Developing A Rotation Program

Considering both the insecticide and pest — instead of using a blanket plan — is the best way to develop a truly effective rotation plan.

By Ron Oetting

At a recent Southeast Greenhouse Conference, I was giving a presentation on the management of a greenhouse pest. At the end of the talk, a gentleman in the audience asked what insecticides to use to manage this pest. I told him a possible rotation of two or three compounds that involved applying one compound three times at a 7-day interval and then rotating to a second compound.

Another participant in the audience spoke up and said a colleague of mine had just stated that you should only use an insecticide once and then change, not three times. A discussion ensued, and I tried to explain how both answers were right depending on what the pest was and what insecticides were involved.

It was obvious that we often speak of using rotations while discussing individual pests and people accept this as the gospel for all pests. We also fail to discuss how rotations can take on a completely different personality depending on the situation. Maybe we should not talk about rotations as they relate to a particular pest but look at individual insecticides and how they would fit into rotations. In this article, I am going to try to look at both the pest and the insecticide as I discuss rotations.

Definitions

First, we need to define some of the terms commonly used in discussions of rotation and resistance management.

Resistance. Resistance to an insecticide is a reduction in the sensitivity of a pest population to that insecticide. This is an inheritable change that results in the failure of an insecticide to control an insect that was controlled by that compound in the past. This is usually a gradual process resulting from continued exposure to a particular insecticide. Once resistance has been established, it is passed to future generations, but the resistance may or may not be reversible when the exposure to that insecticide is stopped. Thus, a goal in resistance management is to reduce repeated exposure.

Resistance management. Resistance management is a strategy to try to prolong the effective life of an insecticide by managing its use and reducing continuous exposure of a pest to one particular chemistry and mode of action (MOA). Pesticides have a section on the label for resistance management. This section usually includes recommendations for rotation (see below) and other instructions aimed at reducing the development of resistance. Limits to the number of applications that can be made on a single crop are also on many labels.

Rotations. Rotations are an important part of the resistance management instructions. A rotation uses different insecticides of different MOA in some sequence so the MOA is changed and there is not constant exposure to a single chemical. Insecticide resistance was found in greenhouse-grown ornamentals in the late 1970s when the Liriomyza leafminer became resistant to the insecticides used to manage them. This was followed by resistance to insecticides in the western flower thrips in the early 1980s.

Mode of action. The MOA is the particular nerve synapse or bodily process that the chemical interferes with, resulting in insect death. Different compounds and MOA will affect different sites. Resistance is usually the ability of the insect to reduce, slow or stop interference at a particular action site. Switching to different sites makes it more difficult for an insect to develop resistance to all of the different action sites at one time. Thus, pesticides must be

When developing an insecticide rotation plan growers need to consider many variables such as mode of action, insecticide resistance and insect type. (Photos: Ron Oetting)


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A successful rotation program is essential for pests such as silverleaf whitefly.

selected from different MOA to be a true rotation.

The Insecticide Resistance Action Committee (IRAC) has developed an excellent list of chemicals classified by their MOA at www.irac-online.org. IRAC has classified each active ingredient into groups based on the primary site of action within the insect and given them a number to make it easy to remember.

Changing Advice

Resistance management has changed as our understanding of chemicals and pests has improved. In the early 1980s when thrips started becoming resistant to common insecticides, we had to change our way of thinking about rotation; we went from a set formula of spray intervals to one based on pest lifespan. We had been recommending a rotation of at least two compounds be used on a 7-day interval. This was later changed to apply one compound three times on a 7-day schedule and then rotate.

The logic was that this time, the 21 days a chemical was used was equal to one generation of development from egg to adult. An insect was exposed, but there would be a rotation to a second compound for the next generation. Rotating with each application would result in every generation being exposed to the same insecticide and ultimately in resistance.

Then the question was, "What could be rotated?" The insecticides in the rotation had to be different, so the first idea was to rotate insecticides of different classes. The problem with this is that there could be cross-resistance where an insect develops resistance to one compound and is automatically resistant to a similar compound. Therefore, it was not just a rotation of individual insecticides but also a rotation of different types of insecticides — it was the class and the MOA that were really important.

Developing A Rotation

So why are rotations now more difficult to develop and understand? There have been numerous new classes of pesticides with different MOA developed in the last decade. In addition, these new chemistries include insect growth regulators (IGR), systemic insecticides and unique compounds with MOA that do not fit the spray-every-seven-days pattern of the first rotations.

To make my point, I will use an example of possible rotations for Bemisia whitefly management on poinsettias. We will assume there is a need to control whiteflies throughout the season to facilitate listing different rotations. The poinsettia plants are stuck in a pot, and one week later you need to spray. Between week one and week three, you decide to use one of the following three choices (MOA is in parentheses after each active ingredient, na refers to active ingredients that attack the insect through the external cuticle):

1) Three repeat applications at 7-day intervals of either an oil (na), soap (na), Aza Direct (23, azadirachtin, Gowan Company) or Avid (23, abamectin, Syngenta Professional Products);

2) Four applications of Naturalis T&O (na, *Beauveria bassiana*, Troy Biosciences) at 4- to 5-day intervals;

3) A single application of Aria (9C, flonicamid, FMC Corporation) or Talus (16 buprofezin, SePRO Corporation).

After week three, you need to treat the plants again and choose from the following three choices to protect the plants for the next six weeks:

1) A drench of a systemic neonicotinoid — Celero (4, clothianadin, Arysta Life Science), Safari (4, dinotefuron, Valent USA Corporation), Marathon (4A, imadacloprid, OHP) or Flagship (4A, thiamethoxam, Syngenta Professional Products) — which should protect the plants for six weeks;

2) A couple of foliar sprays of either Tristar (4A, acetamiprid, Cleary Chemical Corporation), Celero (4A), Aria or Flagship (4A) at 2- to 3-week intervals;

3) Two applications of the IGR Distance (7C, pyriproxyfen, Valent USA Corporation) at a 3- or 4-week interval.

You may want to hold off on the second application until just before color because the label allows only two applications during one crop cycle. The same limit of two applications is true for some other compounds. The period before poinsettias start to show color is important because you must make sure the plants are free of whiteflies. If an application is needed at this time, there are several compounds that can be rotated. If a neonicotinoid (4) was used as a drench, it should not be used again as a spray during the crop cycle. I often suggest using pyrethroids (3), but you should only use one application and then rotate to another MOA.

Once poinsettias have colored bracts, the choice of insecticides is greatly diminished. An old standard was to use sulfotep (1B) smoke before shipping, but this product is no longer available. The only smoke available is nicotine (4B), and it is not widely used. A neonicotinoid (4) spray could be used if not used earlier in the crop cycle, Avid (23) could be used or some pyrethroids (3) if they do not leave a residue.

There are several other compounds that could be used during the production cycle of poinsettias, but I selected examples that demonstrate different schedules and label restrictions. All of these must be considered when selecting different insecticides to fit into a management program for whiteflies.

Conclusion

Selecting a rotation is no longer as simple as it was when we first started rotating insecticides against the leafminer and western flower thrips. There are approximately 28 different active ingredients that can be used against whiteflies on greenhouse crops. These insecticides have different durations between applications that range from almost daily, with smokes, to six weeks or more with drenches of systemic compounds. This can be even more complicated if you use tank mixes. Now we have another strain of whitefly, the 'Q' strain that adds another dimension because it is resistant to some of the insecticides that are used for the common Bemisia whitefly.

It is easy to see that developing rotations for insecticide resistance management can be difficult. We know that resistance can develop with any pest/insecticide combination, and it is our responsibility, as good stewards of the pesticides available today, to do our part to make sure they are effective as long as possible. Growers must be very aware of pesticide label instructions and educate themselves about the different MOA that are available and how to rotate them for a particular pest. GPN

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