Is my garden soil harboring harmful herbicide residues?

Herbicides are chemicals used to control unwanted plants. While these chemicals are effective and safe when used according to the product label, lingering residues may have unintended effects on gardens and landscapes.

Chemical breakdown

Herbicide products undergo extensive testing to determine the appropriate rate and application sites. As a part of the testing, the appropriate authority determines how and when the product breaks down in the environment.

The chemical breakdown of many herbicides involves a mix of photodegradation by sunlight, biodegradation by soil microbes, and a chemical reaction with soil chemicals that renders the herbicide unavailable to any additional plants. This breakdown process can be as quick as hours, or as long as years in extreme cases. The variability of herbicide carryover is heavily dependent on site-specific factors such as soil pH and organic matter content.

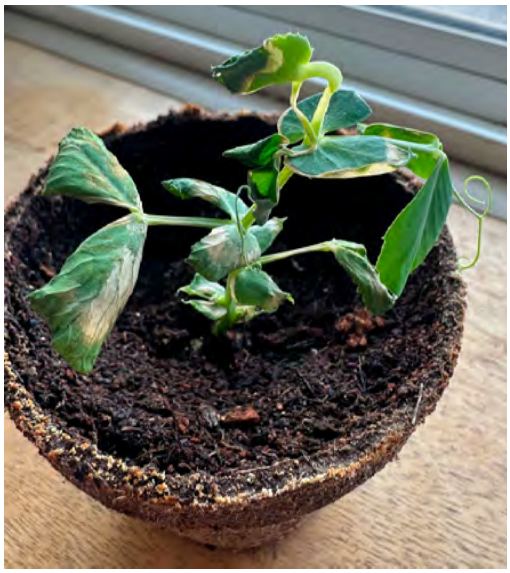
In most proper use cases, the chemical is rendered inert to the next desirable plant in a matter of months. The time of concern for herbicide carryover is variable, but it is crucial to follow the label instructions to reduce the risk of any undesirable outcomes. The timing of herbicide carryover also depends on how much chemical is present in the soil; contamination time can increase significantly if a large amount is released on site. For more information on how long herbicides remain active, visit https://bit.ly/va-ext-herbicide.

Common herbicides

Herbicides commonly used in residential areas include glyphosate, 2,4-D, dicamba, Mecoprop, and triclopyr, or a combination. Glyphosate, the active ingredient in RoundUp®, is a short-acting systemic contact herbicide that becomes unavailable to plants within a day or two after application. When used correctly, glyphosate does not typically cause secondary plant poisonings.

Dicamba, 2,4-D, Mecoprop, and aminopyralid pose a greater risk for secondary carryover. These herbicides are intended to be applied to the target plant and surrounding areas to inhibit weed growth for a short period of time, typically up to a single growing season. All four are considered growth regulators, which means they mimic plant growth hormones and cause cellular damage to treated plants. They have a long history of safe and effective use as they target bio-systems exclusive to plants.

When growth regulators alone are not effective, as in the case of perennial mustard species, another type of herbicide, such as Metsulfuron, may be used. Metsulfuron is not typically used in residential settings, but when plant material or soil containing Metsulfuron residue is removed from the site of application prior to breakdown of the chemical, it may damage plants in the receiving garden or landscape.



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Pea plant grown in soil contaminated with Metsulfuron. Note the bleached stem and leaves. Photo taken approximately 15 days after planting.

Conducting a bioassay

A garden can become contaminated with herbicide residues in many ways, even without intentional application. Contaminated soil, compost, hay, and manure can all bring in unwanted herbicide residues. To determine whether contamination that might affect plant growth has occurred, a simple test called a bioassay can be performed. This experiment should be used as part of a due diligence determination of contamination before drawing a conclusion.

A bioassay can be used to check for contaminated soil, compost, or mulch. The goal is to observe differences in plant growth characteristics when an herbicide-sensitive species, such as pea or tomato, is grown in soil suspected to be contaminated versus soil known to be uncontaminated.

The steps are listed below:

1. Obtain at least 6 individual seed starter pots and waterproof bases or liners to catch any water. Procure potting soil or a suitable good quality growing medium from a known uncontaminated area.
2. Plant the peas or tomatoes. At least 4 of the pots should contain the suspect soil or soil amendment and 2 pots should contain uncontaminated soil (the "control" pots).
   Note: Do not allow water that runs off the pots suspected to be contaminated to contact the uncontaminated control pots.
3. Find a suitable area with adequate sunlight or artificial light to place the seedlings.
4. Note or take pictures of the plants as they grow.
5. Complete the project when the plants reach the second set of true leaves—most issues will be visible by this point. The first "leaves" to emerge are cotyledons that are used to feed the plant and usually shrivel and/or drop off as the plant grows. The true leaves have the leaf shape we expect from that plant, while cotyledons do not.

Note that this test will not yield accurate results unless you isolate the potentially contaminated pots from the uncontaminated pots and have enough repetition to make a determination. Simply testing one potentially contaminated pot and one control pot is not adequate.

Also, make sure to use soils with similar characteristics in all pots. If potting soil is used as the uncontaminated soil and clay/sand is the suspect soil, significant differences in plant growth will be observed that may not relate to herbicides. In this case, mix potting soil with the suspect sand/clay soil in a 1:1 ratio before filling the potentially contaminated pots. Fill the control pots with potting soil only.

Signs of contamination

In the event of possible contamination with a growth regulator herbicide, epinasty can occur. Epinasty is a bending and twisting of a stem or leaf. This is caused by increases in the internal pressure of the plant cells. Plant cells cannot survive this increase in pressure and death is caused by the bursting of the cells. If just a small amount of herbicide is present, the plants can survive long term but the damage will be visible.

Other herbicides, such as Metsulfuron, cause a bleaching of the leaves followed by necrotic, or dead, spots on the leaves. The picture on page 24 displays some of this damage.

Mitigation

If you suspect herbicide contamination of your soil, conduct a bioassay well before spring planting. Remedies for contaminated soil include removal from site and replacement with new topsoil, growing crops that are less likely to be affected by the contamination, and not planting until an unaffected bioassay is completed. Time will reduce the effect of herbicide residues and in some cases, a season or two will be all that is needed.

All soil suspected to be contaminated should be handled with care and to label instructions. Always follow all label instructions when using herbicides and use personal protective equipment appropriate for your situation.

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