Title
Body-Movement Reaction to Irradiation in Flour Beetles

Authors
Yang, Chui-hsu
Welch, G

Publication Date
2023-09-06

Yang, Chui-hsu and G. Welch
Donner Laboratory and Lawrence Radiation Laboratory
University of Californai
Berkeley, California

2 M. 73

*Body-movement Reaction to Irradiation in Flour Beetles

Immediate and reflex-like reactions to irradiation in invertebrates have been observed and studied by many investigators. When dark-adapted moths (Noctuidae) were exposed to x-rays, Smith et al (1963) showed that the flight movement (wing beat) was initiated immediately (less than 1 sec). This reflex response was thought to be resulted from visual stimulation. Terwilliger and Levy (1964) also reported that a transient cessation of locomotor activity in the fiddler crab on termination of irradiation duplicated an "off" response to light and was abolished by removal of the eye stalks.

Can Tribolium be stimulated by radiation and how do they detect it had not been studied and reported before and is of interest for people who use Tribolium as experimental animals for pest control, genetics, ecology, nutrition, general physiology, behavior, and radiobiology studies. This report summarizes our recent findings about the sensitivity of Tribolium beetles to different types of radiations and the possible mechanism(s) involved in the radiation detection of flour beetles.

About one-month old normal T. confusum and T. brevicornis adults, raised in flour-yeast medium at 30°C, were selected and adapted to red light or dark for at least one hour before radiation was given. Radiation included alpha particles, x-rays, and gamma-rays were used. All experiments were done at room temperature. Through a TV-camera and microscope set-up, with a low intensity of red light, the reaction of beetles to irradiation could be seen on a TV screen. Beetles were irradiated only when all of them were found not moving.

It was found that adults responded to 40-Mev alpha particles (3000 rads/min)

DISCLAIMER

Yang, Chui-hsu and G. Welch
Donner Laboratory and Lawrence Berkeley Laboratory
University of California
Berkeley, California

with noticable body movement at a dose of 20 rads. Both normal and antennal amputated adults were used and showed same sensitivity to alpha particles irradiation. With a better control of lighting condition, beetles responded to x-rays (200 kV, 15 mA, 1.0 mm Cu + 1.0 mm Al filter, 16 R/min) at a dose as low as 2 to 3 R.

When the red plastic chamber, in which the beetles were kept, was partially shielded with a piece of lead, adults ran into the shield area during x-irradiation. Antennal and maxillary palps amputated beetles showed same kind response. A direct hit of radiation to adults, therefore, appears to be the cause of response, and antennae and maxillary palps are not the radiation receptors.

In order to check whether the eyes of beetle are involved in detecting radiation, one group of adults were x-irradiated under red light and the another under white light. Results, given in Table 1, clearly indicating that beetles can be stimulated by radiation more easily under red light than in white light. Evidences accumulated through all these radiation experiments suggest that the compound eyes of beetle might be the radiation receptors.

Yang, Chui-hsu and G. Welch
Donner Laboratory and Lawrence Berkeley Laboratory
University of California
Berkeley, California

Table 1. Radiation detection in T. brevicornis beetles.

Trial No.	Light Condition	Exposure time*	No. Adults Responded
1	red light	5 sec	5/10
	white light	5 sec	1/10
2	red light	10 sec	4/5
	white light	10 sec	0/5
3	red light	30 sec	3/5
	white light	30 sec	0/5

*Radiation condition: Norelco MG 150 x-ray unit. 150 kV; 12 mA; 1 mm Al + 0.5 mm Cu filter; 140 R/min.

References:

1. Smith, J. C., D. J. Kimeldorf, and E. L. Hunt; Motor Responses of Moths to Low-Intensity X-ray Exposure. Science 140:805-806 (1963)

2. Terwilliger, R. C. and C. K. Levy; Behavioral Response of the Fiddler Crab (Uca pugilator) to Light and Ionizing Radiation. (Abstract) Physiologist 7:270 (1964)

RW

Feb. 26, 1973

MEMORANDUM

To: R. K. Wakerling

From: T. C. H. Yang

Subject: Research note to be published in TIB

For your record enclosed please find a copy of research report -- Body-movement Reaction to Irradiation in Flour Beetles, to be published in TRIBOLIUM INFORMATION BULLETIN Vol. 16 (1974), edited by A. Sokoloff, School of Natural Sciences, California State College, San Bernardino, California.