

NOTE

Response of the Imported Willow Leaf Beetle to *Bacillus thuringiensis* var. *san diego* on Poplar and Willow¹

The imported willow leaf beetle, *Plagioderia versicolora* (Laicharting) (Coleoptera: Chrysomelidae), a multivoltine defoliator of willow and poplar (Salicaceae), is considered a significant pest throughout eastern North America (W. T. Johnson and H. H. Lyon, "Insects that Feed on Trees and Shrubs," Cornell University Press, Ithaca, 1988).

Bacillus thuringiensis var. *san diego*, a coleopteran-toxic isolate (C. Herrnstadt, G. G. Soares, E. R. Wilcox, and D. L. Edwards, *Bio/Technol.* 4, 305-308, 1986), is the active ingredient of M-One insecticide (Mycogen Corp., San Diego, CA). This note reports the comparative median lethal concentrations for larval and adult *P. versicolora* treated with M-One on the foliage of willow and poplar.

Laboratory colonies of *P. versicolora* were maintained on excised poplar or willow shoots in ventilated plastic boxes at $24 \pm 1^\circ\text{C}$ with a 16:8 (L:D) photoperiod. Newly molted second- and third-instar larvae and 1-day-old adults were selected for bioassays. The leaf-dip assay used in this study was similar to that described by L. S. Bauer (*Environ. Entomol.* 19, 428-431, 1990) except that a wetting agent, Silwet L-77 (0.1% v/v) (Union Carbide, Danbury, CT), was added to suspensions of M-One. Phenologically similar leaves were taken from freshly cut growing branch tips from field-grown trees (*Populus* \times *euramericana* 'Eugenii' and *Salix babylonica*).

¹ This article reports the results of research only. Mention of a proprietary product does not constitute an endorsement or a recommendation for its use by USDA.

The M-One used for these bioassays was technical powder (Lot 5653) and contained 50,000 Colorado potato beetle IU/mg formulation (D. N. Ferro and W. W. Gelernter, *J. Econ. Entomol.* 82, 750-755, 1989) or 7.3 μg δ -endotoxin/mg formulation (Gelernter, personal communication) as determined by laser densitometer analysis of SDS polyacrylamide gels. Five concentrations of M-One were prepared by serial dilutions from a stock solution. These concentrations ranged from 2.5×10^5 to 2.5×10^4 CPB IU/ml of sterile distilled water for second instars, from 8×10^5 to 2.5×10^3 CPB IU/ml for third instars, and from 8×10^6 to 2.5×10^5 CPB IU/ml for adults. Sterile distilled water served as a control. Insects were treated in groups of 10 larvae per petri dish with a total of 30 larvae per concentration; following a 96-hr exposure period insects were placed on fresh poplar or willow foliage. Insects were monitored daily for mortality and provided with fresh food every 2 to 3 days. Each assay was replicated at least three times using separate batches of insect.

Estimates of M-One median lethal concentrations (LC_{50}) for larval and adult *P. versicolora* are summarized in Table 1. The LC_{50} s were significantly lower for younger stages when compared to older stages. The reduced susceptibility among stages could not be explained entirely on the basis of increased weight gain. Despite its much smaller size, *P. versicolora* is more tolerant of *B. thuringiensis* var. *san diego* than toxicity measures reported for *Leptinotarsa decemlineata* (Say) (D. N. Ferro and W. W. Gelernter, *J. Econ. Entomol.* 82, 750-755, 1989) and *Chrysomela scripta* F. (L. S. Bauer, *Environ. Entomol.* 19, 428-431, 1990). The me-

TABLE 1

Maximum-Likelihood Estimates of the Median Lethal Concentrations^a for *P. versicolora* Treated with M-One at 24°C on Poplar or Willow Foliage

Stage	Poplar			Willow		
	LC_{50}^b	95% fiducial limits	slope \pm SE	LC_{50}^b	95% fiducial limits	slope \pm SE
Instar II	146	107-249	2.5 ± 0.5	45	40-51	2.8 ± 0.2
Instar III	611	565-680	4.6 ± 0.7	455	396-559	3.1 ± 0.7
1-day adult	7619	5847-17,930	1.9 ± 0.5	3066	2699-3568	3.4 ± 0.6

^a LC_{50} estimates include larval or adult mortality occurring during the 96-hr *B. thuringiensis* var. *san diego* exposure period.

^b LC_{50} unit = $\times 10^5$ Colorado potato beetle IU/ml sterile distilled water.

dian lethal times were similar for *P. versicolora* stages and host plants tested, ranging from 2.2 to 3.4 days. Although most mortality occurs during the 96-hr exposure period, more die after this time. The LC_{50} value is significantly reduced if the estimate is made at pupation for larval assays or after a 10-day period for adult assays.

The M-One LC_{50} estimates for *P. versicolora* reared on poplar were significantly higher ($P \leq 0.05$) than for cohorts reared on willow. These differences ranged from one- to threefold higher depending on insect stage. Although there were no significant differences in slopes for the LC_{50} estimates, the slopes tended to be high, suggesting a relatively homogeneous response to the treatments.

Reasons for differences in susceptibility to M-One on the two host plant species are not known. Comparisons of insect performance on poplar and willow showed no significant differences in mortality, larval developmen-

tal time, or adult weight. This suggests that factors other than feeding rate may be involved.

B. thuringiensis var. *san diego*, formulated as M-One, shows promise for suppression of the larval stages of *P. versicolora*. However, repeat applications may be necessary due to relatively long-lived and refractive adults.

KEY WORDS: Insecta; *Plagioderia versicolora*; *Bacillus thuringiensis* var. *san diego*; Salicaceae.

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