Influence of vermicomposting on crop protection and yield of Tomato cultivation threatened by pests

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Abstract **- The use of chemicals for disease management in tomato cultivar may leave antimicrobial's in the fruits which may lead to drug resistance bacterial strain. Also the use of pesticides to control pest in the fruit plant tomato may leave harmful residues. The important causative agent for the bacterial disease in tomato cultivar is Xanthomonas compestris and the most threatening pest is aphids [mealy bugs]. In order to prevent and reduce this bacterial disease and aphid infestation vermicompost prepared using different vermibed with leaf litters containing leaves of Azadirachta indica, Lantana camara, Ficus religiosa and assorted leaf litter and applied in tomato cultivars so as to minimize the use of chemical biocides. In the vermicompost prepared using neem leaves (T4) the inhibition effect on Xanthomonas compestris was28.36 ± 0.97 and it was maximum (P<0.05). But it was less in vermicompost prepared using assorted leaf litter (22.49 ± 1.06), vermicomposted ficus (17.46 ± 1.23) and Lantana vermicompost (10.63 ± 0.87). In the experiments it was observed that the vermicomposted neem leaf was very effective in preventing the damage caused by Xanthomonas compestris pathogen. Among all the treatments treatment neem based vermicompost showed the highest yield (16.34 ± 4.04t/ha followed by treatment with Ficus compost (14.24 ± 2.36 t/ha). From the results it was observed that the vermicompost extracts were very effective in preventing the damage caused by aphids to tomato plants. The number of aphids were suppressed significantly (P≤0.05) by all three vermicompost solution concentration with high suppression by 20% vermiwash than 10% extract and 5% extract. A dose dependent increment was observed in the mean dry weight of shoot and leaf area of tomato plants infested with mealy bugs and aphids when they were treated with different concentrations of vermicompost extract.**

Index Terms **- Bacterial spot disease, Pests, Tomato, Vermicompost.**

INTRODUCTION

Vermicompost is an organic nutrient having the potentiality to offer resistance to pests attack and disease outbreak in the farms. Vermi-composts increased the quality and of the quantity of production of the crop in addition to preservation of the environment [1]. Vermicomposts are produced through interactions between earthworms and micro-organisms in the breakdown of organic wastes[2] . For the production of vegetable crops, green forming using vermicompost will give safe, organic, and tasty products. Also vermicompost protect the crops from disease attack. For the most used global vegetable tomato, if vermicopost is used, it will give quality, pesticide free, and long shelf life products. Among the different vegetable crops, tomato is much affected by bacterial spot disease. So vermicompost was recommended as a fertilizer to improve tomato fruit quality and yield and soil quality[3]. The vermicompost derived from horse manure in the composition of greenhouse fertile soils contributed to better development of tomato seedlings [4]. Vermicompost on tomato growth responded well for any type of soils (loamy sand, silt loam, and silty clay[5]. Vermicompost application has been shown to promote tomato plant growth, by altering the rhizosphere microbiome, and suppress plant pathogens. These beneficial properties are often attributed to the activity of vermicompost-associated microorganisms [6]. The in vitro efficacy of different aqueous extracts of vermicompost prepared from leaves of Azardirachta indica, Lantana camera, Parthenium hysterophorous were tested for the management of the pathogen and aqueous extract of vermicomposted neem along with the soil amendment with the same vermicompost reduced pest and pathogen attack [7]. The incorporation of vermicomposts in substrates for commercial production of tomato promotes significant benefits,

such as early flowering and fruiting and productivity increased[8,9]. The use of chemicals for disease management in tomato may leave antimicrobial's in the fruits which may lead to drug resistance bacterial strain. The chief causative agent for the bacterial disease in tomato is *Xanthomonas compestris* and the most threatening pest is aphids[mealy bugs]. In order to prevent and reduce this bacterial disease and aphid infestation vermicompost application was tried in tomato cultivars and the study provided a positive sign.

MATERIAL AND METHODS

Vermicompost Preparations

For the preparation of vermicompost, the earthworm *Eudrilus eugeniae* was employed. The vermibed was prepared using leaf litters containing leaves of *Azadirachta indica*, *Lantana camara* Linn, *Ficus religiosa* and assorted leaf litter. The leaf litters were preliminarily decomposed for three weeks after mixing with thin slurry of country cow dung with occasional turning in small mud pot 12 × 6 × 4 cm. After 21 days of decomposition, the earthworm *E.eugeniae* (Kinb) was introduced in to the vermibed. Vermicompost from different beds were collected and sieved separately. Using the vermicompost 10% aqueous extract (vermiwash)was taken with sterile distilled water.

Fresh vermicompost (10g) was taken in a conical flask and mixed with 100ml of sterile distilled water. The flask was kept in orbital shaker for 5 h and allowed to settle for 1 hour. The supernatant was filtered using a membrane filter of size 0.4p and stored at 4^0Cfor further use. The supernatant is the vermiwash.

Bactrial strain preparation

Pure culture of the bacterial pathogen, *Xanthomonas campestris* (Diodge) was obtained from Tamilnadu Agricultural university, Coimbatore. For the experiment 10^8 CFU/mL of the inoculums was prepared . The bacterial isolates were inoculated in to nutrient broth and incubated for 48 h at room temperature (27 ± 3^0C). The optical density of 48 hours nutrient broth culture was adjusted to 0.450 at 610 nm using UV-visible spectrophotometer to get the inoculums of 1×10^8 CFU/mL.

In-Vitro antibacterial studies

Antibacterial activity of the above mentioned extracts was determined using the agar well diffusion assay method. The bacterial culture was swabbed onto the Nutrient agar plates. Wells of uniform size were bored in the medium and 1mL of the respective extracts was added into the wells. The antimicrobial activity was recorded on the basis of diameter of zone of inhibition, which was measured after 24 h of incubation at 37^0C. Sterile distilled water was used as control. Plates were maintained in triplicates.

Seed treatment and raising of seedlings

Tomato seeds (S-22) were soaked in 10% aqueous extracts of different vermicomposts (T1-Seeds soaked in water+no amendment to soil; T2-seeds soaked in water+FYM amendment to soil; T3-seeds soaked in water+soil amendment with vermicomposted neem leaves; T4-seeds soaked in aqueous extract of vermicomposted neem leaves; T5-seeds soaked in aqueous extract of vermicomposted assorted leaf litter + soil amendment with vermicomposted neem leaves; T6-seeds soaked in aqueous extract of lantana flowers+ soil amendment with vermicomposted neem leaves ad T7-seeds soaked in aqueous extract of *Ficus religiosa* leaves+ no amendment with vermicomposted neem leaves) for experimental plots. They were soaked in water for control plots for one h before sowing in the nursery beds. The seedlings were raised in separate nursery beds of size 1 × 1 m to which vermicompost was applied @ rate of 5 tons ha^{-1}.

Micro plot studies

Micro plots each of size 2 × 1.5 m were prepared in triplicates using completely randomized block design. Pathogen inoculum (60 mL) was inoculated into each plot at the rate of 1×10^8 CFU mL^{-1} five days before sowing the seeds. The presence of pathogen was confirmed in the field on fourth day (*X. campestris* - 34×10^3 CFU/g). From the nursery beds seedlings were transplanted to plots and each plant received 250 g of vermicompost (spot application) in two split doses -50% at the time of transplantation and 50% after one month. Micro plots without any amendment was used as control and the application of farm yard manure served as an additional control. Each microplot had a density of 50 plants. During crop growth, plants were monitored for survival rate and number of infected

plants. The fruit yield per plot was recorded for each treatment.

Treatment

For the experiments the plant tomatoes (*Lycopersicon esculenlum*) was chosen. The vermicompost was prepared using the earth worm, *Eudrilus euginiae*. For the experimental trial earthen pots with 25cm diameter was used. The pots were filled with sterilized real and black soil and plant nutrients up to the neck region. The pots were placed in green house. To each pot 8 tomato seeds were seeded. When the plants started to germinate all pots were thinned to 4 seeds per plot. Plants were watered regularly with nutrient rich solution three times weekly. This nutrient is easily soluble fertilizer and it is rich with balanced NPK and micronutrients. The plants were grown for 4 weeks in green houses before they were infested with the pests' aphids for a test period of 14 days.

To the pot reared tomatoes, 3 concentrations of vermicompost extracts viz., 5%, 10% and 20% were applied. For the control deionized water was given. The vermicomposts doses and (200ml) and deionized water (200ml) were applied to plants on soil drenches to approximately field capacity moisture content at sowing, and at weekly intervals thereafter. The tomatoes were exposed to infestations by green peach aphids and mealy bugs for 14 days in cages. The aphids were collected from fields. After 6 weeks plants were harvested to find out, shootand root dry weight, and leaf study. Shoots were oven dried at 60^0c for 24 h. Leaf areas were measured using Licor model 3100 leaf area meters.

Aphid attack study

To study the pest attack in vermicompost used and non-used tomato cultivar the pests infested were with tomatoes seedlings were kept under a cage covering (40cm × 40cm × 40cm) with a mesh size 0.2mm. Each cage treatment was kept in triplicate. For the treatment the pots were filled with soil, drenched with 5%, 10% and 20% vermicompost extracts. In each experimental cage 25 aphids (*Myzus persicae*) and 25 (*Planococcus citri*) mealy bugs were released on the 1st day of experiments. After 1, 3, 5, 7, 9, 11, 13 and 14 days of infestation the number of aphids in the treatment plants were counted. Also, the damage caused by the infested pests to the tomatoes plants were recorded using a rating scale of 0 (none) to 5 (total) based on areas of leaf damaged.

After 14 days the plants in the green house was analyzed thoroughly. The results for damaged leaves based on ratings were subjected to statistical analysis.

RESULTS AND DISCUSSION

Vermicompost and bacterial infection

The inhibitory effect of different vermicomposts expressed in percentage after by treating the seedlings of tomato plant shows the influence of different vermicomposts.]Fig.1]. .In the vermicompost prepared using neem leaves (T4) the inhibition effect on *Xanthomonas compestris* was28.36 ± 0.97 and it was maximum ($P<0.05$). But it was less in vermicompost prepared using assorted leaf litter (22.49 ± 1.06), vermicomposted ficus (17.46 ± 1.23) and Lantana vermicompost (10.63 ± 0.87). In the experiments it was observed that the vermicomposted neem leaf was very effective in preventing the damage caused by *Xanthomonas compestris* pathogen. In the *Ficus religiosa* vemicomposed treatment the survival of the plant was 95%. In the control the pathogenic effect of xanthomonas was high and only 53% of the plant survived. The yield of tomatoes fruits per plot from three harvests was analysed. In the second harvest, the yield was higher in all treatments. The duration between each harvest was 10 days.

Among all the treatments treatment T4 (Neem) showed the highest yield (16.34 ± 4.04t/ha followed by treatment with *Ficus* compost (T7) (14.24 ± 2.36 t/ha). In the control the yield was 1.04 ± 0.88 t/ha). An evaluation of yield in relation to the soaking of the seeds before seedling showed that the seeds soaked in neem compost extract provided a higher degree of protection against the pathogen. So, the present study informs that the seed treatment is also very important for getting good yield and crop protection. As neem leaves are naturally having a good antimicrobial potency, the vermicompost prepared using neem leaves are more potential than other treatments as reported earlier [10,11].

The present study emphasized that the seed treatment with neem leaf processed vermicompost extracts are more potential to control *Xanthomonas compestri* than other treatments. The damage noted was 2.4 on the 2nd day. The damage as assessed using damage index

showed that the pests attack increased in an ascending manure in the successive days. It was 3.1, 3.6, 3.9, 4.1,4.7 and 4.8 on the 4th, 6th, 8th, 10th, 12th, and 14th day respectively (Fig. .2).

The damage level was declined in 5%, 10% and 20% vermicompost extract treatments. In 5% treatment the damage level ranges from 1 to 2.7. The minimum damage reported was on the 2nd day and it was 1. Maximum damage was 2.7 on the 14th day. In 10% treatment the damage level decreased and it was 2.3 on the 14th day. The maximum decrease in damage was observed in plants treated with 20% concentration of vermicompost extract. From the results it was observed that the vermicompost extracts were very effective in preventing the damage caused by aphids to tomato plants. The number of aphids were suppressed significantly ($P \leq 0.05$) by all three vermicomposts solution concentration with high suppression by 20% vermiwash than 10% extract and 5% extract. In the experimental cages 25 aphids were allowed to settle per plant. In the deionised control, the number of aphids increased significantly ($P < 0.05$) to 39 percent from day 1 to 14 days. In the 5% and 10% treatment, the number of aphids increased upto 7 and 15 days respectively. In the control plant that was not given vermicompost, the damage was 5.0 (Total damage). The damage level on the 2nd day was 0.2 and it was only 1.1 on the final day (14th day) (Fig. .2).

Likewise an increment in the mean dry weight of shoot and leaf area of tomato plants were observed when the aphid infested plant were observed. When the aphid infested plants were treated with vermicpompost extract (Fig. 3). The mean day weight of control plant aphids was 2.1g/plant. It was 2.7g/plant in the 5% of concentration of vermicompost treated plants and 3.3g/plant in 10% concentration of vermicompost treated plants. In 20% treatment the mean dry weight per plant was maximum and it was 3.8g/plant.

The impact of vermicompost extracts on the mean dry weight of shoot and leaf area of tomato plant infested with mealy bugs in represented in Fig. 4. A dose dependent increment in the mean dry weight of shoot and leaf area of tomato plants infested with mealy bugs was reported when they were treated with different concentrations of vermicompost extract. The mean dry weight of shoot and leaf of control plant was 1.52 g/plant whereas the mean dry weight of shoot and leaf of 5% maximum concentration of vermicompost treated plant was 1.68g/plant and in 20% concentration it was 3.28 g/plant. Thus the result of the present work was in accordance with the earlier reports [12,13].

CONCLUSION

The vermicomposts are believed to provide immunity to the plants for which it is applied. This was tested using the vermicompost produced by E.eugeniae. Tomato seeds treated with vermiwash showed a good defensive condition against mealy bugs attack. The vermicompost prepared using neem leaves was found to be effective to inhibit the damage caused by the bacterial pathogen Xanthomonas compestris and mealy bug and aphid infestation.

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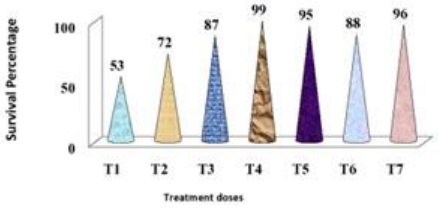

Fig.1.Influence of vermicomposts on the survival of tomato cultivars raised in Xanthomonas infected soil

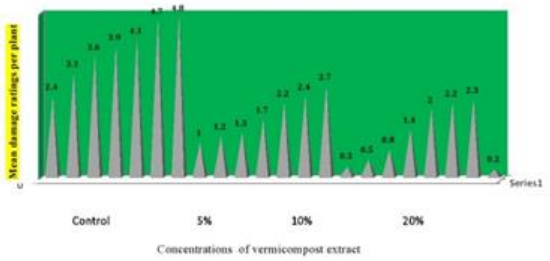

Fig.2. Damage ratings (0 – 5) of aphids on tomato plant treated with different concentrations of vermicompost

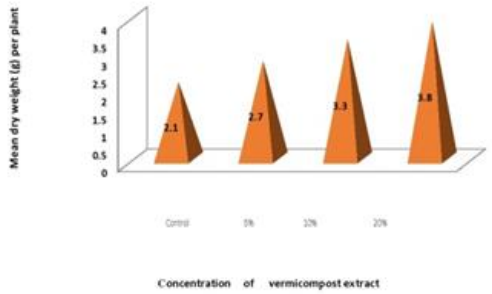

Fig .3 Mean dry weight of shoot and leaf area of tomato plant infested with aphids

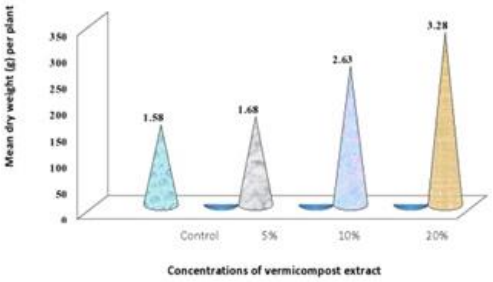

Fig .4 Mean dry weight of shoot and leaf area of tomato plant infested with mealy bugs