

Herbicide Carryover

A Guide to Responsible Residual Herbicide Management



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Productive Farms, Gardens and Responsible Growers

Composts made from animal manures, hay, grass clippings, etc., are excellent sources of nutrients and organic matter for growing broadleaf crops. Soils mulched or amended with manure and compost become dark, aromatic, fertile and active with earthworms and beneficial microorganisms. Farmers and gardeners are encouraged to use compost for these reasons, but they must exercise caution to prevent damage from unintentional additives. One of these unintentional additives could be a residual herbicide.

Herbicide Carryover in Hay, Manure, Compost, Soil and Grass Clippings

Commercial and home gardeners have reported injury to vegetable and flower crops after applying livestock manure, compost, hay and grass clippings to their gardens. The symptoms reported include: poor or absent seed germination; death of young plants; twisted, cupped and elongated leaves; misshapen fruit; and reduced yields. These symptoms can be caused by numerous biotic and abiotic factors, including: nutrient deficiencies, diseases, insects and nematodes, extreme temperature change and herbicide drift. Another possibility for the source of these crop injuries could be the presence of herbicide residue in manure, compost, grass, hay or grass clippings applied to the soil.

Possible Herbicides of Concern

Aminopyralid, clopyralid, picloram, 2,4-D, aminocyclopyrachlor and dicamba are in a class of herbicides known as growth regulators. These herbicides are registered on numerous sites that may include application to pastures, rangeland, small grain crops, nonresidential and residential lawns, certain vegetables and fruits, and roadsides.

These herbicides are used to control a wide variety of broadleaf weeds, including several toxic plants that can sicken or kill animals that graze them or eat them in hay. Based on evaluations by the U.S. Environmental Protection Agency (EPA) and European Union, when these herbicides are applied to registered sites where grass and plant material is grazed, the forage can be safely consumed by horses and livestock — including livestock produced for human consumption. The herbicides can pass through the animal's digestive tract unchanged and are excreted as active herbicides in urine and manure. While clopyralid will degrade during the finishing phase of composting, an appropriate time interval for finishing does not always occur and thus, all of these materials can remain active in the manure even after it is composted. As with many other herbicides, they can remain active in the soil until vegetative plant parts of treated forages are decomposed in the soil and then the herbicide residues are degraded by soil microbes. Depending on the herbicide properties, the herbicide residue and breakdown can take months to years to fully decompose.

These herbicides eventually break down through exposure to sunlight, soil microbes, heat and moisture. Depending on the situation, the herbicide can be deactivated in as few as a couple of months, but some field reports indicate that breakdown can take as long as three to four years. With the exception of clopyralid, where degradation during the composting process occurs efficiently, degradation is particularly slow in anaerobic environments found in piles of manure and compost. When mulches, manures or composts with herbicide contaminants present are applied to fields or gardens to raise certain vegetables, flowers or other broadleaf crops, herbicide damage can occur.

Table 1: Some herbicides registered for uses that have residual properties as of 10/15/2012 (NOTE: This list is not all inclusive; these are only examples.):

Pasture and Hayfields	Commercial Turf and Lawns	Commercial Vegetables and Fruits
Curtail® (2,4-D+ clopyralid)	Confront® (triclopyr + clopyralid) (Confront is not registered for home lawns), Lontrel®	Clopyr™ AG (clopyralid)
Stinger®, Transline® (clopyralid)		
ForeFront® HL, GrazonNext® HL, PasturAll® HL (aminopyralid + 2,4-D)	Millennium® Ultra 2 (clopyralid)	Stinger® (clopyralid)
Grazon® P+D (picloram + 2,4-D)		Spur® (clopyralid)
Opensight®, Chaparral™ (aminopyralid)		
Milestone® (aminopyralid)		
Surmount® (picloram + fluroxypyr)		
Tordon® 22K, Tordon K (picloram)		
Truslate™, WideMatch® (clopyralid + fluroxypyr)		

Table 2: Crops known to be sensitive to picloram, clopyralid or aminopyralid:

Beans	Carrots	<i>Asteraceae</i> family
Cotton	Dahilas	Eggplant
Flowers, in general	Grapes	Legumes
Lettuce	Marigolds	Mushrooms
Peas	Peppers	Potatoes
Roses, some types	Soybeans	Spinach
Sugar beets	Strawberries	Sunflowers
Tobacco	Tomatoes	<i>Umbelliferae</i> family (carrot family)
Vegetables, in general	<i>Fabaceae</i> family (pea family)	

How to Prevent Herbicide Damage to Non Target Plants

The label on every herbicide container contains detailed instructions for use and use precautions, including animal feeding restrictions and appropriate use of manure or crop residues. When used as directed on the labels, these herbicides should not cause any issues in gardens. The manure and plant residues are allowed to be applied to grass pastures, rangeland, grass hayfields, corn or grass grown for seed — effectively recycling them. Most of these herbicides have a crop rotation restriction of 12 months or more before certain broadleaf vegetables or forage legume crops can be planted or grown on treated land.

Problems arise when the hay (treated plant parts), manure, grass clippings or other affected materials are sold or given to others who have no knowledge of the history of herbicide use or of the adverse effects their residues can have on other non target and susceptible plants. The information about the herbicide presence and effects on broadleaf plants may not always follow the hay, manure, compost or other materials as it changes hands to another person. Every individual in the chain of use for products treated with these herbicides should provide or expect to be provided detailed information on applicable herbicide restrictions to prevent potentially catastrophic problems for other farmers and gardeners, and for themselves (including possible liability).

Hay Producers, Dealers and Purchasers of Hay and Straw

If you raise hay or purchase hay, make sure you know if any herbicides were used on the hay prior to your possession. The primary focus of concern pertains to grass hay since legume hays, such as alfalfa, clover and other broadleaf hay crops, will be injured or killed by applications of most residual broadleaf weed herbicides. These herbicides have the potential to remain active in manure or urine after consumption by simple stomach and ruminant-consuming livestock. Producers and retailers of hay must communicate — verbally and in writing — that herbicide-treated forages and plant matter converted into manure are not usable as a fertilizer, soil amendment or compost in areas used for growing broadleaf plants. Landowners should know and maintain a written record of the herbicides applied to their fields. Upon selling products of herbicide-treated inputs, sellers must inform purchasers of these precautions.



Custom applicators should communicate what products are applied to customers' fields (including any cropland and rangeland herbicide applications) or turf and provide a copy of the herbicide label(s) highlighting manure and compost use precautions. The labels provide information on use restrictions. Some herbicides also can remain active on the hay or small grain straw/stubble itself. As these plant parts decompose in the soil and become part of the soil profile, the herbicide residue can be released back into the soil and affect non target plants and vegetables before it has a chance to be broken down by soil microbes. Be cautious about selling, giving away or purchasing new or old hay for use as mulch or for making compost. The hay can be sold for consumption by livestock and horses, but the purchaser needs to be aware that if a herbicide was used, the herbicide will pass through the animals' digestive system unchanged and into the manure, thus potentially being a contaminant of soil and compost.

Advise people feeding this hay to their animals to spread the manure on grass pastures or grass hayfields, being sure to follow all safety guidelines and regulations. According to the herbicide labels, plant materials treated with these herbicides should not be considered safe for growing sensitive crops or vegetables until the herbicide residue is completely decayed and broken down. Users of these contaminated plant parts can accelerate breakdown of herbicide residues by incorporating them evenly into the soil. Breakdown of the herbicides is most rapid under warm, moist aerobic conditions and may be enhanced with irrigation. Breakdown of these herbicide residues are done by microbes that naturally live in the soil.

Livestock and Horse Owners

If you buy hay for your animals, ask the farmer or seller which herbicides, if any, were used in producing the hay. If a herbicide was used, obtain a copy of the herbicide label from the grower or online (at www.cdms.net/LabelsMsds/LMDefault.aspx), and refer to the Use Precautions and Restrictions section. A simple indicator that these herbicides were not used in the production of hay is the presence of legumes, such as clovers, alfalfa or sainfoin. If the hay has legumes in it, it has likely not been treated with any of these herbicides. The absence of legumes in hay, however, does not mean that these herbicides are present. If you do not know the herbicide history of the hay, do not sell or give away the manure from animals that consumed the hay for use in growing plants or to make compost. If you wish to sell or give away the manure in question, have it lab-tested or conduct a bioassay (see below) as it may contain one of the herbicides of concern. Manures that contain these herbicide residues can be safely spread on grass pastures, rangelands, grass hayfields corn or grass grown for seed.



Contact your local Extension agent or NRCS office to develop a manure management plan. Note: Depending on the herbicide used, it takes three to seven days feeding on non treated materials for most animals' digestive tracts to produce manure clear of any herbicide residue. Consult the appropriate product label for specific information.



Farmers and Gardeners Wanting to Use Manure or Compost

Before acquiring or using manure — fresh, aged or composted — ask what the animals were fed, the origin of the hay and which, if any, herbicides were used on the hay, pasture or rangeland. Some livestock owners may suggest the manure is “safe” because their animals have not been affected. However, herbicides registered for use on pastures and hayfields are allowed by their labels to be consumed by animals. Thus the livestock owner may not know if herbicide products were used or the origin of the hay they may be selling or brokering. If you don't know which, if any, herbicides were used, make use of the bioassay described below to test for the presence of these herbicides.

Do not use the manure or compost to grow sensitive crops without knowing its herbicide history or testing to see that it is safe. If you find yourself with a small quantity of contaminated manure or compost, spread it on a grass pasture or rangeland, grass hayfield or corn. Great care should be taken in using contaminated manure or compost to only grow non susceptible plants, such as pasture and rangeland grasses. Consult the herbicide product label to determine if the pesticide is labeled for use (legally permitted to be applied) to that crop or land use. If the product already has been applied to the soil, tilling it several times during the growing season, irrigating the area and planting it into a non sensitive cover crop for one year or two will help the herbicides break down. Conduct a pot or field bioassay, as described below, before planting any sensitive crops in the area.



Farmers and Gardeners Wanting to Use Hay or Grass Clippings

If you want to use hay or grass clippings as mulch or in your compost pile, find out what, if any, herbicides were used previously on the field or lawn. Be particularly careful about obtaining grass clippings from golf courses and other commercial turf fields where some of these herbicides are commonly used. If you find yourself with contaminated hay or grass clippings, spread them on non sensitive, pasture, rangeland or corn; burn them; or arrange to have them disposed of properly and safely. If the hay or grass clippings already have been applied to the field or garden, remove them; till the soil; sow a non sensitive cover crop; and let the crop grow for one or two years to help the herbicide break down. Conduct a pot or field bioassay, as described below, before planting any sensitive crops in the area.

How to Test for the Presence of Herbicides with Pot and Field Bioassays

Some laboratories can test for the presence of these herbicides, but the tests are expensive and not as sensitive as a plant bioassay that you can perform yourself. The simple pot and field bioassays involve growing beans or peas, which are very sensitive to the presence of these herbicides, in the manure, compost or soil.

First, take a number of random, representative samples (small shovelfuls) from throughout the manure, compost or soil, being sure to get deep inside of the piles. Mix samples thoroughly. If there are separate sources of manure, compost or soil, conduct individual assays for each. Prepare three to six small (4- to 5-inch) pots with a 1:1 mix of the manure, compost or soil with uncontaminated soil. Also prepare one pot with uncontaminated soil as the "control" pot. Put saucers underneath each pot, or position the pots far enough apart so water running out of the bottom of the pots will not reach another pot.



Plant three pea or bean seeds in each pot, water and let them grow for two to three weeks, until there are three sets of true leaves. If the peas or beans in the control pots grow normally and the ones in the pots with manure, compost or soil do not, you can assume the manure, compost or soil is contaminated with a herbicide that will adversely affect sensitive plants. If they all grow normally, it would be reasonable to assume the manure, compost or soil is fine. A similar test can be done with young tomato transplants, but herbicide damage may not appear until the plants first set fruit. Keep in mind, that these tests will be only as good as the samples you take. It would be better to err on the side of too many samples than too few (at least 20 per pile). You can create a similar test for hay or grass clippings by filling the pot with commercial potting mix and spreading a thick layer of the hay or grass clippings on top or mixing in the soil medium. This bioassay is explained in detail on the Washington State University website: www.puyallup.wsu.edu/soilmgmt/Pubs/CloBioassay.pdf.

If a field or garden site has previously been treated with residual herbicides or been exposed to residual herbicides through the application of treated manure, compost, soil, hay or grass clippings, a field bioassay can be conducted. Plant peas or beans in short rows scattered throughout the affected garden area. If herbicidal symptoms appear, do not plant sensitive plants; plant grasses instead. Test again the following year. If the test plants grow normally, it should be safe to grow broadleaf crops. If you have contaminated soil in your garden from any source, you have the option to relocate the garden site or dig out the contaminated soil and replace with uncontaminated soil.

Note: The preceding bioassay is designed to test only for growth regulator (auxinic) herbicide residues and not other herbicides with different modes of action or substances.



In addition to any questions you may have about the possibility of herbicides in your manure or compost, gardeners should be aware of the general precautions relating to the use of manure in gardens. The following is guidance provided by the University of Minnesota Cooperative Extension (www.extension.umn.edu/distribution/horticulture/M1192.html) when using fresh manure as a soil amendment:

“Fresh manure is high in soluble forms of N, which can lead to salt build-up and leaching losses if over applied. Fresh manure may contain high amounts of viable weed seeds, which can lead to weed problems. In addition, various pathogens such as E. coli may be present in fresh manure and can cause illness to individuals eating fresh produce unless proper precautions are taken. Apply and incorporate raw manure in fields where crops are intended for human consumption at least three months before the crop will be harvested. Allow four months between application and harvest of root and leaf

crops that come in contact with the soil. Do not surface apply raw manure under orchard trees where fallen fruit will be harvested.”

Label precautions apply to forage treated with Chaparral, ForeFront HL, GrazonNext HL, Milestone or PasturAll HL and to manure from animals that have consumed treated forage within the last three days. Consult the label for full details.

When treating areas in and around roadside or utility rights-of-way that are or will be grazed, hayed or planted to forage, important label precautions apply regarding harvesting hay from treated sites, using manure from animals grazing on treated areas or rotating the treated area to sensitive crops. See the product label for details.

*Chaparral, Confront, Curtail, ForeFront, Grazon, GrazonNext, Lontrel, Milestone, Opensight, PasturAll, Stinger, Surmount, Tordon, Transline and WideMatch are trademarks of The Dow Chemical Company (“Dow”) or an affiliated company of Dow.

*Spur is a trademark of Albaugh, Inc.

*Millennium and Truslate are trademarks of NuFarm Americas Inc.

™Clopyr is a trademark of United Phosphorus, Inc.

Grazon P+D, Surmount, Tordon 22K and Tordon K are federally Restricted Use Pesticides.

State restrictions on the sale and use of Opensight, Transline and WideMatch apply. Consult the label before purchase or use for full details.

Chaparral, ForeFront HL, GrazonNext HL and Milestone are not registered for sale or use in all states. Contact your state pesticide regulatory agency to determine if a product is registered for sale or use in your state.

Milestone specialty herbicide is labeled for use in forestry site preparation treatments in AL, AR, GA, LA, MN, MS, NC, SC, TX and VA. Milestone specialty herbicide is labeled for use in longleaf pine plantations in NC, SC and VA. See the supplemental label for details.

Stinger is not available for sale, distribution or use in Nassau and Suffolk counties in the state of New York. State restrictions on the sale and use of Stinger apply. Consult the label before purchase or use for full details.

Confront is not for sale or use in Nassau and Suffolk counties, New York. Other state restrictions on the sale and use of Confront and Lontrel apply. Consult the label before purchase or use for full details.

PasturAll HL is not available for sale, distribution or use in the state of New York.

Always read and follow label directions.

Resources for More Information

Washington State University Web site on clopyralid carryover. Includes pictures of affected vegetables, research results, and the bioassay protocol:

<http://www.puyallup.wsu.edu/soilmgmt/Clopyralid.html>

Article from Minnesota Extension explaining the problem in hay and how to avoid it. The article is devoted to “ditch hay,” but the information is relevant to all hay:

<http://www.extension.umn.edu/agriculture/horse/nutrition/harvesting-ditch-hay/>

CDMS Agro-chemical database with access to all the herbicide labels: <http://www.cdms.net/LabelsMsds/LMDefault.aspx?t>

Dow AgroSciences United Kingdom Web site with information on aminopyralid: <http://www.manurematters.co.uk/>

2014 NC Agricultural Chemicals Manual for information on recommended pesticides for use in NC: <http://ipm.ncsu.edu/agchem/agchem.html>

Herbicide Carryover in Manure-Last of the Tomato Study Results: ncalternativecropsandorganics.blogspot.com/2010/08/herbicide-carryover-in-manure-last-of.html

This paper was adapted for use based on: Herbicide Carryover in Hay, Manure, Compost, and Grass Clippings: Caution to Hay Producers, Livestock Owners, Farmers, and Home Gardeners: <http://content.ces.ncsu.edu/herbicide-carryover.pdf>

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