mechanism by which bile salts act on the irradiated intestine will be reported later.

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Comparative X-ray Sensitivity of *Tribolium confusum* and *T. castaneum* (Coleoptera: Tenebrionidae) at Different Developmental Stages during their Life-cycle

THE X-ray sensitivities of two ecologically similar species of flour beetles, *Tribolium confusum* (Chicago 'Standard' strain) and *Tribolium castaneum* (Brazil CI strain), were compared at eight different ages which span the life-cycle.

The X-ray was delivered at 1 kr./min by a General Electric Maxitron generator operated at 30 m.amp, 250 kV, 0.25 mm copper + 1.0 mm aluminium filtration and a 2.5 in. anode-subject distance. Below 10 kr., doses were given in 0.5 kr. increments, while higher doses were given in 10 kr. increments. Groups of 50-100 individuals per life-cycle stage were exposed at each dose. Culture conditions were $29 \pm 2^\circ\text{C}$ and 70 ± 10 per cent relative humidity.

A dose was assumed to induce sterility if no progeny developed, and lethality if exposed individuals failed to mature into adults or if they died within 3-4 weeks after eclosion.

The radiosensitivities for both species are compared in Fig. 1. The egg (1-3 h after oviposition) was the most radiosensitive stage. At this highly mitotic period, 1-2 kr. was lethal. In subsequent life-cycle stages, lethal doses were higher than sterilizing doses. *T. confusum* was consistently more X-ray sensitive than *T. castaneum*. Radiation sensitivity remained more or less constant during the larval stages except the tolerance of *T. castaneum* decreased at the 15-day old larval stage. The marked radioresistance in

terms of lethality of *T. castaneum* pupae persisted through adulthood. Young pupae of *T. confusum* were less radioresistant than old pupae or adults.

The differential radiosensitivity of gametes in adults (more sensitive in 1 than in 11-day old adults) corroborates Dick's histological observation¹ that *T. confusum* females were not sexually mature until the fourth or fifth day of adult life. A differential radiation response of reproductive tissues was also observed in *Habrobracon*²⁻⁴ and *Drosophila*⁵.

Experiments are planned to explain the species differences in response to radiation. Perhaps the one more pair of autosomal chromosomes in *T. castaneum*⁶, nuclear volumes, DNA contents, oxygen consumptions, or specific chromosomal (genic) sensitivities, contribute to the differential radiotolerances between these species of flour beetles.

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BIOLOGY

Relations between Day-length and Annual Patterns of Plant Development

THE relatively unchanging annual sequence of anthesis of plant species which occurs naturally each year could be explained in terms of a primary effect of light duration with which secondary factors such as temperature and rainfall interact, provided all species were sensitive to the effects of light duration with respect to anthesis, that is, if there were no completely day-neutral plants.

The tomato (*Lycopersicon esculentum*) has long been regarded as a typical day-neutral plant with respect to flowering. Results from work at this Institute suggest that there is a hyperbolic relation between day-length and the age of the tomato at first anthesis of the form shown in Fig. 1 by the continuous line, the longer the day-length the younger the plant at anthesis. This would suggest that the tomato is basically a weak long-day plant, and that it is not day-neutral. The interaction of a hyperbolic response curve of this type with the parabolic curve of annual variation in day-length at the latitude of the Institute would mathematically produce an annual pattern of age at anthesis of the skew form shown in Fig. 2 by the continuous line. The mathematically derived curve was found to correspond with the experimentally determined annual pattern of anthesis. I thank my colleague, Mr. D. Cooke, for the calculation of the curves in Fig. 1 and 2.

By recalculation of the data on the anthesis of kenaf (*Hibiscus cannabinus*) collected by Walker, Sierra, Bedia and Hopp¹ it can be shown that there is a hyperbolic relation between day-length and the age of kenaf at anthesis of the form shown in Fig. 1 by the broken line, the shorter the day-length the

Fig. 1. Comparative sterilizing and lethal X-ray doses at various development stages in the life-cycles of *Tribolium confusum* and *T. castaneum*.