Preparing Pesticide Tank Mixes
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**PESTICIDE MIXTURES**

The correct tank mix of two or more pesticides may save time and labor and may reduce equipment and application costs. In addition, such a mixture might also control a range of pests or enhance the control of one or a few pests. Tank mixes of two or more herbicides are more common than other pesticide combinations. For example, a herbicide and fungicide mixture is much less common because the different target pests usually require treatment at different times or with different nozzles and operating pressures.

Whether you want to tank-mix pesticides to increase the effectiveness of the application or simply to save time, there are some important things to consider before you proceed. First, it is important to know that it is illegal to mix pesticides with other products (such as other pesticides, adjuvants, or carriers) when such mixtures are expressly prohibited on the label. In some cases, the labels may not prohibit or provide guidance about the mixture you wish to make. If so, it is your responsibility to make sure the pesticides will retain their properties when mixed together—sometimes they do not. When two or more pesticides can be safely mixed and applied in combination without unfavorably affecting toxicity, physical properties, or plant safety, they are considered compatible. If problems develop from using the combination (for example, phytotoxicity, reduced activity of one or more of the active ingredients, excessive foaming, or formation of sludge in the tank), the chemicals are considered incompatible. Pesticides may be chemically or physically incompatible.

**Chemical Incompatibility**

Sometimes even products that mix well should not be used together because the activity of the mixture may be different than if the products were applied separately. The result can be either decreased activity, which is called *antagonism*, or increased activity, which is called *synergism*. While reduced activity through antagonism is never beneficial, the known synergistic activity of some mixtures can be useful. For example, one pesticide may not significantly affect the pest when used alone—but when mixed and applied with another product, the total activity may be very effective. Therefore, in some situations you may want to take advantage of synergism to increase control or to decrease the amount of pesticide needed. Some synergistic combinations, however, may injure the crop or nontarget organisms. *You cannot tell if pesticides are chemically incompatible just by mixing them; you won’t find out until it is too late.* Again, the label often tells you to avoid certain tank mixes.

**Physical Incompatibility**

Some pesticides cannot be physically mixed together; we call this *physical incompatibility*. Physical incompatibility can be caused by improper mixing, inadequate agitation, or lack of stable emulsifiers in some ECs. In most cases, solids settle out of the mixture or the mixture separates into layers after you agitate it. Sometimes, the mixture may curdle, gel, or become sludgelike. For example, when WPs and ECs are improperly mixed, they can form a putty or paste with an oily layer that floats on the top of the tank. Many physical incompatibility problems occur when combinations of pesticides (ECs, for example) are mixed with liquid fertilizers. A few pesticides are available in special fertilizer-grade formulations that reduce incompatibility problems. Some poor mixtures develop when pesticides are mixed with hard water. A physically incompatible mixture may be unsprayable—and even when you are able to spray it, the concentration will likely vary during the application. The label often tells you to avoid certain tank mixes or to do a compatibility test.

**Physical Compatibility Test**

Before you mix pesticides or pesticide-fertilizer combinations in your spray tank, conduct a jar compatibility test. This test shows whether the components are physically compatible and whether you need to add a compatibility agent. The
advantages in doing the test are that you only have to use a small amount of each product, and you won’t have an ugly mess in your spray tank if the mixture is physically incompatible (incompatible mixtures may need to be disposed of as pesticide waste). This test cannot detect chemical incompatibility.

To conduct a jar test, you need to add proportionate amounts (convert gallons or pounds to milliliters, ounces, or teaspoons) of all the products you intend to mix in your spray tank to a clear quart jar. When using a liquid fertilizer carrier, many herbicide labels recommend the use of two jars for this test (with and without a compatibility agent), and may even tell you how much of each product to use. Begin by labeling the jar(s) clearly, so you’ll know what it contains, and then fill it one-half full with your carrier. Add proportionate amounts of each of the products, one at a time, in the order suggested on the label (or see “Making Tank Mixes” in the next section). Gently shake or invert the capped jar, then let it stand for 15 to 30 minutes. If the mixture shows signs of physical incompatibility, shake the jar again to redisperse its ingredients. If it easily redisperses, you will not need a compatibility agent; however, you will need to maintain constant agitation in the spray tank. If the mixture will not disperse after the second shaking, you may want to perform the test again, using a compatibility agent, or decide at this point not to perform the tank mix.

It is advisable to conduct a jar test even if the tank mix is described on a product label. The pH, chemical composition, and even the temperature of your water can affect physical compatibility. Likewise, a pesticide may be registered for use with liquid fertilizers, but how effectively you can mix the two could depend on the nature (factors such as temperature and salt index) of the fertilizer you use.

Making Tank Mixes

It is extremely important that you add the components of the mixture in the order that the label specifies; sometimes, whether pesticides are physically compatible or not depends on the order in which you add them to the tank. This is especially true for pesticides that are packaged in water-soluble packets; a mistake in mixing order could prevent the packet from dissolving completely, and thus prevent uniform distribution of the pesticide in the spray tank. The label will provide mixing instructions for all registered tank mixes. Unless the label states otherwise, you cannot apply any pesticide in a mixture at a rate higher than the label allows for when the pesticide is used alone for the same purpose.

Some pesticide labels do not provide adequate mixing order directions. The usual method for tank mixing is as follows. First, fill the tank one-quarter to one-half full with the carrier and begin agitation. If you need to add a compatibility, buffering, or defoaming agent, these products should be added before the other products. If you are using a drift control additive, always consult the label; some are added very early, while some are added nearly last. Next, slowly add and thoroughly mix the pesticide products, one at a time, beginning with those hardest to mix (such as suspension-forming formulations). Generally, wettable powder (WP) and dry flowable or water-dispersible granule (DF, WDG) products should be added first, followed by flowable (F, FL) and microencapsulated (ME) products. Add emulsifiable concentrates (EC) next, followed by any solution (S) or soluble powder (SP) products. Any crop oils and/or surfactants should be added last. Dry formulations should be preslurried (mixed with a little water) before adding them to the spray tank; this is also a good idea (even with ECs) if you are using liquid fertilizer as the carrier. Finally, continue adding your carrier to the desired level.

To make certain you have a uniform spray mixture at all times, keep the mixture agitated during the entire application and until the tank is empty. If possible, do not allow it to stand overnight without agitation. If you do end up with a physically incompatible spray mix, call the manufacturer of each product to see if you can rejuvenate the mix; adding a compatibility agent may return the mix to a sprayable form. If you cannot rejuvenate the mix, treat it as pesticide waste (see Chapter 4 for disposal instructions).

### Making Tank Mixes

<table>
<thead>
<tr>
<th>Step</th>
<th>Instruction</th>
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<tbody>
<tr>
<td>1</td>
<td>Fill the tank ¼ to ½ with carrier and begin agitation</td>
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<tr>
<td>2</td>
<td>Add compatibility or defoaming agents if needed</td>
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<tr>
<td>3</td>
<td>Pesticides, in the order of WP, DF, WDG, F, FL, ME, EC, S, SP</td>
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<tr>
<td>4</td>
<td>Crop oils or surfactants</td>
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*Always consult the label of each product for product-specific mixing instructions.*