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Nagendra KumarPh.D. Research Scholar (In-
service, RPCAU, Pusa)Department of Entomology
UBKV, Pundibari, Coochbehar,
West Bengal, India**Nripendra Laskar**Professor and Head, Department
of Entomology UBKV,
Pundibari, Coochbehar, West
Bengal, India

Evaluate the efficacy of different coloured traps in capturing *Bactrocera cucurbitae* (Coq.) (Diptera: Insecta) under Terai region of West Bengal

Nagendra Kumar and Nripendra Laskar

Abstract

Self-made rectangular PET plastic jars around 1 liter capacity were used and having four circular holes of 2 cm in diameter on four sides of the jar just below the shoulder of the bottle (i.e. 1/3rd from top) openings for entry of flies of different colour viz red, blue, green, black, yellow, orange and white. In addition to that, transparent PET plastic jars were also used as a trap. An experiment was conducted to evaluate the colour preference of trap by the fruit fly, different coloured traps were used in field condition using cuelure as an attractant at Pundibari, Coochbehar, West Bengal during the year 2017 and 2018 at farmer field. Marked differences were recorded in different colours trap catches range from 12.72 to 3.97 flies/ trap/ day. Efficacy of different coloured traps in capturing *B. cucurbitae* from Days After Installation (DAI) has been depicted that in yellow coloured trap captured significantly the highest mean number of *B. cucurbitae* (30.14 flies/ trap/ day) followed by orange, green, red, white, black, transparent and blue coloured traps with catches of 25.95, 22.26, 18.21, 15.52, 13.55, 10.69 and 9.07 flies/trap/week, respectively at 7th DAI. When overall mean values of trap-catch were considered DAI, yellow coloured trap attracted a significantly highest number of fruit flies (12.72 fruit flies/trap/day) followed by orange coloured trap (10.82 fruit flies/trap/day). The least number of fruit flies was attracted to blue coloured trap (3.97 fruits flies/trap/day) followed by transparent trap (4.74 fruits flies/trap/day).

Keywords: *B. cucurbitae*, coloured trap, transparent trap, efficacy, cuelure

1. Introduction

The fruit flies of the family Tephritidae are well-known pests of fruits and vegetables throughout the world. The devastating effects that fruit flies inflict to the horticultural industry worldwide, and the crossborder nature of the problem, have placed fruit flies on top of the world's list of key insect pests (Enkerlin, 2003) [1]. The melon fruit fly, *Bactrocera cucurbitae*, the most serious of them all, causes severe damage to cucurbits and is geographically distributed throughout the tropics and subtropics of the world (Drew, 1992) [2]. Northern part of the state West Bengal experienced a typical sub-tropical per humid climate which befit the region for cultivation of a number of seasonal vegetables including cucurbits, an important and large group of vegetables. Due to the prevalence of favourable environmental conditions, these crops suffer intense pest invasion right from seedling stage and continued till harvesting of the fruit. Among them the most devastating melon fruit fly, *Bactrocera cucurbitae* (Coq.) resulting in considerable loss of the produce. The *B. cucurbitae* (Coq.) (Diptera: Tephritidae) which attacks the ultimate economic part, i.e. fruits of the crop, alone can inflict yield loss in different cucurbitaceous vegetables ranging from 30-100% depending upon cucurbit species and the season.

The responses of fruit flies to visual stimuli are dependent on colour, shape and size of the stimulus (Katsoyannos, 1989) [3]. Recent reports from China have revealed that for *B. dorsalis* UV and green stimuli would enhance the attractiveness of a coloured paper, while blue stimuli would diminish the attractiveness (Wu *et al.*, 2007) [4]. The importance of visual cues has long been recognized but there is increasing evidence of the relevance of olfactory cues (Dalby-Ball and Meats, 2000) [5]. However, after studying the response of *B. cucurbitae* female to host associated visual and olfactory stimuli, Pinero *et al.* (2006) [6] reported that a combination of both of these stimuli needed to elicit high levels of response compared to each stimulus offered alone. Earlier, Prokopy and Owens (1983) [7], stated that adult flies use visual and olfactory

Correspondence

Nagendra KumarPh.D. Research Scholar (In-
service, RPCAU, Pusa)
Department of Entomology
UBKV, Pundibari, Coochbehar,
West Bengal, India

stimuli to locate hosts and the traps that combine visual and olfactory cues proved to be the most efficient for capturing fruit flies. Cuelure is the most effective male lure of adult melon fly and as such one could assume that male adult fly would enter the trap that contained cuelure irrespective of colour of the trap. However, Stark and Vargas (1992) [8] indicated that visual cues are also involved in the search for methyl eugenol by *Bactrocera dorsalis* (Hendel), although probably only in a secondary manner but also found high capture rate in white and yellow traps.

2. Materials and Methods

Self-made rectangular PET plastic jars around 1 liter capacity were used and having four circular holes of 2 cm in diameter on four sides of the jar just below the shoulder of the bottle (i.e. 1/3rd from top) openings for entry of flies of different colour viz red, blue, green, black, yellow, orange and white. In addition to that, transparent PET plastic jars were also used as a trap. The transparent PET plastic jars were painted with their respective colour and used as a trap because they are cheap, long lasting and can be recycled. A warm pen knife or soft drill facilitated the slitting/drilling of a hole. In addition, four random holes of 2-3 mm diameter punched at the bottom with warm needles to allow drainage of water that may get collected in the bottle due to rain. Cuelure block were hung from the roof of the trap by a thread and cotton wicks soaked with 1 ml spinosad 45 SC. The traps thus prepared were randomly placed at an average height of 1 meter from the ground level all over the field. The area of cuelure block was 4cm² having side 2cm were placed within the traps.

The study was conducted during the summer season of 2017 and 2018. Daily observations on the number of fruit flies trapped/ trap, till zero catch were recorded for consecutive two days. Thereafter the weekly average flies' trapped/trap/week has been calculated by using the following formula. The average flies trapped/ traps/ week has been reported in the result and discussion part as

$$\text{Flies trapped/trap/ day} = \frac{\text{Total number of flies in 7 days}}{7}$$

The distance two traps were maintained at 50m to avoid trap interference and the position of traps were randomly changed at alternate day to nullify the effect of position of trap in attracting fruit flies. The experiment was conducted in a Randomized Block Design (RBD) with eight treatments

replicated three times. The data on trap catches were statistically analyzed as per standard protocol. Observations had been recorded on number of fruit flies trapped/ traps/ day.

3. Results and Discussion

With a view to identify the colour preference of the fruit fly, different coloured traps were used to catch the fly in field condition using cuelure as attractant. The colours used were yellow, orange, green, blue, black, red and white. In addition to that, transparent PET plastic jars were also used as a trap. Marked differences were recorded in different colours trap catches range from 12.72 to 3.97. Efficacy of different coloured traps in capturing *B. cucurbitae* from Days after Installation (DAI) has been presented in (Table-1 and Fig-1) during 2017-18. It has been recorded that yellow coloured trap captured significantly highest mean number of *Bactrocera* flies (27.71 flies/ trap/ day) followed by orange, green, red, white, black, transparent and blue coloured traps with catches of 22.10, 18.71, 14.81, 12.95, 11.48, 9.19 and 7.86 flies/trap/day, respectively at 7th DAI. When overall mean values of trap-catch were considered at DAI, highest efficacy was recorded by yellow coloured trap (11.64 flies/trap/day) followed by orange colored trap (9.13 flies/trap/day) whereas lowest catch was recorded by blue coloured trap (3.45 flies/trap/day) followed by transparent trap (4.08 flies/trap/day).

Relatively a similar trend was noticed during 2018-19 (Table-2 and Fig-2). The highest mean number of flies (32.57 flies/ trap/day) was captured in the yellow coloured trap followed by orange (29.81), green (25.81), red (21.62), white (18.09), black (15.62) and transparent (12.19) whereas the least was recorded in blue coloured trap (10.29) DAI. The overall mean values of fly capture data in yellow coloured trap maximum flies (13.80) were found to be attracted followed by orange (12.51). However, there exists no significant difference among the two. The mean data also indicated the least acceptability of blue colour (4.49) by male adult fly.

However, the mean values of fly capture data of two years has been depicted in (Table-3 and Fig-3) reveals that in yellow coloured trap captured significantly highest mean number of *B. cucurbitae* (30.14 flies/ trap/ day) followed by orange, green, red, white, black, transparent and blue coloured traps with catches of 25.95, 22.26, 18.21, 15.52, 13.55, 10.69 and 9.07 flies/trap/week, respectively at 7th DAI. When overall mean values of trap-catch were considered

Table 1: Efficacy of different colored traps in capturing fruit flies using cue lure block under Tarai region of West Bengal during 2017-18

Trap colour	Mean number of flies trapped/trap/day(DAI)*				Mean
	7 th	14 th	21 st	28 th	
T1-- Black	11.48 (3.46) ^e	6.33 (2.61) ^{cd}	1.52 (1.42) ^{cd}	0.00 (0.71) ^a	4.83 (2.05) ^e
T2- Blue	7.86 (2.89) ^f	4.87 (2.31) ^e	1.10 (1.26) ^d	0.00 (0.71) ^a	3.45 (1.79) ^f
T3- Red	14.81(3.91) ^d	7.29 (2.79) ^c	2.05 (1.59) ^{bc}	0.00 (0.71) ^a	6.04 (2.25) ^d
T4- Orange	22.10 (4.75) ^b	11.52 (3.47) ^b	2.90 (1.84) ^a	0.00 (0.71) ^a	9.13 (2.69) ^b
T5- Green	18.71 (4.38) ^c	10.29 (3.28) ^b	2.52 (1.74) ^{ab}	0.00 (0.71) ^a	7.88 (2.53) ^c
T6 - Transparent	9.19 (3.11) ^f	5.52 (2.45) ^{de}	1.62 (1.45) ^{cd}	0.00 (0.71) ^a	4.08 (1.93) ^{ef}
T7- White	12.95 (3.67) ^{de}	7.52 (2.83) ^c	2.00 (1.57) ^{bc}	0.00 (0.71) ^a	5.62 (2.19) ^d
T8- Yellow	27.71 (5.31) ^a	15.57 (4.01) ^a	3.29 (1.94) ^a	0.00 (0.71) ^a	11.64 (2.99) ^a
S. Em (±)	0.085	0.081	0.076	-	-
CD (0.05)	0.257	0.245	0.229	-	-

* DAI-Days after Installation

Mean of three replications

Figures in parentheses are square root transformed values

Figures following by same letters are not significantly different.

DAI, yellow coloured trap attracted significantly highest number of fruit flies (12.72 fruit flies/trap/day) followed by orange coloured trap (10.82 fruit flies/trap/day). The least number of fruit flies was attracted to blue coloured trap (3.97 fruits flies/trap/day) followed by a transparent trap (4.74 fruits flies/trap/day).

The responses of fruit flies to visual stimuli are dependent on colour, shape and size of the stimulus as reported by Katsoyannos (1989) [3]. The importance of visual cues has long been recognized as reported by several authors (Fletcher, 1987) [9]. Results of the present study are in agreement with Sarada *et al.* (2001) [10], preference of yellow colour traps by *A. ludens*. Vayssières and Dall (2002) [11], while working with different species of Dacine fruit flies viz. *Bactrocera dorsalis*,

B. correcta, *B. zonata* and *B. ciliatus*, also found similar results. Robacker *et al.* (1990) [12] and Stark and Vargas (1992) [8] opined that the reflectance of yellow and orange colour might be a factor in the attractiveness of fruit flies to those colour. However, the present results partially endorse the findings of Vargas *et al.* (1991) [13], Stark and Vargas (1992) [8], Jalaluddin *et al.* (1998) [14], Madhura (2001) [15], Sarada *et al.* (2001) [10], who observed greater preference of fruit flies towards yellow and transparent traps. Moreover, a combination of visual and olfactory stimuli is needed to elicit high levels of response as compared to each stimulus offered alone (Pinerro *et al.*, 2006) [6]. The overall mean number of flies trapped in all weeks from DAI in different coloured traps using cuelure block has been shown in Fig-4.

Table 2: Efficacy of different coloured traps in capturing fruit flies using cuelure block under terai region of West Bengal during 2018-19

Trap colour	Mean number of flies trapped/trap/day (DAI)				Mean
	7 th	14 th	21 st	28 th	
T1-- Black	15.62 (4.01) ^e	7.62 (2.85) ^{ef}	1.90 (1.54) ^{cd}	0.00 (0.71) ^a	6.28 (2.28) ^d
T2- Blue	10.29 (3.28) ^e	6.19 (2.58) ^f	1.48 (1.40) ^d	0.00 (0.71) ^a	4.49 (1.99) ^e
T3- Red	21.62 (4.70) ^c	9.48 (3.15) ^{de}	2.76 (1.80) ^{bc}	0.00 (0.71) ^a	8.46 (2.59) ^e
T4- Orange	29.81 (5.50) ^a	15.33 (3.98) ^{ab}	4.90 (2.32) ^a	0.00 (0.71) ^a	12.51 (3.13) ^a
T5- Green	25.81 (5.13) ^b	12.81 (3.64) ^{bc}	3.33 (1.95) ^b	0.00 (0.71) ^a	10.49 (2.86) ^b
T6 - Transparent	12.19 (3.56) ^f	7.19 (2.76) ^f	2.19 (1.63) ^{cd}	0.00 (0.71) ^a	5.39 (2.17) ^{de}
T7- White	18.09 (4.31) ^d	10.71 (3.34) ^{cd}	2.90 (1.84) ^{bc}	0.00 (0.71) ^a	7.93 (2.55) ^e
T8- Yellow	32.57 (5.75) ^a	17.67 (4.26) ^a	4.95 (2.33) ^a	0.00 (0.71) ^a	13.80 (3.26) ^a
S. Em (±)	0.081	0.119	0.094	-	-
CD (0.05)	0.245	0.360	0.284	-	-

* DAI-Days after Installation

Mean of three replications

Figures in parentheses are square root transformed values

Figures following by same letters are not significantly different.

Table 3: Efficacy of different coloured traps in capturing fruit flies using cuelure block under terai region of West Bengal (Pooled over 2017-18 and 2018-19)

Trap colour	Mean number of flies trapped/trap/day (DAI)				Mean
	7 th	14 th	21 st	28 th	
T1-- Black	13.55 (3.75) ^f	6.98 (2.73) ^e	1.71 (1.48) ^{de}	0.00 (0.71) ^a	5.56 (2.17) ^e
T2- Blue	9.07 (3.09) ^h	5.53 (2.45) ^f	1.29 (1.34) ^e	0.00 (0.71) ^a	3.97 (1.90) ^e
T3- Red	18.21 (4.33) ^d	8.38 (2.98) ^d	2.40 (1.70) ^{bc}	0.00 (0.71) ^a	7.25 (2.43) ^d
T4- Orange	25.95 (5.14) ^b	13.43 (3.73) ^b	3.90 (2.10) ^a	0.00 (0.71) ^a	10.82 (2.92) ^b
T5- Green	22.26 (4.77) ^c	11.55 (3.47) ^c	2.93 (1.85) ^b	0.00 (0.71) ^a	9.18 (2.70) ^c
T6 - Transparent	10.69 (3.34) ^g	6.36 (2.61) ^{ef}	1.90 (1.55) ^{cd}	0.00 (0.71) ^a	4.74 (2.05) ^f
T7- White	15.52 (4.00) ^e	9.12 (3.10) ^d	2.45 (1.71) ^{bc}	0.00 (0.71) ^a	6.77 (2.38) ^d
T8- Yellow	30.14 (5.54) ^a	16.62 (4.14) ^a	4.12 (2.15) ^a	0.00 (0.71) ^a	12.72 (3.13) ^a
Mean	18.18	9.74	2.59	0.00	-

* DAI-Days after Installation

Mean of three replications

Figures in parentheses are square root transformed values

Figures following by same letters are not significantly different.

Factors	Trap Colour	DAI	Trap colour X DAI
S. Em (±)	0.036	0.018	0.051
CD (0.05)	0.105	0.052	0.148

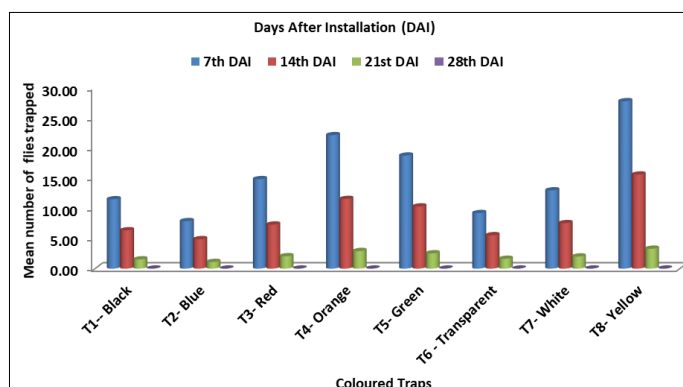


Fig 1: Mean number of flies trapped/trap/day in different coloured traps in capturing fruit flies using cuelure block under terai region of West Bengal during 2017-18

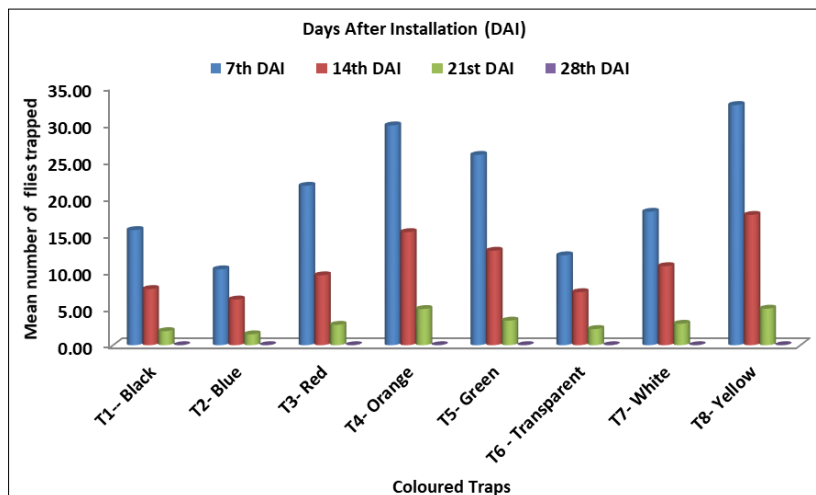


Fig 2: Mean number of flies trapped/trap/day in different coloured traps in capturing fruit flies using cuelure block under terai region of West Bengal during 2018-19

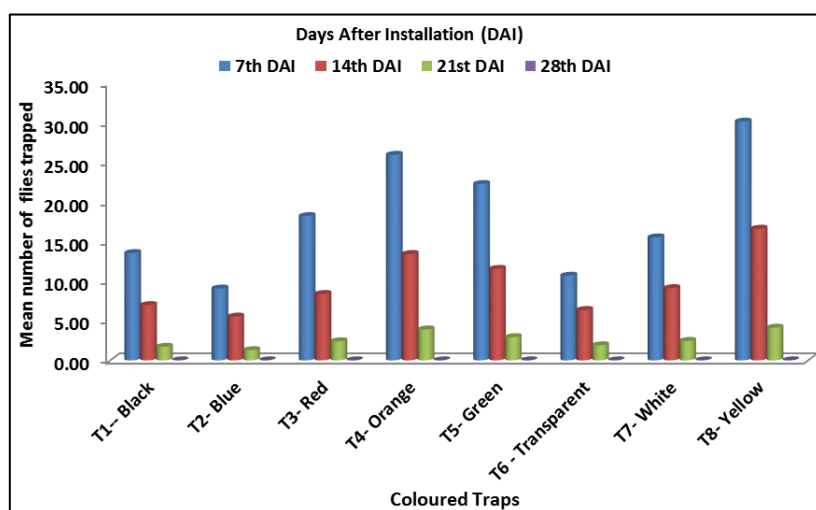


Fig 3: Mean number of flies trapped/trap/day in different coloured traps block in capturing fruit flies using cuelure under terai region of West Bengal during (pooled over 2017-18 and 2018-19)

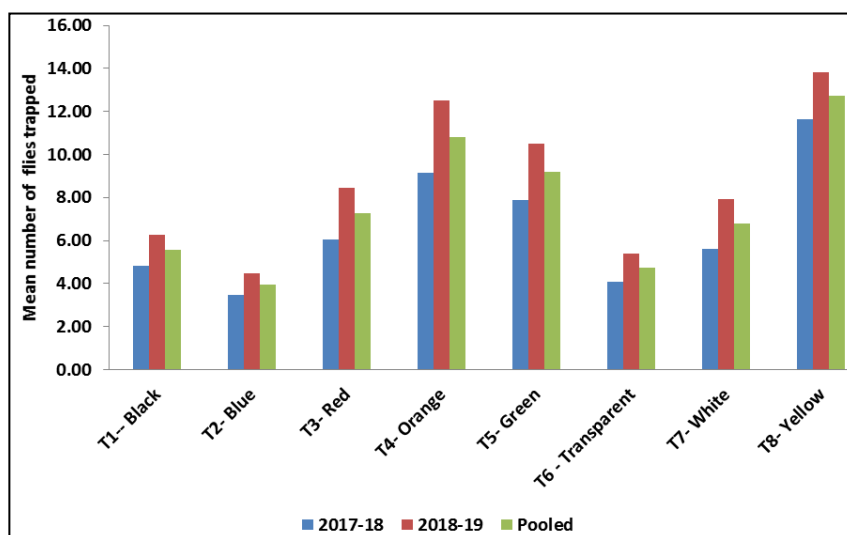


Fig 4: Means of all weeks of flies trapped/trap/day in different coloured traps in capturing fruit flies using cuelure block under terai region of West Bengal

4. Conclusion

It is concluded from the results that fly capture data in different coloured trap using cuelure as an attractant revealed that yellow coloured trap attracted a significantly highest number of fruit flies (12.72 fruit flies/trap/day) followed by

orange coloured trap (10.82 fruit flies/trap/day). The least number of fruit flies was attracted to blue coloured trap (3.97 fruits flies/trap/day) followed by a transparent trap (4.74 fruits flies/trap/day).

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