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Effects of Various Photoperiods on Morphology in *Euschistus Tristigmus Tristigmus* (Hemiptera: Pentatomidae)

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EFFECTS OF VARIOUS PHOTOPERIODS ON MORPHOLOGY IN *EUSCHISTUS TRISTIGMUS TRISTIGMUS* (HEMIPTERA: PENTATOMIDAE)[1]

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ABSTRACT

Rearing immatures of *Euschistus tristigmus tristigmus* in a range of photoperiods showed that a threshold photoperiod is involved in the adult dimorphic response (shoulder shape and number of midventral abdominal spots) with the mean threshold probably near 14.5L:9.5D (light: dark). This threshold is consistent with the seasonal distribution of the adult morphs.

Euschistus tristigmus occurs from southern Mexico to northern Canada (Van Duzee, 1904) and contains two subspecies, *luridus* Dallas and *tristigmus* (Say) [= *pyrrhocerus* (Herrich-Schaeffer)]. McPherson (1975a) has shown *E. t. tristigmus* to be dimorphic as adults and bivoltine; the *pyrrhocerus* form (adults with spinose shoulders and 0-2 midventral abdominal spots) are found during the summer months, and the *tristigmus* form (subtriangular shoulders, 3-4 spots) during the fall and spring. McPherson has also reported that (1974) the *tristigmus* and *pyrrhocerus* forms can be produced in the laboratory by rearing immatures under a 12L:12D and 24L:OD photoperiod, respectively, and that (1975b) the older instars are most sensitive to photoperiod influence. Not determined previously was the effect of a range of developmental photoperiods on adult morphology. The results of experiments designed to determine this effect are presented here.

MATERIALS AND METHODS

Thirty males and 30 females from F_1 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, from Jackson County, in southern Illinois. They were maintained in mason jars (10 of each sex/jar) provided with cheesecloth as an oviposition site, filter paper, and paper toweling, and fed green snap beans (*Phaseolus vulgaris* L.) as described by McPherson (1971).

Each resulting egg cluster was placed in one of the following eight photoperiods and the insects reared to adults as described by McPherson (1971): 8L:16D, 10L:14D, 12L:12D, 13L:11D, 14L:10D, 15L:9D, 16L:8D, and 18L:6D. All experiments were conducted at 23.9 ± 1.1°C during the light and dark phases, and ca. 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 12L:12D and 24L:0D photoperiods (McPherson, 1974; McPherson and Vangeison, 1975).

Shoulder ratios were compared with Duncan's multiple range test (Table 1). Number of spots were compared in sequential pairs of increasing photophase with Fisher's exact probability test; for example, individuals reared in 10L:14D were compared with those

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reared in 8L:16D and 12L:12D. The 0.01 level of significance was chosen for all comparisons.

RESULTS

Rearing males and females in the eight photoperiods produced two distinct groupings of shoulder ratios, those less (subtriangular shoulder = *tristigmus* form) and those greater than 1.00 (spinose shoulder = *pyrrhocerus* form) (Table 1). Although the results show that there was a slight but significant increase from 0.89 to 0.94 as the photophase increased from 8L:16D to 14L:10D, the most noticeable increase occurred at 15L:9D.

There was no significant difference in number of spots in males and females reared in 8L:16D-14L:10D (Table 2); most adults had 3-4 spots (*tristigmus* form) (males 90-100%; females, 75-100%). At 15L:9D, the number of adults with 0-2 spots (*pyrrhocerus* form) increased markedly (males, 100%; females, 95%) dropped at 16L:8D (but not as low as at 14L:10D), and again increased at 18L:6D (Table 2). Shoulder ratios over 1.00 were also lowest at 16L:8D (Table 1). I have no explanation for the weaker effect of 16L:8D among the photoperiods producing primarily *pyrrhocerus* form adults (15L:9D-18L:6D).

DISCUSSION

The results show that a threshold photoperiod is involved in the dimorphic response, and that it probably lies near 14.5L:9.5D.

These results are consistent with those of earlier studies of the role of developmental photoperiod in producing adult dimorphism (McPherson, 1975b), and of the life history of this insect in which seasonal dimorphism was observed (McPherson, 1975a). McPherson (1975b) showed that 3rd and 4th instars were most sensitive to 24L:0D photoperiod influence in producing spinose shoulders (*pyrrhocerus* form), and 2nd, 3rd, and 4th instars to 12L:12D in producing subtriangular shoulders (*tristigmus* form). The effect of photoperiod on the various immature stages in producing 0-2 or 3-4 spots was not as obvious, but the 3rd, 4th, and 5th instars appeared most sensitive to the two photoperiods (McPherson, 1975b). McPherson (1975a) also reported that summer generation adults (from immatures developing during the spring-summer months) generally possessed spinose shoulders and 0-2 spots (*pyrrhocerus* form) and fall/spring generation (overwintering) adults (from immatures developing during the summer-fall months), subtriangular shoulders and 3-4 spots (*tristigmus* form). During the field study, summer generation 3rd-5th instars were collected between 29 May and 29 July, the first adults on 22 June. Natural photophases between 29 May and 29 July were 14 hr:28 min (29 May)

Table 1. Comparison of shoulder shape (length/width) between *E. t. tristigmus* adults reared in various photoperiods.

Photoperiod	Sex	No.	Shoulder[a] $\bar{x}$	Sex	No.	Shoulder[a] $\bar{x}$
8L:16D	♂	20	0.89a	♀	20	0.89a
10L:14D	♂	20	0.89a	♀	20	0.91ab
12L:12D	♂	20	0.93ab	♀	20	0.92ab
13L:11D	♂	20	0.92ab	♀	20	0.92ab
14L:10D	♂	20	0.94b	♀	20	0.94b
15L:9D	♂	20	1.09c	♀	20	1.10cd
16L:8D	♂	20	1.05c	♀	20	1.07c
18L:6D	♂	20	1.07c	♀	20	1.12d

[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.

to 14 hr:08 min (29 July) (Table 3), peaking on 22 June (14 hr:43 min). The estimated threshold (14.5L:9.5D) occurred on 30 May and on 13 July. By 13 July, 80% of the spring-summer occurrence of the 4th, and 70% of the 5th, instars had passed (McPherson, 1975a). Those left to complete development in photophases less than the threshold had

Table 2. Comparison of number of midventral abdominal spots between *E. t. tristigmus* adults reared in various photoperiods.

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	♂	0	20		♀	0	20	
10L:14D		0	20	1.00		0	20	1.00
10L:14D	♂	0	20		♀	0	20	
12L:12D		0	20	1.00		0	20	1.00
12L:12D	♂	0	20		♀	0	20	
13L:11D		2	18	0.24		5	15	0.02
13L:11D	♂	2	18		♀	5	15	
14L:10D		2	18	0.70		2	18	0.20
14L:10D	♂	2	18		♀	2	18	
15L:9D		20	0	0.00		19	1	0.00
15L:9D	♂	20	0		♀	19	1	
16L:8D		13	7	0.00		11	9	0.00
16L:8D	♂	13	7		♀	11	9	
18L:6D		18	2	0.06		16	4	0.09
18L:6D	♂	18	2		♀	16	4	
8L:16D		0	20	0.00		0	20	0.00
14L:11D	♂	2	18		♀	2	18	
16L:8D		13	7	0.00		11	9	0.00

[a]Fisher exact probability test.

Table 3. First and last dates of seasonal occurrence of 2nd-5th instars and adults[a] and corresponding photophases[b].

Generation	Instar	Occurrence in field samples	Corresponding photophases
Summer	3rd	29 May-29 June	14 hr:28 min-14 hr:40 min
	4th	2 June-23 July	14 hr:33 min-14 hr:17 min
	5th	5 June-29 July	14 hr:36 min-14 hr:08 min
	adult (*pyrrhocerus* form)	22 June-14 Sept.	14 hr:43 min-12 hr:28 min
Fall/spring	2nd	29 July-29 Aug.	14 hr:08 min-13 hr:05 min
	3rd	6 Aug.-28 Sept.	13 hr:53 min-11 hr:56 min
	4th	15 Aug.-2 Oct.	13 hr:36 min-11 hr:46 min
	5th	24 Aug.-29 Oct.	13 hr:16 min-10 hr:46 min
	adult (*tristigmus* form)	7 Sept.-13 Nov.	12 hr:45 min-10 hr:16 min

[a]McPherson, 1975a.
[b]At Cairo, Illinois (No. 1089, U.S. Govt. Ptg. Off.,.Washington, D.C., 1965).

apparently spent enough of their earlier development in photophases above the threshold since all became *pyrrhocerus* form adults.

The 2nd-5th instars of the fall/spring generation were collected between 29 July and 29 October, the first adults on 7 September. Natural photophases between these dates were 14 hr:08 min (29 July) or lower, well below the estimated threshold.

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