Cooperative Extension University of California Ventura County

Landscape Notes

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Vol 16. No. 1 June 2002

Herbicide Residue in Compost

The Herbicide Contaminated Compost Issue

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Herbicide contaminated composts have suddenly come to the fore as another important environmental issue threatening California's landscape and greenwaste recycling industries. Starting late last year, articles began appearing in some of the state's major newspapers which the public's attention on the issue and raised its level of importance. It is borne out of problems that began in Washington State where herbicide-contaminated composts were found to be causing injury to garden plants.

Clopyralid was confirmed as the culprit by the manufacturer, DowAgrosciences (formerly known as DowElanco). Clopyralid residue has since purportedly been found in finished composts in California, but so far no plant damage from tainted compost has been reported in state. The problem occurs in spite of warning language on many product labels to avoid composting clopyralid-treated plant material. This has sparked a storm of controversy and concern in the green industry and the public over the safety of composted greenwastes here in California. The following discussion is intended to provide information on clopyralid and the problems it causes in compost, the California situation, and suggest steps the landscape industry can follow to minimize contamination of compost.

Clopyralid Products and Use

Clopyralid is a pre- and post-emergent herbicide with activity against a narrow range of certain annual and perennial broadleaf weeds. Products containing clopyralid have been on the U.S. market for more than 15 years and have been registered in California since 1997.

Clopyralid is a constituent of products sold under several trade names registered for a variety of uses including cropland, rangeland, turfgrass, roadsides, right-of-way and other non-crop applications. *Confront* is a turfgrass herbicide that also contains tryclopyr and is registered for use in commercial turfgrass applications and golf. *Lontrel* is an herbicide containing only clopyralid that is also registered for commercial turfgrass. *Stinger* is a product registered for use in agricultural crops, and *Transline* is used for industrial and right of way weed control. *Trupower* is formulated for use by Trugreen/Chemlawn in their commercial applications to turfgrass. *Millenium* is formulated by Scotts as a fertilizer/herbicide granule for use in golf and commercial turfgrass applications. *Millenium Ultra*, formulated by Riverdale Chemical Company, is a combination product (clopyralid, 2,4-D, and dicamba) registered for use on ornamental turf sites such as golf courses and lawns. No clopyralid products are available for use by homeowners in California.

Clopyralid has excellent activity certain difficult to control leguminous weeds. In turfgrass it is particularly effective in controlling clovers and dandelions. Use of clopyralid enables applicators to attain control of certain broadleaf weeds with fewer herbicide applications. However, a relatively limited amount of clopyralid is used in California on turfgrass due to its expense and narrow registration of uses.

Clopyralid Basics and Mode of Action

Clopyralid is a plant growth regulator herbicide from the picolinic acid group of compounds. In susceptible plants, clopyralid disrupts auxin-regulated processes, including cell respiration and growth, causing uncontrolled and disorganized plant growth that leads to plant death. Uptake of the herbicide is either through roots or leaves, and it is both phloem and xylem mobile. Translocation throughout the plant is rapid and the material accumulates in growing points of the plant where it has its primary effect.

Clopyralid affects sensitive plants at a concentration as low as 10 parts per billion, a very low concentration. Typical clopyralid toxicity symptoms include curved and twisted stems and leaves, cupping and crinkling of leaves, stem cracking, and hardened growth on stems and leaves. Complete browning and death can take a couple of weeks for seedlings or an entire season for susceptible perennial or woody plants.

Clopyralid is more selective (kills a more limited range of plants) than some other auxin-disrupting herbicides like picloram, triclopyr, or 2,4-D. Like these herbicides, has little effect on grasses and other monocots clopyralid does little harm to members of the mustard family (Brassicaceae) and several other groups of broad-leaved plants. The basis of its selectivity is not well understood. Clopyralid is primarily effective against four plant families: Asteraceae (sunflower family); Solanaceae (nightshade/tomato family); Fabaceae (legumes/peas/clover family); and the Polygonaceae (buckwheat/knotweed family).

Clopyralid is water-soluble and does not bind strongly with soils or evaporate easily. The chemical breaks down comparatively slowly in soil and persists in plant material, even in non-susceptible and non-target species. Clopyralid may persist in the environment from a month to over a year. Its persistence is greatest in soils that are low in oxygen (compacted or water saturated most of the time) and low in microorganism activity (cold, heavily graded or disturbed soils). It is degraded almost entirely by microbial action in soils or aquatic sediments, not by sunlight or contact with water. break downare highest in warm, moist soils that are low in organic matter, and lowest in cold, dry, compacted or waterlogged soils.

The only clopyralid degradation product is carbon dioxide. The inability of clopyralid to bind with soils and its persistence imply that it has the potential to contaminate water resources and non-target plant species, but no extensive offsite movement has been documented. Clopyralid is low in toxicity to aquatic animals and very low in toxicity to most animals, but it can cause severe eye damage including permanent loss of vision in humans.

Toxicity Problems and Compost Contamination

Toxicity problems started in Spokane, Washington when symptoms were first noted on tomato plants. Clopyralid was found as a contaminant in greenwaste composts incorporated in to the soil or applied around plants The problem was noted at about the time that curbside recycling of green wastes and the associated composting programs began in that state. Since grass clippings are an important component in that state's green wastes, they were soon identified as the source of the herbicide, and the origins of it were traced back to applications of *Confront* to residential lawns.

There are a number of desirable crop and ornamental plant species among the families which clopyralid might affect including tomato, pepper, eggplant, potato, beans, peas, sunflower, chrysanthemum, daisy, petunia, acacia, honey locust and other leguminous plants. Age of the plant and rate of herbicide application will greatly impact the degree of injury that might occur. Plants are most tolerant to clopyralid applications when they are established and when there is some

woody tissue around the stem or trunk. Thus, it is believed that woody plants are less likely to be damaged from the presence of clopyralid-contaminated compost in the landscape.

The characteristics of clopyralid allow it to remain active and available for plant uptake for a long period, thereby reducing the amount of herbicide and number of applications needed to achieve control of susceptible plants. Conversely, its characteristics cause a significant problem when greenwaste from clopyralid-treated plants is composted. Clopyralid survives the composting process and very little of its residue is needed to cause toxic effects on non-target plants that come in contact with finished composts used as soil amendments or mulches.

Considerable study has been undertaken by the manufacturer to understand the persistence of clopyralid. Clopyralid persists to a variable degree in soil when applied to turfgrass or directly to soil as a pre-emergent treatment, so it remains available for any plants present to take it up and translocate it. However, it was discovered that when grass clippings or other plant materials containing clopyralid are composted, the herbicide becomes bound in the organic matter and it becomes more persistent, not less persistent after composting. For some time it was thought that the wrong microbes were in the compost and that addition of new clopyralid degrading organisms found in soil would solve the problem. This was subsequently tried and, unfortunately, it was shown that these organisms will not break down the herbicide when they are added to finished composts.

Other research showed that clippings collected between 2 and 14 days after being sprayed with the herbicides 2,4-D, triclopyr, clopyralid, or isoxaben caused unacceptable injury to tomatoes, beans, and impatiens when applied directly as mulch around these plants. However, after composting these clippings all of the herbicides except clopyralid degraded to non-detectable levels during 128 days or less of composting. In one study clopyralid was still detected after 365 days of composting.

Based on this research, labels of herbicides containing clopyralid typically state that turfgrass clippings treated with the herbicide should not be used as agarden mulch, and treated clippings should not be used to make compost during the season of herbicide application.

Recent research was conducted at the Washington State University – Puyallup turfgrass research facility to address the contaminated grass clipping problem. The objective was to determine if mowing practices or formulation (sprayable or granular) could be used to limit the amount of clopyralid entering the compost stream over a 10 week period. Clopyralid-treated turf was mowed weekly with clippings collected or mowed twice weekly with clippings returned. Clopyralid was applied to each mowing regime as a sprayable formulation or a granular formulation embedded on granules of 12-12-12 fertilizer. Sprayed plots received equivalent rates of fertilizer nutrients. Turf clipping samples were collected in each mowing regime at 0, 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 weeks after clopyralid treatment. Regardless of formulation, the mowing treatment did not impact clopyralid concentration in clippings. By four and ten weeks after application, clopyralid concentrations in clippings were 7% and 0.4% of their initial concentrations in sprayed and granular formulation plots, respectively. Concentrations still averaged 150 ppb in clippings at ten weeks after application, which would be high enough in compost to cause injury to many plants. What is not known is what the final clopyralid concentration in compost would be based on an initial concentration of 150 ppb. A companion study is ongoing to measure the clopyralid degradation during composting.

What about California?

In late March, the California Department of Pesticide Regulation (CDPR) initiated cancellation action against 15 clopyralid-containing herbicide products intended for use on residential lawns. On May 3, the CDPR and California Integrated Waste Management Board hosted an "External Stakeholders Meeting on Clopyralid and Compost" at the Cal/EPA building in Sacramento. Approximately 50 stakeholders attended -- these included composting operators, herbicide manufacturers, applicators, agricultural and horticultural end-users, County Agricultural Commissioners, city officials, and Federal agencies. Discussion topics included California's

organics recycling infrastructure, clopyralid use patterns, residue pathways, regulatory framework and actions, and education and outreach. Stakeholders established three working groups on testing, clopyralid use and composting feedstock patterns, and education and outreach. Each working group was charged with developing a workplan that includes objectives and initial tasks; these workplans will be considered at the next meeting of the external stakeholders group, which will take place in June or early July.

Compared to Spokane and perhaps other areas of the Pacific Northwest, many of California's urban areas produce greenwastes formulated from a variety of feed stocks with a higher proportion of woody materials to grass clippings. Also, the Spokane area has a relatively high concentration of residents who utilize commercial lawn care services, perhaps as much as twice the national average, and clopyralid is a popular herbicide used by them. There is a comparatively limited amount of clopyralid used in California landscapes and it is believed much of it, though not all is applied to turfgrass where the clippings are left to decay on the lawn (grasscycling), so they never enter the waste stream. In addition, Dow AgroSciences clopyralid herbicides have label restrictions on using compost containing grass clippings treated with the product.

Despite all of this, trace clopyralid residues have purportedly been found in greenwaste composts in Los Angeles, San Diego, and Sonoma Counties. Homeowners using professional lawn care services may not have been informed that clopyralid was used, or may not have known that restrictions apply, and unwittingly sent their grass clippings into the greenwaste stream. Fortunately, no serious damage has been reported on crop or ornamental plants receiving composted greenwastes in California.

Clopyralid, and possibly other persistent herbicides, threaten the state's greenwaste composting and recycling industry, the landscape industry, and state and local government programs that promote backyard and centralized composting as a method of dealing with greenwaste. Many in these industries and the public believe the existence of a class of herbicides that can damage the marketability of compost products is contradictory to recycling, resource conservation, and sustainability.

At this time, University of California weed scientists and Dow AgroSciences do not know the extent of contamination in California greenwastes. There is need for additional testing of greenwaste composts to get a clearer view of the threat.

However, clopyralid contamination should not become a disaster for California because our compost feed stocks are diverse and it appears there is simply not enough clopyralid applied to turfgrass entering California's greenwaste stream for it to be a widespread, serious problem in compost.

Management Practices for Preventing Herbicide Contamination of Composts

There are multiple practices that can be followed to prevent herbicide contamination of greenwaste composts. The greatest risk is from herbicide-treated grass clippings, so steps must be taken to keep such clippings from entering the greenwaste recycling stream.

Landscape managers should carefully consider whether a clopyralid-containing herbicide is really needed to control the spectrum of weeds found in a given site. There are other herbicides that effectively control many broadleaf weeds but do not persist in turf clippings or other greenwaste. Also, turf that is maintained in good health and mowed at the correct height is less likely to be invaded by clover and other broadleaf weeds, which in turn reduces the need for herbicide applicationsIf a clopyralid-containing product is applied to turfgrass, take all necessary actions to ensure clopyralid-treated grass clippings are not allowed to be used as mulch or compost feed stock. Be certain to follow label instructions and precautions and notify clients of the property that turfgrass clippings are not to be composted or used as mulch. Using a mulching mower to return clippings to the lawn area is the best way to manage treated grass clippings.

Contaminated compost should not be used in vegetable gardens, but it is probably safe to use it as a soil amendment for lawns or woody landscape plants, as most of these plants are not highly sensitive (although there may be exceptions). Compost should not be used as a sole growing

medium, but should be mixed with soil at rates of up to 20% compost by volume. This will dilute clopyralid residue to a level most plants can tolerate. Also, microorganisms present in soil can break down clopyralid over time. It is recommended that landscape contractors ask their compost supplier about possible clopyralid contamination.

For additional information on clopyralid in compost, see the following web sources:
1. Washington State University:
www.puyallup.wsu.edu/soilmgmt/Clopyralid.htm
www.css.wsu.edu/compost/compost.htm

2. Dow Agrosciences:
http://www.grrn.org/dow/DOW_Clopyralid_Compost_10-5-01.pdf
http://www.wa.gov/agr/Dow_TolerantPlants.pdf

3. Technical background information on clopyralid: http://tncweeds.ucdavis.edu/handbook.html (scroll down to Chapter 7 and click on "Clopyralid")

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