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PREFERENCE OF RED FLOUR BEETLE *TRIBOLIUM CASTANEUM* (HERBST) TOWARDS COLOUR CUES

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ABSTRACT

Behavioural response of the red flour beetle *Tribolium castaneum* towards various colour cues was evaluated and preference was assessed. Among the coloured surfaces, dark pink was observed to be the most preferred one (27.78, 28.39 and 29.33% at 24, 48 and 72 hrs after release, respectively). Blue, black and yellow revealed moderate preference. Influence of coloured lights on *T. castaneum* revealed that violet coloured LEDs had superior effect on attraction. The trend on preference of colour cues did not vary with increase in time period and red was the most avoided colour indicating its repellency nature.

Key words: *Tribolium castaneum*, *Corcyra cephalonica*, visual stimuli, coloured discs, coloured LEDs, distribution, dark pink, violet, red, blue, black, yellow.

In India, the losses due to insect pests have been decreasing over the years from 23.3 to 15.7% owing to the advancements in biocontrol techniques and strategies (Dhaliwal et al., 2015). In India, the rice moth *Corcyra cephalonic*a (Stainton) despite being a notorious pest is being used and mass produced as a factitious host for rearing parasitoids like *Bracon hebator*, *B. krikpatricki*, *B. brevicornis*, *Chelonus blackburni* and *Goniozous nephantidis*, trichogrammatids and predators like anthocorid bugs and chrysopid larvae (Lalitha and Ballal, 2015). This is because of its adaptability, amenability and beneficial impact (Gauraha and Deole, 2016). *Corcyra cephalonica* rearing is influenced by biotic and abiotic factors and among the biotic ones, contamination with red flour beetle *Tribolium castaneum* (Herbst) is a major one. In addition to food competition, predatory habit of *T. castaneum* leads to reduction in moth emergence which ultimately affects the *C. cephalonica* egg production. In the absence of food, the adults and larvae of *T. castaneum* feed on the eggs and larvae of *C. cephalonica* voraciously (Murugesan et al., 1997); and thus, it has a significant negative impact on the early developmental stages of *Corcyra* (Nagalakshmi and Balaji, 1999). Control of this insect pest in *Corcyra* rearing will demand excluding chemical control options and thus will require new approaches, especially those which alter their behavioural or locomotory responses. Using colour cues can be an option as these play a crucial role in the process of locating the host (Briscoe and Chittka, 2001). It is observed that when multimodal cues such as odour and colour gets combined, greater attraction is ensured (Arnold et al., 2015). Light sources emitting different colours influence the behaviour of insects (Nirmal et al., 2017). The present study evaluates the possibilities of managing *T. castaneum* using visual stimuli.

MATERIALS AND METHODS

The experiments were conducted in the *C. cephalonica* mass rearing room, Insectary, Department of Agricultural Entomology, Agricultural College and Research institute, Madurai during 2020- 2021. Preference of colours by *T. castaneum* was assessed using LED lights and paper discs of different colours. Paper discs of size 7.5 cm painted with various poster colours such as green, red, yellow, blue, dark pink, violet, black, white and transparent paper were kept over the *Corcyra* rearing trays artificially infested with *T. castaneum* (Shelja et al., 2019) and 600 adults of *T. castaneum* were released into the rearing trays. Transparent disc served as control. Beetles aggregated above and below the paper discs were counted at 24, 48 and 72 hr after release. In other set of experiment, differently coloured small electric LED bulbs were set in a plastic chamber with seven arms made up of glass tubes (Sheribha et al., 2010). In each arm, a coloured light viz., green, red, yellow, blue, violet and white was provided and electrical source was given with the help of batteries. The arm without light was treated as control. 10 g of *Corcyra* rearing diet was provided as

food source inside each of the arms. Totally 300 adults were released at the centre and beetles attracted to each colour was counted after 24, 48 and 72 hr. The beetles were discarded from the arms after taking observations on 24 and 48 hr after release. Both the experiments were laid in completely randomized design with three replications. Distribution % was calculated according to Reza and Parween (2006). The experimental data were subjected to arc sine transformation and the means separated using DMRT (Duncan's Multiple Range Test, p=0.05) with SPSS 16.0 software.

RESULTS AND DISCUSSION

The results of variation in responses from *T. castaneum* adults to different colour cues revealed the preference of *T. castaneum* adults to specific visual stimuli (Table 1); maximum preference was observed in dark pink colour- 27.78, 28.39 and 29.33% at 24, 48 and 72 hr after release (HAR), respectively; this increased with time period and the preference to other coloured discs varied. Dark pink was followed by violet (14.11%) and blue (12.39%) at 24 HAR. After 48 HAR, the preference towards green, violet and white got increased when compared with the preference at 24 HAR. Evaluation of coloured LED lights revealed violet as the most attractive one- 24.22, 5.78 and 2.00% at 24, 48 and 72 HAR, respectively; at 48 and 72 HAR, the beetles tend to response equally to violet and blue, and statistically on par with each other. At 48 HAR, yellow (4.33%), green (2.11%) and white (2.33%) revealed a moderate distribution of *T. castaneum,* meanwhile at 72 HAR it was yellow (1.33%) and green (0.89%) LEDs which were preferred next to violet and blue. Distribution on arms with red LED was meagre indicating the avoidance by adults.

Thus, the dark pink and violet are the most attractive cues and red colour is a repellent for *T. castaneum*. These observations corroborate with earlier ones- violet and green exhibiting the maximum and least preference, respectively (Shelja et al., 2019). Higher attraction in dark pink colour is in conflict with the reports of Reza and Parween (2006). Least preference of red colour observed now is in agreement with those of Arab and Salem (2018); also, with those of Sheribha et al (2010). Park and Lee (2017) observed that preference of red LED by *T. castaneum* was low in comparison with other LEDs. Song et al. (2016) evaluated the attractiveness of *T. castaneum* towards LEDs and BLB (black light bulb) traps and observed that red LED trap was more attractive which is in contrast with present study.

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Table 1. Distribution of *T. castaneum* adults in coloured paper discs and coloured lights

	24 HAR	48 HAR	72 HAR		24 HAR	48 HAR	72 HAR
Green	5.33 (13.35)^{e}	6.11 (14.31)^{ef}	5.61 (13.70)^{f}	Green	4.67 (12.48)^{d}	2.11 (8.35)^{c}	0.89 (5.41)^{cd}
Red	4.22 (11.86)^{f}	3.50 (10.78)^{g}	3.83 (11.29)^{g}	Red	2.67 (9.40)^{e}	1.00 (5.74)^{d}	0.67 (4.68)^{de}
Yellow	7.67 (16.07)^{d}	6.78 (15.09)^{e}	7.17 (15.53)^{d}	Yellow	13.44 (21.51)^{c}	4.33 (12.01)^{b}	1.33 (6.63)^{bc}
Blue	12.39 (20.61)^{c}	10.61 (19.01)^{c}	12.89 (21.04)^{c}	Blue	15.67 (23.32)^{b}	4.78 (12.63)^{ab}	1.67 (7.42)^{ab}
Dark pink	27.78 (31.81)^{a}	28.39 (32.20)^{a}	29.33 (32.79)^{a}	Violet	24.22 (29.48)^{a}	5.78 (13.91)^{a}	2.00 (8.13)^{a}
Violet	14.11 (22.06)^{b}	15.83 (23.45)^{b}	14.39 (22.29)^{b}	White	3.78 (11.21)^{d}	2.33 (8.79)^{c}	0.45 (3.83)^{e}
Black	7.39 (15.77)^{d}	7.83 (16.25)^{d}	6.83 (15.15)^{de}	Control	1.33 (6.63)^{f}	0.78 (5.06)^{d}	0.33 (3.30)^{e}
White	5.00 (12.92)^{e}	5.78 (13.91)^{f}	6.28 (14.51)^{ef}	-	-	-	-
Transparent	0.78 (5.06)^{g}	0.72 (4.88)^{h}	0.67 (4.68)^{h}	-	-	-	-
SEd	0.44	0.43	0.44	-	0.70	0.64	0.63
p value	0.00	0.00	0.00	-	0.00	0.00	0.00
F value	581.33	647.29	626.52	-	294.24	56.91	16.71

HAR – Hours After Release;* Mean values of three replications; Figures in parentheses arcsine transformed values; Mean followed by same letter (s) in a column not significantly different by DMRT (p =0.05)

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