SUSCEPTIBILITY OF SELECTED BENEFICIAL INSECTS TO DPX-MP062

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Abstract

Effects of DPX-MP062 (Steward® in cotton, Du Pont Agricultural Products, Wilmington, DE) on survival of five natural enemies, *Cardiochiles nigriceps, Coccinella septempunctata, Geocoris punctipes, Microplitis croceipes*, and *Cotesia marginiventris* were determined. For *C. nigriceps, C. septempunctata*, and *G. punctipes*, treatment by Steward® at the lower rates (0.045-0.065 lb ai/a) resulted in high to moderately high survival when sprayed directly onto the insects. The highest rate of Steward® was very toxic to *C. marginiventris* and *G. punctipes*. Except for *C. marginiventris*, the lower rates (0.045-0.065 lb ai/a) of Steward® were much less toxic than Karate®. Survival of *C. marginiventris* and *G. punctipes* was high after 24 h of exposure to residues of Steward® on cotton leaves. Exposure to Steward® residues on cotton leaves at 0 and 24 hours after treatment in the field did not effect survival of *C. nigriceps*, *C. septempunctata*, *G. punctipes*, or *M. croceipes*.

Introduction

Insecticides which are highly toxic to beneficial arthropods can disrupt populations of natural enemies of potential pest insects and may lead to outbreaks of secondary pests. Falcon et al. (1971) and Eveleens et al. (1973) demonstrated that heavy outbreaks of beet armyworms can be generated by insecticide treatments used to suppress the plant bug, *Lygus hesperus* in cotton in California. Use of selective insecticides could preserve beneficial arthropods and possibly prevent outbreaks of secondary pest populations.

DPX-MP062 (Steward® in cotton, Du Pont Agricultural Products, Wilmington, DE) is an insect control agent containing the active ingredient DPX-KN128 which has been reported to exhibit low toxicity to non-target organisms. Following 4-6 applications of 0.027-0.045 lb ai/a DPX-KN128, little or no adverse effects were reported on the parasitic wasp *Aphidius rhopalosiphi*, the predatory mite *Typhlodromus pyri*, the ground dwelling predator *Aleochara bilineata*, and the aphid predator *Episyrphus balteatus* (Mead-Briggs et al. 1996). Tests also have shown outstanding larval control of *Heliothis virescens* in cotton with DPX-KN128 in the range 0.034-0.07 lb ai/a (Harder et al. 1996). Our research goal was to determine the toxicity of DPX-MP062 to selected natural enemies of cotton pests, i.e. the parasitic wasps *Cardiochiles nigriceps, Microplitis croceipes*, and *Cotesia marginiventris*, and the predators *Coccinella septempunctata*, the C-7 lady beetle, and *Geocoris punctipes*, the big-eyed bug.

Materials and Methods

A laboratory spray chamber was used to topically treat adult insects. The chamber was calibrated to deliver the equivalent of 10 gal/a, using a single TX 6 cone nozzle and maintaining 30 lb/in^2 pressure at the spray nozzle. Height of the nozzle above the spray surface was 40 in. Each treatment replicate consisted of 5 females (single Petri dish) for adult parasitoids or 5 adults for predators. Each treatment was replicated 6 times so there were 6 Petri dishes per treatment for a total of 30 insects per treatment. Insects for a single treatment were aspirated into new Petri dishes, lightly anesthetized with CO_2 and immediately placed uncovered on the spray surface in the chamber for treatment. After spraying, the insects were placed in new plastic Petri dish bottoms which then were covered with untreated tops. The wasps were provided with honey and the predators were provided with *H. virescens* eggs for food. This was repeated for each treatment for each insect species. After 48 h these insects were checked for survival.

The same laboratory spray chamber was used to topically apply insecticides to cotton leaves to determine the effect of residual insecticides on *C. marginiventris* and *G. punctipes* in the laboratory. The treatments and rates used are shown in Table 2. Cotton leaves were placed in 6 Petri dish bottoms and then sprayed with an insecticide treatment. After being sprayed, cotton leaves were placed into new plastic Petri dishes. Then 5 insects were placed in each Petri dish which were covered with untreated tops. This was repeated for each treatment for each species. The experiment was designed in a RBC with 6 replications and 5 insects/replicate. After 48 h these insects were checked for survival.

A John Deere 6000 high cycle was used to apply insecticide treatments on cotton in small field plots. The treatments used are shown in Table 3. A randomized complete block design was used. Plots were 4 (40") rows x 200' (0.06 A). Each treatment was replicated 4 times. Ten treated leaves per replicate were collected at 0 and 24 hours after treatment (HAT). Bioassays were conducted in the laboratory using insects in Petri dishes. One insect was placed in a Petri dish holding one treated leaf collected from the field. Insect survival was determined after 24 hours of exposure.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1112-1114 (1998)
National Cotton Council, Memphis TN

C. nigriceps, *C. marginiventris*, and *M. croceipes* used in this test were newly emerged females reared at the USDA, ARS Biological Control and Mass Rearing Research Laboratory at Mississippi State, MS. *G. punctipes* and *C. septempunctata* were collected from a cotton field in Stoneville, MS. None of 500 *C. septempunctata* which were held to assess parasitism were parasitised. Survival data were corrected for control mortality using Abbott's formula (Abbott 1925). Percentage survival data were converted to arcsine values and analyzed by analysis of variance (ANOVA) (SAS 1988). Means were separated by a least significant differences test (LSD) (SAS 1988).

Results and Discussion

Topical application of Steward® at the lower rates (0.045-0.065 lb ai/a) directly to *C. nigriceps*, *C. septempunctata*, and *G. punctipes* resulted in high to moderately high survival (Table 1). The highest rate of Steward® was very toxic to *C. marginiventris* and *G. punctipes*. Except for *C. marginiventris*, the lower rates (0.045-0.065 lb ai/a) of Steward® were much less toxic to parasitic wasps and predators than Karate®. Lower rates of Steward® also were less toxic than Vydate® for *C. nigriceps*, *G. punctipes*, and *M. croceipes*. Treatment with Vydate® resulted in high survival of *C. septempunctata* and *C. marginiventris*.

Exposure to residues of Steward® applied to cotton leaves had little impact on *C. marginiventris* and *G. punctipes* (Table 2). Treatment with Vydate® and Karate® did not adversely affect *C. marginiventris*, while residues of both of these insecticides were very toxic to *G. punctipes*.

Exposure to Steward® and Lannate® residues at 0 and 24 HAT resulted in high survival for *C. nigriceps*, *C. septempunctata*, *G. punctipes*, and *M. croceipes* (Table 3 and 4). Residue of Karate® at 0 and 24 HAT was more toxic than that of Steward® for *C. nigriceps*, *G. punctipes*, and *M. croceipes*.

In summary, residues of Steward® had no significant effect on survival of the beneficial insects as tested. Generally, except for *C. marginiventris*, the lower rates of Steward® were not toxic to the beneficial insects when the insecticides were applied directly to the insects. The examination of possible sub-lethal effects of Steward® and field toxicity studies over time should be done to obtain a more complete evaluation of the effects of this insecticide on beneficial arthropods.

Disclaimer: Mention of a proprietary product does not constitute a guarantee or warranty of the product by the USDA and does not imply its approval to the exclusion of other products.

References

Abbott, W. S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol. 18:26-27.

Eveleens, K. G., R. van den Bosch, and L. E. Ehler. 1973. Secondary outbreak induction of beet armyworm by experimental insecticide applications in cotton in California. Environ. Entomol. 2: 497-503.

Falcon, L. A., R. van den Bosch, J. Gallagher, and A. Davidson. 1971. Investigation of the pest status of *Lygus hesperus* in cotton in central California. J. Econ. Entomol. 64: 56-61.

Harder, H. H., S. L. Riley, S. F. McCann, and S. N. Irving. 1996. DPX-MP062: A novel broad-spectrum, environmentally soft, insect control compound. Brighton Crop Protection Conference - Pests and Diseases 1996. In Press.

Mead-Briggs, M., F. M. Bakker, A. J. Grove, and M. M. Primiani. 1996. Evaluating the effects of multiple-application plant protection products on beneficial arthropods by means of extended laboratory tests: case studies with predatory mites and hoverflies, and the insecticide DPX-JW062 and DPX-MP062. Brighton Crop Protection Conference - Pests and Diseases 1996. In Press.

SAS Institute. 1988. SAS/STAT, version 6.03 ed. SAS Institute, Cary, NC.

Table 1. Effect of topically-applied insecticides on survival of *Cardiochiles nigriceps* females (Cn), *Coccinella septempunctata* adults (Cs), *Geocoris punctipes* adults (Gp), *Microplitis croceipes* females (Mc), and *Cotesia marginiventris* females (Cm).

		% Survival[1]				
Treatment	Rate[2]	Cn	Cs	Gp	Mc	Cm
Water		100 a	100 a	100 a	100 a	100a
Steward®	.045	100 a	100a	100 a	72 b	
Steward®	.055	100 a	100 a	74 b	64 b c	
Steward®	.065	100 a	92 a	73 b	42 c d	8 c
Steward®	.11	83 b	57 b	13 c		0 c
Lannate®	.25	100a		91 a	22 d	0 c
Vydate®	.25	18 c	93 a	17 c	0 e	93 a
Karate®	.025	11 c	0 c	0 d	0 e	39 b

[1]Survival is corrected for control mortality using Abbott's (1925) formula. Values within a column followed by the same lower case letter are not significantly different ($P > 0.05$) between insecticides for a single species. Comparisons were based on LSD.
[2]lb ai/a

Table 2. Effect of insecticide residues topically-applied to cotton leaves on survival of *Cotesia marginiventris* females and *Geocoris punctipes* adults.

		% Survival[1]	
Treatment	Rate lb ai/a	*C. marginiventris*	*G. punctipes*
Water		100.0 a	100.0 a
Steward®	0.065	100.0 a	88.6 a
Vydate®	0.25	95.0 a	0 c
Karate®	0.025	90.0 a	14.8 b

[1]Survival is corrected for control mortality using Abbott's (1925) formula. Values within a column followed by the same lower case letter are not significantly different ($P > 0.05$) between insecticides for a single species. Comparisons were based on LSD.

Table 3. Effect of insecticide residues 0 hours after spraying cotton leaves in small field plots on survival of *Cardiochiles nigriceps* females (Cn), *Coccinella septempunctata* adults (Cs), *Geocoris punctipes* adults (Gp), and *Microplitis croceipes* females (Mc).

		% Survival[1]			
Treatment	Rate lb ai/a	Cn	Cs	Gp	Mc
Control		100.0 a	100.0 a	100.0 a	100.0 a
Steward®	0.045	100.0 a	97.5 a	95.0 a	94.7 a
Steward®	0.055	94.4 a	100.0 a	95.0 a	100.0 a
Steward®	0.065	92.7 a	90.0 a	100.0 a	94.7 a
Lannate®	0.25	100.0 a	100.0 a	100.0 a	100.0 a
Karate®	0.025	60.0 b		12.5 b	32.5 b

[1]Survival is corrected for control mortality using Abbott's (1925) formula. Values within a column followed by the same lower case letter are not significantly different ($P > 0.05$) between insecticides for a single species. Comparisons were based on LSD.

Table 4. Effect of insecticide residues 24 hours after spraying cotton leaves in small field plots on survival of *Cardiochiles nigriceps* females (Cn), *Coccinella septempunctata* adults (Cs), *Geocoris punctipes* adults (Gp), and *Microplitis croceipes* females (Mc).

		% Survival[1]			
Treatment	Rate lb ai/a	Cn	Cs	Gp	Mc
Control		100.0 a	100.0 a	100.0 a	100.0 a
Steward®	0.045	97.5 a	92.5 a	97.9 a	97.5 a
Steward®	0.055	100.0 a	97.5 a	97.9 a	100.0 a
Steward®	0.065	100.0 a	92.5 a	92.8 a	100.0 a
Lannate®	0.25	97.5 a	97.5 a	100.0 a	97.5 a
Karate®	0.025	65.0 b		45.0 b	57.2 b

[1]Survival is corrected for control mortality using Abbott's (1925) formula. Values within a column followed by the same lower case letter are not significantly different ($P > 0.05$) between insecticides for a single species. Comparisons were based on LSD.