

Table 2.—Effectiveness control of *D. abbrevia* plants.

Chemical	Rate lb/AI/100 gal
Azinphosmethyl	2
Carbaryl	2
Carbofuran	3
Carbofuran	4
Carbophenothion	2
Chlorpyrifos	2
Chlorpyrifos	2
Chlorpyrifos	2
Dyfonate	1
Imidan	1
Metasystox-R	0.50
Mocap	0.375
Vydate	2
Controls <sup>b</sup>	

<sup>a</sup> Avg of 5 plants; 5 larvae.  
<sup>b</sup> Avg of 23 plants; 5 larvae

## Evaluation of Insecticidal Dips for Effectiveness Against *Diaprepes abbreviatus*<sup>1</sup> Larvae Infesting Nursery Stock<sup>2</sup>

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### ABSTRACT

A total of 16 compounds was evaluated for control of *Diaprepes abbreviatus* (L.) larvae in nursery stock. Chlorpyrifos and Abate® 2 (*O,O'* (thiodi-*p*-phenylene) *O,O,O'*, *O'*-tetra-methyl phosphorothioate) at 2 and 2.69 lb/100

gal, respectively, were the most effective treatments with no phytotoxic symptoms. Several other compounds were effective but were either phytotoxic or rates were too high for practical use.

*Diaprepes abbreviatus* (L.), commonly known as the "sugarcane root-stalk borer weevil," was first found in the United States in Apopka, Fla., where a single adult was collected in a citrus nursery (Woodruff 1964). In 1968, eradication measures were implemented. Limited larval control data were obtained with aldrin at a rate of 0.516/acre (Wolcott 1952). Metcalfe (1959) recommended dieldrin at 2 lb AI/acre for larval control in sugarcane in Barbados.

In May 1974, heavy infestation of *D. abbreviatus* was found in an ornamental nursery in the Apopka area. An emergency program was initiated by the Florida Department of Plant Industries and the USDA Methods Development Laboratory to screen insecticides for control of larvae infesting nursery stock.

At the present time, there is no accepted dip or drench method for certifying infested nursery stock for shipment outside the quarantined area. An attempt was made by Simanton and Bullock (1973) to develop an effective nursery stock dip, but none was considered effective or safe for practical use.

**MATERIALS AND METHODS.**—All tests were performed in the quarantined area. Test larvae were field collected from the infested nursery and used daily. Larvae were identified by the key of Beavers and Woodruff (1971). Five larvae, when available, were used for each test plant. Larvae were placed in a cavity (10–15 cm deep) formed in the soil of each potted plant, covered, and dipped immediately. Five test plants were used unless otherwise indicated. When available, 22 plant species were used for phytotoxic tests.

Phytotoxic test plants were held for a period of 8 wk before final assessment. Soil of test plants was either in ball and burlap or containerized. The root system of each plant was immersed for 5 min in the test insecticide and then placed on a draining bench

in a covered greenhouse with open sides. All controls (5 larvae/plant) were handled and dipped in water for 5 min in a separate vat by personnel not involved in chemical testing to prevent cross-contamination.

Mortality was determined at either 2, 5, 7, or 8 days posttreatment depending upon the compound used, based upon previous preliminary data. Mortality was adjusted by Abbott's formula. Insecticides and formulations, all EC, were azinphosmethyl, carbaryl, carbofuran, carbophenothion, chlorpyrifos, dimethoate, endosulfan, methomyl, and naled.

Candidate materials without approved common names were: Abate® EC (*O,O'* (thiodi-*p*-phenylene) *O,O,O'*, *O'*-tetra-methyl phosphorothioate); Dyfonate EC (*O*-ethyl *S*-phenyl ethylphosphonodithioate); Imidan® EC (*O,O*-dimethyl phosphorothioate *S*-ester with *N*-(Mercapto methyl) phthalimide); Metasystox-R™

EC (*S*-[2-(ethylsulfinyl) thioate]; Mocap™ E (phlorodithioate); Nema (propylpropane); and Vydate (methyl-N-[ (methylcarbamoyl) carbonyl] dihydrophosphorothioate).

**RESULTS AND DISCUSSION**  
Data obtained from dip treatment

Table 3.—Phytotoxicity to plants.<sup>b,c</sup>

Plant species	Plant species
Acer sp	Asparagus
Asparagus sprengeri Regel	Callistemon sp.
Callistemon sp.	Carissa grandiflora Dc.
Carissa grandiflora Dc.	Cinnamomum camphora N
Cinnamomum camphora N	Cocos australis Mart.
Cocos australis Mart.	Drygotheca elegantissima V
Drygotheca elegantissima V	Hemerocallis sp.
Hemerocallis sp.	Ilex cornuta Lindl.
Ilex cornuta Lindl.	Ilex opaca Ait.
Ilex opaca Ait.	Ilex vomitoria Ait.
Ilex vomitoria Ait.	Juniperus chinensis L.
Juniperus chinensis L.	Ligustrum lucidum Ait.
Ligustrum lucidum Ait.	Liriope sp.
Liriope sp.	Nerium sp.
Nerium sp.	Pinus clausa Vasey
Pinus clausa Vasey	Pittosporum sp.
Pittosporum sp.	Podocarpus macrophyllus I
Podocarpus macrophyllus I	Pyracantha sp.
Pyracantha sp.	Ulmus pumila Linn.
Ulmus pumila Linn.	Viburnum odoratissimum K
Viburnum odoratissimum K	Viburnum suspensum Lind

<sup>a</sup> Observations at 8 weeks.  
<sup>b</sup> S = Safe, U = Unsafe.  
<sup>c</sup> Rates are at the indicated 1

Table 1.—Effectiveness of insecticidal dip treatments for control of *D. abbreviatus* larvae in ornamental nursery plants.

Chemical	Rate lb/AI/100 gal	% mortality (corrected) <sup>a</sup>	
		2 days	5 days
Abate	2.69		100
Abate	2.69		100
Abate	2.69		100
Abate	6		100
Dimethoate	2	100	
Dimethoate	4	100	
Dimethoate	6	100	
Endosulfan	2		27
Methomyl	6		64
Methomyl	8		100
Naled	4		0
Naled	6		76
Naled	6		61
Nemagon	6		100
Nemagon	8		8
Checks <sup>b</sup>			

<sup>a</sup> Avg of 3 plants; 3 larvae/plant unless otherwise indicated.  
<sup>b</sup> Avg of 12 plants; 3 larvae/plant.

<sup>1</sup> Coleoptera: Curculionidae.

<sup>2</sup> Mention of a proprietary product does not constitute endorsement by the USDA. Received for publication Feb. 13, 1975.

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Table 2.—Effectiveness of insecticidal dip treatments for control of *D. abbreviatus* larvae in ornamental nursery plants.

Chemical	Rate lb/AI/100 gal	% missing larvae	% mortality (corrected) <sup>a</sup>		
			5-day	7-day	8-day
Azinphosmethyl	2	1.2	79		
Carbaryl	2	0.8	66		
Carbofuran	3				91
Carbofuran	4				87
Carbophenothion	2	1.6	0		
Chlorpyrifos	2		100		
Chlorpyrifos	2			100	
Chlorpyrifos	2			100	
Dyfonate	1	0.8			54
Imidan	1	1.2	70		
Metasystox-R	0.50		33		
Mocap	0.375		75		
Vydate	2	0.8	54		
Controls <sup>b</sup>		0.05			5

<sup>a</sup> Avg of 5 plants; 5 larvae/plant.  
<sup>b</sup> Avg of 23 plants; 5 larvae/plant.

EC (S-[2-(ethylsulfinyl) ethyl] O,O-dimethyl phosphorothioate); Mocap<sup>TM</sup> EC (O-ethyl S,S-dipropyl phosphorodithioate); Nemagon<sup>TM</sup> EC (1,2-dibromo-3-chloropropane); and Vydate<sup>®</sup> L (oxamyl methyl N',N'-dimethyl-N-[(methylcarbamoyl) oxy]-1 thiooxamimidate).

RESULTS AND DISCUSSION.—Table 1 gives results obtained from dip treatments where no missing larvae

were involved. Table 2 reports results where missing larvae in both treatments and controls were encountered. Missing larvae were considered to be alive although there were indications in treatment tests that they were dead. Most of the time larvae were located where they had been inserted, indicating they were quickly affected by the treatment since no movement had occurred. It was difficult to find decomposed larvae, and those not found were considered alive. Missing larvae from the controls probably escaped from the openings in the container bottoms, since the majority of the live larvae was nearly always found at the bottom of the containers.

Although dimethoate gave the best control at minimum dosage in the shortest time, severe phytotoxic symptoms resulted to the nursery plants (Table 3). Chlorpyrifos proved to be the most effective compound for larval control with no phytotoxic symptoms at minimum rates (Tables 1 and 3). Abate was just as effective at a slightly higher rate with no phytotoxic symptoms on the treated plants (Tables 1 and 3). All compounds tested gave some control except carbophenothion.

Table 3 shows results of the phytotoxic tests with 5 of the compounds tested. Chlorpyrifos, Abate, Mocap, and Metasystox-R proved safe as a dip treatment for those plants tested.

ACKNOWLEDGMENT.—We thank the Central Florida Nursery of Plymouth, Fla., for supplying necessary test plants and facilities, and Paul Gibson of the Florida Department of Plant Industry for his assistance in evaluating the tests.

Table 3.—Phytotoxic observations<sup>a</sup> following insecticidal dip treatments of balled and burlap and container nursery plants.<sup>b, c</sup>

Plant species	Abate				Dimethoate			Mocap 0.375	Meta- systox-R 0.50	Chlor- pyrifos 2
	0.25	1	2.69	4	1	2	4			
<i>Acer</i> sp	S		S	S	U	U	U			
<i>Asparagus sprengeri</i> Regel.	S		S				U			
<i>Callistemon</i> sp.	S									
<i>Carissa grandiflora</i> Dc.		S								
<i>Cinnamomum camphora</i> Nees & Eborn.							U			
<i>Cocos australis</i> Mart.	S		S		U	U				
<i>Dizygotheca elegantissima</i> Veitch.	S		S							
<i>Hemerocallis</i> sp.		S					U			S
<i>Ilex cornuta</i> Lindl.	S	S	S		U	U		S	S	S
<i>Ilex opaca</i> Ait.				S			U	S	S	
<i>Ilex vomitoria</i> Ait.	S		S				S	U		
<i>Juniperus chinensis</i> L.			S	S	S	S	U			S
<i>Ligustrum lucidum</i> Ait.		S		S			S			S
<i>Liriope</i> sp.		S		S	U	U	U			S
<i>Nerium</i> sp.							U			
<i>Pinus clausa</i> Vasey				U						
<i>Pittosporum</i> sp.		S		S			S	S	S	S
<i>Podocarpus macrophyllus</i> Don		S					S	S	S	S
<i>Pyracantha</i> sp.					S	S	U			
<i>Ulmus pumila</i> Linn.				U	S	U	U	S	S	
<i>Viburnum odoratissimum</i> Ker	S				S	U	U			S
<i>Viburnum suspensum</i> Lindl.		S			S		S		S	

<sup>a</sup> Observations at 8 weeks.  
<sup>b</sup> S = Safe, U = Unsafe.  
<sup>c</sup> Rates are at the indicated lb/AI/100 gal.

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The effectiveness of the application on the development of *D. tryoni* (Froggatt) at the larval stage was t

A fruit fly, *D. tryoni* (Froggatt), pest of eastern Florida (Woodruff 1970), and its presence on the marketing of citrus. These quarantines require the application of fumigants to the imported fruit to kill all fruit fly larvae.

The effectiveness of ethionamide (EDB) against larvae of the Oriental fruit fly (*D. tryoni*) (Froggatt) (Woodruff 1951), and fumigation schedules for other citrus fruits (Leggo et al. 1964) were used against *D. tryoni* in orange groves. A schedule for orange groves with a concentration of 0.1% was undertaken. The effectiveness of EDB against *D. tryoni* in orange groves was proved the effectiveness against very large numbers of larvae.

MATERIALS AND METHODS  
Washington Navy Yard, Washington, D. C. chased locally. Fruit was placed in cages (1-450x250x250 mm) containing 10 females to oviposit and to simulate the field conditions.

Infested fruit was placed on fiberboard cartons. The fruit was fumigated with larvae to develop. The fruit was fumigated with young and old fruit, respectively, to determine the effectiveness. All fruit was fumigated at a temperature for 24 hours. Temperatures, treatments, and fumigation times did not differ significantly.

Two-h EDB fumigation was conducted in a 10 ft<sup>3</sup> gallon chamber with a built-in injection system throughout each chamber. The fumigant was represented by a thick layer of fruit which was injected with a thick layer of fruit through a thick layer of fruit chamber, onto a

• Diptera: Tephritidae  
• Received for publication  
• Endorsed and approved  
• Research Horticulture