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ORIENTATION OF *CALLOSOBRUCHUS CHINENSIS* (L.) TOWARDS COLOURED LIGHTS

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ABSTRACT

Orientation of *Callosobruchus chinensis* (L.) towards seven coloured light emitting diodes was observed under three conditions at different time intervals. In multi-choice test, *C. chinensis* adults were more attracted towards green (13.13 to 13.80%), blue (12.13 to 13.73%) and ultraviolet (13.20 to 14.20%) LEDs which have shorter wavelengths and high frequencies, while white (control) (7.20 to 9.67%) and red (6.13 to 8.40%) LEDs having longer wavelengths and low frequencies showed the least preference.

Key words: *Callosobruchus chinensis*, light emitting diode, green gram, multi-choice test, orientation, preference, attraction, wavelength, frequency, IPM

Insects are one of the major constraints in grain/seed storage, and storage of food grain is difficult in the northeast India due to high humidity which encourages infestation. Bruchids (Coleoptera: Bruchidae) are the most serious pests of pulses in storage. The bruchids which are commonly distributed throughout the country are *Callosobruchus chinensis, C. maculatus* and *C. analis* (Raina, 1970). Among these *C. chinensis* is the most commonly encountered species in Assam and other parts of the north east. Both grub and adult are responsible for the damage. The reasons for their attaining major stored grain pest status are short life span and a high degree of reproductive potentiality. To protect the stored grains from infestation several measures have been undertaken, with use of pesticides being the most convenient and effective. But these pesticides have many harmful effects like residual toxicity in food and cause adverse effect on non-target animals. Therefore, it is necessary to develop some alternative IPM methods. The orientation of insects towards the light in the darkness of night (phototropism) can be exploited to kill them mechanically. Entomologists have used this phenomenon since long to capture night-flying insects with light traps, but this technology has been hardly tried under storage. Light emitting diodes (LED) have become one of the primary means to control the insect attack. The LED lights could effectively reduce the dosage of pesticides used and can be utilized as a component in IPM for control of storage pests. The present study is formulated to identify the most effective light spectrum, which attracts maximum insects.

MATERIALS AND METHODS

The experiment was carried out during 2018-2019 in the laboratory-II of All India Coordinated Research Project on Post-Harvest Engineering and Technology (AICRP on PHET) under the Department of Agricultural Engineering, Assam Agricultural University, Jorhat. The culture of *C. chinensis* was maintained on sound healthy seeds of green gram continuously in 5l plastic jars, covered with muslin cloth. Seven coloured LEDs were used to study the orientation of *C. chinensis*, and these include: green, yellow, infrared, blue, ultraviolet and red, with white one being the control. An experimental set up with eight containers made of acrylic was used in the multi-choice test. The set consisted of an octagonal shaped mother container (5l) and seven square-shaped small containers (1l) which are symmetrically attached with the mother container by acrylic pipes (12.5x 1.5 cm). The two ends of the pipes were put through holes made in the mother and square-shaped containers to facilitate free movement of the test insects. Square-shaped containers were fitted with green, yellow, infrared, blue, ultraviolet, red and white LEDs and were glued with white paper on inside and black on outside along with the respective walls of the mother container and the connecting pipes. The test insects were kept starved for 1 day before their release. Five hundred insects were released in the mother container of multi-choice experimental sets. Three replications were maintained in a completely randomized design. Observations were recorded under three conditions. In

Table 1. Orientation of *C. chinensis* towards coloured lights in storage

Treatments	% oriented to different coloured LEDs											
	Food only in square-shaped containers				Food only in mother container				Food both in mother container and square-shaped containers			
	1 HAR	3 HAR	6 HAR	24 HAR	1 HAR	3 HAR	6 HAR	24 HAR	1 HAR	3 HAR	6 HAR	24 HAR
Green	13.67	13.80	13.33	13.13	9.47	11.67	11.33	11.73	12.20	12.60	12.40	12.06
	(21.68)	(21.79)	(21.40)	(21.24)	(17.87)	(19.96)	(19.66)	(20.02)	(20.43)	(20.77)	(20.60)	(20.32)
Yellow	10.27	11.33	11.47	10.80	7.53	9.73	8.60	9.40	8.93	9.13	8.80	9.33
	(18.68)	(19.66)	(19.78)	(19.17)	(15.89)	(18.16)	(17.07)	(17.84)	(17.38)	(17.58)	(17.24)	(17.78)
Infrared	12.20	12.67	12.93	11.93	7.93	10.27	10.13	10.67	10.67	10.47	10.13	10.53
	(20.43)	(20.84)	(21.07)	(20.19)	(16.33)	(18.68)	(18.55)	(19.05)	(19.05)	(18.86)	(18.55)	(18.92)
Blue	8.13	10.07	10.87	9.73	12.13	13.73	12.87	13.20	12.93	13.07	12.73	12.60
	(16.54)	(18.49)	(19.24)	(18.16)	(20.36)	(21.74)	(21.01)	(21.29)	(21.07)	(21.18)	(20.89)	(20.78)
Ultraviolet	10.07	10.80	11.60	10.13	10.33	12.27	12.20	12.93	13.40	14.20	13.47	13.20
	(18.46)	(19.16)	(19.90)	(18.55)	(18.71)	(20.49)	(20.43)	(21.07)	(21.46)	(22.12)	(21.52)	(21.29)
Red	11.93	12.07	12.00	11.07	6.13	7.80	6.67	8.40	6.67	7.53	7.93	7.40
	(20.19)	(20.30)	(20.26)	(19.42)	(14.33)	(16.19)	(14.95)	(16.84)	(14.93)	(15.88)	(16.32)	(15.76)
Control	7.20	8.53	9.67	7.47	8.87	11.06	11.27	11.40	11.13	11.47	11.20	11.13
(White)	(15.53)	(16.96)	(18.09)	(15.82)	(17.29)	(19.42)	(19.60)	(19.72)	(19.48)	(19.78)	(19.54)	(19.48)
S.Em ±	0.74	0.65	0.44	0.52	0.97	0.59	0.37	0.33	0.49	0.67	0.59	0.40
C.D. (p=0.05)	1.59	1.39	0.94	1.13	2.08	1.26	0.79	0.71	1.06	1.43	1.27	0.87

HAR- hours after release; data within parentheses angular transformed values the first case, whole grains of green gram for *C. chinensis* was kept in the square-shaped containers (250 g) and no food was provided in the mother container. In second case, food was provided only in the mother container and all small sized containers were kept empty; and in the third case, both the mother container and square-shaped small containers were provided with food. In vitro movement of insects were recorded through counting the number of migrated insects from the mother container to the small containers lit with different coloured LEDs at 1, 3, 6 and 24 hr after release, and % of insects attracted were counted. These were statistically analysed by ANOVA after angular transformation.

RESULTS AND DISCUSSION

The results revealed that *C. chinensis* preferred different colours of LEDs in the multi-choice tests. When food was kept only in square-shaped containers and no food was provided in the mother container significantly higher preference of *C. chinensis* at 1, 3, 6 and 24 hr after release was observed with green LEDs (13.67%, 13.80%, 13.33% and 13.13%). The next best was infrared (12.20%, 12.67%, 11.93% and 12.93%), while white (control) LEDs (7.20%, 8.53%, 7.47% and 9.67%) showed the least preference (Table 1). Preference of *C. chinensis* was highest towards blue LEDs (12.13%, 13.73%, 12.87% and 13.20%) followed by ultraviolet (10.33%, 12.27%, 12.20% and 12.93%) when food was kept only in the mother container and all the square-shaped containers were kept empty at different time intervals. In this condition red (6.13%, 7.80%, 6.67% and 8.40%) was the least preferred. Data recorded at 1, 3, 6 and 24 hr after release when food was kept both in the mother container and square-shaped containers, showed ultraviolet (13.40%, 14.20%, 13.47% and 13.20%) to be the highest preferred followed by blue (12.93%, 13.07%, 12.73% and 12.60%) and red (6.67%, 7.53%, 7.93% and 7.40%) was observed to be the least preferred (Table 1).

These findings derive support from those of Pate and Curtis (2001) who reported that insects were more attracted to lights with short wavelengths and high frequencies. This might be attributed to the reason that most insects have only two types of visual pigments. One of them absorbs green and yellow light (550 nm) while the opposite absorbs blue and ultraviolet light (<480 nm). Ashfaq *et al.* (2005) also reported that insects were attracted in more number to lights with short wavelengths and high frequencies. According to Pfannenstiel and Phillips (2017) lights of longer wavelengths (i.e. red and yellow) had little to no effect on the beetles, while the lights with shorter wavelengths (i.e. violet and ultraviolet) attracted the beetles. Jeon et al. (2016) evaluated the attraction effects of *Sitotroga cerealella* and *Plodia interpunctella* adults to LED traps in granary and found that the green LED was significantly more attractive to *P. interpunctella* than the BLB. Duehl et al. (2011) compared the responses to light spectra across the visible and UV regions of the electromagnetic spectrum which indicated that *Tribolium castaneum* was most attracted to near UV LED at a 390 nm dominant wavelength. Nakamoto and Kuba (2004) found that sweet potato weevil *Euscepes postfasciatus* preferred the green LED. It can be concluded from the present study that for the management of *C. chinensis* in the grain storage, blue, ultraviolet and green LED traps could be used to attract beetles or storage structures fitted with white and red LED could be used to keep away the adults.

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