A new and Simple Detection Method
for Carbamate Resistance in the
Green Rice Leafhopper, *Nephotettix*
cincticeps UHLER
(Hemiptera : Deltocephalidae)^{1,2}

Tadashi MIYATA, Tetsuo SAITO,
Hiroshi HAMA*, Toshikazu IWATA*
and Kozaburo OZAKI**

Laboratory of Applied Entomology and Nematology,
Faculty of Agriculture, Nagoya University,
Chikusa, Nagoya 464, Japan

*National Institute of Agricultural Sciences,
Kannondai, Yatabe-machi, Tsukuba,
Ibaraki 305, Japan

**Plant Pathology and Entomology Section,
Fuchu Branch of Kagawa Agricultural
Experiment Station, No. 6117 Fuchu-cho,
Sakaide, Kagawa 762, Japan

(Received March 1, 1980)

Distribution of carbamate resistance in the green rice leafhopper, *Nephotettix cincticeps* UHLER has spread wider in the area year by year (ASAKAWA and KAZANO, 1976). Monitoring the insecticide resistance is important for the control of insect pests. Simple detection methods for organophosphate resistance in the green rice leafhopper and the smaller brown planthopper, *Laodelphax striatellus* FALLÉN (OZAKI, 1969) and organophosphate and carbamate resistance in the green peach aphid, *Myzus persicae* SULZER (SAWICKI et al., 1977) have been reported.

Bioassay methods such as topical application,

dipping, spraying etc. are usually more accurate. However, these methods require a large number of insects and longer time to get results.

According to HAMA et al. (1980), the substrate specificity of acetylcholinesterase (AChE) of the green rice leafhopper to acetylthiocholine (ATCh) is different between susceptible and carbamate resistant strains. Relative activity of AChE from the susceptible strain was suppressed by more than 3×10^{-3} M of ATCh, but no evident inhibition of activity was observed in the AChE from the resistant strain.

Each adult leafhopper was crushed on a filter paper with a glass rod. The filter paper was sprayed with a mixed solution of ATCh and 5,5'-dithio-bis (2-nitrobenzoic acid) (DTNB), and was kept at 37°C. After 30 min, the enzyme reaction was stopped by spraying 10^{-3} M eserine.

As shown in Table 1, at the high concentration of ATCh (2×10^{-2} M), a strong yellow color was detected in carbamate resistant strains, but no yellow color was detected in a susceptible strain. At lower ATCh concentrations (2×10^{-3} and 2×10^{-4} M), such a significant difference was not observed between susceptible and resistant strains. Therefore, applying the high concentration of ATCh, it might be possible to detect carbamate resistance in the green rice leafhopper. By means of this simple biochemical method, we can monitor the carbamate resistance among the populations of the green rice leafhopper, individually.

Resistance levels of Nakagawara and Rmc strains to some of carbamate insecticides are different (HAMA and IWATA, 1978), however, it is impossible to estimate these differences by this biochemical method.

Table 1. EFFECT OF ATCh CONCENTRATION ON ACETYLCHOLINESTERASE ACTIVITY^a

Strain		Concentration of ATCh (M)		
		2×10^{-2}	2×10^{-3}	2×10^{-4}
Susceptible	Miyagi	±	++	+
Carbamate resistant	Nakagawara	+++++	++	+
	Rmc	+++++	++	+

^a Activity was graded from very high (+++++) to very low (±).

¹ Appl. Ent. Zool. **15** (3) : 351-352 (1980).

² This research was supported in part by a Grant-in-Aid for Scientific Research No. 456037 from the Ministry of Education, Science and Culture, Japan.

REFERENCES

- AASAKAWA, M. and H. KAZANO (1976) *Rev. Plant Protec. Res.* **9** : 101-123.
- HAMA, H. and T. IWATA (1978) *Appl. Ent. Zool.* **13** : 190-202.
- HAMA, H., T. IWATA, T. MIYATA and T. SAITO (1980) *Appl. Ent. Zool.* **15** : 249-261.
- OZAKI, K. (1969) *Rev. Plant Protec. Res.* **2** : 1-15.
- SAWICKI, R. M., A. L. DEVONSHIRE and A. D. RICE (1977) *Med. Fac. Landbouww. Rijksuniv. Gent.* **42/2** : 1403-1409.

A Simple Method for Measuring
the Mandibular Movements of
the Cabbage Armyworm
(*Mamestra brassicae* L.)¹

Toshiaki SHIMIZU, Katsuhiko MATSUZAWA,
Shigemi YAGI², and Robert J. ROBBINS³

*The Institute of Agriculture and Forestry
The University of Tsukuba
Sakura, Niihari, Ibaraki 305, Japan*

(Received March 27, 1980)

A measurement of the mandibular movements of phytophagous insect larvae is often useful in various biological, pharmacological, or toxicological studies. A device, capable of continuously recording mandibular activity following treatment with drugs, repellents, or feeding stimulants, would be particularly useful in feeding studies. Although several studies on sucking insects (GETTING, 1971; GETTING and STEINHARDT, 1972; FREDMAN and STEINHARDT, 1973; FREDMAN, 1975) and on phytophagous insects (WAGO and YAMAMOTO, 1978) have reported electrophysiological measurements of motor output during feeding, a direct measurement of mandibular movement would also be desirable.

Therefore, the present paper will describe and present representative data from a recording apparatus, consisting of a kymograph and an electronic counter, which is capable of directly monitoring mandibular activity.

Animals: Last instar larvae and post-wandering-

stage prepupae of the cabbage armyworm (*Mamestra brassicae*), reared on an artificial diet at 25°C under a long-day photoperiod, were used in the present study. The subjects were ligated with three threads located between the head and thorax, between the mesothorax and metathorax, and just anterior to the anal proleg. The free ends of the ligatures were used to secure the animals, venter-side up, to a small wooden block.

Apparatus: The basic apparatus is illustrated in Fig. 1. A clip was attached to the subject's mandible so that lateral movements of the mandible would activate the arm of the kymograph, thus recording the movement on the smoked drum. An electronic counter (DC-UB4-A, Hokuyo Automatic Co., Ltd.) was attached to the apparatus to count the individual movements. The kymograph was modified so that slight displacements of the arm would activate the counter by making or breaking an electrical connection through the dipping of a contact into a solution of NaCl. The use of a liquid contact instead of a mechanical switch minimized the interference of the counter with the animals' movements. The mandibular movements were simultaneously recorded through change of blood pressure with the outward and inward movements (unpublished data).

Sample Data: Fig. 2 gives a representative recording of the spontaneous mandibular movements (SMM) of a prepupa and a last-instar larva. The last-instar larva was considerably more active than was the prepupa. The kymograph tracings for the last-instar larva were similar to those

¹ *Appl. Ent. Zool.* **15** (3) : 352-355 (1980).

² Present address : Laboratory of Applied Entomology, Tokyo University of Agriculture and Technology, Fuchu, Tokyo 183, Japan.

³ Present address : Department of Zoology, Michigan State University, East Lansing, Michigan, 48824, U.S.A.