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TRAP COLOR EFFECTS OF FRUIT FLIES IN CROPPING LIME VILLAGE SIGAM MUARA ENIM DISTRICT DISTRICT GELUMBANG

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ABSTRACT: *The use of pesticides tends to be the best controlling choice for the farmer to obtain satisfactory results regardless of environmental conditions. While the impact of pesticides on other fauna as well as\ the decrease of the pest insect populations have been overlooked. Studyof the response of fruit flies to the trap color difference has been carried out in the lime farm of SigamVillage II Miora from March to April 2014. The experiment used a completely randomized design with 4 treatments and 9 replications. The treatments tested were steiner traps baited in methyl eugenol without color treatment (control) and steiner traps baited with methyl eugenol treatment of the red, yellow and green. The results obtained show that there is one type of fruit flies which were trapped namely Bactrocera dorsalis Hendel. From the experiments, there are more fruit flies trapped in yellow color baited with Methyl eugenol, the average number of the fruit fly trapped is (11.74), followed by the Green color trap by the number of average (8.67), then the trap without color (control) (7.46) and the Red traps (7.28).*

KEYWORDS: Female Fruit Fly, Male Fruit Fly, Traps Color.

INTRODUCTION

Citrus is one of the most important fruit commodities in Indonesia. Some types of citrus has been widely cultivated in Indonesia such as sweet orange, lime, lemon, tangerine and a grapefruit. Based on the data from the Ministry of Agriculture (2007) as cited in Alchin (2009) grapefruit harvested area in Indonesia reached 70,000 ha annually in 2004 with a total production of 1,600,000 tons. That puts Indonesia as citrus producing countries ranked in 13th place in the world after Vietnam. The productivity of the national citrus now ranges from 17-25 tons / ha which can be potentially reaching of 25-40 ton/ ha.

South Sumatra Province is one of the centers of planting orange (MoA, 2011). In the village sigam Gelumbang District of Muara Enim, Lime is the most widely cultivated citrus bt the local community. In cultivation, farmers often suffered losses due to pests and diseases of citrus. There are many kinds of pest that attack plants, but fruit flies are the major one. Fruit fly attack can drop off the production and quality of fruit. According to Hashim, et al. (2006), the mechanism of fruit flies attack is by inserting their eggs with its ovipositor thrust into the fruit where the larvae will further develop into the fruit. Damage caused by these pests will cause the death of the fruit before it reaches the desired ripeness, so that the production of both quality and quantity decreases.

Fruit fly pest is a pest that is difficult to control. There has been a lot of control techniques applied such as wrapping, fumigation and spraying of synthetic insecticides. However, these techniques are less efficient because the fruit packing technique take too much time and energy, especially in a vast cropping. Fogging is aimed to expel and prevent fruit flies to come back but it is only effective for 3 days, when the smoke cleared the fruit fly will commonly return. Synthetic insecticide spraying technique can affect the consumer because the residue can be

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incidentally consumed and turn it to be inedible fruits. In addition the nature of fruit flies which are always moving is caused to the spraying pesticide applications that are not on target.

The use of insecticides can cause damage to the skin of the fruit, the use of synthetic insecticides in pest control fruit flies also cause a number of negative effects such as increased pest resistance to insecticides, resurgence and environmental pollution because of insecticides contain harmful chemicals. This can be done by controlling the fruit fly by using traps. In order to trigger the fruit flies to get into the prepared trap, it takes some substances which can attract fruit flies. Some suggested efforts that can be done are to use methyl eugenol and to apply the color of the trap.

According to Sunarno (2011), other efforts which can have been made to control fruit flies that are safe for the environment and efficient is the use of pheromones as methyl eugenol. This is because the methyl eugenol has an aroma similar to that sex pheromones produced by female fruit flies so that male fruit flies will be attracted to approach her. Sex pheromones are used for communicating with other species and for attracting other insects to make the process of reproduction. By the nature of this particular insect, so it will be developed by using attractant traps aroma, which has an aroma similar to sex pheromones produced by the insects.

Methyl eugenol is an attractant, which is often used to control fruit flies, Bactrocera sp. This substance is volatile. It will evaporate and release scent with a radius of 20-100 m reach, but if assisted by the wind range, it can reach 3 km. Apart from its synthetic materials; methyl eugenol can also be made directly from some crops such as cloves, eucalyptus, the fragrant leaves and basil (Kardinan, 2013). Control by using methyl eugenol is a common and proven effective way in trapping fruit flies. However, these compounds will only trap male fruit fly. Female fruit flies are not too keen on the scent produced by attractant. The fruit fly females tend to be more attracted to color, especially the color on the ripe fruit. According to Alchin (2009) characteristic of female fruit flies in finding a host plant is determined by the color. That is because the female fruit flies have a visual stimulus, which will provide specific responses to the color of fruit ripeness.

Insects use a number of cues (chemical cues) and visual cues (visual cues) to locate and select the host plant habitat, includes for fruit flies. There is a correspondence between the visual or chemical cues, which determine the interest of fruit fly to its host fruit flies. Some research suggests that chemical cues such as the smell released by fruit or synthetic attractant (paraferomon) causes fruit flies attracted to approach the material. While the fruit flies are more interested in the shape, size, and color of a particular trap (Anonym, 2012).

There are several types of insect, which can distinguish colors, and some of the others can see the flowers plant polarized by the light. The insects can respond to light and other stimuli both in directed and undirected ways. Insect eye also serves to see the picture of the shape of objects, the eyes has the omatida and every omatida has function to capture light with different intensities and work together to form the observed picture. The ability of insects to distinguish colors is due to differences of amatoda, which is owned in good shape and ability to receive reflected light. Insect eye sensitivity depends on the pigment characteristics of nerve connections in the back of the eye and the influence of light. Differences in sensitivity to wavelength does not show the ability of insects to distinguish wavelengths but if insects have a visual pigment with different sensitivity spectrum then the insect is able to distinguish the wavelength of a color. For example :bees can distinguish six primary colors of yellow, green, blue, violet, ultraviolet, violet and a mixture of yellow and ultra violet. It is not yet known on

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the other insects, but in generally the blue and yellow colors can be distinguished by all insects (Anonymous, 2010).

It is already known from the description above that methyl eugenol is very effective as an attractant to attract and control fruit flies. Nevertheless, it is not known just yet if the appeal of methyl eugenol is combined with the color of the trap. Therefore, it is necessary to study the effect of various colors of traps in attracting either females or a male fruit fly in the lime farm of Sigam Village in Muara Enim District.

MATERIALS AND METHODS

This study was conducted in March-April 2014. It is located in the village of Sigam Gelumbang District of Muara Enim. Identification of fruit flies is done at the Laboratory of Biology, Faculty of Mathematics, and University of PGRI Palembang.

The tools used were stationery, mineral water bottle, and book of determination key, syringes, magnifying glass, a camera, a paintbrush, meter, tweezers, tape, marker, plastic rope, and plastic containers. Materials used were water, alcohol (70 %), the paint (red, yellow, green), cotton, methyl eugenol (Petrogenol).

This study used a completely randomized design, nine replications and four treatments as follows:

WO = Control, the trap without color

W1 = Trap with red color

W2 = Trap with yellow color

W3 = Trap with green color

Data analysis on trap color effects in attracting fruit flies, the number of fruit flies in each treatment were analyzed variance. If F count larger than F table then continued with different test LSD (Least Significant Difference) at the level of 0.05.

Land Measurement

Measurement of land and manufacture of the plots trap. The land area used for research is one ha with a spacing of 4 x 4 m, and a population of 625 stems of citrus. Making the trap in a 1 ha plot area planted is divided into nine regions trap placement, which is then divided into small plots of 20 x 20 meters.

Trap Making

Firstly, it needs 600 ml mineral water bottle which neck shape is conical. Bottled mineral water is then painted using the colors red, yellow, green and blue. There will be five bottles for each color. After that, the painted bottles dried in the sun. For bottles with no treatment (control), they won't be painted with any colors. The conical section of the bottle is cut with a distance of 8 cm from the mouth of the bottle, then both sides of the jar that has been cut, attached with cone-shaped mouth of the bottle mounted upside down. The cotton will be put in the bottle using a plastic strap that is useful as fruit fly bait.

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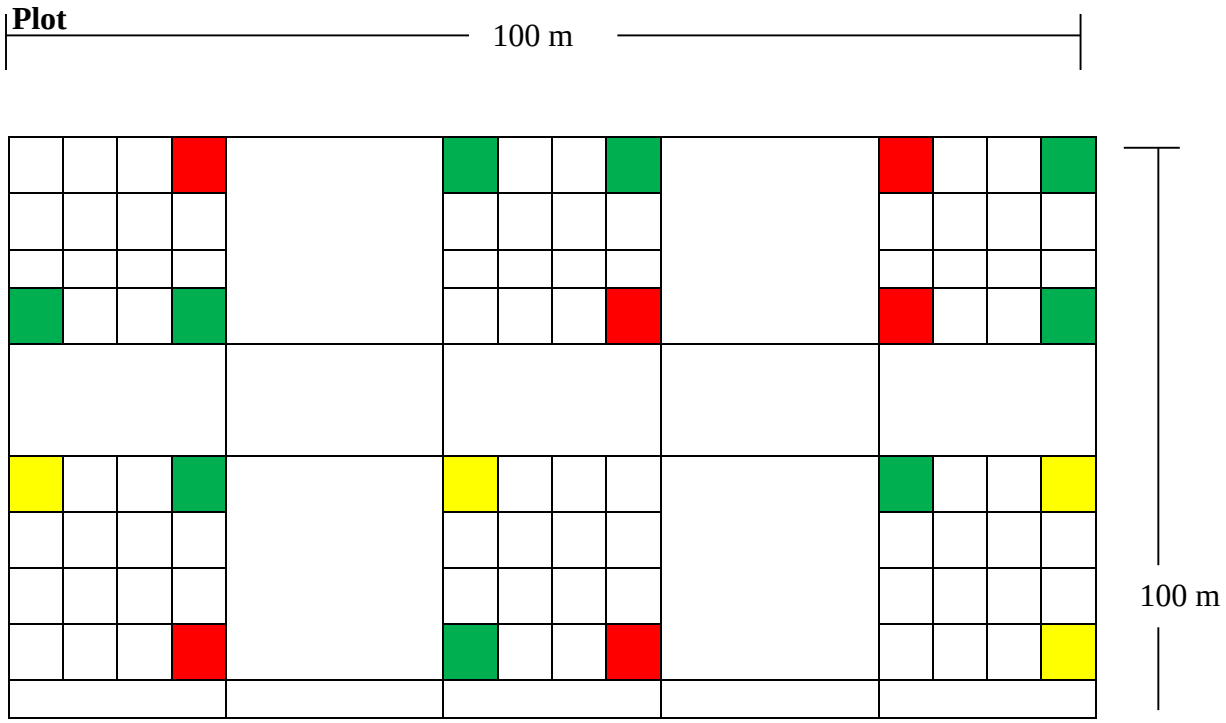
The Installation of the Trap

The Trap of fruit flies that had been made must be dropped as much as 0.2 ml of methyl eugenol. The traps were hung on the branches of lime using a plastic strap with a height of 15 m above the ground. Trapping should be accordance with the observation chart. Observations were made at 15:00 pm. Make observations three times, which is done in once in two days.

Observation Parameter

The parameters observed in this study are the average of fruit flies trapped and the sex ratio of fruit flies. The average fruit flies were obtained by counting the number of fruit flies in each treatment and repetition. Fruit fly sex ratio is obtained by looking at the gender of fruit flies using luv. After that, the amount of each gender of fruit flies will be recorded and calculated. Furthermore, fruit flies were identified to species using book of *Training Workshop on Fruit Flies of Indonesia Their Identification and Pest Status.*



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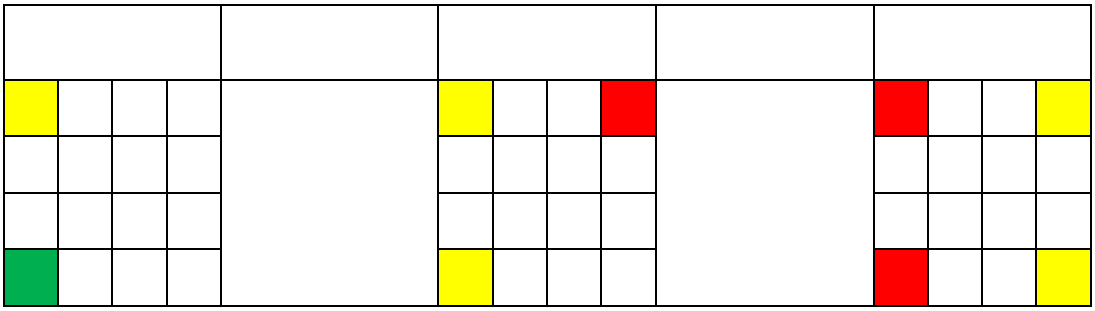

RESULTS AND DISCUSSION

Results Identification of Fruit Flies

Result of identification of the type of fruit flies, which are trapped in an orange plantation, found one fruit fly species (Table 1.)

Table 1. Type of trapped - Fruit Flies

No.	Types (Species)	Subgenus	Genus
1.	*Bactrocera dorsalis* Hendel	Bactrocera	Bactrocera

The Number of Trapped - Male and Female Fruit Flies

The variance analysis results of color trapping effect on the number of fruit flies ♂and fruit flies ♀ trapped on a sampling of the 2nd , 4th , and 6th days can be seen in Table 2 .

Table 2. Analysis of Variance of Color Trap Effect on the Number of Flies

Fruits ♂ and Fruit Flies ♀ (Data is transformed by roots $\sqrt{y+\frac{1}{2}}$)

Sources of Variety	Degree of Freedom	Number of Square	Central Square	F. Count	F. Table (5%)
Treatment	3	114,74	38,25	1,21	2,9
Residual	32	1012,2	31,63		
Total	35	1126,94			

Note: Not significant at 95% confidence level

Results of Data Analysis on Variance (ANSIRA) Table 2 shows that the difference in the color trap has no significant effect on the number of fruit flies ♀ and fruit flies♂, where F count is smaller than the F table.

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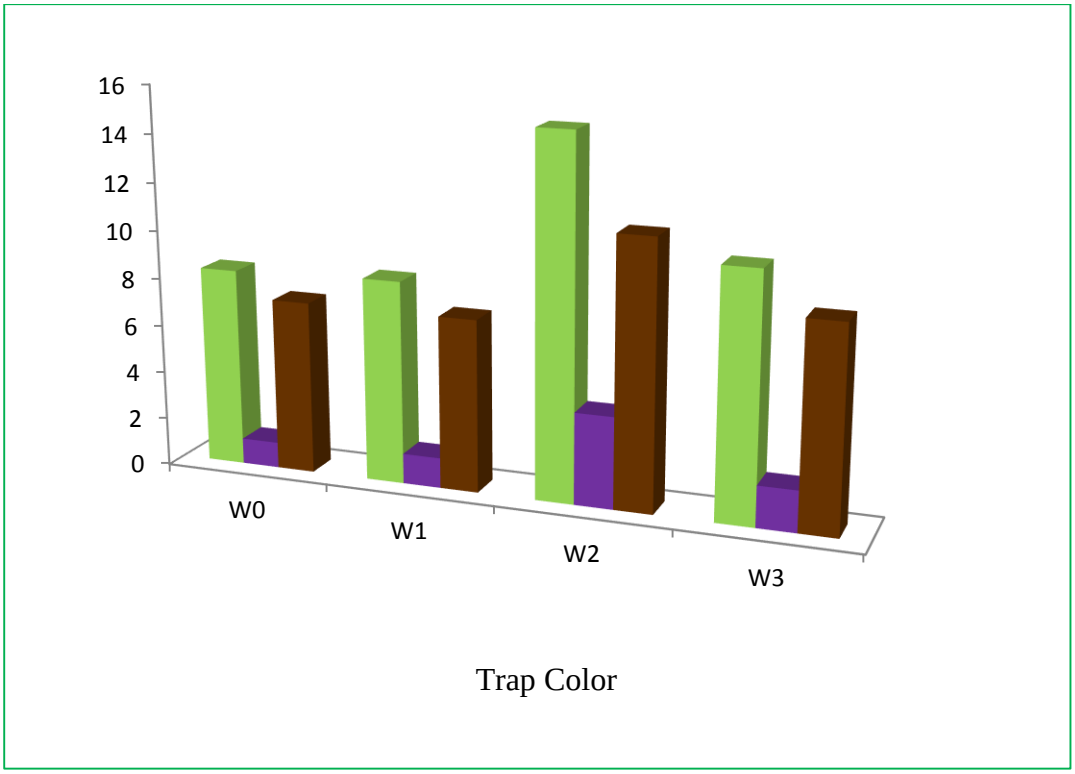

Note:

The average amount of fruit flies ♀and fruit flies ♂

Average number of flies ♀

Average number of flies ♂

W0 : Control (trap without color)

W1 : Trap with red color

W2 : Trap with yellow color

W3 : Trap with green color

Figure 2. Histogram of Average Comparison of the Fruit Fly Trapped

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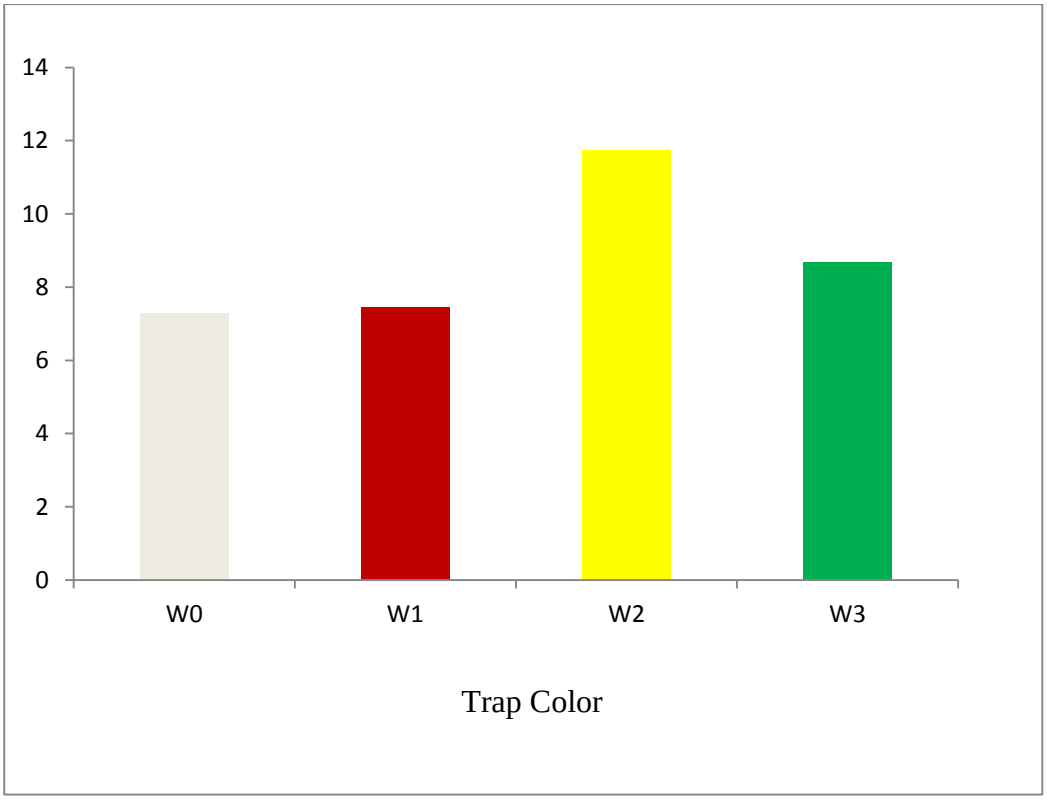

W0 : Control (trap without color)

W1 : Trap with red color

W2 : Trap with yellow color

W3 : Trap with green color

Figure 3. Histogram Number of Fruit Flies ♂ and Fruit Flies ♀ on the sample taking of 2nd, 4th and 6th days.

The amount of the Fruit Fly ♀ Trapped

Variance Analysis Results of color trapping effect on the number of fruit flies ♀ trapped to sampling of the 2nd, 4th, and 6th day can be seen in Table 3.

Table 3. Variance Analysis of Color Trap Effect on the Number Fruit Flies ♀

(Data is transformed in roots $\sqrt{y+\frac{1}{2}}$)

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Source of Variety	Degree of Freedom	Number of Square	Central Square	F. Count	F. Table (5%)
Treatment	3	38,72	12,91	4,71*	2,9
Residual	32	87,84	2,74		
Total	35	126,56			

Note: Influence on real confidence level of 95%

From the results of Data Variance Analysis (ANSIRA), Table 3 shows that the difference in the color trap has a significant effect on fruit flies ♀, where F count is greater than the F table, then the Advanced Test Least Significant Difference (BNT). This BNT Test results are shown in Table 4.

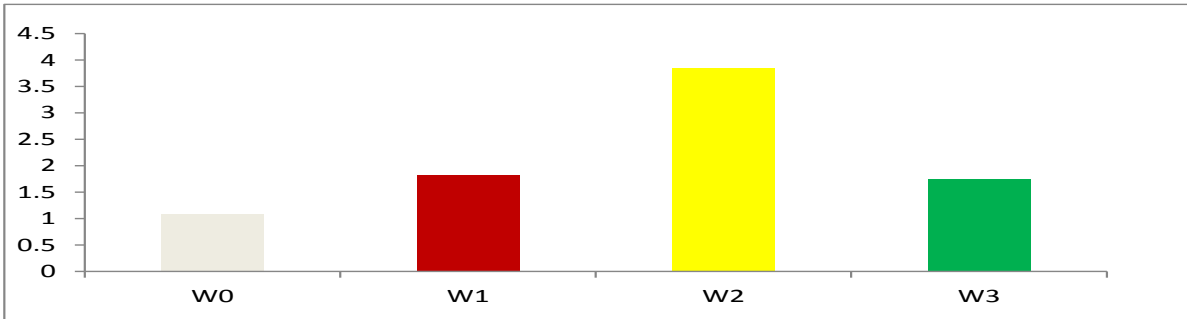
Table 4. BNT Test Results of Total Fruit Fly ♀ Trapped in Various Colors.

(Data is transformed in roots $\sqrt{y+\frac{1}{2}}$)

Treatment	Average Number of Fruit Flies ♀
W0	1,08 a
W1	1,83 a
W2	3,85 b
W3	1,74 a
BNT, 0,05 = 1,71	

Description: Average in the table which are followed by the same letter are not

Significantly different at BNT Test 5 %



W0 : Control (trap without color)

W1 : Trap with red color

W2 : Trap with yellow color

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W3 : Trap with green color

Figure 4. Histogram Number of Fruit Flies♀ on Sampling Day 2nd, 4th and 6th.

Variance Analysis Results of the influence of the color trap on the number of fruit flies ♂ trapped in sampling of day the 2nd , 4th , and 6th can be seen in Table 5 .

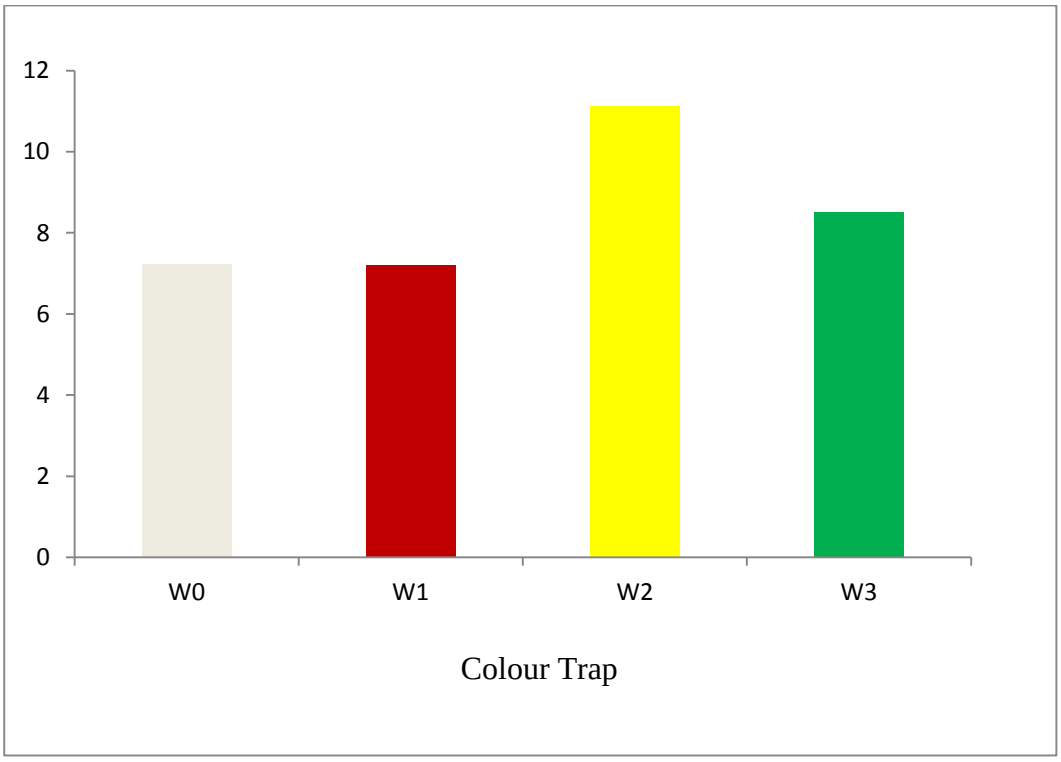
Table 5. Variance Analysis of Color Trap Effect on the Number of Fruit Flies ♂

(Data is transformed in roots $\sqrt{y+\frac{1}{2}}$)

Source of Variety	Degree of Freedom	Number of Square	Central Square	F. Count	F. Table (5%)
Treatment	3	91,58	30,53	1,05	2,9
Residual	32	933,59	29,17		
Total	35	1025,17			

Note: Not significant at 95% confidence level

From Results of Data Variance Analysis (ANSIRA), Table 5 shows that the difference in the color trap has no significant effect on fruit flies ♂, where F count is smaller than the F table.



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W0 : Control (trap without color)

W1 : Trap with red color

W2 : Trap with yellow color

W3 : Trap with green color

Figure 5. Histogram Number of Fruit Flies ♂ on Sampling of Day 2nd, 4th and 6th.

DISCUSSION

Table 1 shows that only one type of fruit flies was trapped namely Bactrocera dorsalis. This is because Bactrocera dorsalis is a major pest of citrus. This is consistent with the statement from Achrum, et al. (1995) who found an insect, Bactrocera dorsalis, fruit flies that affects all types of citrus, banana and star fruit.

Based on the results obtained, it is known that all treatments and controls color traps (transparent) using methyl eugenol bait so may only capture one type of fruit fly namely Bactrocera dorsalis. Appealing substance (attractance) is a substance that attracts insects towards the source of the substance. The source of Appealing substances found in insects, birds, mammals, fresh herbs and plants that have decayed. Insects usually have visual cues and chemical cues to find its host. Chemical cues released by fruit or synthetic attractance can cause fruit flies to be attracted or to approach the material. Synthetic attractant is called paraferomon because it will give the same response to pheromones, but it is not produced by the insect species that provide a response, methyl eugenol is paraferomon to attract male insects, Bactrocera dorsalis. This is consistent with the statement given by Siwi, et al (2006) who states that methyl eugenol can attract fruit flies from the genus of Bactrocera sub, but it wouldn't be applicable for members of the sub genus Zeugodacus, so the methyl eugenol trap has only one type of fruit fly, which is Bactrocera dorsalis. The following are the results for the identification of trapped fruit flies.

Bactrocera dorsalis

Brick red Abdomen, oval -shaped, on the dorsal part, there is the form of the letter T that is in black and the males have *pectin* hair on its third joint. A pair of round-shaped patches on the fifth Target can also be found on this type.

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Figure 6. Morphology of Fruit Flies ♀ Fruit Flies ♂

Cells rib, transparent wings , have costal band on the stigma so wingtip has a pattern which covers all parts R2 + 3 and extends down to the end of the venation R4 + 5, the wing does not have a cross band , also covering the anal cells and extension of anal cells. From the research that has been done, the number of fruit flies ♂ and fruit flies♀ trapped in various colors traps found to result in Variance Analysis (Ansira), in Table 2 which obtained F count equal to 1.21 after the data is transformed in roots. In Table 2, it can be seen that the value of F count is smaller than the value of F table, so the treatment of a wide variety of colors traps has no significant effect on the control.

The average number of fruit flies ♂and fruit flies ♀ trapped on a sampling of the 2nd, 4th and 6th are provided in a histogram (Figure 2).

On Histogram Figure 2, it can be seen that the average number of fruit flies ♂ and fruit flies ♀ trapped, the highest is in W2 (yellow traps) amounted to 11.74, followed W3 (green traps) amounted to 8.67, then W1 (red trap) of 7.46 and the lowest is W0 (by control / traps transparent) of 7.28. Although there are differences in the average number of fruit flies in each treatment but it did not give a significant difference. The treatment of the color trap had no significant effect on the control due to trapped fruit flies ♂ were influenced by each treatment, which is dominated fruit flies fruit flies ♂. In each treatment, color trap was given methyl eugenol, methyl eugenol known to attract male fruit flies. As noted from Alchin, Denise (2009) that methyl eugenol is a food lure and needed by male flies for consumption. From the research that has been obtained, it is not only fruit flies ♂ were trapped but fruit flies ♀ also trapped. It relates to the fruit fly mating behavior. According to Cuba (1991), male imago forms a group and settle or do not disperse and mate at dusk. In the evening, fog will be seen around the cage, for instance, this male will be ready to mate. The fog contains a sex pheromone, during the production of the fog, male imago will always vibrate his wings, and this behavior is used to spread sex pheromones to the female imago. The movements of adult males were in the plant and they form groups that do not disperse, then imago males begin vibrate its wing underside of the leaf surface and emit sex pheromones, each male imago occupies a leaf into a territory and maintained during an invasion with other males in the leaves.

According to Hashim et al (2006) methyl eugenol is an attractant of synthetic chemicals that have been found to capture male fruit flies Bactrocera sp and specific only to certain fruit fly species . The synthetic attractant called paraferomon due to the same response that it provides just like a pheromone but it is not produced by the insect species, which can provide a response.

It can be seen that the level of the fruit fly trapped on the day 2nd, 4th and 6th is influenced by several factors as disclosed by Rukmana and Sugandi (1997). They found that factor influenced on the low or high number of fruit fly is on rainfall and temperature (Appendix 1, 2, and 3). Fruit flies do not like the very low temperature, but preferably the temperature, which is not too high. The intensity of the attacks and the fruit fly population will increase in the state of low rainfall, at temperatures ranging from 26 ° C.

For the average number of fruit flies ♀ that have been transformed, it is found that the Variance Analysis Result (Ansira) in Table 3, which gained F count 4.71 and has a 5 % greater value than F Table which is 2.9. These results indicate that treatment of the color trap has a significant effect in a female fruit fly trap. LSD test is obtained to determine the differences level in each treatment. Further Test Results BNT of 5 % showed that yellow color is the only trap that gives

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significantly different results against a control, while the green and red colors do not give significantly different results against a control.

In Table 4, it can be seen from Test Results BNT that the average number of fruit flies ♀ at W1 (1.83) was not significantly different with W0 (1.08) and was not significantly different with W3 (1, 74). In the trap W2 (3.85), it was significantly different with W0 , trap W2 and W4 trap. Trap W4 (1.74) was significantly different with W2 but not significantly different with W0.

The high average number of fruit flies in the trap ♀ W2 (yellow) is caused by female fruit flies, which prefer ripe fruit. In finding a host, fruit flies use a number of visual cues or chemical cues. Yang, et al (2005) stated that the three visual characteristics of plants that cause a plant selected by insects to lay eggs and eat namely, the size, shape and plants color quality. Besides, insects have a different color spectrum than humans. This is supported by the opinion of Meyer (2006), that most insects have only two types of visual pigment, the pigment that can absorb green and bright yellow color and pigment that absorbs blue and ultra-violet rays.

Suitability of visual and chemical cues will cause the fruit flies attracted to find a host. In an interest research of insects to color as a visual stimulus, it can be seen that the average of the highest to the lowest traps are W2 traps (yellow), W4 (Green), W1 (red) and W1 (control). According to Gustilin (2008) insect can distinguish colors, probably because of the differences in retinal cells in the eye of insects. Wavelength range that is acceptable for insect is 2540 - 6000 A. In this study fruit flies ♀ are more attracted to the yellow color because it has a wavelength of 4240 – 4910 A.

In relation to the control techniques, it is clear that the physical pest control techniques using color trap can be used as a control technique, which is effective, efficient and environmentally friendly. Fruit flies control, especially Bactrocera dorsalis in citrus will be more effective if use of methyl eugenol bait and yellow trap. It is because besides male fruit flies can concurrently be trapped with methyl eugenol and also trap female fruit flies with yellow color trap.

If earlier said that the color trap has significant effect on the number of female fruit flies, another case with trapped male fruit flies did not give tangible results. This can be seen in Table 5 in which the value of F count Treatment of 1.05 is less than the value of F table 2.9. Histogram can be seen in Figure 5 that the average number of highest male fruit flies are in W2 (yellow traps) amounted to 11.13 then W3 (green traps) amounted to 8.51, then W0 (control) of 7.23 and the W1 is the lowest (red trap) of 7.21. The big difference in the average number of male fruit flies are not due to the influence of the various pitfalls of color but influenced more on methyl eugenol bait.

Besides, the traps setting and plot determination also may affect. If the trap is placed on a plot at the center of the planting, it will provide more catches than the traps that are on the side of cropping land. Mobility owned by male fruit flies also affect catches. According to the statement proposed by Sunarno (2011), male fruit flies flying ability is influenced by the speed and direction of winds that carry the scent of methyl eugenol, which can help, facilitate male flies to find sources of methyl eugenol. The color on the trap does not give real effect to control the male fruit flies. That is because the trap that is color-coded and control is given the same dose of methyl eugenol. According to Hashim (2006), methyl eugenol is required as food lure by male fruit flies to be processed in the body into a sex pheromone to attract female fruit flies.

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Just like other insects, male and female fruit flies have the ability to distinguish colors. However, only female fruit flies that can determine or identify its host to lay eggs. According Gustilin (2008) insect can distinguish colors probably due to differences in retinal cells in the eye of insects. Meyer (2000) in Sunarno (2011) that most insects have two types of visual pigment, pigment that can absorb green and bright yellow color and pigment which can absorb blue and violet supports this also. Female fruit flies activity in finding a host plant is determined by the color and aroma of the fruit, when the fruit is ripe and yellow fruit flies seemed to recognize its host to lay eggs.

CONCLUSION

Based on the results of this study, it is concluded that:

1. Type of fruit flies, which are trapped in this study, is *Bactrocera dorsalis*.

2. The use of color in trapping trap fruit flies generally does not give a tangible effect. However, the use of trap color in fruit flies ♀concurrently has significant effect.

3. The attraction of fruit flies ♀ to colors can be seen from the average number of fruit flies, which were trapped and caught in the yellow trap followed by traps in green, red and controls.

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