

The Termination of Diapause in the Hibernating  
Nymphs of the Small Brown Planthopper,  
*Laodelphax striatellus* FALLÉN

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INTRODUCTION

Diapause in the small brown planthopper, *Laodelphax striatellus* FALLÉN has long received no study since MIYAKE (1932) discovered and characterized the phenomenon. In recent years, as the occurrence of stripe-disease is becoming increasingly severe the subject of diapause of this species has attracted considerable attention eco-physiologically for the basis of the entire life cycle, particularly for analyzing the cyclic development during the spring. Recent studies of KISHIMOTO (1958) and MIYAKE (1966) demonstrated in detail that 2 environmental stimuli, photoperiod and temperature, induced diapause of this species. In their studies, however, comparatively little attention has been given to this species during the period of diapause under field conditions. In the previous paper, therefore, the phenology of the small brown planthopper during the fall to spring, i. e. the dates of the onset of diapause, the completion of nymphal diapause development and the dates of the emergence of adults from the hibernating nymphs in the spring, were given from the rearing experiments and field observations (FUJIWARA 1965).

Thus, these features of diapause are exceedingly important from both the ecological and practical standpoints. The present study was designed to obtain further information on the importance of these problems.

MATERIALS AND METHODS

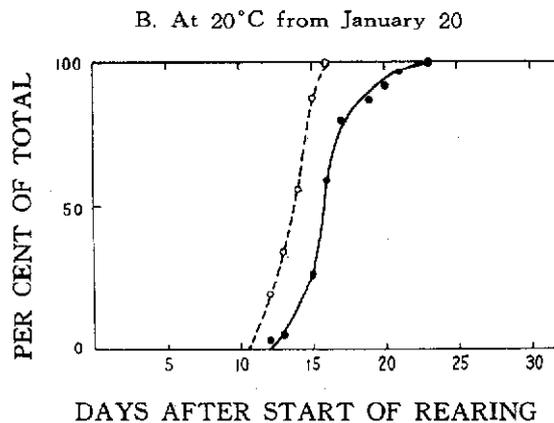
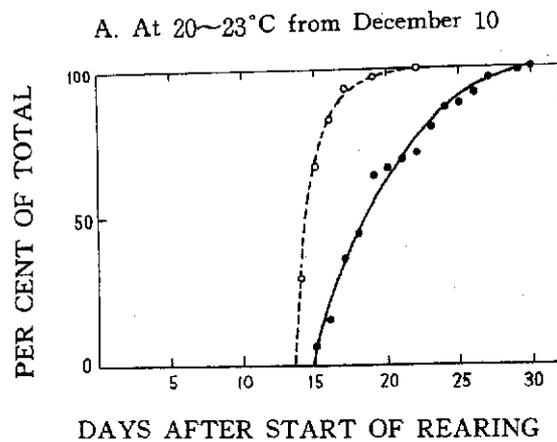
Diapausing nymphs used were obtained from Saijo in the middle regions of Hiroshima Pref., 210 m above sea level, and Yuki at altitude of about 500 m in the mountains of the northern regions. Periodic collections of them were made from December 1964 to March 1965 from their favorite hibernation sites having ample weed growth of the large crab-grass, *Digitaria adscendes* HENR., and the small crab-grass, *Digitaria violascens* LINK during summer to early winter. The collected samples were separated into two groups based on different photoperiods and reared individually in a glass tube, 1.5 cm in diameter and 15 cm long, with the annual bluegrass, *Poa annua* L., as food plant. Each of the two groups was placed at 20~23°C or 20°C. One group was exposed to a short day of 8 hours of light and another to a long day of 16 hours of light. Two 30-w fluorescent lamps provided light. Adult emergence was recorded daily from the start of rearing until completed. The small brown planthopper nymphs in a state of diapause develop gradually when exposed to a temperature

of 20°C and short photoperiod and their development is promoted under 20°C and a long photoperiod (KISHIMOTO 1958). Therefore, the termination of diapause was determined on the basis of emergence from two groups exposed to a short and long photoperiod.

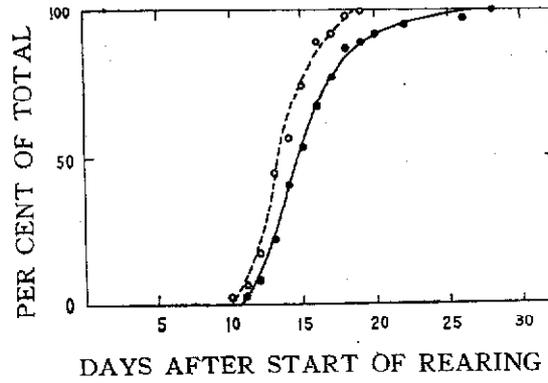
## RESULTS AND DISCUSSION

The rearing was started on December 10 1964, January 20 1965, February 9, 22 and March 13 according to the collecting dates in Saijo, respectively. The accumulated curves of adult emergence obtained in each plot are shown in Fig. 1.

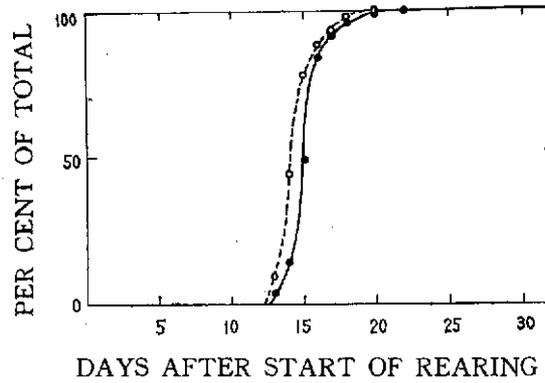
For the purpose of comparison between localities, experiments in the simultaneous rearing of the Saijo and the Yuki populations were conducted. Fig. 2 shows the patterns of emergence of adults from the Yuki population. The results are based on the emergence of 32~72 adults from each group in the Saijo population and 17~52 adults in the Yuki population, respectively.



C At 20°C from February 9



D At 20°C from February 22



E. At 20°C from March 13

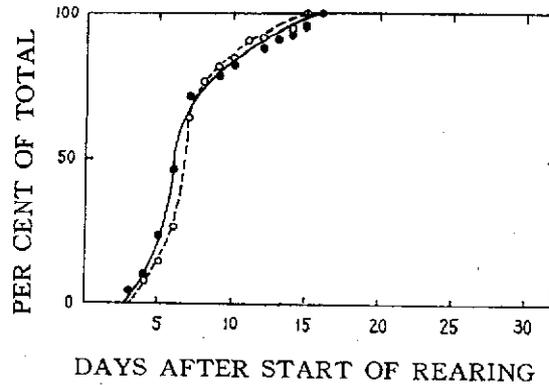
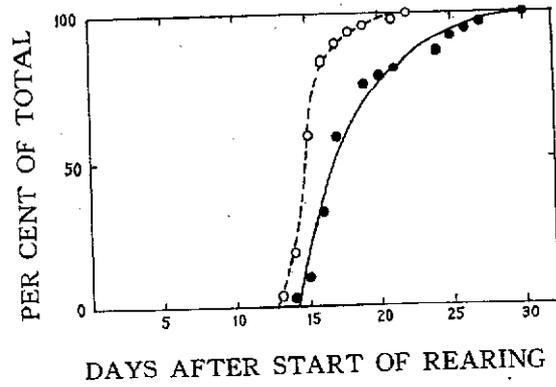


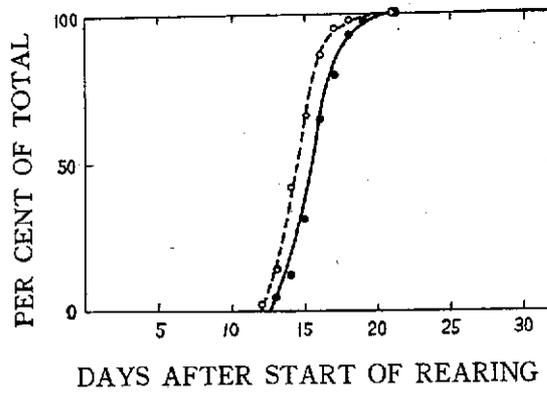
Fig. 1. Accumulative emergence of adults from the hibernating nymphs of the small brown planthopper collected in Saijo, 1964-1965.

○.....○ Long photoperiod. ●-----● Short photoperiod.

A. At 20~23°C from December 10



B. At 20°C from February 9



C. At 20°C from March 13

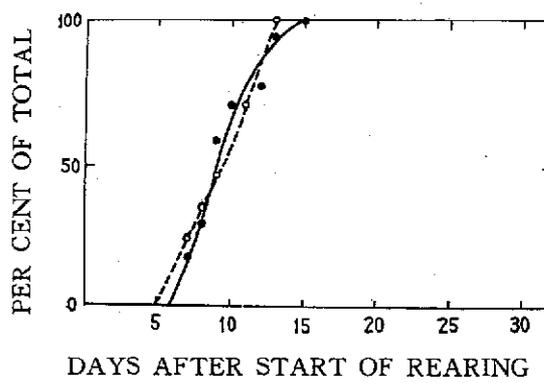


Fig. 2. Accumulative emergence of adults from the hibernating nymphs of the small brown planthopper collected in Yuki, 1964~1965.

○.....○ Long photoperiod, ●——● Short photoperiod.

From Fig. 1, A it is seen that there was a distinct difference in emergence rate as compared with those in other plots, with adults in the group exposed to a long photoperiod emerging earlier than a short photoperiod. This difference is evident also in the Yuki individuals, as is shown in Fig. 2, A. Namely, these show that the hibernating nymphs collected from their hibernating quarters on December 10 were in diapause. While the emergence curves from the two groups of Fig. 1, D and E and Fig. 2, B and C where the rearings were started on February 22 and March 13 overlapped completely each other. These nymphs taken in the last days of February were considered to be free of diapause. An experiment of the data presented in Fig. 1, B and D suggests that in both cases some of the hibernating nymphs were released from their diapause since the small differences in the patterns of emergence of adults from two groups were found. Comparison of emergence from hibernating nymphs in the Saijo and Yuki populations shows that there is always no difference between them (Fig. 1 and 2).

From these facts it is now clear that the hibernating nymphs were often released from their diapause during the last days of January to the first days of February and diapause of them disappeared completely by the last days of February in Hiroshima Pref. According to the similar experiment of KISHIMOTO (1966), the disappearance of diapause of the hibernating nymphs was observed in the first days of January in Kagawa Pref.

The above results lead to the conclusion that the temperature conditions after the termination of diapause, i. e. from February to April, have a great effect on the formation of spring cycles. The emergence period of the adults of the hibernating-generation, in Hiroshima Pref., occurs from late March to early May, reaching a maximum in the mid-April (FUJIWARA 1965, OKAMOTO et al. 1967, FUJIWARA & NODA 1968). In particularly warm years (e. g. in April of 1964 and in February and March of 1966) an earlier emergence of the spring adults was observed. On the contrary, in 1965, because of the lower temperature during February to April, the hibernating nymphs developed slowly and the emergence of adults was much delayed. These are easily explained on the basis of the experimental data quoted above.

Although there was no difference in the time of termination of diapause between the Saijo and Yuki populations, field observations have shown that at altitude such as Yuki the appearance of the first adults is delayed. This difference in development of the hibernating nymphs at stations on the plain and on the higher ground is also well explained by the data presented in this study.

#### SUMMARY

The time of termination of diapause in the hibernating nymphs of the small brown planthopper, *Laodelphax striatellus* FALLÉN, was determined on the Saijo and the Yuki populations on the basis of their emergence under a long and short photoperiod.

Some of the hibernating nymphs became free of diapause in the first days of February and their diapause disappeared completely by the last days of February. There was no difference in the termination of diapause between the Saijo and Yuki individuals. Therefore, the

temperature conditions with a given year and altitude after the termination of diapause, i. e. during the period from February to March, have a great effect on the appearance of the spring adults.

### ACKNOWLEDGEMENTS

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### REFERENCES

- FUJIWARA, A. (1965) Relation between the larval instars during hibernation and the time of their emergence in spring in the small brown planthopper. *Ōdōkon-Chūgoku*, 7 : 5-9. (In Japanese).
- FUJIWARA, A and Y. NODA (1968) Host plant factors influencing oviposition of the small brown planthopper, *Laodelphax striatellus* FALLÉN, with special reference to oviposition preference and fecundity. *Bull. Hiroshima Agr. Exp. Sta.*, 26 : 91-103.
- KISHIMOTO, R. (1958) Studies on the diapause in the planthoppers. Effect of photoperiod on the induction and the completion of diapause in the fourth larval stage of the small brown planthopper, *Delphacodes striatella* FALLÉN. *Jap. Jour. Appl. Ent. Zool.*, 2 (2) : 128-134.
- KISHIMOTO, R. (1966) Ecology and chemical control of the small brown planthopper, *Laodelphax striatellus* FALLÉN. *Shokubutsu-Boeki (Plant Protection)*, 20 (3) : 126-130. (In Japanese).
- MIYAKE, T. (1932) Studies on diapause in insects (1). *Kontyu*, 6 (1,2) : 20-36, 47-65. (In Japanese).
- MIYAKE, T. (1966) Studies on the bionomics of three species of planthopper, *Laodelphax striatellus* FALLÉN, *Sogata furcifera* HORVATH and *Nilaparvata lugens* STAL, especially on their diapause. *Bull. Hiroshima Agr. Exp. Sta.*, 24 : 1-53. (In Japanese with English summary).
- OKAMOTO, D., J. HIRAO, M. TERAGUCHI and M. OKADA (1967) Studies on the small brown planthopper, *Laodelphax striatellus* FALLÉN, as a vector of rice stripe virus. I. On the life cycle of the small brown planthopper. *Bull. Chugoku Agr. Exp. Sta. Series E*, 1 : 89-113. (In Japanese with English summary).

### 摘 要

## ヒメトビウンカ越冬幼虫の休眠覚醒時期

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野外条件下におけるヒメトビウンカ越冬幼虫の休眠覚醒時期を、西条(海拔210m)および油木(500m)産ヒメトビウンカについて明らかにした。

越冬幼虫が休眠から離脱しはじめる時期は1月下旬頃からで、2月下旬までには全個体休眠離脱を完了した。また西条、油木産ヒメトビウンカ間の休眠覚醒時期に地域差は認められなかった。

以上の結果から、年によるまた地域による第1回成虫発生の早晩は、休眠覚醒後すなわち2~3月の温度条件に大きく左右されるものと考えられた。