

Response of Insects to the Light and Coloured Sticky Traps

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ABSTRACT

Research regarding response of insects to the light and coloured sticky traps have been done in fruit and red chili garden in Sumedang and Lembang area. The coloured sticky traps consisted of transparent, grey, brown, black, red, yellow, green, blue, and white were placed at fruit and red chili garden, meanwhile light traps were placed in red chili garden. Research was designed at Randomized block design, 9 treatments and 3 replications. Size of coloured sticky traps are 30 cm X 30 cm. Observations were made on the number and kind of insects trapped on the seventh day, especially for fruit fly (*Bactrocera* spp.); which became the main pest of fruits and red chili; and thrips. The results showed that the most favoured colour for fruit flies is white, either it was installed on fruits, or on red chili. Yellow is the most attractive colour for insects generally, especially thrips in the red chili garden. Light and coloured sticky traps are able to trap a variety of insect pests, including useful insects such as pollinating insects and predators, but the numbers are quite small (under 1%) when compared with the number of insect pests trapped.

Keywords: insects, response, traps

1. INTRODUCTION

Insect activity is generally classified into groups of nocturnal, diurnal (active daytime) and crepuscular (active at dusk or morning before sunrise/sunset). This activity is influenced by biotic factors (competition, predators, etc.) [1]. Insects in several ways try to avoid predators, such as through mimicry, disguises, chemical defenses, and other methods. Insects regulate their activity patterns to be safe and avoid predators, so that their activities do not coincide with the time of predator activity [2,3]. Jin *et al.* [4] states that the most catches of insects is in the evening (sunset), followed in the early morning, namely in the crepuscular group. An understanding of pest insect behaviour, one of which is its preference for colour, light, and others; is very important as a basis for developing control techniques. In this research, nocturnal variations and populations of insects will be observed through light traps and in the daytime (diurnal) through sticky traps of various colours. Some pest insects that attack vegetables (especially chili) as well as mangoes and oranges are fruit flies (*Bactrocera* spp.) and thrips especially in red chili, and other pests. Fruit fly pests cause fruit to rot and become curled and eventually fall out, thereby reducing production by 30-40%, even in certain commodities such as papaya, guava, and starfruit can lead to crop failure [5]. Likewise, thrips pests which attack the flowers and shoots of red chili have the potential to thwart fruit formation and reduce yields by 30-50% [6]. Control

that has been carried out by farmers is to use synthetic chemical insecticides which have become a guarantee of success in farming farmers (dependence on synthetic chemical insecticides). Farmers often mix several kinds of pesticides with concentrations above the recommendations, thus endangering the environment and human health [7]. The results of the study of Rasipin *et al.* [8] in the red chili production center in Brebes District, Central Java Province, Indonesia showed that 97% of elementary school children were exposed to pesticides with an indication of swelling of the thyroid gland. The objective of the study is to obtain information about the response of pest insects, both diurnal and nocturnal to the light and coloured sticky traps, so that they can be used as a basis for integrated pest control which can ultimately reduce the use of synthetic chemical insecticides and reduce farmers' dependence on chemical synthetic insecticides.

2. MATERIALS AND METHODS

The study was conducted in 2018 in orchards (mangoes and oranges) in Sumedang District, West Java, Indonesia and in the Red Chili Garden in the Lembang area, Bandung District, West Java, Indonesia.

2.1. Research in Fruit Gardens (Mangoes and Oranges)

Research is designed at Randomized Block Design, nine treatments and three replications. In the mango and orange orchards, 9 coloured sticky traps are installed at each replication, namely: transparent, grey, brown, black, red, yellow, green, blue, and white. The coloured sticky traps measuring 30 cm X 30 cm placed in an orchard. Research in orchards focused on fruit fly pests (*Bactrocera* spp.) which are the main pests of mangoes and oranges. Observations were made a week after installing coloured sticky traps in the garden by counting the number of fruit flies and other insects trapped.

2.2. Research in Vegetable Gardens (Red Chili)

In the chili garden there are two research activities, namely research on the use of light traps combined with coloured sticky traps, and testing of coloured sticky traps consisting of 9 colours, namely: transparent, grey, brown, black, red, yellow, green, blue

and white, measuring 30 cm X 30 cm. The study was designed in randomized block design, 9 treatments and 3 replications. Observations were made a week after setting traps by counting the number and kind of trapped insects.

3. RESULTS AND DISCUSSION

3.1. Research in Fruit Gardens

3.1.1. Mango Garden

Observations made one week after the installation of coloured sticky traps showed that the highest number of fruit flies trapped were at white sticky traps (185), followed by grey (171) and green (137), whereas based on the total number of trapped insects (any insect) showed that white is the highest (448), followed by green (356) and grey (334), as in Table 1.

Table 1. The number of fruit flies and other insect trapped on coloured sticky traps in mango garden

| Colour of the trap | Fruit flies (<i>Bactrocera</i> spp.) | Other insects | Total |
|--------------------|---------------------------------------|---------------|--------|
| Transparent | 117 d | 167 | 284 c |
| White | 185 a | 263 | 448 a |
| Yellow | 95 e | 162 | 257 c |
| Grey | 171 b | 163 | 334 b |
| Red | 52 g | 40 | 92 e |
| Brown | 73 f | 46 | 119 de |
| Green | 137 c | 219 | 356 b |
| Blue | 63 fg | 48 | 111 e |
| Black | 50 g | 85 | 135 d |

Numbers followed by the same letter at the same column are not significantly different at 5% DMRT

3.1.2. Orange Garden

Observations made one week after the installation of coloured sticky traps showed that white colour still dominates the catch of *Bactrocera* spp. (183), followed by transparent colours (83) and red colours (64), likewise based on total number of trapped insects showing a consistent number of catches, i.e. white trapped as many as 207 insects, followed by transparent (119) and red/grey (92/93), as in Table 2.

From the two data above conducted in two ecosystems (mango and orange orchards) showed that the white trap is most attractive on trapping the fruit flies of *Bractocera* spp., as well as trapping other types of insects compared to other coloured sticky traps. Allegedly with the nature of the white colour with the characteristic of being able to reflect stronger light than other colours, the white colour is more attractive to insects in general that are diurnal (active during the day).

Table 2. The number of fruit flies and other insects trapped on coloured sticky traps in orange garden

| Colour of the trap | Fruit flies (<i>Bactrocera</i> spp.) | Other insects | Total |
|--------------------|--|---------------|-------|
| Transparent | 83 b | 36 | 119 b |
| White | 183 a | 24 | 207 a |
| Yellow | 54 cd | 26 | 80 cd |
| Grey | 43 d | 23 | 66 d |
| Red | 64 bc | 28 | 92 c |
| Brown | 23 e | 10 | 33 e |
| Green | 43 d | 22 | 65 d |
| Blue | 54 cd | 39 | 93 c |
| Black | 34 de | 29 | 63 d |

Numbers followed by the same letter at the same column are not significantly different at 5% DMRT

3.2. Research in Vegetable Gardens (Red Chili)

3.2.1. Coloured Sticky Traps

The results of observation done in the red chili garden on the type and average number of insects per trap showed that white was still the most attractive colour for the fruit fly *Bactrocera* spp., which was 36 insects/trap, followed by grey (26/trap) and transparent (20/trap (Table 3). Fruit fly (*Bactrocera* spp.) is the main pest in the red chili which often results in rotting and fall of fruit. Research conducted by Sikandar *et al.* [9] in an orange orchard in Pakistan showed that the most preferred colour of fruit flies is yellow and transparent, while the results of the study of Said *et al.* [10] in the chili garden showed that the most preferred fruit flies were yellow and white. This is due to differences in ecosystems, especially climate and also the possibility of differences in species of fruit fly pests, because fruit flies are known as complex species (*Bactrocera dorsalis* Complex) where among the species themselves are difficult to distinguish. When looking at catches between ecosystems in fruit orchards and in red chili vegetable gardens, there is a slight difference in the number of insects caught in certain colours, but both ecosystems show that white is consistent as the preferred colour of the fruit fly.

In addition to fruit fly pests, thrips are also serious pests in the red chili crop, where these pests often attack shoots and flowers in the red chili crop and result in

decreased production. Observation showed that yellow traps the most thrips (683), followed by red (212) and transparent (64). However, the yellow colour is not only able to trap the thrips, but it also traps useful insects such as predatory beetles (Coccinellidae) and pollinating insect (Shyrpidae). Of the total number of trapped insects, yellow is the colour most preferred by insects, which is able to trap several types of insects as much as 806 insects, followed by red (240) and transparent (113). The results of this study differ from the results of research conducted by Devi and Roy [11] on red onion plants which stated that the colour that Thrips most liked was blue, also the same result that was done by Ranamukhaarachchi and Wickramarachchi [12] who did research on tomatoes showed that the blue was most preferred colour by thrips. But the results of the study of Thongjua *et al.* [13] in orchids shows that yellow is the most preferred colour of thrips. The results of Pickering and Stock [14] which was conducted at the horticultural center in Australia showed that the colour of the flowers most preferred by insects were white and yellow, as well as the colour of the sticky traps that trap most insects is white, especially dominated by insects from the Diptera order (Fruit flies including the Diptera order).

From the explanations above shows that the interest of a type of pest to colour, in this case fruit flies and thrips will be very dependent on the existing ecosystem and plant commodities that allow differences in species or the response of a species to a colour that is influenced by the local ecosystem.

Table 3. The number and kind of insects trapped on coloured sticky traps in red chili garden

| Colour of The Trap` | Kind of insects | Genus | Family | Number |
|----------------------------|------------------------|--------------|---------------|---------------|
| Transparent | Fruit flies | Bactrocera | Tephritidae | 20 |
| | Thrips | Thrips | Thripidae | 64 |
| White | Plutela | Plutella | Lepidoptera | 2 |
| | Green planthopper | Empoasca | Cicadellidae | 13 |
| | Leaf eater | Liriomyza | Agromyzidae | 14 |
| | Green planthopper | Empoasca | Cicadellidae | 11 |
| | Leaf eater | Liriomyza | Agromyzidae | 9 |
| | Thrips | Thrips | Thripidae | 43 |
| | Fruit flies | Bactrocera | Tephritidae | 36 |
| Yellow | Helicoverpa | Helicoverpa | Noctuidae | 1 |
| | Plutela | Plutella | Lepidoptera | 2 |
| | Fruit flies | Bactrocera | Tephritidae | 15 |
| | Predator | Menochilus | Coccinellidae | 2 |
| | Polinator | - | Shyrpidae | 1 |
| | Plutela | Plutella | Lepidoptera | 1 |
| | Helicoverpa | Helicoverpa | Noctuidae | 2 |
| | Thrips | Thrips | Thripidae | 683 |
| | Green planthopper | Empoasca | Cicadellidae | 72 |
| | Leaf eater | Liriomyza | Agromyzidae | 28 |
| Grey | Fruit flies | Bactrocera | Tephritidae | 26 |
| | Spodoptera | Spodoptera | Noctuidae | 1 |
| | Plutela | Plutella | Lepidoptera | 3 |
| | Leaf eater | Liriomyza | Agromyzidae | 8 |
| | Thrips | Thrips | Thripidae | 41 |
| | Green planthopper | Empoasca | Cicadellidae | 8 |
| | Red | Helicoverpa | Helicoverpa | Noctuidae |
| Crocidolomia | | Crocidolomia | Pyralidae | 2 |
| Fruit flies | | Bactrocera | Tephritidae | 18 |
| Thrips | | Thrips | Thripidae | 212 |
| Leaf eater | | Liriomyza | Agromyzidae | 6 |
| Brown | Fruit flies | Bactrocera | Tephritidae | 7 |
| | Crocidolomia | Crocidolomia | Pyralidae | 1 |
| | Green planthopper | Empoasca | Cicadellidae | 3 |
| | Leaf eater | Liriomyza | Agromyzidae | 1 |

| | | | | |
|-------|-------------------|--------------|--------------|----|
| Green | Fruit flies | Bactrocera | Tephritidae | 5 |
| | Green planthopper | Empoasca | Cicadellidae | 6 |
| | Crocidolomia | Crocidolomia | Pyalidae | 2 |
| | Plutela | Plutella | Lepidoptera | 1 |
| | Leaf eater | Liriomyza | Agromyzidae | 7 |
| Blue | Fruit flies | Bactrocera | Tephritidae | 11 |
| | Green planthopper | Empoasca | Cicadellidae | 26 |
| | Leaf eater | Liriomyza | Agromyzidae | 26 |
| | Thrips | Thrips | Thripidae | 11 |
| | Plutela | Plutella | Lepidoptera | 4 |
| | Crocidolomia | Crocidolomia | Pyalidae | 1 |
| Black | Fruit flies | Bactrocera | Tephritidae | 5 |
| | Green planthopper | Empoasca | Cicadellidae | 4 |
| | Plutela | Plutella | Lepidoptera | 1 |

3.2.1. Combination of Light Traps and Coloured Sticky Traps in The Red Chili Garden

The observations showed that although the number of insects trapped by light traps differed from the number of insects trapped by coloured sticky traps, the composition was almost the same, i.e. the dominant insects were thrips, followed by *Liriomyza* (Agromyzidae). No fruit flies (*Bactrocera* spp.) were found trapped by light traps, but in coloured sticky traps (Table 4 and Table 5). This is because the fruit fly is diurnal (active during the day), therefore fruit flies were not interested by light traps.

The same thing was shown by observations on coloured sticky traps, where insects were dominated by thrips (438) which were the main pests of red chili and followed by *Liriomyza* leaf-cutting (Agromyzidae). Pollinators insects from Family Aleyrodidae and Anthoporidae, and also fruit fly *Bactrocera* spp. which are the main pest of the red chili were also trapped (Table 5).

From Table 4 and Table 5 above, it can be seen that both light traps and coloured sticky traps may trap either pest insects or useful insects, such as predatory and pollinator insects, but the numbers of useful insects trapped are quite small, which is under 1%.

Table 4. The number and kind of insects trapped by light traps in red chili garden

| Family | Genus | Kind of Insects | Number |
|---------------|-------------|-----------------------|--------|
| Aeshinidae | Neurothemis | Dragon flies/predator | 1 |
| Coccinellidae | Microspic | Predator | 2 |
| Scarabidae | Exopholis | White grub | 2 |
| Staphylinidae | Paederus | Predator | 3 |
| Agromyzidae | Liriomyza | Leaf eater pest | 41 |
| Cicadellidae | Empoasca | Green planthopper | 5 |
| Noctuidae | Spodoptera | Armyworm | 7 |
| Noctuidae | Plusia | Plusia | 4 |
| Tripidae | Thrips | Thrips | 111 |
| Total | | | 176 |

Table 5. The number and kind of insects trapped by coloured sticky traps in red chili garden

| Family | Genus | Kind of Insects | Number |
|---------------|------------|-------------------|--------|
| Calliphoridae | Chrysomya | Green flies | 13 |
| Tephritidae | Bactrocera | Fruit flies | 29 |
| Culicidae | Culex | Mosquitos | 12 |
| Tahinidae | Musca | House flies | 27 |
| Agromyzidae | Liriomyza | Leaf eater | 243 |
| Cicadellidae | Empoasca | Green planthopper | 98 |
| Aleyrodidae | Bemisia | Bemisia | 15 |
| Anthoporidae | - | Pollinators | 1 |
| Syrphidae | - | Pollinators | 5 |
| Noctuidae | Spodoptera | Armyworm | 23 |
| Noctuidae | Plusia | Plusia | 2 |
| Tripidae | Thrips | Thrips | 438 |
| Total | | | 906 |

4. CONCLUSION

The white coloured sticky trap is the most attractive trap to *Bactrocera* spp./fruit flies, both in the fruit garden ecosystem and in the vegetable/red chili gardens. Yellow is the most attractive colour for insects, especially the thrips in the red chili garden. Light traps and coloured sticky traps are able to trap various types of pest insects, including useful insects such as pollinating insects and predators, but the numbers of pollinator and predator trapped are quite small (under 1%) when compared to the number of insect pests trapped.

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