Effect of Chlordimeform and Its Analogues on Mandibular Movements of the Cabbage Armyworm,
Mamestra brassicae L.
(Lepidoptera: Noctuidae)¹

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Use of chemical antifeedants for insect control is a concept different from conventional insecticide application. Since the chemical structure and mode of action of antifeedants may be unlike those of conventional chemicals, they would be useful against a variety of pests that have developed resistance to other insecticides. They may also be employed effectively in an integrated pest control program. Among known insecticides chlordimeform is unique because of its antifeeding activity as well as its chemical structure. Phytophagous larvae affected by the chemical cease feeding without overt symptoms of poisoning, and die a slow death through debilitation (Watanabe et al., 1976). Hirata and Sogawa (1976) found that chlordimeform and its analogues caused a decrease in feeding in several species of Hemiptera and suggested that the mortality observed was the result of starvation and not a direct toxic action of this compound.

Recently, we found the antifeeding action of chlordimeform on mandibular movements of the cabbage armyworm (unpublished). The present study has been undertaken to survey the structural requirement of chlordimeform analogues for inhibition of mandibular movements of the cabbage armyworm.

Larvae of the cabbage armyworm, Mamestra brassicae, were reared on an artificial diet at 25°C under a long-day photoperiod. Post-wandering-stage prepupae were used in the present experiment. Spontaneous mandibular movements of the final instar larvae were considerably more active than for the prepupa, therefore, prepupae were used as the subjects in order to distinguish between spontaneous mandibular movements and continuous bursts (Shimizu et al., 1980) of mandibular movement.

The method of recording mandibular movements was the same as reported in another paper (Shimizu et al., 1980). Briefly, 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 to a wooden block. A clip was attached to the subject’s mandible so that movements of the mandible would activate the arm of the kymograph.

Chlordimeform hydrochloride and its analogues were obtained from Nihon Noyaku Co. Ltd. (Tokyo, Japan) and they were recrystallized and redistilled to more than 98% pure. The structures of the compounds used in this experiment

| 2. Cl-<O-N=CHN-CH₃ | 5. HO-<O-N=CHN-CH₃ | 8. Cl-<CH₃-N=CHN-CH₃ |
| 3. O-N=CHN-CH₃ | 6. CH₃-<O-N=CHN-CH₃ | 9. CH₃-<O-N=CHN-CH₃ |
|                | 10. O-N=CHN-CH₃       | 11. OCH₃-N=CHN-CH₃ |

Fig. 1. Structures of test compounds.

Fig. 2. Spontaneous mandibular-movement patterns and continuous bursts of mandibular movement induced by application of chlordimeform and its analogues. The chemicals were introduced where indicated by arrows. Each record represents separate individuals. Time mark, 3 min. A, compound 6; B, compound 9; C, compound 3; D, chlordimeform (compound 8).
are shown in Fig. 1. To test these compounds 1,000 ppm aqueous solutions were prepared and 2 µl aliquots were applied to the mouthparts of prepupae.

Of the eleven chemicals tested (Fig. 1), only three (compound 3, 8 and 9) with 2-methyl substitution on phenyl group evoked continuous bursts of mandibular movement, chloridimeform (compound 8) being the most active (Fig. 2). Compound 2 produced weak continuous mandibular movements while other compounds were not effective. Since compounds 2 and 8 were more effective than compound 3 and 7, respectively, 4-chloro substitution appears to enhance the activity. LUND et al. (1979) reported that changes in the ring substituents markedly affected activity, producing tremors and feeding inhibition, and that an excellent one was a 2,4-dichloro substituted compound. 2,4-dimethyl substituted compounds (compound 9 in the present experiment) were also effective in the production of the symptoms (LUND et al., 1979). Besides these compounds in Fig. 1, WATANABE and FUKAMI (1977) reported in the silkworm that desmethyl chloridimeform disturbed feeding activity.

Recently, NAKAMUTA and SAIITO (1977), WATANABE and FUKAMI (1977) reported that silkworm and armyworm larvae exhibited a slight disruption of their feeding activities when exposed to chloridimeform.

From the present experiment, it is presumed that the feeding disturbance results from continuous bursts of mandibular movement as induced by compounds 3, 8 and 9. However, antifeeding activity may be induced by abnormal mandibular movements with fine tremors (LUND et al., 1979) and repetitive motor discharge from the metathoracic legs (WATANABE and FUKAMI, 1977).

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REFERENCES


The Blue-Green Alga, Spirulina platensis, as a Protein Source for Artificial Rearing of Bombyx mori (Lepidoptera: Bombycidae)1

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A number of semi-synthetic diets have been formulated for rearing the silkworm, Bombyx mori. Defatted soybean meal is commonly used for most diets as the main protein source, chlorella powder is also used for the same purpose by some researchers (YAMADA et al., 1978). However, both dietary components must be pretreated with different solvents to exclude possibly deterrent or inhibitory factors on growth or feeding activity of silkworm larvae (ITO et al., 1973a; OGATA et al., 1977). This kind of treatment is laborious and costly in preparing the feeding diets.

TULAGANOVA and KUCHKAROVA (1976) added the spiral blue-green alga, Spirulina platensis, to silkworm diets as the vitamin-protein source, indicating that this unicellular alga could increase the cocoon yield, larval survival and silk yield to some degree. Strains of another species, Spirulina sp., were also adopted to substitute the protein sources, e.g., casein, soy flour and