

HUANGLONGBING (HLB) RAPID DETECTION KIT DISSEMINATION TO BUILD COMMUNITY-BASED EARLY WARNING SYSTEM: CASE STUDY IN KOTO TINGGI, WEST SUMATERA, INDONESIA

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ABSTRACT

Huanglongbing (HLB) is a disease of citrus that can lead to plant death. Most farmers are unaware of the symptoms of HLB from the beginning of plant growth, and normally they suspect the condition as a result of nutrient deficiency. The usual detection of HLB conducted is through expensive and complicated laboratory tests using PCR. A quick detection method is necessary in order to formulate a strategy to solve the HLB outbreak appropriately. The HLB Rapid Detection Kit is an innovation that can identify the presence of HLB easily and inexpensively. Even farmers can do the test by themselves with realtime result. An observation has been done to test the effectiveness of the HLB Rapid Detection Kit in a citrus plantation area at Koto tinggi, Agam district, West Sumatera. The results on productive citrus crops revealed that the number of plants infected by HLB was between 19.22%-41.84% of the citrus population. The use of the HLB Rapid Detection Kit in Koto Tinggi, Agam district, West Sumatera was successful in detecting the level of HLB infections at the citrus plantation. The kit was also able to predict the cause of infection, which was found to be from the use of citrus seedlings that were already infected with HLB. The strategies for restoration of citrus areas infected by HLB are eradicating HLB vectors and replanting citrus plants using certified healthy planting materials. The implementation of the program should be integrated in one area.

Keywords: citrus, HLB, rapid detection kit

1. INTRODUCTION

Citrus is one of the fruits that is a source of vitamin C and popular among consumers everywhere.. However, currently the national citrus supply has not been able to meet domestic needs. Although the production and area of citrus continue to increase, but its productivity has declined, especially in West Sumatera area where in 2016, the productivity was 60.45 kg/Ha, but has decreased to 55.87 kg/Ha in 2017. Another problem is the quality of citrus still does not meet consumers' preferences, and also cannot compete in the global market. Indonesia's citrus trade balance has constantly been on a deficit whereby in 2018 Indonesian citrus exports amounted to 1,220 mton while imports were much higher reaching 85,273 mton.

One of the main causes of the declining productivity and quality of citrus is due to the Huanglongbing (HLB) outbreak. Huanglongbing disease (HLB), also known as CVPD (citrus vein phloem degeneration) is a disease caused by the bacterium *Liberobacter asiaticus*, which causes damage to the phloem vessels in citrus plants. Plants affected by this disease will have photosynthetic translocation disorders. In the initial stages even though the plant has been infected with HLB, it will still show healthy growth. At a later stage, the visible symptoms will

manifest in the form of yellowing or chlorosis, leading to stunted canopy, leaves becoming stiff and slender, small and asymmetrical fruits, with branch and twig dieback, eventually causing the plants to die (Wijaya, 2007; Himawan, *et al.*, 2010; Nurhadi, 2015; Burhansyah, 2014).

HLB disease can infect citrus plants at the seeding phase, because infection can occur through grafting by using buds or cuttings taken from infected mother trees. The spread of the HLB disease can occur through the planting of infected seedlings, even though the seedlings look healthy, because the incubation period is 3-5 months. It is therefore, necessary to strengthen the domestic quarantine system in preventing the spread of HLB from endemic areas to disease free areas (Rustiani *et al.*, 2015; Zamzani & Arsanti 2014; Wijaya 2007). This systemic disease spreads rapidly through a vector, the Asian citrus psyllid known as *Diaphorina citri*. A HLB epidemic can reach, more than 95% within 3-13 years after the first symptoms appear (Wijaya 2007; Nurhadi 2015; Rustiani *et al.*, 2015). It can be said that the HLB epidemic is a threat to the sustainability of citrus farming in Indonesia.

Upon observing initial chlorosis symptoms, farmers are often led to generally suspect that the plants suffer from nutrient deficiency, prompting more intensive fertilization. But what happens within a period of 2-4 years after the initial symptoms appear is that plants fail to develop and produce. Decreased fruit production and quality due to HLB attacks cause farming to be economically unfeasible within 7-10 years after planting (Nurhadi, 2015), compounded with the fact that even citrus fruits produced by HLB-infected plants experience nutrient deficiency and poor quality (Wirawan, *et al.*, 2017). However, because the plants are still in production, farmers object to destroying their citrus plants. Whereas in terms of epidemiology, this condition will increase the availability of inoculum sources in the farm which in turn leads to high risk conditions for citrus plants that are still healthy (Nurhadi, 2015). Misdiagnosis of the disease causes errors in decision making, which in turn leads to ineffective and inefficient management, and ultimately causing greater losses for farmers.

The detection of HLB is usually conducted using expensive and complicated laboratory tests through PCR (Polymerase Chain Reaction) analysis (Wijaya, 2007; Rustiani, 2015). The Indonesian Citrus and Subtropical Fruit Research Institute (ICSFRI) under the Ministry of Agriculture (MoA) has created innovations to detect HLB diseases rapidly. The HLB Rapid Detection Kit is an innovation that can identify the presence of HLB easily and inexpensively. Even farmers can perform the test themselves with realtime results obtained. The HLB Rapid Detection Kit has been disseminated and tests conducted at various citrus centers in Indonesia, including in Koto Tinggi Village, Agam Regency, West Sumatra. Dissemination of this kit is expected to help farmers and the local government detect the possibility of an HLB outbreak rapidly in citrus growing areas, so that strategic steps can be taken immediately to handle the outbreak effectively.

2. METHODOLOGY

This research was carried out in November 2018 in Koto Tinggi Village, Baso District, Agam Regency, West Sumatra. The location was chosen purposively because it's one of the locations of citrus development programs from the government. The selection of respondents was also conducted purposively consisting of 15 respondents who were representatives of three farmer groups. The number of respondents was determined based on the consideration of limited funds and time and the amount was considered to be sufficiently representative.

Primary data collection was done through farmer interviews in groups, commonly called Focus Group Discussions (FGD) regarding the development of the citrus area and current conditions.

While secondary data were obtained from the observations conduct by the research team from ICSFRI of the possibility of HLB outbreak on citrus plants using HLB Rapid Detection Kit.

3. RESULT AND DISCUSSION

Based on information from the FGD results, the citrus area in Koto Tinggi village, Agam district, West Sumatra began to be developed since 2008 which was a government program. From the initial citrus area of 20 hectares, there are only 30% left, while the others are no longer in production and have been replaced by other commodity crops. Based on farmer information, in 2011 citrus plantations produced well with an average productivity reaching 50 kg/tree, and peak production of up to 60-70 kg/tree in 2013-2015, but at the end of 2016 to 2017 production began to decline, plants began displaying symptoms of nutrient deficiency such as leaf chlorosis, shoots and stems turning yellow, abnormally small leaves and erect stems (Figure 1).



Figure 1. Citrus Plants infected by HLB in Kototinggi village, Agam District, West Sumatera

At the end of 2017, the affected plants were not able to recover even though fertilizing was carried out. These conditions positively reflect HLB symptoms, but most of the farmers were not alerted and assumed that their plants were damaged and under developed due to nutrient deficiency or have reached the peak of physiological age. Generally, plants that are not infected with HLB and well cared for can continue producing for more than 20 years (Nurhadi, 2014).

Those affected citrus plants could still produce fruit which were abnormal, low quality, sour, small sized and misshapened which were generally sold for fresh juice consumption at low prices. Therefore, many citrus trees were cut down, and replaced with other commodity crops. However, there were farmers who preferred maintaining their citrus plants as these were grown as polyculture with vegetable commodities such as caisim, cabbage, eggplant, tomatoes, and chillies for additional income.

Based on the information from farmers, pests and citrus plant diseases that were most feared were fruit fly and powdery mildew whose effects were seen directly on the citrus fruits produced, especially fruit damage, such as rotten fruit. Farmers were not yet aware of the symptoms and deadly consequences of HLB disease.

The results of HLB disease testing using the HLB rapid detection kit in the citrus area in the Koto Tinggi, Agam district are presented in Table 1. From \pm 3500 plants originating from citrus plantations in 3 farmer groups, there were 19.22%-41.84% plants positively infected with HLB. Moreover, in one of the farmers' citrus farm, based on initial symptoms which appeared, plants

were 100% infected with HLB. However, the infectious vector *Diaphorina citri* was not found, indicating the possibility that a location of higher altitude could affect the presence of the vector. From the results of this observation, the absence of vectors indicates that the number of citrus plants that have been infected with HLB was because the source of planting materials or the seedlings used were already infected.

Table 1. Test results of the HLB Rapid Detection Kit in Koto Tinggi citrus development area, Agam District, West Sumatera

No.	Farmer Groups	Plant Age	Number of Citrus Plants	Number of Citrus plants infected with HLB	Vector existence	% infected with HLB
1.	Tunas Baru	3 - 8 years	951	243	0	25
2.	Bumi harapan	5 - 8 years	1336	559	0	41,84
3.	Amanah	4 -15 years	1321	254	0	19,22

Data source: ICSFRI (2018)

The advantages of the HLB rapid detection kit are 1) Quick detection process (60-75 minutes) from preparation to interpretation of results, 2) Easy, simple protocols and the application does not require special expertise, 3) Inexpensive, does not require special laboratory facilities and less sophisticated. The HLB rapid detection kit can help control HLB disease in endemic areas where infrastructure, facilities and resources are minimal. Test results can be observed visually by the occurrence of discoloration that can be seen with the naked eye. The advantages of the HLB Rapid Detection Kit compared to other detection methods is presented in Table 2.

Table 2. The advantages of the HLB Rapid Detection Kit compared to the PCR and RT-PCR methods

No.	Parameter	PCR	Kit Detection	RT-PCR	Validation
1.	Affordable	+	+++	-	Respondent
2.	Sensitivity	ND	+++	+++	Genie II
3.	Spesivity	ND	+++	+++	Genie II
4.	User-friendly	-	+++	+	Referensi
5.	Rapid and robust	+	45'	++	Genie II
6.	Economic	+	+++	+	Economy Analysis
	Laboratoium	+++	-	+++	Economy Analysis
	Equipment	+++	+/-	+++	Economy Analysis
7.	Deliverable to end user	-	+++	-	Economy Analysis
8.	False negative	< 10	< 5	< 1	Participant
9.	False positive	< 10	< 5	< 1	Participant

Data source: ICSFRI (2018)

Based on the results of the FGD and the results of observations of the HLB outbreak rate, the following are recommendations that require follow through:

1. It is important to provide farmers with knowledge and understanding of the specific HLB disease – its symptoms and its effects.
2. Strategy to rehabilitate citrus areas that have been infected can be done by eradicating infected plants and replanting with certified healthy citrus seedlings. Handling of HLB and improving plantations must be carried out in one area through an integrated manner.
3. The use of healthy seeds is important to ensure disease free plants. However, currently the number of certified citrus seeds is very limited, so it is necessary to establish seedling institutions at the farm level. The acceleration of technology transfer of disease-free citrus

seedlings to farmer/breeder groups needs to be done to ensure the availability of healthy citrus seeds..

4. At present, ICSFRI is the only institution for citrus research which has the responsibility in producing and distributing disease-free mother trees. In the context of developing citrus agribusiness in Indonesia through the development of citrus areas, and realizing the independence of seeds at the farm level, the ICSFRI can arrange to provide technological assistance to farmers to produce healthy citrus seeds. The seeds produced by farmers can be used to revitalize the citrus farmers' own estate, or can be sold so that it can be an additional income.
5. Optimizing the role of quarantine institutions between regions to prevent the spread of HLB through citrus seedling deployment.
6. The local government should play a role in assisting the procurement of HLB Rapid Detection Kits for farmers and field officers in citrus centers. This would enable the farmers and field officers to detect HLB attacks early, so they can immediately make decisions and execute rapid and accurate actions to minimise the impact of the disease.

4. CONCLUSION

The application of the HLB Rapid Detection Kit in Koto Tinggi, Agam district, West Sumatera was successful in detecting the levels of HLB infection in citrus plantations, and in predicting the cause of the infection which was from the use of citrus seedlings that had already been infected with HLB. Strategic steps could then be immediately determined to overcome the HLB outbreak in the area.

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