Ann Ent Soc Am
63(5) 1975

Wing Polymorphism in *Acheta domesticus* (Orthoptera: Gryllidae)[1]

ROBERT L. PATTON
Department of Entomology, Cornell University, Ithaca, NY 14850

ABSTRACT

In *Acheta domesticus* (L.) wing polymorphism, the development of macropterous, monopterous, or micropterous metathoracic wings, is a function of the quality of the diet upon which the insect feeds. Photoperiod showed no measurable relationship.

Wing polymorphism occurs in many insect species and is a phenomenon that has been studied by developmental biologists who have linked various factors to wing production and form. Polymorphism in crickets refers to the length and development of the metathoracic wings. It is very apparent in *Acheta domesticus* (L.). Alexander (1961) suggested that in some crickets the polymorphism is related to photoperiod. Later (Alexander 1968) he presented data to show that with *Gryllus integer* an increase in daily light exposure resulted in an increase in body length and the incidence of the macropterous form. He also noted that: "Some variation in tegminal length is associated with these drastic variations in length of the hind wings . . . ."

Observations of laboratory colonies of *A. domesticus* extending over a period of more than 10 years suggest that in this species the development of metathoracic wings (i.e. polymorphism) is related to nutrition and not to photoperiod. The observations also indicate the presence of an intermediate form with one completely formed wing and one undeveloped wing. This has not been reported previously and can be described as *monopterous*.

MATERIALS AND METHODS

A laboratory colony of ca. 20,000 individual crickets is maintained for nutritional and other experimental study. These are bred and grown in a closed room which is held at a temperature of 30±2°C. No attempt is made to control the humidity, which varies appreciably. Illumination is provided by a battery of time switch-operated lights producing principal wavelengths between 550 and 600 nm.

For routine rearing, the insects were fed diet no. 16 (Patton 1967), which contains 30% protein. During the course of experimentation, an experimental colony of ca. 150 1st-stage nymphs was drawn from a single hatch and isolated. These were placed in an incubator set to control both temperature and photoperiod. Of the 150 1st instars, 74 adults matured. At the same time as these matured, a sample of 98 adults was drawn from the laboratory colony. The photoperiod of the incubator was 8 h of light per day, and that of the laboratory colony, 24 h. The incubator was opened only during the light period.

To verify the effects of protein level in the diet, 4 colonies were isolated from a single hatch to provide ca. 150 first instars in each colony. These were reared in the same environment with a 24-h light period, and with the dietary protein level being the single variable. The diets used (nos. 7, 13, 3, and 16, Patton 1967) contained, in round figures, 15, 20, 23, and 30% protein. All essentials were present in each diet.

To assess the length of the tegmina, a sample totalling 111 was drawn from an experimental colony of adults, the crickets were frozen, and photographs were made. Measurements from 2× enlargements provided the data.

RESULTS

Examples of the 3 polymorphic forms are shown in Fig. 1. When the photoperiod was constant and protein content of the diet the variable, the incidence of macropterous forms decreased with the decrease in protein and that of the monopterous and micropterous forms increased. With 30% protein ($n = 258$), 78% were macropterous, 13.3% monopterous and 8.7% micropterous. The colonies reared on 20% and 23% protein level were pooled ($n = 413$). The percentages of each form were 71.6, 21.4, and 7%, respectively. With the 15% diet ($n = 102$), percentages were 39, 32, and 29%.

When light was the variable (8-h light period) a colony totalling 74 adults reared on diet no. 16 (30% protein) produced 79% macropterous adults, 12.7% monopterous, and 8.3% micropterous. The incidence of each form was within 1% of that observed with the same diet and a 24-h day.

The length of the tegmina was nearly constant. The measurement of 111 individuals yielded a mean of 11.48 mm with a standard deviation of 1.22 mm. The crickets shown in Fig. 1, selected from an experimental colony for their metathoracic wing form, all fall within this measurement.

DISCUSSION

De-alation is known in *Acheta*, particularly in older colonies where it is not unusual to find aging individuals with both the tegmina and the metathoracic wings gone completely; it is equally common to observe metathoracic wings in both sexes damaged at their distal tips where they extend beyond the tegmina. In both sexes the tegmina forms a protective cover over the reduced metathoracic wings in the monopterous and micropterous forms and must be nibbled away to gain access to the reduced wings. Pulling

[1] Received for publication Dec. 2, 1974.

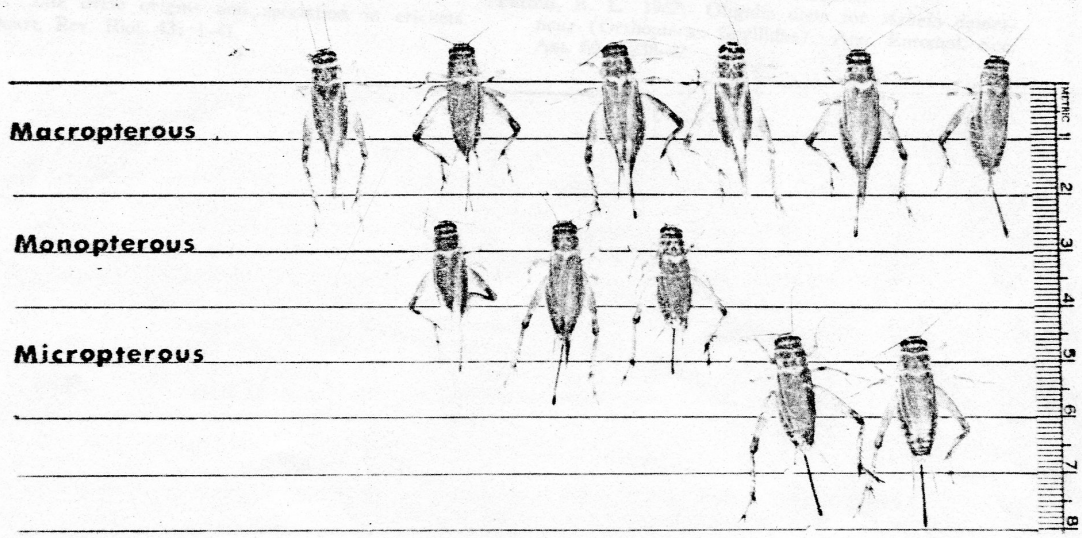

FIG. 1.—Examples of the 3 polymorphic forms.

aside or removing the tegmina in either of the latter forms will reveal the undeveloped metathoracic wings as shown in Fig. 2.

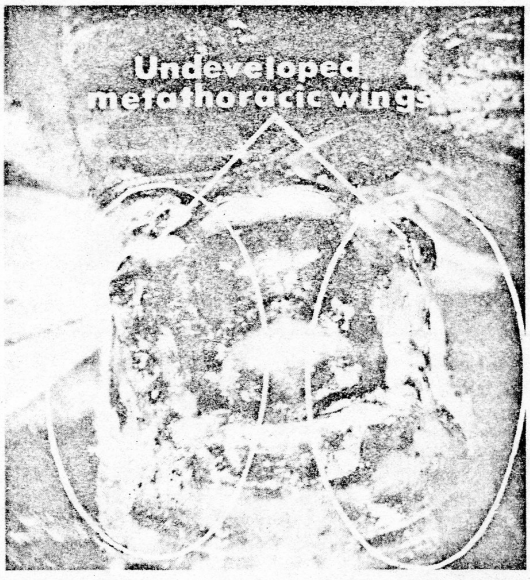

FIG. 2.—Macrophotograph of the meso- and metathorax of a micropterous cricket showing the undeveloped metathoracic wings.

In the experiments, colonies reared under controlled conditions with one variable at a time were sampled. When the protein was constant at the 30% level the incidence of each form produced was within 1% at both 24 h and at 8 h of light exposure, but varying the protein and retaining the light exposure at 24 h showed an increase in the incidence of the monopterous and micropterous forms as the protein level decreased.

In nature *Acheta domesticus* is a scavenger—in North America it has been observed only near city dumps (Back 1936). It can survive on a wide range of food materials and the resulting crickets show great diversity both in size and development rate. Blatchley (1903) recorded the length of the tegmina of field-collected house crickets as 11 mm for both sexes. The lengths of the tegmina of the crickets shown in Fig. 1 appear to be different; however, measurement will show that they are within the limits of a normal population. Comparison of the length of the tegmina with the total size of the cricket creates an optical illusion.

CONCLUSIONS

From long-term observation and controlled experiments, it may be concluded that in *Acheta domesticus* wing polymorphism is linked to the nutritional quality of the diet and that photoperiod has no significant effect.

The length of the tegmina remains nearly constant regardless of the size of the cricket or the length of the metathoracic wings.

REFERENCES CITED

Alexander, R. D. 1961. Aggressiveness, territoriality, and sexual behaviour in field crickets. Orthoptera: Gryllidae. Behaviour 17: 130–223.

1968. Life cycle origins and speciation in crickets. Quart. Rev. Biol. 43: 1–41.

Back, E. A. 1936. *Gryllus domesticus* and city dumps. J. Econ. Entomol. 29: 198–202.

Blatchley, W. S. 1903. Orthoptera of Indiana (p. 439–41). W. S. Blatchley, Indianapolis.

Patton, R. L. 1967. Oligidic diets for *Acheta domesticus* (Orthoptera: Gryllidae). Ann. Entomol. Soc. Am. 60: 1238–42.