The Truth Behind TANK MIXES

Tank mixes were common years ago, but are they worth it now?

By Ron Oetting

Top: While the use of mixes will save time, labor cost and applicator exposure time to pesticides, if the end result is that they loose effectiveness, this could be a temporary saving (Photo courtesy of Jim Barrett); Bottom: Tank mixing took center stage when leafminer became a management problem in the mid 70s. (All other photos courtesy of Jim Bethke)

"Can I use tank mixes?" This is a question I have heard from growers for more than 25 years, and I still do not have an answer that is backed up by facts and figures. Tank mixes were a common practice during my early experience with greenhouse growers, but mixes are not as common today. When I first started working with pest management in greenhouse production, it was common for chrysanthemum growers to use weekly sprays of tank mixes. These tank mixes usually included a pesticide for worms, one for mites and at least one for diseases. It was also common to apply a systemic pesticide, usually aldicarb, as a general preventative against several pests. Integrated pest management was being researched and practiced, especially for field and orchard crops, but not much emphasis had been placed on ornamental crops and research in this area was in its infancy.

When Liriomyza leafminer became a management problem in the mid 70s, there was a change in traditional management strategy. Pesticide resistance became a new topic of concern, and recommendations for pest management took on a new picture. There was a rush to find a management tool for leafminers, and pest biology became an important part of this strategy. Prior to this time, the only concern was pure efficacy of pesticide against the target pest. Researchers across the country diligently searched new and old chemistry for a solution to the problem of leafminer resistance. When a solution was found, it was used extensively to reduce leafminer populations; as a result, resistance was developed against some of these compounds. The prime example was the rapid development of leafminer resistance against permethrin in about 1980.

Resistance management really became an issue when western flower thrips became resistant to available pesticides and spread across the United States and around the world. Thrips were already hard to control in the mid 70s, but there were a few insecticides that were effective. Methomyl was the standby, and acephate was new on the market at that time — both were effective. By the early 80s, western flower thrips and the accompanying tospovirus (tomato spotted wilt virus) had become a dominant concern in

pest management for greenhouse growers. This was a result of western flower thrips' resistance to available insecticides and the lack of any means of controlling the tospovirus vectored by the thrips. A management approach was to develop a rotation of insecticides to control western flower thrips. The theory was that this rotation would slow down the development of resistance when new insecticides were found. At that time, the recommendation of rotating chemicals was the standard, and tank mixes were discouraged in extension recommendations.

What is the role of tank mixes, or the lack thereof, in resistance management today? This is a good question with answers supported by various theories, but the most common theory is that mixing compounds will result in resistance developing faster than if each pesticide is used separately in a rotation. The purpose of this article is to address some of the reasoning behind the use of tank mixes and rotations in pest management.

TANK MIX PROBLEMS

The first major problem with tank mixes is the increased potential for phytotoxicity. I have seen numerous examples of increased phytotoxicity as a result of mixing two or more chemicals together. Two serious examples come to mind. One grower lost his newly rooted poinsettias because of a foliar spray of a tank mix of three chemicals all targeting silverleaf whitefly, and a second situation resulted in complete loss of a poinsettia crop because of the mixing of an insecticide and an off-the-shelf spreader sticker formulated for homeowners. In these situations, all chemicals were sprayed at label rates. None of the selected pesticides were illegal. Data does not exist for all possible mix combinations, let alone for all plants. Growers who use tank mixes must take the responsibility of checking out a tank mix on a few plants to make sure that phytotoxicity will not occur.

Another problem sometimes encountered with tank mixes is the incompatibility of components in the mix. This incompatibility results because the chemistries of the two compounds are not compatible, and they react with each other, often reducing the activity of mix against the target pests. It could also cause the new tank mix to be more phytotoxic to the host plant as discussed above. Often, if the chemicals are incompatible, there is a chemical reaction between the two compounds, which can be seen in the mixed solution. The common test of physical compatibility is to mix the correct proportions of each pesticide component with water in a quart jar and shake the mixture. Observe the mixture to see if they mix together uniformly or if there is separation of layers, precipitation to the bottom of the jar or other abnormal mixing characteristics. The problem of incompatibility is not limited to mixing two or more pesticides but could also be the result of mixing a pesticide with fertilizer or other horticultural chemicals.

RESISTANCE MANAGEMENT PROGRAMS

The most common tank mix is the use of a pesticide with an additive to enhance efficacy of the pesticide. Additives such as buffers are added to adjust the pH, without which the pesticide will break down too fast or not be as active as it should be; surfactants are often used to increase coverage on plants, especially waxy plants; pyrethrin has been used as a flushing agent to irritate a pest and make it move, allowing better contact and control; attractants have been used to attract pests to feed on the pesticide component of the mix; and sugar has been mentioned as an additive for increased thrips activity. Many of these additives are not only enhancing the activity of the primary pesticide, but some of them also have pesticidal activity themselves. The pesticide label often contains guidelines concerning the use of additives in the tank mix.

The big question is whether tank mixes are bad for resistance management programs? Resistance is the result of a pest becoming more tolerant of a pesticide, which was once effective against it. This begins when a few individuals are more tolerant to a chemical than the remainder of the population. These individuals survive and pass this genetic trait of tolerance on to the next generation. As a result, more individuals in the next generation are less susceptible to being killed by the pesticide. If this continues for several generations, the tolerance can be much greater than what was present in their ancestors. Most new pesticides now have resistance management instructions on their labeling, and most recommend limiting the number of applications on a crop and/or using a rotation of a different mode of action. The purpose of restricting the frequency of use and limiting exposure to that chemistry is to decrease the chance of having a population that has developed resistance against that chemistry. How does the use of tank mixes fit into resistance management programs? The key concern in tank mixes and resistance management is whether the mix is targeting one pest or different pests.

ONE-PEST MIXES

The use of tank mixes, which targets only one pest, goes against the general philosophy of many researchers and is not good resistance management. My general perspective is that we do not use tank mixes targeting one pest unless it is absolutely necessary. One philosophy is that by mixing two effective insecticides from two different classes, you should be able to kill all of the individuals of the species, and there will not be any individuals to carry on resistant genes. This is good in theory, but I don't think it is true that we will kill all individuals in the greenhouse. It is more probable that a few individuals that do survive will demonstrate some tolerance to both pesticides and will pass that on to the next generation.

Western flower thrips quickly develop resistance with repeated chemical use, causing unsalable plants with discoloration on gerbera flowers (top) and brown spots on anthurium (bottom).

You probably would not be thinking about mixing compounds if you were not already having problems controlling this pest with one or both of the components of the mix. We also know that if you can remove the population of a particular pest from exposure to an insecticide, in some cases, they will actually recover and become more susceptible to that insecticide again. Therefore, the rotation of compounds is a better management practice against a particular pest species. There are many different types of pesticides and different pests that enter this picture, and each must be considered ➧

separately to make a sound decision on tank mixing two or more pesticides to manage a single pest species.

There are exceptions where mixes are recommended, but these usually follow the loss of efficacy of the primary component. For example, when we encountered problems with abamectin for the management of western flower thrips, we used a tank mix of abamectin and horticultural oil, and it improved efficacy. The use of oil is acceptable in tank mixes by many researchers. Another example was when acephate and a pyrethroid were used to manage silverleaf whiteflies when no other control was available. If possible, it is still a good practice to rotate these tank mixes with other alternative control practices.

A question is often raised about mixing two insecticides together to kill different developmental stages of a pest. A common example is an insecticide spray for adult fungus gnats and an insecticide drench for immatures in the medium or a miticide to kill active mites and an ovacide to stop reproduction. This is a little more valid than the situation discussed above, but I still feel that we need to be careful with these mixes. We need to fully evaluate the situation. Do we really need to attack both developmental stages? If the crop is going to be in the house for a few weeks, then an effective material will reduce the population, and you can still rotate pesticides appropriately. If you are ready to ship the crop this week, then there may be more justification for looking at controlling all stages.

Leafminer pupae in and around the root system of heavily infested matsumoto asters.

MIXES FOR DIFFERENT PESTS

What about mixing together pesticides that target different pests? A mix that targets different pests might include an insecticide for an insect, a miticide for a mite or a fungicide for a disease. There are varying opinions on the validity of this mix, but the truth is that growers are going to use them. The biggest problem is the already-mentioned phytotoxicity.

A commonly asked question is what is the difference in a tank mix and spraying the pesticides separately within a very short time of each other? The answer is probably nothing as far as resistance management goes but everything when it comes to phytotoxicity.

Mixes targeting different pests make better sense in resistance management, but care should be taken that the components do not overlap in their activity. For example, using abamectin for mites and spinosad for thrips does not make sense. Both are used for thrips control, so they overlap in that use and should be rotated in a thrips management program. In addition, abamectin is used at a lower rate for mites than for thrips. Applying an insecticide at a sublethel dose is a sure fire way to increase the probability for resistance. If you are going to mix different pesticides for different pests, you need to really study the characteristics of the components. You definitely do not want to mix a fungicide with a fungal bioinsecticide that has insecticidal activity, such as *Beauvaria bassiana*. Care should be taken to test any tank mix before using it on the entire range. Spray a few plants, and observe for plant damage and pest control to see if they are safe and compatible.

Tank mixes are much easier for growers to use than trying to spray all pesticides at different times. The use of mixes will save time, labor and applicator exposure to pesticides. However, if the end result is that you loose the effectiveness of those pesticides, this could be a temporary saving. More information is needed to assist growers with compatibility and other concerns of tank mixes. Pesticide labels do contain more information about mixing and resistance management than in the past, but growers still need to take care to test pesticides and mixes on a few plants before using over a large area. GPN

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