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Control Of Wilting Disease in Tomato Plants Caused by *Ralstonia solanacearum* Compounds

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Abstract

This study aimed to determine the optimal application of betel leaf, cloves, and cinnamon to control bacterial wilt caused by Ralstonia solanacearum in tomato plants. The analyze conducting at the Laboratory Park of the Faculty of Agriculture, Lambung Mangkurat Banjarbaru University. A completely randomized design with seven treatments include leaf powder (betel nut, clove, cinnamon), bokashi from leaves of the above three components, and control (no powder and bokashi). The results showed that the application of betel leaf bokashi and clove leaf bokashi was more able to suppress the intensity of *R. solanacearum* on tomatoes.

Keywords: tomato, *R solanacearum*, anti-microbial plant powder

Introduction

Tomato (*Lycopersicum esculentum* Smith) is a major vegetable crop because it contains nutrients beneficial to humans and has economic value. Tomatoes are a source of vitamins and minerals that can be eaten fresh and further processed as raw materials for the food industry.

Tomatoes are widely cultivated in the villages of Guntung Payung, Sukamara, and Guntung Mangosteen in Banjarbaru City, South Kalimantan Province. Tomato production from these three villages is still low because farmers prefer other, more profitable crops such as spinach, mustard greens, and celery. Besides, the lower production of tomatoes was also due to the high level of attack by *Ralstonia solanacearum (wilt disease)*. Wilt disease in tomatoes, eggplant, and chilies. *R. solanacearum* founded in banana (*Musa paradisica*), eggplant (*Solanum molongena*), peanut (*Arachis hypogaea*), potato (*Solanum tuberosum*), tobacco (*Nicotiana tabacum*), tomato (*Lycopersicum esculentum*) and patchouli (*Pogostemon cablin*) (Nasrun, 2007). *R. solanacearum* on eggplant can cause yield losses of up to 50-100% (Prihatiningsih and Djamiko, 2015).

R. solanacearum in tomatoes treated with plant leaves contains anti-microbial compounds. Some research results state that the leaves of betel, clove, and cinnamon plants contain anti-microbial compounds such as phenolic compounds in essential oils. The application of pesticides for controlling soil-borne diseases on a laboratory or greenhouse scale was to use plant parts in extracts, soaking water, powders, and chopped leaves. This study aims to determine the ability and application of leaf powder (betel, clove, and cinnamon) and a mixture of Bokashi from the same ingredients to control bacterial wilt disease in tomato plants caused by *R. solanacearum*.

Materials and Methods

The research takes place in the experimental field of the Faculty of Agriculture, Lambung Mangkurat University, Banjarbaru.

R. solanacearum used was derived from tomato plants with wilting symptoms from the village of Guntung Manggis. The environmental design used was a completely randomized design with seven treatments and four replications. Each experimental unit has ten plants planted in polybags. The treatments tested were betel leaf powder, clove leaf powder, cinnamon leaf powder, betel leaf bokashi, clove bokashi, cinnamon leaf bokashi, and control (without powder and leaf bokashi application). Each plastic bag contains 4 kg of a mixture of soil and cow dung manure, steam sterilized for 1 hour (compare 3:1).*R. solanacearum* with a concentration of 2 x108 cfu ml-1, carried out one week before planting. The application of powder or bokashi was carried out three days before planting as much as 20 grams per polybag. The application was *frequent* at the age of 25 days. The tomato seeds used are the Ratna variety.

Observation of wilting symptoms in tomato plants started one day after planting until 40 days after planting. The intensity of attack was calculated by the formula:

$$I = \left(\frac{n}{N}\right) x\ 100\%$$

I = Intensity of attack
n = Number of wilted plants per experimental unit
N = Number of plants per experimental unit (10 plants)

Results and Discussion

The results of data analysis on the intensity of wilt disease in tomato plants can be seen in Table 1, below:

Table 1. Intensity of wilt disease in tomato plants

Treatment		Intensity of disease (%)
P1 Control (without powder application and leaf bokashi)		45.00 e
P2	Betel leaf powder	12.50 ab
P3	Clove leaf powder	15.00 c
P4	Cinnamon leaf powder	25.00 d
P5	Betel leaf bokashi	5.00 a
P6	Clove leaf bokashi	10.00 bc
P7	Cinnamon leaf bokashi	22.50 d

Description: Numbers followed by the same letter means not significantly different

Treatment of betel leaf, cloves, and cinnamon, both in powder and bokashi form, suppressed the intensity of *R. solanacearum* attacks on tomato plants. *Piper betle* L. contains antiseptics, antioxidants, insecticides, bactericides, and fungicides (Darwis, 1991). Betel leaf contains essential oils that give the leaves a distinctive smell, the components of which include phenolic compounds and their derivatives. Phenolic can inhibit the growth of bacteria by denaturing bacterial cell proteins, five times that of other phenolic compounds (Rizkita, 2017; Pradhan et al., 2013; Carolia & Noventi, 2016).

Betel leaf is thought to be able to suppress the development of pathogens because it contains active compounds that are anti-bacterial. Betel leaf has a spicy taste because its essential oil contains the active ingredients of phenol betel, hydroxyvasikol, kavikol, cavibetol, eugenol, and diastase (Muhlisah, 1995). Proof to inhibit the growth of pathogens, namely phenols and tannins (Grainge & Ahmed, 1988).

The results showed that the administration of betel leaf extract in the minor concentration (0.5 g in 100 ml of SPA medium) could inhibit the growth of *R. solanacearum*. Betel leaf extract in the medium concentration, the more inhibited bacterial growth (Fachri 1997). According to research by Maharina *et al* (2014), the application of betel leaf extract has the potential to suppress bacterial wilt in tomato plants and the development of *R. solanacearum* in the soil, besides that it also has the potential to increase tomato plant growth and tomato fruit production up to 1301.67 grams per plant. The use of plant extracts to control *R. solanacearum* has also been investigated by Hendra, Firdausil, and Hasanah (1997) using cinnamon leaf extract (*Cinnamomum burmanii*) and betel leaf. In this study, ginger rhizomes were soaked in a solution containing cinnamon or betel leaf extract before planting. The results showed that soaking ginger rhizome in cinnamon leaf extract (30% concentration) for two hours, or soaking betel leaf extract (40% concentration) for two hours was able to suppress the intensity of pathogen attack on ginger.

The results of Tombe, Sukamto, Zulhisnain & Taufiq (1999) research showed that clove leaf and flower powder could be used to control vanilla stem rot disease caused by *Fusarium oxysporum* f. sp. *vanilla*. Anonymous (1993) stated the results of Sri Yuni Hartati's research, that flour and oil from clove flowers and leaves can be used to control *R. solanacearum* derived from ginger, potato and patchouli.

On the other hand, efforts to control soil-borne pathogens are carried out by applying organic matter such as bokashi to the soil. Bokashi from agricultural waste has been known to contain volatile compounds that are toxic to plant pathogens (Romine & Baker 1972, Linderman & Gilbert 1971). Some spice plants such as cloves, cinnamon and betel are known to contain volatile compounds that are toxic to pathogens. So if the plant residue is used as raw material for compost (bokashi) it will have great potential as an organic pesticide to control pathogens. The results of research by Tombe, Kobayashi, Ma'mun, Triantoro & Sukamto (1992) stated that volatile compounds derived from clove leaves with the main component of eugenol were quite toxic to several soil pathogens, including *F. oxysporum*, *Phytophthora capsici*, *R. solani* and *S. rolfsii*.

The ability of cinnamon leaves to suppress the development of pathogenic bacteria is due to the fact that cinnamon leaves have the main component of eugenol, and other components such as cinnamaldehyde, cinnamyl acetate, eugenol acetate, benzaldehyde and major compounds humulene, isokaryophyllene, methyl cinnamate and ethyl cinnamate, anthosinins and essential oils containing sugar, protein, simple fat, pectin (Leung, 1980 in Hermani & Marwati, 1999, Al-Dhubiab, 2012). Ervina et al (2016) stated that the extraction of cinnamon contains the main

antioxidant compounds in the form of polyphenols (tannins, flavonoids) and essential oils of the phenol group. The main content of cinnamon essential oil is cinnamaldehyde and eugenol compounds. Wang et al (2009) stated that the main components of the essential oil contained in the leaves of this plant consisted of transcinnamaldehyde (60.17%), eugenol (17.62%) and coumarin (13.39%). the main compounds are cinnamaldehyde and polyphenols (proanthocyanidins and epi-catechins) (Hasan, 2011; Shan B, *et al*, 2007).
Cinnamon can inhibit the growth of several types of bacteria such as *Campylobacter jejuni*, *Salmonella enteritidis, Escherichia coli, Staphylococcus aureus, Listeria monocytogenes* (Palmer *et al*., 1998), Haemophillus *influenzae, Streptococcus pneumoniae, Streptococcus pyogenes,* and *Staphylococcus aureus* (Inouye *et al*., 2001). Research by Huang and Ho (1998) showed that cinnamon oil was also toxic to insect pests *Tribolium castaneum* and *Sitophilus zeamays*. saponins in cinnamon extract act as stomach poison in *Aedes aegypti*. Saponins can inhibit and kill larvae by damaging cell membranes and acting as stomach poisons (stomach poisoning) (Ishak, 2019).

The ability of clove leaves to suppress the growth of pathogens is thought to be due to the compounds they contain are anti-bacterial. According to Asiman, Rusli & Ma'mun (1999), clove leaves, stems and flowers contain phenolic essential oils. Phenol groups such as eugenol and eugenol acetate compounds contained in clove oil have an active role as anti-microbial. Leaf flour, stalks, flowers, clove oil, eugenol and clove extract can inhibit the growth and even kill several types of fungi and pathogenic bacteria that cause plant diseases *in vitro* (Tombe, Kobayashi, *et al*., 1993). Separation of chemical content from clove leaves showed that clove leaves contain saponins, alkaloids, flavonoid glycosides and tannins. Flavonoids are one type of compound that is toxic / allelopathic, which is a compound of sugar bound to flavones (Fatonah, *et al*., 2013).

Previous studies have reported that eugenol, which is the main component of clove oil, is toxic to several plant pathogens, including *Phytophthora capsici, Phytophthora palmivora, Sclerotium rolfsii, Rigidoporus lignosus, Ralstonia solanacearum* and *Fusarium oxysporum* (Manohara, Wahyuno & Hartatimto, 1994; Hartatimto, 1994). Adhi, Asman & Karyani, 1994; Tombe *et al*., 1992).

The application of betel leaf, clove and cinnamon in the form of leaf powder and bokashi was able to suppress the intensity of bacterial wilt disease in tomato plants. Powder form or bokashi is also able to suppress the intensity of disease in tomatoes. Cinnamon leaf application, although the disease intensity was lower than the control, but over time it was assumed that the intensity of the disease would increase

. Compost made from the leaves has been shown to suppress the development of several types of soil-borne pathogens in various types of plants. Compost in the form of agricultural waste has been known to contain volatile compounds that are toxic to plant pathogens (Romine & Baker, 1972; Linderman & Gilbert, 1971). According to Tombe *et al*. (1992) some spice plants such as cinnamon, cloves, betel, patchouli, nutmeg and jatropha are known to contain volatile compounds that are toxic to pathogens. Therefore, if the plant residue is used as raw material for compost, it has the potential as a vegetable pesticide to control soil-borne pathogens. The application of plants that produce essential oils of patchouli, lemongrass, cinnamon leaves, and clove leaves in the planting medium was able to reduce the amount of propagules/initial inoculum Foc in the soil. Percentage decrease in initial propagule/inoculum *Fusarium oxysporum* f. sp. Cubense causes banana wilt between 50.05-70.62%. (Riska, *et al*., 2011).

Conclusion

Betel leaf, clove and cinnamon in powder or bokashi form can reduce the intensity of wilt disease caused by *R. solanacearum* in tomato plants. Betel leaf bokashi and clove leaf bokashi were more able to suppress the intensity of wilt disease caused by *R. solanacearum* in tomatoes.

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