Insecticide rotation and management for whitefly on poinsettia

Juang Horng "JC" Chong
Clemson University
Department of Plant and Environmental Sciences
Pee Dee Research and Education Center, Florence, SC
E-mail: juanghc@clemson.edu

Remember what the voice says to Kevin Costner in "Field of Dreams?" "If you build it, he will come." You could rephrase that as "if you grow poinsettias, the whiteflies will come." Poinsettia has relatively few insect and mite pests, but whitefly alone will consume all the attention and (sometimes) the entire budget for pest management during poinsettia season.

I'm not going to talk about general management against whitefly in this newsletter. You can find one of my articles on whitefly management in *GrowerTalk's* 2019-2020 Insecticide, Miticide, & Fungicide Guide (https://www.growertalks.com/pdf/2019_2020_insecticide-fungicide_Guide.pdf), where I discuss in general terms whitefly management approaches during sticking, growing and close to shipping. Lance Osborne of the University of Florida posts a handy whitefly management guide on his website (https://mrec.ifas.ufl.edu/lso/bemisia/WhiteflyManagementProgram_January%2011,%202017.pdf), from which I draw much of my information.

I'm going to focus on whitefly management on poinsettias using an insecticide rotation program. Before I do my nozzle-head dive, however, I want to remind you of the fact that biological control can be successful in managing whitefly on poinsettia. In fact, I would consider biological control of whitefly in poinsettia production the classic success story in greenhouse pest management. In this newsletter, Rose Buitenhuis talks about pre-planting dip with oil, soap and *Beauveria bassiana*, and the success of using that method in reducing the initial population of whiteflies on your poinsettia cuttings. Have a clean start, followed by regular, preventive releases of *Eretmocerus* parasitoids or predatory mites can help keep the whitefly population low or undetectable for the entire growing season.

When managing whiteflies with insecticides, you must rotate among insecticides of different modes of action (MOA). Again, you *MUST* rotate. The emergence of Q-biotype sweetpotato whitefly has taught us the consequences of not rotating insecticides or relying on only a handful of chemistries. The Q-biotype whitefly, or more properly known as *Bemisia tabaci* Mediterranean (MED), is highly resistant to insect growth regulators (buprofezin and pyriproxyfen; IGR) and neonicotinoids. If you suspect a Q-biotype infestation (particularly after repeated failure with neonicotinoids and IGRs), you should contact Dr. Cindy McKenzie of USDA-ARS in Fort Pierce, Florida (cindy.mckenzie@ars.usda.gov), about sending in samples for biotype confirmation. You have to rotate among MOAs (excluding IRAC Group 4, 7 and 16; also avoid Group 9 because of potential cross-resistance with Group 4) when managing a Q-biotype whitefly population.

The B-biotype sweetpotato whitefly (a.k.a. the silverleaf whitefly), or more properly known as *Bemisia tabaci* Middle East – Asian Minor 1 (MEAM1), is by far the most common biotype. Our discussion today will focus on this biotype.

A large number of insecticides of different MOAs (or IRAC numbers) are registered for whitefly management on ornamental crops in greenhouses, nurseries, landscapes and interiorscapes (Table 1). The same principles in developing insecticide rotation program for thrips (https://gallery.mailchimp.com/ca5e65b556621df76e0f77da5/files/07105cb2-4c7b-4d0b-93bc-946701de1c15/Develop_an_Insecticide_Rotation_Program_for_thrips.pdf) also apply to whitefly. Briefly:

1. Select products of 4 different MOAs.
2. Whiteflies complete a generation in about two weeks under normal greenhouse conditions. If you spray weekly, you can spray the same product twice before switching to another MOA. If you spray every other week, then you need to rotate to a new MOA at every spray.
3. Number 2 above also applies to systemic insecticides applied as drench or granule. If you apply systemic insecticides to the medium, you have to use a MOA different from that of the systemic insecticides in your foliar spray program.
4. Avoid tank mixing unless you have to manage another insect, mite or disease. If that's the case, choose a MOA that is different from the one you use for whitefly.

Every operation has to develop its own rotation program based on what's grown, other pest issues, the predominant life stage of the whitefly population, and other constrains. For poinsettia production, one of the most critical considerations is the growth stage of the poinsettias.

Producing a great poinsettia crop starts at the rooting stations. Propagators have a unique responsibility of avoiding resistance development in their operations because resistant populations "cultured" at the rooting stations can be passed on to their clients through infested cuttings. This is easier said than done. Growers demand pest-free cuttings. As a result, propagators have to rely heavily on insecticides to keep the stock plants whitefly-free and meet this "zero tolerance." As we have witnessed in the past few years, such insecticide-heavy approach of producing cuttings has not been particularly successful. The result is a not-so-pest-free product and a process that promotes pesticide resistance and difficulty in establishing biological control program (due to pesticide residue).

I don't think the "zero tolerance" approach in poinsettia cutting production is sustainable. Perhaps it is time for us to consider an alternative: poinsettia cuttings that have a very low number of non-resistant whiteflies that can be controlled with toys in our current toolbox. The "new paradigm" cuttings can be produced with a combination of chemical and biological pest control tools. Whitefly population on the stock plants can be maintained at a low level with frequent releases of parasitoids (*Eretmocerus* spp.) and predators (such as

Amblyseius swirskii with supplemental food), as well as applications of entomopathogenic fungi such as *Beaveria bassiana* and *Isaria fumosorosea*.

Only when the cuttings are to be harvested that the whitefly population on the stock plants is knocked down with insecticides. We can reduce the exposure of whiteflies to insecticides (and thus the risk of resistance development) by limiting insecticide applications to the end of the crop cycle. The selection of insecticides at this stage depends on the time to harvest. If harvest is within 2 or 3 weeks, a medium drench with neonicotinoids (IRAC Group 4A), Altus (4D) or Mainspring (28) has enough time to spread through the canopy and bring down the whitefly numbers. If you prefer not to do medium drench, you can also make rotating foliar applications with neonicotinoids (4A), Altus (4D), Avid (6), Sanmite (21A), Kontos (23), Savate (23) and Mainspring (28). Whitefly population that persists until a few days before harvest can be reduced with one application of Avid + pyrethroid (6 + 3A), Safari (4A), Sanmite (21A) or horticultural oil (unclassified).

Most growers receive rooted or unrooted cuttings. The unrooted cuttings should be treated with a pre-plant dip before sticking as described by Rose Buitenhuis in this newsletter. Biological control agents should be released soon after sticking. If your operation does not practice biological control, whitefly population on these unrooted cuttings (when detected) could be suppressed with insecticides applied through aerosols (see Table 1 for products with TR, or total release, formulations) or low volume spraying. Entomopathogenic fungi and bacteria, such as Botanigard, Ancora and Grandevo (UNB and UNF), are particularly suitable at this stage because of the generally high humidity maintained during the rooting stage.

Regardless of whether you start the crop with rooted or unrooted cuttings, there is no sense in drenching the plants with systemic insecticides before the root system is well developed. In addition to the entomopathogenic fungi and bacteria used in the rooting stage, products can also be selected from insect growth regulators (Enstar, 7A; Distance, 7C; and Talus, 16) or IRAC Group 9 (such as Endeavor, Rycar and Ventigra). Usually this stage is so short that a full-scale rotation program is not possible, but every effort should be made to ensure that each application uses a different MOA.

Once the plants are actively growing, the options for an insecticide rotation program widen significantly. The insecticides listed in Table 1 can be considered. I think that a preventive drench of poinsettias with one of neonicotinoids (4A), Altus (4D), Kontos (23) or Mainspring (28) should be considered since infestation by whiteflies is almost a given. A preventive treatment can result in a lower whitefly population, which makes biological control program or foliar sprays with other insecticides more effective. When you develop an insecticide rotation program for the finishing stage, you should keep four considerations constantly at the back of your mind.

1. Are the insecticides I choose compatible with biological control?
2. Am I selecting insecticides that are the most efficacious against the predominant life stage in the whitefly population?
3. Am I dealing with a Q-biotype population?
4. Are the insecticides I choose "bract safe" or leave no residue?

The topic of compatibility with biological control agents deserves its own six-volume thesis. It's impossible for me to cover this topic comprehensively in this newsletter, so I will only suggest that you consult with your biological control agent suppliers on what to use. Keep in mind that when deciding which insecticides to use, you'll also have to consider what other pests are in the same greenhouse and if biological control program is used against them. Every player needs to be considered. This exercise will be more cerebral than the daily task of growing beautiful plants. So, have a big ole mug of coffee ready.

You have to scout for and know thy enemies. Scouting will tell you the predominant life stage of your whitefly population. The predominant life stage plays a prominent role in my philosophy of developing a rotation plan—you use the most effective product to knock down your predominant life stage, followed by another product to mop up the remnants or the subsequent life stage. If you have a population made up of mainly adults, you can start with Orthene (1B), pyrethroids (3A), Avid, a Group 9 insecticide (Endeavor, Rycar and Ventigra), insecticidal soap or horticultural oil to knock down the adult population, followed by an insect growth regulator, entomopathogenic fungus, Group 9 insecticide, Savate or Kontos to reduce the nymph population in the next application. If you have more nymphs than adults, you will start the rotation program with a product that is more suitable against nymphs. If you have a population with all life stages, the rotation program may start with systemic insecticides (neonicotinoids, Altus, Mainspring and Kontos), Savate, Sanmite, oil or soap.

You should not include neonicotinoids, Altus, Enstar, Distance and Talus in your rotation program if you have a confirmed population of Q-biotype whitefly. Data suggested that Safari, Flagship and Altus are effective against Q-biotype, so you may use these products when you are in a tight spot or when alternative option is not available. My justification for not including them in a rotation program against Q-biotype is that Safari, Flagship and Altus are in the same mode of action as Marathon and TriStar, to which the Q-biotype are resistant. Continue to use these insecticides may perpetuate the resistance, especially on stock plants. There are many other insecticides you can use in a rotation program without considering Groups 4, 7 and 16.

Lastly, not every insecticide is bract safe. Residue will be a concern if you spray in the last week or two before shipping. The bract safety information in Table 1 is drawn largely from product labels and Dan Gilrein's (Cornell Cooperative Extension) work. Note that the information does not cover all poinsettia varieties. Phytotoxicity is the result of a complex dance among pesticide, adjuvant, plant species or cultivar and environmental conditions. An insecticide that was shown to cause phytotoxic reaction on the bract of "Prestige Red" in the summer of 2010 may not cause the same reaction on "Christmas Magic" in the fall of 2019. The best thing to do, for all growers of poinsettia, is to test every pesticide (that would also include miticide and fungicide) on a small group of poinsettias. Wait a few days to see if objectionable amount of residue is left on the bracts, or if any discoloration, burn or other phytotoxic symptoms show up. If nothing occurs, cheers from all and broadcast. If phytotoxicity occurs, take note and remember where you leave the note before the next poinsettia season.

Whiteflies are big headaches for poinsettia growers but they don't always have to be. We have multiple effective management tools—cultural, biological and chemical. All it takes to have a successful poinsettia season is some persistence and careful planning with our tools.

Table 1. Insecticides registered for the management of whiteflies in the United States. Check label for uses on poinsettias.

IRAC #	Active ingredient	Trade name[1]	Bract safe?
1A	carbaryl	Sevin, Carbaryl	Test
1B	acephate	Acephate, Orthene	Test
		1300 Orthene TR	Test
	chlorpyrifos	Chlorpyrifos	Test
		DuraGuard ME	Test
1B + 3A	acephate + fenpropathrin	Tame/Orthene TR	No
	chlorpyrifos + cyfluthrin	Duraplex TR	Test
3A	bifenthrin	Talstar, Bifen, etc.	Test
		Attain TR	Test
	cyfluthrin	Decathlon	Test
	lambda-cyhalothrin	Scimitar, etc.	Test
	fenpropathrin	Tame	Test
	tau-fluvalinate	Mavrik Aquaflow	Test
	permethrin	Astro, Permethrin, etc.	Test
	pyrethrins	Lynx, Pyganic, etc.	Test
		Pyrethrum TR	Test
	cyfluthrin + imidacloprid	Discus N/G	Test
3A + UN	pyrethrins + azadirachtin	Azera	Test
3A + UC	pyrethrins + *Beauveria bassiana*	Botanigard MAXX	Test
4A	acetamiprid	TriStar	Test
	dinotefuran	Safari	Test
	imidacloprid	Marathon, etc.	Test
	thiamethoxam	Flagship	Test
4D	flupyradifurone	Altus	Test
6	abamectin	Avid, Lucid, Minx, etc.	Not at 8 fl oz.
6 + 20D	abamectin + bifenazate	Sirocco	Test
7A	s-kinoprene	Enstar AQ	Test
7C	pyriproxyfen	Distance, Fulcrum	Test
9B	pymetrozine	Endeavor	No
	pyrifluquinazon	Rycar	Test
9D	afidopyropen	Ventigra	Up to bract color.
10B	etoxazole	Beethoven TR	Test
16	buprofezin	Talus	Test
21A	fenazaquin	Magus	Test

	fenpyroximate	Akari	Test
	pyridaben	Sanmite	Test
	tolfenpyrad	Hachi-Hachi	No
23	spiromesifen	Savate	Not for some cultivars; test.
	spirotetramat	Kontos	Test
28	cyantraniliprole	Mainspring GNL	Test
29	flonicamid	Aria	Test
32	GS-omega/kappa HXTX-Hv1A peptide	Spear O	Test
UN	azadirachtin	Azatin, Ornazin, etc.	Not for some cultivars; test.
UNB	heat-killed *Burkholderia* spp.	Venerate	Test
	Chromabacterium subtsugae	Grandevo	Test
UNE	neem oil	Trilogy, Triact, etc.	Test
UNF	*Beauveria bassiana*	Botanigard, Naturalis, etc.	Test for EC formulation.
	Isaria formosorosea	Ancora, NoFly	Test
	Metarhizium anisopliae	Met-52, Tick-Ex	Test
Unclassified	potassium salt of fatty acids (insecticidal soap)	M-Pede, Kopa, etc.	No
	mineral, petroleum or paraffinic oil (horticultural oil)	SuffOil-X, Ultra-Pure, Sunspray Ultra-fine, etc.	Test
	capsicum oleoresin extract + oils	Captiva Prime, Prevasyn	Test

[1]Trade names are provided for examples only. The mentioning of trade names does not constitute an endorsement.