

**WHITEFLY (*BEMISIA TABACI*) MANAGEMENT PROGRAM FOR ORNAMENTAL PLANTS
LANDSCAPE-Active-Ingredients
(<http://mrec.ifas.ufl.edu/Iso/bemisia/DOCUMENTS/LANDSCAPE-Active-Ingredients.pdf>)**

This document presents a program to manage *Bemisia tabaci* whiteflies on ornamental plants. This program does not require a pesticide application when the first whitefly adult is detected. However, it does outline steps to manage and maintain whitefly populations throughout the initial propagation and active growth stages at levels to minimize the whitefly numbers on the final plant material being shipped. This will minimize development of resistance irrespective of whitefly biotype while helping to achieve top quality plant materials. Growers should apply pesticides when scouting reports identify population densities at levels where experience and/or extension personnel dictate action be taken. These densities would depend on many factors including the crop, source(s) of infestation, and environmental conditions.

Start with the Line 1 in the “Key to Tables for Suggested Whitefly Applications”, and then work your way through the key to the growth stage of your crop. Then refer to the tables (A – F) for suggested products, which are listed with recommended ‘yes’ or ‘no’ in the tables for each biotype based on current research. As you are developing your own personalized management plan, test products for crop safety on a small set of plants and check label restrictions for number of total applications per crop. It is highly recommended that any whiteflies in your facility be tested periodically for biotype because more management tools are available for B-biotype than Q-biotype whiteflies. The contact information for the laboratory authorized to biotype whiteflies is presented following the program. Testing biotype is especially important if a product does not adequately control whiteflies. Select products based on the biotype of any whiteflies that are present.

- b. Plants are two weeks from shipment or first cutting harvest Table E
- c. Plants or cuttings are 2 – 3 days from shipment..... Table F

Key to Tables for Suggested Whitefly Applications

1. Plants are *Bemisia tabaci* hosts
 - a. Yes 2
 - b. No Table E
2. Plants are cuttings in propagation being rooted
 - a. Yes 3
 - b. No 4
3. Rooting level during propagation
 - a. Mist on, cuttings are newly stuck and not anchored Table A
 - b. Mist off, cuttings are anchored in the soil and able to withstand spray applications..... Table B
4. Plants are rooted cuttings and ready for shipment
 - a. Yes Table F
 - b. No 5
5. Plant development after transplanting
 - a. Root system is not well developed Table C
 - b. Roots are well developed and penetrating the soil to the sides and bottom of the pots 6
6. Plants are actively growing finished plants or stock
 - a. Plants are more than two weeks from shipment or first cutting harvest Table D

Whitefly Resistance Management

The greater the number of whiteflies present when a pesticide application is made the greater the chance that at least one individual might possess the ability to survive the treatment. In addition, the more frequently a given pesticide or mode of action is used, the greater the potential for developing a problem. Similarly, the longer the residual activity the greater the selection pressure on a resident whitefly population. Therefore, fewer applications of products with similar modes of action the smaller the potential for resistance development.

Application timing should be based on residual activity of the pesticide instead of an established five to seven day schedule. Many of the new insecticides have residual activity of greater than one week; check the product labels for specific reapplication intervals. However, it is highly recommended that no more than 2-3 applications be made during the entire growing season of compounds belonging to any single IRAC-Mode of Action Group and especially those in Group 4 (see tables). Talus and Distance should not be used more than twice during a crop cycle. Growers should utilize non-selective products such as soaps, oils and biological controls when possible.

If the insecticide is properly applied and is not providing control, change to another material with a different mode of action because whitefly populations have the propensity to develop resistance. **Scouting** every week is critical to success by catching populations early and evaluating insecticide performance during production.

Table A. Cuttings are Not Anchored in Soil

Suggested Products	IRAC Class	B-Biotype	Q-Biotype
Foggers and aerosol generators	Many	Yes	Yes

Table B. Cuttings Able to Withstand Sprays

Suggested Products	IRAC Class	B-Biotype	Q-Biotype
Foggers	Many	Yes	Yes
Avid (abamectin) + pyrethroid or acephate	6 + 3 or 1	Yes	Yes

<i>Beauveria bassiana</i>	n/a	Yes	Yes
PFR-97	n/a	Yes	Yes

Table C. Root System is Not Well Developed

Suggested Products	IRAC Class	B-Biotype	Q-Biotype
Avid (abamectin)	6	Yes	Yes
Distance (pyriproxyfen)	7C	Yes	No
Endeavor (pymetrozine)	9B *	Yes	No
Enstar II (kinoprene)	7A	Yes	No
Sanmite (pyridaben)	21	Yes	Yes
Talus (buprofezin)	16	Yes	No
Tank Mixes:			
Avid + Talstar	6 + 3	Yes	Yes
Pyrethroids + acephate	3 + 1	Yes	No
Pyrethroids + azadirachtin	3 + 18	Yes	No

Table D. Plants are Actively Growing (for sale or for cutting stock plants; table in next column)

Select products based on the biotype of any whiteflies that are present. Rotating products during this production stage is essential. Where plants are tolerant, tank mix with horticultural oil to help minimize resistance development. Not all poinsettia cultivars are tolerant to Judo or Kontos during bract color development; it is recommended to apply these prior to bract formation and test on a small number of plants prior to spraying entire crop.

Table D. Plants are Actively Growing

Suggested Products for Foliar Applications on Actively Growing Plants	IRAC Class	B-Biotype	Q-Biotype
Avid + Pyrethroid	6 + 3	Yes	Yes
<i>Beauveria bassiana</i>	n/a	Yes	Yes
Distance (pyriproxyfen)	7C	Yes	No
Enstar II (kinoprene)	7A	Yes	No
Horticultural Oil	n/a	Yes	Yes
Insecticidal Soap	n/a	Yes	Yes

Judo (spiromesifen)	23	Yes	Yes
Kontos (spirotetramat)	23	Yes	Yes
M-Pede	n/a	Yes	Yes
Mainspring (cyantraniliprole)	28	Yes	Yes
Orthene + pyrethroid	1 + 3	Yes	No
PFR-97	n/a	Yes	Yes
Rycar (pyrifluquinazon)	Unknown	Yes	No
Sanmite (pyridaben)	21	Yes	Yes
Talus (buprofezin)	16	Yes	No

Table E. Plants are Two Weeks from Shipment or First Cutting Harvest (table on next page)

Control of whiteflies is often challenging during this stage due to the difficulty of achieving adequate under leaf spray coverage, a lack of labeled products from multiple IRAC Classes, and concerns about phytotoxicity or residue on final product.

Apply a drench or foliar application 14 days prior to shipment of finished plants or the initial harvest of cuttings from stock plants. If adequate spray coverage cannot be achieved, plants should be drenched. **To reduce resistance development**, do not use products listed in Table E that were applied prior to this growing stage. If multiple cutting harvests are taken from stock plants, rotate a neonicotinoid drench application (IRAC Group 4) with foliar applications of Judo and Sanmite, including other products as needed from Table D in different IRAC Classes.

Follow all label guidelines for use rates, reapplication intervals, and resistance management strategies.

Table E. Plants are Two Weeks from Shipment or First Cutting Harvest

Suggested Products for Plants or Stock Plants	IRAC Class	B-Biotype	Q-Biotype
Soil Drench or Foliar Applications:			
Flagship (thiamethoxam)	4	Yes	Yes
Marathon (imidacloprid)	4	Yes	No
Safari (dinotefuran)	4	Yes	Yes

Foliar Applications:			
Mainspring	28	Yes	Yes
PFR-97	n/a	Yes	Yes
Rycar	unk	Yes	No
Sanmite (pyridaben)	21	Yes	Yes
TriStar (acetamiprid)	4	Yes	Yes
XXpire	4C + 5	Yes	?

Table F. Plants or Harvested Cuttings are 2 – 3 Days before Shipping

Make foliar applications 2 - 3 days before shipping finished plants or rooted cuttings or before each cutting harvest when shipping unrooted cuttings. **To reduce resistance development**: avoid applications of modes of action used in the previous growth stage (Table E for finished plants or stock, and Table B for rooted cuttings).

Suggested Products for Harvested Cuttings	IRAC Class	B-Biotype	Q-Biotype
Avid (abamectin)	6	Yes	Yes
Flagship (thiamethoxam)	4	Yes	Yes
Judo (spiromesifen) – targeting nymphs at this plant stage for unrooted cuttings or cultivars tested for crop safety	23	Yes	Yes
Mainspring	28	Yes	Yes
PFR-97	n/a	Yes	Yes
Safari (dinotefuran)	4	Yes	Yes
Sanmite (pyridaben)	21	Yes	Yes

TriStar (acetamiprid) – targeting adults at this plant stage	4	Yes	Yes
XXpire	4C + 5	Yes	?

IRAC Class 9B exhibits cross resistance with IRAC Class 4

Laboratory Authorized to Determine Whitefly Biotype

There are a number of specifics concerning how one collects a sample and preserves it for evaluation. For this information and scheduling shipments, you MUST contact:

Cindy McKenzie, Ph.D.
 Research Entomologist
 USDA, ARS, US Horticultural Research Laboratory
 2001 South Rock Road
 Fort Pierce, FL 34945
 Phone: 772-462-5917
 Email: cindy.mckenzie@ars.usda.gov

For questions, concerns, or comments please contact:

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Contributors in alphabetical order:

Table G-1. Insecticide efficacy for *Bemisia tabaci* Q and B biotypes on Poinsettia.

Experiment	Bethke 2005a	Bethke 2005b	Gilrein 2005	Oetting 2005a	Oetting 2005b*	Gilrein 2006a	Gilrein 2006b*	Oetting 2006b	Oetting 2007e	Oetting 2008e	Gilrein 2009a	Gilrein 2009b*
Initial Population Level of Untreated per leaf	n/a	n/a	2.1 to 2.4	2.3 to 6.5	2.6 to 7.0	15.2 to 22.3	57.4 to 75.2	2.7 to 8.3	6.4 to 37.2	3.1 to 5.1	31.2 to 43.2	65.0 to 88.1
DAT of assessment	21 DAT	24 DAT	21 DAT	21 DAT	21 DAT	17 DAT	20 DAT	22 DAT	21/28 DAT	22 DAT	21 DAT	20 DAT
Population Assessed	Adults		Immatures									
Population Counts per Leaf on Untreated	n/a	n/a	16.8	23.1	9.1	35.4	59.2	13.8	38.2	10.1	178.2	523.4
Aria 50SG				-					- (++ 35 DAT)	-		
Avid 0.15EC		+					+			+		++
Distance 0.86EC		++	-	+								
DuraGuard		-										
Flagship 25WG (Meridian 25WG)	-		-		+		+/-		- (+ 35 DAT)	+		
Judo 4F (Forbid 4F)		++	+	++		+			- (++ 35 DAT)	++		
Kontos									- (++ 35 DAT)	+	++	++
Marathon II 2F (Imidacloprid)	-		-	+					- (++ 35 DAT)	+	+/-	
Ornazin						-						
Orthene + Tame					+		+/-					
Pedestal								-				
Safari 20SG	++		+	++		+	- (++ 45 DAT)	++	++	+	++	++
Sanmite		+								+		++
Talstar		-										
Talus		-										
Tame		-										
TriStar 30WSP	++							++				++
TriStar 70WSP					++				- (++ 35 DAT)	++	++	

This table is extracted from the IR-4 Whitefly Summary 2009 found at <http://ir4.rutgers.edu/Ornamental/ornamentalSummaryReports.cfm>. To review the entire table or individual experiments, download the full summary.

¹ Rating Scale: ++ = clearly statistically better than untreated and greater than 95% control; + = statistically better than untreated and between 85 and 95% control; +/- statistically better than untreated with control between 70 and 85%; - = statistically equivalent to untreated and/or efficacy less than 70%.

² Where more than one rate or application type for a product was included in the experiment and each performed statistically different, the better rating is provided in this table.

Note: Mention of a commercial or proprietary product or chemical does not constitute a recommendation or warranty of the product by the authors. Products should be used according to label instructions, and safety equipment required on the label and by federal or state law should be employed. Users should avoid the use of chemicals under conditions that could lead to ground water contamination. Pesticide registrations may change so **it is the responsibility of the user to ascertain if a pesticide is registered by the appropriate local, state and federal agencies for an intended use.** Trademarks and registered trademarks for mentioned products or chemicals belong to their respective owners.

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