Control strategy of citrus greening based on the vector population density

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Abstract

For the contribution of the establishment of the management of citrus greening, we performed ecological and ethological studies on the vector psyllid, Diaphorina citri Kuwayama, in three provinces located in southern Vietnam: Tien Giang (TG), Ben Tre (BT) and Vinh Long (VL). Although the population density of this pest was different both between provinces, its seasonal changes showed similar trends between locations. In BT, the population density was likely to be lower in the other provinces, and in all provinces the population density was lower in November to December than in the other months. The collection of psyllids by yellow sticky traps indicated that this insect flied more frequently at heights around 1.3 m above the ground surface. The peak of the catch of psyllids by the trap nearly corresponded to that of the population density, indicating that this insect increased most from the end of dry season to the beginning of rainy season and moved according to the increase of the population. Taking into consideration the results of our studies, we propose a possible control strategy of the psyllid for the management of citrus greening.

Introduction

Citrus greening (CG) is a serious disease which often causes significant loss of fruit yield of citrus in southern Vietnam. The pathogen is transmitted by the citrus psyllid (Diaphorina citri) in Asian countries (Capoor et al., 1967; Aubert, 1984, 1987). Huynh et al. (1995) pointed out the wide spread of this disease by the abundance of the psyllid in the area as well as the use of pre-infected seedlings produced by marcotting from infected mother trees. Therefore, both the use of disease-free seedling (Su and Chen 1991) and the control of the vector are primary components for the establishment of the management of this disease. This means that the understanding of the population dynamics of the vector is indispensable for this problem.

Unfortunately, there are relatively few reports on the psyllid in southern Vietnam. Thus, we attempted to perform ecological and ethological studies on this insect in the following provinces located in southern Vietnam: TG, BT and VL. Based on the results of our studies, we propose the control strategy of the psyllid for the establishment of citrus greening problem in southern Vietnam.
Seasonal change in the population density of the psyllid

We counted the number of psyllids on 30 king mandarin trees, *Citrus nobilis*, in Tan Phu Tay, BT, monthly in 2009 to estimated the population density in this area. Psyllids were likely to increase from May to September, and decrease in October to February (Fig. 1).

![Graph showing psyllid and young shoot population over months](image)

**Fig. 1.** The psyllid population and the number of the young shoots at the demonstration in Tan Phu Tay village, Mo Cay district, Ben Tre province in 2009.

The psyllid population in Hoa Hiep, VL, was increased from April to September, and kept lower thereafter until the next increase. The population density was correlated with the number of new shoots, except for February and December (Fig. 2). Densities in Hoa Hiep were lower than in Loan My, VL, located about 10 km south-west to Hoa Hiep (Fig. 2).

Similar seasonal change in the population of the psyllid density was observed in My Luong, TG, in 2009 (Fig. 3). Psyllids in My Duc Tay, TG, started to increase earlier in 2009 than in the other locations. The highest population density was attained in April and the lowest one in November (Fig. 3). The distance between these two locations was about 15km.

![Graph showing psyllid and young shoot population over months](image)

**Fig. 2.** The number of psyllids and young shoots counted on 30 king mandarin trees in Hoa Hiep (left) and Loan My (right), Vinh Long, in 2009.
Fig. 3. The psyllid population and the number of the young shoots at the demonstration in My Luong (a) and My Duc Tay (b), Tien Giang province in 2009

**Studies of the psyllid population by yellow stick traps**

Psyllids were collected by 36 yellow sticky traps settled in an orchard of king mandarin located in My Duc Tay, TG, monthly from November 2006 to October 2007. Results showed that the numbers of psyllids trapped were seasonally changed, higher in February to June and lower thereafter (Fig. 4). The trends in the trap catch were more similar to the change in the population in the same location than that in the other locations.

Fig. 4. The psyllid population was recorded in two methods of monitoring at the demonstration in My Duc Tay, Tien Giang province.

**Discussion**

Studies of the psyllid population in five locations in three provinces of southern Vietnam showed that psyllids generally increased from March to August and decreased in other months, although there were some small differences in the periods between locations. The former months correspond to the end of the dry season to the beginning of the wet season in this region. Thus, it can be expected that the increase of the psyllid population would be triggered by the transition of the climate. In this scenario, since the pathogen of this disease is transmitted by the psyllid which moves more likely when the population density is increased (Halbert and Manjunath 2004), the risk of the spread of this disease is increased also in the season when psyllids are more. The correspondence of the results of the trap study with those of the population
density supports this possibility. It also suggests that if the timing of the insecticide application for the control of the psyllid would be determined in accordance with the change of the climate, either the overuse or underuse of insecticides would be less occurred.

The results of our studies also suggest the importance of the timing of planting. Traditionally, planting of citrus seedlings has been recommended to perform in May to July, when sufficient precipitation can be expected for the subsequent growth of the seedling. The planting season was determined mainly by the physiological conditions of the citrus and climatic conditions. However, this season corresponds to that when the psyllid increases and the risk of the disease spread would be higher. In turn, if seedlings are planted in other seasons, especially when the psyllid population decreases in October to December, the infection risk would be effectively lowered. Therefore, the control strategy of the psyllid for the management of citrus greening should be considered on the population density of the psyllid: more intensively from the end of the dry season to the beginning of the wet season and less intensively in the other seasons in southern Vietnam.

References
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