

The Application of PGPR, Tricocompost, and MOL on the Growth and Quality of Production, as well as the Incidence of Disease-causing agents in Tomato Plants in the Rurukan I District of Tomohon City

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Abstract:

*The objective of this research is to assess the impact of PGPR, Trichocompost, and MOL on the growth and quality of production, as well as the incidence of disease-causing microorganisms in tomato plants. This study will be conducted by comparing the use of beneficial organic microorganisms namely PGPR, Trichocompost, and MOL with inorganic farming systems that utilize synthetic fertilizers and manure as sources of nutrition for tomato plants. The research method employed a randomized block design consisting of three treatments as follows: Treatment A involved a combination of PGPR, Trichocompost, and MOL; Treatment B utilized inorganic fertilizers N, P, K along with foliar fertilizers Gandasil D and B; Treatment C consisted of chicken manure. Each treatment was replicated five times, with 50 plants per plot, resulting in a total of 750 plants for observation. The results indicated that the application of PGPR, Trichocompost, and MOL positively influenced the average flowering time, the average weight of 50 fruits, and the duration until fruit decay during the growth, development, and production phases of tomato plants. Furthermore, the use of PGPR, Trichocompost, and MOL effectively reduced the incidence of the fungal pathogen *P. palmivora* on leaves, the bacterial disease *Erwinia sp.* on leaves, and the fungal disease *P. palmivora* on fruit stems.*

Keywords:

PGPR, Tricocompost, MOL, Growth and Quality of Production

I. Introduction

The growth and production of tomato plants (*Solanum lycopersicum*) are consistently threatened by pests and diseases. The impact of these infestations can vary significantly, potentially leading to reduced yields or crop failure (Warisno and Dahana, 2010; Sudarjat, 2018). According to Pracaya (2010), the susceptibility of tomato plants to these threats can be attributed to various biotic factors, including insect pests, mites, fungi, bacteria, and viruses, as well as abiotic factors such as water deficiency and imbalances in nutrient availability.

Farmers' control measures have often proven inadequate for several reasons, including the fact that once tomato plants are infected, they cannot be cured due to the absence of chemical agents capable of eradicating viruses. Furthermore, nearly all cultivated tomato varieties are vulnerable to viral infections (Nurfalach, 2010). Efforts to manage pests and diseases affecting tomato plants have increasingly focused on environmentally friendly approaches, such as the application of organic fertilizers (EM4 and compost) (Veerapagu et al., 2018) and the use of beneficial bacteria (PGPR) that can produce IAA hormones and fix nitrogen and phosphate. The utilization of beneficial microorganisms, such as bacteria and fungi, which can generate essential macro and micronutrients, exhibit antagonistic properties against pathogens, and produce growth hormones like auxins, gibberellins, and cytokinins, has

emerged as a valuable outcome of research aimed at advancing organic farming systems (Taufik, 2010).

1.1 Research Objective

To determine the impact of the application of PGPR, Trichocompost, and Local Microorganisms (MOL) on the growth, yield, and disease incidence in tomato plants (*S. lycopersicum*).

II. Research Method

2.1 Location and Duration of Research

The study will be conducted in the tomato cultivation area located in Ruruan I, Tomohon City. Identification of pest and disease types affecting chili plants will take place at the Plant Protection Laboratory within the Department of Plant Pests and Diseases, Faculty of Agriculture, Unsrat. The research will span a duration of eight months, commencing from the first month to the eighth month of the year 2023.

2.2 Materials and Equipment

The materials utilized in this research include PGPR organic fertilizer, banana pseudostem MOL, Trichocompost, NPK inorganic fertilizer, tomato seeds, Gandasil D and B foliar fertilizers, chicken manure, samples of insect pests and plant diseases affecting chili, insecticides, silver polyethylene plastic, and alcohol. The equipment required comprises a hand counter, markers, binocular microscope, plastic bags, collection bottles, brushes, loupes, hoes, bamboo poles, sprayers, scissors, plastic bags, raffia twine, cutters, GPS devices, cameras, writing instruments, flash drives, and other miscellaneous items.

2.3 The implementation of the research utilized a randomized block design comprising three treatments

Treatment A: a combination of PGPR, Trichocompost, and MOL.

Treatment B: the application of inorganic fertilizers N, P, K, along with foliar fertilizers Gandasil D and B.

Treatment C: the use of chicken manure as fertilizer.

Each treatment was replicated five times, with 50 plants per plot, resulting in a total of 750 plants for observation. The parameters assessed included the time of flower formation, weight per 100 fruits, percentage of disease incidence, storage duration, and the number of fruits that fell during the fruiting period. All data were analyzed using variance analysis, and if significant differences were found among treatments, a 5 percent BNT test was conducted.

III. Results and Discussions

Growth, Development, and Production of Tomato Plants

The research findings on the combination of using PGPR, Trichocompost, and MOL, compared to the application of inorganic fertilizers and manure, indicate positive outcomes for flowering time, the weight of 50 tomatoes, and the duration until the onset of decay in tomato plants cultivated in the horticultural fields of Ruruan 1 Village, North Tomohon District, Tomohon City. The results demonstrate that the use of organic components (the combination of PGPR, Trichocompost, and MOL) significantly supports the growth, development, and production of tomato plants, thereby promoting sustainable and environmentally friendly agricultural practices.

The analysis of the effects of all treatments on the average flowering time of tomato plants is presented in Table 1 below.

Table 1. Results of the BNT Test on the Average Flowering Time of Tomatoes According to Treatment.

Treatment	Average (days)	Notation
C. Control (chicken manure fertilizer)	65.6	a
B. (Organic Fertilizer N, P, K + Gandasil D and B)	58.8	b
A. (Combination of PGPR + Trichocompost + MOL)	53.1	c

BNT 5 % = 4,7

Based on Table 1 above, it is evident that Treatment A, which involves the combination of PGPR, Trichocompost, and MOL, results in an average flowering time of 53.1 days for the plants. This is notably quicker than Treatment B, which averages 58.8 days, and Treatment C, which averages 65.6 days. The accelerated flowering time in tomato plants is advantageous for enhancing overall tomato production. This finding aligns with the research conducted by Sembel et al. (2012), which indicates that the combination of PGPR, Trichocompost, and MOL is highly effective in promoting plant growth and development. This is attributed to the functions of these organic components, which act as biostimulants that produce growth hormones such as IAA, cytokinins, and gibberellins. Additionally, they play a significant role as biofertilizers, contributing essential nutrients, both micro and macro, to the plants.

Furthermore, the analysis of the effects of all treatments A, B, and C on the weight of tomatoes per 50 fruits can be observed in Table 2 below.

Table 2. Results of the BNT Test on the Average Weight of Fruit per 50 Tomatoes According to Treatment.

Treatment	Average (grams)	Notation
C. Control (Chicken Manure Fertilizer)	1905.6	a
B (Organic Fertilizer N, P, K + Gandasil D and B)	2291.0	b
A (Combination of PGPR + Trichocompost + MOL)	2400.0	c

BNT 5 % = 98,5

Table 2 indicates that the average weight of tomatoes per 50 pieces is highest in treatment A (a combination of PGPR, Trichokompos, and MOL), which shows a significant difference compared to treatment C (Control) and treatment B (inorganic fertilizer). The average weight of tomatoes reflects the success of plant growth, which is supported by the availability of both micro and macro nutrients. This condition is further enhanced by the adequate supply of growth hormones, resulting in relatively larger and heavier tomatoes. According to Hersanti et al. (2000), the sufficient availability of both micro and macro nutrients through the use of organic components as fertilizer sources in tomato growth and production can facilitate the development of good and relatively large tomatoes. This study's findings are corroborated by Lilik et al. (2010), who state that the use of antagonistic microorganisms and organic components, such as Trichokompos, can improve plant productivity.

The analysis of the effects of treatments A, B, and C on the duration of fruit decay indicates that the combination of PGPR, Trichokompos, and MOL results in fruit that is more resistant to decay. The impact of treatments A, B, and C on the onset of decay can be observed in Table 3 below.

Table 3. Results of the BNT Test on the Average Duration Until the Onset of Decay in Tomatoes According to Treatment.

Treatment	Average (days)	Notation
C. Control (chicken manure fertilizer)	9.8	a
B (Organic Fertilizer N,P,K + Gandasil D and B)	10.2	a

BNT 5 % = 2,07

Based on Table 3 above, it is evident that the results of the BNT test regarding the effects of treatments on the average duration of tomato fruit decay indicate that the combination treatment of PGPR, Trichocompost, and MOL exhibited the longest decay time when compared to treatment B (inorganic fertilizer) and treatment C (control; manure). The findings of this study reveal significant differences among the treatments, particularly highlighting the impact of the combination of PGPR, Trichocompost, and MOL, which resulted in the longest fruit decay time compared to the other treatments. According to Sembel (2012), the use of PGPR and other organic components for the growth and production of tomato plants can enhance the resistance of the fruit to decay compared to plants fertilized with synthetic or inorganic fertilizers.

3.1 The Causes of Disease Attacks on Tomato Plants

Research findings indicate that during the observation of the effects of various treatments, including the use of PGPR, Trichocompost, and MOL, as well as inorganic fertilizers and manure, tomato plants are susceptible to several microorganisms responsible for diseases. Notably, the fungus *P. palmivora* attacks the leaves, fruit stalks, and fruits, while *Erwinia* sp. targets the leaves of the plants.

The analysis of the impact of all treatments on the disease caused by the fungus *P. palmivora* in tomato plants is presented in Table 4 below.

Table 4. Results of the BNT Test on *P. palmivora* Disease Attack on Tomato Plant Leaves According to Treatment.

Treatment	Average (leaves)	Notation
C. Control (chicken manure fertilizer)	32.3	a
B. (Organic Fertilizer N,P,K + Gandasil D and B)	25.1	a

BNT 5 % = 14,02

Table 4 illustrates that the effects of treatments on the number of leaves infected by the fungal pathogen *P. palmivora* vary significantly. The analysis reveals that the combination treatment of PGPR, Trichocompost, and MOL shows a statistically significant difference compared to treatment B (inorganic fertilizer) and treatment C (control, manure). Treatment A experienced the least infection from *P. palmivora*, with only 8.2 infected leaves, while treatment C (control) had the highest number of infected leaves at 32.3, followed by treatment B (inorganic fertilizer) with 25.1 infected leaves. This study indicates that the application of

PGPR, Trichocompost, and MOL can effectively suppress the development of *P. palmivora* infections. According to Lilik et al. (2010), the use of organic nutrients for plant growth, particularly in horticultural crops, enhances the plants' resilience against soil-borne microorganisms such as *P. palmivora*, a capability demonstrated by beneficial microorganisms with antagonistic properties, such as *Trichoderma* sp. and other useful microorganisms.

Subsequently, the observations regarding the attack of *Erwinia* sp. on tomato plant leaves indicate that necrosis occurs, which progressively enlarges, leading to a color change in the leaves to a yellowish-brown and resulting in dryness. This condition will hinder the photosynthesis rate of the tomato plants, thereby affecting their growth, development, and overall production. The analysis of the effects of treatments A, B, and C on the *Erwinia* sp. attack on tomato leaves is presented in Table 5 below.

Table 5. Results of the BNT Test on *Erwinia* sp. Disease Attack on Tomato Plant Leaves According to Treatment.

Treatment	Average (Leaf Weight)	Notation
C. Control (Chicken Manure)	35.6	a
B. Organic Fertilizer (N, P, K + Gandasil D and B)	22.8	a
A. Combination of PGPR + Trichocompost + MOL	5.8	b

BNT 5 % = 14,06

Based on Table 5, it is evident that the application of Treatment A (a combination of PGPR, Trichocompost, and MOL) significantly reduces the incidence of *Erwinia* sp. disease on the leaves of tomato plants by 5.8 leaves. This result is markedly different from Treatment B, which recorded 22.8 leaves affected, and Treatment C, which showed 35.6 leaves impacted. The findings of this study indicate that the use of PGPR, Trichocompost, and MOL can effectively protect tomato plants from *Erwinia* sp. disease. Furthermore, it is apparent that the organic components utilized contribute to enhancing the plants' resilience, thereby reducing their susceptibility to diseases. The biostimulant and biofertilizer properties of these treatments enable tomato plants to grow more robustly and achieve optimal yields (Hersanti et al., 2000). The analysis of the fungal disease *P. palmivora* affecting the fruit stems, which leads to fruit drop, is presented in Table 6 below.

Table 6. Results of the BNT Test on *P. palmivora* Disease Incidence on Tomato Fruit Stems According to Treatment.

Treatment	Average (Number of Fruits)	Notation
C. Control (Chicken Manure Fertilizer)	14.5	a
B. (Organic Fertilizer N, P, K + Gandasil D and B)	13.0	a
A. (Combination of PGPR + Trichocompost + MOL)	3.4	b

BNT 5 % = 8,02

From Table 6, it is evident that the impact of all treatments on the fungal disease caused by *P. palmivora* can lead to fruit drop or loss. The research findings indicate that Treatment A (a combination of PGPR, Trichokompos, and MOL) is highly effective in reducing the incidence of *P. palmivora*, resulting in only 3.4 affected fruits, which is significantly different from Treatment B (inorganic fertilizer) with 13.0 affected fruits, and Treatment C with 14.5 affected fruits; however, there is no significant difference between Treatments B and C. These results further illustrate that the use of organic components is highly beneficial in protecting plants from soil-borne fungal attacks such as *P. palmivora*.

IV. Conclusion

1. The application of PGPR, Trichocompost, and MOL positively influences the average flowering time, the average weight of 50 fruits, and the duration until the onset of fruit decay during the growth, development, and production phases of tomato plants.
2. The use of PGPR, Trichocompost, and MOL can reduce the incidence of pathogenic microorganisms, specifically the fungal disease *P. palmivora* on leaves, bacterial disease *Erwinia* sp. on leaves, and the fungal disease *P. palmivora* on fruit stems.

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