Communication disruption for control of the sugarcane wireworm, *Melanotus okinawensis* Ohira (Coleoptera: Elateridae), with synthetic sex pheromone

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Summary

For the control of the sugarcane wireworm *Melanotus okinawensis* Ohira (Coleoptera: Elateridae), communication disruption using sex pheromone was attempted at the cultivating land on Minami-Daito Is., from middle February to early June, in 2001. Almost no males were caught in monitoring traps excepting a few traps in the treated area. Conversely, large number of males was caught in traps set on the untreated the Japanese pampas grass field. These facts indicate that the communication disruption was certainly effective throughout the period in the treated area. Females collected from treated area of Minami-Daito Is., their mating ratios were significantly lowered than that of Miyagi Is. Therefore, communication disruption system should be effective as the sugarcane wireworm management tool.

Key words: wireworm, *Melanotus okinawensis*, sex pheromone, communication disruption, mating rate, pheromone dispenser

1. Introduction

The sugarcane wireworm, *Melanotus okinawensis* Ohira (Coleoptera: Elateridae), is serious pest of sugarcane on the Ryukyu Islands (Ohira, 1988) (Photo 1). Larvae of this species (photo 2) injure underground buds, causing germination failure, dead-hearts and ratooning failure (Hokyo, 1980; Nagamine and Kinjo, 1981). A large amount of insecticide is applied before planting or during the early growth period of the sugar canes to control the larvae (Yasuda and Hokyo, 1983), Anxiety that these practices are causing water pollution is
especially high in area where people rely on groundwater as the source of their drinking water. Therefore, attention in recent years has focused on sex pheromone as a potential component in the management of the sugarcane wireworm.

Female sex pheromone was identified as \textit{n}-dodecyl acetate in \textit{M. okinawaensis} (Tamaki, et al., 1986). Thus, these synthetic sex pheromones have been employed for monitoring and control of wireworm populations (Nagamine and Kinjo, 1990). As the results of monitoring, seasonal occurrence pattern of adults of \textit{M. okinawaensis} became obvious. Adults of \textit{M. okinawaensis} emerge on the ground for almost three months from early March to early June in Okinawa Is. (Nagamine and Kinjo, 1981). Nagamine and Kinjo (1990) attempted the control of \textit{M. okinawaensis} by mass trapping using the water pan traps baited with synthetic sex pheromone in the sugarcane fields at Yomitan-cho, Okinawa Is. They concluded that mass trapping resulted in the reduction of larval density in the treated area. However, water pan trap is a labor-intensive system, and requires maintenance of a sufficient water level. Seeking to replace the water pan trap system, Iwanaga and Kawamura (2000) designed a new funnel-vane trap. Furthermore, commercially available funnel-vane traps showed almost equivalent trapping efficacy with that of water pan traps (Kawamura et al., 2002). Mass trapping needs for high density of taps for control area which in turn renders the technique too laborious and costly. Furthermore, this has not always resulted in reduction in infestation rate.

The use of pheromone dispensers to control insect pests by communication disruption in now practiced with a wide range of lepidopteran pests (Wakamura et al., 1992; Carde and Minks, 1995, Howse at al., 1998), however, a few works have reported in coleopteran pests such as African sweetpotato weevils \textit{Cylas brunneus} and \textit{C. puncticollis} (Downham et al., 2001).

In this paper, we evaluate the efficacy of synthetic pheromone applications as communication disruption for \textit{M. okinawensis}, assess the potential of this technique as a control strategy.

2. Materials and Methods

(1) Experiment area
All the experiments were conducted on Minami-Daito Is., Okinawa, Japan in April 2001. Minami-Daito Is. (3,057 ha) is an oceanic Island, distant about 392 km from Okinawa Is. This island originated from the elevated coral atoll, therefore, the concave shape in topographically, highest at the fringe and lowest at the center. Several ponds are extending at the center. For the windbreak, tree belts are surrounding the island with double or triple circles according to the circular rocky zone. Inner area surrounding by the outer windbreak belt has been using as the cultivated land (1,835 ha). Sugarcane has been cultivated exclusively in this land. The most outer fringe of Island were dominated the plants such as the Japanese pampas grass *Miscanthus sinensis* Anderss and the beach apple *Pandanus odoratissimus* L.f. *M. sinensis* is one of the wild hosts for *M. okinawensis*.

(2) Pheromone dispenser

The dispensers used were supplied by Shin’Etsu Chem. Co., Ltd, a sealed polyethylene tube 20 cm long (this size was treated as a unit of dispenser when counting the number of dispensers) and containing 80 mg of *n*-dodecyl acetate. One roll of dispensers was 80 m long (400 dispensers) and packed with aluminum bag (Photo 3). Synthetic sex pheromone permeates through the polyethylene layer and evaporates from the surface into the air. Dispensers were set at the rate of 1,000 dispensers/ha in young summer planted sugarcane fields (the sugarcanes were planted from October to November) and 400 dispensers/ha in case of the harvested sugarcane field. Dispensers of 10m long (50 dispensers) set evenly in the field and were sustained by the bamboo sticks (1 m long, 1 cm diam.) at 40 to 50 cm above the ground (Photo 4). In the tree belt, the dispensers had set at the margin of the belt and directly attached on the trees at 1 to 1.5 m above the ground at the rate of 80 m of dispensers per 100 m of tree belt. The total number of dispensers was 900,000, and the total amount of sex pheromone used was ca. 75 kg. These pheromone dispensers were set on the middle of February 2001 and removed on early June (both years) to cover the adult emergence season. In case of the Japanese pampas glass extending on the outer fringe of Island, this field was difficult to approach, because this consisted of steep incline covering with weathered and rugged rocks. Therefore, we have to give up the setting of the dispensers in this field in 2001.

(3) Trap catches of *M. okinawensis* in 2000
To know the trap catches of *M. okinawensis* before the treatment of the communication disruption, the data of the trap catches conducted in 2000 (one year before the treatment) using water pan traps (see, Kawamura et al., 2002) were utilized. Totally 114 traps were set on various sites of cultivated land in Minami-Daito Is.

### (4) Monitoring trap

For the evaluation of the effect of the treatments against *M. okinawensis*, pheromone traps were set in the treated cultivated area and untreated the Japanese pampas grass field fringing the Island. The pheromone lures used for *M. okinawensis* were polyethylene tubes (60 cm length, 2 mm i.d.) containing 1 ml of *n*-dodecyl acetate [acetic acid *n*-dodecyl ester, >95.0% (GC), Tokyo Chemical Industry Co., Ltd., Tokyo]. A funnel trap with crossed vanes (15 cm dia. × 38.5 cm ht., Trécé Inc., Salinas, Calif., U.S.A.) was attached with a pheromone tube and allowed to stand on the ground using wire and a stick (ca. 1 cm dia. × 60 cm) that was inserted into the soil at ca. 10 cm depth. Traps were set at 24 locations in the cultivated land. Each trap in the treated area was accompanied by another trap 5-10 m away in which no lure was baited, in order to offset chance of male catches. In the Japanese pampas grass field fringing the Island, four sites (east, west, south, north), 4-5 traps were set at each site, and total 18 traps were used in the Japanese pampas grass field.

### (5) Mating rate

The effectiveness of the treatments was also assessed by mating rate of the wild females. Adults *M. okinawensis* were collected from the sugarcane fields in middle and late April on Minami-Daito Island and Miyagi Island (as control). Each captured adults were stored in plastic cup labeled with the treatment and plot. They fed on diluted sports drink (Otsuka Pharmaceutical Company, Tokyo) solution impregnated in a tissue paper as food. These females were dissected to examine the presence of sperm in the spermatheca.

### 3. Results and Discussion

The year before treatment of communication disruption, large number of males captured in monitoring traps on Minami-Daito Is. in 2000, especially, the area enclosed by the outer and inner tree belt (Fig. 1). In this area, some traps
exceeding 800 males were sporadically observed. Generally, the small number of males captured in the traps located in the central area where enclosed by the inner tree belt. The central area of this Island is the lowest. In case of the heavy rain, some sugarcane fields in central area are submerged. Therefore, it will be difficult for wireworms to propagate in this area.

The year of treatment of communication disruption, almost no males were caught in monitoring traps excepting a few traps in the treated area in 2001, however, large number of males were caught in traps set on the untreated Japanese pampas grass field (Fig. 2). These facts indicate that the communication disruption was certainly effective throughout the period in the treated area.

The mating ratios of the females were compared between the females collected from the treated sugarcane fields in middle and late April on Minami-Daito Is. and untreated sugarcane fields on Miyagi Is. All of females collected from the Miyagi Island were inseminated. On the contrary, in the females collected from Minami-Daito Is., their mating ratios were significantly lowered than that of Miyagi Is. (unpublished data). Therefore, communication disruption system should be effective as the sugarcane wireworm management tool.

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4. References


Fig. 1. Trap catches of the click beetles in the mass trapping experiment over an agricultural area on Minami-Daito Island in March through May in 2000. Size of each circle indicates the number of beetles caught in traps.
Fig. 2. Trap catches of the click beetles in the mating disruption over an agricultural area and the Japanese pampas grass area at the fringe on Minami-Daito Island in March through May in 2001. Size of each circle indicates the number of beetles caught in traps.
Photo 1  Adult of *Melanotus okinawensis*

Photo 2  Larva of *Melanotus okinawensis*
Photo 3. Pheromone dispenser

Photo 4. Setting dispensers on the sugarcane field using sticks