



GREENHOUSE IPM: SUSTAINABLE WHITEFLY CONTROL

PEST MANAGEMENT TECHNICAL NOTE

ATTRA is the national sustainable agriculture information center funded by the USDA's Rural Business -- Cooperative Service.

Abstract: This publication focuses on integrated pest management for greenhouse whitefly on both vegetable and ornamental crops. It is designed to complement the ATTRA publication *Integrated Pest Management for Greenhouse Crops*, which discusses techniques for good greenhouse supervision. Monitoring of whiteflies, biological controls, biopesticides, and insect growth regulators are discussed below. The appendices include information on the newest biopesticides and biological control organisms.

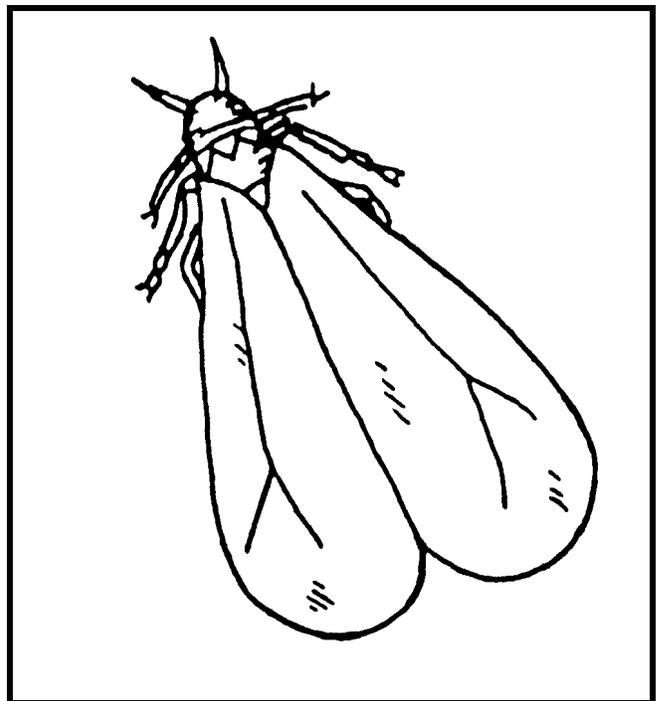
By Lane Greer
NCAT Agriculture Specialist
June 2000

Introduction

Whiteflies began showing resistance to synthetic insecticides early on, and by the 1980s they were a very serious greenhouse pest. Not only do they feed on plants, but they also produce honeydew, which detracts from the plants' appearance and attracts other insects and sooty mold. Whiteflies can also transmit plant viruses. The mere presence of whiteflies in a greenhouse will stop customers from buying your product.

Contents

Introduction.....	1
Crop Scouting and Trapping.....	2
Biological Control.....	2
Biopesticides and Biorational Pesticides.....	3
Insect Growth Regulators.....	3
Controlled Atmosphere.....	4
References.....	4
Web Sites.....	5
Suppliers.....	5
Appendix I: Beneficial Organisms.....	8
Appendix II: Biorational Pesticides.....	10



Courtesy of Hercules Incorporated
Wilmington, Delaware

Several species of whiteflies attack greenhouse plants, and they typically have a wide host range and resist insecticides. Greenhouse tomatoes and poinsettias are especially plagued by whiteflies. The most common whiteflies on greenhouse crops are the greenhouse whitefly (*Trialeurodes vaporariorum*), sweetpotato whitefly (*Bemisia tabaci*) and the silverleaf whitefly (*Bemisia argentifolii*).

The various whitefly species and biotypes look very much alike, but they have subtle physiological differences. These differences can

cause them to respond differently to control strategies. Because control measures must be selected according to the type of whitefly present, accurate identification is critical to successful control. The Cooperative Extension Service is an excellent resource for assistance with pest identification. There are also several web sites that provide pictures of the various whiteflies. See the **Web Sites** section for more information.

Crop Scouting and Trapping

Plants should be visually inspected for signs of a whitefly infestation – e.g., off-color or stunted plants. A hand lens is useful for systematically inspecting a number of individual plants for the presence of eggs, nymphs or adults. Both the upper and lower leaf surfaces should be inspected. It is important to check the greenhouse in the same pattern on each scouting trip. Locations where whiteflies are found should be flagged so that population development and control efforts can be evaluated. Scouting frequency should be increased during warm weather as whitefly populations multiply faster than.

Trapping with yellow sticky cards, both inside and outside the greenhouse, is essential for a successful whitefly management program. The cards are used to detect and monitor population levels. As a general rule, 1 to 4 cards spaced evenly throughout 1000 square feet of greenhouse are sufficient (1). A generally acceptable threshold for whiteflies is 0.5 per card per day when the crop is young, and 2 per card per day as the crop reaches maturity (2). Traps should be hung level with the tops of the plants since whiteflies are most attracted to young foliage. Doors, vents and other openings where whiteflies can enter the greenhouse are other good sites to hang yellow sticky cards.

Researchers in California have successfully used silver-painted pot spaces and silver polyethylene mulch to control whiteflies on greenhouse poinsettias (3). The reflective materials were used in conjunction with yellow sticky cards or

tape and resulted in significantly enhanced trapping of whiteflies, relative to controls with sticky traps only.

Greenhouse plastics themselves may have significant influence on the initial attraction of insects into greenhouses. A study from the late 1990s showed that silverleaf whiteflies preferred to enter greenhouses covered with film that transmitted higher levels of ultraviolet light (4).

Biological Control

Several types of beneficial organisms are available for biological control of whiteflies. The parasitic wasp *Encarsia formosa* preys on immature whiteflies and is commonly used for greenhouse whitefly. *Encarsia* wasps kill whitefly nymphs in one of two ways: they either lay an egg inside the nymph, providing food for their young, or they kill the nymph right away and feed on the fluids inside of it (2). Greenhouse whitefly pupae that have been parasitized by *Encarsia formosa* turn black; silverleaf whitefly pupae turn amber-brown (2). The cost of *E. formosa* is comparable to foliar pesticides (2).

Sweetpotato and silverleaf whiteflies are not well controlled by *Encarsia formosa*. Two other wasp parasites, *Encarsia luteola* and *Eretmocerus californicus* are commercially available for control of these species, but *E. formosa* remains the mainstay of most whitefly biological control programs due to the expense and intermittent availability of these other beneficials (5). Researchers are also examining different strains of *E. formosa* to determine their effectiveness against sweetpotato and silverleaf whiteflies.

Mark Hoddle, University of California, Riverside, has done some recent research dealing with *Eretmocerus eremicus*. *E. eremicus* was effective for silverleaf whitefly control and is best used in combination with the insect growth regulators Precision™ or Applaud™. Enstar™ was not compatible with natural enemies he tested. Biological control should be used only at low whitefly levels (less than one nymph per 10 cuttings) and must be regularly evaluated (6).

Mark has also compared the effectiveness of *Encarsia formosa* and *Eretmocerus californicus* on silverleaf whitefly. In a 1996 study, both parasitoids controlled whiteflies at a 99% control rate. However, fewer numbers of *E. californicus* had to be released, which would result in cost savings for growers. Another benefit: Fewer parasitoids meant more food for each, so the reproduction rate was much higher (7).

Delphastus pusillus, sometimes called the whitefly destroyer, is a very small, black ladybird beetle that attacks all stages of whiteflies, but prefers eggs and nymphs. The females lay their eggs within clusters of whitefly eggs. Adults can consume 160 eggs or 12 large nymphs every day. A larva consumes 1000 whitefly eggs during its development. These beetles perform best at temperatures between 65 and 90°F, with relative humidity above 70%. These predators can be used in combination with *Encarsia* species (8).

See **Appendix I** for a complete listing of biological controls for whiteflies.

Biopesticides and Biorational Pesticides

Some microorganisms also control whiteflies. For instance, the fungus *Beauveria bassiana* (trade names Naturalis-O™ and BotaniGard™), is effective against eggs, immature and adult whiteflies. Thorough coverage of leaf undersides and correct timing of applications result in best control.

Another fungus, *Paecilomyces fumosoroseus* (trade name PFR-97™), is now commercially available. It controls whiteflies, aphids, and spider mites. Both *B. bassiana* and *P. fumosoroseus* need high humidity for best results.

Several least-toxic, or biorational, pesticides have been evaluated for their effectiveness against the different whitefly species. These include neem-based formulations (Neemazad™ and Azatin™ are two registered products), insecticidal soap (M-Pede™), and horticultural oil. Enhanced whitefly control is achieved with

thorough spray coverage. Wider plant spacing and removal of dead lower leaves improve pesticide coverage and pest control.

A 1995 study conducted in Florida compared the effectiveness of Sunspray Ultra-Fine Spray Oil™, M-Pede insecticidal soap, a sucrose ester extract surfactant derived from tobacco, and Garlic Barrier™, for killing and repelling silverleaf whiteflies (*Bemisia argentifolii*) on tomatoes. Sunspray provided the best control, followed by M-Pede and the tobacco surfactant. The Garlic Barrier did not provide any control (9).

Researchers at Ohio State University showed that mortality rates of silverleaf whitefly were higher when BotaniGard was used together with Adept™ (an insect growth regulator), insecticidal soaps, horticultural oil, Fulex SO-2000, glycerol and a yeast extract (10). In most cases, the rate of infection and kill was faster than with BotaniGard alone. This is important because it would allow more biopesticides and biorationals to be used retroactively. When several substances are used together, they are applied at lower-than-recommended rates (one-tenth to one-half were used in this study). The researchers are trying to "develop management guidelines on spray-tank mixes that would enhance fungal efficacy" (10).

See **Appendix II** for a complete listing of biopesticides and biorational pesticides available for whitefly management.

Insect Growth Regulators

Insect growth regulators (IGRs) are another least-toxic pesticide control option. IGRs typically kill insects by disrupting their development. They have a complex mode of action that precludes insects from rapidly developing resistance. IGRs can work in one of several ways: 1) they can mimic juvenile hormones, so that insects never enter the reproductive stage of development; 2) they can interfere with the production of chitin, which makes up the shell of most insects; or 3) they can interfere with the molting process.

IGRs usually work through ingestion, so good spray coverage is essential. They generally don't affect non-target species – such as humans, birds, fish or other vertebrates. For most IGRs there are minimal re-entry restrictions. IGRs typically take several days to have an effect on pest populations. Because IGRs do not affect mature insects, adult beneficials released into the greenhouse after an IGR application are not likely to be affected. Use of IGRs is generally prohibited by organic certification organizations because the products are synthetic.

IGRs can sometimes be used in conjunction with biological control efforts and may provide growers with a “safety net” should beneficials fail to keep the pests below economically damaging levels. The table below lists some well-known insect growth regulators. (See the **Resources** section for suppliers' contact information.)

Table 1. Selected Insect Growth Regulators

<u>Brand Name</u>	<u>Supplier</u>
Adept, Dimlin	Uniroyal Chemicals
Azatin	Hydro-Gardens, Olympic Horticultural Products
Citation, Precision	Novartis
Distance	Valent
Enstar II	Wellmark Intl.
Neemazad, Neemix	Thermo Trilogy
Preclude, Pyrigro	Whitmire Micro-Gen

Controlled Atmosphere

Changing the composition of the atmosphere in the greenhouse by either reducing oxygen or increasing carbon dioxide appears to provide some control of greenhouse whiteflies, especially adults. Reduced-oxygen experiments by Dr. Susan Han at the University of Massachusetts resulted in 100% adult mortality after less than two hours of exposure, though eight-hour treatments were needed to control most (about 80%) of the eggs and pupae (11).

Horticulturists at North Carolina State University reported that whitefly population levels were lower in greenhouses where carbon dioxide enrichment occurred daily for about eight hours. The likely reason for the population reductions is that plants grown in atmospheres with high carbon dioxide levels tend to have higher concentrations of carbohydrates in the plant tissue relative to nitrogen, resulting in a nitrogen-dilute diet for the whiteflies. Lower dietary nitrogen would slow the growth and reproduction of the pests, without adversely affecting crop yields or quality (12).

References

- 1) McHugh, Jennifer. 1991. Monitoring – the first line of defense. *Greenhouse Grower*. February. p. 66.
- 2) Gill, Stanton. 2000. Pest control: whitefly control for cut flower growers. *The Cut Flower Quarterly*. Vol. 12, No. 1. p. 26-30.
- 3) Price, Robert P. Jr. 1999. Reflective mulches and yellow sticky tape control whiteflies in greenhouse poinsettia (*Euphorbia pulcherrima*). As reported in Williams, Greg and Pat. From the 1999 ASHS conference. *HortIdeas*. August. p. 85.
- 4) Costa, H.S. and K.L. Robb. 1999. Effects of ultraviolet-absorbing greenhouse plastic films on flight behavior of *Bemisia argentifolii* (Homoptera: Aleyrodidae) and *Frankliniella occidentalis* (Thysanoptera: Thripidae). *Journal of Economic Entomology*. June. p. 557-562.
- 5) Anon. 1995. Biological pest control. *Greenhouse Product News*. July. p. 17.
- 6) Daughtrey, Margery and Christine Casey. 1998. Highlights from SAF's pest conference. *Grower Talks*. April. p. 44, 46.
- 7) Grossman, Joel. 1996. Conference notes. *The IPM Practitioner*. March. p. 14.

- 8) Cloyd, Raymond A. 1999. Know your friends: *Delphastus pusillus*: whitefly predator. *Midwest Biological Control News*. October. p. 3.
- 9) Williams, Greg and Pat. 1995. Oil, soap, surfactant, and garlic vs. whiteflies on tomatoes. *HortIdeas*. May. p. 55-56.
- 10) Brownbridge, Michael, Margaret Skinner, and Bruce L. Parker. 2000. Enhancing the activity of insect-killing fungi for floral IPM. *Ohio Florists' Association Bulletin*. January. p.14-16.
- 11) Anon. 1995. Controlled atmosphere to manage whitefly. *The Cut Flower Quarterly*. July. p. 14-16.
- 12) Tripp, Kim and Mary Peet. 1993. New use for CO₂: Slowing whiteflies. *American Vegetable Grower*. November. p. 43-44

Web Sites

<http://www.ifas.ufl.edu/~ent2/wfly/index.html>
 USDA's Whitefly Knowledgebase

<http://www.imok.ufl.edu/entlab/projects/whitefly.htm>
 Information on silverleaf whitefly from the University of Florida

<http://pwa.ars.usda.gov/wcrl//wwghome.html>
 Whitefly Working Group's site on whitefly research at the University of Arizona

Suppliers

A-1 Unique Insect Control
 5504 Sperry Dr.
 Citrus Heights, CA 95621
 916-961-7945
 916-967-7082 fax
 Email: ladybugs@a-1unique.com
<http://www.a-1unique.com>

ARBICO Inc.
 PO Box 4247 CRB
 Tucson, AZ 85738
 800-SOS-BUGS
 520-825-2038 fax
 Email: arbico@aol.com
<http://www.arbico.com>

Beneficial Insectary
 14751 Oak Run Rd.
 Oak Run, CA 96069
 800-477-3715
 530-472-3523 fax
 Email: bi@insectary.com
<http://www.insectary.com>

BioLogic Co.
 PO Box 177
 Willow Hill, PA 17271
 Email: pyealber@epix.net
 717-349-2789/292

Caltex Agri-Marketing Services
 PO Box 576155
 Modesto, CA 95357
 209-575-1295
 209-575-0366 fax
<http://www.caltexag.com>

Florikan ESA Corp.
 1523 Edger Place
 Sarasota, FL 34240
 800-322-8666
 941-377-3633 fax
 Email: buglady@aol.com

The Green Spot, Ltd.
 93 Priest Rd.
 Nottingham, NH 03290-6204
 603-942-8925
 603-942-8932
 603-942-5027 voice mail
 Email: GrnSpt@internetMCI.com

Harmony Farm Supply
 3244 Hwy. 116 No. F
 Sebastopol, CA 95472
 707-823-9125
 707-823-1734 fax
 Email: kate@harmonyfarm.com
<http://www.harmonyfarm.com>

Hot Pepper Wax, Inc.
305 Third St.
Greenville, PA 16125
888-667-3785
724-646-2302 fax
Email: lindag@hotpepperwax.com
<http://www.hotpepperwax.com>

Hydro-Gardens, Inc.
PO Box 25845
Colorado Springs, CO 80932
719-495-2266
719-531-0506 fax
<http://www.hydro-gardens.com>

International Technology Services Inc.
PO Box 19227
Boulder, CO 80308-2227
303-473-9141
303-473-9143 fax
Email: intertechserv@worldnet.att.net

IPM Laboratories
PO Box 300
Locke, NY 13092-0099
315-497-2063
315-497-3129 Fax
<http://www.ipmlabs.com>

M&R Durango, Inc.
PO Box 886
Bayfield, CO 81122
970-259-3521
970-259-3857 fax
<http://www.goodbug.co>

Mycogen Crop Protection
5501 Oberlin Dr.
San Diego, CA 92121
800-745-7476
619-453-9089 fax
Email: soares@mycogen.com

Mycotech Corp.
PO Box 4109
Butte, MT 59702-4109
800-383-4310
406-782-9912 fax
Email: mycotech@montana.com

Natural Pest Controls
8864 Little Creek Dr.
Orangeville, CA 95662
916-726-0855
916-726-0855 fax
Email: natpestc@cwnet.com
<http://www.natural-pest-control.com>

Nature's Control
PO Box 35
Medford, OR 97501
800-698-6250
541-899-9121 fax
Email: bugsn@teleport.com

Novartis Crop Protection, Inc.
PO Box 18300
Greensboro, NC 27419-8300
800-395-8873
<http://www.cp.us.novartis.com>

Olympic Horticultural Products
PO Box 1885
Bradenton, FL 34206-1885
800-659-6745
<http://www.hortnet.com/olympic/>

Plant Health Care
440 William Pitt Way
Pittsburg, PA 15238
800-421-9051
<http://www.planthealthcare.com/>

Praxis
2723 116th Ave.
Allegan, MI 49010
616-673-2793
616-673-2793 fax
Email: praxis-ibc@datawise.net
<http://www.praxis-ibc.com>

Rincon-Vitova Insectaries, Inc.
PO Box 1555
Ventura, CA 93002
800-248-2847
805-643-6267 fax
Email: bugnet@west.net
<http://www.rinconvitova.com>

SePro Corp.
11550 N. Meridian St., Suite 180
Carmel, IN 46032-4562
800-419-7779
<http://www.sepro.com>

Soil Technologies Corp.
2103 185th St.
Fairfield, IA 52556
800-221-7645
515-472-6189 fax
Email: soiltech@lisco.com
<http://www.lisco.com/soiltech>

Stoller Enterprises, Inc.
8582 Katy Freeway, Suite 200
Houston, TX 77024
800-539-5283
713-461-4467 fax

Thermo Trilogy Corp.
9145 Guilford Rd., Ste. 175
Columbia, MD 21046
800-847-5620
301-604-7015 fax
<http://www.thermotrilogy.com>

Wellmark International
1000 Tower Lane, Suite 245
Bensonville, IL 60106
800-248-7763

Uniroyal Chemicals
Benson Rd.
Middlebury, CT 06749
203-573-2400
<http://www.uniroyalchemical.com>

Whitmire Micro-Gen
3568 Tree Court Ind. Blvd.
St. Louis, MO 63122
800-777-8570

**Insect drawings courtesy of
Hercules Powder Company;
Wilmington, DE- *Handbook of the
Insect World 60p.***

**By Lane Greer
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The electronic version of **Greenhouse IPM:
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[http://www.attra.org/attra-pub/gh-
whitefly.html](http://www.attra.org/attra-pub/gh-whitefly.html)

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Appendix I: Beneficial Organisms

Organism	Supplier	Pests Controlled	Application/Comments
<i>Chrysopa carnea</i> weeks (predator)	Natural Pest Controls, Beneficial Insectary, Caltec, Arbico, A-1 Unique Insect Control, Praxis, Rincon-Vitova, Hydro-Gardens	aphids, caterpillars, mealybugs, scales, spider mites, thrips, whiteflies	1 lacewing/5-30 aphids; 1000 eggs/200 sq. ft. Apply every 1-3 as needed. May arrive as eggs, immatures, or adults.
<i>Chrysoperla rufilabris</i> (predator)	Arbico, Beneficial Insectary, IPM Labs., A-1 Unique Insect Control, Nature's Control, Praxis, Rincon-Vitova	see above	
<i>Chrysoperla</i> spp. (predator)	M&R Durango, Florikan, Green Spot	see above	
<i>Coleomegilla imaculata</i> (pink ladybird beetle)	Arbico	aphids, caterpillars, mites, scales, thrips, whiteflies	1/sq. ft.; shipped as larvae and eggs.
<i>Deraeocoris brevis</i> (predator)	Green Spot	aphids, whiteflies , thrips	
<i>Delphastus pusillus</i> (predatory beetle)	Arbico, IPM Labora- tories, Nature's Control, Harmony Farm Supply, Hydro-Gardens, Rincon-Vitova, Praxis, Green Spot	greenhouse whitefly , sweetpotato whitefly	2000/3000 sq. ft.; temperature should be 60-85°F. Will feed on spider mites if no whiteflies are available. Should be used along with <i>Encarsia formosa</i> and traps.

Organism	Supplier	Pests Controlled	Application/Comments
<i>Encarsia formosa</i> (parasitic wasp)	Arbico, Nature's Control, IPM Laboratories, Intl. Technology Services, Florikan, Harmony Farm Supply, Hydro-Gardens, Natural Pest Controls, A-1 Unique Insect Control, Praxis, Rincon-Vitova, Green Spot	greenhouse whitefly, sweetpotato whitefly, silverleaf whitefly	Release 1/sq. ft. weekly for 3 weeks when pest numbers are low. Release 2-4/sq. ft. when pest numbers are high. Apply when pests are first observed. Should be used in conjunction with traps. May be used along with other beneficials. <i>E. formosa</i> is very susceptible to chemicals. Temps. should be at least 64°F. Re-apply every two weeks.
<i>Encarsia luteola</i> or <i>E. deserti</i>	Hydro-Gardens	whiteflies	
<i>Eretmocerus californicus</i> or <i>E. eremicus</i> (parasitic wasp)	Beneficial Insectary, Hydro-Gardens, IPM Labs., Arbico, Praxis, Green Spot	greenhouse whitefly, silverleaf whitefly, sweetpotato whitefly	Capable of handling hot, dry temperatures. Introduce when whiteflies are first observed. May be used in combination with other beneficials such as green lacewings. <i>Eretmocerus</i> is more tolerant of pesticides than <i>Encarsia formosa</i> .
<i>Harmonia axyridis</i> (Asian lady beetle)	Green Spot	scale, whiteflies, mealybugs, aphids	Temps. should be 70-85°F; humidity around 70%.
<i>Hippodamia convergens</i> (lady beetle) (predator)	A-1 Unique Insect Control, Arbico, Caltec, IPM Laboratories, Natural Pest Controls, Harmony Farm Supply, Green Spot, Nature's Control, Hydro-Gardens, Praxis	aphids, mites, whiteflies	Release at dusk near an immediate food source. Spray plants with water prior to release.

Appendix II: Biorational Pesticides

Azadirachtin – extract of neem seed; IGR that works through contact or ingestion

<u>Brand Name</u>	<u>Supplier</u>	<u>Pests Controlled</u>	<u>REI</u>	<u>Application/Comments</u>
Azatin	Green Spot	aphids, caterpillars, fungus gnats, leafhoppers, leafminers, Western flower thrips, whiteflies , psyllids	4 hours	Apply when pests first appear.
Neemazad	Thermo Trilogy	aphids, caterpillars, thrips, greenhouse whitefly , leafminers, sweetpotato whitefly , psyllids, leafhoppers	12 hours	Cannot be applied through irrigation. Low rate can be used as a preventative.

Beauveria bassiana – fungus that works through contact; exposure to non-target insects should be avoided

<u>Brand Name</u>	<u>Supplier</u>	<u>Pests Controlled</u>	<u>REI</u>	<u>Application/Comments</u>
Naturalis-O	SePro	aphids, caterpillars, mites, psyllids, thrips, whiteflies	4 hours	Apply when insects first appear and repeat every 7-10 days. Need good spray coverage. Not compatible with other fungicides.
BotaniGard	Mycotech	giant whitefly , green peach aphid, black vine weevil, other aphids and whiteflies , thrips, leafhoppers, psyllids, white grubs	12 hours	See above.

Garlic extracts

<u>Brand Name</u>	<u>Supplier</u>	<u>Pests Controlled</u>	<u>REI</u>	<u>Application/Comments</u>
Garlic Gard	Soil Technologies	repels many insects		Use late in the day. Can be mixed with fish oil or horticultural oil.

Garlic Barrier	Green Spot	repels many insects	4 hours	Do not use in combination with pollinating bees.
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Horticultural oil – includes dormant and summer superior oils

<u>Brand Name</u>	<u>Supplier</u>	<u>Pests Controlled</u>	<u>REI</u>	<u>Application/Comments</u>
All Seasons	Green Spot	aphids, mealybugs, scales, thrips, whiteflies , spider mites	4 hours	Use on sunny days to promote rapid drying and decrease chance of phytotoxicity. Not compatible with beneficials.

Hot pepper wax – contains capsaicin, paraffin, and mineral oil

<u>Brand Name</u>	<u>Supplier</u>	<u>Pests Controlled</u>	<u>REI</u>	<u>Application/Comments</u>
Hot Pepper Wax	Green Spot	aphids, loopers, beet armyworms, mites, whiteflies , thrips, mealybugs, etc.	4 hours	Also contains herbal essential oils. Not compatible with beneficials.
Hot Pepper Wax	Hot Pepper Wax, Inc.	see above		

Insecticidal soap – contains potassium salts of fatty acids

<u>Brand Name</u>	<u>Supplier</u>	<u>Pests Controlled</u>	<u>REI</u>	<u>Application/Comments</u>
M-Pede	Mycogen	aphids, mealybugs, scales, thrips, whiteflies , spider mites	12 hours	Phytoxicity is often a concern, esp. after repeated applications.
Safer	Green Spot	see above	4 hours	See above.
Insecticidal soap	Olympic	see above		

Neem oil – multi-purpose organic insecticide/fungicide/miticide; kills eggs, larval and adult stages of insects

<u>Brand Name</u>	<u>Supplier</u>	<u>Pests Controlled</u>	<u>REI</u>	<u>Application/Comments</u>
Trilogy 90EC	Thermo Trilogy	greenhouse whitefly, silver-leaf whitefly, sweetpotato whitefly , thrips, whiteflies, leafminers, aphids, mites, psyllids, San Jose scale, scale, spider mites, downy mildew, powdery mildew, <i>Alternaria</i> , <i>Botrytis</i> , etc.	4 hours	Apply at first signs of damage. Repeat every 7-10 days as needed.
Triact 90EC	Thermo Trilogy	see above	4 hours	For ornamental crops only.

Paecilomyces fumosoroseus – fungus

<u>Brand Name</u>	<u>Supplier</u>	<u>Pests Controlled</u>	<u>REI</u>	<u>Application/Comments</u>
PFR-97	Olympic	whiteflies , aphids, spider mites, Western flower thrips	4 hours	

Soybean oil

<u>Brand Name</u>	<u>Supplier</u>	<u>Pests Controlled</u>	<u>REI</u>	<u>Application/Comments</u>
Golden Natur'l Spray Oil	Stoller	aphids, fungus gnats, lace bugs, leafminers, scales, mealybugs, spider mites, whiteflies	12 hours	