Flexible Diapause Response to Photoperiod of a Laboratory Selected Line in the Small Brown Planthopper, *Laodelphax striatellus* FALLÉN[1]

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Laodelphax striatellus is characterized by a worldwide distribution occurring from the Philippines to Scandinavia, mainly in the temperate zone. This insect transmits various virus diseases of cereals, in addition to the damage it causes by sap sucking. In most parts of mainland Japan it overwinters mainly as diapausing 4th instar nymphs and partly as 3rd instar nymphs. The nymphal diapause is induced by a short daylength at a low temperature during the nymphal development (KISIMOTO, 1958). In the course of studies on the geographical variation of the photoperiodic diapause response of this planthopper, a line which enters diapause at the 3rd instar or at the 4th instar depending on photoperiod was selected. Nymphs of this line entered diapause at the 3rd instar under a short daylength of less than 11 hr and at the 4th instar under an intermediate daylength between 11 to 14 hr. No diapause was observed under a daylength longer than 15 hr.

The original colony was collected at Memuro, Hokkaido, 42°55′N, 143°03′E, where the planthopper completes two generations a year. Thirty to 50 nymphs within a day of hatching were put into a glass vial 3×20 cm in size with ca 20 rice seedlings. Under a photoperiod of 8 hr light at 25°C and 16 hr dark at 15°C, the nymphs which developed to the 4th instar on and after the 15th day of rearing entered a prolonged arrest of development (4th instar diapause). Eigthy-eight percent of the nymphs entered 4th instar diapause by the 25th day, but the remaining nymphs did not develop beyond the 3rd instar (3rd instar diapause). Nymphs of both types remained in the same state for 2 months or more. Non-diapausing nymphs appearing under a photoperiod of 15 hr light completed nymphal development by the 35th day.

The diapausing nymphs were sensitive to a long photoperiod (KISIMOTO, 1958). When exposed to a photoperiod of 16 hr light at 25°C, the 3rd instar diapausing nymphs (H3 line) completed nymphal development within 2 to 3 weeks, and the 4th instar diapausing nymphs (H4 line) within 10 days to 2 weeks. Offspring of the two types were reared separately under the same conditions as the original colony. The 3rd instar diapausing nymphs appearing in the H3 line and the 4th instar diapausing nymphs in the H4 line were selected for 6 generations (Table 1).

The 3rd instar diapausing line (H3) and the 4th instar diapausing line (H4) were established by the

Table 1. Incidence of 3rd instar diapause in the 3rd and 4th instar diapause line under 8 hr daylength at each successive selected generation in *L. striatellus*

Generation	Percent of 3rd instar diapause	
	3rd instar diapause line (H3)	4th instar diapause line (H4)
1 (Original)	12.0% (115/958)[a]	
2	28.1 (143/509)	13.3 (77/577)
3	43.8 (249/569)	3.9 (22/569)
4	44.2 (53/120)	5.5 (31/560)
5	41.8 (242/579)	2.4 (10/420)
6	63.7 (419/658)	0.8 (1/127)[b]
7	95.2 (177/186)	0 (0/224)

[a] (Number of nymphs entering diapause at the 3rd instar/Total nymphs entering diapause).

[b] Under a 10 hr daylength.

[1] Appl. Ent. Zool. **24** (1): 157–159 (1989)

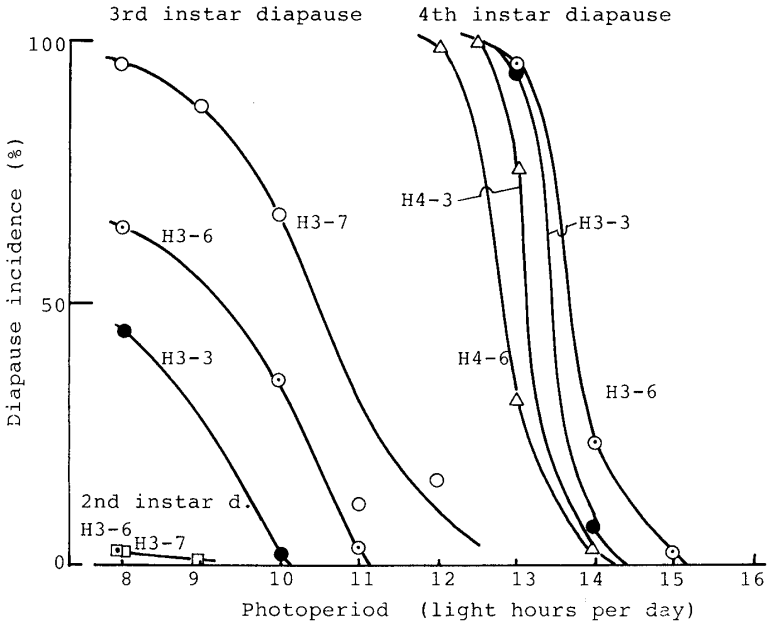

Fig. 1. Incidence of 3rd and 4th instar diapause in the 3rd, 6th and 7th selected generations of 3rd instar diapause (H3) and 4th instar diapause (H4) lines in *L. striatellus*. The numbers beside each line denote the selected generation.

Table 2. Incidence of 3rd instar diapause under a 8 hr daylength and different temperature cycles in the 4th selected generation of the 3rd instar diapause line (H3) in *L. striatellus*

Temperature cycle (°C)		Incidence of 3rd instar diapause (%)
Light phase (8 hr)	Dark phase (16 hr)	
25	22	0 (0/103)
25	19	9.8 (10/102)
25	15	44.2 (53/120)
25	12	34.6 (47/136)
19	19	21.2 (24/113)

7th generation. Nymphs of the 3rd, 6th and 7th generations were observed for their diapause response under various photoperiods (Fig. 1). Light phases longer than 8 hr were set by subjecting the nymphs to a supplementary light period at the beginning of the 15°C phase, while the temperature cycle of 25–15°C remained unchanged.

Under transitional photoperiods inducing the 3rd and 4th instar diapause together or the diapause and non-diapause, the 3rd and 4th moultings tended to be delayed (Kisimoto, 1958) compared to the moulting under 8 hr or 16 hr photoperiod. The latest 3rd moulting in the H3 line occurred on the 35th day.

The proportion of the 3rd instar diapausing nymphs in the H3 line appearing under daylengths of less than 11 hr increased along with the selection (Fig. 1). The daylength inducing the 3rd instar diapause apparently became longer as the selection proceeded. The daylength inducing the 4th instar diapause which corresponded to 13–14 hr in the original stock (Kisimoto, 1976) became shorter in the H4 line and longer in the H3 line. It is also worth noting that 2% of the nymphs of the 6th and 7th generations in the H3 line entered diapause at the 2nd instar under daylengths of 8 to 9 hr.

The incidence of the 3rd instar diapause was compared under daylength of 8 hr and various temperature cycles in the 4th generation of the H3 line (Table 2). Incidence of the 3rd instar

diapause increased under low temperatures in the dark phase.

The flexible response of the diapause incidence to shorter daylengths at low temperatures seems advantageous. When nymphs hatch in early autumn the temperature is suitable for nymphal development before the onset of diapause at the 4th instar by the end of autumn. On the other hand, the nymphs that hatch in late autumn are able to enter diapause at an earlier instar under shorter daylength than in the former case before the temperature lowers, particularly when temperature fluctuates. In the central part of Hokkaido the daylength loses 11 hr at the end of October and the average temperature decreases to ca 10°C, which corresponds to the developmental threshold of the species. These observations suggest that *L. striatellus* occurring in areas located further north may evolve a geographical strain entering diapause at the 3rd or even at the 2nd instar under natural conditions.

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