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Short Communication

Effect of ultra-violet rays on growth and development of rust red flour beetle, *Tribolium castaneum* (Herbst)

R. P. Naga, Ashok Sharma, K. C. Kumawat* and B. L. Naga

Department of Entomology, S. K. N. College of Agriculture (S. K. Rajasthan Agricultural University), Jobner (Rajasthan)- 303329, India.

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The adults of *Tribolium castaneum* were exposed to ultraviolet (UV) light (254 nm) for different time periods (2, 4, 6, 8, 10, 12, 14, and 16 min) and each replicated thrice. The culture of unexposed beetles was maintained for comparison. The different time period levels were maintained in the laminar flow cabinet using ultra-violet radiations (254 nm). The fecundity (113.00 eggs/female), hatchability (55.33%), pupation (53.01%) and adult emergence (F_1) (36.67) were maximum in unexposed beetles, whereas, minimum in beetles exposed for 16 min (23.50 eggs/ female, 29.33, 24.98 and 4.00%, respectively) under UV radiation.

Key words: *Tribolium castaneum* (Herbst), ultraviolet (UV) radiation, beetles, fecundity.

INTRODUCTION

Wheat (*Triticum aestivum* Linn.) is one of the important crops in Indian agriculture occupying an area of 28.0 million hectares with the production to the tune of 78.6 million tons (Anonymous, 2009). In developing countries, the grains (cereals and legumes) constitute the key resource of daily energy and protein intake. Among the wheat growing countries, India ranked second both in terms of area and production (Anonymous, 2008). A number of insect pests are found attacking the wheat and its products, among them, the rust red flour beetle, *Tribolium castaneum* (Herbst) causes both quantitative and qualitative damage (Bhargava and Kumawat, 2010). Irradiation is effective against stored grain pests as it causes mortality as well as sterility in insects depending on the dose and time of exposure. Complete reduction of *Alphitobius diaperinus* populations was achieved from 6 to 9 months storage periods, when eggs were exposed to UV-rays for 8 min (Begum et al., 2007). *Cadra cautella* eggs were less sensitive to UV-rays than *Tribolium castaneum* and *Tribolium confusum*. No adult emerged when three days old eggs of *T. castaneum* were irradiated for 16 or 24 mins, or from two and 3 days old eggs of *T. confusum* irradiated for 16 or 24 min (Faruki et al., 2007). The Ultra-low-voltage (ULV) has been found effective against many stored grain pests and has obvious trend of mortality against *T. castaneum* (Calderon et al., 1985; Collins and Kitchingman, 2010). However, meagre work has been done on the effect of UV-rays on the life processes of *T. castaneum.* The present study aimed to find out the effect of UV-rays with the search of a non-chemical method against life processes of *T. castaneum* which is a secondary pest and causes more qualitative damage than the quantitative.

MATERIALS AND METHODS

To maintain the stock culture of *T. castaneum,* it was procured from the pure culture already maintained in Department of Entomology, S. K. N. College of Agriculture, Jobner. The wheat grains were

*Corresponding author. E-mail: kck1965@rediffmail.com.

Table 1. Fecundity, hatchability, pupation percentage and adult emergence (F_1) of *T. castaneum* as influenced by different exposure periods of UV rays.

S/N	Exposure time to UV rays	Fecundity/ female*	S.D.	Hatchability (%)**	S.D.	Pupation (%)**	S.D.	Adult emergence (F_1) ***	S.D.
1	2 min	36.00 (1.56)	2.97	47.33 (43.47)	1.15	45.77 (42.57)	0.10	17.33 (4.16)	0.58
2	4 min	36.00 (1.56)	2.00	45.33 (42.32)	0.58	42.64 (40.77)	0.73	15.33 (3.92)	0.58
3	6 min	32.50 (1.51)	0.87	42.67 (40.79)	1.53	39.85 (39.14)	0.55	13.33 (3.65)	1.15
4	8 min	30.00 (1.48)	1.50	40.33 (39.42)	1.53	37.20 (37.58)	0.53	11.67 (3.42)	0.58
5	10 min	30.00 (1.48)	1.50	37.67 (37.86)	0.58	31.86 (34.36)	0.55	9.33 (3.05)	1.15
6	12 min	29.00 (1.46)	2.25	35.33 (36.47)	1.53	29.23 (32.73)	1.15	7.67 (2.77)	1.15
7	14 min	27.67 (1.44)	0.76	32.67 (34.86)	1.15	26.51 (30.99)	1.31	6.00 (2.45)	0.58
8	16 min	23.50 (1.37)	1.32	29.33 (32.79)	1.53	24.98 (29.99)	1.46	4.00 (2.00)	0.58
9	Unexposed	113.00 (2.05)	2.65	55.33 (48.06)	2.52	53.01 (46.73)	1.08	36.67 (6.06)	1.73
	SEm±	0.04		0.18		0.35		0.09	
	CD at 5%	0.11		0.52		1.05		0.26	

Data based on two pairs of adults (three replications). *Figures in the parenthesis are log X values. **Figures in the parenthesis are angular transformed values. *** Figures in the parenthesis are √X values.

cleaned, rinsed in water, sun dried and were subjected to sterilisation at 60°C temperature for five hours to eliminate any insect infestation, hidden or otherwise. These grains were conditioned for 48 h at 29 ± 1.5°C temperature and 70 ± 5.0% relative humidity and crushed. For maintaining subsequent insect culture, 20 pairs of newly emerged adults were released for oviposition in the glass jar (size 18 × 10 cm) containing 200 g crushed wheat grains. For handling the infested grains and insects, a forcep and a camel hair brush was used. Subsequent experiment was conducted at 29 ± 1.5°C temperature and 70 ± 5.0% relative humidity. The newly emerged adults of *T. castaneum* (immediately after hatched out from the eggs, unmated) were exposed to UV light for different time periods (2, 4, 6, 8, 10, 12, 14, and 16 min) and each replicated thrice. The culture of unexposed beetles was maintained for comparison. The different time period levels were maintained in the laminar flow cabinet using UV radiations (254 nm).

The UV light tube was of Philips make (30 Watt) and the equipment to hold the same was manufactured by Kirloskar Electrodyne. The distance of beetles and the UV tube was 50cm emitting energy at the 254 nm at an intensity of 600 uw/cm^2. Two different pairs of adults immediately after emergence (one pair male and one pair female) were exposed to the ultra-violet radiations (for each time periods mentioned above) and were transferred into the Petri dishes having black paper in the bottom and 3 g sterilized and conditioned broken wheat grains on it. The beetles were allowed to mate and oviposit. Three replications of the culture were maintained. The eggs laid by the beetles were separated every 24 h by sieving (50 mesh sieve) and were counted under the microscope. The survival of the eggs was recorded after examining the egg chorion and by recording the number of larvae that hatched out. The hatched out larvae were transferred into different glass vials having sterilized and conditioned broken wheat grains and reared at 29 ± 1.5°C temperature and 70 ± 5.0 30% relative humidity. The pupation percentage was worked out on the basis of larvae pupated out of the total larvae. The number of adults emerged were counted every 24 h. After counting, the newly emerged adults were discarded from the samples so as to avoid further counting.

The percentage data on hatching and pupation were transformed into angular values (arc sine √percentage) to convert the percentage into degrees. The data on fecundity were converted into log X values and that of adult emergence into √X for ease in analysis of variance.

RESULTS AND DISCUSSION

The results on fecundity (Table 1) indicated that the treatments, on which the *T. castaneum* was allowed to feed and breed, significantly affected the fecundity. The fecundity on different treatments differed greatly (23.50 to 113.00 eggs/female). The maximum number of eggs was laid by the unexposed female beetles (113 eggs/female) and differed significantly (p 0.05 = 0.11) from rest of the treatments. The minimum fecundity (23.50 eggs/female) was recorded in the beetles exposed for 16 min which was found at par with 14 min (27.67 eggs/female), 12 min (29 eggs/female), 10 min (30 eggs/female) and 8 min (30 eggs/female). The descending order of ovipositional potential recorded on different exposed time periods was: unexposed beetles, 2, 4, 6, 8, 10, 12, 14 and 16 min.

The hatchability on different exposure periods was in the range of 29.33 to 55.33% and differed significantly to each other. The maximum hatchability of the eggs was recorded in unexposed beetles (55.33%) followed by 2 min (47.33%) and differed significantly from rest of the treatments. The minimum hatchability (29.33%) was recorded in 16 min exposed beetles, followed by 14 min (32.67%) and 12 min (35.33%). Rest of the treatments ranked in the middle order. All these treatments differed significantly (p 0.05 = 0.52) from each other. The ascending order of hatchability was found to be in the treatments of 16, 14, 12, 10, 8, 6, 4, and 2 min exposed beetles and unexposed beetles. The pupation percentage on different exposure periods was in the range of 24.98 to 53.01%. The maximum pupation was recorded in the unexposed beetles (53.01%), whereas minimum in the

Table 2. Correlation and regression coefficient between exposure time of UV rays and life processes of *T. castaneum*.

S/N	Aspects	Correlation coefficient (r value)*	Regression equation ($y = \alpha + \beta x$)*	Coefficient of determination (R^2)
1	Exposure to UV rays vs. fecundity	-0.66	Y = 66.374 - 3.329X	0.42
2	Exposure to UV rays vs. hatchability	-0.98	Y = 52.198 - 1.441X	0.97
3	Exposure to UV rays vs. pupation	-0.98	Y = 50.12 - 1.681X	0.97
4	Exposure to UV rays vs. adult emergence	-0.86	Y = 25.747 - 1.533X	0.75

*Significant at 5% level.

16 min exposure period (24.98%). The unexposed treatments differed significantly (p 0.05 = 1.05) with the 2 min (45.77%), 4 min (42.64%) and 6 min (39.85%) exposure periods with respect to the pupation percentage. The pupation in 16 and 14 min exposure periods differed non-significantly to each other.

The descending order of pupation percentage was recorded to be in the treatments of unexposed beetles, 2, 4, 6, 8, 10, 12, 14 and 16 min exposure periods. The (F_1) adults emerged was in the range of 4.00 to 36.67. The minimum adults were emerged from 16 min exposed beetles (4.00) and differed significantly over rest of the treatments. The maximum number of adults were emerged from unexposed beetles (36.67) and stood significantly inferior to other treatments. The rest of the treatments were in the middle order to reveal the adult emergence. The ascending order of adult emergence was: 16, 14, 12, 10, 8, 6, 4, and 2 min exposed beetles and unexposed beetles. It was demonstrated that ULV was effective in reducing development in different storage insect pests (Collins and Kitchingman, 2010). This could be possible due to the fact that the UV radiation reduced hatching of eggs and adult eclosion which gets support from the findings of Faruki et al. (2007).

The fecundity, hatchability, pupation percentage and adult emergence (F_1) was maximum in unexposed beetles, whereas, minimum in beetles exposed for 16 min under UV radiation (254 nm). The correlation analysis indicated that there was a significant negative correlation (r = -0.66, -0.98, -0.98 and -0.86) between the exposure period to UV rays and fecundity, hatchability, pupation and adult emergence of *T. castaneum* (Table 2). However, the simple correlation does not disclose the facts of significance, the regression equations Y = 66.374 to 3.329X, Y = 52.198 to 1.441X, Y = 50.12 to 1.681X and Y = 25.747 to 1.533X were obtained which permitted the amount of resultant effect for each unit period of exposure to UV rays. The equations indicated that 66.374, 52.198, 50.12 and 25.742 are the intercepts and exposure to UV rays for one minute was responsible to cause reduction in fecundity, hatchability, pupation and adult emergence by 3.329, 1.441, 1.681 and 1.533%, respectively. A decreasing trend in these parameters was evident when period of exposure was increased. Mohan and Kumar (2010) reported the UV irradiation as a promising agent for controlling the cotton stainer, *Dysdercus koenigii* and observed significant decrease in survival with increasing exposure time, delayed moulting into adult, and morphological deformities in adults and nymphs.

REFERENCES

Anonymous (2008). Partiyogita Darpan, March P. 1549.

Anonymous (2009). Economic Survey. Directorate of Economics and Statistics, Government of India. P. 183.

Begum M, Parween S, Faruki SI (2007). Combined effect of UV-radiation and triflumuron on the progeny of *Alphitobius diaperinus* (Panger) (Coleoptera: Tenebrionidae) at different storage period. Univ. J. Zool. Rajshahi Univ. 26:45-48.

Bhargava MC, Kumawat KC (2010). Insect pests of stored grains and grain products. Pests of stored grains and their management, New India publishing Agency, New Delhi. pp. 29-70.

Calderon M, Bruce WA, Leesch JG (1985). Effect of UV radiation on eggs of *Tribolium castaneum*. *Phytoparasitica* 13(3-4):179-183.

Collins DA, Kitchingman L (2010). The effect of ultraviolet radiation on stored product pests. 10th International Working Conference on Stored Prod. Protect. pp. 632-636.

Faruki SI, Das DR, Khan AR, Khatun M (2007). Effects of ultraviolet (254 nm) irradiation on egg hatching and adult emergence of the flour beetles, *Tribolium castaneum, T. confusum* and the almond moth, *Cadra cautella*. J. Insect Sci. 7:7-36.

Mohan S, Kumar D (2010). Effects of UV irradiations on the survival of the red cotton bug, *Dysdercus koenigii* (Heteroptera, Pyrrhocoridae). Aust. J. Agric. Eng. 1(4):132-135.