

INVESTIGATION OF PEST SPECIES AND POPULATION DYNAMICS OF THE ORIENTAL FRUIT FLY, *BACTROCERA DORSALIS* (HENDEL, 1912), IN THE WATER APPLE GARDENS IN DIFFERENT SEASONS, CAOLANH CITY, DONGTHAP PROVINCE

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Abstract - Twenty-six species of insect pests belonging to thirteen families, eight orders were identified after the surveys in some gardens of the water apple (*Syzygium samarangense*) in Hoa An Commune of Caolan city, Dongthap province, Southern Vietnam. Some species of the pests, e.g., *Aleuroclava aucubae*, *Trialeurodes lauri*, *Trichopsocus clarus*, are new recorded in Vietnam. The oriental fruit fly *Bactrocera dorsalis* is one of the major pest species devastating the water apple. Rainfall is a factor comprehensively influencing the population fluctuation of the oriental fruit fly. The pest population was exploded in the dry season, but reduced remarkably in the rainy season. The fruiting period from February to April was regarded as another major factor influencing the oriental fruit fly population in that area. The results provide scientific data for establishing practical management strategy for the fly under the particular geographical and climatic conditions, especially for the oriental fruit fly *Bactrocera dorsalis*.

Key words - Insect pests; water apple, *Syzygium samarangense*; *Bactrocera dorsalis*; population

1. Introduction

The water apple (*Syzygium samarangense*) Merr. (Myrtaceae) is widely grown for its fruits throughout Southeast Asia, India, Samoa, Sri Lanka and Taiwan. The fruit name is commonly known as wax apple, wax jambu, water apple, rose apple or Java apple. In Vietnam, the fruit is called “Roi” or “Man” and one of the main fruits. Five varieties of the fruit trees are widely cultivated in Dongthap province, southern Vietnam including Xanh Duong, Hong Dao Da, Sua, An Phuoc, Hoa An and Indian. Among them, a variety of delicious water apple called “Hoa An water apple” or “Man Hoa An” is only cultivated in Hoa An Commune, Caolan city, Dongthap province, Southern Vietnam. The fruit variety is pear-shaped, often juicy, with a subtle sour-sweet taste, and used to be considered as a special fruit of the local community.

The water apple is often attacked by pest insects, especially the wasp *Anselmella malacia* and oriental fruit fly *Bactrocera dorsalis* [1]. Only some publications have described the insect pests on the trees of *Syzygium* species [1], [2]. In another study, a destructive disease of *Syzygium samarangense* in Thailand caused by a new fungal species was reported [3]. Among insect pests, the oriental fruit fly *Bactrocera dorsalis* Hendel (Diptera: Tephritidae: Dacinae) causes serious damage to tropical and subtropical fruits. The popular host plant species of *Bactrocera dorsalis* include mango, pear, plum, peach, guava, lichee, orange, longan, rambutan, grape, watermelon, capsicum, tomato, etc. [4],

[5]. However, the development of the pest inside the fruit of *Syzygium samarangense* and population fluctuations of the fly in the fruit plant gardens were still lacking.

Because of the damage caused by insect pests, the plantation area of Hoa An variety has been narrowed. Our survey showed that only nearly three hectares are still cultivated with the variety in the Hoa An Commune, although other water apple varieties are widely cultivated. Therefore, the aim of this study is to investigate the insect pests of the water apple in Hoa An Commune. We also provided the population dynamic pattern of the oriental fruit fly *Bactrocera dorsalis* in a water apple garden in the study site. The determination of the pests on the water apple provides valuable information to reduce the damage of insect pests on the ongoing restoration of the variety.

2. Materials and methods

2.1. Collection of insect pests

Insect samples were collected from some gardens in Hoa An Commune, Caolan city, Dongthap province, where the water apple variety named Hoa An is planted. The trees are mainly grown more than 50 years old in the gardens. The average area of each garden is 500-1000 m². Samples were mainly collected by sweep nets, test tube, and by hand from March 2020 to March 2021. Most samples were measured, taken photos and classified. Some others were stored in 70% ethanol (except butterflies and mealybugs). The collection and investigation were conducted every ten-day period. Obtained samples were transported to the laboratory for analysis and classification.

The abundance (C%) of an insect pest species (a) was calculated by the following equation:

$$C(\%) = \frac{a}{b} \times 100$$

In which, a is the number species a was found on trees in a site, and b is the total number of the investigated sites.

A digital camera (Sony DSC W-800 20.1 Mp) and a stereo microscope Meiji Techno DK3000 (Japan) equipped with a Lumenera INFINITY1-3C camera (Canada) were used to take photographs to identify and classify collected insect pests. The measurement of specimens and image processing was performed using scale ruler software (Lumenera INFINITY1 - 3C, Canada). The classification of insect species was based on the morphological characteristics compared to the classification keys according to several previous studies [6], [7], [8], [9], [10], [11], [12].

2.2. Population fluctuation of the oriental fruit fly *Bactrocera dorsalis*

Adults of *Bactrocera dorsalis* were trapped and collected using intercept traps (Hai Lua Vang Agrobio Joint Stock Company, Vietnam) (Figure 1). The trap was made from plastic (22 cm in height), a roof cover (28 cm in diameter), a collection tray (18 cm in diameter). Three traps were equidistantly placed in a water apple garden in Hoa An Commune. The garden was quadrilateral (100×300 m; 10°28'26"N, 105°36'32"E).

A solution used to lure adults of *Bactrocera dorsalis* was also made by Hai Lua Vang Agrobio Joint Stock Company. The solution containing components was extracted from several kinds of fruits which only lure some species of genus *Bactrocera*. The solution can attract both males and females from a long distance of 70-100 m. The solution was mixed with an insecticide trade named Dr.

Jean 800EC. The pesticide Dr. Jean 800EC component consisted of 700 g/L methyl eugenol and 100 g/L propoxur. 20 mL the mixture of the insect attraction solution and the insecticide (5:1, v/v) was added into the collection tray, and 100 mL tap water was added into the container. Each trap was hung on a water apple tree about 2.0 m above land surface. Water in the container gradually leaked to the collection tray. Water was added whenever it was dried. The pesticide was added into the tray every two-week period. The adults of *Bactrocera dorsalis* died on the collection tray after sucking the media. Three intercept traps were used in a garden of the water apple. Samples of dead *Bactrocera dorsalis* were collected every 3-day period to enumerate the adults of *Bactrocera dorsalis*. Weather conditions during the experiment were provided by the Center of Meteorological and Hydrological Administration, Dongthap.

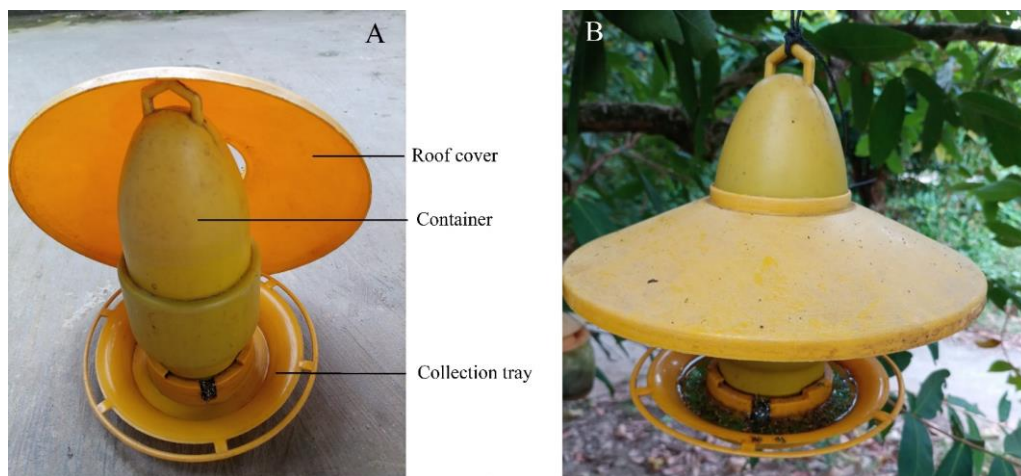


Figure 1. (A) parts of an intercept trap and (B) the trap hung on the water apple tree used to attract *Bactrocera dorsalis*

3. Results and discussion

3.1. Insect species on the water apple *Syzygium samarangense*

Twenty-six species of insect pests were identified after the surveys in gardens of the water apple *Syzygium samarangense* in Hoa An Commune. The insect pests belonged to thirteen families of eight orders: Coleoptera, Diptera, Homoptera, Hemiptera, Hymenoptera, Lepidoptera, Psocoptera and Thysanoptera. The types of insect pests varied, depending on the plant parts being attacked, e.g., tree-trunk, stems, branches, leaves, flowers and fruits (Table 1). *Bactrocera dorsalis*, *Ceroplastes floridensis*, *Ceroplastes stellifer*, *Vinsonia stellifera*, *Trialeurodes lauri*, *Parabemisia myricae*, *Anselmella malacia*, *Orgyia postica*, *Trichopsocus clarus*, *Scirtothrips dorsalis* and *Frankliniella fusca* were more abundant than other pests, with more than 50% found. The figures of insect species which are abundant and first recorded in Vietnam are shown in Figure 2. Among the pest, *Anselmella malacia* and *Bactrocera dorsalis* cause the most serious damage to the fruit of water apple. This pest develops inside the fruit, so it is not affected by insecticides. The protection of the fruits with garden net bags does not effectively prevent the devastation of *Anselmella malacia*. However, some species

rarely found on the fruit trees.

Some species, e.g., *Aleuroclava aucubae*, *Trialeurodes lauri*, *Trichopsocus clarus*, were first found in Vietnam. *Aleuroclava aucubae* is native to Japan and recently was recorded in Hungary [13]. *Aleuroclava aucubae* distributes in Mediterranean and the Black Sea Coast of Russian Caucasus, Sochi National Park, is found to form dense colonies of ultimolarvae (pseudopupae) on leaves of *Ficus carica* and *Ulmus glabra* [14]. *Trialeurodes lauri* is found in some countries in Europe in Africa was first described by Malumphy et al. [15]. *Trichopsocus clarus* was reported to distribute in some countries in Europe, Australia and New Zealand [16].

In our previous study, five insect species recorded from six varieties of the cultivated *Syzygium samarangense* in Caolanh city, Dongthap province [1]. However, the variety Hoa An is only cultivated in Hoa An Commune, although it was used to cultivated widely because of devastation by insect pests. For determination of pests on *Syzygium* species, Juniper and Britton [2] recorded forty-one insect species reared from the fruit of cultivated and wild *Syzygium paniculatum* and *Syzygium australe* (Myrtaceae). This study provides more information on the pests of the water apple.

Table 1. Insect pests on collected from water apple gardens in Hoa An Commune

	Order	Families	Species	Affected parts	Abundance
1	Coleoptera	Byturidae	<i>Byturus tomentosus</i> De Geer, 1774	Fruit	++
2	Diptera	Attelabidae	<i>Bactrocera dorsalis</i> (Hendel, 1912)	Fruit	+++
3	Homoptera	Coccidae	<i>Ceroplastes ceriferus</i> (Fabricius, 1798)	Three-trunk	++
4			<i>Ceroplastes floridensis</i> (Comstock, 1881)	Three-trunk, leaves	+++
5			<i>Ceroplastes stellifer</i> (Westwood, 1871)	Leaves	+++
6			<i>Vinsonia stellifera</i> (Westwood, 1871)	Leaves	+++
7			<i>Chloropulvinaria aurantii</i> Cockerell, 1896	Leaves	+
8			<i>Parasaissetia nigra</i> (Nietner, 1861)	Leaves	+
9			Pseudococcidae	<i>Pseudococcus crytus</i> Hempel, 1918	Leaves
10		Hemiptera	Aleyrodidae	<i>Aleyrodes</i> sp.	Leaves
11	<i>Aleuroclava aucubae</i> (Kuwana, 1911)*			Leaves	+
12	<i>Aleuroclava</i> sp.			Leaves	+
13	<i>Trialeurodes lauri</i> (Signoret, 1882)*			Leaves	+++
14	<i>Parabemisia myricae</i> (Kuwana, 1927)			Leaves	+++
15	Aphididae		<i>Aphis gossypii</i> Glover, 1877	Leaves	++
16	Monophlebidae	<i>Icerya seychellarum</i> (Westwood, 1855)	Three-trunk	+	
17	Hymenoptera	Eulophidae	<i>Anselmella malacia</i> Xiao & Huang, 2006	Fruit	+++
18	Lepidoptera	Erebidae	<i>Orvasca subnotata</i> Walker, 1865	Flower, fruit	++
19			<i>Orgyia postica</i> (Walker, 1855)	Leaves, flower, fruit	+++
20		Tortricidae	<i>Epiphyas postvittana</i> (Walker, 1863)	Fruit	++
21			<i>Cydia</i> sp.	Fruit	++
22	Psocoptera	Trichopsocidae	<i>Trichopsocus clarus</i> (Banks, 1908)*	Leaves	+++
23	Thysanoptera	Phlaeothripidae	<i>Gynaikothrips ficorum</i> (Marchal 1908)	Leaves	++
24			<i>Haplothrips leucanthemi</i> (Schrank, 1781)	Leaves	++
25		Thripidae	<i>Scirtothrips dorsalis</i> Hood, 1919	Young leaves, flower	+++
26			<i>Frankliniella fusca</i> (Hinds, 1902)	Flower	+++

(+): not abundant (< 25%); (++): quite abundant (25 - 50%); (+++): very abundant (>50%).

(*): Species first recorded in Vietnam.

3.2. Population fluctuation of oriental fruit fly *Bactrocera dorsalis*

Bactrocera dorsalis is one of the major pest species of a broad host range of cultivated and wild fruits [17]. We observed that the females lay eggs under the skin of water apple fruits in pre-ripening stage, about 30 days after anthesis (Figure 3). Moreover, the eggs are laid in ripened and ripening fruits. Mature larvae detach from the fruits, fall on the ground and develop to pupate in the soil until sexual maturation [18]. The survey of the population fluctuation of the oriental fruit fly provides information which can be applied to trap the pest.

The fruit fly was present all year round, enumerated and shown in Figure 3. The highest sample was recorded in 3 months in 2020: March, April, May, and 3 months in 2021: January, February and March. During these times, from more than 11.000 to nearly 15.600 adults of the fruit fly were collected from each trap a month. The lowest numbers of *Bactrocera dorsalis* were recorded from August to November 2020, with 3852 ± 498 corpses on the collection tray in the trap in November 2020. The trees of *Syzygium samarangense* produce flowers and fruits through the year, but three main harvest times are from February to April, August and November-December. The population explosion of the pest coincided with the ripening and harvest stage from February to April.

The results showed that rainfall was the major factor to

influence the population fluctuation of adult *Bactrocera dorsalis*. The appearance of the adult *Bactrocera dorsalis* was more frequent in the dry season and less frequent in the rainy season (Figure 4A). Monthly rainfall amounts were higher than 150 mm in the time of July–October 2020, but not over 12.0 mm from January to April 2021. There was no rain in March, 2020. The previous reports also showed that rainfall comprehensively influences the occurrence of the oriental fruit fly *Bactrocera dorsalis* [4], [5]. Appropriate rainfall provides favorable conditions of the soil moist for adults to hatch from the pupae. However, superabundant precipitations cause too high soil humidity, negatively impacting the pupating and emerging the fly. In a previous report, rainfall less than 50 mm or more than 200 mm suppressed population growth of the fruit fly, while the pest population increased when rainfall ranged from 100 mm to 200 mm [4]. In this study, the population explosion occurred at the low rainfall condition, even no rainfall in March 2020. The soil moist was probably still suitable for the pest development because farmers watered the plants in their orchards and gardens.

However, temperatures did not apparently influence the appearance of the adult *Bactrocera dorsalis* in this study. The temperature fluctuations were not much at the investigated site, ranged from 25.0 to 30.4°C on average (Figure 4B). This temperature ranges are suitable for development and reproduction of *Bactrocera dorsalis* according to previous studies [4], [5], [19], [20].

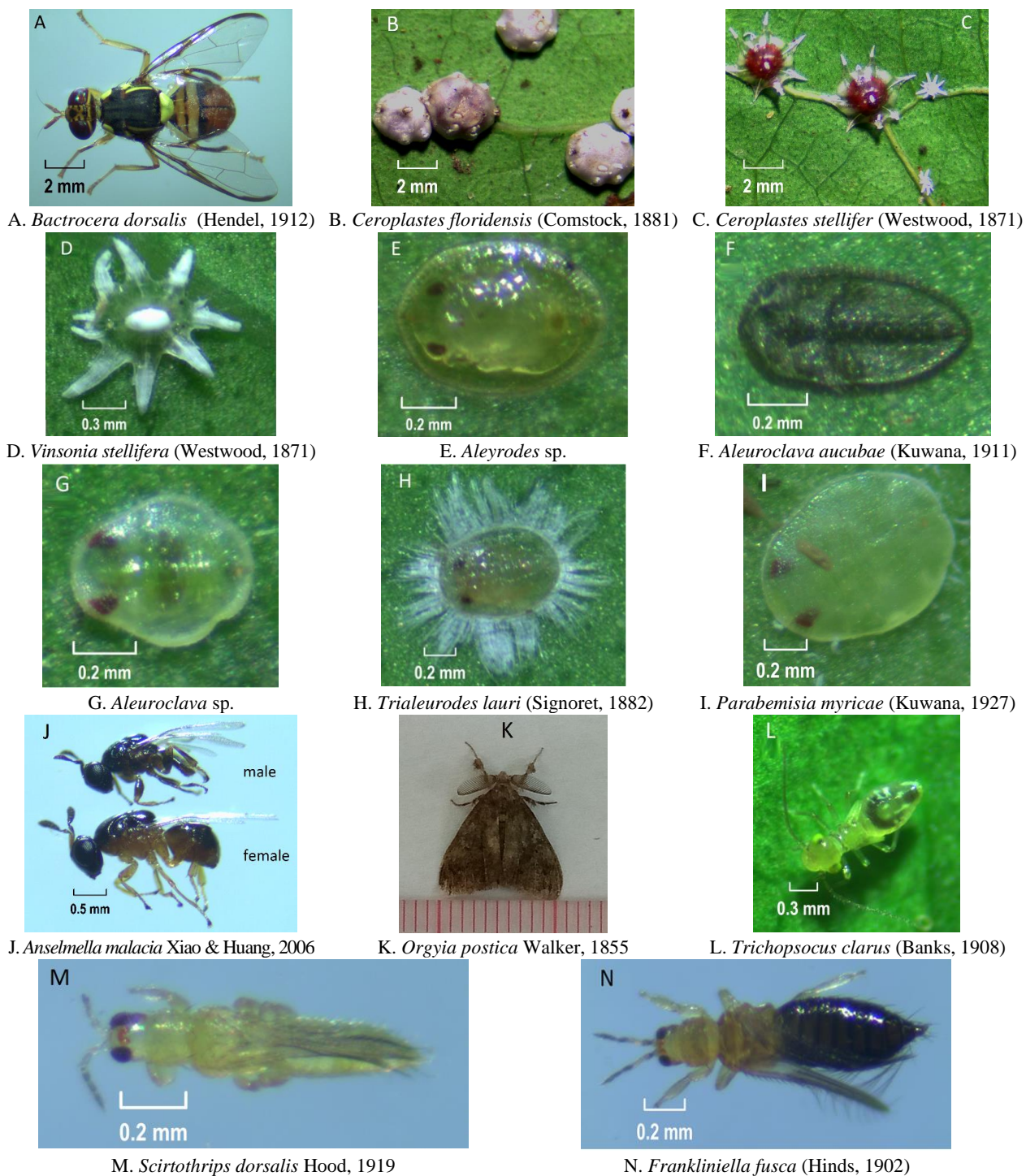


Figure 2. Some abundant species found on water apple (*Syzygium samarangense*) trees or first recorded in Vietnam



Figure 3. (A) *Bactrocera dorsalis* laying eggs and (B) its eggs inside the fruit of *Syzygium samarangense*

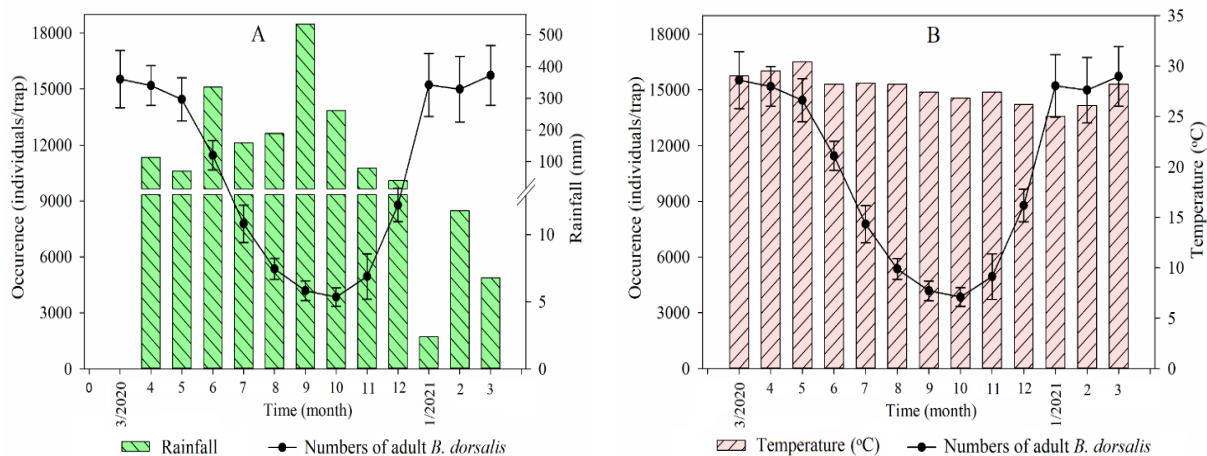


Figure 4. Fluctuations of *Bactrocera dorsalis* fly captured by intercept traps in a water apple garden in relationship with the (A) average monthly rainfall and (B) temperature

4. Conclusion

Twenty-six species of insect pests were found in gardens cultivated with the water apple *Syzygium samarangense*, variety Hoa An in the Caolanh city, Dongthap province, southern Vietnam. Three species of the pests were really first found in Vietnam. Most pests devastated fruits and leaves. Rainfall was major factors comprehensively influencing the population fluctuation. The oriental fruit fly *Bactrocera dorsalis* was one of the major pest species devastating the fruit of *Syzygium samarangense*, and was present all year round. From more than 11.000 to nearly 15.600 samples on averages were collected from each trap/month in the dry season. Meanwhile, the population density of the pest was reduced in the rainy season. This study provides information of insect pests and the population dynamic pattern of *Bactrocera dorsalis* in the area cultivated with the water apple.

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