

# Vermicomposting to defend the bacterial disease caused by *Xanthomonas compestris*, in Tomatoes (*Solanum lycopersicum*) plant

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**Abstract:** The in vitro efficacy of different aqueous extracts of vermicompost prepared from leaves of *Azadirachta indica*, *Lantana camara*, and *Ficus religiosa* were tested for the management of a bacterial pathogen *Xanthomonas compestris* commonly challenging Tomato crops.. Vermicompost was prepared by neem was found to be superior than vermicompost prepared using *Lantana* and *Ficus* in inhibiting the growth of *Xanthomonas compestris*. The seeds of tomato were soaked for one hrs in different aqueous extracts of vermicomposts before sowing. The aqueous extract of vermicomposted neem showed better suppression of the pathogen in in vitro studies, the same vermicompost was used for soil application. Similarly neem seed based vermicompost applied to the soil reduced the incidence of bacterial spot by 98% and the yield was 15.4 t ha<sup>-1</sup>. The aqueous extract of other plant based vermicompost also yielded the suppression. Use of such alternate material are found to non-polluting, cost effective, nonhazardous and do not disturb ecological balance can reduce the use of copper based bactericides, leading to elimination of copper entry into the soil system.

**Key words:** Seed treatment, soil-borne plant pathogen, soil amendment, vermicompost *Xanthomonas compestris*,

## INTRODUCTION

Vermicompost is an organic nutrient having the potentiality to offer resistance to pests attack and disease outbreak in the farms. Among the different vegetable crops tomatoes are much affected by bacterial spot disease (Aravinda et al. 2022). Kavitha and Umesha (2007) reported an average annual loss of 10 – 20% due to this disease tomatoes crop. The use of bactericides to tomatoes many leave antimicrobial's in the fruits which may lead to drug resistance bacterial strain. The chief causative agent for the bacterial disease in tomatoes is *Xanthomonas compestris*. *Xanthomonas campestris* is a Gram-negative, rod-shaped, aerobic soil and plant bacterium. It is best known as a major agricultural pathogen that causes black rot in cruciferous crops like cabbage and cauliflower, but it is also widely used in industry to produce xanthan gum. *Xanthomonas campestris* pv. *vesicatoria* (now reclassified into species like *Xanthomonas vesicatoria*. *Xanthomonas vesicatoria* is a destructive bacterial pathogen that causes Bacterial Spot in tomato and pepper plants. It thrives in warm, humid environments and can severely reduce crop yield and quality (Tamir-Ariel et al. 2011). Vermicompost acts as an effective biocontrol agent and organic fertilizer to suppress Bacterial Spot disease caused by *Xanthomonas campestris* (or *Xanthomonas vesicatoria*) in tomato plants. (Agarwal et al. 2012). Beyond promoting plant growth, the specialized application of vermicompost triggers systemic resistance and directly inhibits this destructive bacterial pathogen Bacterial spot is one of the most devastating diseases of tomato grown in warm, moist environments. It is highly destructive both in greenhouses and field grown tomatoes causing 10– 50 % yield loss in many tomato production areas (Soto-Caro et al. 2023). In India losses ranging from 10 – 80 % have been reported. On an average, annual loss due to this disease is 10-20 %, which may go up to 80 % in rare cases.

The recurrent and indiscriminate use of bactericides has posed a serious threat to human health. Some of them have already been proved to be mutagenic, teratogenic and carcinogenic. Keeping in view, the harmful effects and drawbacks of the chemical methods of plant pathogen management, use of bioagents for pathogen management is gaining importance. The present study was carried out to evaluate the efficiency of vermicomposts prepared using the earthworm *E.euginiae* (Kinb) and leaves of *Azadirachta indica*, *Lantana camara* and *Ficus religiosa* along with farm manure to control and manage the bacterial spot in tomato at field level in microplots.

## RESEARCH METHODOLOGY

### MATERIAL AND METHODS

#### Vermiwash Preparations

For the preparation of vermicompost, the earthworm *Eudrilus euginiae* 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 x 6 x 4cm. After 21 days of decomposition, the earthworm *E.euginiae* 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 one hr. The supernatant was filtered using a membrane filter of size 0.4µ and stored at 4°C for further use. The supernatant is the vermiwash.

#### Bacterial Strain Preparation

Pure culture of the bacterial pathogen, *Xanthomonas campestris* was obtained from Tamilnadu Agricultural University, Coimbatore. For the experiment 10<sup>8</sup> 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°C). The optical density of 48 h nutrient broth culture was adjusted to 0.450 at 610nm using UV-visible spectrophotometer to get the inoculums of 1 × 10<sup>8</sup> CFU/ml. Before the trial the antibacterial activity of the above mentioned extracts was determined, using the agar well diffusion assay method as a pilot study. 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 hrs of incubation at 37°C. Sterile distilled water was used as control. Plates were maintained in triplicates. The extracts were then used for field applications

#### Seed treatment and seedlings

Tomatoes seeds (S-22) were soaked in 10% aqueous extracts of different vermicomposts (T1-Seeds soaked in water and 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 and T7-seeds soaked in aqueous extract of *Ficus religiosa* leaves+ no amendment with vermicomposted neem leaves) for experimental plots and 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 meter to which vermicompost was applied @ rate of 5 tons ha<sup>-1</sup>.

#### 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<sup>8</sup> CFU mL<sup>-1</sup> five days before sowing the seeds. The presence of pathogen was confirmed in the field on fourth day (*X. campestris* 34 × 10<sup>3</sup> 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 micro plot 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

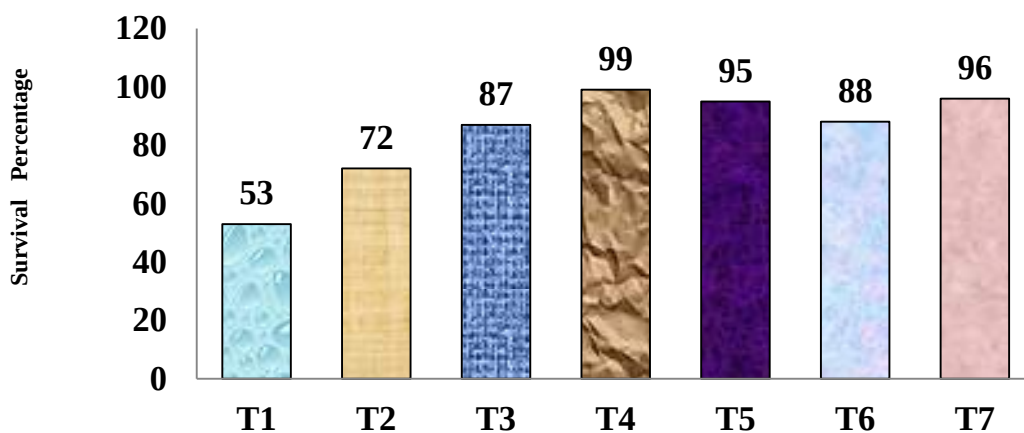
### IV. RESULTS AND DISCUSSION

Among the different bio-agents tested the aqueous extract of vermicomposted neem showed maximum inhibitory effect (P<0.05) on *X.campestris* (25.33 ± 1.27) than that of vermicomposted assorted leaf litter (21.66 ± 0.48),vermicomposted *Lantana* (10.50 ± 1.32) and vermicomposted *Ficus* (9.50 ± 2.15). The vermicomposted neem which was very effective in inhibiting the pathogen in the *in vitro* studies was used for soil application in the field. The survival of tomato plants treated with different bioagents is shown in Figure 1. The survival was 99% in the treatment T4 followed by 95 % in the treatments T5 and T7. Treatments T6 and T3 had comparatively better survival as against 70 % and 58 in control treatments T2 and T1 respectively. Figure1. Influence of bioagents on the survival of tomato plants raised in *Xanthomonas* infected soil. The yield of tomato fruits per plot from three harvests was recorded. Yield was higher in second harvest in all the treatments and it reduced during the third harvest. The duration between each harvest was 10 days. Among all the treatments, treatment T4 (15.4±7.63 t ha<sup>-1</sup>) registered the highest yield followed by treatments T7 (14.46±6.01 t ha<sup>-1</sup>), T6 (14.41±2.91 t ha<sup>-1</sup>), T5 (13.32±6.24 t ha<sup>-1</sup>) and T3 (5.46±4.41 t ha<sup>-1</sup>).Treatments T1 (0.62±1.20 t ha<sup>-1</sup>) and T2 (2.33±0.88t ha<sup>-1</sup>) recovered very low yield. The yield in treatment T3 where seeds were soaked in water before transplanting to plots amended with vermicomposted neem leaves was only 136.66kg/plot indicating that application of vermicompost alone is not enough to protect the plants against the disease but coupling it with seed treatment is important to achieve complete disease suppression and to get better yield. In the present study neem based vermicompost has shown best results in suppressing the bacterial spot. It is evident from the several reports that vermicompost extracts are effective antimicrobial agents against soil-borne pathogens. Belgüzar, (2023) reported vermicompost treatment significantly suppressed tomato bacterial canker and wilt disease and recommended its use for integrated pests and disease management.

These bioagents are non-polluting, cost effective, and non-hazardous and can be prepared with available materials in the field. It does not disturb soil ecological balance. Sujatha and Padmalatha (2021) reported that the treatment of tomato plant with vermicomposts enhanced yield.

Vermicomposting of materials such as *Lantana* and *Ficus* for pathogen management can also help in better weed management. Antimicrobial property of neem and its extracts has been reported. It can be concluded that soil application of vermicompost coupled with seed treatment with 10% aqueous extract of vermicomposted neem for one hrs. significantly reduce the incidence of bacterial spot caused by *X. campestris* in tomato. The results also show that the organic matter composition used in the preparation of the vermicompost has a role to play in assessing the performance of the vermicompost in acting against the prevalent pathogens at the site of application.

**Fig.1. Influence of bio-agents on the survival of tomatoes plants raised in *Xanthomonas* infected soil**



Treatments with Vermicompost

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