Isolating Factors between the Smaller Tea Tortrix and the Summer Fruit Tortrix (Lepidoptera : Tortricidae)

III. Seasonal Occurrence and Mating Time

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The smaller tea tortrix and the summer fruit tortrix occur synchronously throughout the flight season in the sympatric areas. Mating times of the two species under the natural conditions of light were not significantly different in June–July, but there was about a 2-hour difference in November. Observations at 20°C, under various light-dark (LD) cycles, revealed about a one-hour difference in mating time under a 12 : 12 LD-cycle. The difference was smaller under shorter scotophases. From the seasonal day-length in the sympatric areas, the different timings of mating alone seemed not to be enough for the isolation between the two species.

INTRODUCTION

The smaller tea tortrix and the summer fruit tortrix are important pests of tea plants and various fruit trees in Japan. The sex pheromones of the two species have been identified as mixtures of (Z)-9- and (Z)-11-tetradecen-1-ol acetates (TAMAKI et al., 1971 a, b; MEIJER et al., 1972). The difference in the ratio of the two components was suggested to be a possible factor of their reproductive isolation (TAMAKI et al., 1971 b). This information prompted further investigation of the isolating mechanism between the two species. The paper deals with their mating times and seasonal occurrence in Japan.

The smaller tea tortrix and the summer fruit tortrix have so far been called *Adoxophyes fasciata* and *A. orana*, respectively. However, YASUDA (1975) examined the type specimen of *A. fasciata* in the British Museum (Natural History) and regarded the Japanese population of the summer fruit tortrix as the subspecies *fasciata* of *A. orana*. He also regarded the smaller tea tortrix as a distinct species from *A. orana* without denoting the species name. Thus, the scientific name of this economically important pest of tea plants seems to be pending (YASUDA, 1975). In this paper, therefore, we use the common names, the smaller tea tortrix (STT) and the summer fruit tortrix (SFT), in order to avoid the confusion by the “scientific name”.

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MATERIALS AND METHODS

Insects were reared on an artificial diet (TAMAKI, 1966) at 25°C under a 14 : 10 LD (light-dark) cycle. Pupae obtained were sexed and kept in plastic boxes (15 × 20 × 35 cm) at 20°C under various LD-cycles or at room temperature under conditions of natural light. Adult moths were kept under the same conditions until use. Each pair of male and 1- to 4-day-old female was enclosed in an airtight transparent plastic cup (4 × 6 cm). The number of mating pairs was recorded at 10- or 20-min intervals, and observation during the scotophase was made in dim red light.

RESULTS AND DISCUSSION

The geographic ranges of the smaller tea tortrix (STT) and the summer fruit

Fig. 1. Seasonal occurrence of STT and SFT in the sympatric areas, Naruto-shi in Tokushima Pref. and Chiba-shi in Chiba Pref. Ordinate indicates the number of male moths captured by a light-trap for 5 successive days.

tortrix (SFT) overlap each other in the central and the southwestern districts of Japan (HONMA, 1974). STT prefers ever green trees and SFT deciduous trees. The two species, however, are polyphagous and their habitat isolation through difference in host preference is incomplete (HONMA, 1974).

Fig. 1. shows typical examples of the seasonal occurrence of the sympatric populations in Chiba and Tokushima Prefectures. Data are expressed as the number of moths captured by a light-trap during 5 successive days. The data apparently indicate that STT and SFT occur concurrently throughout the season, showing no seasonal isolation between them.

The occurrence of mating at room temperature under natural conditions of light is shown in Fig. 2. From the end of June to the beginning of July, there was no

Fig. 2. Mating times of STT and SFT at room temperature under natural conditions of light. m, the mean mating time in the Japan standard time; s, standard deviation; n, number of pairs mated; the mean in parenthesis shows the time after sunset.

Fig. 3. Mating times of STT and SFT at 20°C under various LD-cycles. m, the mean mating time after the onset of scotophase; s, standard deviation; n, number of pairs mated; values in parenthesis show the mean for delayed matings.

difference in mating time between the two species. The duration of night (sunset to sunrise) at this season was about 10 hours. However, about a two-hour difference in the mean mating time was observed in November, when the duration of night was about 14 hours. The mating peaks occurred about 8 and 10 hr after sunset in STT and SFT, respectively, under the conditions of a 14-hr night. It should be noted, however, that the 14-hr night has no ecological significance, because November is not the actual flight season of the two tortricids. The mean mating times in June–July, the season of 10-hr night, ranged from 8 hr 20 min to 8 hr 48 min after sunset in the two species. These results suggest an important role of LD-cycle in eliciting the mating behavior.

A series of experiments under various LD-cycles were, therefore, conducted at 20°C. The results are shown in Fig. 3. The mating occurred about 1 hr earlier in STT than in SFT under a 12 : 12 LD-cycle. The difference in the mating time between the two species became smaller with a shorter scotophase. Under 18 : 6 LD-cycle, a sharp peak of mating activity was observed in both species just after the onset of scotophase and, interestingly, a second peak of activity occurred a few hours later. The mean times for the delayed peaks were about 8 and 9 hr after the onset of photophase in STT and in SFT, respectively; there being a difference of about one hour between the two species.

Another experiment was conducted to further examine the inherent difference in the timing of mating between the two species. Individuals were kept under continuous light from the pupal stage until the third day of the adult stage. Then, the moths were placed in continuous darkness and the mating was observed. In these “LL–DD” conditions, STT began to mate about 1 hr earlier than SFT (Fig. 4).

The data under LL–DD and 18 : 6 LD-cycles suggest that the difference in mating time between STT and SFT is due to inherent species characteristics. The difference in mating time, however, apparently varies with the photoperiodic conditions. Duration of scotophase more than 12 hr is necessary for one-hour difference in the mating times between the two species. It is apparent, from the light-trap records, that both STT and SFT occur from the beginning of May to the end of September, when the duration of night (from sunset to sunrise) is 10 hr 30 min to 12 hr. If the twilight hours are taken into account, the actual duration of scotophase would be less than 11 hr throughout the season.

The mating time in various insects is also under the control of temperature (e.g.,

Fig. 4. Mating times of STT and SFT at 20°C under the LL-DD conditions. For m, s, and n, see the caption of Fig. 3.

CARDÉ et al., 1975). A low temperature shifts the mating time of STT to an earlier time of day (NOGUCHI, unpublished). A similar effect of low temperature is also suggested in SFT, although there is no detailed comparative study of the two species in this respect. If the effect of temperature on mating time is similar in the two species, the difference in mating time between STT and SFT, in the field, may be inferred to be less than one hour in most parts of their sympatric areas. Thus, difference in mating time alone is not enough for the isolation between STT and SFT.

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