Population Fluctuation of the Stink Bug, *Plautia crossota stali*, as Affected by Cone Production of Japanese Cedar

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Abstract – There was a highly positive correlation between the overwintering density of the bug, *Plautia crossota stali,* and the amount of airborne pollen produced by Japanese cedar, which is closely related to cone production. This suggests that bug density is regulated primarily by food availability. The amount of airborne Japanese cedar pollen is a useful index for forecasting bug population density.

I. Introduction

The brown-winged green stink bug, *Plautia crossota stali* Scott, is one of the most devastating pests of fruit crops in Japan [2, 8]. It mainly reproduces on the cones of two conifers, Japanese cedar (*Cryptomeria japonica* D. Don) and Japanese cypress (*Chamaecyparis obtusa* Endl.) which were widely planted for timber in Japan after World War Ⅱ [2, 9]. As a result infestation levels on fruit crops have been increasing remarkably since the 1990's. It is, however, not easy to estimate cone production in these conifers. Hospital research into hay fever has produced considerable amounts of data on airborne pollen density of Japanese cedar in Japan [1], while there has been little data on Japanese cypress. I have used the airborne pollen count of Japanese cedar related to cone production in order to forecast the bug density in Wakayama Prefecture, western Japan.

II. Materials and Methods

A. Airborne pollen density

A survey on airborne pollen density of Japanese cedar was carried out at three districts (Wakayama, Hashimoto and Goboh) in 1986-2002. A slide grass(6×6cm) with a sticky substance placed in a Darham sampler was on the roof of a hospital building and was replaced every day during the dispersal season from February to April. Pollen grains were counted under a microscope.

B. Light trap catches

Adults of *P. crossota stali* were caught by a light trap (100W mercury lamp) in our laboratory located in Kokawa in Wakayama Prefecture during April and October.

C. Density of overwintering adults

Adults overwinter in fallen leaves on the deciduous forest floor. A total of 50 liters of fallen leaves was collected using plastic containers and the adults were sorted in February. This survey was conducted at 60 sites.

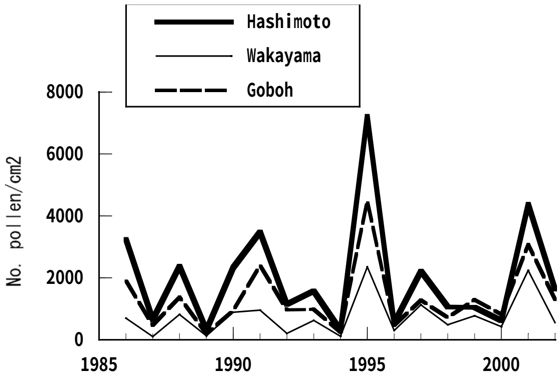

Fig. 1. Annual changes in the number of airborne pollen of Japanese cedar at three sites in Wakayama Prefecture.

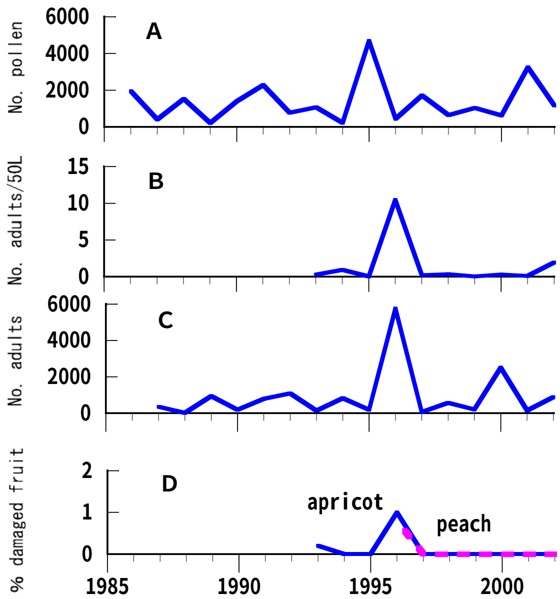

Fig. 2. Annual changes in the amount of airborne pollen of Japanese cedar (mean value of three sites: A), density of *P. crossota stali* in fallen leaves in winter (mean value: B), and light trap catches of *P. crossota stali* in April-July (C), and the percentage of damaged fruit of peach and Japanese apricot which ripen in June-July (D) in commercial orchards.

III. Results

The amount of airborne pollen grains of Japanese cedar fluctuated synchronously at the different sites, although there were differences in the peak number among three sites (Fig. 1). The largest peak was in 1995.

Figure 2 shows that the increases in pollen counts were followed by increases in the density of overwintering adults and light trap catches in the following year. The largest peak of the overwintering density was observed in the winter of 1995/1996 and the largest peak of the light trap catches in 1996. Outbreak of the bug in 1996 was responsible for heavy damage of summer fruit crops such as peach and Japanese apricot in that year.

A highly positive correlation was found between the overwintering density of *P. crossota stali* and the amount of airborne pollen of Japanese cedar which is closely related to the cone production (Fig. 3). There also was a highly positive correlation between the amount of airborne pollen and the number of *P. crossota stali* caught in light trap during April-July of the following year. These results suggest that the amount of airborne Japanese cedar pollen is a helpful index for forecasting the bug population density in the following spring-summer season.

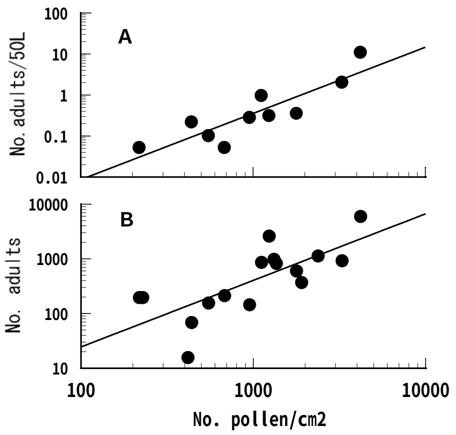

Fig. 3. Relationships between the amount of airborne pollen of Japanese cedar (mean value of three sites) and overwintering adult bug densities (A), and light trap catches of *P. crossota stali* in April-July (B). A, $Y_1 = 0.000004898\ X^{1.621}$ (R^2= 0.7912), B, $Y_2 = 0.09931X^{1.201}$ (R^2=0.5463), where X is the amount of airborne pollen, Y_1 is the overwintering adult density and Y_2 is light trap catches in April-June of the following year.

IV. Discussion

Dispersal of Japanese cedar pollen occurs from February to April with a peak in March and seeds begin growing from July and fully ripen from August [6]. *P. crossota stali* appear two generations every year [4, 7]. It overwinters as adult and then disperses to feeding sites such as orchards and seed-bearing trees in spring [8]. They begin flying to groves of Japanese cedar and Japanese cypress to reproduce when their seeds reached maturity. Oviposition on cones occurs from June to August and nymphs are most common from August to September [5].

Japanese cedar has been through out Japan whereas Japanese cypress is more common in western Japan [6]. Airborne pollen counts of both conifers have fluctuated in a similar manner in recent years [Inamori, unpublished] suggesting that both conifers contribute to reproduction of two stink bugs in a similar manner.

There was a highly positive correlation between the overwintering bug density and the amount of airborne Japanese cedar pollen (Fig. 3). This suggests that bug population dynamics are dominated by bottom-up regulation as a result of strong fluctuation in seed abundance, although mortality from natural enemies and cold in winter temperatures is currently unknown. Further research is needed on the ecological process that link bug densities to the amount of cones [3].

Forecasts of damage to autumn fruit (e.g., persimmon and pear) by the bug cannot be directly predicted from damage to summer fruit (peach and Japanese apricot), because the dispersal of bugs from groves of Japanese cedar to orchards depends on Japanese cedar cone abundance . Therefore, additional work is needed to determine when and how many bugs migrate into fruit orchards in the autumn.

Acknowledgements

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