POPULATION STUDIES OF *ANOPLOPHORA MALASIACA* ADULTS (COLEOPTERA: CERAMBYCIDAE) IN A CITRUS GROVE¹

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INTRODUCTION

The white-spotted longicorn beetle, *Anoplophora malasiaca* (Thomson), is the most dreaded wood-infesting pest of citrus trees in Japan. The plant is damaged by the larval stage, which lasts more than 10 months (Kawamura, 1986). During development, larvae bore through the trunk, tunneling in the phloem and pith system.

Adult populations of *A. malasiaca* in citrus groves have received considerable attention from the applied viewpoint of pest management. Kawamura (1980) investigated the seasonal prevalence of adults in connection with the schedule of control actions. Komazaki and Sakagami (1989) estimated the beetle population by mark-recapture technique, and evaluated the effects of insecticides. But our knowledge of adult populations is still scanty.

The present paper aims at describing the adult population dynamics, in particular the dispersal and the spatial distribution pattern in a citrus grove. Such information will contribute to better control strategies for this pest.

MATERIALS AND METHODS

The study was conducted in 1986–1988 in a citrus grove of the Okitsu Branch of the Fruit Tree Research Station in Shizuoka Prefecture. The study site was a flatland with an area of about 0.4 ha (Fig. 1). Northwest and southwest fringes of the study site faced an area of citrus groves of more than 5 ha, and northeast and southeast fringes residential areas. Trees killed by *A. malasiaca* were removed from the study grove and neighboring groves each winter. The study site contained 489, 352 and 298 healthy citrus trees at the start of the study in 1986, 1987 and 1988, respectively. Each tree was numbered and mapped (Fig. 1).

In 1988, the bases of 273 tree trunks were covered with fine-meshed (6 openings/cm) wire netting 20 to 25 cm in width. This treatment trapped and killed the adults which emerged from the trunks. Some adults escaped from the net because its placement was not always exact. However, mortality rate (no. of dead adults inside the net/total no. of new emergence holes) was about 0.8 (=125/158), enabling us to ex-

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amine the extent of beetles immigrating from outside the study site. This treatment also was effective in preventing females from laying eggs in the trunks (Adachi and Korenaga, 1989; Adachi, 1990).

Censuses were carried out at 2–7 day intervals throughout the study period by the mark-recapture of adults. Each tree was shaken by hand and long sticks used to knock down the beetles. The captured beetles were numbered with red and yellow lacquer paint on the elytra. Records were kept of sex, number, the tree number from which the beetle fell, and body size (the body length from top of the head to end of the elytron, and body width). After recording, the beetle was carefully returned to the tree from which it fell, with the head upward. Adult population estimates of the number of adults and survival rates were derived by the Jolly (1965)-Seber (1982) method.

Two kinds of controls were carried out in the study site every year: (1) application of insecticide (methidathion) and (2) capture of adults by hand (hereafter referred to as the hand-killing method). Insecticide was sprayed on tree canopies, according to a spray calendar. The procedure of the hand-killing method was similar to the census technique described above. These two control measures were also applied in the adjacent citrus groves within a few days of the study site schedule.

**Results**

**Population Parameters**

**Seasonal population trends.** Figure 2 shows seasonal fluctuations in the number of adults estimated by Jolly-Seber method ($\hat{N}_t$) and of those actually observed ($n_t$). The population trend in 1988 was similar to those in the other two years in spite of the net treatment. Adults began to emerge in early June, reached a peak number in late June, and thereafter decreased at a rather constant rate. The peak numbers ($\hat{N}_t; \pm SD$)