

研究论文

光周期与温度对林地德国小蠊生长发育与繁殖的影响

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摘要 为弄清湖南株洲(北纬27°50', 东经112° 54') 栖息于林地的德国小蠊 (*Blattella germanica*) 季节生活史策略, 研究了光周期和温度对其若虫发育、龄数变异及成虫繁殖的影响。结果表明, 德国小蠊的若虫发育明显受光周期的影响。长日条件 (LD 16: 8h) 下若虫发育最快, 中间日长 (LD 14: 10h) 次之, 短日条件 (LD 12: 12h) 下若虫发育最慢。将孵化后30日的若虫自长日条件向短日条件转移, 则若虫发育受到明显抑制, 反方向的转移, 则若虫发育迅速。说明德国小蠊若虫存在滞育现象, 短日条件诱导并维持滞育, 长日条件解除滞育。若虫期经历的龄数受光周期和温度的影响, 25°C 的温度条件下, LD 16: 8h、LD 14: 10h及LD 12: 12h若虫期的龄数分别为7、8和9龄; 长日条件下, 30°C和25°C的若虫龄数为7龄, 而20°C为9龄。根据实验室观察和林地调查结果, 德国小蠊在湖南株洲1年发生1代, 以滞育若虫越冬。30°C、25°C、20°C 的温度条件下, 卵鞘成活率分别为14.3%、90.1%和51.9%, 高温和低温均不适合德国小蠊的繁殖。因此, 可以认为控制若虫发育和龄数的光周期、温度反应的生态意义在于调控繁殖虫态和繁殖的适宜季节保持同步。

关键词 [德国小蠊](#); [滞育](#); [龄](#); [光周期](#); [生活史策略](#)

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Effects of photoperiod and temperature on nymphal development and adult reproduction in the forest-dwelling cockroach, *Blattella germanica*

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Abstract Cockroaches are one of the most commonly used laboratory insects. However, few attempts have been made to describe their life-cycle strategy. In this study, the environmental effects on nymphal development and adult reproduction were investigated to understand the seasonal life-cycle strategy and its control mechanism of one forest-dwelling population of a nymphal-overwintering cockroach, *Blattella germanica*, in Zhuzhou, Hunan (27°N).

Newly-hatched nymphs were reared at constant photoperiods LD 16: 8, LD 14: 10 or LD 12: 12 h and 25°C. Nymphal development was the fastest at LD 16: 8 h, followed by LD 14: 10 h, and the slowest at LD 12: 12 h. Similar results were obtained at 30°C and 20°C. When nymphs were exposed to LD 16: 8 h during the first 30 days and then transferred to LD 12: 12 h at 25°C, adults emerged later than those reared continuously at LD 16: 8 h and LD 12: 12 h. At constant LD 16: 8 h and LD 12: 12 h the mean nymphal durations were (88.7±15.8) (mean±SD) and (195.1±53.6) days respectively, whereas those transferred from LD 16: 8 h to LD 12: 12 h adult emergence took 240.3±29.3 days. However, in the reverse transfer, i.e. from LD 12: 12 to LD 16: 8 h, made 30 days after hatching, the duration of nymphal development was dramatically shortened. Nymphs matured almost simultaneously and developed faster than those kept at constant LD 12: 12 h, the mean durations of nymphal development being 86.1±7.5 days. These results indicate that nymphal development was markedly influenced by the photoperiod and the nymph of this species has a winter diapause that is induced and maintained by short days and terminated by long days.

Both photoperiod and temperature influenced the number of nymphal instars. The number of nymphal instars were 7, 8 and 9 at LD 16: 8h, 14: 10h and 12: 12h under 25°C and were 7, 7 and 8 at 30°C and 20°C respectively.

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d 9 at 30°C, 25°C and 20°C under long days. These results indicate that this cockroach species varies the number of nymphal instars in response to photoperiod and temperature.

To examine how temperature would influence adult reproductive of this cockroach species, adults obtained at 25°C were exposed to 30°C, 25°C and 20°C in long days. The rate of surviving oothecae were 14.2%, 90.1% and 51.9% and the egg numbers per ootheca were (2.7 ± 6.1) , (35.8 ± 7.8) and (20.5 ± 16.1) , at 30°C, 25°C and 20°C, respectively.

To determine the overwintering stages and the time of adult emergence in the field, head widths of nymphs and adults collected from March through December were measured. Insects collected from September through next March showed a unimodal pattern in head width distribution and were all nymphs, whereas those collected in May and July contained nymphs and adults, indicating that they overwinter as nymphs and adults emerge in late Spring in Zhuzhou, Hunan.

Based on these observations and field-census data, it was suggested that this cockroach has a univoltine life-cycle overwintering as diapause nymphs, and that the photoperiod and temperature response controlling nymphal development and the number of nymphal instars might have evolved to adjust the timing of adult emergence and reproduction to the favorable season.

Key words [cockroach](#) _ [diapause](#) _ [instar](#) _ [Blattella germanica](#) _ [photoperiod](#) _ [life-cycle](#) _ [strategy](#)

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