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Effects of Continuous and Split Developmental Photophases During Each 24 Hour Period on Adult Morphology in *Euschistus Tristigmus Tristigmus* (Hemiptera: Pentatomidae)

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EFFECTS OF CONTINUOUS AND SPLIT DEVELOPMENTAL PHOTOPHASES DURING EACH 24 HOUR PERIOD ON ADULT MORPHOLOGY IN *EUSCHISTUS TRISTIGMUS TRISTIGMUS* (HEMIPTERA: PENTATOMIDAE)[1]

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ABSTRACT

Rearing immatures of *Euschistus tristigmus tristigmus* in 8L:16D, 8L: 4D:8L;4D, and 16L:8D showed that the length of each photophase, rather than an accumulated total of shorter photophases, during each 24 hr period was the determining factor in producing adult dimorphism in shoulder shape and number of midventral abdominal spots.

Euschistus tristigmus occurs from northern Canada to southern Mexico (Van Duzee, 1904) and contains two subspecies, *luridus* Dallas and *tristigmus* (Say) [= *pyrrhocerus* (Herrich-Schaeffer)]. *E. t. tristigmus* is seasonally dimorphic (McPherson, 1975a). Adult dimorphism results from developmental photoperiod (McPherson, 1974; 1975b) with a threshold photoperiod of ca. 14.5L:9.5D (light:dark) involved in the dimorphic response (McPherson, 1979); animals reared in photophases above and below the threshold develop into *pyrrhocerus* (spinose shoulders, 0-2 midventral abdominal spots) and *tristigmus* (subtriangular shoulders, 3-4 spots) form adults, respectively.

All of the photoperiods used in the above experiments involved a 24 hr day and continuous periods of light and dark (e.g., a 16 hr photophase followed by an 8 hr scotophase). Not determined previously was the necessity of these continuous periods for it was possible that the same results could be obtained by split photophases during each 24 hr period. The results of an experiment to determine this are presented here.

MATERIALS AND METHODS

Thirty males and 30 females from F_3 generation laboratory stock were placed in an incubator (23.9 ± 1.1° C) under an 18L:6D photoperiod; the stock was established with individuals collected June-July, 1977, in Jackson County, in southern Illinois. They were maintained in mason jars (10 of each sex/jar) provided with cheesecloth as an oviposition site, paper toweling strips and filter paper, and fed green snap beans (*Phaseolus vulgaris* L.) as described by McPherson (1971).

Each resulting egg cluster was placed in one of the following three photoperiods and the individuals reared to adult as described by McPherson (1971): 8L:16D, 8L:4D:8L:4D, and 16L:8D. The 8L:4D:8L:4D photoperiod exposed the animals to only 8 hr of continuous light but a total of 16 hr of light/24 hr. All individuals were reared at 23.9 + 1.1° C during the light and dark phases, and in about 130 ft-c during the light phases (Ken-Rad, 15W Daylight, F15T8/D).

Adult characters compared were shoulder shape (ratio of length/width) and number of midventral abdominal spots (McPherson, 1974). These characters had previously been shown to be dimorphic between adults reared in 8L:16D and 16L:8D (McPherson, 1979), Shoulder ratios were compared with Duncan's multiple range test (Table 1), and number of spots with Fisher's exact probability test (Table 2). The 0.01 level of significance was chosen for all comparisons.

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Table 1. Comparison of shoulder shape (length/width) between *E. t. tristigmus* adults reared in continuous or split photophases during each 24 hr period.

Photoperiod	Sex	No.	Shoulder[a] $\bar{x}$	Sex	No.	Shoulder[a] $\bar{x}$
8L:16D	♂	20	0.89[a]	♀	20	0.89[a]
8L:4D:8L:4D	♂	20	0.90[a]	♀	20	0.90[a]
16L:8D	♂	20	1.07[b]	♀	20	1.06[b]

[a]Means followed by same letter within columns are not significantly different at the 0.01 level of probability by Duncan's multiple range test.

Table 2. Comparison of number of midventral abdominal spots between *E. t. tristigmus* adults reared in continuous or split photophases during each 24 hr period.

Photoperiod	Sex	No. spots 0-2	No. spots 3-4	Prob.[a]	Sex	No. spots 0-2	No. spots 3-4	Prob.[a]
8L:16D	♂	1	19		♀	1	19	
8L:4D:8L:4D	♂	2	18	0.50	♀	1	19	0.75
8L:4D:8L:4D	♂	2	18		♀	1	19	
16L:8D	♂	15	5	0.00	♀	16	4	0.00

[a]Fisher exact probability test.

RESULTS AND DISCUSSION

There was no significant difference in shoulder ratios between males or females reared in the 8L:16D and 8L:4D:8L:4D photoperiods; all had shoulder ratios less than 1.00 (subtriangular shoulder = *tristigmus* form) (Table 1). Those reared in 16L:8D had shoulder ratios greater than 1.00 (spinose shoulder = *pyrrhocerus* form). There was also no significant difference in number of spots between males or females reared in the 8L:16D and 8L:4D:8L:4D photoperiods; most had 3-4 spots (= *tristigmus* form) (males, 90-95%; females, 95%) (Table 2). Those reared in 16L:8D generally had 0-2 spots (= *pyrrhocerus* form) (males, 75%; females 80%).

These results show that the length of the developmental photophase, rather than the total amount of light, during 24 hr determines the adult morph. They also help to explain the function of the dark period.

In previous experiments it had been assumed that the observed dimorphism resulted from the length of the photophase, not the scotophase. For example, in the experiments to determine the threshold photoperiod (McPherson, 1979), animals were reared in photoperiods ranging from 8L:16D to 18L:6D. It was possible that the range of scotophases, not photophases, determined the results.

In the above experiment, scotophases of 16 and 4 hr were involved in the production of the *tristigmus* form and 8 hr, the *pyrrhocerus* form. Thus, it appears that photophase does determine the morph, that scotophase is functioning only to break the photophase, and that the length of the scotophase is unimportant between 16 and 4 hr, perhaps less.

LITERATURE CITED

McPherson, J. E. 1971. Laboratory rearing of *Euschistus tristigmus tristigmus*. J. Econ. Entomol. 64:1339-1340.

————. 1974. Photoperiod effects in a southern Illinois population of the *Euschistus tristigmus* complex (Hemiptera: Pentatomidae). Ann. Entomol. Soc. Amer. 67:943-952.

——————. 1975a. Life history of *Euschistus tristigmus tristigmus* (Hemiptera: Pentatomidae) with information on adult seasonal dimorphism. Ann. Entomol. Soc. Amer. 68:333-334.

——————. 1975b. Effects of developmental photoperiod on adult morphology in *Euschistus tristigmus tristigmus* (Say) (Hemiptera: Pentatomidae). Ann. Entomol. Soc. Amer. 68:1107-1110.

——————. 1979. Effects of various photoperiods on morphology in *Euschistus tristigmus tristigmus* (Hemiptera: Pentatomidae). Great Lakes Entomol. 12:23-26.

Van Duzee, E. P. 1904. Annotated list of the Pentatomidae recorded from America north of Mexico, with descriptions of some new species. Trans. Amer. Entomol. Soc. 30:1-80.