Diagnosing Off-target 2,4-D and Glyphosate Herbicide Damage to Tomato

Pasture, turf, home lawn and right-of-way herbicides have the potential to move off-target and adversely affect tomato production. Herbicides are important tools for controlling weeds, especially in the southern United States where weed pressure is particularly high. Glyphosate and 2,4-D are the most widely used herbicides in the world and are used routinely to control weeds in pastures, turf, and field crops such as soybeans, corn, and rice. Tomatoes are very sensitive to both of these chemicals and damage can result in reduced yields, product rejection, bad publicity for the industry and hard feelings between neighboring farmers or homeowners. All cultivars of tomatoes are sensitive to glyphosate and 2,4-D injury and symptoms are often confused with plant diseases or insect damage.

Herbicide Injury Symptoms

The steps involved in identifying herbicide injury in the field are similar to those taken to identify plant diseases. It is important to determine when symptoms first appeared, what crop was grown on the site previously, what herbicides were previously applied, what cultural practices were used, and the appearance of surrounding plants. Looking for symptom patterns in the field will help with the final identification of herbicide injury. Noting changes in symptom severity within a block of injured plants may indicate the directional movement of the herbicide. The type and severity of herbicide injury symptoms will vary depending on the amount of exposure, exposure time, the age of the plant at exposure, and the cultivar type.

2,4-D Injury Symptoms

Tomato plants and other solanaceous crops such as potato and eggplant are very sensitive to 2,4-D injury and damage can occur by just touching the plants with herbicide-contaminated hands, brushing up against plants with clothing exposed to 2,4-D or by 2,4-D volatiles. The most common symptom of 2,4-D injury is the twisting of petioles and deformed leaflets (Figures 1 and 4).
Stem and petiole elongation, downward cupping or rolling of new leaves (Figure 1), stem splitting, vein yellowing, and stunting may also be observed. Tomatoes exposed to high doses of 2,4-D may develop large, reddish-brown patches on the main stem. 2,4-D symptoms are sometimes confused with diseases caused by viruses or phytoplasma.

**Glyphosate Injury Symptoms**
The most distinct and recognizable symptom of glyphosate damage is bleaching at the base of leaflets (Figure 2). Upward cupping of leaflets, browning of the leaflet edges, and deformed fruit with dark brown scarring are also common. Foliar symptoms of glyphosate injury can be confused with sun bleaching or physiological leaf roll.

**Management**
Herbicide injury can't be reversed, but if the symptoms are not severe and the plant does not die, new growth may be normal. However, the likelihood of a plant fully recovering from herbicide damage is low. Plants injured by herbicides often produce fewer flowers and are stunted, resulting in reduced yield. Fruit exposed to herbicide may also be deformed. Using good stewardship practices to apply herbicides can reduce the risk and impact of off-target herbicides to tomato. Sources of off-target herbicide contamination include drift, sprayer contamination, carry-over in soil or soil amendments, volatiles, accidental applications, and workers.

**Recommendations to minimize off-target herbicide contamination**

*Herbicide drift* is the movement of herbicides from a target area to an off-target area and is caused by the movement of spray droplets. Large spray droplets drift less than small droplets. Therefore, the risk of spray drift is dependent on the size of the spray droplet as well as wind speed and direction, temperature and herbicide volatility. Applying herbicides when temperatures and wind speeds are low (i.e. in the evenings) and selecting nozzles with larger droplet sizes will reduce the risk of drift (Figure 3). Before applying herbicides around the perimeter of a greenhouse with tomatoes greenhouse vents should be closed. Little can be done to prevent drift as a result off-label practices.

Restrictions to alleviate adverse affects from off-target drift are regulated at the state level. The application of 2, 4-D or products containing 2,4-D in specific parishes within Louisiana requires prior approval from the Louisiana Department of Agriculture and Forestry (LDAF).
In restricted areas, applicators must obtain a waiver, permit, or written permission from the LDAF at least 24 hours prior to the scheduled date of a 2, 4-D application. **Details of state restrictions, regulations and maps of restricted areas can be found under the programs section of the LDAF website (www.ldaf.state.la.us).**

Tomato herbicide injury from *sprayer contamination* can occur up to several months after using a sprayer if it has not been cleaned properly. To avoid injury due to herbicide residues in a sprayer, the best practice is to dedicate a sprayer for herbicides and a single crop only. However, for many growers and homeowners this is not economically feasible. In all cases, sprayers should be cleaned after each use according to the recommendation on the pesticide label. Unless the herbicide label specifies a different cleanout procedure the following procedure can be used to clean a sprayer between crops and/or pesticides.

1. Using a combination of agitation and spraying flush tanks, lines, booms and nozzles for at least 5 minutes with fresh water. The rinse water should be sprayed onto an area of land with good drainage and away from production crops.

2. Fill the tank with a dilute solution of household ammonia (1 quarts/25 gallons). If 2,4-D was used, allow the ammonia solution to sit in the tank over night. Alternatively, trisodium phosphate (TSP) cleaner at a rate of 2 pounds/25 gallons) can be prepared and used.

3. Operate the sprayer long enough to ensure that all the nozzles and boom lines are filled with the cleaning solution and let the solution sit in the system for 3-18 hours.

4. Agitate and spray the cleaning solution onto an area suitable for the cleaning solution.

Pastures, lawns and turf are frequently treated with herbicides to control weeds. *Carry over of herbicides in soil or soil amendments* can cause injury to tomato seedlings and other vegetable crops. Herbicide residues can persist in livestock manure or composted manure, and fresh or composted hay and grass clippings (**Figure 5**). Before purchasing or obtaining grass clippings or hay ask if and what herbicides were used for weed control. Symptoms may include poor or no seed germination, seedling mortality, distorted and curled leaflets or leaves, weak stems, reduced fruit set, and reduced plant vigor.
Many forms of 2,4 D are highly volatile under high temperatures. Herbicides should not be stored in locations without venting or in locations that will reach high temperatures. Glyphosate and 2,4-D should not be stored in tomato transplant or production greenhouses.

**Workers**

Tomatoes are very sensitive to glyphosate and 2,4-D. Agricultural workers or gardeners who have handled herbicides should wash their hands and change their clothes before touching tomatoes to prevent cross contamination.

**Alternative Herbicides for Tomatoes**

Alternative products that can be used safely for weed control around commercial field or greenhouse and homegrown tomatoes in Louisiana are listed in the *Louisiana Suggested Chemical Weed Management Guide* (LSU AgCenter Pub. 1838). This guide is updated yearly and thus provides the most current information on herbicides labeled for use in Louisiana. It also includes sprayer calibration instructions, suggestions for reducing herbicide drift, and a guide to proper spray tip selection.

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Images courtesy of K. Fontenot, LSU AgCenter, North Carolina State University PDIC and W. Wallace, LSU AgCenter

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PPCP-VEG-004  April 2016

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