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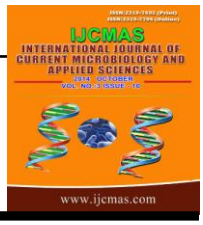

Original Research Article

Effect of vermicompost enriched with bio-fertilizers on the productivity of tomato (*Lycopersicum esculentum* mill.)

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A B S T R A C T

The present investigation was aimed at determining the effect of vermicompost with biofertilizers on growth and yield of tomato plants. Vermicompost were produced by earthworm species, *Perionyx ceyalenensis*, on vegetable waste. Experiment was conducted in a completely randomised block design. Thirty-nine days old seedlings were transplanted into pots containing sand, soil and vermicompost in the ratio of 1Kg+4Kg+3Kg. After two weeks, about 20 g of *Azospirillum* species were added to the pot as per treatment structures. Observations indicate that T4 showed significantly high performance in whole plant height (cm), number of leaves per plant, number of branches, length of the root, number of fruits per plant, and harvest index compared to T0, T1, T2 and T3. The overall results suggest that vermicompost with biofertilizer inoculation improves plant mineral concentration through nitrogen fixation and thereby alters fruit production in tomato plants.

K e y w o r d s

vermicompost, bio-fertilizers, Azospirillum, tomato

Introduction

Tomato (*Lycopersicum esculentum* Mill.) is one of the most commonly grown vegetable crops in India. Tomato belongs to the family Solanaceae. The world scenario indicates that India is the second largest producers of vegetables after China. Tomato, aside from being tasty and nutritious, a good source of vitamins A and C and lycopene content. Hence, this crop is gaining importance both in developing and developed countries and efforts are being made for the quality and quantity production of this commodity (Mahajan and Singh, 2006).

Vermi- compost could be used as an excellent soil amendment for main fields and nursery beds and has been reported to be useful in raising nursery species plants. Edwards (1988) reported that vermicompost could promote early and vigorous growth of seedlings. Vermicompost has found to effectively enhance the root formation, elongation of stem and production of biomass, vegetables, ornamental plants, etc. The nutrient level, especially the (macro or micro-nutrients) were found to be always higher than the compost derived from other

methods (Kale, 1998). One of the unique features of vermicompost is that during the process of conversion of various organic wastes by earthworms, many of the nutrients are changed to their available forms in order to make them easily utilizable by plants.

Biofertilizer is a natural product carrying living microorganisms derived from the root or cultivated soil. So they don't have any ill effect on soil health and environment. Besides their role in atmospheric nitrogen fixation and phosphorous solubilisation, these also help in stimulating the plant growth hormones providing better nutrient uptake and increased tolerance towards drought and moisture stress. A small dose of biofertilizer is sufficient to produce desirable results because each gram of carrier of biofertilizers contains at least 10 million viable cells of a specific strain (Anandaraj and Delapierre, 2010).

Azotobacter and *Azospirillum* are the two most important non-symbiotic N-fixing bacteria in non-leguminous crops. Under appropriate conditions, *Azotobacter* and *Azospirillum* can enhance plant development and promote the yield of several agricultural important crops in different soils and climatic regions (Okon and Labendera-Gonzalez, 1994). These beneficial effects of *Azotobacter* and *Azospirillum* on plants are attributed mainly to an improvement in root development, an increase in the rate of water and mineral uptake by roots, displacement of fungi and plant pathogenic bacteria and, to a lesser extent, biological nitrogen fixation (Okon and Itzigshohn, 1995).

All these factors combined together produce positive effects on crop yield especially for vegetables and cereals. Therefore, the present study was to evaluate the effect of Vermicomposts enriched with biofertilizers on growth and yield of tomato plants.

Materials and Methods

The effect of vermicompost with biofertilizer in comparison to chemical fertilizers was tested on tomato plants (*Lycopersicum esculentum* Mill.) through randomized block design method (Panse and Sukhatmo, 1967)

Preparation of vermicompost

Vegetable wastes were collected from market shop of Kancheepuram, Tamil Nadu and subjected to initial decomposition in rectangular draining cement tanks of 75cm×60cm×45cm size by sprinkling water, regular mixing and turning of the substrates for 15 days. The cowdung (CD) was collected from nearby cattle sheds in fresh form and allowed to stabilize for one week and used for the study. The stabilization of cowdung was done to make it acceptable by the worms. The earthworm, *Perionyx ceylanensis*, originally collected from culture bank of the Department of Biology, Gandhigram Rural University, Tamilnadu was mass multiplied in cowdung and used for the study. This preparation has been carried out 3 months before start of the experiment.

Microbiological examination of vermicompost

Vermicasts were collected (fresh and after 3 weeks) and stored at ambient temperature. All samples were collected in triplicates using sterilized polythene bags. Serial dilutions of vermicast samples were prepared, from each dilution, 0.1 ml of sample was inoculated in to appropriate media for the isolation of microorganisms. Sabouraud dextrose agar supplemented with 0.01% Streptomycin sulphate were used for isolation and enumeration of fungi. Mac Conkey agar and Nutrient agar was used for

isolation of bacteria and Nutrient agar was used for total viable count of bacteria.

Experiment on plant - tomato (*Lycopersicum esculentum* Mill.)

Seed Preparations: The seed of tomato var. PKM1 was obtained from Govt. District Agriculture institute, Kancheepuram, Tamilnadu. Tomato seeds were surface sterilized with 0.05% sodium hypochloride for 45min before sowing. Experiment was conducted in a completely randomised block design. Thirty-nine days old seedlings were transplanted into pots (29x27 cm) containing sand, soil and vermicompost in the ratio of 1Kg+4Kg+3Kg. Each plant was transplanted in to the respective pot as per the experiment. All the plants were given water daily for two weeks and after that irrigated on alternate days. Before transplanting, the shoot length, root length and number of leaves of the seedling were recorded. Fifteen pots were selected for pot culture experiments. The 15 pots were arranged in three rows. About 20 g of *Azospirillum* species were added to the pot as per experiment and treatment structure. Bio fertilizers were collected from Govt. District Agriculture institute, Kancheepuram, Tamilnadu.

The experiment and treatment structure are as followed:

Experiment: Number of treatments – 5 (T0, T1, T2, T3, T4 &T5).
Number of replication – 3.
Design – CRD (Completely Randomised Design).
Number of pots – 15.
Period of pot culture – 10 months.
Treatment: T0- Soil+ *Lycopersicum esculentum* mill
T1- Soil+ *Lycopersicum esculentum* mill + NPK
T2- Soil+ *Lycopersicum esculentum* mill + AZO
T3- Soil+ *Lycopersicum esculentum* mill + VC
T4- Soil+ *lycopersicum esculentum* mill + VC+AZO

Note- AZO- *Azospirillum* (Biofertilizer), VC- Vermicompost from *Perionyx ceylanensis*

Effect on tomato plant - growth characteristics:

a) **Height of the plant** - Height of the plant were examined at the time of transplantation and different intervals.
b) **Number of branches** - The total number of branches in each treatment was counted at the maximum growth stage and then the average was taken.
c) **Number of leaves** - Number of leaves of each treatment was counted at different intervals and the mean number of leaves per plant was worked out.
d) **Root length -** Root length of each treatment were recorded after harvest.

Effect on tomato plant – yield characteristics:

a) **Number of Fruits -** Total number of fruits from each treatment was counted and then average was calculated to get number of fruits per plant.
b) **Harvest index** - The harvest index was worked out from the data on total dry matter production and fruit yield as follows.

Harvest index = Total fruit biomass / Total plant biomass x 100

Result and Discussion

Isolation and identification of microbes in vermicompost

Table 1 shows total aerobic count of different treatments in fresh and 3 weeks old vermicompost. Maximum aerobic count recorded is in T1 and minimum in T4 treatment. Fresh vermicompost shows maximum aerobic count than 3 weeks vermicompost.

Table 2 shows total fungal count of microorganisms. Almost same fungal count was observed in 3 weeks vermicompost and fresh vermicompost.

Table 3 and 4 shows names of microorganisms isolated from fresh and 3 weeks old vermicompost in different treatments.

Effect on plant - growth characteristics

Height of the plant

Effects of treatments on height of the plant at different stages of tomato during growth were furnished in Table 5. Plants that recorded in T4 resulted in maximum height at all growth stages.

Number of leaves

The effect of treatments on number of leaves at different growth stages during the period of study is presented in the Table 5. Vermicompost with microbial fertilizers significantly influenced the number of leaves of plants (T4).

Number of branches

Compared to controls, number of branches was higher in T4 followed by T3 (Table 5).

Length of the root

Length of the root in each treatment was observed after harvesting the plants. Maximum root length was observed in T4. Length of the root in each treatment was observed after harvesting the plants. Maximum root length was observed in T0 (Table 5).

Effect on tomato plant – yield characteristics

Total number of fruits

Total number of fruits in each treatment was counted and recorded (Fig.1). Compared to other treatments, T4 (50.3) showed significantly higher number of fruits.

Harvest index

Harvest index of the treatments was shown in Fig.2. Harvest index was higher in T4 (3.31) compared to other treatments.

The results of total aerobic counts of microflora obtained from earthworm castings (fresh and 3 weeks old) produced by earthworm species indicated that total number of microorganisms were higher in fresh earthworm casts compared to 3 weeks older casts. More fungal count was observed in 3 weeks old vermicompost compared to fresh vermicompost. Earthworms have been shown to influence greatly the microbiological properties of substrates they inhabit (Tiwari, 1993). It is assured that other factors, such as the presence of beneficial micro- organisms or biologically active plant growth influencing substances such as phytohormone that are released by beneficial microorganisms present in the vermicompost rich soil (Tomati and Galli, 1995; Edwards, 1998). Root initiation, increased root biomass, enhanced plant

growth and development and sometimes, alterations in plant morphology are among the most frequently claimed effects of vermicompost treatment (Tomati *et al.*, 1988). Stem elongation, dwarfing and early flowering have been found due to the hormone effect in a wide variety of plants and in a number of physiological situations, stem elongation is promoted (or inhibited) by endogenous phytohormones, a class of growth- regulating substance which inhibited stem elongation without affecting leaf or flower development.

Most of the Indian agriculture lands are deprived of some of the essential nutrients for growth and development of crop plants. One of the major essential elements for growth of plant is nitrogen. Nitrogen is provided in the form of chemical fertilizers like urea, such chemical fertilizers pose health hazard and microbial population problem in soil. In such a situation the biofertilizers like *Azospirillum* play a major role in agriculture. Plant and crop physiologists, microbiologists and agronomists agree that plant growth and development are strictly dependent on biological fertility factors. Earth- worms stimulate microbial activities and metabolism and at the same time bio fertilizer influence plant metabolic activity such as nitrogen fixation. As a consequence more available nutrients and microbial metabolites are released into the soil.

Table.1 Total aerobic count vermicompost (cfu/ml)

Treatment (T)	Aerobic count of fresh vermicompost (Mean)	Aerobic count of vermicompost after 3 weeks (Mean)
T0	4.5	3.6
T1	2.9	2.5
T2	3.1	2.8
T3	3.9	3.1
T4	2.8	2.4

Table.2 Total fungal count (cfu/ml)

Treatment (T)	Fungi of fresh vermicompost (Mean)	Fungi of vermicompost after 3 weeks (Mean)
T0	2.5	2.5
T1	2.3	2.3
T2	2.4	2.2
T3	2.2	2.3
T4	1.9	1.9

Table.3 Distribution of microorganisms in fresh vermicompost

BACTERIA	T0	T1	T2	T3	T4
Staphylococcus sps.	+	+	+	+	+
Bacillus sps	+	-	+	+	+
Pseudomonas sps	+	+	+	+	+
Clostridium sps	+	+	+	+	+
Serratia sps	-	+	+	+	-
Acetobacter sps	+	+	+	+	+
Acinetobacter sps	+	+	+	+	+
FUNGI	+	+	+	+	+
Aspergillus sps	+	+	+	+	+
Fusarium sps	-	-	-	+	-
Rhizopus sps	-	+	-	-	+
Candida sps	+	-	+	-	+
Saccharomyces sps	+	+	+	-	+
Pichia sps	-	+	-	+	-

Table.4 Distribution of microorganisms :3 weeks old vermicompost

BACTERIA	T0	T1	T2	T3	T4
Staphylococcus sps.	+	+	+	+	+
Bacillus sps	+	-	+	+	+
Pseudomonas sps	+	+	+	+	+
Clostridium sps	+	+	+	+	+
Serratia sps	-	+	+	+	+
Acetobacter sps	+	+	+	+	+
Acinetobacter sps	+	+	+	+	+
FUNGI	+	+	+	+	+
Aspergillus sps	+	+	+	+	+
Fusarium sps	+	+	-	+	+
Rhizopus sps	+	+	+	+	+
Candida sps	+	+	+	+	+
Saccharomyces sps	+	+	+	-	+
Pichia sps	-	+	+	+	-

Table.5 Effect on plant - Growth parameters

Growth characteristic	Treatment				
	T0	T1	T2	T3	T4
Height of the plant	60.3	85.3	88.6	93.3	119
Number of leaves	7.6	10.3	9.6	11.3	17.3
Number of branches	2	3.6	3.6	4	5
Length of the root	20	45.6	46	46	50.3

Fig.1 Graphical representation for effect of plant Yield – Fruits

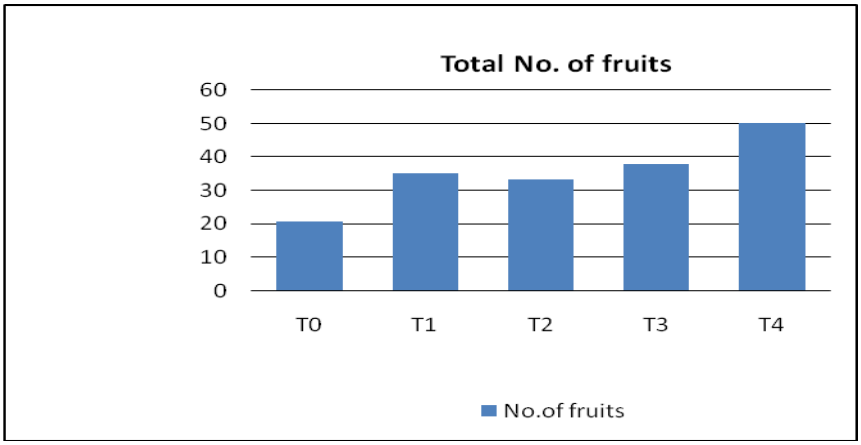
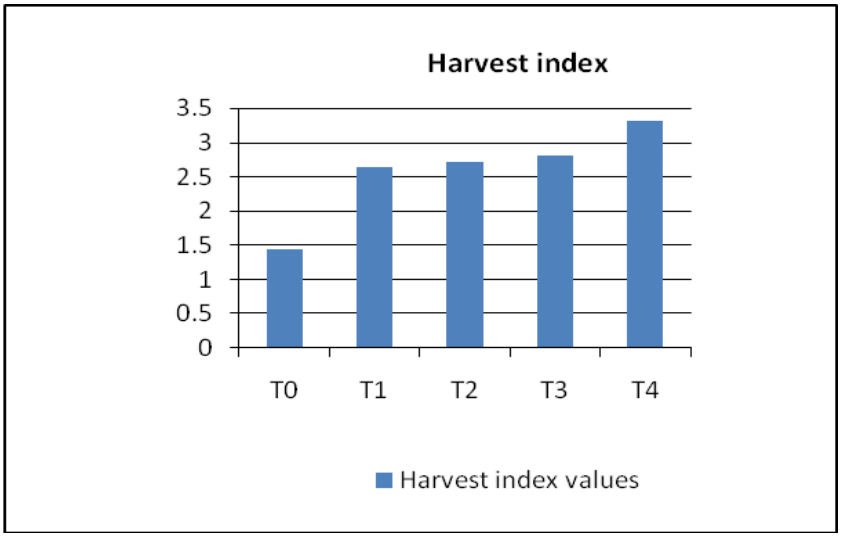


Fig.2 Graphical representation for effect of plant Yield – Harvest index



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