Jurnal Perlindungan Tanaman Indonesia, Vol. 24, No. 2, 2020: 224–228
DOI: 10.22146/jpti.52825
Available online at http://jurnal.ugm.ac.id/jpti
ISSN 1410-1637 (print), ISSN 2548-4788 (online)

Research Article

Oviposition Preference of *Bactrocera dorsalis* Hendel (Diptera: Tephritidae) on Different Fruit in Snake Fruit Orchard

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ABSTRACT

The oriental fruit fly *Bactocera dorsalis* (Hendel) is an important pest of snake fruit (*Salacca zalacca*) in Sleman District. Due to the high level of damage by the fruit flies, it is necessary to do. The aim of this research was to find out suitable fruit traps, by testing the oviposition preferences of the fruit flies in the orchard to lay eggs on several types of fruit. The research was done in snake fruit orchard located at Sleman Yogyakarta and owned by farmers, while the lab works were done at the Laboratory of Entomology, Department of Plant Protection, Faculty of Agriculture, Universitas Gadjah Mada. All researchs were done between April–June 2019. Guava (*Psidium guajava*), watery rose apples (*Syzygium aqueum*), starfruit (*Averrhoa carambolae*), and snake fruit (*Salacca zalacca*) were used as trap crops. Each fruit, with the same maturity level, was hung 1.5 m above the ground for 4 days with 12 days total trapping at intervals of 3 times. After the test each fruit was taken and the insects in its were reared in the laboratory. The number of pupae and flies emerged from each fruit were counted and compared. The results showed that in the orchard 1 as well as 2, of guava fruit produced the highest number of (151 pupae) followed by salak (94 pupae), star fruit (83 pupae), and water guava (2 pupae). The finding of seeds shows that guava fruit is the most suitable host for the fruit flies to be used in the trapping, followed by star fruit and watery guava.

Keywords: *Bactrocera dorsalis*; guava; oviposition preference; trap crop

INTRODUCTION

The oriental fruit fly, *Bactrocera dorsalis* (Hendel), is currently a major pest causing significant economic loss in the fruit and vegetable industry (Clark *et al*., 2005). Since 2016, the pest infestation in snake fruits in Sleman, Yogyakarta has decreased yield significantly and hindered export due to its infestations (Deny, 2018; Sugiyanto, personal communication, 2018). Due to its economic significances to the snake fruit industry, various management techniques are incorporated to control this pest. However, due to the organic label snake fruits are marketed, options of control techniques are reduced and chemicals insecticides are prohibited. Therefore, there is a merit in maximizing effectiveness of the preventive control techniques.

Preventive measure is an essential component in Integrated Pest Management Programs (IPM). Preventive techniques used in IPM vary from using resistant varieties, cultural practices such as cladding, tree trimming; maintaining orchard sanitation; or by planting trap crops in the orchard. The trap crops that attract the pest of interest will avoid infestation in main crops. In order, for this technique to be effective, the most preferred host by the target pest should be identified.

B. dorsalis is a polyphagous pest. It is reported that in Indonesia it infests fruits of 9 families of plant, including Anacardiaceae, Annonaceae, Sapindaceae, Solanaceae, Thymelaeaceae, Lauraceae, Caricaceae, Combretaceae, and Rutaceae (Suputa *et al*., 2010). These families consist of not only horticultural crops, but also forestry plants which serve as alternative host in main host scarcity situations. These nutritional variations may cause variances within larva and pupae size, development time, imago eclosion, imago age, and fecundity. Higher infestation by *B dorsalis* have been found in guava and starfruit compared to in oranges and melon suggesting these fruits as prefer and suitable host to female *B. dorsalis* (Sohail *et al.,* 2015). Consistent with previous findings, Clarke *et al.* (2005) also stated that *B. carambola* (syn *B. dorsalis*) are mostly found in guava and starfruit in Indonesia and South East Asia.

In order to successfully incorporate trap crops into snake fruit IPM programs in a snake fruit agroecosystem, identifying suitable trap crop is needed. In this study, to a series of trap crop tests were conducted, aiming: (1) to identify the oviposition preference of the fruit fly population in snake fruit orchards; (2) to determine survivorship of the fruit fly in each tested trap crop based on the success rates to reach pupae and imago, and sex ratio.

MATERIALS AND METHODS

Research Location

The trap crop tests were conducted between April–June 2019 in two different snake fruit orchards in Sleman, Yogyakarta owned by farmers of Asosiasi Prima Sembada, and Mitra Turindo. Laboratory works were conducted at laboratory of Entomology, Department of Plant Protection, Faculty of Agriculture, Universitas Gadjah Mada. One orchard with more varied vegetation than the other.

Fruit Traping and Fruit Flies Collection

Four fruits were used during this research as traps, i.e. guava, watery rose apple, starfruit and snake fruit. The fruits had equal size and maturity (70–80 %), and were hung on tree 1.5 m above the ground. The traps were installed 3 times for 12 days with an interval of 4 days, and then the traps were taken to the laboratory for observation. The study was conducted with a randomized block design (RBD) with 10 replications from each orchard.

Orchard Condition

Orchard 1 is located at Tempel District, Sleman. This orchard has 0–10% slope with various crops within this orchard, such as guava, malay apple (*Syzygium malaccense*), mango (*Mangivera* sp.), mangosteen (*Garcinia mangostana*), jackfruit (*Artocarpus heterophyllus*), papaya (*Carica papaya*), banana (*Musa* sp.), rambutan (*Nephelium lappaceum*), katapang (*Terminalia catappa*), chili (*Capsicum annuum*), eggplant (*Solanum melongea*), cucumber (*Cucumis sativus*), bitter melon (*Momordica charantia*), and oranges (various species). Spacing between snake fruit crops are narrow and an irrigation system is adjacent to the north side of this orchard; thus, causing high air humidity within the orchard.

Orchard 2 located at Turi District, Sleman, has 0–5% slope. This orchard has less species of plant surrounds compared to orchard 1, which has katapang (*Terminalia catappa*), jengkol (*Archidensron pauciflorum*), and lamtoro. An irrigation system of this orchard is located on the east of the orchard. Crop spacing in this orchard is larger compared to orchard 1 causing lower air humidity.

***B. dorsalis* Rearing**

Trap fruits from the orchard were brought into the lab and placed in plastic containers to allow pupae and imagoes to develop and emerge. Plastic containers (ø 15 cm and 10 cm height) with a 4 × 3 cm hole were placed on one side and closed using fine cloth to allow air circulation. Sterilized saw dust was placed on the bottom of plastic containers. The number of pupae that emerged was counted after the larvae turned into cocoons on the first day of emergence and left for 10–14 days for becomes imago, and the imago that appears is counted on the first day of appearance. Only images were gendered during this study.

Data Analysis

Numbers of pupae, male and female flies were analyzed using analysis of variance (ANOVA) to find differences among treatments. If so, Duncan Multiple Range Test (DMRT) post-hoc comparison was applied. All tests were analyzed at α=5% and done using *R program 3.5.2.*

RESULTS AND DISCUSSION

Pupae Collected from Trap

Results showed that the average number of pupae collected in orchard 1 were significantly different among crops. Highest number of pupae, male, and female flies were collected from guava, whereas those from watery rose apple had the lowest numbers (Table 1). In orchard 2, the number of pupae between orchards was observed, where the average pupae collected from guava showed the highest number (orchard 1: 8.73 ± 4.16; orchard 2: 8.47 ± 0.62) while watery rose apple showed the

Table 1. Number of pupae, male, and female imagoes collected from trap crops in snake fruit orchard

Treatment	Orchard 1			Orchard 2		
	Pupae	Male Imago	Female Imago	Pupae	Male Imago	Female Imago
guava	8.73 ± 4.16 a	5.90 ± 36.64 a	6.37 ± 21.52 a	8.47 ± 0.62 a	5.59 ± 29.00 a	5.65 ± 36.23 a
carambola	3.96 ± 0.87 ab	3.73 ± 39.26 ab	3.74 ± 16.80 ab	0.90 ± 6.68 ab	2.02 ± 3.00 ab	1.82 ± 1.73 a
snake fruit	0.50 ± 5.46 b	1.49 ± 13.53 b	1.32 ± 3.46 b	3.63 ± 0.40 ab	3.08 ± 24.58 ab	3.45 ± 24.01 a
watery rose apple	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.23 ± 5.05 b	1.09 ± 1.73 b	1.09 ± 1.73 a

Numbers followed by different alphabets are significantly different based on DMRT post-hoc test at α=0.05.

lowest (orchard 1: 0 ± 0; orchard 2: 0.23±5.05) compared with starfruit and snake fruit. Trends of males collected from orchard 2 was similar to orchard 1 where highest numbers were collected from guavas (orchard 1: 5.90 ± 36.64; orchard 2: 5.59 ± 29.00) and watery rose apples resulted in the lowest (orchard 1: 0 ± 0; orchard 2: 1.09 ± 1.73). Only female collected from orchard 1 were significantly different between treatments. Highest numbers were collected for guavas (6.37 ± 21.52), while the lowest were collected from watery rose apple (0 ± 0).

The results obtained from the number of pupae in both gardens showed that *B. dorsalis* was preferred mostly to guava compared to other fruits. Female *B. dorsalis* attraction and oviposition preferences to fruit is implied to be based on volatile compounds excreted from fruits (Brévault & Quilici, 2009; Siwi, 2005; Bernays & Chapman, 2000). In addition, fruit maturity also has been reported to significantly affect female *B. dorsalis* attraction due to different levels of volatile compounds emitted (Rattanapun *et al.,* 2009). Based on these previous study, higher pupae emergence within guava is due to its specific volatile compounds.

Sauer-Muller (2005) stated that shape and size of fruit affected female *B. dorsalis* oviposition. Starfruit and snake fruit were most preferred for oviposition by female flies after guava. Starfruit possess wide fruit surface area, smooth surfaces, and sufficient nutritional content which attract female flies to oviposit (Koswanudin *et al.,* 2018). Larger and roundness of fruit were found to be attractive of fruit fly oviposition (Sohail *et al.,* 2015). Snake fruit and watery rose apple were smaller in size and had hard skin textures decrease female oviposition. Nutrition and chemical content, such as content of amino acid, vitamin, sugar, and minerals; affect larval development thus, sweet fruit are more susceptible to fruit flies (Sauers-Muller, 2005; Allwood, 1996; Kostal, 1993).

Pupae emergence in orchard 1 showed different number of pupae collected among observations even for the same trap crop treatment (Figure 1). During the first observation, only guava, snake fruit, and starfruit resulted in pupae emergences with starfruit demonstrating highest pupae collection (83 pupae). The second and third observation resulted in guava having most pupae. During the last observation, pupae were collected only from guavas. Pupae emergences from orchard 2 differed from orchard 1. First observation found that fruit fly pupae from snake fruit were 94 pupae due to snake fruit as *B. dorsalis* main host. In the second and third observation demonstrated, pupae collected from guava was the highest by > 5-folds among all trap crop treatments (Figure 2).

Pupae, male, and female fly emergences in watery rose apples were 0 during all observations and both orchards. The inability of *B. dorsalis* to develop in watery rose apple and unavailability of suitable host are the reasons on why these low numbers may have occur. Snake fruits in orchard 1 and 2 have reached 80% of maturity. Host availability greatly affect fruit fly population. Research had reported that availability of snake fruit is the main factor of fruit fly population within snake fruit orchards. This indicates that scents and volatiles from main hosts and trap fruit deployed within the orchards have disrupted female fly oviposition (Win *et al*., 2014).

During this research, methyl eugenol traps were placed by farmer within snake fruit orchards. High male fly capture might have disrupted mating with females. Jang (1995) reported that female flies only react to volatiles from host after mating dan are ready for oviposition. Thus; the significant reduction

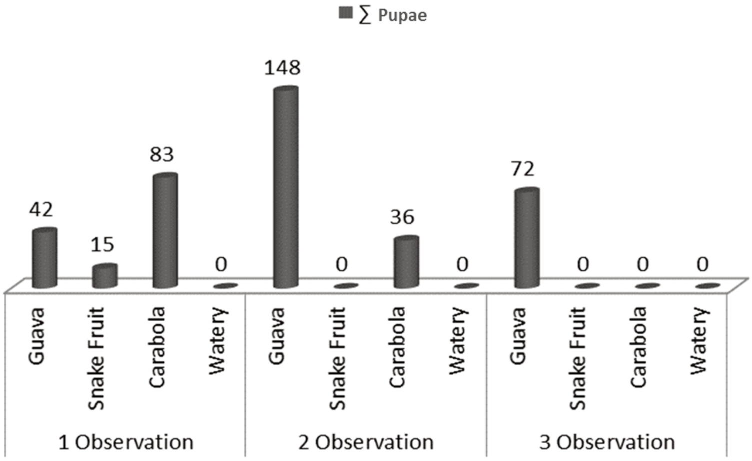

Figure 1. Number of pupae collected from trap crops in orchard 1 over 3 observations

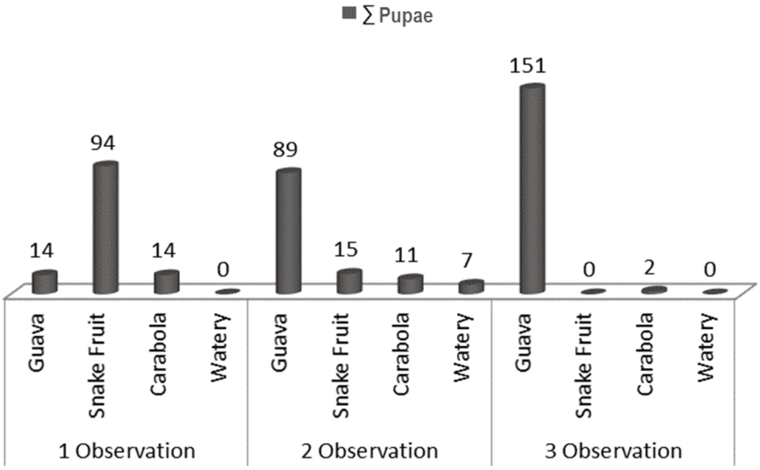

Figure 2. Number of pupae collected from trap crops in orchard 2 over 3 observations

of males might have caused these low number of infestations during the first observations. In addition, effective area of fruit volatile of 2–5 m (Kardinan, 2009) might have not been attractive enough to female *B. dorsalis* in the orchards.

CONCLUSION

Guava is the most interesting fruit for *B. dorsalis* for oviposition in orchard 1 and orchard 2 with the average pupa in garden 1 is 87 pupae, followed by star fruit with 39 pupae, salak fruit 5 pupae, and at least 0 water guava fruit. whereas in orchard 2 it was obtained with an average of 84 pupae in guava, followed by 36 pupae of salak fruit, 9 pupae of star fruit and 2 guava of water guava. Results from this research imply guava is the most suitable fruit to be used as trap for *B. dorsalis* to manage its infestation level in snake fruit orchard of Sleman.

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