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

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ABSTRACT

Rearing immatures of *Thyanta calceata* in a range of split photophases during each 24 h period and in constant light showed that the adult dimorphic response in color and pubescence could be produced; individuals reared in photoperiods in which each scotophase was at least 2 h in length generally developed into the fall/spring morph.

Thyanta calceata (Say) ranges from New England south to Florida, and west to Illinois (Blatchley 1926) and Missouri (Oetting and Yonke 1971). This phytophagous stink bug exhibits adult dimorphism. McPherson (1977a) has shown it to be bivoltine and seasonally dimorphic; green adults with short pubescence (shorter than diameter of tibia) are found during the summer months, and brown adults with long pubescence during the fall and spring. Adult dimorphism results from developmental photoperiod (McPherson 1977b, 1978a) with a threshold photoperiod of about 12.5L:11.5D involved in the dimorphic response (McPherson 1978b); animals reared in photophases above and below the threshold develop into the summer and fall/spring morphs, 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 and Paskewitz (1982) 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 to a total of 16 h of light/24 h. They found that those reared under 8L:16D and 8L:4D:8L:4D became the fall/spring morph, and those in 16L:8D the summer morph. Thus, during each 24 h period, it is the length of each photophase, rather than the combined lengths of all photophases, that determine the adult morph. Also, since scotophases of 16 h and 4 h were involved in the production of the fall/spring morph, and 8 h the production of the summer morph, 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 the summer morph? The results of an experiment to determine this are presented here.

METHODS AND MATERIALS

Fifty males and 50 females from F_1 generation laboratory stock were placed in an incubator (23.9 ± 1.1°C) under a 24L:OD photoperiod; the stock was established with individuals collected July 1982 in Poinsett County, Arkansas. They were maintained in mason jars (five of each sex/jar) provided with cheesecloth as an oviposition site, a paper toweling strip, and filter paper, and fed green snap beans (*Phaseolus vulgaris* L.), as described by McPherson (1971).

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Table 1. Comparison of color and pubescence between *Thyanta calceata* adults reared in various split photophases and constant light.

		Color						Pubescence		
		Dorsal			Ventral					
Photoperiod	Sex	Brown	Green	Prob.	Brown	Green	Prob.	Short	Long	Prob.
8L:4D:8L:4D	♂	49	1		49	1		0	50	
9L:3D:9L:3D		49	1	0.76[a]	48	2	0.50[a]	1	49	0.50[a]
9L:3D:9L:3D	♂	49	1		48	2		1	49	
10L:2D:10L:2D		48	2	0.50[a]	48	2	0.69[a]	2	48	0.50[a]
10L:2D:10L:2D	♂	48	2		48	2		2	48	
11L:1D:11L:1D		19	31	35.46[b]*	19	31	35.46[b]*	18	32	14.06[b]*
11L:1D:11L:1D	♂	19	31		19	31		18	32	
11.5L:0.5D:11.5L:0.5D		1	49	18.06[b]*	1	49	18.06[b]*	50	0	0.00[a]*
11.5L:0.5D:11.5L:0.5D	♂	1	49		1	49		50	0	
24L:0D		3	47	0.31[a]	3	47	0.31[a]	49	1	0.50[a]

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8L:4D:8L:4D	♂	49	1		49	1		0	50	
24L:0D		3	47	81.13[b]*	3	47	81.13[b]*	49	1	0.00[a]*
8L:4D:8L:4D	♀	43	7		43	7		3	47	
9L:3D:9L:3D		46	4	0.41[b]	45	5	0.09[b]	3	47	0.00[b]
9L:3D:9L:3D	♀	46	4		45	5		3	47	
10L:2D:10L:2D		44	6	0.10[b]	44	6	0.00[b]	3	47	0.00[b]
10L:2D:10L:2D	♀	44	6		44	6		3	47	
11L:1D:11L:1D		8	42	49.08[b]*	8	42	49.08[b]*	36	14	43.04[b]*
11L:1D:11L:1D	♀	8	42		8	42		36	14	
11.5L:0.5D:11.5L:0.5D		1	49	4.40[b]*	1	49	4.40[b]*	50	0	0.00[a]*
11.5L:0.5D:11.5L:0.5D	♀	1	49		1	49		50	0	
24L:0D		0	50	0.50[a]	0	50	0.50[a]	49	1	0.50[a]
8L:4D:8L:4D	♀	43	7		43	7		3	47	
24L:0D		0	50	0.00[a]*	0	50	0.00[a]*	49	1	81.13[b]*

[a]Fisher exact probability test.
[b]2 × 2 χ^2 test for independent samples corrected for continuity.
*Significant at the 0.05 level of probability.

Each resulting egg cluster was placed in one of the following six photoperiods and reared to adults as described by McPherson (1971): 8L:4D:8L:4D, 9L:3D:9L:3D, 10L:2D:10L:2D, 11L:1D:11L:1D, 11.5L:0.5D:11.5L:0.5D, and 24L:OD. 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 color (green or brown) and pubescence (long or short); short hairs were defined as those shorter than the diameter of the tibia. The 0.05 level of significance was chosen for all comparisons.

RESULTS AND DISCUSSION

Rearing males or females in 8L:4D:8L:4D, 9L:3D:9L:3D, and 10L:2D:10L:2D produced similar results; most individuals were brown (males, 96–98%; females, 86–92%) with long pubescence (males, 96–100%; females, 94%) (Table 1). Rearing the two sexes in 11L:1D:11L:1D produced a marked increase in the percentage of green adults (males, 62%; females, 84%) and adults with short pubescence (males, 36%; females, 72%). Rearing individuals in 11.5L:0.5D:11.5L:0.5D produced a second increase (98% green adults, 100% short pubescence; both sexes) and these percentages were similar to those for individuals reared in constant light.

These results show that the developmental photophase generally must be longer than 2 h for the fall/spring morph (brown with long pubescence) to be produced. Between 2 h and 1/2 h, most individuals no longer respond but appear as though reared in constant light (i.e., develop into green adults with short pubescence). As the length of the scotophase is decreased, females generally fail to respond before males (recall that at 11L:1D:11L:1D, 84% of the females were green compared to only 62% of the males). Thus, scotophase, as shown in the earlier experiment (McPherson and Paskewitz 1982), does function to break the photophase but can be overridden if the scotophase is not of sufficient duration.

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LITERATURE CITED

Blatchley, W. S. 1926. Heteroptera or true bugs of eastern North America with especial reference to the faunas of Indiana and Florida. Nature Publ. Co., Indianapolis.

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

————. 1977a. Notes on the biology of *Thyanta calceata* (Hemiptera:Pentatomidae) with information on adult seasonal dimorphism. Ann. Entomol. Soc. Amer. 70:370–372.

————. 1977b. Effects of developmental photoperiod on adult color and pubescence in *Thyanta calceata* (Hemiptera:Pentatomidae) with information on ability of adults to change color. Ann. Entomol. Soc. Amer. 70:373–376.

————. 1978a. Sensitivity of immature *Thyanta calceata* (Hemiptera:Pentatomidae) to photoperiod as reflected by adult color and pubescence. Great Lakes Entomol. 11:71–76.

————. 1978b. Effects of various photoperiods on color and pubescence in *Thyanta calceata* (Hemiptera:Pentatomidae). Great Lakes Entomol. 11:155–158.

McPherson, J. E. and S. M. Paskewitz. 1982. Effects of continuous and split developmental photophases during each 24 hour period on adult color and pubescence in *Thyanta calceata* (Hemiptera:Pentatomidae). Great Lakes Entomol. 15:97–98.

Oetting, R. D. and T. R. Yonke. 1971. Biology of some Missouri stink bugs. J. Kansas Entomol. Soc. 44:446–459.