Best Practices Intercropping Citrus Controlling Asian Citrus Psyllids (*Diaphorina citri*) in Indonesia

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Abstract. Asian Citrus Pysillid (ACP), *Diaphorina citri* is one of the important pests in Citrus plantation. It as a vector of *Candidatus liberibacter* (CLs), caused Huanglongbing (HLB) diseased in citrus. Citrus is one the primary tropical fruit product in every region in Indonesia including in Java, Sumatera, and Kalimantan. Controlling of ACP in citrus is needed to increasing citrus production in Indonesia. As tropical country, Indonesia farmer has some practices that could be useful for controlling ACP including their intercropping model. The objectives of these research are to observe the best practice of intercropping citrus in Purworejo, Central Java and monitoring population of ACP in certain areas.

The research was conducted in central citrus production of Purworejo District, East Java Province, from July-December 2021. The direct observation was carried out biweekly in plantation from 06.00–10.00 AM, randomly on young leaves of citrus. Additionally, the population also monitored by placing yellow sticky trap on the plant. One side yellow sticky trap are placed in an edge of citrus canopy using 0.5 bamboo stick, which tied with plastic rope. The result showed that citrus inter cropping in Purworejo using several crops, including seasonal and annual plants. Those crops are rice, papaya, bean, cassava, chili, cucurbits, peanuts, and guava. The direct observation and sticky trapping resulted in no ACP was trapping during the periods. This condition reflected that populations of ACPs were low in intercropping plantation. Another way, intercropping gave a direct effect of controlling ACP since population goes lower time by time.

Keywords: best practice · intercropping · ACP · Citrus · Central Java

1 Introduction

Citrus is a major tropical fruit crop in every region in Indonesia. National citrus production is supported by at least five provinces, where the contribution of production in 2015 are North Sumatera (29, 82%), East Java (23, 89%), West Kalimantan (9, 04%), Bali (6,

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64%), and South Kalimantan (6, 56%) and remaining 24, 04% from other provinces [1]. The main disease of Citrus is Huanglongbing (HLB) which is transmitted by The Asian Citrus Pysllid (ACP), *Diaphorina citri* [2, 3]. HLB symptoms in citrus included brown spot on leaves; yellowing leaf sheath, dieback on apex bud, lopsided fruit segments, usually contains fallen seeds, and has an unpleasant taste tends to be bitter, reduced quality and quantity of production, and prematurely fruit drops [4]. HLB Diseases caused by bacterial infection of Candidatus Liberibacter (CLs) on floem which transmitted by ACP [5]. Considering the seriousness of the disease this research is very important to conduct in Indonesia. Currently, it is noted from various reports that ACP is still a major pest on citrus plants in Indonesia, including in Sambas, Kalimantan [6] and other cities.

Diaphorina citri or more often known as ACP (Asian citrus pysillid) is an insect from the order Homoptera [7]. Worldwide, ACP has 58 species of host plants [8] which is dominated by the family Rutaceae, including various types of citrus and jasmine orange. ACP is the main vector of Candidatus Liberibacter bacteria that causes HLB disease in citrus plants. ACP is currently distributed in at least 40 different countries in Asia, Africa, Europe, and America [9, 10]. This indicates that the ACP has become an invasive pest on citrus crops around the world, since its first discovered in the 18th century in India [5, 9].

ACP causes huge losses to citrus farmers through at least two commonly known mechanisms, namely sucking plant fluids, specifically on young leaves and stems in large quantities and becoming vectors of bacteria that cause HLB disease. [3]. Mapping and controlling ACP directly or indirectly will provide input for better citrus crop quality in the future, particularly in Indonesia as a tropical country that has various superior citrus varieties.

According to Wang et al. [9, 11], mapping distribution is essential in mitigating future ACP outbreaks, especially when it comes to local climate and environmental factors. Moreover, Indonesia is an archipelago country that has varied environmental factor. For this reason, surveying based on climatic and environmental conditions is very relevant to be carried out in the context of integrated pest control [12] especially in citrus.

The objectives of this study are to examine natural citrus farmer practices and the population of ACP on their farm based on Yellow Sticky Trapping.

2 Material and Methods

2.1 Sticky Trap Preparation

The yellow Commercials yellow sticky card will be used for the study. The single-sided sticky card (16.5 × 20 cm) will be suspended 1.5 m above ground in the exterior canopy using bamboo stick and ties using plastic through hole in the middle top edge of the card. Test lures will be placed at the center of the card. The sticky cards will be placed weekly for four weeks. Replaced card will be placed in a transparent plastic bag (20 × 20 cm), with put two cards on the nonstick side to prevent stickiness of the two cards. All retrieved traps will be examined under stereomicroscope for counting number of adult ACP cached and tabulated in excel software program (Microsoft Corp. USA).

2.2 Individual ACP and Location Assessment

The collected cards are examined under hand lens or if needed through stereo microscopes immediately since collected. The adults ACP are tabulated for each card and each location. The adults ACP was counted are preserved on to alcohol 70% and labeled based date collection and location. The card collects.

Farm assessment contained information of citrus plantation, location in UTM format, and their intercropping composition. All information is noted dan tabulated for analyzing in number and significance different if any (under 95% significance different).

2.3 Time and Location

The location of trapping and collection are in Purworejo regency, Central Java, in seven different location including district (Bayan dan Grabag). The trapping was conducted during June- December 2021.

3 Results and Discussion

3.1 Farm Intercropping Citrus

Citrus farm examined during this research are mostly intercropped with seasonal crops including bean, cucumber, peanuts and cassava (Fig. 2). Basically location of Purworejo closed to ocean and has climatic condition, temperature 21–33 °C and rainfall 195–15.502 mm (13).according to farmer practices mostly type of citrus farm are intercropping. The seasonal plant are regularly applied various type of pesticides. The pesticides application either direct or indirectly effect to insect abundance (14) including ACP in citrus. Pesticides are most hope for farmer since provides: (1) an increased production of food and fiber trough protection from pathogens, weeds, insects, and nematodes; (2) the prevention of spoilage of harvested and stored foods; and (3) the saving of many millions of human lives by the prevention of certain diseases (15). Those reasons caused came as hopes for farmer, so pesticides are most reliable for them. Otherwise, pesticides also as important component in integrated pest management (16), unfortunately with many considerations in many aspect.

The seasonal plants including crop legumes, vegetable, and Cerealia are most take an pesticides than annual crops as well as citrus. The application of pesticides by farmer, some time an controllable since pest are invested on their farm. In Indonesia this condition are common for almost all seasonal crops (17) other wise depend on pesticides for controlling pest. As affect either direct or indirect ACP population become low in several location of intercropped farm.

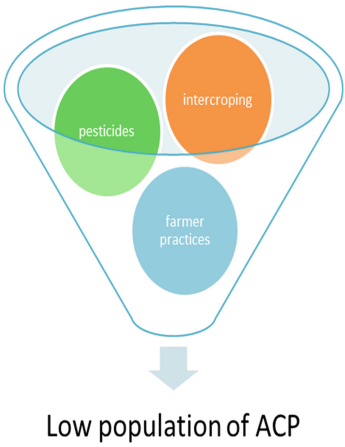

Fig. 1. Possibilities factor caused of low population ACP

No	Location	Number of tresses	Number traps	Intercropping composition
1	7°42'43.1"S 109°56'02.0"E	98	10	Papaya and guava
2	7°42'48.8"S 109°56'00.0"E	100	10	Bean and cucumber
3	7°42'49.0"S 109°56'00.6"E	56	7	Peanuts and cucumber
4	7°42'48.3"S 109°56'02.9"E	7	2	Peanuts
5	7°42'49.5"S 109°56'03.3"E	23	5	Cassava and peanuts
6	7°42'49.9"S 109°56'06.0"E	30	4	Cassava and peanuts
7	7°52'03.9"S	15	4	No artificial planted plants

Fig. 2. Number of citrus trees and intercropping composition on farm

3.2 ACP Abundance

The results of this study showing that ACP population are can not be detected by yellow sticky trap since during study not cached even single ACP. Selected location are high population of ACP in period of early 2000 [13] and trough this study showing very low population since undetected by yellow sticky trap. The analytical reason of this low population in such areas are figure it follow (Fig. 1).

The three possible factors that cause the condition of population decline are pesticides, intercropping and other farmer practices. Pesticides are the main factor that the author believes is the trigger for the decline in the population of almost all types of pests including ACP. This is supported by several important reasons that pesticide are provide possible to increase yields, simplify cropping systems, and forego more complicated

crop protection strategies (19). Intercropping caused input pesticides higher than monoculture of citrus since farmer applied more pesticides to their intercropped commodities especially seasonal plants. Last, other farming practices believed to cause a decrease in pest populations, including sanitation, and over-cultivating land. Other things need further assessment to get evidence of the effect on the decline in ACP population including planting various types of plants for land boundaries.

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Authors' Contributions. Haris Setyaningrum responsible for carrying field research and preparing manuscript. Edhi Martono guided for field research and reviewing manuscript. Alan Soffan prepared and reviewing all data scientific during manuscript preparation. Jianhua Mo provided funding trough ACIAR project and reviewing manuscript.

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