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ONGOING INVESTIGATIONS

PREVALENCE AND FATE OF CLOPYRALID IN COMPOST

Lab technicians evaluate plant bioassays for clopyralid injury.

More extensive sampling in Washington state shows presence of the herbicide in composts and a variety of feedstocks, while a study of grass clippings found both significant loss and residue of clopyralid 10 weeks after application.

Robert Rynk

NOW THAT clopyralid has been found in compost and composting feedstocks, the question that immediately leaps out is "What should we do about it?" This, of course, is the big question. The answer hinges on the answers to lots of other questions like: How widespread is the contamination? Is it a regional problem? Where does the clopyralid come from? Why doesn't it breakdown during composting? Can we help it to breakdown faster? What levels are safe enough?

The discovery of clopyralid in compost is relatively recent so the effort to gather the answers is just beginning. It may take some time to sort through the information before the big question can be addressed. Nevertheless, the information gathering process at least has started. There are a number of interested parties looking into the issue including the U.S. Composting Council, U.S. Environmental Protection Agency, state environmental and agricultural agencies, universities, laboratories, compost producers, compost users, herbicide applicators and Dow AgroSciences, the manufacturer of clopyralid.

Not surprisingly, the leading edge of the investigation is taking place in Washington state, where the problem first hit the fan in the United States. Both Washington State University (WSU) and Washington State Department of Agriculture (WSDA) have started collecting and analyzing samples to determine how pervasive clopyralid is in compost and composting feedstocks. There are also new efforts to determine what the fate of clopyralid is in the environment (composting and otherwise) after it is applied.

WSDA STATEWIDE SAMPLING

In the wake of the problems resulting from clopyralid-tainted compost, WSDA is reexamining the uses of clopyralid in the state (see accompanying article, "Clopyralid Developments in Washington State"). First, WSDA needs to determine whether clopyralid residue in compost is potentially a statewide problem. Up until now, damage from clopyralid in compost has been documented only in eastern Washington, specifically in Spokane and Pullman. In addition, it has been suggested that the clopyralid contamination is due to the much higher than normal use in the eastern region.

In October, WSDA gathered samples of composting feedstocks and compost to test them for clopyralid and picloram, a clopyralid-like herbicide that also has caused problems in compost. The program was voluntary for composting facilities. Nine major facilities participated, five from western Washington and four from the eastern side of the mountains. The facilities known to have clopyralid contamination, from Spokane and WSU, were not included in this survey. The

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participating facilities are fairly diverse. In addition to their location differences, they comprise windrow and forced aeration operations and several are enclosed. Most process yard trimmings but some operations also handle food residuals, paper products or animal manures and bedding.

Separate samples were taken on the same day of incoming feedstocks and compost, both immature and final products. All samples were analyzed by the Anatech Lab. The detection limit was one part per billion (ppb).

The results of WSDA's clopyralid analysis program are shown in Table 1. Picloram was not detected in any of the samples. However, clopyralid was detected above critical levels at every facility. To put the numbers into perspective, clopyralid is damaging to sensitive crops (e.g. tomatoes, potatoes, sunflower, beans, peas) at concentrations as low as 10 ppb (and even lower). The feedstock analysis does seem to implicate yard trimmings, and grass clippings in particular, as a primary source of clopyralid. However, the herbicide also was present in worrisome levels within feedstocks that included straw or manure. The most alarming numbers came from an eastern Washington facility where clopyralid was found in grass clippings at 1,550 ppb and at 477 ppb in immature compost. At the other facilities, the clopyralid concentrations in the mature or finished compost ranged from nondetect to 182 ppb. Seven of nine compost samples from eastern Washington and 12 of 14 compost samples from the Western region had clopyralid concentrations greater than 20 ppb. This is clearly not an eastern Washington phenomenon.

It is worth noting that, for each facility, this data represents a one-day in time picture. It does not necessarily show how the clopyralid concentration changes through the composting process.

Table 1. Results of WSDA sampling and analysis of clopyralid in composting feedstocks and compost

Facility	*Composting Feedstocks*	*Clopyralid Concentration (ppb)*	*Compost*	*Clopyralid Concentration (ppb)*
		Western Washington Results		
Facility #1	Mixed yard trimmings	ND	Compost	25
	Dairy manure	ND	Compost	182
	Hay and straw (feed)	ND		
	Corn silage	ND		
	Feed pellets	ND		
Facility #2	Mixed feedstock	12	Immature compost A	27
			Mature compost B	43
			Mature compost from grass	52
			Mature compost Sept. - Feb.	9
			Mature compost - sales pile	75
Facility #3	Commercial yard waste	250	Immature compost	24
	Mixed commercial and residential yard waste	100	Mature compost	124
	Residential yard waste	ND	Compost w/ county fair feedstocks — straw, wood shavings, animal manure	150
Facility #4	Mixed yard waste	33	Immature compost	86
			Mature compost	124
Facility #5	Grass clippings, leaves	ND	Immature compost	46
	Chipped woody yard waste	ND	Mature compost	ND
	Straw & manure from fair	62		
		Eastern Washington Results		
Facility #6	Feedlot manure	11	Immature compost	20
	Apple & grape pomace	ND	Finished compost	66
	Grape pomace	ND		
	Hop waste	ND		
Facility #7	Straw	200	Immature compost	477
	Grass clippings	1550		
	Leaves	11		
	Manure & bedding	56		
Facility #8	Animal manure	16	Immature compost	18
	Leaves & grass	600	Mature compost	23
	Straw	ND	Finished compost	29
Facility #9	Mixed yard waste from staging area (new)	26	Immature compost - beginning of process	103
	Mixed yard waste from staging area (old)	35	Mature compost from curing area	43
			Mature bagged compost	40

ND = Nondetect below practical limit of detection of 1ppb (unless noted);

WSU MONITORING PROGRAM

Since it was beset by herbicide contamination in 2000, the WSU composting program has been working to remove and prevent clopyralid and picloram from entering the feedstock stream. On an ongoing basis, WSU has tested a wide range of feedstocks and agricultural residuals that may affect compost quality, including animal bedding, manure, straw, hay and grain fed to cattle. The results of the analysis are available on the WSU compost program web site (www.css.wsu.edu/compost/). They are reproduced in Table 2.

As Table 2 shows, WSU compost continues to contain significant concentrations of clopyralid. Although timothy hay consistently contains some clopyralid, the feedstock analysis does not point to a specific clopyralid source. Rather, the detection of clopyralid in the feedstocks is sporadic and variable. While one batch of straw or hay can be relatively free of the herbicide, the next batch may carry enough clopyralid (or picloram) to contaminate several batches of compost. In general, the WSU test results suggest that clopyralid contamination is not restricted to grass clippings. Many agricultural products can move the herbicide into compost. For example, the horse manure tested (used to amend a local garden) showed damaging levels of both clopyralid and picloram.

Several of the feedstock test results are notable. First, hay produced on campus (sampled on October 26) still has a high concentration of picloram. This may include residual hay from the crop that brought picloram into the facility in 2000. (Overall, the levels of picloram, the herbicide that initially caused WSU problems, has appeared to have subsided.) Second, one sample of barley contained a relatively high concentration of clopyralid (114 ppb). This is a feed product, not a crop residue. When fed to cattle, much of the clopyralid will pass through the urine of the animals and be collected with the manure. At least one other cattle manure composting facility (outside of Washington) has reported barley as a likely source of clopyralid in compost. It demonstrates that herbicide residues are a concern to any agricultural products treated with clopyralid.

OTHER INVESTIGATIONS

The clopyralid problem is being investigated on other fronts as well. For instance, Dow AgroSciences is funding several studies that are intended to provide information about the degradation of clopyralid after it is applied.

One Dow AgroSciences-funded study is being conducted by WSU researchers in Puyallup. They are looking at clopyralid concentrations in grass clippings following application. The objective is to identify management practices that might reduce the concentrations in clippings collected for composting. Although the study is not completed, some preliminary results are available. The average clopyralid concentration in grass

Table 2. Sampling and analysis by WSU (Pullman) for clopyralid and picloram residues in feedstocks and compost

Sample	Sample Date	Clopyralid [1] (ppb)	Picloram [1] (ppb)
Washington State University Feedstocks			
WSU dairy cattle manure	10/30/01	3	ND
WSU beef cattle manure	10/30/01	4	24
WSU beef cattle manure	10/11/01	11	ND
WSU beef cattle manure (vet school)	10/11/01	27	ND
WSU dairy cattle manure	7/31/01	3	ND
WSU dairy cattle manure	3/14/01	6	45
Timothy hay	10/26/01	25	ND
Timothy hay - from campus	10/26/01	ND	117
Timothy hay - from campus	10/26/01	ND	136
Timothy hay	10/26/01	55	ND
Oat hay	10/26/01	ND	ND
Bluegrass hay	10/26/01	ND	ND
Timothy hay	10/1/01	39	ND
Timothy hay	7/18/01	9	ND
Timothy hay	6/6/01	67	ND
Grain feed - barley (composite sample)	10/26/01	114	ND
Grain feed - barley (campus)	10/26/01	ND	ND
Grain feed - wheat	10/26/01	ND	ND
Grain feed - corn	10/26/01	ND	ND
Grain feed - corn	10/26/01	ND	ND
Straw purchased for WSU dairy farm	10/26/01	ND	ND
Straw purchased for WSU dairy farm	10/26/01	ND	ND
Straw purchased for WSU dairy farm	10/1/01	ND	ND
Straw from animal research unit	7/31/01	ND	12
Straw purchased for WSU dairy farm	7/31/01	ND	ND
Straw purchased for WSU dairy farm	3/13/01	14	ND
Straw - veterinary clinic	6/12/01	ND	ND
WSU greenhouse waste[2]	6/12/01	7	ND
Washington State University Composts			
Typical WSU compost with dairy manure	10/1/01	105	ND
Typical WSU compost with dairy manure	10/1/01	215	ND
Typical WSU compost	5/8/01	206	38
Typical WSU compost	5/8/01	39	18
Typical WSU compost	5/8/01	25	3
Typical WSU compost	5/8/01	18	3
Typical WSU compost	5/8/01	120	72
Typical WSU compost	5/8/01	184	44
WSU compost that first caused problems[3]	1/5/01	11.2	500
Typical WSU compost	1/5/01	3.8	31
Typical WSU compost	10/27/00	7	24
WSU bedding compost product	10/11/01	96	ND
WSU bedding compost product	10/11/01	169	ND
WSU bedding compost product	10/1/01	70	ND
WSU bedding compost product	10/1/01	346	ND
WSU bedding compost product	10/1/01	94	ND
WSU bedding compost product	10/1/01	98	ND
WSU bedding compost product	7/31/01	ND (@10 ppb)	ND (@10 ppb)
WSU bedding compost product	7/31/01	ND (@10 ppb)	ND (@10 ppb)
WSU bedding compost product	3/29/01	66	5
WSU bedding compost product[4]	3/14/01	16	70
WSU bedding compost product	3/12/01	102	25
WSU bedding compost product[4]	3/9/01	15	250
Other Agricultural Products Tested			
Chicken manure	11/30/01	7	ND
Chicken manure	11/30/01	ND	ND
Chicken feed	11/30/01	ND	ND
Horse manure used in garden	7/30/01	67	132
Timothy hay	10/11/01	421	ND
Timothy hay	10/11/01	446	ND
Chopped straw used for erosion blanket	7/30/01	ND	ND
Other Composts (Not WSU)			
Western Washington sample	8/28/01	ND	ND
Eastern Washington sample[5]	8/28/01	278	ND
Garden Soils That Did Not Get WSU Compost			
Garden soil treated with local manure	8/2/01	3	2
Garden soil treated with local manure	8/2/01	4	18

ND = below practical limit of detection of 1ppb (unless noted); [1]Analytical test by Anatek (EPA 8151 modified); [2]Predominantly potting mix; [3]Dried and screened; [4]Isolated from dairy; [5]Chicken manure and bluegrass straw

CLOPYRALID GETTING U.S. EPA'S ATTENTION

THE INCIDENTS of clopyralid in compost have captured the attention of the U.S. Environmental Protection Agency (EPA) — the federal agency responsible for regulating pesticides on a national level. To explore the clopyralid issue, an ad hoc work group has been formed by EPA's Herbicide Branch, a unit within the Registration Division of the Office of Pesticide Programs. The work group is chaired by Donald Stubbs, chief of the Herbicide Branch. Members of the group include EPA staff chemists, biologists, plant scientists, soil scientists, policy specialists and attorneys. Jean Schwab, with the EPA's Office of Solid Waste, also serves on the work group and provides a link to the composting industry.

The work group has no specific charge. "It is more of an informal effort among staff members to learn more about the clopyralid controversy in order to determine whether any action needs to be taken by EPA to help resolve and prevent problems with clopyralid contamination," explains Stubbs. The work group is just starting the process of gathering information about the presence of clopyralid in compost and also about composting feedstocks, methods and practices in general. For that purpose, the work group recently met with Stuart Buckner, executive director of the U.S. Composting Council (USCC), Jeff Gage, who is on the board of directors of the USCC and Washington Organics Recycling Council (and who manages a composting facility in Washington state impacted by clopyralid contamination), David Bezdicek of Washington State University and Bob Rynk of *BioCycle*.

One of the principal tasks for EPA's clopyralid work group is to determine the extent of clopyralid contamination in composts — geographically and with regard to feedstocks. Thus far, most of the information has come from Washington state. The group would like to have documentation of clopyralid residues in compost and composting feedstocks from other states. This includes any documented test data from composting facilities, organic residuals managers, farmers and public agencies that would help identify the sources of clopyralid in compost and the fate of clopyralid during composting (also for organic materials that are being land applied). Anyone with clopyralid test results is encouraged to share the data with the work group. Without broad information, the matter may be viewed as a regional problem or of minor economic and environmental importance. Information for the task force can be sent via email to clopyralid.compost@epa.gov, or via mail to Public Information and Records Integrity Branch (PIRIB), Information Resources and Services Division (7502C), Office of Pesticide Programs (OPP), Environmental Protection Agency, 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. If you would like to supply information but prefer to remain anonymous, send your information to Bob Rynk at *BioCycle* (419 State Ave., Emmaus, PA 18049; rrynk@jgpress.com). *BioCycle* will compile the data submitted and pass it to the task force without identifying the specific facility.

clippings mowed ten weeks after herbicide application were less than one percent of the initial concentration. However, that average concentration was 150 ppb, still high enough to potentially cause plant damage.

In conjunction with these trials, Woods End Research Laboratory is conducting studies investigating the fate of clopyralid during and after composting. Woods End also is attempting to determine what may be acceptable uses for compost that contains various levels of clopyralid contamination. Clopyralid behaves in a very specific manner. Some plant species — mostly in the grass family — are not affected at all at moderate to low levels, while others — in the broadleaf family — are severely affected. In conjunction with transportation agencies that use composts for roadsides, Woods End is determining which species of plants will not be affected in the time between application and sufficient biodegradation of the herbicide residues. According to Woods End, "the goal is not at all to condone clopyralid in composts, but to help retain value of composts by showing appropriate uses that do not affect crops."

The fact that research is finding clopyralid difficult to eradicate should not be surprising. First, it is known to be a moderately persistent chemical (see this month's Q&A column). Although it is dangerous to generalize, the test results from both WSDA and WSU suggest that clopyralid is sticking around through the composting process (see Tables 1 and 2). More importantly, we are trying to achieve residual levels on the order of a few parts per *billion*. Even substantial degradation of clopyralid could leave behind damaging concentrations as is being demonstrated by the WSU grass clippings study.

Woods End researchers stress from plant studies that clopyralid does not affect all crops in the same way, and certain genus are largely unaffected except by very high levels. Thus, certain composts that contain some residues can still be safely used, however, this requires good communication between the producer and the user. Whether such communication is practical in the long term remains to be seen.

END NOTE ON LAB ANALYSES

With regard to laboratory analyses for clopyralid, labs have had to adjust their methods in order to get detection at the parts per billion level. (More common detection is in the parts per million range.) The adjustments basically revolve around the methods to extract the chemical from the sample. For example, the Anatech lab cited earlier has been able to lower its detection level to one ppb.

However, Woods End Research Laboratory, in a separate study, has found that other test methods give different concentration levels, depending on how the sample is extracted. More aggressive extraction methods for plant tissue from Europe show higher levels present, according to Will Brinton of Woods End, but conversely, suggest lesser toxicity of the residues. For this reason, Woods End stresses that bioassays may more accurately reflect the real situation, since they report probable damage levels to crops.

In general, bioassays are a less expensive method to determine whether damage may occur from clopyralid. Several bioassay methods are available, including ones developed by Woods End and WSU (posted on the WSU web site at the address cited above). However, bioassays may show damage that is not related to clopyralid, such as high soluble salts, therefore it is important to look at the probability of contamination in feedstocks before making a judgement on the bioassay alone. ■