Correlated response of nymphal period to selection for wing forms in the pyrrhocorid bug, *Pyrrhocoris sibiricus* (Heteroptera: Pyrrhocoridae)

Takuji Sakashita, Fusao Nakasui and Kenji Fujisaki

Faculty of Agriculture, Okayama University, Okayama 700-0082, Japan

(Received 25 June 1997; Accepted 14 October 1997)

Abstract

The pyrrhocorid bug, *Pyrrhocoris sibiricus*, which is a ground-dwelling seedfeeder, shows wing polymorphism producing brachyptery and macroptery. This study was undertaken to investigate nymphal periods of the two wing morphs, which were derived from two lines artificially selected for different wing forms, at 20°C and 30°C under 12L-12D. No macropters appeared from either selected line at 20°C. At 30°C, however, only the macropterous-selected line produced macropters. Nymphal period of brachypters was longer in the macropterous-selected line than in the brachypterous-selected line. This result suggests that the selection for wing form affects not only wing form but also nymphal period. No significant difference in the nymphal period was shown between the two wing morphs in the macropterous-selected line at 30°C.

Key words: *Pyrrhocoris sibiricus*, wing polymorphism, nymphal period, temperature

INTRODUCTION

In wing polymorphic insects, wing form is often associated with other life history traits (Roff, 1986). The ground-dwelling pyrrhocorid bug, *Pyrrhocoris sibiricus* Kuschakewitsch, feeds on seeds of leguminous and gramineous plants. This species shows remarkable wing polymorphism producing brachyptery and macroptery (Sakashita et al., 1995, 1996). The nymphal period of *P. sibiricus* brachypters was associated with temperature and photoperiod in both sexes (Sakashita et al., 1997). The redfire bug, *Pyrrhocoris apterus*, which is closely related to *P. sibiricus*, also shows wing polymorphism producing brachyptery and macroptery (Honěk, 1985), and rarely microptery (Socha et al., 1993). Developmental period of *P. apterus* tended to be longer in macropters than in brachypters, and the tendency was clearer in a macropterous-selected strain than in a wild strain (Honěk, 1985). This study was undertaken to investigate nymphal periods of the two wing morphs, which were derived from two lines artificially selected for different wing forms, at two temperature regimes.

MATERIALS AND METHODS

Newly hatched nymphs, which were used for the present experiment, were obtained from two lines selected for different wing forms. A detailed procedure for the wing form selection was described in Sakashita et al. (1998). The brachypterous- and macropterous-selected lines were maintained for 8 and 7 generations at 30°C under 12L-12D, respectively, before the onset of the present experiment. No macropters of either sex appeared at the 8th generation in the brachypterous-selected line. In the macropterous-selected line, the incidence of macroptery was 67.8 and 87.0% in females and males, respectively, at the 7th generation. We obtained eggs from macropterous parents in the macropterous-selected line. The nymphs of each selected line were reared at moderate density, such as 8 individuals per Petri dish (9 cm in diameter, 2 cm in depth), and were provided with soybean seeds and water. Petri dishes, seeds and water were replaced every 3 days. The nymphs of each selected line were reared at either 20°C or 30°C under 12L-12D. Adult emergence was checked daily. Twenty five replications were prepared for each temperature regime of each selected line. Newly emerged adults of each selected line were checked for wing forms according to the definition by Sakashita et al. (1996).
### Table 1. Correlated response of nymphal period to selection for different wing forms

| Temperature (°C) | Selected line | Wing form | Females | | Males |
|------------------|---------------|-----------|---------| |---------|
|                  |               |           | N       | Mean±SE | N       | Mean±SE |
| 20               | Brachypterous | Brachyptery | 42      | 43.1±0.6 | 39      | 44.3±0.5 |
|                  | Macropterous  | Brachyptery | 43      | 48.7±0.5 | 30      | 49.3±0.5 |
| 30               | Brachypterous | Brachyptery | 64      | 18.9±0.2 | 86      | 19.1±0.2 |
|                  | Macropterous  | Brachyptery | 14      | 22.4±0.6 | 8       | 22.8±0.7 |
|                  | Macropterous  | Macroptery | 70      | 22.8±0.2 | 69      | 22.4±0.2 |

*Significant differences at the 5% level (Mann-Whitney U-test).

### RESULTS AND DISCUSSION

Percentages of adult emergence were 40.5 and 36.5 at 20°C, and 75.0 and 80.5 at 30°C in the brachypterous- and macropterous-selected lines, respectively. No significant difference in the percentage of adult emergence was shown between the two selected lines at either temperature regime (p > 0.05, chi-square test).

No macropters appeared from either selected line at 20°C. At 30°C, however, only the macropterous-selected line produced macropters, and the incidence of macroptery was 83.3 and 89.6% in females and males, respectively.

When compared with brachypters of the brachypterous-selected line, those of the macropterous-selected line had significantly (p < 0.05, Mann-Whitney U-test) prolonged nymphal periods at both temperature regimes (Table 1). This result suggests that the selection for wing form affects not only wing form but also nymphal period in *P. sibiricus*. In this species, macropters of both sexes are larger than brachypters (Sakashita et al., 1996). If the selection for wing form also affects adult body size, the prolonged nymphal period in brachypters of the macropterous-selected line may be associated with a larger body size. However, we could not test this hypothesis because we did not measure the body size of adults in the present experiment.

No significant difference in the nymphal period was shown between the two wing morphs from the macropterous-selected line at 30°C (Table 1). In many wing polymorphic insects, the formation of flight apparatus such as flight muscle is energetically expensive (e.g. Roff, 1986; Mole and Zera, 1993). Therefore, it is generally expected that macropters have prolonged nymphal periods due to the formation of flight apparatus. However, in *P. sibiricus*, most macropters as well as brachypters do not develop flight muscles (Sakashita, unpublished). This may explain why the nymphal period did not differ between the two wing morphs of the macropterous-selected line.

Macropeters of *P. apterus* were considered as non-flyers (Socha, 1993), similar to macropters of *P. sibiricus*. Nevertheless, macropters of *P. apterus* had a longer developmental period than brachypters in the macropterous-selected strain (Honěk, 1985). In this species, the incidence of reproductive diapause of adults was positively correlated with nymphal period, and it was higher in macropters than in brachypters (Honěk, 1983). This could explain why *P. apterus* macropters have a longer nymphal period than conspecific brachypters. In *P. sibiricus*, however, the nymphal period did not differ between the two wing morphs in the macropterous-selected line (Table 1). Therefore, it is expected that the relationship between wing polymorphism and reproductive diapause is different between two closely related species. This is an interesting subject for future research.

### REFERENCES


underlies the dispersal-reproduction trade-off in the wing-
Sakashita, T., K. Fujisaki and F. Nakasuji (1995) Environmental
Sakashita, T., F. Nakasuji and K. Fujisaki (1996) Definition of
wing form and morphometric traits of the adult stink bug,
*Pyrrhocoris sibiricus* (Heteroptera: Pyrrhocoridae). *Appl.
Sakashita, T., F. Nakasuji and K. Fujisaki (1997) Effects of tem-
perature and photoperiod on nymphal development of the
stink bug, *Pyrrhocoris sibiricus* Kuschakewitsch (Hetero-
Sakashita, T., F. Nakasuji and K. Fujisaki (1998) Response to
selection for different wing forms in the pyrrhocorid bug,
*Pyrrhocoris sibiricus* (Heteroptera: Pyrrhocoridae). *Appl.
Socha, R. (1993) *Pyrrhocoris apterus*—an experimental model spe-
polymorphism in a strain of *Pyrrhocoris apterus* (Hemiptera: