Preventing herbicide failure

By Brent Sellers and Steve Futch

There is perhaps nothing more frustrating than spending time, money and effort applying herbicides onto weeds and failing to adequately control them or have new weeds emerge in just a few weeks. Unfortunately, when this happens, the primary reason behind the failure is most often due to our negligence in one area or another. Although it is not reasonable to expect perfect weed control every time, we have the ability to make decisions that can significantly improve weed control in our groves.

START WITH IDENTIFICATION

The first step in any weed management program is to properly identify the weeds present or anticipated to emerge. Without properly identifying the weed, the appropriate herbicide cannot be chosen. For example, common ragweed and ragweed parthenium have many similar characteristics. However, common ragweed is much more susceptible to glyphosate than ragweed parthenium, especially as the plants mature. Therefore, make sure all the weeds are properly identified and then choose the right product(s) for the entire job.

While weeds are being identified, pay close attention to the size and morphology of the plants. It is generally accepted that smaller weeds in the seedling stage are easier to control than larger, mature plants. In regard to morphology, weeds with small or narrow leaves generally intercept and retain less of the spray solution than plants with larger leaves.

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Additionally, hairs present on the leaf surface can reduce the amount of surface area of the leaf that interacts with the spray droplets. Leaf orientation can also impact control, as leaves that are perpendicular to the stem intercept more herbicide solution than those that are angled upward or downward. Also, some plants "track" solar radiation, resulting in leaf movements throughout the day to intercept additional light, which can result in reduced herbicide interception or retention on the leaf surface.

WEATHER EFFECTS

Environmental conditions also play a pivotal role in herbicide activity, as herbicides are most effective against actively growing plants. Drought has a significant impact on plant processes. Under such conditions, plants have thickened cuticles (typically referred to as "hardening off"), reduced transpiration and limited growth. Reduced surface area of wilted leaves will result in less spray interception. Cuticle thickness has a direct impact on herbicide uptake into the leaf. Plants with thick cuticles in response to drought stress typically take up less herbicide than those that are actively growing with relatively thin cuticles. As growth slows during drought, the herbicide that enters the plant has less of a chance of interrupting the biochemical process that normally occurs.

During the rainy season, rainfastness may also be an issue. Some post-emergence herbicides only require one hour of drying time, while others may require four hours or more of drying time before it is safe to run irrigation or encounter rainfall.

ADJUVANT ACTIVITY

Many herbicide labels recommend the addition of an adjuvant to the spray mixture. An adjuvant is any substance in a herbicide formulation or added to the spray mix to improve herbicidal activity or application characteristics. In most cases, this refers to the addition of a surfactant, crop oil concentrate or methylated seed oil to decrease the surface tension of the spray droplets (Figure 1), enhance spreading on the leaf surface or dissolve leaf waxes.

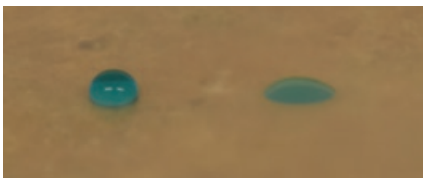

PHOTO: Fred Whitford, Purdue University

Figure 1. Water droplet without surfactant (left) and with surfactant (right). The addition of a surfactant decreases the surface tension of the water droplet and enhances the spreading of the herbicide solution on the leaf surface.

Ammonium sulfate, another adjuvant, is often added to the water to bind dissolved hard water cations (calcium, magnesium and iron) prior to the addition of glyphosate. In this situation, more glyphosate is theoretically in solution and able to be absorbed by the plant. Adjuvant selection should be based on several factors including what the herbicide label calls for, what the adjuvant claims to be, cost of the adjuvant and what is available in your area. However, the primary source in deciding whether an adjuvant is necessary and the type of adjuvant used should come from the herbicide label.

FOLLOW THE LABEL

Before applying any herbicide, the applicator should read the label in its entirety to be sure that it is followed

appropriately. This is extremely important as the label is the law. Labels can be difficult to read, but reading the label is one of the most important things you can do before applying any herbicide product.

Labels provide safety precautions, the appropriate rates for different species or for different growth stages/heights, proper adjuvant selection, the required output volume of the sprayer, rainfastness, crop rotation restrictions and allowable tank-mix partners. The latter can be very important when attempting to control a mix of weed species as some tank mixes are not allowed, and special mixing instructions may be required.

CALIBRATION IS KEY

Once the herbicide(s) have been chosen, the applicator should ensure that the sprayer is properly calibrated before mixing herbicides in the tank. A routinely asked question is "How much herbicide do I need to put in the sprayer?" The first question to ask in response to that question is "What is the sprayer output in gallons per acre (GPA)?" If the GPA output of the sprayer is not known, the appropriate amount of the herbicide to be added to the tank cannot be determined, especially for broadcast applications. Unfortunately, sprayer calibration is often overlooked, but if the sprayer output is unknown or different than you expect, then the herbicide will likely be applied at the wrong rate. If herbicides are underapplied, weed control will not be satisfactory. If herbicides are overapplied, weed control may be extremely good, but crop safety and residues may become a factor.

MIX AND MEASURE PROPERLY

After the sprayer is properly calibrated and sufficient water is put into the spray tank, the correct amount of adjuvants and herbicides are ready to be added to the tank. Be sure to follow the proper mixing order to prevent any mixing compatibility

issues that may arise when mixing multiple herbicides.

Another very common issue of concern that is overlooked is using the correct measuring devices for herbicides. This is becoming more important as today's herbicides are often measured in ounces rather than pounds. It is very common for many applicators to have measuring pitchers that they have collected from tradeshows over the years. While this is a great benefit to increasing the accuracy of mixing herbicides in the tank, many things need to be considered.

First, make sure the graduations on the pitcher are legible. Oftentimes, graduations become hard to read from overuse, and the accuracy of measurement is greatly reduced.

Second, be sure to use the correct pitcher for the job. If you need to measure ounces, make sure that there are graduations in ounces. It is very difficult to measure 11 ounces of material if the pitcher only has graduations in pints.

Third, there is a difference between measuring fluid and dry ounces. Fluid ounces are based on volume, while dry ounces are based on weight. These can be very different if the incorrect measuring device is used. While it is best to weigh dry materials before adding them to the spray tank, some companies provide a special container to measure their dry products. It is very important that these measuring containers are not used interchangeably among products (Figure 2).

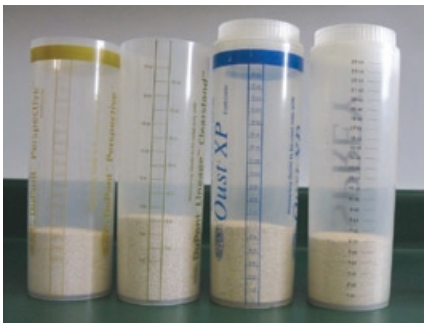

PHOTO: Fred Whitford, Purdue University

Figure 2. Measurement of herbicides in these tubes is product-specific for measuring the weight of dry materials. Each tube contains 6 ounces of product, according to the manufacturer's tube.

TOLERANCE VS. RESISTANCE

Other reasons for a weed control failure include weed tolerance and resistance. There is a significant difference between tolerance and resistance. An herbicide-tolerant plant is a species that has never been adequately controlled by a given herbicide; it is inherently immune. For example, 2,4-D is very effective on most broadleaf weed species, but grasses are largely immune. In contrast, an herbicide-resistant plant is a biotype of a species that was once controlled by a given herbicide. To date, we have no documented cases of herbicide resistance in citrus.

However, weed tolerance has become an issue due to overreliance on glyphosate. Many growers have indicated increased prevalence of dayflowers, Spanish needles, goatweed and various other weed species over the past several years. These species were likely never adequately controlled with glyphosate alone; therefore, we have had a weed species "shift" in our groves to those that are more difficult to control with glyphosate alone. If you spot a species that was normally controlled with glyphosate, and there are several dead plants surrounded by a single living plant of the same species, resistance may be occurring. Keep in mind that herbicides do not cause resistance directly; however, overapplication of the same herbicide or same mode of action results in the selection of herbicide-resistant biotypes.

APPLY ACCURATELY

Perceived tolerance or resistance may actually be the result of improper application of the herbicides. Proper boom height is very important in obtaining sufficient coverage of the weeds to obtain control. However, in many cases, we attempt to control weeds that have become extremely large, and adequate spray coverage cannot be achieved (Figure 3). In some cases, we only treat the lower stem of the plant, which may have become woody and no longer absorbs sufficient

PHOTO: Steve Futch

Figure 3. Spray coverage of large weeds is significantly reduced as the boom will cause many species to lay on top of others.

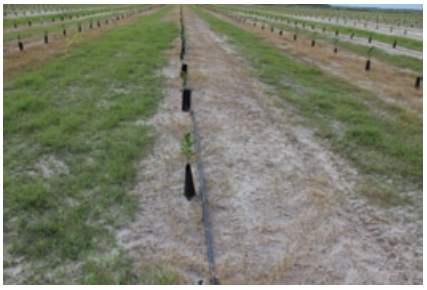

PHOTO: Steve Futch

Figure 4. Proper orientation and size of the off-center nozzle allows for optimal control of weeds in the tree row.

amounts of the applied herbicide to kill the plant. In addition to proper boom height, proper orientation and size of the off-center (OC) nozzle on the end of the boom can have significant impacts on weed control. It is quite common to see weeds emerge in the tree row parallel to the irrigation tubing. Proper size and adjustment of the OC nozzle can greatly improve weed control in the tree row (Figure 4).

Unsatisfactory herbicide performance can be avoided in many instances if the items discussed above are properly addressed. Many factors need to be considered for a given herbicide to provide optimum activity on weed species and to reduce the likelihood of herbicide failure. Remember, nothing is a substitute for our own eyes and mind in developing an effective weed management program.

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