

SEASONAL POPULATION DYNAMICS OF THE ORIENTAL FRUIT FLY, *Bactrocera dorsalis* (Hendel), IN MANGO ORCHARDS, CAO LANH CITY, DONG THAP PROVINCE

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Abstract

*This report presents observational results of seasonal variations for nearly one year of the oriental fruit fly, *Bactrocera dorsalis* (Diptera: Tephritidae), collected using Malaise trap in mango orchards in Cao Lanh city, Dong Thap Province and the seasonal fluctuations of the pest were analyzed. A Malaise-trap was set in the mango orchard from June 2018 through April 2019 in Cao Lanh city, Dong Thap Province to investigate the occurrence of *Bactrocera dorsalis*. In the study, the total 1,335 specimens collected from a Malaise trap were shown that a strong dominance of *Bactrocera dorsalis* over the two other fruit fly species, being *Bactrocera cucurbitae* and *Bactrocera zonata* was recorded. The species oriental fruit fly, *Bactrocera dorsalis*, frequently appeared in mango orchards, with low numbers from July 2018 the February of the next year. The number of adult fruit flies markedly increased from mid-March to mid-June. Meanwhile, the number of adults entering traps peaked in mid-June 2018 and early April 2019, depending on the development cycle of mango trees. After that time, the density of fruit fly significantly reduced from early August to December.*

Keywords: Dong Thap, fruit fly, Malaise trap, mango, seasonal variations.

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BIẾN ĐỘNG THEO MÙA CỦA RUỒI ĐỤC QUẢ PHƯƠNG ĐÔNG, *Bactrocera dorsalis* (Hendel), TRONG VƯỜN XOÀI Ở THÀNH PHỐ CAO LÃNH, TỈNH ĐỒNG THÁP

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Tóm tắt

Bài báo đề cập đến kết quả theo dõi biến động theo mùa trong gần một năm của ruồi đục quả phương đông, *Bactrocera dorsalis* (Diptera: Tephritidae) thu được bằng bẫy màn treo (Malaise trap) trong vườn xoài tại thành phố Cao Lãnh, tỉnh Đồng Tháp. Trưởng thành ruồi đục quả được thu từ bẫy màn treo trong thời gian từ tháng 6 - 2018 đến tháng 4 - 2019. Phân tích 1.335 mẫu ruồi trưởng thành thu được cho thấy số lượng trưởng thành ruồi đục quả vào bẫy màn treo trong vườn xoài thay đổi theo thời gian, trong đó loài ruồi đục quả *B. dorsalis* chiếm ưu thế, lớn ít hơn so với hai loài ruồi đục quả khác là *B. cucurbitae* và *B. zonata*. Ruồi đục quả phương đông *B. dorsalis* gần như xuất hiện thường xuyên trong các vườn xoài, với số lượng thấp từ tháng 7 - 2018 đến tháng hai năm sau, ruồi trưởng thành có số lượng tăng rõ rệt từ giữa tháng ba đến giữa tháng sáu. Số lượng ruồi trưởng thành *B. dorsalis* vào bẫy đạt đỉnh cao vào giữa tháng 6 - 2018 và đầu tháng 4 - 2019 phụ thuộc vào thời gian sinh trưởng của cây xoài. Sau đó, quần thể ruồi đục quả giảm đi rõ rệt từ đầu tháng tám đến tháng mười hai.

Từ khóa: Đồng Tháp, ruồi đục quả, bẫy màn treo, xoài, biến động theo mùa.

1. Introduction

Over 4,000 species of fruit flies (Diptera: Tephritidae) are known in the world. Approximately 500 of them show an economic importance and are associated with fruits and vegetables (Doorenweerd *et al.*, 2018). The oriental fruit fly, *Bactrocera dorsalis* (Hendel), is a polyphagous and destructive pest of fruit in areas whenever it occurs. The pest is native to large parts of tropical Asian countries and has become established over most of sub-Saharan Africa (Zida *et al.*, 2019). Fruit flies cause severe losses (more than 30%) to horticultural production worldwide (Ye and Liu, 2005). In Sudan, nearly 40 fruit fly species were recorded; the most serious ones are those attacking mangoes (*Mangifera indica*), guava (*Psidium guajava*) and *Citrus* spp. (Hasyimab *et al.*, 2008).

In Vietnam, Le Duc Khanh *et al.* (2010) reported that only two *Bactrocera* species, viz. *B. dorsalis* and *B. correcta*, infested on mango fruits. The study by Nguyen Thi Oanh *et al.* (2019) showed that *B. dorsalis* devastates *Syzygium samarangense* Merr. and Perry. in Dong Thap Province, including rose apples called Xanh Duong, Hong Dao Da, Sua, An Phuoc, Hoa An, Indian by native people. In the Mekong Delta, including Dong Thap Province, mango is an important fruit and severely damaged by *Bactrocera* species. Adults of *B. dorsalis* usually lay eggs in mango fruits, and larvae grow in inside fruits. The investigation of the dynamics of pest adults of the species provides valuable data to reduce the damages. However, the seasonal population dynamics of *B. dorsalis* on Mango trees have not been studied yet.

This study aims to investigate the fluctuation of fruit fly adults by numerating them in a Malaise trap

set in a mango fruit orchard in Cao Lanh city, Dong Thap Province, South Vietnam. The insect abundance was estimated from occupancy data collected from a Malaise trap.

2. Materials and methods

2.1. Collection site

This study was carried out in mango orchards in Hoa An commune, Cao Lanh city, Dong Thap Province during the consecutive period, from early June 2018 to April 2019. Dong Thap is one of Provinces located in the Mekong Delta, southern Vietnam, and characterized by monthly rainfall on average. Weather conditions during experiment were provided by Center of Meteorological and Hydrological Administration, Dong Thap. In the rainy season, the monthly rainfall was 120-260 mm on average, and in the dry season with monthly rainfall was less than 3.0 mm on average during the study period of 2018-2019. Average temperatures ranged from 23.2 to 33.8°C, average humidity (RH) was from 78 to 85%. It was dry and hot from November to April, gets wet and warm from May to October. The highest rainfall was from June to August in the studying time.

2.2. Collecting method

To collect fruit flies, we used one Malaise trap set up in the center of a mango orchard (> 10.000 m²) for trapping fruit fly adults (Fig. 1). The Malaise trap was a stationary intercept-type, which captures a large diversity of flying insects, including fruit flies. Therefore, the Malaise trap was used to ascertain the fruit fly occurrence in fruit orchards and, being a 'flight intercept' trap particularly good at catching species of flying insect.



Figure 1. Malaise trap used to capture insects in Hoa An mango orchard

The Malaise trap was erected in orchards to a natural insect flight line. Flying pests were collected from the trap at 10-day period. The principle activity of traps is based on light orientation and behavior of insects to collect adult insects.

2.3. Sample analysis

Specimens retrieved from the trap were preserved in 96% ethanol and stored in laboratory condition temperature. Collected specimens were dried and pointed or/and pinned. Fruit fly adults were identified by using the Australian Handbook for the Identification of Fruit Flies (Version 3.1).

A Sony® DSC-WX500 digital camera attached to an Olympus®SZ61 binocular microscope at IEBR and processed with Adobe Photoshop CS5 to adjust the size and background was used to photograph specimens. Occupancy and abundance of species were numerated by recording whether any individuals of the species were present or absent.

3. Results and discussion

Total 1,335 specimens from the mango orchard in Cao Lanh city, Dong Thap Province were collected, in

which three species were identified, namely *Bactrocera dorsalis*, *Bactrocera cucurbitae*, *Bactrocera zonata* and *Bactrocera* sp. (Fig. 2). One species was not unidentified. Of the total 1,335 specimens collected from a Malaise trap, 1,295 individuals belonged to *B. dorsalis* (97.0%); *B. cucurbitae* was 26 adults (1.9%), and *B. zonata* represented by 8 individuals of (0.6%). The unidentified species was 6 individuals (0.5%) (Fig. 2). Of the total of 1,295 captured individuals of *B. dorsalis*, 1,224 individuals were trapped in the rainy season (from early June to late July), and 71 individuals were captured in the dry season (from early January to early April).

According to Le Duc Khanh *et al.* (2010), in Vietnam, *B. dorsalis* was recorded as a pest infested on 23 species of fruit trees, including mango tree, and another fruit fly named *B. correcta* was also recorded on mango fruit. In our study, the Malaise trap was set up in a mango monoculture orchard, and *B. cucurbitae* and *B. zonata* were trapped, which were proved to be pests of mango. However, *B. cucurbitae* and *B. zonata* were not mentioned as the pests of mango fruits in Le Duc Khanh *et al.* (2010) somehow.

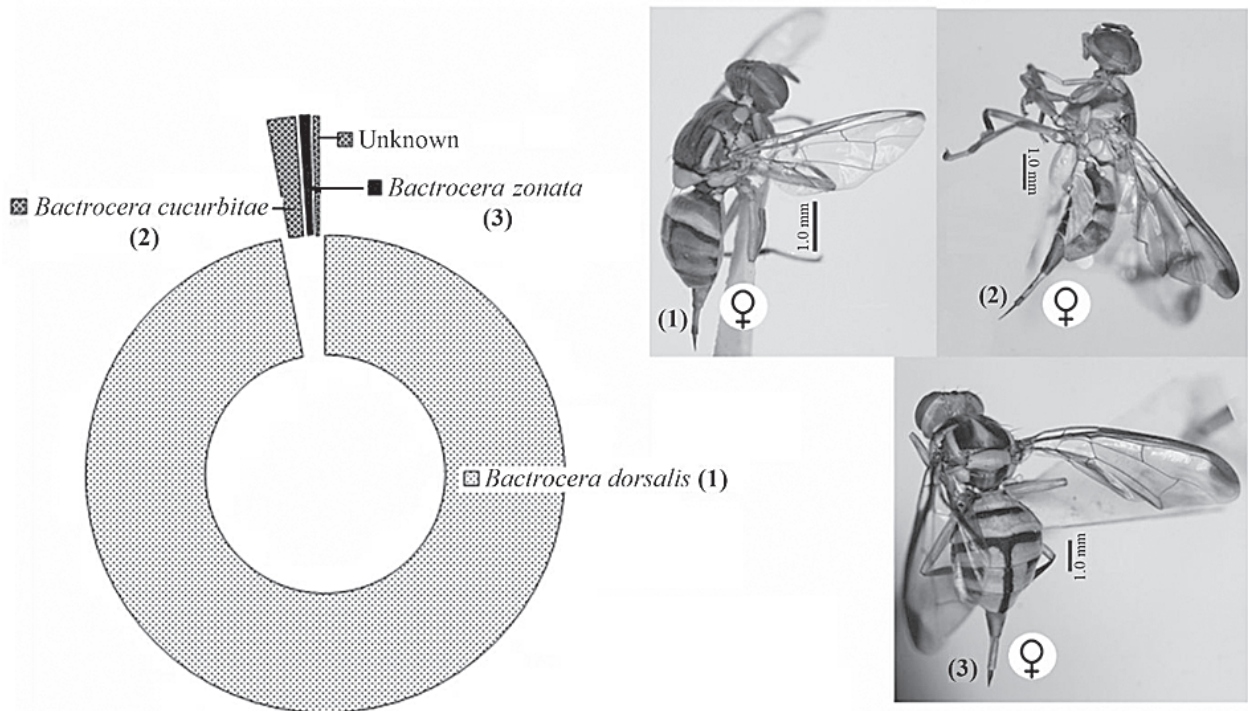


Figure 2. Composition of fruit fly species infested on mango orchards in Cao Lanh city, Dong Thap Province in 2018-2019

3.1. The relationship between fruit fly *B. dorsalis* dynamics and weather conditions

The pest numbers were collected from the trap at the 10-day period, which was more suitable for determining its population dynamics. However, weather conditions provided by Center of Meteorological and Hydrological Administration, Dong Thap were monitored on a monthly basis. Rainfall was another essential factor affecting population fluctuation.

Monthly rainfall amounts were higher than 120 mm in the time of May-October (2018). The fruit fly *B. dorsalis* population was increased markedly, and the highest density was observed in the middle of June (Fig. 3). The monthly rainfall amounts were gradually

increased from May then reached a maximum in October (Fig. 3), Meanwhile *B. dorsalis* population was dramatically decreased in early August until December (2018) (Fig. 3).

The monthly average temperature in Cao Lanh was in the ranges suitable for the development of most pests. The temperatures from December to February were lower than other months. The temperature fluctuation was somewhat affected the population dynamics of the oriental fruit fly. For example, the pest percentages collected in January with lowest temperature (26.5°C) and April with highest temperature (30.0°C) were 5.63% and 46.65% (Fig. 3). These results indicate that the population dynamics of *B. dorsalis* was related to weather conditions, especially rainfall values.

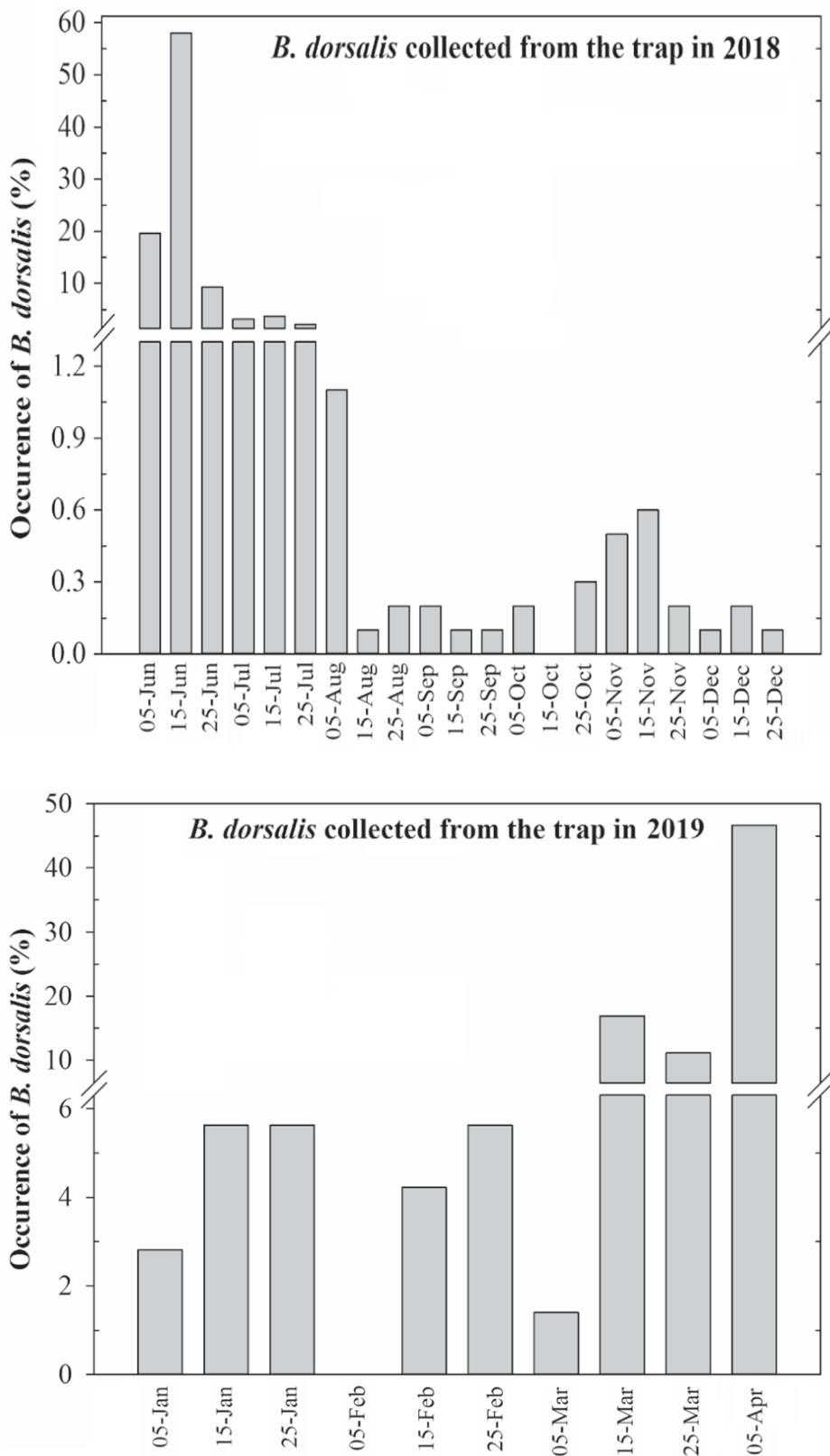


Figure 3. Fluctuations of *Bactrocera dorsalis* flies captured by a Malaise trap in a mango orchard in 2018-2019 and average monthly rainfall and temperature

3.2. The relationship between fruit fly *B. dorsalis* fluctuation and development stages on vegetative and reproductive growth of mango trees

As reported, the preferred hosts of *B. dorsalis* were several crops, such as mango, orange, pear, guava, and peach. The fruit fly *B. dorsalis* was more abundant in the rainy season than in the dry season. In our study, adults *B. dorsalis* abundantly occurred in the rainy months (94.5%) were much higher than those in the dry months (5.5%) (Fig. 3). This phenomenon was characterized by development stages of vegetative and reproductive growth of mango.

In Cao Lanh city, Dong Thap Province, the taiwan mango is widely planted in orchards. Two flowering periods are normally in February and August; however, most farmers use flowering stimulants to increase the amount of flowers and yield in their orchards. In this case, mango trees give three flowering periods: April, August and December. The fruiting periods and productivities exerted essential effects on *B. dorsalis* population fluctuation, and the peak of *B. dorsalis* population in mango orchards was observed during the period of fruit ripening and harvesting, i.e. in June (rain season) and from March to April (dry season) (Fig. 3). In Cao Lanh city, Dong Thap Province, the fruit bagging is used in mango orchards, therefore, the infested fruits were the main source, from which fruit fly *B. dorsalis* adults were accumulated and increased rapidly. The results indicated that development stages of vegetative and reproductive growth of mango were supposed to be the major factors affecting the population fluctuation of *B. dorsalis*.

These results agreed a previous study by Ye and Liu (2007) who presented that the number of adult *B. dorsalis* fruit fly in mango orchards increased when the rainfalls was in a range of 100-200 mm. When the monthly rainfalls were higher than 250 mm, the population of fruit flies decreased significantly. Rainfalls indirectly affected the soil moisture, so it related to the development of *B. dorsalis* (Jiang *et al.* 2001; He *et al.* 2002). In another study, monthly rainfalls from 50 mm to 200 mm were suitable for the development of *B. dorsalis*.

The surveys of *B. dorsalis* on other fruits have

been reported. For example, seasonal population dynamics of the pest on dragon fruit (*Hylocereus* sp.) in Binh Thuan Province were closely depended on harvest times rather than rainfalls (Nguyen Thi Thanh Hien *et al.*, 2016). This study also showed that the number of pest male adult collected from a Steiner trap was highest from April to August even though the fruit fly appeared all year round. The result was different from our study probably because each investigation sites are different in terms of local climates, edaphic conditions and hosts of the pest.

4. Conclusion

Our study indicates that Oriental fruit fly *Bactrocera dorsalis* is the abundant pest in mango orchards in Cao Lanh City, Dong Thap Province. The concentrated occurrence of *B. dorsalis* was observed at mango harvest times. Weather conditions also affected the pest population with more apparently for rainfall condition. Moreover, the fallen infested fruits either on the trees that present signs of attack or on the ground, and pest larvae developing inside the fruit were the main source of *B. dorsalis* adults. Therefore, sanitation should be practiced to reduce the pest development.

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