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Tank Mixes

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Tank mixes of pesticides always seem to be an attractive way to save time and money. Instead of applying an insecticide one day and then a fungicide or miticide the next day, growers sometimes tank mix pesticides to control two problems with one application. Growers are doing much more testing of pesticide mixtures than extension or research personnel. According to Section 2 (ee) of the Federal Insecticide, Fungicide and Rodenticide Act as amended, mixing a pesticide or pesticides with a fertilizer is permitted if such a mixture is not prohibited on the label. (It is important to read the label of each pesticide before use.) Section 2 (ee) also seems to permit the mixing of pesticides without fertilizers, again as long as the labels of each pesticide used do not prohibit such mixtures; the current unwritten policy of EPA is to allow tank mixes without fertilizers. One important question concerning tank mixes: If phytotoxicity occurs from a tank mix which is not listed on the label, how does this affect the chemical company's liability for the pesticide? We don't know. Here are some precautions to consider when contemplating a tank mix.

Phytotoxicity Considerations: Pesticides are highly active biologically. When a chemical at very low concentrations has a profound impact on one organism, there is always a chance there will be some effect on other organisms (including the crop and the workers). In a commercial greenhouse it would be foolish to leave unsprayed plants when treating highly mobile pests such as thrips and whiteflies, but the uniform application of pesticides to the whole crop may obscure stunting or chlorosis which would be noticeable if part of the plants were not sprayed. On the other hand, phytotoxicity is often cultivar specific so damage may occur on one or two cultivars but not on the rest. No matter how "safe" a pesticide seems to be, there is always some risk in applying biologically active chemical mixtures to a crop. For that matter, even single ingredient sprays involve some risk to ornamentals. In most phytotoxicity lists, pesticides which are most often listed as damaging are the ones in most common use.

Whenever applying a new pesticide or pesticide mixture, test the mixture on a few plants before trying it on the whole crop. It is amazing

how often growers will try a new pesticide mixture on whole crops rather than a small portion of the crop. A mixture which works well for one grower may cause significant damage to the crops of another grower.

Mixtures can be safe under some conditions, but plant damage may occur under a different set of conditions. For example, as long as the temperature is moderate and the plants are turgid, plants can tolerate pesticide mixtures which would cause excessive plant damage in the heat of July and August, especially if the plants are slightly wilted.

Adjuvants: To Use or Not to Use. Adjuvants are substances which are added to a pesticide mixture to improve its properties. Some adjuvants are designed to lower surface tension and help the solutions spread across the leaves of waxy plants. Other adjuvants are added to buffer pH. Other adjuvants are designed to control drift, prevent foaming in the spray tank, or enhance compatibility of tank mixes. This latter sounds too good to be true. Compatibility adjuvants are labeled primarily for use in liquid fertilizer/insecticide tank mixes or herbicide/insecticide mixes on field crops. When pesticides are formulated, adjuvants are usually added during production by the manufacturer. Part of the excessive cost of pesticide development is spent on testing adjuvants to find a combination which will make the solution spread and stick without damaging the plants to which it must be applied. Since pesticides are formulated with spreaders and stickers already included, this presents a hazard for tank mixing. For example, when applying a single pesticide at the normal rate, the final solution has the normal rate of pesticide and the normal rate of adjuvants. When the second pesticide is added, there is the normal rate of the first and second pesticides but twice the normal rate of adjuvants. Out of habit, some growers add an adjuvant to every spray mixture. This means that many tank mixes created by growers contain three times the normal rate of adjuvants!

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There are at least 60 basic manufacturers of adjuvants ranging from Amway to Woolfolk (Thomson 1986). Perhaps because adjuvants are not pesticides in themselves, relatively little research has been done by entomologists on the effect of adjuvants on ornamentals. Their enormous number also makes starting research on the effects of adjuvants a daunting task.

If an adjuvant is really needed, it is best to use the adjuvant recommended on the label of the pesticide being applied. The manufacturer lists such an adjuvant for two reasons: 1) the adjuvant is made by that manufacturer and 2) the company has tested that specific adjuvant and is confident the mixture will not damage plants and is confident the adjuvant will not inhibit the effectiveness of the pesticide. Adjuvants for a systemic pesticide may be completely different than those for a protectant material. When the wrong adjuvant is tank mixed, the efficacy of both pesticides could be reduced.

Compatibility. Some pesticide mixtures are physically incompatible. When mixed together, the two form a gel or a precipitant, which settles to the bottom of the tank where it clogs hoses and filters and creates a problem with cleanup. *(Speaking of pesticide cleanup and disposal problems, the best bet is to call the Solid and Hazardous Waste Management Branch, Division of Health Services, N. C. Department of Human Resources, P. O. Box 2091, Raleigh 27603, (919-733-2178) to ask for advice.)* When contemplating a new pesticide tank mix, follow these guidelines:

(1) Measure out one pint of water.

(2) Measure the pH and adjust, if necessary.

(3) Add ingredients in the following order: (a) adjuvants (half of the total amount you intend

to use), (b) wettable powders, (c) water soluble concentrates or solutions, (d) emulsifiable concentrates and flowables, (e) soluble powder formulations, (f) the remaining half of adjuvants.

(4) Mix and let stand for 15 minutes.

(5) After letting the mixture set for 15 minutes, stir well and observe whether the mixture combines well after stirring (compatible--worthy of biological testing) or if separation, clumps, grainy appearance or settling occurs (incompatible--bad mixture that should not be applied to crops). To dispose of incompatible residues, add additional water to the mixture and stir (in hopes that the precipitate will dissolve or go into suspension), filter the mixture, spray the liquid onto a crop for which it is labeled and put the residue into an appropriate container for proper disposal. When mixing large amounts of pesticides, it is best to add some water to the tank before adding the other ingredients in the above order. Then the rest of the water can be added to fill the tank.

Biological Activity. If pests persist after a pesticide mixture has been applied, it is difficult to figure out if the lack of efficacy was caused by resistance in the pest population, poor coverage, poor timing, or by one ingredient hampering the effectiveness of another. The effectiveness of some insecticide mixtures is supposed to be additive. For example, the Orthene™ plus pyrethroids mixture is much more effective than either pesticide alone (although when you think about it, the mixture ought to be as there is twice as much active ingredient in the mixture). Tame™ is actually labeled as a tank mix with Orthene™. Soaps used at the adjuvant rate are supposed to increase the effectiveness of the insecticide beyond soap's property of breaking the surface tension of the water suspension and spreading the pesticide mixture more thoroughly.

Compatibility Charts. Meister Publishing Company at one time published a compatibility chart which indicated which pesticides could be tank mixed. The chart was intended primarily for fruit growers although lots of other people extrapolated information from it for use on other crops. Meister stopped publishing the chart several years ago and nothing seems to have come to the market place to replace it. The long and short of the chart was that most pesticides are subject to alkaline hydrolysis and consequently Bourdeaux mixture and other alkaline fungicides were not compatible with many synthetic petrochemicals.

Fertilizers can drastically alter the pH of a tank mix and will greatly increase the break down of pesticides. The carbamate molecule is a chelating agent of iron, zinc or manganese. Mixing carbamate fungicides with fertilizers can change the entire active ingredient of the fungicide and reduce the effectiveness of the fungicide. Therefore, mixing pesticides and fertilizers, whether for sprays or drenches, may not achieve the desired results. As with all other tank mixes, always test a fertilizer/pesticide mixture prior to widespread use.

Tank mixing requires test mixing, test applications, and precise records. Record mixing procedures, environmental conditions at application, and plant conditions at time of application. All three parameters will be needed to duplicate a successful tank mix application.

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