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MONTANA STATE UNIVERSITY EXTENSION

MontGuide

How to prevent non-target injury of broadleaf crops and vegetables by residual herbicides

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This publication was designed to help homeowners and herbicide applicators avoid issues with persistent herbicides stemming from contaminated soil amendments.

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OVER THE PAST SEVERAL YEARS, COMMERCIAL growers and home gardeners in Montana have reported injury to fruit and vegetable crops following the application of soil amendments like compost, manure, hay, or grass clippings. The culprit is sometimes residual herbicides that, when present in soil amendments, can present a long-term problem for growers of broadleaf plants. These herbicides include those with the active ingredients aminopyralid, clopyralid, aminocyclopyrachlor and picloram. These herbicides are in a class known as plant growth regulators (PGRs), which are synthetic auxins, or substances that mimic plant growth hormones. In Montana, PGRs are labeled for weed control on pasture, rangeland, roadsides, hay, cereal crops, and turf. While they are effective against many noxious weeds, they can cause non-target plant injury partly because they are broken down slowly by microorganisms in our cool, dry climate. Additionally, PGRs are metabolized by mammals at low rates and are present as the same compound in manure and urine as the active ingredient applied as an herbicide.

When plant material treated with PGRs, resulting manures, or composts produced from these materials are used as soil amendments they can injure non-target broadleaf plants. Topsoil containing residues from these herbicides can also be a source of contamination. Labels on PGRs are designed to prevent such contamination by specifying proper use of both the herbicides and end-products. It is important for herbicide applicators and vegetable growers to understand that applying soil amendments contaminated with PGR herbicides to susceptible plants can have the same effect as applying the herbicide to them.

Herbicide Carryover Symptoms

Symptoms of herbicide damage from PGRs vary with application rate and plant species. Certain plants are more susceptible than others including tomatoes, peppers, potatoes, beans, peas, carrots, and greens. These herbicides do not usually affect grasses and other monocots such as garlic and onions.

Symptoms of PGR injury include upward cupped leaves, fringed or frilled leaf margins, distorted growth at growing points, and in extreme cases poor seedling emergence and plant death (Figures 1 and 2). Other factors can create similar symptoms including insect damage, drought, excess water, extreme temperature fluctuations, and ammonia toxicity. Samples can be submitted to your local Extension office to determine if herbicide carryover may have been a factor in plant symptoms.

FIGURE 1 This tomato plant was grown in topsoil contaminated with picloram. The symptoms of twisting and distortion of leaves, petioles, and main stem are consistent with PGR herbicide damage. Photo by Noelle Orloff.

FIGURE 2 This bean plant is showing symptoms consistent with PGR herbicide damage, including distortion and puckering of leaves. Photo by Katrina Mendrey.

Preventing Contamination

Applicators can avoid contamination by following the product label. Secondary users such as livestock owners purchasing hay, farmers or gardeners using hay or manures on crops, or composters receiving materials to supplement operations should have careful conversations with producers and

suppliers to rule out potential contamination. Questions to consider include:

- Which herbicides were used on the hay? Producers should have records of herbicide use. If any PGR product is mentioned, avoid using the hay, bedding, or resulting manure.
- When were the herbicides applied? Read the label of the product applied to determine how long to wait before using amendments on susceptible crops. This interval could be up to 18 months.
- What type of hay was used? Hays containing broadleaf plants, particularly legumes, were likely not treated with PGRs as broadleaf plants are sensitive to these herbicides.
- In the case of topsoil, ask suppliers whether soil was treated for weeds, what herbicide was used, and if the topsoil has been amended with other materials including compost. In addition, ask about previous land use, particularly if it was used for keeping livestock or growing hay.

If there is any doubt regarding potential contamination of the material, avoid using it on susceptible crops until performing a bioassay to rule out contamination.

Step by Step Bioassay

While laboratory testing for herbicide contamination is possible, it is also expensive. Additionally as plant susceptibility varies by species, and can be as low as 1 part per billion (ppb), it is often more informative to simply perform a pot bioassay on the soil amendment.

1. **Prepare 3-6 pots.** Take several random, representative samples from throughout the questionable compost, manure, or soil and mix the samples together. Fill 3-6 pots with a mix of the amendment in a 1:1 ratio with non-contaminated soil. Prepare two or three pots with just non-contaminated soil to serve as the "control," or non-treated pots. Allow enough space between pots so potentially contaminated water from one pot will not reach another pot, or use saucers to catch runoff.
2. **Sow the test plants.** Plant three bean or pea seeds in each pot and allow them to grow for three weeks, or until there are three sets of true leaves.
3. **Observe the pots.** If you do not see a difference between the control pots and the pots with the amendment, the amendment is likely not contaminated. If, on the other hand, pots with the amendment have poor emergence or distorted growth compared to control pots there may be herbicide residue in your amendment.

To test grass clippings or straw, perform a similar bioassay. Fill the pots with commercial potting soil and spread the amendment on top, or incorporate the amendment in the soil. Proceed with the bioassay as outlined above (Adapted from www.whatcom.wsu.edu/ag/aminopyralid/bioassay.html).

What to do if Soil is Contaminated

Focus on increasing soil microbial activity to more quickly break down herbicides. Try keeping the soil moist, growing a monocot cover crop, turning the soil to increase aeration, and providing adequate non-contaminated organic matter to support soil organisms. Any plant material grown in contaminated soil should be removed and either disposed of or used in an area where broadleaf plants are not desired. Incorporating these materials back into the soil will result in continued contamination. The time required to reduce contamination to undetectable levels depends on climate and environmental factors influencing microbial communities and soil health. Prior to planting a broadleaf crop, a pot or field bioassay should be performed to ensure PGR levels have decreased adequately for the crop in question.

Additional Resources

Davis, J., Johnson, S.E., and F. Yelverton. 2015. *Herbicide Carryover; Hay, Manure, Compost, Soil & Grass Clippings.* North Carolina Cooperative Extension.

Tharp, C. 2012. *Minimizing pesticide contaminated soil around the home and garden.* Montana State University Extension MontGuide: MT201008AG.

Tharp, C. Montana State University Non-Target Plant Toxicity website: http://www.pesticides.montana.edu/reference/planttoxicity.html

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