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The Effect of Soaking Red Chili Seeds (*Capsicum annum* L.) with Various Trichoderma Species in Suppressing Chili Seed-Borne Pathogens Caused by Colletotrichum

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Abstract: Red chili (*Capsicum annuum* L.) is a horticultural plant that belongs to the Solanaceae family. Chili cultivation often encounters problems, namely anthracnose disease caused by the fungus Colletotrichum. This study aims to determine the most effective Trichoderma species for suppressing red chili seed-borne Colletotrichum pathogens. This study was conducted from March to April 2025. This research method used a Completely Randomized Design (CRD) with 5 treatments and 3 replications. P0 = Control (Without soaking with Trichoderma suspension) P1 = Red chili seeds soaked with *Trichoderma harzianum* suspension for 9 hours P2 = Red chili seeds soaked with *Trichoderma viride* suspension for 9 hours P3 = Red chili seeds soaked with *Trichoderma asperellum* suspension for 9 hours P4 = Red chili seeds soaked with fungicide for 5 minutes. The parameters observed were: Germination percentage (%), seedling height (cm), and number of leaves (stalks). Trichoderma treatment significantly affected germination percentage, red chili seedling height, and leaf number. In terms of treatment percentage, P1, P2, and P3 were significantly different in red chili seed germination percentage, but the three treatments were not significantly different from P0 and P4. Soaking local chili seeds with various Trichoderma suspensions was best found in the types of *Trichoderma viride* and *Trichoderma asperellum* because it can be seen from the value of the results of the percentage of germination power, the average height of seedlings, and the number of leaves, the values of *Trichoderma viride* and *Trichoderma asperellum* were the highest.

Keywords: Chili, colletotrichum, seed, trichoderma

1. INTRODUCTION

Red chili (*Capsicum annuum* L.) is a horticultural plant belonging to the *Solanaceae* family. Red chili has high economic and nutritional value. The nutritional content of red chili plants such as protein, fat, carbohydrates, calcium, vitamins (A and C) makes red chili a commodity needed by the community for cooking ingredients, because it has a spicy taste

and also has good nutritional content. In 100 g of chili fruit contains 90.9% water content, 31 calories, 1 g protein, 0.3 g fat, 7.3 g carbohydrates, 29 mg calcium, 24 mg phosphorus, 47 mg vitamin A and 18 mg vitamin C (Sutrisni, 2016). Red chili is very popular in Indonesia, the growth of chili plants is influenced by several environmental factors, such as temperature, humidity, and soil fertility. Consumption of red chili will continue to increase from year to year due to the increasing population (Fahmi and Sujitno, 2011).

Chili cultivation often faces the problem of reduced chili production caused by many factors including dangerous fungi, namely anthracnose disease caused by *Colletotrichum*. (Fitriani et al., 2013). Attacks can occur at any time, both on young fruit and fruit that is about to be harvested (Suwardani et al., 2014). The most severe attacks can occur during high rainfall (Firdhausi, 2014). Anthracnose disease reduces chili production in terms of quantity and quality. Anthracnose disease is relatively difficult to control, anthracnose disease control generally uses synthetic fungicides, but if applied continuously can harm non-target microbial life and environmental pollution, so it is necessary to consider other control alternatives using biological agents. The use of biological agents to control soil-borne pathogens (rhizosphere) is widely carried out with fairly good to very good effectiveness, but to control pathogens that attack the phyllosphere area is still less applied, especially in Indonesia. *Trichoderma* fungi have been used in the biological control of pathogens in the rhizosphere and phyllosphere due to their broad host range. The effectiveness of *Trichoderma* in suppressing seed-borne pathogens varies depending on their individual characteristics (Soesanto, 2008).

Several previous studies have reported the success of *Trichoderma* which has proven effective in controlling various pathogens including *Colletotrichum* because *Trichoderma* is one of the fungal genera that offers great prospects for the application of environmentally friendly agriculture, especially through its activity as a nutrient provider for plants and a plant growth support agent. In addition, *Trichoderma* can be used as a biological control and has the ability as a biofertilization agent for plants (Wachid & Sutarman, 2019). Several *Trichoderma* species have been reported as biological agents in controlling plant pathogens such as *Trichoderma harzianum*, *Trichoderma viridae*, and *Trichoderma asperellum* which have a broad spectrum in various agricultural crops (Purnama, et al 2015).

The use of the fungus *T. harzianum* is an alternative to reduce pathogen attacks on chili plants. The *T. harzianum* species, as a decomposing organism, also functions as a biological agent and plant growth stimulator. *Trichoderma harzianum* has a positive effect on plant roots, plant growth, and crop yields (Herlina and Pramesti, 2004). The application of *Trichoderma harzianum* can reduce the percentage of anthracnose disease attacks caused by the fungus *Colletotrichum* on local chili fruit by 36.67% (Yanty and Wahyunil, 2019). The use of *Trichoderma viride* is a type of microorganism included in PGPR (Plant Growth Promoting Rhizobacteria), which is an endophytic fungus found in plant tissue, especially in the roots (Suanda et al., 2020).

Trichoderma asperellum is a species of *Trichoderma* that can increase seed germination, increase plant growth and development such as seedling height, and increase chili plant leaves, so it is expected to increase production. *Trichoderma asperellum* treatment can be

given to seeds, so that the level of dormancy can be reduced and the percentage of germination remains high. This treatment can be aimed at the seed coat, embryo, and endosperm of the seed with the intention of eliminating factors inhibiting germination and reactivating dormant seed cells According to Yuniarni (2015). This research on the effect of soaking chili seeds with various types of *Trichoderma* species on red chili plants is very important to do because this research aims to determine which *Trichoderma* is efficient for the growth of red chilies and to determine the effect on the vegetative phase of red chili plants.

2. METHOD

This research was conducted in the Laboratory of the Faculty of Agriculture, Graha Nusantara University, Padangsidimpuan, at an elevation of 450 m above sea level from March to April 2025. The tools used were a 9 cm diameter glass petri dish, a spatula, a measuring cylinder, a stirring rod, an analytical balance, a knife, tweezers, a brush, a steamer, a sprouting tray, a hand sprayer, scissors, a camera, and stationery. The materials used in this study were local Padang chili variety seeds from West Sumatra showing anthracnose symptoms, manure, *Potato Dextrox Agar* (PDA) media, distilled water, 70% alcohol, 3% NaOCl (Sodium Hypochlorite), label paper, plastic, tissue, sterile soil, *Trichoderma harzianum*, *Trichoderma viride*, and *Trichoderma asperellum* fungi (collection of the Plant Phytopathology Laboratory, Faculty of Agriculture, Andalas University), and fungicides.

This study used a Completely Randomized Design (CRD) with 5 treatments and 3 replications. Each seedling tray contained 36 chili seeds. The total number of seeds observed in this study consisted of 540 seeds, or 5 treatments x 3 replications x 36 seeds/sprouting tray = 540.
P0 = Control (No soaking in Trichoderma suspension)
P1 = *Trichoderma harzianum* (106 conidia/90 ml water for 9 hours)
P2 = *Trichoderma viride* (106 conidia/90 ml water for 9 hours)
P3 = *Trichoderma asperellum* (106 conidia/90 ml water for 9 hours)
P4 = Fungicide (5 grams/90 ml water for 5 minutes)

Red Chili Seed Preparation and *Trichoderma* Application
The variety used was a local Padang variety from West Sumatra. Seeds were collected from fruit that were physically infected with anthracnose. Only the seeds from the middle two-thirds of the fruit were collected. These seeds were air-dried and taken to the laboratory for testing. The seeds were randomly selected for each treatment.
Before treatment, chili seeds were disinfected by soaking them in a 3% NaOCl solution for five minutes, followed by washing three times with sterile distilled water. The seeds were then air-dried. The seeds were then soaked in a *Trichoderma* suspension for the appropriate treatment duration, which was 9 hours. The treated seeds were then air-dried before planting.

Growing Media Preparation and Chili Seed Sowing

Soil and manure were mixed thoroughly in a 2:1 ratio, then placed in plastic bags and sterilized in a steamer at 100°C for 60 minutes, then cooled for 24 hours. Each germination tray was filled with 36 polybags of treated and untreated chili seeds. Seeds were sown in holes approximately 1 cm deep, evenly spaced, then covered with soil and observed for 5 weeks.

Data Analysis

Observation data were analyzed using analysis of variance. If the results were significantly different, the LSD test was performed at the 5% level.

3. RESULT AND DISCUSSION

Table 1. Germination percentage is calculated by summing the seeds that germinated 7 Days After Planting (DAP).

Treatment	Growth Percentage
Control	55.6667b
Trichoderma harzianum	85.3333c
Trichoderma viride	95.3333c
Trichoderma asperellum	95.3333c
Fungicide	0.0000a

Note: Numbers followed by the same letter in the same column indicate no significant difference between treatments (ANOVA with LSD test at the α level of 0.05)

Table 1 shows that the analysis of variance (ANOVA) showed that soaking red chili seeds with *Trichoderma* did not significantly affect germination rates. On average, treatments P2 and P3 had a relatively high germination rate of 95.3333%, while treatment P4 had the lowest germination rate at 0.0000%.

This is likely due to factors that increase nutrient availability or provide protection against pathogens. This is consistent with a study by Herlina and Dewi (2009) which showed that the application of active *Trichoderma* sp. can enhance chili plant growth.

Based on the results of the analysis of variance (ANOVA) on chili seed soaking treatments with various types of *Trichoderma* suspensions, the observed chili plant height at 7, 14, 21, 28, and 35 days after planting can be seen in the following table:

Table 2. Average Chili Plant Height at t 7, 14, 21, 28, and 35 Days After Planting (cm)
Treatment Age

Control	0.8633a	1.1967a	0.8367a	0.7767	0.8933
Trichoderma harzianum	2.1467b	3.5800b	3.4567b	2.2633	2.5467
Trichoderma viride	2.5067b	3.0967b	3.1000b	1.4933b	1.6700
Trichoderma asperellum	2.0433b	3.5033b	3.3800b	2.6200	2.9600
Fungicide	0.0000a	0.9733a	3.4067a	1.8166	2.2133

Note: Numbers followed by the same letter in the same column indicate no significant difference between treatments (ANOVA with LSD test at the α level = 0.05)

Based on Table 2, from the results of the analysis of variance that the treatment of giving various types of *Trichoderma* suspension after further testing with LSD can be seen that the average height of chili plants in each week experienced changes indicating that there was a significant effect on the height of chili plants at the age of 7, 14 and 21 HST while at the age of 28 and 35 HST there was no significant difference in the height of chili plants. In table 2, it shows that at the age of 7 HST, the highest *Trichoderma* treatment was in the *Trichoderma viride* treatment, namely with a value of 2.5067. The *Trichoderma viride* treatment was not significantly different from the *Trichoderma harzianum* and *Trichoderma asperellum* treatments while the control and Fungicide showed a significant effect.

At 14 days after planting (DAP), the highest *Trichoderma* value was found in the *Trichoderma harzianum* treatment, with a value of 3.5800. The *Trichoderma harzianum* treatment was not significantly different from the *Trichoderma viride* and *Trichoderma asperellum* treatments, while the control and fungicide treatments showed a significant effect.

At 21 days after planting (DAP), the highest *Trichoderma* value was found in the *Trichoderma harzianum* treatment, with a value of 3.4567. The *Trichoderma harzianum* treatment was not significantly different from the *Trichoderma viride* and *Trichoderma asperellum* treatments, while the control and fungicide treatments showed a significant effect.

At 28 days after planting, the *Trichoderma harzianum*, *Trichoderma viride*, and *Trichoderma asperellum* treatments had no significant effect on the control and fungicide treatments. The average value showed that the highest *Trichoderma* treatment was *Trichoderma asperellum*, with a value of 2.6200 cm, while the lowest was in the control treatment, with a value of 0.7767 cm.

At 35 days after planting, the *Trichoderma harzianum*, *Trichoderma viride*, and *Trichoderma asperellum* treatments had no significant effect on the control and fungicide treatments. The average value showed that the highest *Trichoderma* treatment was *Trichoderma asperellum*, with a value of 2.9600 cm, while the lowest was in the control treatment, with a value of 0.8933 cm.

This shows that soaking with *Trichoderma* from each growing medium can increase vegetative growth in the form of increased height of chili plants. Castro et al., (2009) stated that *Trichoderma* also produces auxin hormones in the form of IAA (Indole Acetic Acid) which plays a role in the elongation of plant root cells, thus causing wider and higher nutrient absorption. This condition occurs because the applied *Trichoderma* is able to protect host plants against pathogenic fungi and *Trichoderma* and stimulate plant growth by producing growth hormones. This favorable condition for plants is thought to be because the antagonistic fungus *Trichoderma* has a PGPF (Plant Growth Promoting Fungi) mechanism (Suanda, 2017).

The results of the study indicate that soaking local chili seeds in various *Trichoderma* fungal suspensions resulted in different results for each treatment. Observations and analysis of the variance indicate that soaking chili seeds in various *Trichoderma*

suspensions on leaf number at 7, 14, 21, 28, and 35 days after planting is shown in the following table:

Table 3. Average number of leaves at 7, 14, 21, 28, and 35 days after planting (sheets)
Age Treatment

	7 HST	14 HST	21 HST	28 HST	35 HST
Control	0.4567a	0.5800a	0.3600a	0.3800	0.5533
Trichoderma harzianum	1.0200bb	1.3200b	1.3333bc	21.4267	1.5200
Trichoderma viride	1.3167b	1.2000b	1.3267bc	0.7367	0.9100
Trichoderma asperellum	1.1833b	1.3333b	1.6200c	1.2700	1.5733
Fungicide	0.0000a	0.5733a	0.7700ab	1.2967	1.4400

Note: Numbers followed by the same letter in the same column indicate no significant difference between treatments (ANOVA with LSD test at the α level = 0.05)

Based on the results of the analysis of variance in Table 3, it shows that at 7 days after planting, the highest treatment was *Trichoderma viride*. This treatment was not significantly different from *Trichoderma harzianum* and *Trichoderma asperellum*, but it had a significant effect on the control and fungicide. At 7 days after planting, the highest number of leaves was *Trichoderma viride*, with 1,3167 leaves.

At 14 days after planting, the highest treatment was *Trichoderma asperellum*. This treatment was not significantly different from *Trichoderma viride* and *Trichoderma asperellum*, but it had a significant effect on the control and fungicide. At 14 days after planting, the highest number of leaves was *Trichoderma asperellum*, with 1,333 leaves.

At 21 days after planting, the highest leaf count was found in *Trichoderma asperellum*. This treatment was not significantly different from *Trichoderma viride* and *Trichoderma asperellum*, but it did have a significant effect on fungicide control. At 21 days after planting, the highest number of leaves was found in *Trichoderma asperellum*, with 1.6200 leaves.

At 28 days after planting, each treatment showed no significant effect. However, the highest number of leaves was observed in the *Trichoderma harzianum* treatment, with 21.4267 leaves, while the lowest was found in the control, with 0.3800. At 28 days after planting, each treatment showed no significant effect.

At 35 days after planting (DAP), no significant effect was observed for each treatment. However, the highest number of leaves was observed for the *Trichoderma asperellum* treatment, at 1.5733, while the lowest was observed for the control, at 0.5533. At 35 days after planting, no significant effect was observed for each treatment.

Based on research by Rahmadani (2016), the propagation of *Trichoderma* in chili seed media produced relatively better results. This indicates that soaking chili seeds in various *Trichoderma* suspensions from each growing medium can enhance vegetative growth by increasing the number of leaves on chili plants. The differences in vegetative growth of chili plants in each *Trichoderma* growing medium treatment are likely due to the availability of nutrients for the growth and reproduction of the *Trichoderma* fungus in the growing medium.

4. CONCLUSIONS

Based on the analysis and discussion, soaking chili seeds in various *Trichoderma* suspensions from different media significantly affected the vegetative growth of local chili plants. *Trichoderma* treatments significantly affected the germination rate, seedling height, and leaf number of red chili seedlings. The percentages of treatments P1, P2, and P3 did not significantly affect the germination rate of red chili seeds, but these three treatments were significantly different from treatments P0 and P4.

The best results for soaking local chili seeds in various *Trichoderma* suspensions were found for *Trichoderma viride* and *Trichoderma asperellum*, as evidenced by the highest germination rate, seedling height, and leaf number for *Trichoderma viride* and *Trichoderma asperellum*.

REFERENCES

Arsensi, I. (2014). Response of Red Chili Plants, Prabu Variety, to the Use of *Trichoderma* sp. in Controlling Fusarium Wilt Disease. Journal of Agricultural Dynamics. XXIX (2)

Castro, Ortiz, R.H.A., Cornejo, C.L., Rodriguez, M., and Bucio, J.L. (2009). The role of microbial signals in plant growth and development. Journal of Plantsignaling & Behavior; 4 (8): 701-712

Elita, N. (2022). The effects of the application of *Trichoderma asperellum and biochar on the growth and productivity of rice cultivated by the SRI method and on soil qu*ality. IOP Conference Series: Earth and Environmental Science, 1097(1), 01/2018

Fahmi, T., and E. Sujitno. (2011). Increasing Red Chili (*Capsicum annum* L.) Production Through the Use of Superior Varieties in Sukamantri District, Ciamis Regency, West Java Province. West Java Agricultural Technology Assessment Center, Bandung

Fitria, E., Kesumawaty, E., and Basyah, B. (2021). The Role of *Trichoderma harzianum* as a Plant Growth Regulator on the Growth and Productivity of Chili (*Capsicum annum* L.) Varieties. Indonesian Journal of Agronomy, 49(1): 45–52.

Herlina, L., D. Pramesti. (2004). The Use of *Trichoderma harzianum* Active Compost to Improve Chili Plant Growth. Journal of the Faculty of Mathematics and Natural Sciences, Semarang State University

Hermeria. (2021). Use of *Trichoderma* sp. to Improve Chili Plant Growth and Control Diseases in Taeh Baruah Village, Payakumbuh District, Limapuluh Regency. Journal of Downstream Science and Technology.

Nasahi, C. (2010). The Role of Microbes in Organic Farming. Faculty of Agriculture, Padjadjaran University, Bandung.

Nuraini, A. N., Aisyah, A., & Ramdan, E. P. (2021). Selection of Rhizosphere Bacteria in Rambutan Plants as Biocontrol Agents for Anthracnose Disease in Chili Peppers (*Capsicum annum* L.). Journal of Precision Agriculture, 4(2), 100-112.

Nurfalach, D. R. (2010). Cultivation of Red Chili Peppers (*Capsicum annum* L.) at the Horticultural Plant Nursery Unit (UPTD) in Pakopen Village, Bandungan District, Semarang Regency. Surakarta: Sebelas Maret University.

Piay Sherly S., A. Tyasdjaja, Y. Ermawati, and F. R. P. Hantoro. 2010. Cultivation and Post-Harvest of Red Chili Peppers (*Capsicum annum* L.). Ungaran, Central Java BPTP.

Purnama, H., Hidayati, N., & Setyowati, E. (2015). Development of Natural Pesticide Production from Beauveria Bassiana and *Trichoderma* Sp. Towards Organic Farming. Warta LPM, 18(1), 1-9.

Ramdan, Evan Purnama, I. M. A., and Risnawati1. (2019). Identification and Virulence Testing of Anthracnose Disease in Post-Harvest Chili Fruit. 67–76.

Ramadhani, D. (2016). Propagation of *Trichoderma* sp. on Several Laboratory Media. Final Project Research Report.

Rindani, M. (2015). Land Suitability for Red Chili Plants in Jorong Land, Lubuak Batingkok Subdistrict, Harau District, Lima Puluh Kota Regency, Payakumbuh. National Ecopedon. 2(2): 28-33.

Rohmawati, T. (2000). The Effect of Mulching on Growth and Yield and the Spread of Peanut Stripe Virus (PSTV) in Six Peanut Varieties (Arachis hypogaea L.). Thesis. Faculty of Agriculture, Bogor Agricultural University. Bogor. Soesanto, L. 2008. Introduction to Plant Disease Control. Rajawali Press. JakMarta.

Suanda, I.W. (2017a). Utilization of *Trichoderma* sp. as an Environmentally Friendly Biological Agent in Controlling Fusarium Disease in Tomato Plants (*Lycopersicum esculentum* Mill.). Proceedings of the National Seminar on Strengthening and Teaching Biology as a Basic Science, Faculty of Mathematics and Natural Sciences, Indonesian Hindu University. Denpasar. pp. 390-398).

Suanda, I.W., I.W. Suarda, N.W. Ratnadi. (2020). The Effect of *Trichoderma* sp. Fertilizer with Different Growth Media on the Vegetative Growth of Large Red Chili Peppers (Capsicum Frutescens L.). Widya Biologi.

Sutrisni, A. (2016). Testing the activity of bioactive compounds of mold (*Gliocladium* sp) against *Fusarium oxysporum*, capsici, which causes wilting in chili plants in vitro. Bachelor Thesis. Muhammadiah University of Purwokerto, Central Java

Suwardani, N. W. Purnomowati, and E. T. Sucianto. (2014). Study of fungal diseases in red chili (Capsicum annuum L.) plants cultivated by smallholders in Brebes Regency. Scripta Biologica Journal. 1(3): 223-225.

Wachid, A. & Sutarman. (2019). Inhibitory Power Test of Two *Trichoderma* Isolates in In Vitro Way Against Fusarium Oxysporum, the Cause of Red Chili Stem Rot. J. Phys.: Conf. Ser. 1232: 01/2020.

Yanti, Y. (2018). Endophytic Bacillus Screening and Identifications as Growth Promoter and Biocontrol of *Colletotrichum capsici* on Chili. Oral Presentation at Safe in the Philippines.

Yanty, D. P., & Wahyuni, S. H. (2019). The Effect of Soaking Length of *Trichoderma harzianum* on the Growth of Local Chili Peppers. Journal of Tropical Agriculture, 6(3), 477–481.

Yuniarni, N. (2015). The Potential of *Trichoderma* as a Biological Agent in Plant Disease Control. Journal of Agricultural Biotechnology, 10(2), 123–130.

Zhang, W. J., Jiang F. B., Ou J. F. (2011). Global Pesticide Consumption and Pollution: With China as a Focus. Proceedings of the International Academy of Ecology and Environmental Sciences 1(2):125–14