MISSISSIPPI STATE UNIVERSITY EXTENSION

Herbicide Damage in Tomatoes

Each year, home gardeners and commercial producers seek assistance in identifying abnormalities in their tomatoes, often thought to be diseases. However, the problem is frequently a disorder rather than a disease. A **disease** is an abnormality in a plant caused by an infectious agent, such as a fungus, virus, nematode, or bacterium. A **disorder**, on the other hand, is an abnormality caused by a non-infectious agent or factor, such as environmental conditions, nutrient deficiencies, or chemicals (for example, an herbicide). The symptoms associated with diseases and disorders often resemble one another. It is important to identify the specific cause of the symptoms in order to choose the best management practices.

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 plant's age 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). The severity of the symptoms depends on the concentration or amount of the herbicide and the type of exposure (spray drift, direct contact, or vapor). Plants may recover from symptoms if exposure to the herbicide was limited. However, in some cases, herbicide exposure may result in plant death. Tomatoes from plants that have been damaged by herbicides or other pesticides not labeled for use on tomatoes should not be sold or consumed.

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, often cause damage that is mistaken for disease. These herbicides and their effects 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, affects the production of amino acids in plants. Plants exposed to sublethal doses of glyphosate may stop growing for a period of time and/or develop chlorosis at the base of leaflets in actively growing terminals (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 mottled, crinkled, cupped, and/or strappy leaves. When plants are exposed to lethal doses of glyphosate, the chlorosis and necrosis described begins in the terminals at the top of the plants and then moves downward toward the bottom. Symptoms also appear on axillary shoots (suckers).

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)

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)

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)

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 caused by pathogen infection is usually localized around foliar lesions or more generalized across leaflets, rather than being limited to the base of leaflets in 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 occurs from drift droplets, vapors after product application, or 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 extended periods. Fruits may be irregularly shaped or have a rough surface, and fruit ripening may be affected. Additionally, 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 in tomato plants depends on growing conditions, the duration of exposure, the plant's age at the time of exposure, and the concentration of 2,4-D. Young plants exposed to 2,4-D may sustain more extensive damage than older plants.

Similar symptoms may be caused by other herbicides that mimic auxins and 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, aminocyclopyrachlor, and clopyralid. Residues of some of these herbicides can persist in hay or livestock manure and urine, potentially damaging tomatoes or other vegetables if exposure occurs. Therefore, it is critical to know which herbicides were used on the pasture or hay that livestock consumed if their manure is to be used in the garden.

2,4-D damage may be confused with plant diseases caused by certain viruses that induce 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 (vectors of CMV) and whiteflies (vectors 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 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* (2nd ed.) American Phytopathological Society Press.

Additional Resources

Common Diseases of Tomatoes (P3175)

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

How to Collect and Package Plant Disease Specimens for Diagnosis (M1562)

MSU Extension Plant Diagnostic Lab website

Plant Disease Sample Submission Form (F1139)

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

Tomato Troubles: Common Problems with Tomatoes (P2975)

Publication 3679 (POD-10-24)

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 (retired); Jason Bond, PhD, Extension/Research Professor, Delta Research and Extension Center; and James Shannon, Extension Specialist I, North Mississippi Research and Extension Center.

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. ANGUS L. CATCHOT JR., Director

MISSISSIPPI STATE UNIVERSITY EXTENSION