Nursery Best Management Practices (BMPs) and Understanding Pesticide Treatment Options

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Outline

- Science Advisory Panel and the Diaprepes Project
- Diaprepes Case Study - The protocols
  - Introduce the pesticides
  - Voluntary Treatment Protocol
- Things to consider

Citrus Root Weevil

Science Advisory Panel

October 2005

Dr. Elizabeth Grafton-Cardwell (UCR)
Dr. Catharine Mannion (Univ. Florida)
Dr.Clayton McCoy (Univ. Florida)
Dr. Herbert Nigg (Univ. Florida)
Dr. Jorge Peña (Univ. Florida)

Input was also provided by Dr. Kris Godfrey (CDFA) and Dr. John Kabashima (UC Coop. Ext.).

Science Advisory Panel

- **Carbaryl (Sevin)** has both a landscape and fruit tree label, and is effective against adults.

- **Neonicotinoids**

Imidacloprid (Merit) enhances the action of nematodes. Larvae normally void themselves of nematodes in the soil, but they can not groom when exposed to imidacloprid. Use as a soil application for larvae. Merit is both a foliar and a soil formulation.

Thiamethoxam (Flagship, Platinum) has efficacy as a soil application against neonates and reduces adults on the foliage. It has not been tested in combination with nematodes.

Other neonicotinoids are being studied.

Science Advisory Panel

- **Pyrethroids**

Zeta cypermethrin (Mustang Max) is very effective on adults in the lab and the field.

Cyfluthrin (Baythroid) is very effective on adults.

Fenpropathrin (Danitol, Tame) is not quite as effective as cyfluthrin or zeta cypermethrin on adults.

Bifenthrin (Talstar) both granular soil and foliar with landscape label. The soil formulation kills the neonates dropping to the soil. It can be used as a foliar for adults. Soil application residual activity can last several months.

Science Advisory Panel

- **Diflubenzuron (Micromite, Dimilin)** is very important for egg control. It acts by sterilizing eggs when the eggs are laid on residues and when adult females feed on treated foliage.

Diaprepes Project

The Diaprepes Project was formed to organize and cooperate in the eradication efforts of the serious threat by *Diaprepes abbreviatus* (L.) to California's agricultural systems. It is a cooperative effort by the University of California Cooperative Extension, UC Riverside, UC Davis, the San Diego, Los Angeles, Riverside, and Orange Counties Ag Commissioners offices, the California Department of Food and Agriculture, the San Diego Farm Bureau, and local nursery growers.

Diaprepes Project

- Approved treatment for nurseries that are a find site
- Approved treatment for nurseries that are not a find site, but are in a quarantined area
- Approved treatments for nurseries that want to be pre-treated for the pest

Diaprepes Case Study

- DRW was first discovered in Orange County in late 2005, in San Diego County on April 26, 2006
- May 2006, CDFA discussed protocols for infested nurseries
- Sept 2006, treatments by CDFA staff began, both foliar and soil treatments

Diaprepes Case Study

- One size does not fit all
- CDFA regulators visited San Diego County to gain a better understanding of the ornamental plant industry before drafting a protocol
- Dec 8, 2006 the first infested nursery was quarantined - the protocol was unfinished
- March 7, 2007 three protocols were developed

Diaprepes Certification Protocol A

Outdoor or Partially Covered Production Areas
Negative for Diaprepes root weevil (all life stages)

1. Project staff will evaluate production area to determine risk of Diaprepes infestation and will notify nursery representatives of certification options. Some or all of the options listed in 5.a through d. of this section may be available.

2. Visual inspections will continue on an on-going basis as required by project staff.

3. Containerized plants brought into nursery from inside the Diaprepes root weevil quarantine area must be accompanied by a certificate issued by Project staff. All certificates must be maintained at the nursery and made available to inspectors upon request.

4. Containerized plants bought into nursery from outside the Diaprepes root weevil quarantine area must be segregated from other nursery stock produced at the nursery, the identity must be maintained, and the plants must be treated as outlined in 5.a., b., c., or d. of this section. However, containerized plants that remain at the nursery for less than 72 hours may be shipped without further treatment. Nursery must maintain records of incoming shipments and make available to inspectors upon request.

5. All plants produced at the nursery must be treated in one of the following ways:

   a. All plants that are started from seed, cutting, or bare root transplants may be planted in growing media with approved pesticide incorporated at a rate to control Diaprepes root weevil larvae and may be certified for movement immediately after treatment.

   OR

   b. Containerized plants that are grown and shipped in 4" or smaller containers that have been continuously treated with an approved pesticide as part of a pest management program may be certified for movement immediately after treatment. See **Protocol A Treatment Table** for list of approved pesticides.

   OR

   c. Containerized plants with a growing cycle of six months or less may be treated with approved growing media pesticide (drench or granular). See **Protocol A Treatment Table** for holding and certification periods.

   OR

   d. Containerized plants with a growing cycle more than six months must be treated with an approved growing media pesticide or pesticide/nematode combination*

      1. Plants that are treated within the first 30 days after becoming regulated may be certified for movement for a period of twelve months with no holding period

Diaprepes Case Study

- Draft protocol was used on the infested nursery

1. Seeds and starts could be treated and moved

2. Plants in 4 inch pots that have been treated on a schedule, could be treated and shipped

3. Plants with a growing cycle of 6-months or less, could be treated and held for the stated time frame

4. Plants with a growing cycle of 6-months or more, could be treated and held for 6-months.


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If You Provoke a Regulator

Diaprepes Project

Approved Treatments for Nurseries under quarantine

Exhibit 4
Nurseries in Diaprepes Root Weevil Quarantine Area
March 7, 2007

Approved Treatments for Nurseries in *Diaprepes abbreviatus* State Interior Quarantine Areas

The following products are approved quarantine treatments for the *Diaprepes abbreviatus* State Interior Quarantine when applied according to the treatment and certification protocols (Protocols A, B, or C attached).

To determine the approved rate for each product, use the maximum label rate listed for your "site" (crop). For instance, if using Talstar Nursery Flowable on ornamental plants, use maximum rate listed under "Ornamental Application Rates."

Talstar Nursery Flowable EPA RegNo. 279-3155

Talstar Nursery Granular EPA Reg No. 279-3130

Up-Star Nursery Granular EPA Reg. No 70506-75 (Talstar Nursery Granular equivalent)

Talstar GC Flowable Reg. No. 279-3156

Up-Star SC Lawn & Nursery EPA Reg. No. 70506-23 (Talstar GC Flowable Equivalent)

Sevin SL EPA Reg No. 432-1227

Admire Pro Systemic EPA Reg. No. 264-827 (may be used for bearing fruit trees as a soil drench in lieu of bifenthrin)

Admire 2 Flowable Insecticide EPA Reg. No. 264-758 (may be used for bearing fruit trees as a soil drench in lieu of bifenthrin)

Nematodes-*Heterorhabditis indica*, *Steinernema riobravis* (no pesticide registration required)

Adept EPA Reg No. 400-477 (Ovicide Diflubenzuron for Greenhouses)

Admire Pro Systemic EPA Reg. No. 264-827

Baythroid 2 Emulsifiable Pyrethroid Insecticide EPA Reg. No. 264- 745-AA (fruit trees)

Decathlon 20WP Greenhouse & Nursery EPA Reg. No. 432- 1402-AA- 59807

Dimilin 25W EPA Reg No. 400-465

Flagship 25 W EPA Reg. No. 100- 955-AA

Marathon II EPA Reg. No. 432- 1369-AA- 59807

Marathon 60WP Greenhouse & Nursery EPA Reg. No. 432- 1361-AA- 59807)

Tame 2.4 EC EPA Reg. No. 59639-77-AA

Danitol 2.4 EC Spray EPA Reg. No. 59639- 35-AA (fruit trees)

It is incumbent upon the user to follow all label directions when using any of the above listed products for certification purposes for this quarantine.

January 19, 2007

Protocol A Approved Treatment Table
(Non-infested Nurseries)

Plant Description	Approved Treatment/Active Ingredient	Product Example	Quarantine Holding Period after Treatment?	Certification Period after Treatment
5.a. Plants started from seed, shoots or transplants	bifenthrin (granular)	Talstar Nursery Granular	none	24 months
5.b. Containerized plants, less than or equal to 4" pots	bifenthrin (foliar)	Talstar GC Flowable	none	continuous
	carbaryl (foliar)	Sevin	none	continuous
	cyfluthrin	Decathlon	none	continuous
	imidacloprid	Marathon, Admire	none	continuous
	diflubenzuron	Dimilin	none	continuous
	fenopathrin	Danitol, Tame	none	continuous
	thiomethoxam	Flagship	none	continuous
5.c. Containerized plants, growing cycle less than six months	bifenthrin (drench)	Talstar Nursery Flowable	none	6 months
	bifenthrin (granular)	Talstar Nursery Granular	none	24 months
5.d.1. Containerized plants, growing cycle more than six months- **treated within the first 30 days**	bifenthrin (drench) and nematode	Talstar Nursery Flowable plus nematode	none	12 months
	bifenthrin (drench)	Talstar Nursery Flowable	none	12 months
	bifenthrin (granular)	Talstar Nursery Granular	none	24 months
5.d.2. Containerized plants, growing cycle more than six months- **not treated within the first 30 days**	bifenthrin (drench) and nematode	Talstar Nursery Flowable plus nematode	6 months	12 months
	bifenthrin (drench)	Talstar Nursery Flowable	6 months	12 months
	bifenthrin (granular)	Talstar Nursery Granular	6 months	24 months
6.a. Non-containerized (balled and burlapped)	bifenthrin (drench) and carbaryl (foliar)	Talstar Nursery Flowable, Sevin	2 weeks after foliar treatment, 6 months after soil drench	4 weeks after foliar treatment, 12 months after soil drench**
	bifenthrin (drench) and nematode and carbaryl (foliar)	Talstar Nursery Flowable, nematode, Sevin	2 weeks after foliar treatment, 5 weeks after nematode treatment	4 weeks after foliar treatment, 12 months after soil drench**

Approved Treatments for Nurseries in Diaprepes Quarantine Areas

Trade Name	Formulation	Common Name	Site Use	REI
Talstar NF*	Nursery Flowable 7.9%	Bifenthrin	GH/Nursery	12 hours
Talstar GC*	Granuals 0.2%	Bifenthrin	Nursery	12 hours
Up-Star Nursery Granular*	Granuals 0.2%	Bifenthrin	Nursery	12 hours
Talstar GC Flowable*	GC Flowable 7.9%	Bifenthrin	Nursery	12 hours
Us-Star SC Lawn & Nursrery*	SC 7.9%	Bifenthrin	GH/Nursery	12 hours
Sevin SL	SL 43%	carbaryl	Nursery	12 hours
Marathon II	21.4% Flowable	imidacloprid	GH/Nursery	12 hours**
Marathon 60WP	60WP	imidacloprid	GH/Nursery	12 hours**
Admire Pro Systemic	42.8 % Flowable	imidacloprid	Fruit Trees	12 hours
Admire 2 Flowable	2F/21.4% Flowable	imidacloprid	Fruit Trees	12 hours
Dimilin*	25W	diflubezuron	Nursery/Fruit T	12 hours
Adept	25% WSB	diflubezuron	GH	12 hours
Baythroid/ Baythroid XL*	2 Emulsifiable	cyfluthrin	Fruit Trees	12 hours
Decathlon	20WP	cyfluthrin	GH/Nursery	12 hours
Flagship	25WG	thiamethoxam	Nursery	12 hours
Danitol 2.4 EC*	2.4 EC	fenpropathrin	Fruit Trees	24hours
Tame 2.4 EC*	2.4 EC	fenpropathrin	GH/Nursery	24hours

*** = Restricted Use**

****= Exception for drench applications**

Approved Treatments for Nurseries in Diaprepes Quarantine Areas

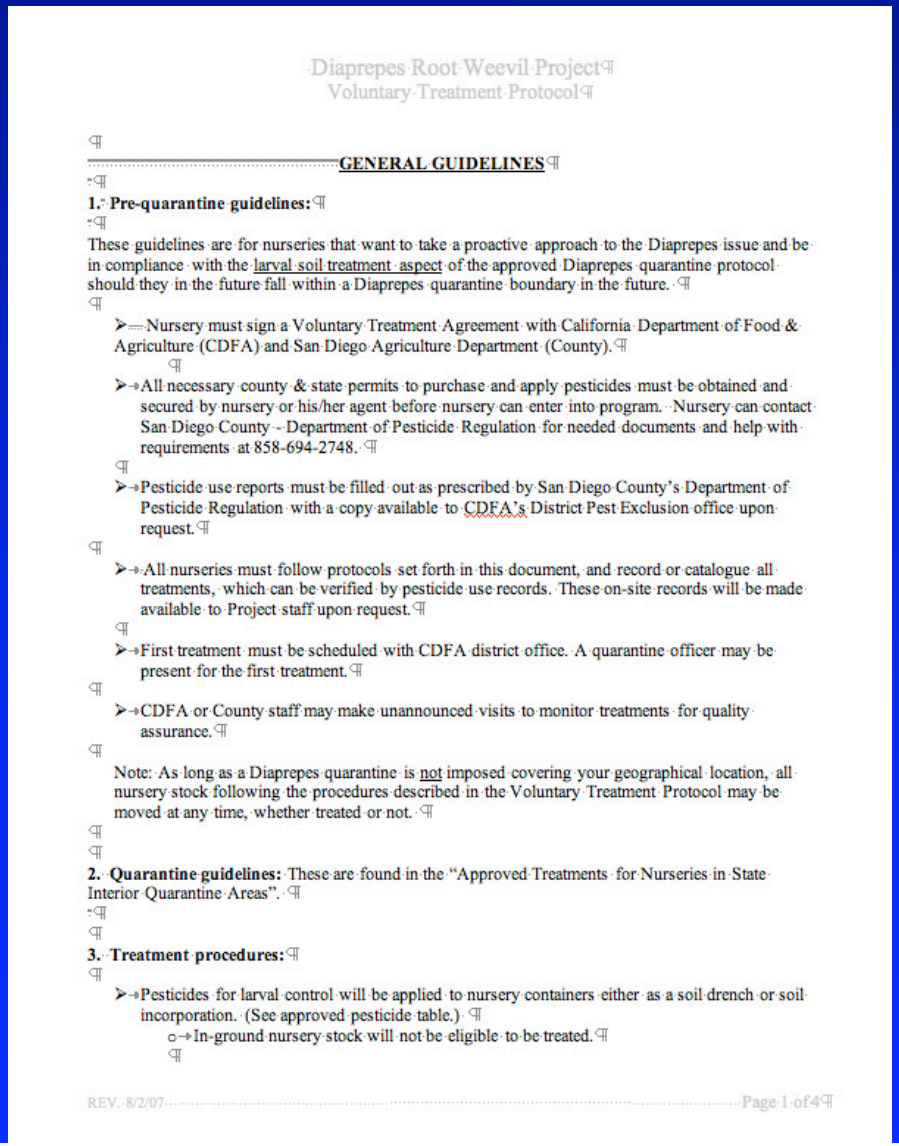
Approved Treatments for Nurseries in *Diaprepes abbreviatus* quarantine areas			
Trade Name	**Chemical Class**	**Foliar Rate**	**Drench Rate**
Talstar NF*	3	20fl oz/acre	40fl oz/100 gal 8-16oz/6inch
Talstar GC*	3		100 lbs/acre
Up-Star Nursery Granular*	3		4.5 lbs/600 cubic yds
Talstar GC Flowable*	3	1.0 floz/ 1000 square feet	
Us-Star SC Lawn & Nursrery*	3	20fl oz/acre	40fl oz/100 gal 8-16oz/6inch
Sevin SL	1	3/4 floz/1000 sqft	
Admire Pro Systemic	4		1.1 ml/ft3 media -citrus
Admire 2 Flowable	4	32 floz/acre	
Adept	15	2.0 oz/100 gal	
Baythroid/ Baythroid XL*	3	3.2 floz/acre	
Decathlon	3	1.9 oz/100 gal	
Dimilin*	15	16 oz/100 gal	
Flagship	4	4.0 oz/100 gal 8.0 oz/acre	8.0 oz/acre
Marathon II	4	1.7 floz/100 gal	1.7 floz/1000 6 inch pots
Marathon 60WP	4	soil trt only	1 pkt/1000 6 inch pots
Tame 2.4 EC*	3	10 2/3 floz/acre	
Danitol 2.4 EC*	3	21 q1/3 floz/acre	

IRAC categories 1, 3, 4, and 15

Voluntary Treatment Protocol

Approved Voluntary Treatments for

Nurseries not yet under quarantine



Diaprepes Root Weevil Project
Voluntary Treatment Protocol

GENERAL GUIDELINES

1. Pre-quarantine guidelines:

These guidelines are for nurseries that want to take a proactive approach to the Diaprepes issue and be in compliance with the larval soil treatment aspect of the approved Diaprepes quarantine protocol should they in the future fall within a Diaprepes quarantine boundary in the future.

- Nursery must sign a Voluntary Treatment Agreement with California Department of Food & Agriculture (CDFA) and San Diego Agriculture Department (County).
- All necessary county & state permits to purchase and apply pesticides must be obtained and secured by nursery or his/her agent before nursery can enter into program. Nursery can contact San Diego County - Department of Pesticide Regulation for needed documents and help with requirements at 858-694-2748.
- Pesticide use reports must be filled out as prescribed by San Diego County's Department of Pesticide Regulation with a copy available to CDFA's District Pest Exclusion office upon request.
- All nurseries must follow protocols set forth in this document, and record or catalogue all treatments, which can be verified by pesticide use records. These on-site records will be made available to Project staff upon request.
- First treatment must be scheduled with CDFA district office. A quarantine officer may be present for the first treatment.
- CDFA or County staff may make unannounced visits to monitor treatments for quality assurance.

Note: As long as a Diaprepes quarantine is not imposed covering your geographical location, all nursery stock following the procedures described in the Voluntary Treatment Protocol may be moved at any time, whether treated or not.

2. Quarantine guidelines: These are found in the "Approved Treatments for Nurseries in State Interior Quarantine Areas".

3. Treatment procedures:

- Pesticides for larval control will be applied to nursery containers either as a soil drench or soil incorporation. (See approved pesticide table.)
  - In-ground nursery stock will not be eligible to be treated.

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Voluntary Protocol

Approved pesticides:
Talstar Nursery Flowable and Granular
Up-Star SC Lawn & Nursery and Granular
Wisdom Flowable and Nursery Granular
Admire Pro Systemic (may be used for containerized citrus)
Admire 2 Flowable Insecticide

Pesticides for use on plants (pot size 4" or less) with short certification needs – See Protocol A-5,b

- **Flagship 25W**
- **Marathon II and 60WP**

Voluntary Protocol

Plant Description	Approved Treatment/Active Ingredient	Product Example	*Rate of Application	Shipping Period after Treatment
1.a. Containerized plants, less than or equal to 4" pots.	bifenthrin (foliar)	Talstar GC Flowable	max rate per label	continuous
	carbaryl (foliar)	Sevin	max rate per label	continuous
	Cyfluthrin	Decathlon	max rate per label	continuous
	Imidacloprid	Marathon, Admire	max rate per label	continuous
	Diflubenzuron	Dimilin	max rate per label	continuous
	Fenopathrin	Danitol, Tame	max rate per label	continuous
	Thiomethoxam	Flagship	max rate per label	continuous
1.b. Containerized plants, greater than 4" pots.	**bifenthrin (drench)	Talstar Nursery Flowable	10oz/100 gal	12 months
			20oz/100 gal	16 months
			30oz/100 gal	21 months
	**bifenthrin (granular)	Talstar Nursery Granular	10ppm	7 months
			15ppm	10 months
			25ppm	18 months

NO HOLDING PERIOD AFTER TREATMENT

Things to Consider

Label Restrictions

- Watch for maximum use rates on the label
- Resistance Management recommendations
- PPE exceptions

  Tame/Danitol - CA specific requirements
- Talstar

  "Users of this product in CA must be in possession of State specific supplemental labeling"
- Chemigation is allowed for some products

  Marathon 60WP - specific safety devices on the label

Diaprepes Monitoring

- BE AWARE - Your location/Diaprepes infestation
- Yellow traps do not work for adults
- Monitoring for eggs is very difficult
- Monitoring for larvae is not possible

Things to Consider

- Host Range: Polyphagous (13 new)
- Increased costs, treatments for adults and larvae
- Exclusion: What is brought into the nursery?
    - Landscapers, cuttings, tree removal, etc.
    - Recycling soil "Hitchhikers"
- The amount of bifenthrin used
    - Resistance
- Routine applications, GWSS, Nursery clean stock program

Things to Consider

Table 7. The common name and scientific name of plants found associated (fed upon or used as an oviposition substrate) with life stages of Diaprepes root weevil in San Diego County, California.

Weevil Life Stage	Common Name	Scientific Name
Eggs only	Privet	*Ligustrum* spp.
	Olive	*Olea* spp.
Larvae only	Loquat	*Eriobotrya japonica*
Adults only	Camphor	*Cinamomum camphor*
	Hibiscus	*Hibiscus* sp.
	Macadamia	*Macadamia* spp.
	Carrotwood	*Cupaniopsis anacardiopsis*
Adults & Eggs	Golden Wattle	*Acacia longifolia*
	Powder Puff	*Calliandria* spp.
Adults & Larvae	Coral Tree	*Erythrina* spp.
	Golden Shower Tree	*Cassia fistula*
	White Rose	*Rosa* spp.
Adults, Eggs, & Larvae	India Hawthorn	*Rhaphiolepis indica*

Things to Consider

- Host Range: Polyphagous (13 new)
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    - Recycling soil "Hitchhikers"
- The amount of bifenthrin used
    - Resistance
- Routine applications, GWSS, Nursery clean stock program

Diaprepes root weevil, a new California pest, will raise costs for pest control and trigger quarantines

Karen M. Jetter, UC Agricultural Issues Center
Kris Godfrey, Biological Control Program

California Agriculture 63(3):121-126. July-September 2009

TABLE 3. Effect of Diaprepes on the nursery industry

	Clean nursery			Infested nursery		
	Floriculture	Other	Combined	Floriculture	Other	Combined
Revenue per acre ($)	93,914	41,158	66,709	93,914	41,158	66,709
Cost of quarantine protocols per acre ($)	300	300	300	525	525	525
Cost increase as share of revenues (%)	0.32	0.73	0.45	0.39	0.88	0.55

Things to Consider

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- The amount of bifenthrin used
  - Resistance
- Routine applications, GWSS, Nursery clean stock program

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- Routine applications, GWSS, Nursery clean stock program

Things to Consider

- Host Range: Polyphagous (13 new)
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    - Recycling soil
- The amount of bifenthrin used
    - Resistance
- Routine applications, GWSS, Nursery clean stock program

On Going Research

- Effort to expand the list of products
- Biological studies
- Nematodes
- Nursery container studies
- Soil treatment efficacy

Larval Mortality/Bifenthrin

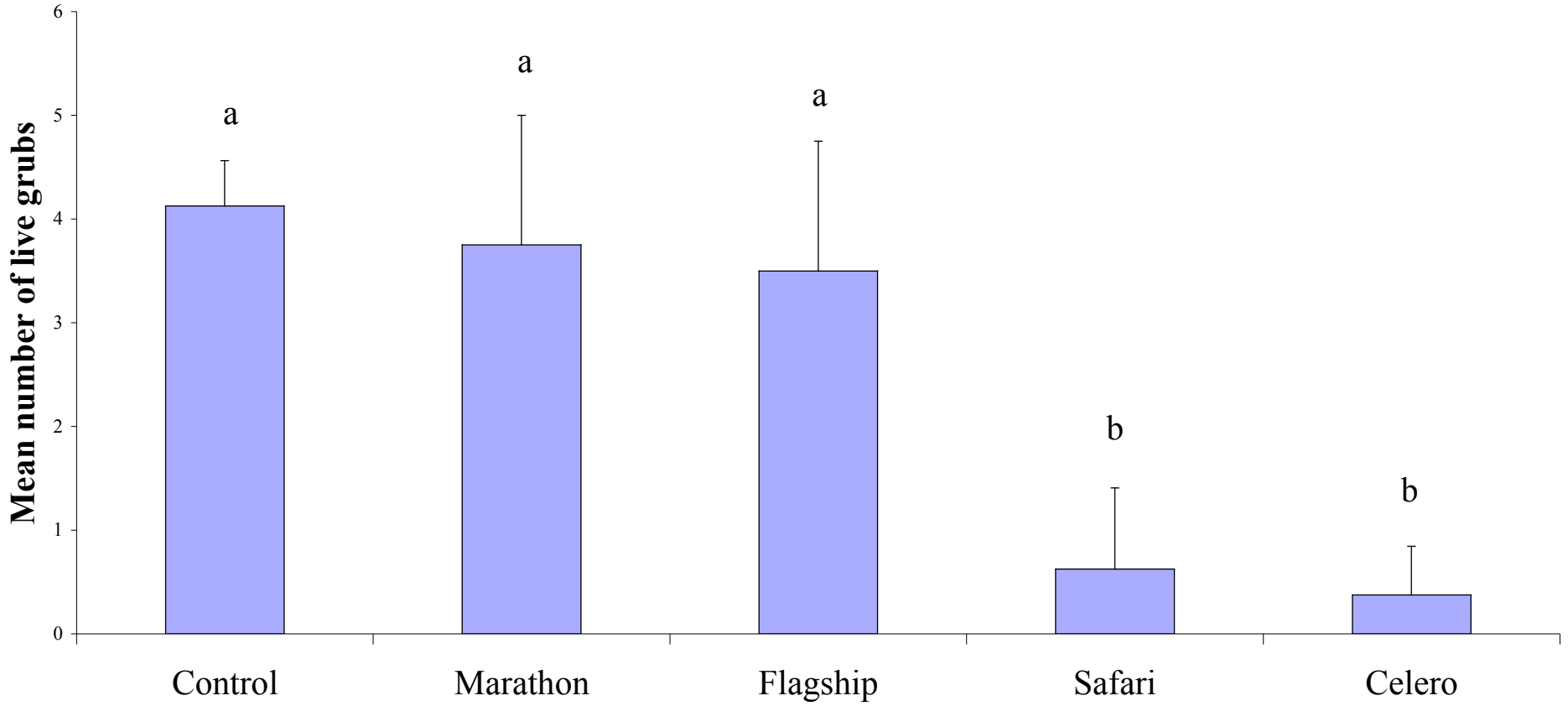
Table 5. The percent survival of first instar larvae placed in soil treated with 4 rates of bifenthrin and water (0 oz. of bifenthrin) for 8 months after treatment.

Time After Application	Rate of Bifenthrin (oz.)				
	0	10	20	30	40
1 day	31	0	0	0	0
1 month	23	0	0	0	0
2 months	10.5	0	0	0	0
3 months	24.5	0	0.5[a]	0	1.5[a]
4 months	75.5	1[a]	0	1.5[a]	2[a]
5 months[b]	20.5	1[a]	1.5[a]	0.5[a]	0.3[a]
6 months	53.5	2[a]	1[a]	1.5[a]	0.5[a]
7 months	78.5	2.5[a]	1.5[a]	0	0
8 months	74.5	9	0	0	0

[a]Larvae were moribund, not feeding, and typically found on bottom of cup with little or no movement.

[b]Very heavy rains just before sample taken. Soil very wet.

Larval Mortality/Neonicotinoids



Bifenthrin Soil Penetration

Table 4. Mean ppm of bifenthrin (Talstar @ 12oz/100) found at different depths of a 24 inch boxed pepper tree in a commercial nursery treated with selected applications of Talstar and a soil surfactant, Suffusion.

Treatment Application	Mean ppm Talstar		
	0-3 inches	11-13 inches	21-24 inches
Talstar	10.7	5.9	5.3
Talstar+Suffusion	10.3	3.6	2.6
Pre-treat Suffusion then Talstar	23.88	8.1	3.4
Mean Totals	15	5.9	3.7

Egg Mortality Trials

Table 2. The percentage of egg masses that hatched, and the mean mortality of eggs and neonates using selected insecticides, and water control.

Treatment	Active Ingredient	No. of Neonates	% of Masses Hatched	Mean % Mortality[a]
Avid	abamectin	324	100%	19.1%
Tame	fenthropathrin	145	100%	78.5%
Talstar	bifenthrin	182	60%	100.0%*
Scimitar	lambda-cyhalothrin	213	60%	61.8%
Conserve	spinosad	275	100%	39.0%
DeltaGard	deltamethrin	292	100%	55.9%
Water	-	57	100%	26.8%

[a]60% of the egg masses hatched but all neonates were dead soon afterwards.