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EFFICACY EVALUATION OF METHYL EUGENOL-BASED STICKY TRAP FOR CAPTURING ORIENTAL FRUIT FLY, *BACTROCERA DORSALIS* IN LYCHEE ORCHARD

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ABSTRACT

Methyl eugenol containing yellow and blue sticky traps were evaluated for their efficacy in attracting and trapping fruit flies in two lychee orchards located in two different areas at Dinajpur Sadar, Bangladesh. In both type of traps, only the males of *Bactrocera dorsalis* were trapped. In both locations, yellow sticky traps captured more fruit flies (174.00 ± 19.41) than the blue sticky traps (114.75 ± 4.57). In both traps, the maximum number of fruit flies was trapped on the first day of trap setting, which continued but gradually decreased up to the last date of fruit fly collection (7th day). On the first day of trapping, the yellow trap captured 60 more fruit flies than the blue trap in Bontara, Luxmitola of Dinajpur Sadar. In Ukundi in Luxmitola of Dinajpur Sadar, on the first day, there was no difference differences but from day 2 to day 7, the yellow trap captured almost double as the blue trap. These findings suggest that the yellow trap is preferable to capture the fruit fly, *Bactrocera dorsalis,* when applied in combination with Methyl eugenol.

Keywords: Lychee, Efficacy, Methyl eugenol, Sticky trap, *Bactrocera dorsalis*

INTRODUCTION

Lychee, *Litchi chinensis* Sonn. (Sapindaceae: Sapindales), is a popular fruit in Bangladesh due to its refreshing taste, flavoured juice, and attractive colours. It can be consumed as fresh fruit or processed products (Singh *et al.* 2012). In Bangladesh, lychee cultivation includes more than 12545 ha of land with an annual production of more than 82,000 metric tons (BBS 2023). Due to high economic return and increased demand, its production is increasing day by day. Infestation

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of insects and mites is the major constraint for lychee cultivation. Lychee fruit borer *(Conopomorpha sinensis*), lychee leaf roller (*Pletypeplus aprobola*), and lychee mites (*Aceria litchi*) are the most common pests that interrupt the production and market value of the lychee in Bangladesh (Taher *et al.* 2023). In the northeastern part of Bangladesh, infestation of lychee stink bug, *Tessaratoma javanica* Thunberg (Hemiptera: Tessaratomidae) found to be prominent (Mondal *et al.* 2020). In Bangladesh, fruit fly infestation in lychee is not reported. However, the Mediterranean fruit fly (*Ceratitis capitata* Wied.), the Natal fruit fly (*Ceratitis rosa* Karsch), and the Marula fruit flies (*Ceratotis cosyra* Walker) are reported to infest lychee in Africa (Grove and De Beer 2014). In Hawaii, the oriental fruit fly, *Bactrocera dorsalis*, is reported to infest the lychee at the later ripening stage, causing deterioration of fruit flesh and secondary infection by bacteria and fungi (Kawabata and Nakamoto 2013).

The fruit fly belongs to the family Tephritidae under the order Diptera. Tephritidae includes around 5000 species under 500 genera. Fruit flies are the major pest of some commercially important fruits, especially mango, guava, lychee, apple, etc. (Doorenweerd *et al.* 2018; Ahmad *et al.* 2021; Jamil *et al.* 2022). Fruit flies are polyphagous and severely affect the fruits and vegetables, causing up to 30-100% loss (Mohanpuria *et al.* 2021). Female fruit flies deposit eggs in tender fruits using their telescopic ovipositors, and after emergence, the larvae feed on the fleshy part of the fruits. Various management practices have been implemented to control fruit fly pests, but chemical applications have been found effective (Ahmad *et al.* 2021). However, almost all the chemical insecticides lead to the development of insecticide resistance in insect pests (Ullah *et al.* 2019). These are also detrimental to non-target (Mollah *et al.* 2022; Mollah *et al.* 2017) and beneficial insects including predator (Mollah *et al.* 2012) and parasitoid (Mollah and Khatun 2023).

The bait application technique (BAT) using different attractants has become an essential component of fruit fly management programs worldwide (El-Sayed *et al.* 2009). Methyl eugenol (4-allyl-1,2-dimethoxybenzene-carboxylate) and cue lure (4-(p-acetoxyphenyl)-2-butanone) are two well-known and widely used attractants (Barclay *et al.* 2014). These are components of male annihilation techniques (MAT) which attract and capture the adult male flies before they mate with females, and

therefore ensure the control of fruit flies in the target area for many years (Kim *et al.* 2019; Kim *et al.* 2018). In the present study, methyl eugenol-based attractant applied in yellow and blue coloured sticky traps. However, 0.5% abamectin was incorporated with the methyl eugenol to kill the captured flies. The objective of the study was to know the prevalence of fruit flies in the lychee orchard and to determine the role of sticky trap colour for attacking fruit flies, in addition to methyl eugenol.

MATERIALS AND METHODS

This study was conducted during June 2024 in two lychee orchard in different locations, namely Bontara and Ukundi in Luxmitola of Dinajpur Sadar, Bangladesh. This area located at 25.6333°N latitude and 88.6500°E longitude, having an elevation of 37 m above the sea level. Lychee was the main fruit plant in these two locations. A commercial bait named Zonatrac as an attractant was tested which is composed of methyl eugenol (35%) and abamectin (0.5%). Two types of sticky traps (10 cm × 25 cm), namely yellow sticky traps and blue sticky traps were used to capture and monitor the attracted fruit flies. Therefore, two combinations, namely Zonatrac in the yellow trap and Zonatrac in the blue trap, were used as treatment. Each combination was replicated thrice in both locations. Zonatrac was applied by dropping at two points in each sticky trap. A sticky trap containing the attractant 'Zonatrac' was hung in the canopy level (5 feet) in the branch of each lychee plant. One yellow and one blue trap were hung in two different branches of the same lychee tree. The experiment was conducted just after harvesting the lychee fruits. Fruit fly capture was recorded every day at 24 h interval and continued up to seven (7) days when some of the sticky trap was saturated with fruit flies and no or very few new fruit flies were captured. All raw data were analysed using Microsoft Excel, and graphs were prepared using SigmaPlot 12.5. All statistical analyses were performed using the R program.

RESULTS AND DISCUSSION

Speciality of 'Zonatrac' to capture *Bactrocera dorsalis*: In the Lychee orchard, males of the oriental fruit fly, *Bactrocera dorsalis* was captured in the eugenol based sticky traps (Fig. 1). Blue sticky traps captured only *Bactrocera dorsalis* (Fig. 1B)

but few other Species found in yellow sticky trap (Fig. 1A). However, comparatively more *Bactrocera dorsalis* were captured in yellow sticky trap than the blue sticky trap.

Effect of sticky trap colour for trapping fruit flies: For location 1 (Bontara, Luxmitola, Dinajpur Sadar), the Color of the sticky trap significantly affects the capture of fruit flies ($P < 0.05$). On the first day of trap setting, a greater number of fruit flies were captured in the yellow trap (113 ± 5.66) than in the blue sticky trap (53 ± 4.24) (Fig. 2). This phenomena were also observed for other days, continuing up to the last day (7^{th} day) of fruit fly trapping (187.5 ± 13.44 fruit flies in the yellow trap and 113.5 ± 4.95 fruit flies in the blue trap). However, for both cases, maximum number of fruit flies were trapping at the first day (113 ± 5.66 fruit fly in yellow trap and 53 ± 4.24 fruit fly in blue trap) of trap setting which gradually increased up to last day (7^{th} day) of fruit fly trapping (187.5 ± 13.44 fruit fly in yellow trap and 113.5 ± 4.95 fruit fly in blue trap) (Fig. 2). Sowmiya *et al.* (2021) also reported that yellow color trap captured more oriental fruit flies, *Bactrocera dorsalis* as well as melon fruit fly, *Zeugodacus cucurbitae*. The reason might be due to the similar yellow color of the ripens fruits.

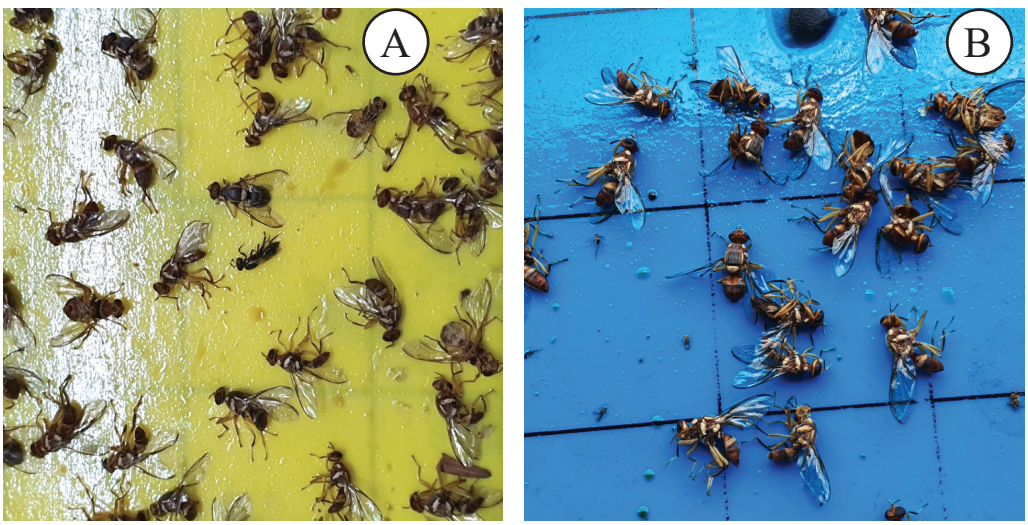

Fig. 1. *Bactrocera dorsalis* were captured more in yellow sticky trap with few other spp. (A). Blue sticky trap captured only *B. dorsalis* (B).

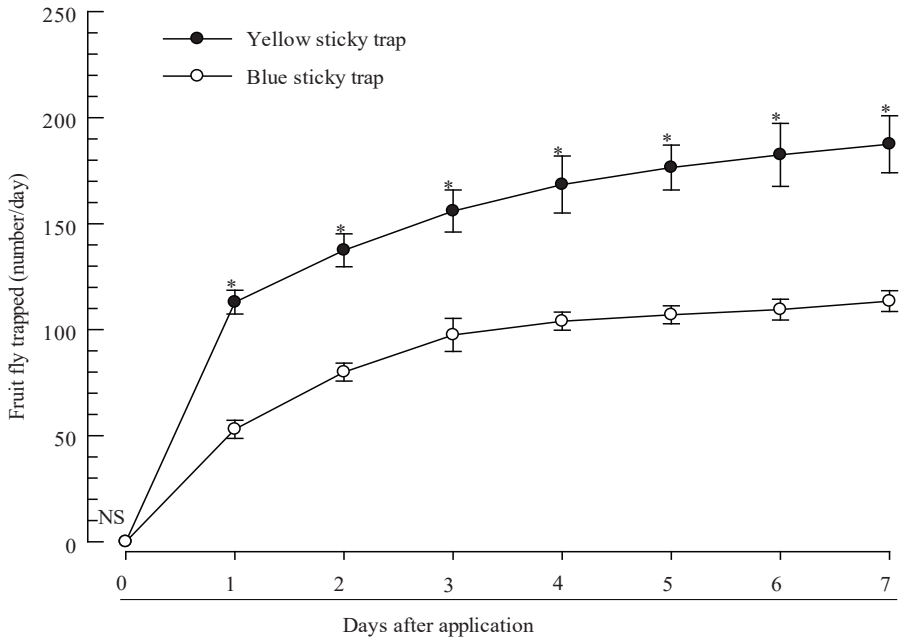

Fig. 2. Effect of yellow and blue sticky trap for capturing fruit flies in Bontara, Luxmitola, Dinajpur Sadar.

For location 2 (Ukundi, Luxmitola, Dinajpur Sadar), the color of the sticky trap also affects the capture of fruit flies (Fig. 3). On the first day of trap setting, capture of the yellow sticky trap (83.50 ± 3.54 fruit flies) was not significantly ($P < 0.05$) different from the capture of the blue sticky trap (84.50 ± 2.12 fruit flies). However, for day 2 significant ($P < 0.05$) difference were observed in fruit fly capture (114 ± 8.49 fruit fly in yellow trap and 101.50 ± 0.71 fruit fly in blue trap) and the same trends were observed up to the last day of trapping (7^{th} day) (160.50 ± 14.85 fruit fly in yellow trap and 116 ± 5.66 fruit fly in blue trap) (Fig. 3). For both cases, maximum number of trappings were observed in first day (83.50 ± 3.54 fruit flies in yellow trap and 84.50 ± 2.12 fruit flies in blue trap) and increase gradually up to the last date (7^{th} day) of trapping (160.50 ± 14.85 fruit fly in yellow trap and 116 ± 5.66 fruit fly in blue trap) (Fig. 3). From both locations, the mean number of fruit flies captured by the yellow trap (174.00 ± 19.41) was significantly ($P < 0.05$) more than the blue sticky trap (114.75 ± 4.57) (Figs. 4, 7).

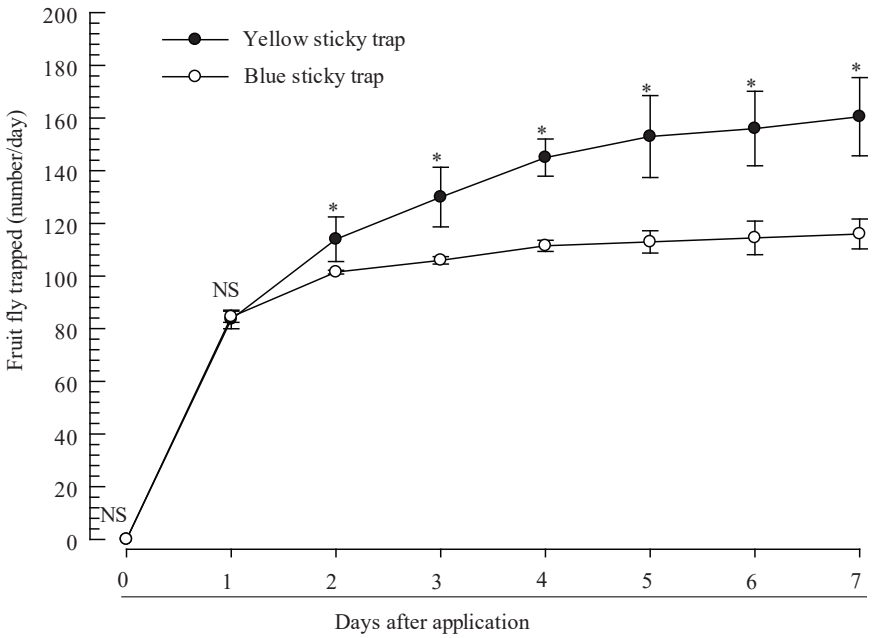

Fig. 3. Effect of yellow and blue sticky trap for capturing fruit flies in Ukundi, Luxmitola, Dinajpur Sadar.

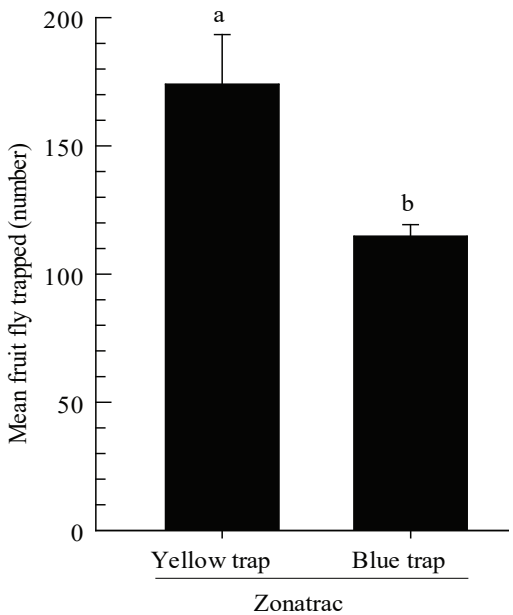

Fig. 4. Average trapping (Zonatrac) of fruit flies at two locations of Luxmitola, Dinajpur Sadar.

Comparative rate (trap/day) of fruit fly captured by the traps: In both locations, differences in the rate (capture/day) of fruit flies captured by the yellow trap and blue trap were observed. On most days, the yellow trap captured more fruit flies than the blue trap, although some exceptions exist. In location 1 (Bontara, Luxmitola, Dinajpur Sadar), maximum capture as well as difference in capture was observed on the first day (113 fruit flies by the yellow trap and 53 fruit flies by the blue trap) (Fig. 5A). However, the new capture of fruit flies decreased in the subsequent days. Capture of fruit flies in days 2, 3, 4, 5, 6, and 7 were 24.50 & 27.00, 18.50 & 17.50, 12.50 & 6.50, 8.00 & 3.00, 6.00 & 2.50, and 5.00 & 4.00, respectively, in yellow and blue traps (Fig. 5A). In location 2 (Ukundi, Luxmitola, Dinajpur Sadar), maximum capture in a day was observed for day 1 (83.50 in the yellow trap and 84.50 in the blue trap), where the blue trap captured 1 fruit fly more than the yellow trap (Fig. 5B). However, in the subsequent days, the per-day capture decreased gradually, but in every case, the yellow trap captured almost double compared to blue trap (Fig. 5B). Mean capture of fruit flies in days 2, 3, 4, 5, 6, and 7 were 30.50 & 12.00, 16.00 & 4.50, 15.00 & 5.50, 8.00 & 1.50, 3.00 & 1.50, and 4.50 & 1.50, respectively in yellow and blue sticky traps (Fig. 5B).

Differences in fruit flies captured by the traps: Differences were observed in the per-day capture of fruit flies by the yellow and blue traps. In location 1 (Bontara, Luxmitola, Dinajpur Sadar), the yellow trap captured 60 fruit flies more than the

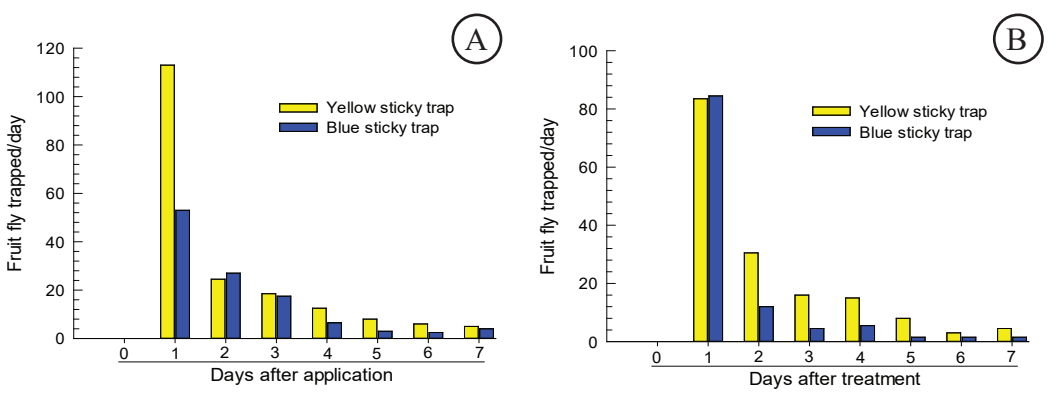

Fig. 5. Rate of fruit fly capture (trap/day) in sticky trap at two locations in Luxmitola, Dinajpur Sadar. (**A**) Bontara (**B**) Ukundi.

blue traps on the first day (Fig. 6A). However, the blue trap captured 2.5 fruit flies on day 2. In the subsequent days, yellow traps captured more than the blue traps, and it was 1, 6, 5, 3.5 & 1 in days 3, 4, 5, 6, and 7, respectively (Fig. 6A). In location 2 (Ukundi, Luxmitola, Dinajpur Sadar), the blue trap captured 1 more fruit fly than the yellow trap (Fig. 6B). However, in the subsequent days, the yellow trap captured more than the blue trap, and it was 18.5, 11.5, 9.5, 6.5, 1.5 & 3 more fruit flies on days 3, 4, 5, 6 & 7, respectively (Fig. 6B). Therefore, in both locations, the yellow traps captured more fruit flies than the blue traps (Fig. 7). Lizmah *et al.* (2025) reported that Methyl eugenol and yellow trap combination trapped the highest fruit flies than other combinations.

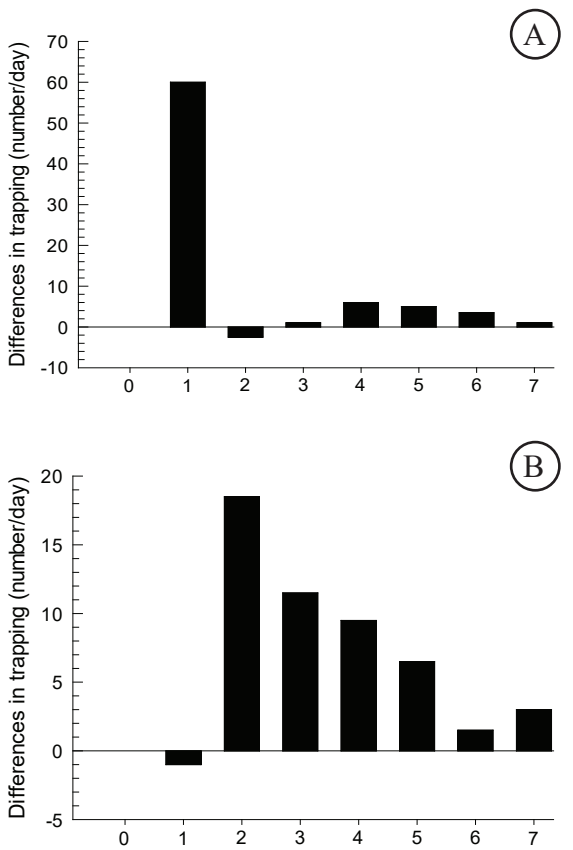

Fig. 6. More fruit flies were trapped in the yellow sticky trap than the blue trap at two locations in Luxmitola, Dinajpur Sadar. (A) Bontara (B) Ukundi.

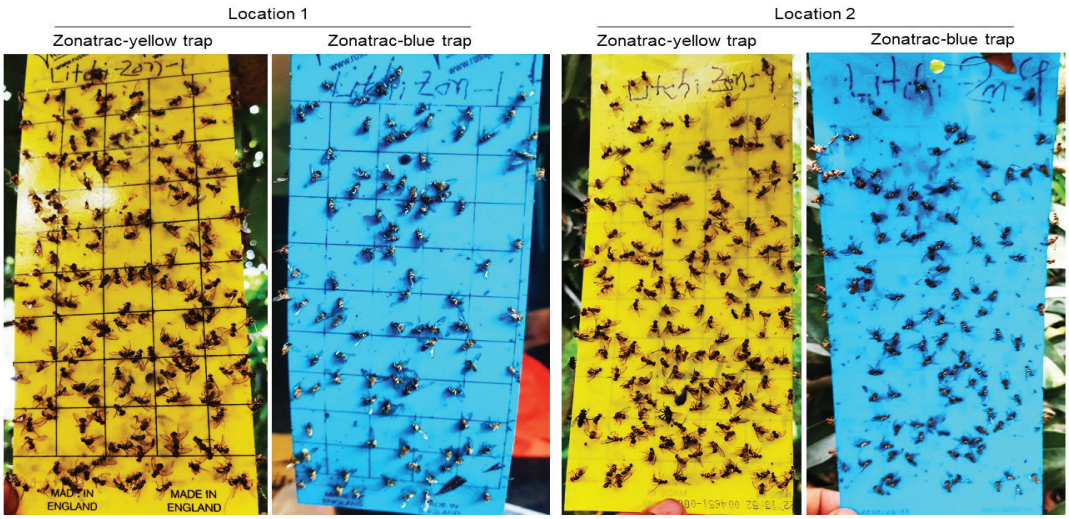

Fig. 7. Pictorial representation of comparative trapping of fruit flies in a yellow and blue sticky trap (Zonatrac) in locations 1 & 2.

CONCLUSION

Methyl eugenol based yellow and blue sticky traps captured only the male oriental fruit fly, *Bactrocera dorsalis.* However, very few other species were observed only in yellow trap. Yellow sticky traps captured more *Bactrocera dorsalis* than the blue traps in both areas. Yellow sticky traps also captured fruit flies very quickly.

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