Herbicide Damage in Tomatoes

MISSISSIPPI STATE UNIVERSITY EXTENSION

Each year, home gardeners and commercial producers ask for assistance identifying abnormalities thought to be diseases in their tomatoes. Often, the problem is not a disease, but a disorder. A **disease** is an abnormality in a plant caused by an infectious agent, such as a fungus, virus, nematode, or bacterium. A **disorder** is an abnormality in a plant caused by a noninfectious agent or factor, such as the environment, a nutrient deficiency, or a chemical (an herbicide, for example). Plant symptoms associated with diseases and disorders often resemble one another. It is important to know the specific cause of the symptoms in order to choose the best management practices for the situation.

Tomatoes are sensitive plants that can be injured by many types of herbicides. The symptoms expressed by a plant depend on the type and dose of herbicide, as well as the age of the plant at the time of exposure. Symptoms of herbicide exposure may include stunting, wilting, fruit deformation, leaf distortion (cupping, curling, or twisting), and tissue yellowing (chlorosis) or death (necrosis). Symptom severity depends on the concentration or amount of the herbicide and the type of exposure (spray drift, direct contact, or vapor). Plants may grow out of symptoms if exposure to the herbicide was limited. However, in some cases, herbicide exposure may result in plant death. Tomatoes on plants that have been damaged by herbicides should not be sold or consumed if the herbicide is not labeled for use on tomato.

Amino-acid-derivative herbicides, such as glyphosate (RoundUp® and other products), and auxin mimics, such as 2,4-dichlorophenoxyacetic acid (2,4-D) and similar herbicides, cause damage commonly mistaken for diseases. These herbicides and their effect on tomatoes are discussed in detail in this publication.

Glyphosate

Glyphosate (HRAC/WSSA Group 9), along with other herbicides that interfere with plant cellular metabolism, affect the production of amino acids in plants. Plants exposed to sublethal doses of glyphosate may stop growing for a period of time and/or may develop chlorosis at the base of leaflets in actively growing terminals

Figure 1. Symptoms of exposure to glyphosate or other herbicides that interfere with plant cell metabolism are first observed in actively growing terminals in tomatoes. (Photo by R. A. Melanson, MSU Extension, Bugwood.org)

(**Figures 1 and 2**). Chlorotic tissue may eventually die and turn brown if the exposure dose or duration is severe. Over time, these symptoms may cease, and plants may resume normal growth. Sublethal doses of glyphosate may also delay bloom and fruit set. When this occurs, plants may produce a large number of small fruits late in the season. These fruits are often not marketable, as they are typically irregularly shaped, have a rough surface, and do not ripen evenly. Other symptoms that may develop as a result of sublethal exposure include the development of mottled, crinkled, cupped, and/or strappy leaves. When plants are exposed to lethal doses of glyphosate, the described chlorosis and necrosis begins in terminals at the top of the plants and then moves down toward the bottom of the plants. Symptoms also appear on axillary shoots (suckers).

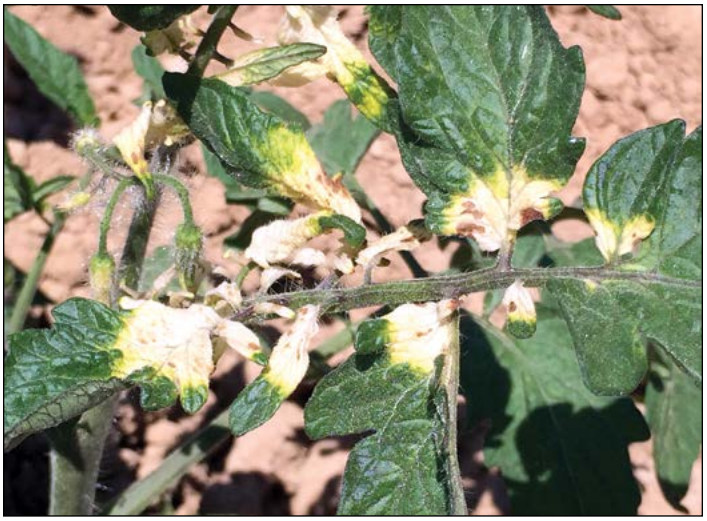

Figure 2. Tissue at the base of leaflets in actively growing terminals becomes chlorotic and eventually necrotic in tomato plants exposed to herbicides, such as glyphosate, that interfere with plant cell metabolism. (Photo by R. A. Melanson, MSU Extension, Bugwood.org)

Exposure to glyphosate often occurs as a result of drift or sprayer contamination. However, tomatoes may also be exposed by coming into contact with residual glyphosate in the soil or on plastic mulch. The RoundUp® label suggests ½ inch of rainfall or overhead irrigation to remove residues from plastic mulch before transplanting. Residual activity, depending on the source, may be observed from 2 days to several weeks after application.

Glyphosate damage may be confused with various plant diseases because chlorosis often occurs as a result of infection by numerous plant pathogens, including various bacteria, fungi, and viruses. Chlorosis that occurs as a result of pathogen infection is usually localized around foliar lesions or more generalized across leaflets rather than being limited to the base of leaflets of actively growing terminals.

2,4-Dichlorophenoxyacetic Acid

2,4-dichlorophenoxyacetic acid (HRAC/WSSA Group 4), commonly called 2,4-D, is a phenoxy-carboxylate herbicide. These herbicides mimic the plant growth hormone auxin, which can cause excessive cell growth. Exposure to 2,4-D often results from drift droplets or vapors after product application or from sprayer contamination.

Foliar symptoms of 2,4-D exposure range from mild to moderate leaf distortion (crinkling, curling, or elongation) to severe distortion of leaves and stems (**Figure 3**). Petioles and stems may become brittle and thickened. Plant growth may stop for short (2 weeks) or long periods. Fruits may be irregularly shaped or have a rough surface. Fruit ripening may be affected. In addition, plants may produce large quantities of small fruits. Exposure to 2,4-D or any other herbicide injury may also predispose plants to other disorders.

The severity of symptom expression by the tomato plant depends on the growing conditions, duration of exposure, plant age at the time of exposure, and the concentration of 2,4-D. Young plants exposed to 2,4-D may be damaged more extensively than older plants.

Similar symptoms may be caused by other herbicides that mimic auxins and that are frequently used as single or blended products to control weeds in pastures, corn, rights of way, and genetically modified soybean and cotton. These herbicides include dicamba, fluroxypyr, triclopyr, quinclorac, picloram, MCPA, MCPP, 2,4-DB, 2,4-DP, aminopyralid, aminocyclorpyrachlor, and clopyralid. Residues of some of these herbicides can persist in hay or livestock manure and urine and will damage tomatoes or other vegetables if exposure occurs. Therefore, **it is critical** to know any herbicides used on the pasture or hay that livestock consumed if livestock manure is used in the garden.

2,4-D damage may be confused with plant diseases caused by certain viruses that cause curling and distortion of leaves, such as cucumber mosaic virus (CMV) and tomato yellow leaf curl virus (TYLCV) (**Figures 4 and 5**). Many of these viruses are transmitted by insect vectors, such as aphids (vector of CMV) and whiteflies (vector of TYLCV). If susceptible varieties are being grown and viruses are the cause of the observed symptoms, the insect vectors will likely be present and easily observed in the planting.

Figure 3. Leaf and stem distortion, as seen in this tomato plant, are common symptoms of exposure to growth regulator herbicides such as 2,4-D. (Photo by P. Bacchi, University of Kentucky Research and Education Center, Bugwood.org)

Figure 4. Tomato plants infected with cucumber mosaic virus commonly exhibit leaf and stem distortion. These symptoms also commonly occur when tomatoes are exposed to 2,4-dichlorophenoyxacetic acid (2,4-D). (Photo by E. Sikora, Auburn University, Bugwood.org)

Figure 5. Tomato plants infected with tomato yellow leaf curl virus commonly exhibit an upward curling (cupping) of leaves. (Photo by D. Ferrin, LSU AgCenter, Bugwood.org)

Management

Plants exposed to herbicides cannot be cured. As indicated, plants that do not die due to the exposure may grow out of the injury, but production may still be affected, and fruit should not be sold or consumed. Thus, the best management methods involve production and pest management practices that reduce the chance of herbicide exposure.

Use a sprayer and mixing tools DEDICATED for herbicides. Have a separate sprayer and mixing tools DEDICATED for other pesticides. Successful crop production often requires the use of chemicals for management of diseases, insects, and weeds. Even a small amount of residual herbicide can injure tomato plants. When possible, it is best to have a dedicated sprayer for application of fungicides and insecticides, as well as a dedicated sprayer for application of herbicides. Having dedicated mixing equipment (containers, measuring spoons, or cups) for these pesticides is also recommended. Clearly label sprayers and all measuring equipment so there is no confusion when it's time to mix the appropriate sprays. This will help to avoid plant exposure to possible residual herbicide on the measuring equipment or in the sprayer. Always be sure to thoroughly clean and rinse sprayers, including the nozzles, and equipment after use. Cleaning is especially important if having dedicated tools is not possible. Never borrow a sprayer from a friend or neighbor as it may be contaminated.

Apply herbicides when environmental conditions do not support vaporization. If you use auxin-mimic herbicides near a garden, pay attention to the active ingredient section of the label. They are produced and used in several forms (amine, choline, ester, salt). The form is identified in the ingredients section of the label. Generally speaking, ester formulations tend to be more volatile than amine, choline, or salt and can vaporize during or shortly after application. These vapors will injure tomato. Air temperatures during application and for a few days after application are critical, as vaporization is correlated with the temperature. As temperatures increase, release of vapors also increases, and vice versa. Environmental conditions are critically important to prevent damage from these vapors.

Use manure fertilizer and mulch only from sources known to be free of herbicide contamination. Livestock manure, stall bedding, or old hay used to fertilize or mulch tomatoes can be contaminated with residual auxin-mimic herbicides. Only use these amendments if you know and trust the source to make certain it was not produced by horses or cattle that grazed pastures treated with or consumed hay treated with residual auxin-mimic herbicides. Free livestock bedding or manure from one of the many dozens of livestock facilities around the state should not be used around sensitive plants like tomatoes.

Numerous types of herbicides can cause various types of symptoms in tomatoes. Only the two types of herbicide damage most commonly confused with diseases in tomatoes are described in this publication. If the observed symptoms are not consistent with those described in this publication and you believe your plants may have been exposed to herbicide, contact your local county agent for further assistance. Your county agent can also assist with troubleshooting if the observed symptoms are not consistent with those described in this publication and you do not believe your plants may have been exposed to an herbicide.

One clue that you may be dealing with a disorder rather than a disease is if multiple plant hosts, particularly from different plant families exhibit similar symptoms. Another clue is when symptoms suddenly appear across all affected plants at the same time. Also, plants affected by herbicides may exhibit more severe damage along one side of a planting, especially when herbicides may have been sprayed in a bordering field or along a bordering road or fence line.

If you suspect that you may be dealing with a disease, images and/or physical samples may be submitted to the MSU Extension Plant Diagnostic Lab for plant disease identification. Details regarding sample collection and submission are available on the laboratory website (**http://extension.msstate.edu/lab**) and in MSU Extension publication *How to Collect and Package Plant Disease Specimens for Diagnosis.* Samples submitted to the Plant Diagnostic Lab must be accompanied by a completed *Plant Disease Sample Submission Form*. Images and descriptions of diseases and other disorders commonly observed in tomatoes are available in the MSU Extension publications *Common Diseases of Tomatoes* and *Tomato Troubles: Common Problems with Tomatoes*, respectively.

Reference

Jones, J. B., Zitter, T. A., Momol, T. M., and Miller, S. A. (eds). 2014. *Compendium of Tomato Diseases and Pests, second edition*. American Phytopathological Society Press, St. Paul, MN. 168 pages.

Additional Resources

Common Diseases of Tomatoes (P3175)
http://extension.msstate.edu/publications/common-diseases-tomatoes

Herbicide Resistance Action Committee website
http://hracglobal.com

How to Collect and Package Plant Disease Specimens for Diagnosis (M1562)
http://extension.msstate.edu/publications/miscellaneous/how-collect-and-package-plant-disease-specimens-for-diagnosis

MSU Extension Plant Diagnostic Lab website
http://extension.msstate.edu/lab

Plant Disease Sample Submission Form (F1139)
http://extension.msstate.edu/publications/forms/plant-disease-sample-submission-form

Southeastern U.S. Vegetable Crop Handbook
https://www.vegcrophandbook.com
(Or contact your local county Extension office.)

Tomato Troubles: Common Problems with Tomatoes (P2975)
http://extension.msstate.edu/publications/tomato-troubles-common-problems-tomatoes

Publication 3679 (POD-8-21)

Prepared by **Rebecca A. Melanson**, PhD, Associate Extension Professor, Plant Pathology, Central Mississippi Research and Extension Center; **John Byrd, Jr.**, PhD, Extension/Research Professor, Plant and Soil Sciences; and **Clarissa Balbalian**, Diagnostic Laboratory Manager, MSU Extension Plant Diagnostic Lab. Reviewed by Rick Snyder, PhD, Professor and Extension Vegetable Specialist, MSU Extension; Jason Bond, PhD, Extension/Research Professor, Delta Research and Extension Center; and James Shannon, Lee County ANR Extension Agent, MSU Extension.

Produced by Agricultural Communications.

Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. GARY B. JACKSON, Director