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Effect of Cinnamon Leaf Extract Formula (*Cinnamomum burmanni* Blume) on *Fusarium* Wilt that Attacks Tomato Plants in Bali

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ABSTRACT

This study aimed to look at the effect of cinnamon leaf extract formula (Cinnamomum burmanni Blume) on Fusarium wilt disease that attacked tomato plants in Bali, Indonesia. The study was conducted in the Experimental Garden of UPT Seeds Food Crops and Horticulture in Bali, located at the village of Luwus, Baturiti District, Tabanan Regency, Bali Province, using a randomized block design (RAK) consisting of six treatments replicated 4 times, so there were as many as 24 experimental units, each consisting of 10 tomato plants in a polybag. Treatment with cinnamon leaf extract formula significantly (P <0.05) reduced the percentage of Fusarium wilt disease in tomato plants. Treatment of 2% was a treatment that provided the best protection for a tomato plant in the control of Fusarium wilt disease by inhibition of 80.95%, followed by treatment with 1.75%, 1.50%, 1.25% and 1%. Treatment of cinnamon leaf extract concentrations of 0% -2% had a significant effect (P <0.05) on the weight of fruit per plant but the effect was not significant (P> 0.05) on the maximum plant height, number of fruits per plant and the sugar acid content of the fruit.

Key words: *Fusarium oxysporum f. sp, lycopersici, cinnamon, anti-microbial activity*

INTRODUCTION

Tomato production in Indonesia is still low compared with other countries, which is only 0.8 million tons, while Turkey, the United States and India respectively 10.8 million tons, 13.1 million tons and 13.6 million tons[10]. One of the causes of the low production of tomatoes in Indonesia is caused by *Fusarium* wilt disease. *Fusarium* wilt disease is caused by the fungus *Fusarium oxysporun* f.sp. *lycopersici*[12]. This wilt disease leads losses on tomato plants at the amount of 20-30%[15]. Losses incurred in Malang, East Java 10.25%[2] in Lembang and Pacet, West Java, at 16.7%[11].

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Based on the preliminary survey conducted in early March 2013 at the centers of tomato plants in Bali, it was found that the disease was spreading in some planting areas of tomatoes such as Petang District Badung Regency, Kintamani Bangli Regency and Baturiti Tabanan Regency with the percentage of the disease by 15%, 10% and 15% respectively.

Controlling the disease using synthetic fungicides can have negative impacts on the environment. Efforts to reduce the negative impact of the use of synthetic fungicides need to be done in the framework of the implementation of environmentally friendly and sustainable agriculture. One way to reduce the impact due to the use of synthetic fungicides is the use biofungicide or vegetable fungicide, namely the use of plant extracts that have active compounds potential as anti-fungal[5]. Darmadi *et al*[1]., reported that cinnamon leaf extract could significantly inhibit the colony growth of mushroom, mushroom biomass, and sporulation of fungi that cause *Fusarium* wilt disease in tomato plants in vitro. At concentrations of cinnamon leaf extract 1%, 1.25%, 1.50%, 1.75% and 2% can significantly inhibit the growth of colonies of *Fusarium oxysporum* f.sp *lycopersici* when compared to controls with respective inhibiting activities of 41.66%, 78.11%, 88.33%, 91.11%, 100%.

MATERIALS AND METHODS

Fieldwork was conducted at the Experimental Garden of Seeds, Food Crops, and Horticulture Center of Bali Province, located in the village of Luwus, Baturiti District, Tabanan Regency, Bali Province, using a randomized block design (RAK) consisting of six treatments, namely: F_0 = Control (without cinnamon extract treatment), F_1 = Formula with extract concentrations of 1%, F_2 = Formula with extract concentrations of 1.25%, F_3 = Formula with extract concentrations of 1.5%, F_4 = Formula with extract concentration of 1.75%, F_5 = Formula with extract concentrations of 2%. Each treatment was repeated 4 times, so that there were as many as 24 experimental units, each consisting of 10 tomato plants in a polybag. Implementation of the research included: seeding, planting media preparation, planting, vegetable fungicide application, fertilization, crop maintenance, and harvest.

Making the formula was made by weighing 100 g of cinnamon leaf extract added to the sterile water containing 1% Tween-80 (w / v) as an emulsifying agent. The final volume was set to 1 liter formula. This formula was used to control testing of *Fusarium* wilt disease.

1. Seedling

Tomato seeds were previously soaked for 2 hours, and then grown in Petri dishes with wet wipes for 3 days to germinate. The germinated seeds were planted in plastic trays filled with planting medium consisting of topsoil that had been mixed with cow manure that had been sterilized by a ratio of 2: 1. Tomato seedlings of 3-4 true leaf pieces were then transferred into a polybag planting medium that had been filled with a mixture of topsoil, husks and cow manure with a ratio of 3: 1: 1.

2. Inoculation of *F. oxysporum* f. sp. *lycopersici*

The inoculation of *F. oxysporum* f.sp. *lycopersic*i was done on the ground by sprinkling 20 ml suspension of F. *oxysporum* f.sp. *lycopersici* with spore density of 2.4 x 105 conidia / l of water. Inoculation was done when the seedlings were planted in polybags. Besides inoculation was done by sprinkling 20 ml of mushroom suspense, inoculation was also performed by immersing the roots of the seedlings whose tip had been cut the 1 mm long into the fungal suspension at the time of planting to polybags. Cutting the root tip of 1 ml long was intended to give the wounds on the roots as the penetration of fungi to the host plant.

3. Applications of cinnamon leaf extract formula

Applications of cinnamon extract formula were done as much as 4 times according to the extract concentrations examined, i.e. 1%, 1.25%, 1.50%, 1.75% and 2%. As a control, sterile water was used with 1% of Tween-80. First application was done one day after the plant was planted, the application II aged 7

days after planting, application III aged 14 days after planting, application IV aged 21 days after planting at a dose of 100 ml / plant. Solution application of cinnamon extract formulation was done by sprinkling it to each plant according to the treatment.

4. Maintenance

Maintenance of tomato plants made included replanting, watering, weeding, and fertilizing. Replanting was done on plants that were damaged or having abnormal growth with plants that had been prepared beforehand in a tray so that growth uniforms. Watering was done after planting and was done every day (morning or afternoon). By the time the weather was hot and the soil too dry, watering was done twice a day, morning and evening. To sustain plants, a pole was given as early as possible so that the plant did not touch the ground. Weeding was done to keep the tomato plants not disturbed by the weeds to prevent the competition of nutrients between weeds and tomato plants. Fertilization was done by providing fertilizer urea, SP-36 and KCl. Urea fertilizer dose of 1 g / plant at the time the plant was given 1, 2, and 4 weeks after planting while the SP-36 fertilizer and KCl were given one time as much as 1 g / plant was given at the time of planting.

5. The parameters observed

a. The percentage of Fusarium wilt disease in the field

Observation percentage of *Fusarium* wilt disease started two weeks after planting and every week until harvest. The percentage of disease was calculated by counting the number of tomato plants showing the symptoms of *Fusarium* wilt disease in comparison with the total number of plants observed for each experimental unit. The calculation of the percentage of disease was done based on the following formula[9]:

$$\mathbf{P = \frac{n}{N} \times 100\%}$$

Where: P = Percentage of disease (%), n = the number of plants showing symptoms of disease, N = the total number of plants observed

b. Height of tomato plants

Tomato plants' height was measured by measuring the height of the main stem of the stem at ground level right up to the growing point. Plant height was measured every week since the plant 2 MST-old until the plant reached its maximum height.

c. The number of fruits per plant

The number of fruits per plant was obtained by summing all the tomatoes on the plant samples in each treatment, and then divided by the number of plant samples. Measurement of the number of fruits was carried out at the time of harvesting.

d. Weight of fruit per plant

Weight of fruit per plant was obtained by dividing the total weight of the fruit crops harvested by the number of plants in each treatment. Measurement of weight of fruit per plant was made at the time of harvesting.

6. Statistic Analysis

The data obtained in this study were analyzed quantitatively by using analysis of variance (ANOVA). If the data obtained showed a significant difference, then followed by *Duncans Multiple Range Test* (DMRT) at a rate of 5%, statistical analysis with the help of software (CoStat Co.). Determining the number of treatments and replications of each study design relied on the specification $(P-1) \times (n-1) \geq 15$[4].

RESULTS AND DISCUSSION

The symptoms of *Fusarium* wilt disease in tomato plants untreated with extract formula (control) had been seen at week IX after planting, while the symptoms of the disease on tomato plants treated with the extract formula with a concentration of 1%, 1.25%, 1.50% ,1.75% and 2% only noticeable at week X. The rate of the development of *Fusarium* wilt disease had increased sharply starting week X to XIII on all treatments including the control as presented in Figure 1. Treatment of cinnamon leaf extract formula significantly ($P < 0.05$) reduced the percentage of *Fusarium* wilt disease in tomato plants. The highest percentage of *Fusarium* wilt disease at week XIII after planting found in the control was

52.5%, while the percentage of wilt disease in the treatment varied between 10 and 27.5% (Figure 1).

The lowest percentage of *Fusarium* in week XIII totaled 10% occurring in 2% concentration treatment which did not have significant difference from all other treatments except the control. Treatment of 2% was a treatment that provided the best protection for a tomato plant in the control of *Fusarium* wilt disease with inhibiting activity of 80.95%, followed with treatment of 1.75%, 1.50%, 1.25% and 1% (Table 1).

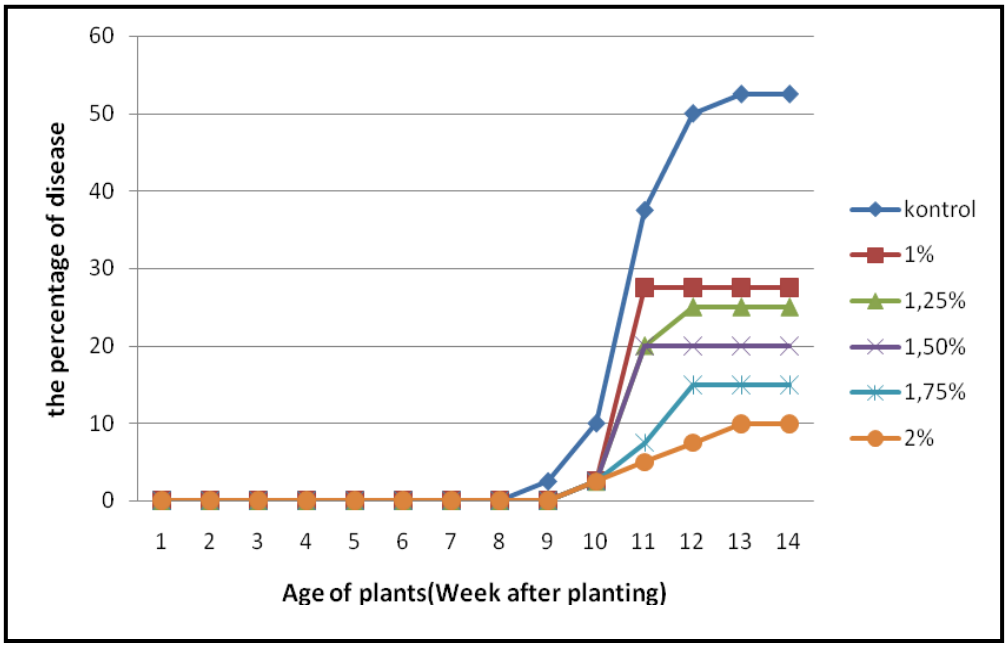

Fig. 1: Graph the effect of cinnamon leaf extract treatment against Fusarium wilt disease on tomato plants

Table 1. The effect of cinnamon leaf extract on the percentage of *Fusarium* wilt disease in tomato plants

Extract concentration (%)	Percentage of *Fusarium* wilt disease at 13 MST	Inhibiting Activity (%) compared with control
Control	52.5a*	-
1%	27.5ab	47.62
1.25%	25b	52.38
1.50%	20b	61.90
1.75%	15b	71.43
2%	10b	80,95

*Figures followed by the same letter showed no significant effects based on Duncan's Multiple Range Test at the level of 5%. The data were analyzed after being transformed into arcsin.

Cinnamon leaf extract treatment with the concentrations of 0% -2% had a significant effect (P <0.05) on the weight of fruit per plant but the effect was not significant (P> 0.05) on the maximum plant height, number of fruits per plant and the sugar acid content of fruit (Table 2). The highest weight of fruit per plant was produced by tomato plants treated with cinnamon leaf extract at a concentration of 2%, i.e. 425.03 g while the weight of fruit per plant was produced by the control plant was 261.23 g. The results of tomatoes per plant in the treatment of the extract with a concentration of 2% were higher by 63% compared with controls. These data indicated that treatment with an extract of cinnamon leaves with a concentration of 2% was effective in reducing the incidence of *Fusarium* wilt disease and avoiding loss of yield on tomato plants.

Table 2. The effect of cinnamon leaf extract treatment on maximum plant height, fruit weight per plant, number of fruits per plant, content of acid sugar in tomato plants

Extract concentration (%)	Maximum Plant height (cm)	Fruit weight per plant (g)	Number of fruits per plant	Sugar acid content in fruits (^{O}Brix)
Control	58.63a*	261.23b*	13.13a*	4.35a*
1%	58.45a	291.9ab (12%)**	13.28a	4.60a
1.25%	56.78a	314.55ab (20%)	12.83a	4.58a
1.50%	53.3a	321.6ab (23%)	13.58a	4.53a
1.75%	59.45a	360.6ab (38%)	16.58a	4.78a
2%	59.13a	425.03a (63%)	18.15a	4.88a

*Figures followed by the same letter showed no significant effects based on Duncan's Multiple Range Test at the level of 5%.

** Figures between brackets indicated the percentage of increased yield of the control.

The effectiveness of cinnamon leaf extract to suppress *Fusarium* wilt disease on tomatoes was likely caused by the presence of several active chemical compounds are as antifungal against *F. oxysporum* f.sp *lycopersici*.

Compounds contained in the extracts of cinnamon leaves are steroids, flavonoids, phenolics and tannins. According to Revany[7], compounds such as triterpenoids / steroids, flavonoids, phenolics and tannins are anti-microbial. The compounds can inhibit the growth of bacteria *Escherichia coli*, *Staphylococcus aureus* and *Candida albicans fungus*. Salisbury and Ross[8] state that phenolic compound can act as fungistatic and even as fungitoxic.

Yeole *et al*[16]., reported on the control of Alternaria solani fungus which causes leaf blight (early blight) in the Solanaceae plant parts, using several types of medicinal plants. A total of eight types of plants shown to have antifungal properties against *A. solani* are *Cinnamomum zeylanicum, Syzygium aromaticum, Ferula foetida, Inula racemosa, Hemidesmus indicus, Rubia cordifolia, Glycyrrhiza glabra and saussurea lappas.* Methanol extract formula *C. zeylanicum* with a concentration of 2 ml /l of water in glasshouse experiments are very effective in controlling the fungus *Alternaria solani* on tomato plants. Govindappa *et al*[3]., proved that the field application of plant extracts and *Adathoda Becopa monniera vasica* at doses of 50% can improve germination, root length, vigor and reduce disease caused by *Fusarium oxysporum* f.sp. *carthami* on Safflower var. plants. *manjira*. Another study by Rachma[6] that cinnamon (*C. burmanni*) had antifungal power against *Candida albicans* in vitro. According to Sukandar *et al*[13]., the essential oil of cinnamon bark had a strong activity against all bacterial and fungal test while the leaf essential oil is active against all bacteria tested. Antibacterial activity of essential bark oils was most powerful against *Bacillus subtilis* with a minimum inhibitory concentration of 0.62%, while the strongest antifungal activity against *Candida albicans* with minimum inhibitory concentration of 1%. Antibacterial activity of essential oils of leaves was the strongest against *Salmonella typhimurium* and strongest antifungal activity against *Candida albicans* each with a minimum inhibitory concentration of 2%.

Research on the use of vegetable fungicide formulas was reported by Suprapta *et al*[14]., Two formula of vegetable fungicide i.e. F1 (the formula containing 10% (w/v) extracts of clove, 1% Tween-80, and 0.5% sticker) and F7 (formula containing 5% clove and 5% betel leaf extract, 1% Tween-80 and 0.5% sticker) tested for their ability to control black rot disease of cacao fruit caused by the fungus *Phytophtora palmivora*. The results showed that the F7 extracts containing clove flowers and betel leaf extract showed the percentage of the disease by 10.56% lower than Formula F1 containing extracts of clove with a percentage of 18.89% of disease. These results demonstrated a synergy of clove flower extract and betel leaf extract related to anti-fungus properties to fungi *P. palmivora*.

CONCLUSION

Cinnamon leaf extract formula effectively inhibited wilt disease in tomato plants caused by the fungus *Fusarium oxysporum f.sp lycopersici*. The treatment with cinnamon leaf extract at a concentration of 2% was effective in reducing the incidence of *Fusarium* wilt disease and avoiding loss of yield on tomato plants.

REFERENCES

1. Darmadi, A.A.K., Suprapta, D.N., Temaja, I G.R.M.T., Swantara, I M.D., Leaf Extract of *Cinnamomum burmanni* Blume Effectively Suppress the Growth of *Fusarium oxysporum* f.sp.*lycopersici* The Cause of *Fusarium* Wilt Disease on Tomato. *Journal of Biology, Agriculture and Healthcare*, **5(4):** 131-137 (2015).
2. Djauhari, S., Efforts to Fusarium Wilt Disease Control in Tomatoes with Plastic Mulching Before Planting. National Congress IX PFI, Surabaya: 318 – 324 (1978). (in Indonesian language).
3. Govindappa, M., Rai, V.R., Lokesh, S., In vitro and In vivo responses of different treating agents against wilt disease of safflower. *Journal of Cereals and Oilseeds*, **2(1):** 16-25 (2011).
4. Gomes, K.A. and Gomes, A.A., Statistical Procedures for Agricultural Research. Second Edition. Publisher University of Indonesia (UI - Press) (2007).
5. Kagale, S., Marimuthu, T., Thayumanavan, B., Nandakumar, R. and Samiyappan, R., Antimicrobial activity and induction of systemic resistance in rice by leaf extract of *Datura metel* against *Rhizoctonia solani* and *Xanthomonas oryzae* pv. *oryzae*. *Physiological and Molecular Plant Pathology*, **65:** 91–100 (2004).
6. Rachma, L.N., Antifungal power of Cinnamon (*Cinnamomum burmanni*) against *Candida albicans in vitro*. *El-Hayah*, **3(1):** 29-34 (2012). (in Indonesian language).
7. Revany, J., Antimicrobial power and Fraction of Betel Red Leaf Extract (*Piper betle* Linn.) *Journal ILMU DASAR*, **12(1):** 6-12 (2011). (in Indonesian language) .
8. Salisbury, F.B. and dan Ross, C.W., Plant physiology, 4th edition. (Lukman, D.R., dan Sumaryono, interpreter). Plant Physiology. Volume II. Plant Biochemistry. Bandung: ITB. 145-148 (1992).
9. Sinaga, S.M., Basics of Plant Disease. Jakarta: Penebar Swadaya. (2006). (in Indonesian language).
10. Secretariat General of the Ministry of Agriculture. *Outlook of* Tomatoes Commodity. Data and Information Openness of Agriculture Secretary General of the Ministry of Agriculture (2014).
11. Semangun, H., Hotikultura Plant Diseases in Indonesia. Yogyakarta: Gadjah Mada University Press (2007). (in Indonesian language).
12. Subramanian, C.V., *Fusarium oxysporum* f.sp. *lycopersici*. C.M.I. Description of Pathogenic Fungi and Bacteria. No.217. issued by the Commonwelth Mycological Institute, Ferry Lane, Kew, Surrey, England. Great Britain: the Eastern Press Ltd., London and Reading. © Commonwealth Agricultural Bureaux (1970).
13. Sukandar, E.Y., Suganda, A.G. and Muslikhati, The Effect Of The Volatile Oil Of Barkand Leaves Of *Cinnamomum Burmanni* Against Bacteria And Fungi). *Majalah Farmasi Indonesia*, **X (1):** (1999).
14. Suprapta, D.N., Sudana, M., Wirya, G.N.A.S., Sudiarta, P.N., Plant Extracts to Control Cocoa Black Pod Disease Caused by *Phytophthora palmivora*. *J. ISSAAS*, **13(3):** 22-30 (2008).
15. Wibowo, A., Colonization of Tomato Root by Antagonistic Bacterial Strains to *Fusarium* Wilt of Tomato. *Indonesian Journal of Plant Protection*, **11(2):** 66-76 (2005).
16. Yeole, G.J., Teli, N.P., Kotkar, H.M. and Mendki, P.S., *Cinnamomum Zeylanicum* Extracts and Their Formulations Control Early Blight of Tomato. *J Biopest*, **7(2):** 110-123 (2014).