March 1969

Some Effects of Photoperiod and Cold Storage on Oviposition of the Cereal Leaf Beetle Oulema Melanopus (Coleptera: Chrysomelidae)

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SOME EFFECTS OF PHOTOPERIOD AND COLD STORAGE ON OVIPOSITION OF THE CEREAL LEAF BEETLE, *OULEMA MELANOPUS* (COLEOPTERA: CHRYSOMELIDAE)[1]

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An expanded program of research on the cereal leaf beetle, ***Oulema melanopus*** (L.), in various north-central states has made it necessary to develop methods of rearing all stages of the beetle for laboratory use. Because the insect survives diapause in the adult state (Castro, 1964 and Connin, *et al.*, 1968) it must presently be stored 10-12 weeks at 38° F before consistent oviposition is obtained. Hoopingarner, et al. (1965) indicated that, while males are sexually mature in the prediapause condition, the female was unwilling to mate until after diapause and was not mature sexually until after mating.

More recent work by Bowers and Blickenstaff (1966) and Connin et al. (1967) indicated the possibility of breaking or eliminating diapause with chemicals. However, photoperiod also seemed influential in terminating diapause after varying periods of cold storage. The present paper reports observations on the photoperiodic effects.

MATERIALS AND METHODS

Effects of storage and light period on oviposition of female cereal leaf beetles

Diapausing laboratory-reared adults refrigerated for 0, 4, 8, 16, or 20 weeks at 38° F. were removed from storage and 15 virgin males and 15 virgin females from each storage period were confined together under lantern globe cages over 3½-inch-diameter pots of Hudson barley seedlings about 5 inches tall. The caged beetles were then exposed to an 8-, 16-, or 24-hour light period. The pots of plants were changed every two days and counts were made of the number of eggs present. Each test was repeated 3 times. All tests were conducted in rearing chambers maintained at 75° F and 50 % R. H. Light intensity at plant height was 300 foot-candles.

Since the purpose of the tests was to determine the optimum period of storage and photoperiod to induce oviposition, the tests were terminated after 30 days, even though mating and oviposition were still occurring. (Since diapausing adults caged under lantern globes will lay some eggs after 30-40 days without storage, oviposition would presently have occurred in all cages.)

Effects of storage and light period on the oviposition of unmated female cereal leaf beetles

Unmated laboratory-reared adults were removed from cold storage at 38° F after 12 or 16 weeks and virgin females were caged separately and with males

[1] Journal No. 4370, Michigan Agricultural Experiment Station. Part of a cooperative project between the Entomology Research Division and Crops Research Division, Agricultural Research Service, U.S. Dept. of Agriculture, and the Departments of Entomology and Crop Science, Michigan State University. The authors wish to acknowledge the assistance of J. C. Arnsman, D. L. Cobb, and G. Lawson in conducting these experiments.

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in lantern globe cages over 3½-inch-diameter pots of seedling Hudson barley and exposed to a 16- or 24-hour light period. Rearing conditions were as before. The pots of plants were changed every 2 days, and counts were made of eggs. Also, eggs were held for hatching. Each test was replicated 3 times and continued for 30 days.

Table 1. Effects of photoperiod on the oviposition of laboratory-reared cereal leaf beetles after various periods of cold storage.

No. of insects/ test	Weeks in storage at 38° F before test	Hours of light daily during 30-day test	Day of first oviposition	Avg. no. eggs/♀	% egg hatch
15♀♀ 15♂♂	0	8	--	0	0
	0	16	--	0	0
	0	24	--	0	0
15♀♀ 15♂♂	4	8	--	0	0
	4	16	15	36	70
	4	24	--	0	0
15♀♀ 15♂♂	6	8	--	0	0
	6	16	9	33	68
	6	24	--	0	0
15♀♀ 15♂♂	8	8	--	0	0
	8	16	10	33	78
	8	24	--	0	0
15♀♀ 15♂♂	16	8	10	32	68
	16	16	9	79	67
	16	24	7	86	80
15♀♀ 15♂♂	20	8	5	70	71
	20	16	3	88	81
	20	24	3	102	78

Table 2. Effects of photoperiod on the oviposition of virgin cereal leaf beetle females after various periods of cold storage.

No. of insects/ test	Weeks in storage at 38° F before test	Hours of light daily during 30-day test	Day of first oviposition	Avg. no. eggs/♀	% egg hatch
10♀♀	12	16	7	4	0
25♀♀	12	16	10	4	0
10♀♀ 10♂♂	12	16	10	48	93
10♀♀	12	24	--	0	0
25♀♀	12	24	--	0	0
10♀♀ 10♂♂	12	24	17	1	0
25♀♀	16	16	7	1	0
15♀♀ 15♂♂	16	16	7	96	78
25♀♀	16	24	--	0	0
15♀♀ 15♂♂	16	24	--	0	0

Table 3. Effects of photoperiod on ovarian development of virgin cereal leaf beetle females after 20 weeks of cold storage.

No. of insects/ test	Hours of light daily during 30-day test	Day of first oviposition	Avg. no. eggs/♀	% egg hatch	% ♀ with dev. ovaries
15♀♀	16	8	11	0	80
8 ♀♀8♂♂	16	11	61	59	100
15♀♀	24	--	0	0	7
8 ♀♀8♂♂	24	--	0	0	0

In another test laboratory-reared adults were removed from storage at 38° F after 20 weeks and virgin females were caged alone and with males under lantern globe cages over 3½-inch-diameter posts of seedling Hudson barley. The caged beetles were then exposed to 16- or 24-hour light periods. Rearing conditions were as before. The pots of plants were changed every 2 days, and counts were made of eggs. All eggs were held for hatching. Each test was repeated 3 times and continued for 30 days. At the end of the test, all females were dissected and observed for ovarian development.

RESULTS AND DISCUSSION

As indicated in Table 1, the duration of cold storage and the daily light period to which beetles were exposed after storage markedly affected the duration of diapause and subsequent oviposition of the female. Oviposition occurred after as little as 4 weeks of cold storage when the beetles were subsequently exposed to 16 hours of light daily; with other photoperiods, as much as 16 weeks of storage were required. Oviposition began earlier, and more eggs were laid per female, as the time in storage increased.

Tables 2 and 3 indicate that virgin females are capable of ovarian development and oviposition after diapause and before mating when they are exposed to a 16-hour daily light period. 80 % of the females held in storage at 38° F. for 20 weeks and subsequently exposed to a 16-hour daily light period completed ovarian development. However, the number of eggs oviposited was small, and none was viable. Females exposed to a 24-hour light period had slight ovarian development, and no eggs were oviposited. Thus, unmated females are capable of oviposition but the eggs are not viable. The possibility will influence investigations of induced sterility.

In future studies of oviposition, both the storage interval and the light exposure after storage must be considered. Such conditions would be particularly critical in studies involving induced sterility in which conclusions should apparently be based on egg hatch instead of total egg production.

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THREE NEW SPECIES OF *HYPERASPIS* FROM EASTERN NORTH AMERICA (COLEOPTERA: COCCINELLIDAE)[1]

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A number of apparently related species, including the three which are newly described in this paper, belong to the large ***binotata*** group of Dobzhansky (1941). It has been found necessary to re-examine this group and to divide it into smaller, more homogeneous species clusters. These new species clusters may indicate more clearly the relationships of the species involved.

Specimens which have formed the basis for the new species were located in the collections of the University of Michigan Museum of Zoology (UMMZ) and Illinois Natural History Survey (INHS). To the custodians of these collections I extend my thanks.

Key to separate some of the species of ***Hyperaspis*** in Eastern North America

1. Elytra with never more than one pair of reddish spots placed near the middle of the elytra 2
   Elytra with two pairs of reddish spots, a larger pair on disc, a smaller pair near apex 3

2. Prosternal lines converging to an anterior point 4
   Prosternal lines parallel (Figs. 3, 4; Watson, 1960). . . . . . ***paspalis*** Watson

3. Sides of abdomen testaceous, disc black; aedeagus asymmetrical but without triangular tooth (Fig. 118, Dobzhansky, 1941). . . . . ***signata*** (Say)
   Abdomen wholly black beneath or with a greyish cast; aedeagus with one side having a distinct triangular tooth (Fig. 3). . . . . . ***congeminata*** n. sp.

1 Contribution No. 1, Department of Biology, Laurentian University, Sudbury, Canada.