Promoting Growth of Tomato (*Solanum lycopersicum* L.) by using *Trichoderma*–Compost–Rice Bran based Biofertilizer

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**Abstract.** Pollution caused by agrochemicals in the field of agriculture has been known to contaminate agricultural soils. Fungal species, e.g. *Trichoderma* is commonly used as biofertilizer owing to its plant growth promoting properties. Combination of *Trichoderma* and organic carrier, e.g. rice bran and compost, is assumed to be an optimum biofertilizer package in promoting plant and soil fertility. The aim of this study was to find the best ratio of rice bran and compost in inoculating *Trichoderma* to enhance the growth of tomato as model plant. Experimental design used in this study was Complete Randomized Design with 5 treatments. Pot trial assay was used to monitor the growth of tomato plants. Ratio of rice bran and compost was varied between 3:1, 2:2 and 1:3. Monitoring of plant growth was observed during 7-, 15- and 30-d post inoculation. Each treatments were replicated three times. We reported that the use of rice bran and compost in a ratio of 1:3 was the optimum formulation to promote the growth of tomato.

**1. Introduction**

*Trichoderma* spp. are soil fungal inhabitants commonly known for its plant growth promoting properties. *Trichoderma* acts as stimulant to plant through synthesis of plant hormones leading to improved growth and development [1]. Numerous *Trichoderma* species have been reported as potential eco-friendly biofertilizer and application due to its non-toxigenic fungal strain which compatible to rhizospheric organisms [2].

In recent days, agrochemical compounds are used by field applicators to enhance plant growth and development. In North Sumatra, field applicators tend to use inorganic fertilizers due to its abundant availability in market and cost-effective. Standard use of synthetic fertilizers has been promoted, however many field applicators still abuse the use of fertilizer without good management practice. As results, the inorganic fertilizer may contaminate agricultural soils caused by accumulating residue which is not readily absorbed by plants. This condition contributes to soil contamination and disruption [3].

During application of biofertilizer, especially *Trichoderma*, two inoculation methods can be applied: Direct inoculation by using conidial suspension namely wet inoculant or Indirect inoculation by using in-/organic carriers, e.g. rice bran and compost namely dry inoculant. In this study, potential strain of *Trichoderma* is evaluated for its optimum colonization to tomato plant by using different ratio of composition of organic carriers. The ratio of rice bran and compost as organic carriers is varied between 1:3, 2:2 and 3:1.
2. Materials and Method

2.1. Preparation of fungal inoculum

The research has been conducted both in field level and laboratory scale. In laboratory, conidial suspension of *Trichoderma* was obtained from collection of Laboratory of Microbiology, Universitas Sumatera Utara. Conidial mass was harvested after 15 d of incubation on Potato Dextrose Agar (PDA) at ambient temperature. Conidial mass was scrapped aseptically using object glass and filtered into 250-mL flask containing sterile distilled water. Conidia was subjected to centrifugation at 1,000 \( \times \) g for 5 min at 4 °C. Pellets containing conidia were removed and suspended into new tube containing sterile distilled water. Conidia were counted 20 times by dropping 5 \( \mu \)L of suspension into haemocytometer. Count was performed under compound microscope and prepared until concentration of \( 10^6 \) conidia/mL. Spore density as number of conidia per mL is measured using formula below:

\[
\text{Spore density} = \text{Mean (R)} \times \text{Dilution factor (F)} \times \text{Coefficient of Instrument (K)}
\]

2.2. Field trial assay

Tomato seedlings were obtained from Berastagi, Tanah Karo, North Sumatra. Tomato seeds were spread into soil medium. A 15-d tomato seedling was transferred into new pots pre-treated with conidial suspension of *Trichoderma* \( \approx 1 \times 10^7 \) conidia/mL. Tomato plants were watered two times during day and night time. During observation time, tomato seedlings were removed and measured for its growth, i.e. plant height, leaf area, and dry & fresh weight of seedlings.

3. Results and Discussion

All growth parameters of tomato are presented in Table 1. Significant level \( (P > 0.05) \) was determined through comparison of mean results from different treatments under same day of observation (30 d).

| Groups | Plant height (cm) | Leaf surface area (cm²) | Number of leaves | Dry weight (g) | Fresh weight (g) |
|--------|-------------------|--------------------------|------------------|---------------|-----------------|
| K-     | 15.95\(^{a}\)     | 3.83\(^{a}\)             | 8\(^{a}\)        | 0.01\(^{a}\)  | 0.49\(^{a}\)    |
| K+     | 17.83\(^{a}\)     | 4.28\(^{ab}\)            | 10\(^{b}\)       | 0.03\(^{a}\)  | 0.55\(^{a}\)    |
| A      | 22.21\(^{b}\)     | 7.5\(^{c}\)              | 12\(^{c}\)       | 0.09\(^{ab}\) | 0.88\(^{d}\)    |
| B      | 18.45\(^{a}\)     | 5.33\(^{bc}\)            | 10\(^{b}\)       | 0.02\(^{b}\)  | 0.62\(^{bc}\)   |
| C      | 17.16\(^{a}\)     | 6\(^{c}\)                | 10\(^{b}\)       | 0.01\(^{a}\)  | 0.64\(^{c}\)    |

Note: Columns sharing similar letter are not significantly different \( (P > 0.05) \)

Description:
- A: Compost and rice bran with ratio (3:1)
- B: Compost and rice bran with ratio (2:2)
- C: Compost and rice bran with ratio (1:3)
- K+: Positive Control (Inorganic fertilizer)
- K-: Negative Control
- R1: Replicate 1
- R2: Replicate 2
- R3: Replicate 3
- H: Days

In general, negative control produced lesser significant growth parameters than positive control and treatment groups. Among treatment groups, treatment A (Compost : Rice bran = 3 : 1) produced the best growth parameters. Treatment A is then considered as optimum formulation to carry *Trichoderma* for field application. Treatment A also surpassed the growth performance of positive control using common inorganic fertilizer.
Formulation of *Trichoderma* as biofertilizer is needed to evaluate since not all combination or composition of carriers are compatible each other. The presence of *Trichoderma* in rhizospheric soil will also increase nutrients availability which nourishing soils and other microorganisms [4]. Other promising properties of *Trichoderma* as biofertilizer is its antagonistic properties against soil-borne fungal pathogens, e.g. *Fusarium oxysporum* to control wilt in Solanaceae [5]. Application of *Trichoderma* will support plant growth by eliminating fungal pathogen in soil, yet compost as composition in formulation may also act as nutrition to plant [6].

Altogether, *Trichoderma* and organic carriers (compost, rice bran) will contribute to improved plant growth starting from roots. *Trichoderma* was reported as trigger to lateral roots development by plants through auxin signaling and synthesis [7]. The higher number of lateral roots will enhance the roots ability in absorbing soil nutrients [8]. Improved soil nutrients absorption will lead to improved growth and development. Previous study has reported the use of *Trichoderma* in promoting growth of banana (*Musa* sp.) [9]. Further consideration is to formulate *Trichoderma* with other microorganisms capable of fixing nitrogen. Previous study has reported the combination of *Trichoderma* and *Bradyrhizobium japonicum* as microbial inoculants with good results of growth performance [10,11].

4. Conclusion
Optimum formulation of *Trichoderma* and organic carriers, i.e. compost and rice bran has been obtained with the ratio of 1 : 3 of compost and rice bran. This microbial inoculants are able to promote growth of tomato plant by increasing plant height, leaf surface area, number of leaves, dry and fresh weight of plant.

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