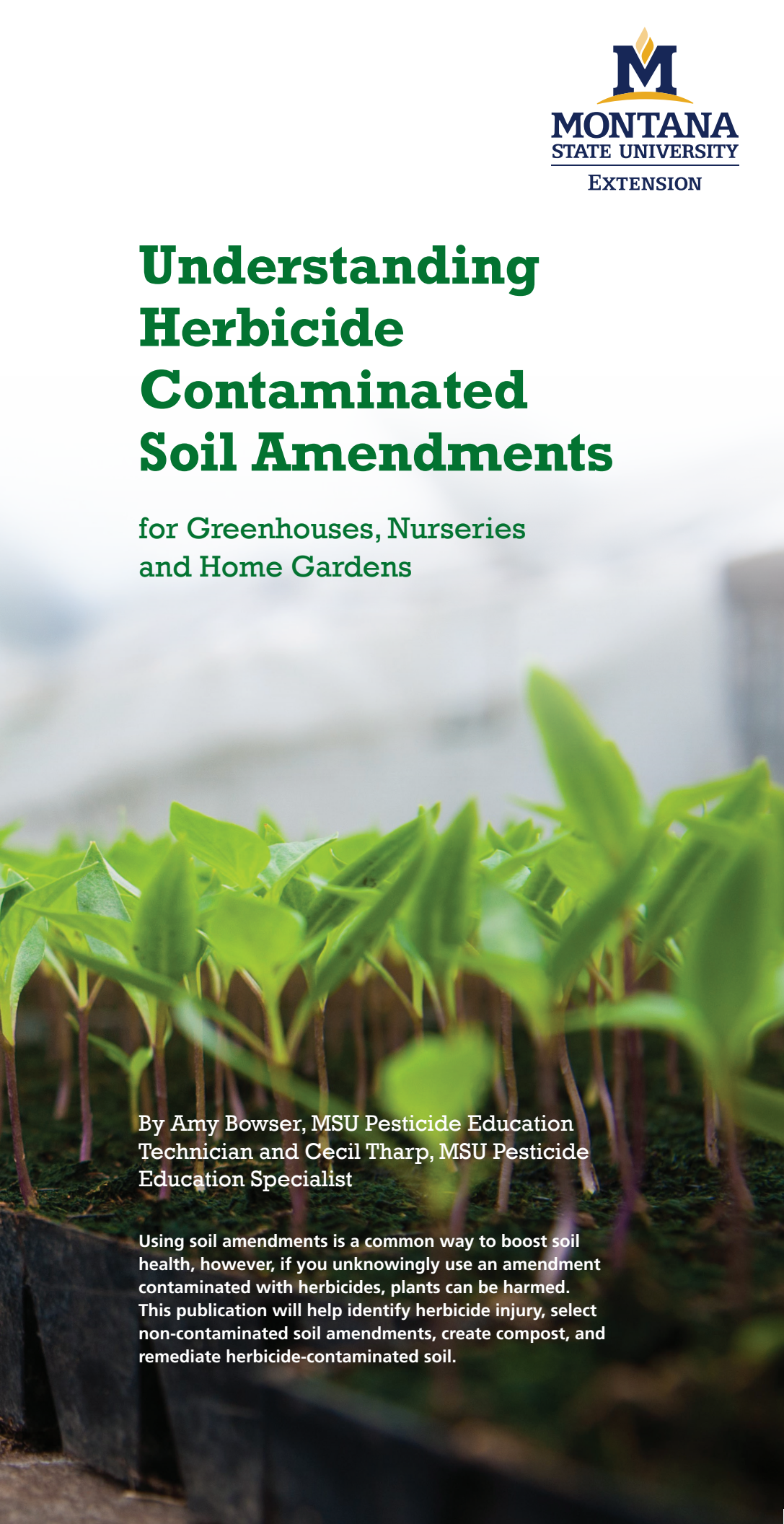
MONTANA STATE UNIVERSITY
EXTENSION

Understanding Herbicide Contaminated Soil Amendments

for Greenhouses, Nurseries and Home Gardens



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Using soil amendments is a common way to boost soil health, however, if you unknowingly use an amendment contaminated with herbicides, plants can be harmed. This publication will help identify herbicide injury, select non-contaminated soil amendments, create compost, and remediate herbicide-contaminated soil.

Figure 1 University of California 2018

Figure 2 Cheryl Moore-Gough, MSU 2015

Figure 3 Washington State University 2010

Figure 4 University of California 2015

Identifying Herbicide Injury

Non-target herbicide injury occurs when a desirable plant is negatively impacted by the presence of an herbicide in the soil or on the plant tissue. Drift is a common source of herbicide injury; however, other routes of entry must be considered if plant injury can't be traced to a recent pesticide application. Injury also occurs when herbicides are unknowingly present in the soil from sources such as contaminated grass clippings, manure, soil or compost introduced to the site.

Herbicides most likely to cause non-target injury from introduction into the soil are termed "persistent" herbicides. These chemicals do not break down quickly in the environment, or through animal digestion or composting. Persistent herbicides can easily cause injury to sensitive plants for several years. Pyridine carboxylic acid (PCA) growth regulator herbicides are a common culprit in herbicide damage and are highly persistent. The most common PCA herbicide active ingredients that persist in soil amendments are aminopyralid, aminocyclopyrachlor, clopyralid, and picloram; they can cause damage to broadleaf plants at very low concentrations.

Symptoms—PCA herbicide injury symptoms include twisting **(Figure 1)**, leaf curling, and leaf cupping **(Figure 2 and 3)** of sensitive broadleaf plants. Chlorosis (yellowing of the leaves) may also be present **(Figure 4)**, as well as leaf drop and death depending on the severity of exposure. The most susceptible plants to PCA herbicides are the legume family (peas, beans, lentils, caragana and clover), the solanaceous family (tomatoes and potatoes), the composites family (sunflower, petunias, daisies, lettuce and asters), and the cucurbit family (cucumber, squash, pumpkin and watermelon). Shrubs and trees may also be affected, though injury severity is dependent on species, whether the plant is stressed, and maturity. In general, the grass family (corn and turfgrass) and the amaryllis family (onions and garlic) will be left uninjured by these broadleaf herbicides.

For a comprehensive manual looking at symptoms of PCA injury and injury from other herbicides, visit http://herbicidesymptoms.ipm.ucanr.edu/. For more information on symptomology, contact your local Extension agent or the MSU Pesticide Education Program (pesticides@montana.edu; 406-994-5067).

Three factors influence the potential for herbicide damage from contaminated soil: *(1) a persistent herbicide must be in the soil, (2) plants susceptible to the herbicide must be present, and (3) concentrations of the herbicide active ingredient must be high enough to cause damage.*

Analytical Testing—Testing for herbicide residues in plant material, soil, or amendments is available through the Montana Analytical Laboratory, however sensitive plants may be damaged at levels lower than detection limits of laboratory analysis. Always contact the lab prior to sending samples. Information can be found at: https://agr.mt.gov/Analytical-Lab. Bioassay testing is strongly recommended to determine if herbicide contamination is present. See bioassay instructions.

Selecting Non-Contaminated Soil Amendments

Guaranteeing a non-contaminated soil amendment can be difficult. If you are purchasing amendments, start by asking the dealer or producer of the amendment a few questions:

1. How does the company prevent herbicide contamination?
2. Does the producer or dealer know the pesticide history of the product and all inputs? Were persistent herbicides used on any inputs to this product?
3. Is plant growth testing (bioassay) used to determine herbicide contamination?
4. Has the producer or dealer had issues with herbicide contamination in the past and if so, what has the company done to remedy the problem?

While the answers to the above questions will help determine the potential likelihood of herbicide contamination in a product, a definitive way to determine if a purchased soil amendment is contaminated is to perform a bioassay prior to applying to the garden (see bioassay instructions).

Creating your own Compost

One method of obtaining herbicide-free compost is to create your own, however you need to understand the history of the compost inputs. For example, to use manure from your horses, make sure they were not fed grass or hay treated with a persistent herbicide. Here are some other steps to take:

- Consider using certified organic hay/straw. If not organic, verify the producer did not use persistent herbicides on the hay/straw.
- Verify manure producers did not feed their animals plants on which persistent herbicides were used. It takes three to seven days of feeding on non-treated plants for livestock to produce manure-free herbicides.
- If pesticide history information for hay/straw or manure cannot be obtained from local distributors, then purchase products directly from producers.
- Read and follow all pesticide labels including restrictions on grass clippings, compost and manure.
- Make sure compost is fully broken down before using in the garden.
- Do a final bioassay before applying to the garden.

Adriane Good

Figure 5: **Bioassay results of known concentrations of aminopyralid.** Washington State University (2010).

Bioassay Instructions

These instructions are intended to determine whether the test material (compost, soil, manure or other material) causes plant growth symptoms consistent with PCA herbicide damage in susceptible plants.

Materials—Here is a list of materials needed to do a bioassay.

- Test material (compost, manure or topsoil)
- Potting mix (pesticide and compost free peat-based commercial mix with fertilizer included)
- 4" plastic pots and saucers
- Garden pea seeds
- Disposable gloves

Steps—Follow these steps to complete a bioassay.

1. **Set up control pots**—Fill at least three pots with potting mix and label. The number of control pots should equal number of test pots. Make sure each pot has its own saucer.
2. **Set up test pots**—If using compost or manure, mix two parts of the suspected material with one-part potting mix. Make sure to collect samples randomly within the material or contaminated site at a few inches in soil depth. Increase number of pots if sampling a large area. Fill at least three pots with the test material mix. Make sure each pot has its own saucer.
3. **Plant three seeds in each pot.**
4. **Grow plants**—Place in a location with adequate sunlight and warmth, water as needed.
5. **Evaluate plant growth**—Record germination when two of the seeds have germinated. Grow until three sets of leaves appear from 14 to 21 days. Though growth may be delayed in topsoil due to nutrient disparities, pay attention to the treated pots, looking for leaf curling, chlorosis, stunting or twisted appearance **(Figure 5).**

Follow detailed directions online at:
http://whatcom.wsu.edu/ag/aminopyralid/bioassay.html.

Remediating Herbicide Contaminated Soils

When deciding if you will attempt to remediate, or remove the herbicide from the contaminated soil, weigh the time and costs associated with each method. Keep in mind each location and soil will have different rates of success depending on local site characteristics and the concentrations of herbicide in the soil. Remediation techniques shorten the time it takes to reduce herbicides to acceptable levels, but exact timing is difficult to predict (i.e. months, years). The most accepted methods of remediation include:

- **Increase microbial breakdown of herbicides within the soil**—microorganisms need water, oxygen and food to live. Increasing these three things through watering, tillage and addition of organic matter or fertilizer will increase microbial breakdown within the soil. Additionally, added water will leach pesticide contaminants deeper in the soil, thus reducing contaminants absorbed by shallow-rooted plants.
- **Bioaccumulation**—a cover crop will remove herbicides from the soil by taking chemicals up into the plant tissue. Suggested cover crops are oats, wheat, corn or grass. Plant biomass must be removed at the end of the summer and disposed in a landfill to prevent the herbicide from returning to the soil.
- **Use a soil additive**—add activated charcoal (1 lb. in 1 gallon of water for every 150 square feet) or biochar to bind to herbicide particles in the soil and make them less available for plant uptake. Due to variability in biochar products, use manufacturer recommended application rates.
- **Combination**—using all or some of the above techniques may increase the amount of herbicide removed from the soil, thus decreasing the time spent remediating when compared to one technique.
- **Do nothing**—leave the soil as is and plant non-susceptible plants or move future plantings to a non-contaminated site. Eventually the herbicide will break down and susceptible plants may be planted in the contaminated location; however, this usually takes a minimum of 2-3 years and often as long as 4-7 years.

Always do a bioassay before planting any susceptible plants in the location after remediation.

Elin Kittelmann

Final Steps and Legal Action

If you find there is herbicide injury from a purchased amendment, return the soil amendment to the place of purchase. You should get your money back, and may save countless other people from having contaminated soil. To request enforcement action, contact the Montana Department of Agriculture.

For More Information

Montana Department of Agriculture
https://agr.mt.gov/OfficeLocations
Phone: 406-444-5400

MSU Extension Pesticide Education Program
Phone: 406-994-5067
Email: pesticides@montana.edu
http://www.pesticides.montana.edu

MSU Herbicide Contaminated Soil and Amendments
http://www.pesticides.montana.edu/reference/contamination.html