



Intensity of *Ralstonia solanacearum* bacterial cause wilting disease in several plants in South Kalimantan, Indonesia

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Abstract

Disease that develops and is very detrimental to plants in South Kalimantan is a bacterial wilt disease and has spread in plantations which are superior commodities, with high attack rates. Since 2007 losses due to this disease have increased until mid-2017 losses of up to 80% (severe attack rate). The cause of this disease is the bacterium *Ralstonia solanacearum*, which is found in almost all of Indonesia. This bacterium is the most important limiting factor for the successful production of 33 families or 150 types of plants both cultivated plants and ornamental plants, such as tomatoes, peanuts, ginger, bananas, eggplant, potatoes and tobacco which are dangerous diseases in the subtropics and tropics because this bacterium has many host plants. This study aims to determine the level of attack on several plants that are widely cultivated in South Kalimantan. This level of attack is very important for a comprehensive alternative control. The method used was sampling at each planting location and sampling in the affected areas of the plantations, then identification was carried out. The results showed that there was no difference in the level of attack on crops caused by these bacteria obtained from the South Kalimantan area of Indonesia.

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Introduction

South Kalimantan in the development of the agricultural sector is felt to be very potential, this is supported by the vast land conditions, and sufficient labor available and conducive security conditions. Various policies and strategic steps in accelerating development in this field, the provincial government of South Kalimantan through the Department of Agriculture, Food Crops and Horticulture carries out policies and activities in the framework of Safeguarding Food Security through policies a). Maintaining/increasing the surplus of rice production, b) Increasing the availability of other food (crops and horticulture). Policy in increasing production, productivity, competitiveness and value added of food crops and horticulture products (TPH) by focusing on the development of superior commodities (Rice, Corn, Peanuts, Oranges, Bananas and Rhizomes) with the commodity zoning approach, as well as optimizing the control of disturbing organisms plants (OPT) and anticipation of natural disasters on agricultural land.

In Indonesia wilting caused by bacteria is a disease that is very detrimental to cropping. In general, bacterial wilt caused by *Ralstonia solanacearum* (Yabuuchi *et al.*, 1995) is one of the main obstacles in the production of almost all types of plants both in tropical and temperate climates. It is estimated that there are 50 plant families including Solanaceae, Musaceae, Asteraceae, Fabaceae, including families of forest trees, shrubs and weeds. The cause of the bacterial wilt disease of *R. solanacearum* is known to have a wide geographical distribution and diversity of races (strains) so to control it first needs to know its races, as well as its biovar and host. So far, wilted bacteria are divided into biovar groups (Hartman, Hong, Hanudin & Hayward, 1993) and racial groups, each of which is differentiated based on phenotypic characteristics and host range.

Bacterial wilt caused by bacteria (*Ralstonia solanacearum*) is one of the main diseases and is widespread especially in plants that have economic value such as potatoes, tomatoes, eggplant, peppers,

ginger, chillies, peanuts, bananas and tobacco in tropical and subtropical regions (Hayward 1990; Hayward 1994). Machmud, (1989) that weed species found in peanut fields are also potential hosts for *P. solanacearum* bacteria. The role of weeds as an important source of inoculum, because bacteria that attack weeds sometimes do not show real symptoms. These bacteria have many races and different levels of attack on different plants, as well as in different regions will be found different races are not the same and sometimes have distinctive characteristics (both biology and physiology). This research will aim to look at the level of attack and spread of these bacteria, so that we will get a type of plant that is safe to be cultivated in certain areas, as well as integrated control tactics that will be prepared to prevent this wilt attack. In South Kalimantan the bacterial wilt of *R. solanacearum* is a major limiting factor in the production of Kepok bananas (2007 to present) Yusriadi *et al.*, 2017). But lately it turns out that wilting is not only found in banana plants, but has been found in vegetable and other horticultural crops. This study aims to determine the level of attack on several vegetable and horticultural crops that are widely cultivated in South Kalimantan, carried out an overall alternative control.

Materials and methods

This research was conducted at the Laboratory of Biological Control and Greenhouses, Department of Pests and Plant Diseases, Faculty of Agriculture, Lambung Mangkurat University, as well as taking samples of diseased plants from the district of South Kalimantan, when the research was conducted in January-April 2018. The materials used are NA (Nutrient Agar) media, TZC (2,3,5-triphenyltetrazolium chlorida) and samples of diseased plants from banana plantations and those around vegetable and horticultural crops in South Kalimantan. The tools used in the form of petri dishes, test tubes, erlenmeyers, pipettes, measuring cups, scales, microscopes, autoclaves, ovens, isolation boxes, shakers, cameras, tape, stationery in the field, and other equipment used for experiments in the greenhouse.

Methodology

The method used is the survey method and sampling of plants withered. The research was carried out at the following stages (Djaya, 1994; Fahy & Persley, 1983): (1) Field surveys of several districts that planted bananas, vegetables and horticulture, which were stricken with bacterial wilt, tested for immersion in sterile water to determine the cause, (2) Sampling of plants affected by disease, (3) Isolation and identification of causes (Yusriadi *et al.*, 1998).

Intake of plants withered by this disease is carried out in the largest area of banana planting, namely the Banjar district, as well as in areas of many vegetable growing. Withered sample plants are taken, then cleaned, cut off at the root. Remdam in sterile water, when removing ose in the water, then conclusions can be drawn while the cause is bacteria (Suryadi & Machmud, 2004). Identification is carried out using an approach based on the host's home region and host range. Approach based on plants and host range is done by planting on several test plants. The tested plants are banana plants that have been aged 5 months old, the level of pathogenicity will be obtained from previous tests.

R. solanacearum isolates obtained from bananas with symptomatic bacterial wilt. Stems and roots of plants are washed, then the roots removed by cutting at the base of the stem. Furthermore, the plant material is put into 70% alcohol solution for several minutes, then washed with sterile water 3 times, then dipped in a diluent solution and allowed to stand until the bacterial ooze comes out. After that it was etched on the TZC medium and incubated in an incubator.

Results and discussion

Plants withered, which were caused by these bacteria, were found to be very widespread in South Kalimantan. Wilt disease caused by the bacterium *R. solanacearum* with typical symptoms of sudden wilting in all parts of the plant and in the stem grows adventitious roots. In severe attacks the stems become rotten and runny and the plants die. This bacterial wilt can attack plants anywhere both in the

highlands and lowlands where the soil is inundated, the temperature of the soil is high and the condition of the air is humid. Plants that suffer from wilting disease, if not dead will only produce a little and small, and even if the attack occurs when the plants are flowering or before the plant is not able to bear fruit at all. Damage due to bacterial attack is very detrimental, especially in the affected fruit (Fig. 1).



Fig. 1. A Planting of bananas attacked, B Fruits attacked by wilting bacteria.

These bacteria have many races and different levels of attack on different plants, as well as in different regions will be found different races are not the same and sometimes have distinctive characteristics (both biology and physiology). This research will be directed to describe (character) and the level of attack and the pattern of spread of this bacterium in South Kalimantan, as well as what plants are the host, so that it will get a safe plant species to be cultivated in certain areas (commodity zoning).

R. solanacearum attacks more than 30 family plants including cultivated plants and weeds. Most of these hosts belong to the family Solanaceae, Musaceae,

Asteraceae and Fabaceae (Kelman 1953 in Djaya, 1994). In 1991 it was stated that the withered bacterial host included 44 families (Hayward, 1991) and in 1994 increased to 50 families, some of which were only discovered (Hayward, 1994). Peanut bacterial wilt disease has been widespread in Indonesia (Machmud, 1986), China and certain areas in Uganda, Fiji, Malaysia, Papua New Guinea, the Philippines, South Africa, Thailand, Sri Lanka and America (Hayward, 1990). According to Machmud (1986), that this disease has spread throughout Indonesia, which includes peanut growing areas in North Sumatra, West Sumatra, Lampung, West Java, Central Java, East Java, Bali, and South Sulawesi. This bacterium has a very varied diversity, so that there is a great diversity between one region and another (Horita, & Tsuchiya, 2001; Kumar *et al.*, 2004).

The results of the research Yusriadi *et al.*, (2017) have succeeded in inventorying a number of bacteria that attack banana, ginger and peanut plants from different regions, in banana plants the attack rate has reached 30-100%, peanuts around 20-70% and Ginger/kencur reach 40-100%. Therefore this research is very important, especially to carry out control measures so that it does not provide the opportunity for wider distribution, then potential host plants will be found to be a source of inoculum, which subsequently is not recommended for cultivation, and will be replaced with plants instead of bacteria. Stem-shaped bacteria, 0.5 x 1.5µm, non-sporous, not encapsulated, moving with a single polar, aerobic, gram-negative flagellum feather. The colony on the agar medium is turbid, brownish, small, irregular, smooth, shiny, wet, reddish and milky white, with jagged edges (Buddenhagen, 1986; Aley *et al.*, 1995 Yusriadi *et al.*, 2012) (Fig. 2.).

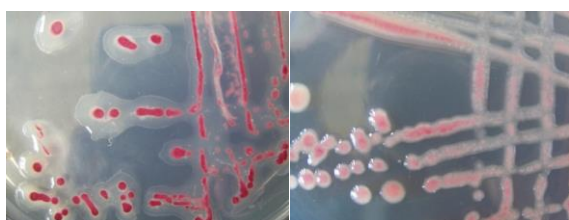


Fig. 2. A Bacterial growth in TZC media, B. Bacterial growth in NA media (Yusriadi Collection, 2017).

The high intensity of this bacterial disease attack on several vegetable and horticultural crops due to *R. solanacearum* is closely related to the abundance of visitor insects (Mairawita *et al.*, 2012). Flower visitor insects suspected as pathogenic vectors of *R. solanacearum* are Diptera (chloropidae, Platyppezidai, Drosophilidae) (Suprijadi, 1997 in Mairawita *et al.*, 2012) and Lepidoptera (Erionata thrax) (Subandiyah *et al.*, 2006 in Mairawita *et al.*, 2012). *Trigona* sp. (Hymenoptera: Apidae), *Polybia* sp. (Hymenoptera: Vispidae) and *Drosophila* sp. (Diptera: Drosophilidae) (Mairawita *et al.*, 2012). The level of resilience of a plant cultivar is not fixed, but is influenced by the virulence and pathogenicity of pathogens that can change rapidly which can kill plant tissues (Suryadi & Rais, 2009). Almost all vegetable and horticultural crops are attacked in several districts in South Kalimantan. The results of the study are as table 1.

Table 1. Some plants used as research samples and original plantations.

Sample Number	Plant	The symptoms	Regency / region	Intensity of disease
1.	Banana	Positive	Banjar	60%
2.	Peanuts	Positive	Banjar	30%
3.	Ginger	Positive	Banjar	30%
4.	Tomato	Positive	Banjar	40%
5.	Eggplant	Positive	Banjar	30%
6.	Chili	Positive	Banjar	30%
7.	Celery	Positive	Banjar	30%
8.	Banana	Positive	Banjarbaru	60%
9.	Peanuts	Positive	Banjarbaru	30%
10.	Ginger	Positive	Banjarbaru	30%
11.	Tomato	Positive	Banjarbaru	30%
12.	Eggplant	Positive	Banjarbaru	30%
13.	Chili	Positive	Banjarbaru	30%
14.	Banana	Positive	Tapin	70%
15.	Peanuts	Positive	Tapin	25%
16.	Ginger	Positive	Tapin	25%
17.	Celery	Positive	Tapin	25%
18.	Banana	Positive	Balangan	70%
19.	Tomato	Positive	Balangan	50%
20.	Eggplant	Positive	Balangan	25%
21.	Chili	Positive	Balangan	25%
22.	Celery	Positive	Balangan	30%
23.	Banana	Positive	Tabalong	70%
24.	Tomato	Positive	Tabalong	40%
25.	Eggplant	Positive	Tabalong	30%
26.	Chili	Positive	Tabalong	25%
27.	Celery	Positive	Tabalong	25%
28.	Banana	Positive	HST	70%
29.	Peanuts	Positive	HST	25%
30.	Tomato	Positive	HST	40%
31.	Eggplant	Positive	HST	20%

Sample Number	Plant	The symptoms	Regency / region	Intensity of disease
32.	Chili	Positive	HST	20%
33.	Celery	Positive	HST	25%
34.	Banana	Positive	HSS	70%
35.	Peanuts	Positive	HSS	30%
36.	Tomato	Positive	HSS	40%
37.	Eggplant	Positive	HSS	25%
38.	Chili	Positive	HSS	25%
39.	Celery	Positive	HSS	25%
40.	Banana	Positive	Tanah Bumbu	70%
41.	Tomato	Positive	Tanah Bumbu	40%
42.	Eggplant	Positive	Tanah Bumbu	25%
43.	Chili	Positive	Tanah Bumbu	25%
44.	Celery	Positive	Tanah Bumbu	25%
45.	Banana	Positive	Batola	70%
46.	Peanuts	Positive	Batola	10%
47.	Tomato	Positive	Batola	10%
48.	Eggplant	Positive	Batola	20%
49.	Chili	Positive	Batola	10%
50.	Banana	Positive	HSU	40%

Criteria :0-25% = Low Attack Rate; 26-50% = Moderate Attack Rate;

51-75% = High attack intensity; 76-100% = Severe attack intensity

The intensity of attacks varies, but on average is under 50% (moderate attack rate) and is not too dangerous and detrimental. The many types of plants that can become hosts, possibly caused by the condition of the surrounding plants, including maintenance and environmental sanitation. The reduction of banana plants which become the main host, so that these bacteria easily attack the surrounding plants (Yusriadi, 2010). The number of vegetable and horticultural plants that are planted close to banana plants that have been attacked first. Extreme environmental conditions that are conducive to bacterial development. *R. solanacearum* is very sensitive to low water levels (drought), high pH (alkaline soils), low temperatures, and low soil fertility. This is likely to cause other types of plants susceptible to this disease in South Kalimantan.

Conclusion

1. Many types of plants host *R. solanacearum* bacteria, especially vegetable plants other than banana plants as the main host, with a moderate attack rate

2. The contributing factor is the reduction in banana plants as the main host

3. Vegetable and horticultural crops are planted on former banana plantations that have bacterial wilt.

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