The Great Lakes Entomologist

Volume 15
Number 3 - Fall 1982 *Number 3 - Fall 1982*

Article 3

October 1982

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

J. E. McPherson
Southern Illinois University

S. M. Paskewitz
Southern Illinois University

EFFECTS OF VARIOUS SPLIT DEVELOPMENTAL PHOTOPHASES AND CONSTANT LIGHT DURING EACH 24 HOUR PERIOD ON ADULT MORPHOLOGY IN *EUSCHISTUS TRISTIGMUS TRISTIGMUS* (HEMIPTERA: PENTATOMIDAE)

J. E. McPherson and S. M. Paskewitz[1]

ABSTRACT

Rearing immatures of *Euschistus tristigmus tristigmus* in a range of split photophases during each 24 h period and in constant light showed that the adult dimorphic response in shoulder shape and number of midventral spots could be produced; individuals reared in photoperiods in which each scotophase was at least 2 h in length developed into the *tristigmus* (short-day) form.

Euschistus tristigmus ranges from northern Canada to southern Mexico (Van Duzee 1904) and contains two subspecies, *luridus* Dallas and *tristigmus* (Say) (= *pyrrhocerus* (Herrich-Schaeffer)). *E. t. tristigmus* exhibits adult dimorphism. McPherson (1975a) has shown it to be bivoltine and seasonally dimorphic; adults with spinose shoulders and 0–2 midventral abdominal spots (*pyrrhocerus* or long-day form) are found during the summer months and adults with subtriangular shoulders and 3–4 spots (*tristigmus* or short-day form) are found during the fall and spring. Adult dimorphism results from developmental photoperiod (McPherson 1974, 1975b) with a threshold photoperiod of about 14.5L:9.5D (light:dark) involved in the dimorphic response (McPherson 1979a); animals reared in photophases above and below the threshold develop into the *pyrrhocerus* and *tristigmus* form adults, respectively.

To determine if the photophase during each 24 h period had to be continuous (e.g., 16 h) or could be split (e.g., 8 h, 8 h) and still produce the same morph, McPherson (1979b) reared animals under 8L:16D, 8L:4D:8L:4D, and 16L:8D photoperiods. The 8L:4D:8L:4D photoperiod exposed the animals to only 8 h of continuous light but a total of 16 h of light/24 h. He found that those reared under 8L:16D and 8L:4D:8L:4D became *tristigmus* adults (short-day form) and those in 16L:8D, *pyrrhocerus* adults (long-day form). Thus, during each 24 h period, it is the length of each photophase, rather than the combined lengths of all photophases, that determines the adult morph. Also, since scotophases of 16 h and 4 h were involved in the production of the *tristigmus* form and 8 h the production of the *pyrrhocerus* form, it appeared that the scotophase was functioning only to break the photophase and the length of the scotophase was unimportant down to 4 h. This raised another question. What was the length of the scotophase below which the animals would no longer respond but, instead, develop into *pyrrhocerus* adults? The results of an experiment to determine this are presented here.

METHODS AND MATERIALS

Fifty males and 50 females from F_1 generation stock were placed in an incubator (23.9 ± 1.1°C) under a 24L:0D photoperiod; the stock was established with individuals collected June–July 1981, in the LaRue-Pine Hills Ecological Area, Union County, in southern Illinois. They were maintained in mason jars (five of each sex/jar) provided with cheesecloth

[1]Department of Zoology, Southern Illinois University, Carbondale, IL 62901.

as an oviposition site, a paper toweling strip, 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 five photoperiods and the individuals reared to adults as described by McPherson (1971): 8L:4D:8L:4D, 9L:3D:9L:3D, 10L:2D:10L:2D, 11L:1D:11L:1D, and 24L:0D. All individuals were reared in 23.9 ± 1.1°C and in about 260 ft-c during the light phases (Sylvania, 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 animals reared in long- and short-day photoperiods (McPherson 1979a). Shoulder ratios were compared with Duncan's multiple range test (Table 1). Numbers of spots were compared with Fisher's exact probability test and generally in sequential pairs of incresing photophases; for example, individuals reared in 9L:3D:9L:3D were compared with those reared in 8L:4D:8L:4D and 10L:2D:10L:2D (Table 2). The 0.01 level of significance was chosen for all comparisons.

RESULTS AND DISCUSSION

There was no significant difference in shoulder ratios between males or females reared in 8L:4D:8L:4D, 9L:3D:9L:3D, and 10L:2D:10L:2D; all had shoulder ratios less than 1.00 (subtriangular shoulder-*tristigmus* form) (Table 1). Males or females reared in 11L:1D:11L:1D had shoulder ratios greater than 1.00 (spinose shoulder = *pyrrhocerus* form) and were not significantly different from those reared in 24L:OD. There was also no significant difference in number of spots between males or females reared in 8L:4D:8L:4D, 9L:3D:9L:3D, and 10L:2D:10L:2D; most had 3–4spots (= *tristigmus* form) (males 85–95%; females 90–95%) (Table 2). Males or females reared in 11L:1D:11L:1D usually had 0–2 spots (= *pyrrhocerus* form) (males 80%; females 85–90%) and were not significantly different from those reared in 24L:0D.

These results show that there is a critical developmental scotophase between 2 and 1 h below which the animals do not respond; as adults, therefore, they appear as though reared in constant light (i.e., develop into the *pyrrhocerus* form). Thus, scotophase, as shown in the earlier experiment (McPherson 1979b), does function to break the photophase but can be overridden by the photophase if the scotophase is not of sufficient duration (i.e., near 1.5 h).

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.

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

———. 1979b. Effects of continuous and split developmental photophases during each 24 hour period on adult morphology in *Euschistus tristigmus tristigmus* (Hemiptera: Pentatomidae). Great Lakes Entomol. 12:79–81.

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.

TABLE 1. Comparison of shoulder shape (length/width) between *E. t. tristigmus* adults reared in various split photophases and constant light.

Photoperiod	Sex	No.	Shoulder ($\bar{X}$)[a]	Sex	No.	Shoulder ($\bar{X}$)
8L:4D:8L:4D	♂	20	0.94 A	♀	20	0.94 A
9L:3D:9L:3D	♂	20	0.93 A	♀	20	0.95 A
10L:2D:10L:2D	♂	20	0.93 A	♀	20	0.94 A
11L:1D:11L:1D	♂	20	1.07 B	♀	20	1.11 B
24L:0D	♂	20	1.09 B	♀	20	1.10 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 various split photophases and constant light.

		No. spots				No. spots		
Photoperiod	Sex	0–2	3–4	Prob.[a]	Sex	0–2	3–4	Prob.[a]
8L:4D:8L:4D	♂	3	17		♀	2	18	
9L:3D:9L:3D		3	17	0.67		1	19	0.50
9L:3D:9L:3D	♂	3	17		♀	1	19	
10L:2D:10L:2D		1	19	0.30		1	19	0.76
10L:2D:10L:2D	♂	1	19		♀	1	19	
11L:1D:11L:1D		16	4	0.00		18	2	0.00
11L:1D:11L:1D	♂	16	4		♀	18	2	
24L:0D		16	4	0.65		17	3	0.50
8L:4D:8L:4D	♂	3	17		♀	2	18	
24L:0D		16	4	0.00		17	3	0.00

[a]Fisher's exact probability test.