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Attractiveness of Trap Size and Direction to Adult Oriental Fruit Fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) in Chili Pepper.

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ABSTRACT

Oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) is one of the most damaging pests of chili pepper (*Capsicum frutescence* L). Sticky colored traps are commonly used to monitor the presence of and to control the fruit fly. The study was conducted to determine the effect of trap size and direction on the fly capture. Four trap sizes: 14 x 8, 21 x 11, 29 x 16, and 42 x 22 cm of yellow traps set up 25 cm above the ground were used and placed facing different cardinal directions; north, south, west, and east. The results showed a general trend, as the traps size increased, the fly catch also increased. Trap with the size of 42 x 22 cm caught the most flies and the catch was significantly higher than the catches on the other treatments, though no significant differences amongst the other treatments were detected. However, there was no significant difference in the average fly counts per cm^2 of the trap surface amongst trap sizes tested. Cardinal directions did not significantly affect the number of trap capture for female and male flies. Male flies constituted about 1.2% of the overall population during the trial.

Keywords: trap size, trap direction, *Bactrocera dorsalis*, pepper

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INTRODUCTION

Oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) is one of the most serious pests of pepper in Indonesia [1]. In South Sulawesi Province, the pest has become a major limiting factor of pepper production and without any control interventions the insect can cause a total loss to the crop (Nasruddin, unpublished data).

Female fruit flies lay eggs under the pepper fruit skin, using their ovipositor. The infested fruit are easily recognized with black spots of ovipositor marks on their skin. Egg stadium lasts 2 – 3 days and the newly formed larvae feed and develop inside of the fruits. Third instar larvae crawl out of the fruit and drop themselves to the ground before pupating in the soil [2]. The abandoned fruits are already damaged, prematurely dropped off the plants, and unmarketable. The pupal stadium is about 10 days. Newly formed adults emerging from the ground fly to seek protein-source foods before they mate. Proteins are very important for the fly's ovarian development and egg production [3]. Insecticide is the main, even in the most cases, is the only control tactic applied by pepper growers to control the Oriental fruit fly. Insecticides are used intensively which is up to 3 times a week. This practice could elicit the development of resistant population of the insect against the insecticides. In addition, other drawbacks of the excessive use of the chemicals such as the effects on non-target organisms and consumers can occur. Therefore, alternative control tactics, such as sticky colored traps to catch fruit fly adults must be used. Sticky substance amended with protein hydrolysate or male annihilation substances such methyl eugenol as lure [4] is widely used in trapping the fruit fly. Protein hydrolysate baits were first used in Hawaii for control of *B. dorsalis* [5].

Oriental fruit fly is most attracted to green, yellow, and orange traps in a laboratory experiment [6]; while the insect is most attracted to green and orange and black traps when the traps were set up in guava and mango fields, respectively [7]. In pepper plantation, *B. dorsalis* were most attracted to yellow, followed by white, green, red, and black traps. In general, traps placed 25 cm above the ground were more attractive to the fruit fly than those set up at 50 and 75 cm above the ground [8]. However, no information is available about trap size and direction that are suitable to catch *B. dorsalis* in pepper plantation. Therefore, the purpose of the current study was to determine the best combination of trap size and direction for catching the Oriental fruit fly adults.

MATERIALS AND METHODS

The study was conducted in the Teaching Farm, Faculty of Agriculture, Hasanuddin University, Makassar, South Sulawesi, Indonesia, from April 1 to August 30, 2016. The rainy season extends from October/November to April/May [9].

Three weeks old seedlings of chili pepper cv. Bhaskara were planted on April 21, 2016 with a planting space of 100 cm between rows and 75 cm within a row. Plant maintenance was performed by following the locally recommended practices. Treatments consisted of four trap sizes: 14 x 8, 21 x 11, 29 x 16, and 42 x 22 cm; and four trap directions: north, south, west, and east. Thus, there were 16 treatment combinations tested in this experiment and they were arranged in a complete randomized block design with four replicates. The traps were made of plastic sheets supported with wooden stakes. The plastic sheets were individually covered with plastic bags and then the plastic bags were painted with a sticky substance amended with protein hydrolysate as a lure for the fruit fly. When the plants started blooming (6 weeks after transplanting), the traps were placed in the chili pepper field. The distance between traps was 15 m. The numbers of flies caught per trap were recorded every 48 h by removing the plastic bags and then bringing them back to the Laboratory of Insect in relation to Plant Disease, Faculty of Agriculture, Hasanuddin University, Makassar for identification and count under a dissecting microscope (10-40X).

Adult fruit fly counts per trap were transformed using log (x + 1) before they were subjected to a two-way analysis of variance (ANOVA). When a significant difference was detected, the treatment means were separated using a Duncan's multiple range test ($P \leq 0.05$).

RESULTS AND DISCUSSION

There was a significant difference in the number of adults of *B. dorsalis* caught amongst the trap size treatments (Table 1). Trap size of 42 x 22 cm caught significantly more adult flies compared to the other trap

sizes tested during the trial. However, no significant differences in the number of fly capture were detected among the other treatments.

Table 1. Average numbers of adults of *Bactrocera dorsalis* caught in yellow traps set up 25 cm above the ground with different sizes and directions

Trap size (cm)	Average numbers of adults caught per trap				
	2 June	4 June	6 June	8 June	10 June
14 x 8	2.6	1.7	3.4	1.8	2.1
21 x 11	4.8	3.2	7.9	5.7	5.4
29 x 16	5.7	5.3	4.9	5.9	4.2
42 x 22	14.1*	11.6*	28.7*	10.3*	16.3*

*indicating significant difference amongst treatments on the same date

In this research, effect of cardinal directions of the traps (north, east, south, and west) on the fly captures were also tested. However, the statistical analysis failed to detect significant differences amongst the trap directions (Table 2).

Table 2. Average numbers of adults of *Bactrocera dorsalis* caught in yellow traps set up 25 cm above the ground with different cardinal directions

Trap direction	Average numbers of adults caught per trap (Mean)				
	2 June	4 June	6 June	8 June	10 June
North	6.7	5.2	8.9	5.2	6.1
South	7.2	6.0	9.8	5.1	5.7
West	6.6	5.1	14.9	6.2	10.0
East	6.7	5.6	11.3	7.2	6.2

No significant difference amongst treatments on the same date

Statistical analysis showed a significant difference in catch numbers amongst size treatments but not amongst direction treatments; and no interaction effects between the two factors existed (Fig. 1).

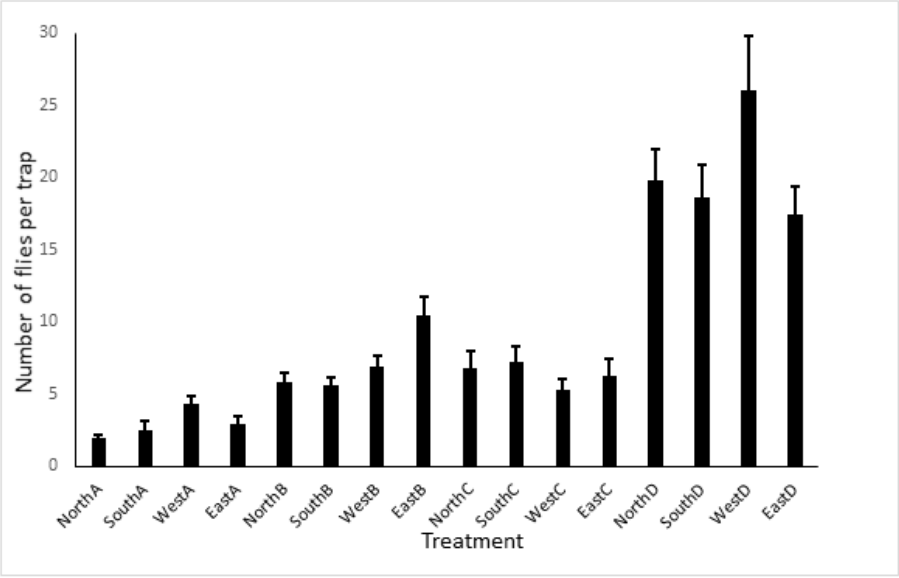

Fig 1: Mean number of adult *B. dorsalis* caught per trap for each trap size-direction treatment combination during five weekly counts. A = 14 x 8 cm, B = 21 x 11 cm, C = 29 x 16 cm, and D = 42 x 22 cm. Bars indicate mean standard errors.

Sticky traps are used to suppress pests' populations or to monitor their presence in a particular place or region [10]. Sticky trap is a safe control measures that can be used to effectively suppress fruit fly population by reducing the adult numbers. Besides that, the presence and population level of fruit fly in a certain place or region and time can also be determined by using sticky trap.

The results showed that the larger the size of the traps the more flies were caught. However, in terms of the average number of flies caught per cm^2 of trap surface, there were no significant differences among trap size treatments. Thus, in order to catch more flies, we should use bigger traps but this has to be economically justifiable because the larger the traps the more expensive they are.

The results showed that cardinal directions of the traps did not significantly affect the fly captures. This was probably due to the research site was surrounded by a variety of fruit trees such as mangoes, papayas, and other vegetables such tomatoes and chili and red peppers. Those plants also had developing fruits during the research; thus, fruit fly influxes into the site could come from multi directions. Therefore, no traps with particular direction caught more flies than the others.

CONCLUSION

Results indicated that trap size affected the trap effectiveness in capturing *B. dorsalis*. Trap size of 42 x 22 cm caught the highest number of flies; however, average numbers of flies per cm^2 of the trap surface were not significantly different amongst the treatments. Trap cardinal directions did not affect the trap captures in the research site. To the best of our knowledge, this is the first report on the effectiveness of trap size and direction in capturing the Oriental fruit fly in chili pepper plantation.

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