its loss by leaching it into the lower soil horizons. A: N mould rates are below those found in the soil A: (Bouchet, 1983). The effects on soil nitrogen and nitrogen cycles of earthworms were summarised in Lee (1983). The earthworm's metabolism's nitrogen products, he says, come back to the soil via the moulds, urine, mucous proteins, and dead earthworm tissue. India, where a lot of organic solid waste is available in various sectors without a shortage of workmanship, can use Earthworms to make waste a source of richness. There have been many works on the vermicomposting of different organic materials, and additional shapes of earthworm have been shown to significantly accelerate composting, while producing better quality compost than those produced by conventional methods. A number of workers have checked that earthworms can be used as a method for treating or managing many organic waste streams (Hand, 1988; Logsdon, 1994; Madan, 1988; Singh, 2002). n Likewise, several industrial waste have been transformed into vermicompost and turned into nutrient-rich manure (Sundaravadivel, 1995). Hande et al. (1988) have defined the treatment of insects as a low cost technical treatment system for organic waste. Vermitechnology or worm composting is an easy and effective way to recycle agricultural waste, city waste, kitchen waste, etc .and convert this organic waste into nutritious compost through earthworm activity. The worms turn the waste into high-quality compost. Vermicast is an important soil amendment and can replace chemical fertilizers to some extent.

II EXPERIMENT ON TOMATO (SOLANUM LY C OPERSICON)

Tomato (Solanum Lycopersicon) as a healthy vegetable food has an important role in the human diet. It is a cheap source of high-quality vitamins C and carotene in the diets of millions of people in developing countries, who cannot afford the high cost of vitamins for a balanced diet. In addition to vitamins, it is a good source of potassium and minerals. The paper aims to analyze different types of fertilizers related to the effect of chemical fertilizers versus organic fertilizers on growth and productivity of tomatoes and the effect of soil.

III METHODOLOGY

The experiment is housed in a completely random design. Tomatoes were planted in the kitchen garden in Jaipur. Sandy clay soil was obtained from the nursery. The soil was sifted to remove any stone or debris and then sun-dried for 10 days. Ceramic conical pots 30.48 cm high and 30.48 cm in diameter were selected for growing vegetables. Each pot was filled with 10 kg after pottery to avoid losing water and soil. Before starting the experiment, a soil sample was collected from the soil mound.

Experiment details

1. Treatment

Table 1: The quantities of various fertilizer inputs

S.No.	Treatment	Quantity (on area weight basis)
1.	(T1) Vermiwash	0.245 g
2.	(T2) Vermitea	0.305g
3.	(T3) Vermicompost	0.625g
4.	(T4) Chemical Fertilizer	Urea 1.3g
		SSP 2.5g
		MoP 0.5g
5.	(T5) Control	Nil

Experiment

Replication: 5

Number of plant per pot: 1

Number of experiment: 3

Seasons: 6 November 2015, 11 November 2016, 29 June 2017

Vermiwash, vermitea, vermicompost, chemical fertilizers and control versus inorganic fertilizer inputs on growth and yield of tomatoes. For the experiment, Eisenia fetida was selected as earthworm and casting treatment. These are voracious cannibals. Eisenia fetida has a wide temperature tolerance.

Produced with buckets, Vermiwash is a liquid fertilizer obtained from earthworms and used as a foliar spray. It contains plant growth hormones like auxins and cytokines apart from nitrogen, phosphorous, potash and other micronutrients. Falling water removes all secretions from the body of earthworms as well as other nutrients from decomposing matter. The pooled water contains many nutrients readily available to crop plants.

Vermitea is produced when worm castings are mixed with water and molasses and fermented for 24 hours. Molasses was a food source for beneficial microorganisms that are part of the worms' castings. The fermentation process multiplies the beneficial microorganisms of the worm that quickly pours tea. The chemical fertilizer urea, monophosphate (SSP) and potash murates (MoP), was weighted according to tomato requirements. One superphosphate and potash murates were added to the soil at the initial level. Urea was added in three divided doses, the first dose was applied 15 days after sowing the seeds. Potted seeds of the "Pusa Nidhi" tomato variety. 5 pots were prepared for each treatment separately. I planted five seeds 2.5 cm below the top layer of soil. Initially 4-5 seeds were planted in each pot. Only one plant was allowed to grow to maturity on all vegetables. Initially the soil was moistened with 2 liters of water. In the summer seasons 500 ml. Water was poured every day in the evening and during the winter the same amount of water was poured every alternate day. Pots containing earthworms were covered with a piece of burlap sacks at the height of the seasons (summer or winter). All the utensils are arranged in such a way that they receive uniform sunlight. Representative samples of tomato fruit were collected from each treatment for vitamin C and-carotene content. For the determination of vitamin C, the ascorbic acid content in tomato fruits during ripening was determined using a 2,6-dichlorphenol endophenol titration method. To determine-carotene, the total carotenoids were extracted and divided into organic solvents (acetone or methanol) on the basis of their solubility. The carotenoids attached to the esters are hydrolyzed using 60% aqueous KOH. The amount of carotenoids present in the sample is color-quantified at 450 nm using-carotene as a standard. Soil sample was collected from each pot to evaluate the impact of various fertilizer inputs on soil. Then soil was sun dried for 15 days and reused for next experiment. In each pot, same treatment input in measured amount was added in next experiment.

The experiment data for growth, yield and quality parameters recorded, were subjected to statistical analysis using analysis of variance technique. The critical differences for the treatment comparison were worked out at 5 percent level of significance.

IV RESULTS

Analysis of variance showed that various organic fertilizers have significantly better on growth and yield attributes.

Table 1 **Impact of vermiwash, vermitea, vermicompost, chemical fertilizer and control group on germination, Plant height, number of branches, numbers of buds, Number of flowers and Fruit Set Percent in Tomato.**

Table 1 shows impact of vermiwash, vermitea, vermicompost, chemical fertilizer and control group on germination, Plant height, number of branches, numbers of buds, Number of flowers and Fruit Set Percent in Tomato. It was observed that seed germination at 15th day was 20.8 (83.2 %) which was maximum with Treatment T1 and decreases to minimum of 9.2 (36.8%) with treatment T5. Treatment T1 leads to maximum growth in mean Plant height of 56.4 cm at 90th day which decreased down to 43.2 cm due to Treatment T5. Fruit set percentage was also maximum with mean 87.9% in treatment T1 and decreased down to 38.6% in treatment T5. Mean number of flowers was highest that is 39.6 due to treatment T1 and lowest in treatment T5 with only 8.4 mean number of flowers.

Treatment	Seed Germination at (15th day) n (%)			plant height at 90th Day in cm (n)			number of branches (at 90th day) (n)			Fruit set percent (Flower to fruit) (%)			Numbers of Buds			Number of flowers		
	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III
T1	**20.8 (83.2)**	**21 (84.0)**	**20.8 (83.2)**	**58.1**	**67.9**	**76.4**	**10.6**	**11.8**	**11.8**	**87.9**	**86.2**	**86.3**	**36.8**	**37.5**	**44.8**	**28**	**39.0**	**39.6**
T2	**17.4 (69.6)**	**18.4 (73.6)**	**17.6 (70.4)**	**55.0**	**58.0**	**63.0**	**9.6**	**10.8**	**11.2**	**78.5**	**80.9**	**78.6**	**28.8**	**40.0**	**41.0**	**22.4**	**33.4**	**34.6**
T3	**15.6 (62.4)**	**15.4 (61.6)**	**15.6 (62.4)**	**53.3**	**55.5**	**61.4**	**8.4**	**11.4**	**12.0**	**73.1**	**76.1**	**75.8**	**29.0**	**34.6**	**34.8**	**19.4**	**26.0**	**27.2**
T4	**11.2 (44.8)**	**10.4 (41.6)**	**10.8 (43.2)**	**45.4**	**49.6**	**55.9**	**8.2**	**9.2**	**9.6**	**53.7**	**61.9**	**52.7**	**17.2**	**20.6**	**20.0**	**13.0**	**16.8**	**18.2**
T5	**9.2 (36.8)**	**10.2 (40.8)**	**9.6 (38.4)**	**43.2**	**45.2**	**50.2**	**5.2**	**6.8**	**7.2**	**40.5**	**50.2**	**38.6**	**13.2**	**14.6**	**15.4**	**8.4**	**8.8**	**11.4**

Table 2: Impact of vermiwash, vermitea, vermicompost, chemical fertilizer and control group on yield parameters in Tomato

Treatment	Av. Fruit Weight (g)			Max. fruit Weight (g)			Av. Numbers of fruits			Total Number of fruit			Av. Fruit diameter (cm)			Max. Fruit diameter (cm)		
	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III
T1	**29.9**	**38.7**	**31.2**	**38.0**	**48.6**	**50.9**	**17.4**	**22.2**	**26**	**24.6**	**33.2**	**34.2**	**4.3**	**5.4**	**6.2**	**6.0**	**7.0**	**7.2**
T2	**24.8**	**24.8**	**22.7**	**32.9**	**38.9**	**38.5**	**11.0**	**16.6**	**22.2**	**17.6**	**27**	**27.2**	**3.7**	**4.1**	**4.4**	**4.7**	**5.3**	**5.3**
T3	**23.5**	**24.7**	**23.6**	**31.3**	**38.0**	**38.3**	**8.8**	**14.4**	**18**	**14.2**	**20.4**	**20.6**	**3.6**	**4.0**	**4.1**	**4.0**	**4.8**	**4.8**
T4	**10.9**	**18.7**	**17.1**	**20.1**	**26.3**	**27.9**	**3.4**	**6.2**	**8.6**	**7**	**10.4**	**9.6**	**3.0**	**3.3**	**3.3**	**3.4**	**3.8**	**3.7**
T5	**9.2**	**11.0**	**9.44**	**13.7**	**19.9**	**20.7**	**1.4**	**3.6**	**4.2**	**3.4**	**4.4**	**4.2**	**2.5**	**2.4**	**2.8**	**2.8**	**3.0**	**3.0**

Table 2 shows Impact of vermiwash, vermitea, vermicompost, chemical fertilizer and control group on yield parameters in Tomato. It was observed that maximum Average fruit weight of 38.7 gm on applying treatment T1 which decreases down to minimum of 9.2 gms with Treatment T5. Mean maximum fruit weight of 50.9 gms, was highest with T1 and lowest of 13.7 gms was with T5. On applying treatment T1 on tomato, mean number of fruits were at their highest level of 34.2 which decreases down to 7 due to treatment T5. Average and maximum fruit diameter were also maximum of 6.2 cm and 7.2 cm due to treatment T1 which decreases to its minimum of 2.5 cm and 2.8 cm on applying treatment T5.

Table 3 Impact of vermicompost, vermiwash, vermitea, chemical fertilizer and control group on nutrient content in tomato.

Treatment	β Carotene (µg)			Vitamin C(mg)		
	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III
T1	**507.4**	**517**	**518**	**28.6**	**30.6**	**34.2**
T2	**502.4**	**498.2**	**501**	**26.6**	**27.6**	**28.0**
T3	**484.6**	**484.8**	**483**	**26.2**	**27.2**	**27.8**
T4	**459.6**	**457.8**	**455.2**	**21.8**	**22.8**	**21.4**
T5	**424**	**428.4**	**423.8**	**19.0**	**17.6**	**18.4**

Table 3 shows the impact of different fertilizers on nutrient content in tomato. Mean β Carotene and vitamin C levels of tomato was 518 µg and 34.2 mg which was highest after Treatment T1 and was 423.8 µg and 17.6 mg which was lowest after treatment T5.

Table 4: Impact of vermiwash, vermitea, vermicompost, chemical fertilizer and control group on soil in tomato plant post.

Treatment	pH			EC(dS/m)			OC (%)			P_2O_5(kg/ha)			K_2O (kg/ha)		
	8.4			1.45			0.12			14.98			183		
	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III	Expt I	Expt II	Expt III
T1	**7.60**	**7.70**	**7.70**	**0.84**	**0.80**	**0.80**	**0.27**	**0.27**	**0.29**	**30.4**	**30.4**	**32.0**	**221**	**228**	**224**
T2	**7.90**	**7.94**	**7.78**	**0.86**	**0.87**	**0.86**	**0.28**	**0.25**	**0.26**	**26.2**	**28.4**	**27.8**	**211.4**	**211.8**	**214.2**
T3	**7.94**	**8.20**	**8.12**	**0.93**	**0.95**	**0.83**	**0.25**	**0.26**	**0.24**	**26.8**	**25.8**	**26.4**	**219.4**	**216.2**	**215.4**
T4	**8.72**	**8.70**	**8.48**	**1.53**	**1.46**	**1.52**	**0.11**	**0.13**	**0.10**	**18.6**	**17.4**	**17.8**	**195.4**	**196**	**191.8**
T5	**8.74**	**8.80**	**8.56**	**1.58**	**1.62**	**1.67**	**0.10**	**0.09**	**0.10**	**13.2**	**14.4**	**14.0**	**171.2**	**162.8**	**163.4**

Table 4 show that mean pH level of soil in tomato plant was 7.60 after treatment T1 which was increased to 8.80 after treatment T5. EC level was also increased from 0.84 dS/m after treatment T1 to 1.67 dS/m after applying treatment T5. Mean P_2O_5 and K_2O levels was decreased from 32.0 kg/ha and 228 kg/ha after Treatment T1 to 13.2 kg/ha and 162.8 kg/ha after treatment T5.

Table 5: Impact of vermiwash, vermitea, vermicompost, chemical fertilizer and control group on Disease Incidence in Tomato.

Treatment	Incidence of disease (in days)			Number of treatment required			Time taken for eradication		
Expt	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
T1	**52**	**0**	**0**	**1**	**0**	**0**	**12**	**0**	**0**
T2	**50**	**0**	**49**	**2**	**0**	**1**	**14**	**0**	**15**
T3	**51**	**48**	**50**	**1**	**1**	**1**	**17**	**16**	**15**
T4	**41**	**39**	**43**	**3**	**3**	**2**	**27**	**24**	**26**
T5	**34**	**38**	**40**	**3**	**3**	**3**	**30**	**26**	**27**

Table 5 show impact of various fertilizers on disease incidence in Tomato. It was observed that after treatment T1 either there was no incidence of disease or disease occurs in 52 days while after treatment T1 it takes only 34 days for disease to occur. For eradication of disease either no treatment or single treatment cycle was required which was increased to 3 treatment cycle for removal of diseases when treatment T5 was applied. Only 12 days it takes to eradicate disease among the tomatoes while it takes 30 days to eradicate diseases among the tomatoes treated with treatment T5.

V CONCLUSION

It can be concluded with the experiment and extensive review that application of vermiwash, vermitea and vermicompost, enhanced growth, yield and quality as compared to chemical fertilizer and control group. Vermitechnology (Earthworms and their casts) contain high concentration of nutrients but releases gradually according to plant requirement. Therefore, the nutrients are absorbed by the plant and do not settle in the ground by leaching. Vermitechnology (Earthworms and their casts) has proved to be powerful growth promoter as well as growth protector. Hence it can be concluded that horticulture with vermitechnology can be beneficial for plant growth, product quality, human health and soil too.

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