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MORPHOLOGICAL IDENTIFICATION AND POPULATION OF FRUIT FLY (*Bactrocera* sp.) (Diptera: Tephritidae) IN CHILI FIELDS, SAVANAJAYA VILLAGE BURU DISTRICT

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ABSTRACT

Morphological identification and population of fruit fly (*Bactrocera *sp.) (Diptera: Tephritidae) in chili fields, Savanajaya Village Buru District. Fruit fly (*Bactrocera* sp.) are pests that damage horticultural crops, one of which is chili and has the potential to reduce the production quality and quantity. The aim of this research was to identify and obtain population numbers of fruit fly species in the chili fields in Savanajaya Village, Buru District. This study used diagonal sampling method with fruit fly traps placed randomly at each sub location of sampling, traps were modified Steiner's Trap type. Each trap was consisted of 1.5 mL of methyl eugenol on cotton ball, the treatment was repeated three times. Observations were at 3, 6, 9 and 12 days after application (daa). The identification results showed that the fruit flies species that trapped were *Bactrocera dorsalis* (Hendel) and *Bactrocera umbrosus* (Fabricius). The highest number of fruit fly was trapped at 6 daa with an average of 110.67 to 134.03 or 48.51 to 58.73% from total catch, in addition the lowest catch was at 12 daa with an average of 29.67 to 64.67 or 12.99 to 28. 34%. The average number of trapped population was 914.62 individuals.

Key words: *Bactrocera* sp., chili, identification, population

INTRODUCTION

Chili pepper (*Capsicum annum* L.) is one of the horticultural crops that has important economic value in Indonesia. It also has the capacity to increase farmer's income, as an industrial raw material and has export opportunities. As the population grows, the need for chili in Indonesia is increasing. The National Big Chili Production in Indonesia is as follows: in 2015 amounted to 1,045,182 tons, in 2016 amounted to 1,045,587 tons and in 2017 amounted to 1,206,266 tons. Harvested area and chili pepper production in Maluku are as follows: in 2015 the harvest area was 535 ha with a production of 2,009 tons, in 2016 the harvested area was 546 ha with a production of 1,444 tons and in 2017 the harvested area was 461 ha with a production of 1,611 tons (BPS Indonesia, 2017; 2018).

The chili cultivation business is inseparable from various limiting factors that become obstacles such as climate and the attack of plant disturbing pest. The common pests that attack chili is fruit fly (*Bactrocera* sp). Fruit flies cause damage to young and ripe chili fruit. The attacked fruit will rot and fall to the ground. Early symptoms can be seen from the black dot on the base of the fruit, the black dot was appeared due to the activity of adult fruit flies that insert their eggs into the chilies. The egg then hatch and develop inside the chili. The larvae found in the fruit cause damage from the inside, the fruit becomes pale yellow and withered. The quality of chili attacked by this pest will decrease and not suitable for sell. Severe attacks usually occur in the rainy season caused by ovipositor punctures of female insects that contaminated with fungi so that the attacked fruit becomes rotten and falls to the ground (Meilin, 2014). In cool climates, high humidity, and winds that are not too strong, the attack intensity of fruit flies population increases. Climate and humidity factors greatly influence the distribution and development of fruit flies.

Improper use of pesticides also results in fruit flies becoming resistant. One of the environmentally friendly control methods have been used is atractans. Attractants has been widely used, in particular the methyl eugenol extract. Methyl eugenol used to contain 800 g/L Petrogenol is an insect-luring compound, especially fruit flies. This substance is volatile and releases fragrance. Methyl eugenol can be obtained in the market at an affordable price and its use is quite

easy. According to Pedigo (1999) there are four components in IPM including monitoring methods and action thresholds supported by human actions. Methyl eugenol is a decoy compound that is widely used because it is the most effective and is one type of kairomone that can attract insects, so it is used for capturing insects. To use methyl eugenol, a drop of the substences and insecticide was added on a wad of cotton wool. This mixture is placed in a trap and installed in the chili farming area.

Savanajaya village Buru District is one of the centers of chili pepper that supplies chili needs to Ambon city. Obstacles of to fruit fly attacks on chili pepper commodities in this area can reduce production by 30 until 45 percent, which also affects the fulfillment of chili pepper supply.This village is also a fruit producer. The conditions allow a host for the development of various types of fruit flies so it is necessary to know what species of fruit fly attack chili plantations in the area. This study aimed to identify the type of fruit fly pest and calculate the number of fruit fly populations on the chili fields.

MATERIALS AND METHODS

Research Site.The study was carried out on farmer's land in Savanajaya Village, Buru District, in August 2019.

Plant Material and Experimental Design. Chili plants used in this study were in the generative phase with a plant age of 2–3 months. The material used a variety of pepper chili plants owned by farmers in Savanajaya Village. Sampling was conducted using diagonal sampling method, then fruit fly traps was randomly placed at each sub location. In 1 ha plantations could be installed 25 placement points with a distance between each trap 20 m. The treatment was repeated three times.

Trapping Fruit Fly. Fruit fly trapping was carried out using a modified Steiner's trap type (Shelly, 1994; Hasyim *et al.*, 2008). Petrogenol 800 L (Methyl eugenol) was used as an attractant (treatment).

Application. The Petrogenol 800 L (Methyl eugenol) was dropped into cotton as much as 1.5 mL, then put into a trap made from 600 mL water bottles. The small hole was pierced at the bottle cap then inserted a ± 40 cm wire. About 10 cm from the top of the bottle, 4 holes (0.7 cm in diameter, each) were pierced at the walls of the bottle. Inside the bottle, a cotton wool (± 1.5 cm diameter) was treated. The bottle trap was placed in the middle of the diagonal sample plot in a chili plantation in expecting that the smell of Petrogenol 800 L could attract male flies. A fairly easy and inexpensive way was to use a drinking water bottle with a conical neck. The cone-shaped tube section was cut and then replaced backwards, the mouth of the tube facing the tube. The connection parts were glued or plastered with masking tape. Petrogenol 800 L attractant was exposed to the cotton medium, compress the cotton by twisting it up to the size of the thumb and then bound with a small wire. Petrogenol 800 L as much as 1.5 mL was dropped on cotton until it was wetted but not drip. Place the cotton twine that had been given Petrogenol 800 L in the trap tube in such a way that it hangs in the middle of the trap tube. Hang the trap on branches or twigs as high as 2–3 m from the ground or on the inside of the tree canopies. Trapping was done from the formation of fruit to harvest.

Observation. Observation of fruit fly population was carried out 4 times at 3, 6, 9, and 12 days after application (daa) in specific time at 11.00–12.00 WIT. The trapped flies was collected, counted, and identified.

Fruit Flies Identification. Identification was done by measuring the body length of the captured male fruit fly. The determination of species was done by using literature (Suputa *et al.*, 2006).

RESULTS AND DISCUSSION

Fruit Flies Identification. The fruit fly *Bactrocera* sp. is a type of pest that is often found in various types of plants, one of which is chili. Based on the observations of trapped fruit flies, there were various types of fruit flies attacking chili. Morphological identification was carried out on the general characteristics of the thorax, abdomen, and wings of the fruit fly *Bactrocera* sp. Morphological characteristics of the type of fruit flies found was done by referring to the fruit fly pest identification book written by Suputa *et al.* (2006) and Drew & Hancock (1994) by observing the matching of all the visible fruit fly characteristics. From the 2 species trapped on the chili fields in Savanajaya Village, Buru District. The key identification of the fruit fly is as follows Larasati *et al*. (2016):

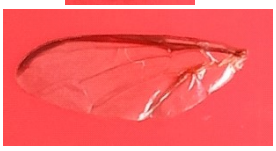
1a. Tergum is not separate, the waist is bounchy, thorax is red to brown .....*Dacus*(*callantra*) *longicornis*

1b. The abdomen is rounded, the waist is not bouncy, separated, thorax consist of various colors..... ..... Genus *Bactrocera*

2a. No ceromae, there is a bulla character in the male insect .....*Bactrocera megragori*
2b. Have ceromae, no bull character in male insects.... 3
3a. There is a medial postsutural vittae on the scutum, generally attracted by the cue lure attractant 4
3b. No medial postsutural vittae in the scutum, generally interested in attracting methyl eugenol lure 7
4a.Threre are bands of costal and cubital streak and no additional bands on the wings ……..……..... 5
4b. Threre are band of costal and cubital streak and there are additional bands on the wings 6
5a. There are no spots on the wing tips on .... *Bactrocera (zeugodacus) vulta*
5b. There is a spot on the tip of the wing 15
6a. The thorax is brown ……... *Bactrocera cucurbitae*
6b. The thorax is black …..... ..... *Bactrocera (zeugodacus) culumiate*
7a. There is no a cross band from the costal boundary to the underside of the wing ……... 9
7b. There is a cross band from the costal boundary to the underside of the wing more than 1 band 8
8a. The number of bands transversely from the costal boundary to the underside of the wing consists of 2 bands …….. *Bactrocera* (*Bactrocera*) *albistrigata*
8b. The number of bands transversely from the costal boundary to the underside of the wing consists of 3 bands ..... *Bactrocera umbrosus* (Fabricius)
9a. Brown scutum, is a large species …..... ..... *Bactrocera* (*Bactrocera*) *molluccensis*
9b. Black scutum, is a small species ……....…… 10
10a. There is no "T" pattern on the abdomen gum, there are spots on the tips of the wings…….. ..... *Bactrocera letifrons*
10b. There is a "T" pattern in the abdominal gum. No spots on the tips of the wings ……..... 11
11a. Lateral postural vittae are narrow .... *Bactrocera* (*Bactrocera*) *verbascifoliae*
11b. Lateral postural vittae of medium to wide size 12
12a. Confluent costal band and overlapping with R2+R3 13
12b. Confluent costal band and overlapping with R4+R5 …….....… *Bactrocera* (*Bactrocera*) *limbifera*
13a. Lateral postural vittae of type parallel or subparalel .....…….....…… 16
13b. Lateral postural vittae tapered ……..… 14
14a. Short laeral postural vittae,he distance between the lateral ends of of he postsutural vittae and the intra alar seta is wide .... *Bactrocera* (*Bactrocera*) *usitata*
14b. The lateral postsutural vittae is elongated, the distance between the lateral ends of the postsutural vittae and the intra alar seta is short …..... ..... *Bactrocera* (*Bactrocera*) *melastomatos*
15a. There is a black line on the face (at the top of the mouth) ……..…….. ..... *Bactrocera* (*Bactrocera*) *caudata*
15b. There is a black roud spot on the face .... *Bactrocera* (*Bactrocera*) *tau*
16a. Costal band overlapping on R2+3 with the same width until it passes through the end of R2+3 ……..... 18
16b. Costal band is confluent to the R2+3 and do not extend along the tips of the wings ……..... 17
17a. Terga III and IV abdomen with widened lateral dark section, small spesies approximately 5,2 mm long ……... *Bactrocera* (*Bactrocera*) *verbascifoliae*
17b. Terga III and IV abdomen with dark lateral narrowing, large 6,2-6,4 spesies approximately 5,2 mm long …..... *Bactrocera* (*Bactrocera*) *papaya*
18a. Terga III and IV abdomen with widened medial dark section, the ends of the lateral bands on the abdomen are square ……...…. 19
18b. Terga III and IV abdomen with narrow medial dark section, triangular ends of the lateral bands on the abdomen ……....…. *Bactrocera dorsalis*
19a. The costal band extend and narrow at the tips of the wings……..... ..... *Bactrocera* (*Bactrocera*) *carambolae*

The observations results of the morphological characteristics found in the two species of *Bactrocera* sp. can be seen in Table 1 and Figure 1. From the morphological characteristics, it was clearly seen that there are two species of *Bactrocera* trapped during the study, they were *B. dorsalis* (Hendel) and *B. umbrosus* (Fabricius). Even though chili is not a host for the *B. umbrosus* (Fabricius). The main host are jackfruit (*Artocarpus heterophyllus*) and cempedak (*Artocarpus integer*) because there is a *B. umbrosus* (Fabricius) host plant around the chili crop so that the species was trapped. Moreover, methyl eugenol traps are also attractive for *B. umbrosus* (Fabricius). According to Drew & Hancock (1994), the type of methyl eugenol binding can attract species of fruit flies *B. dorsalis* (Hendel), *B. musae,* and *B. umbrosus* (Fabricius), while *B. trivialis* is more interested in cue lure. The results of this study was in line with Wee *et al.* (2002), the sensitivity of methyl eugenol is different

Table 1. Morphological characteristics of *Bactrocera* sp. fruit flies found in Savanajaya Village, Buru District

Species		Morphological characters
B. dorsalis (Hendel)		
Thorax		• The scutum and mesonotum is black. • The yellow lateral band on the mesonotum extends near the supra alar hair.
Abdomen		• Mostly pale red (brown). • There is transverse band on the tergit -2 and -3. • The longitudinal narrow black band divides in the middle of the tergit 3 to 5.
Wing		• The wings only have black bands on the rib line and the anal line • They have no pattern on the transverse veins.
B. umbrosus (Fabricius)		
Thorax		• The scutum is black with a yellow stripe on either side of the lateral
Abdomen		• Varies sometimes black widening on the lateral side.
Wing		• There are three bands on the wings • This pattern is brown.

Morphological characteristics refer to Suputa *et al.,* 2006.

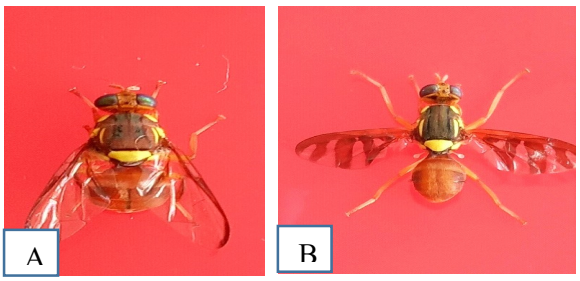


Figure 1. Individual of *Bactrocera sp*. (A) *B. dorsalis* (Hendel), (B) *B. umbrosus* (Fabricius).

in fruit fly species. The morphological characteristics of the fruit fly is as follows Suputa *et al.*, 2006.

Bactrocera dorsalis (Hendel) wings are transparent while *B. umbrosus* (Fabricius) wings have three bands on the wings. This transverse membrane is brown. According to Xu *et al.* (2018), a vertical yellow line in the middle of the scutum can be used to distinguish *B. dorsalis* (Hendel) from *B. umbrosus* (Fabricius).

The number of Fruit Fly. Based on the results of research conducted in the village of Savanajaya Buru, it was known that the number of trapped fruit fly populations was fluctuates in line with the length of trapping time. This showed by the number of fruit flies trapped in steiner traps that were given methyl eugenol.

Based on the observations at the beginning of the trapping, not many fruit flies was caught. It was due to the attractans was need some times to reach the fruit flies and interact with the odor. When the male fruit fly smells the methyl eugenol, the fly will try to find it and approach the source of the aroma. According to Manurung & Ginting (2010), fruit flies look for the origin of the attractant smell of methyl eugenol by using a number of visual or chemical conditions to find the aroma. Pena *et al.* (2002) suggested that, female fruit flies find their hosts using odors and visual designs by jabbing their ovipositors under the surface of the fruit's skin. The visual requirements in the form of a host color that attracts female fruit flies come to eat and lay eggs while the chemical requirements can be in the form of attractants or pheromones such as methyl eugenol which can attract male fruit flies to obtain female insects of the same species. The average number of fruit flies trapped at each observation time can be seen in Figure 2.

On the third day after application (3 daa), the average population in each treatment block was ranged from 44.0 to 65.67 individuals, or 19.29 to 28.78% of the total cacth, increasing from 107.67 to 134 individuals or 48.51 to 58.73% at six. At the 12 daa decreased by 29.67 to 64.67 individuals or 12.99 to 28.34 % (Figure 2). Based on observation, it showed that the number of fruit flies was relatively high. This was greatly supported by local climatic conditions when the research was in a prolonged summer. This indirectly affects the crop production. According to Krebs (1985), an over-population of one species can become economically harmful. In this study, the installation of pheromone traps affected the high and low number of trapped individu. This can be influenced by the volatile ability of methyl eugenol. At the beginning of the methyl eugenol application, it did not reach a large area, so only fruit flies around the traps that were trapped first. The research took place during the summer so that the sun intensity and temperatures were high. These would accelerate the evaporation process and with the help of the wind also influence the speed of the spread of methyl eugenol. In observations at 6 and 9 daa, methyl eugenol had spread further so that the trapped population was increase. According to Tan & Nishida (2012), methyl eugenol is an insect-attracting compound, especially fruit flies that are volatile and release fragrance. This

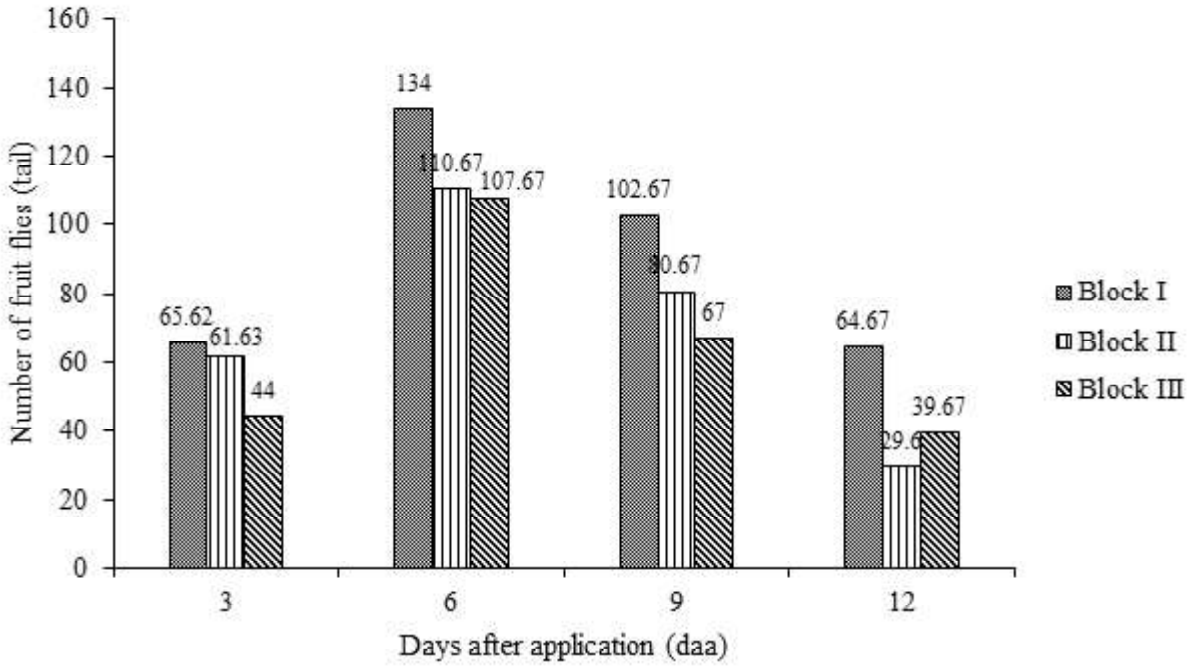


Figure 2. The number of captured fruit flies after application methyl eugenol in Savanajaya Village, Buru District.

substance is a food lure needed by male flies for consumption. When a male fruit fly smells the methyl eugenol, the fly will try to find and approach the source of the aroma and eat it. Generally, attractant scents will be smelled at a distance of 20–100 m, but if influenced by wind, the range can be even broader and can even reach 3 km (Kardinan, 2003). At the 12 daa, the trapped fruit fly had decreased from 29.67 to 64.67, this was due to the active ingredient of methyl eugenol which had been increasingly reduced due to the evaporation process. In addition to chili plants, tomato plantations were also found adjacent to chili plantations, but the land was treated with pesticides, so that fruit flies were suspected to move to chili plantations so that the population was very high.

The fruit fly imago is very fond of the host in the form of half-ripe fruit because in this condition the fruit contains maximum amounts of ascorbate and sucrose (Kardinan, 2003).This was supported by the opinion of Hui & Jianghong (2007), that the availability of fruit and fertilization period are influence population fluctuations. The activity of fruit flies in finding host plants was determined by the color and aroma of the fruit. Male fruit flies know their partners through pheromones, flashes of body color, and ribbons or patches on wings. Moreover, *B. dorsalis* (Hendel) also has other hosts, such as tomatoes, papayas, rose apple, and oranges. On the other hand, the number of *B. umbrosus* (Fabricius) trapped was only a few. *B. umbrosa* (Fabricius) also known as the Artocarpus fruit fly, is an oligophagous fruit fly species that infests mainly fruits from the Moraceae family such as jackfruit (*Artocarpus heterophyllus*), chempedak (*A. integer*)(Wee *et al*. 2018). Hui & Jianghong (2007) reported that the host is the main factor influencing the high and low of the population.

CONCLUSION

Based on the results, it could be concluded that there were two types of *Bactrocera* in the chili field in Savanajaya Village, Buru District, *B. dorsalis* (Hendel) and *B. umbrosus* (Fabricius). The highest number of population; caught with methyl eugenol traps was captured at 6 daa with an average population of 110.67 to 134 individuals or 48.51 to 58.73%, and the lowest at 12 daa was 29.67 to 64.67 individuals or 12.99 to 28.34%.

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