Cooperative Extension
Washington State University
Center for Sustaining Agriculture
and Natural Resources

The Compost Connection

for Western Agriculture

January 1999 *Funded by a grant from the western region USDA-SARE Program* **No. 8**

Compost Workshops Underway

by David Granatstein

The first of three satellite broadcast workshops on composting in the West was held on November 5 focusing on "***Composting" A Tool for Western Agriculture.***" Over 600 people participated in the program at 50 locations throughout the western US and Canada. The 2-hour satellite broadcast used a travelling road show format and highlighted a number of composting operations. Some "stops" touched on why composting was being used as a waste management tool at the particular site, while others focused on unique challenges for composting in the West. Several stops were more detailed case studies of an operation, and several included a focus on a partnership that had formed in order for composting to make sense.

Each participant received a full 3-ringer binder of resource materials on composting, including the British Columbia Agricultural Composting Handbook. Copies of the resources notebook are available for $10 from Cinda Williams at the University of Idaho (Tel. 208 / 885-7499, email: cindaw@uidaho.edu).

The next workshop, ***Compost: A Resource for Western Agriculture,*** will take place on January 14, 1999, with the satellite broadcast scheduled from 9:00-11:00 a.m. PST. Growers who use compost will help us explore some of the potential benefits of compost including soil improvement, increased yields, and improved profitability. For information on a workshop location near you, check the CERWA website at: www2.aste.usu.edu/compost/ ✷

Foliar Disease Control Using Compost Tea

by David Granatstein

Compost tea has been used by many gardeners for years. Now there is growing interest among commercial growers about whether this practice might play a role in ecological farming. Compost tea is also known as compost watery extracts. They are made in various ways, but all involved mixing compost and water, usually in a ratio of one part compost to five to ten parts water. Some tea "brewers" add the compost to the water in a container, and let it passively ferment for a number of days. Others pass the water through the compost, much like making drip coffee.

One of the problems in exploring the effect of compost tea is lack of a standardized process or product. Variables include the type of composts (what feedstocks), the maturity of the compost, the extraction process, and the length of extraction period. Thus, it is not surprising that the results from various experiments with compost tea are inconsistent and often conflicting. Nonetheless, there appear to be some verifiable disease suppression mechanisms at work that could be made useful with additional research and development. *(go to p. 2)*

Inside This Issue

(from p. 1, Compost Tea)
In this article, I will summarize a series of tests of compost tea on foliar disease conducted by Hans Wittig, formerly of Oregon State University. Wittig, a plant pathologist, tested several types of compost tea against a variety of plant diseases. Wittig designed his tests in part based on the existing research studies, mostly from Europe (see references). These studies included the following diseases: gray mold on strawberry and tomato, powdery mildew and downy mildew on grapes, potato late blight, and apple scab. He conducted studies on the university experimental farm in Corvallis, OR, and on several other private farms in western Oregon.

In the fruit trials (both university and on-farm), the following crop/pathogen combinations were treated with compost tea: apple – apple scab, powdery mildew; pear – pear scab; peach – brown rot on fruit; grape - powdery mildew; cherry – brown rot blossom blight. An aerated compost tea was made prior to each application by a recirculating spray of water for 24 hours. Molasses was added at the beginning to serve as a food source for microbes, and some batches also received additions of rock powder and a seaweed powder to add micronutrients.

The compost tea was sprayed on the trees in the field at the same time as other fungicide treatments, as called for by the disease monitoring. Across all the fruit trials, there was no successful disease suppression (Table 1). The average bacterial population of the compost tea was 4×10^8 cfu/ml (colony forming units per milliliter of solution). Fungal populations in the tea were generally much lower. The microbial population on leaves is highly variable, and levels similar to the compost tea bacterial count are not uncommon. In one case, compost tea increased populations of active bacteria 40-fold on grape leaves, and fungal populations also increased. Thus, Wittig demonstrated that the microbial community on leaves could be significantly altered with compost tea applications.

The on-farm tests were conducted at four different locations in western Oregon, each with a different crop/disease combination, including apple – apple scab, powdery mildew; blueberry – botrytis, tomato – early blight; lettuce, broccoli, spinach – sclerotinia; and grape – powdery mildew. Again, an aerobic compost tea was made and sprayed on the crops.

The only observable disease suppression was a slight suppression of drop rot in lettuce (significant at $p<0.1$). There was also a measurable increase in broccoli yield for a summer crop (significant at $p<0.1$), but not for the spring crop. None of the blueberries exhibited any botrytis. However, postharvest fruit rot of the berries was substantially lower with the compost tea at both 7 and 12 days after harvest. The percent infection of tomato by early blight was identical for both treatments. No other significant effects occurred horticulturally (Table 2). The compost tea did not alter the bacterial and fungal populations in the soil beneath the treated plants.

Wittig lists four possible modes of action of compost tea against pathogens. These include: induced resistance against pathogens; inhibition of spore germination; inhibition of lesion expansion; and antagonism and competition with pathogen. A particular compost tea may lack the proper mode of action for a specific pathogen, rendering it ineffective. Given the variables affecting compost tea, plus the variables of application rate, timing, and weather conditions, it is not surprising that this generalist disease suppression strategy has proven inconsistent. Yet some interesting results in previous studies encourage further inquiry.

For example, an Israeli study of gray mold on leaves found that compost teas from chicken, chicken-cattle, and grape marc were less effective in disease suppression than a fungicide. Compost tea effectiveness increased if the incubation period was at least 10 days. And, pasteurization did not reduce efficacy, but dilution did. A German study of downy mildew on grapes tested a tea from horse manure compost, with and without an amendment of microbes. Unamended, the tea provided marginal control. The amended tea provided control comparable to that with fungicides, when disease pressure was severe.

Another German study examined late blight on potatoes. A compost tea from horse manure was only effective when amended with microbes, while a cattle manure compost tea provided good control by itself. Yet, another German study of gray mold on strawberry found that both horse manure and cattle compost teas significantly reduced diseased fruit and increased yields. Compost tea from cattle manure was more effective than a tea from grape marc when used on grapes for powdery mildew. A horse manure compost tea provided control similar to that of wettable sulfur. In both cases, powdery mildew was controlled through inhibition of conidial germination.

At this point in time, compost tea shows promise as a disease suppressive technique, but not for the faint-hearted. For growers with few other options, such as organic growers, experimentation with compost tea makes sense. However, the inconsistency of control is a major risk factor. Much more research is needed on specific combinations of crops, pathogen, type of compost tea, and application procedures. Fortunately, more researchers are looking at these issues. Steve Scheuerell, a graduate student in the Dept. of Botany and Plant Pathology at Oregon State University is actively working on compost tea for disease suppression, with a focus on the nursery industry. He will compare the disease suppression of extracts made from various feedstocks and made by either the aerobic or anaerobic method. He would like to hear from any growers who have experience with disease suppression from compost or compost tea. Contact him at 541-752-9469. With further development, compost tea will likely offer growers another valuable tool for maintaining plant health in an ecologically sound fashion.

For Further Reading

An excellent information packet on compost tea is available from ATTRA at 1-800-346-9140.

The Woods End Research Lab has compost tea information on their web site at: http://www.woodsend.org.

Brinton, W. 1995. The control of plant pathogenic fungi by use of compost teas. Biodynamics 197:12-15.

Brinton, W.F., A. Trnkner, and M. Droffner. 1996. Investigations into liquid compost extracts. BioCycle, p. 68-70 (November).

Cronin, M.J., D.S. Yohalem, R.F. Harris, and J.H. Andrews. 1996. Putative mechanism and dynamics of inhibition of the apple scab pathogen *Venturia inequalis* by compost extracts. Soil Biol. Biochem. 28(9):1241-1249.

Elad, Y. and D. Shtienberg. 1994. Effect of compost water extracts on grey mold (*Botrytis cinerea*). Crop Protection 13(2):109-114.

McQuilken, M., J.M. Whipps, and J. Lynch. 1993. Some effects of water extracts of compost on *Botrytis cinerea*. WPRS Bulletin 12-15.

Sideman, Eric. 1996. Enhancing natural disease control with watery compost extract. Maine Organic Farmer and Gardener (March-May 1996 issue), Augusta, ME.

Urban, J. and A Trankner. 1993. Control of grey mold (*Botrytis cinerea*) with fermented compost/water extracts. WPRS Bull. 8-11.

Weltzien, H. 1990. The use of composted materials for leaf disease suppression in field crops. p. 115-120. IN:1990 BCPC Monograph No. 45, Organic and Low Input Agriculture.

Weltzien, H. 1990. Advances in biological control of fungal leaf pathogens through fermented organic substances and microorganisms. IN: J. Casida (ed.). Pesticides and Alternatives: Innovative Chemical and Biological Approaches to Pest Control. Elsevier Science Publ.

Weltzien, H. 1991. Biocontrol of foliar fungal diseases with compost extracts. p. 430-450. IN: J.H. Andrews and S.S. Hirano (eds.). Microbial Ecology of Leaves. Springer-Verlag, New York. ✷

Table 1. Summary of results from field testing of compost tea for foliar disease control. 1996.

Crop/Disease	No Treatment	Water Control	Compost Tea	Best Fungicide
	- - - - - - - - - - - % infection or infestation - - - - - - - - - - - - -			
Apple / Scab				
Leaves	41	--	40	13
Fruit	52	--	37	11
Apple / Powdery mildew				
Terminals	71	--	76	33
Apple / Scab				
Leaves	47	42	45	9
Fruit	92	90	88	6
Apple / Powdery mildew				
Terminals	80	84	59	2
Cherry				
Brown rot blossom blight	11	--	6	3
Cherry leaf spot	62	--	42	5
Peach / brown rot				
Fruit at harvest	6	--	6	6
Fruit after harvest	56	--	64	11
Grape / powdery mildew				
Leaves	--	25	19	8
Clusters	--	25	17	10
Grape / powdery mildew				
Leaves	--	--	40	0
Clusters	--	--	43	<1

Table 2. Yield comparisons for on-farm tests of compost tea. 1996.

Crop	*Control* Spring	*Control* Summer	*Compost Tea* Spring	*Compost Tea* Summer
Spinach (# bunches)	41	37	33	30
Broccoli (lb)	14	24	16	28
Lettuce (% marketable heads)	66	64	72	61
Tomato (lb)	--	49	--	47

Composting in Southern Idaho

by Dan Sullivan

In early October I traveled to southern Idaho to assist with filming for the CERWA program (Compost Education and Resources for Western Agriculture). Bob Rynk, project leader from the University of Idaho, and I visited several locations where composted dairy manure was being applied to irrigated cropland.

The compost, produced by Compost West, Inc. in Jerome, Idaho, is very dry (20% moisture). The dry compost is spread with a broadcast fertilizer spreader with large flotation tires, the same machine used for commercial fertilizer application. The large tires minimize soil compaction. The spreader can cover about a 30-foot swath as it moves across the field. Compost is usually applied at rates of 3 to 6 tons (at 20% moisture) per acre. The compost sells for about $9 a cubic yard. A cubic yard weighs about 1000 lbs., so the 3 ton per acre application translates into about 6 to 7 cubic yards per acre. In the field, this looks like a light dusting of compost. The 3-ton application costs the grower about $60 to $65 per acre, including the cost of custom application.

According to Compost West manager Sean Mallett, the compost is now trucked to farms within 60 miles of the composting facility (located at a large dry-lot dairy). Sean explained that at farms near the composting site, fresh manure is readily available at little cost, so compost marketing is not viable. Farmers more than 15 to 20 miles from the composting site are most interested in the compost, since alternative organic matter sources aren't readily available.

We visited the Sunset Organic Farm managed by Mike Heath in the Magic Valley near Twin Falls. Mike uses the Compost West dairy compost to provide organic matter and nutrients, particularly phosphorus and potassium, for a variety of crops on the farm. About 400 of the 500+ acres at the farm are managed organically for production of potatoes for the fresh market, dry beans, sweet corn, and other specialty crops. Alfalfa, grown in rotation with the vegetable crops, provides some of the nitrogen needed for optimum crop production. Mike has been using the dairy compost instead of fresh manure and reported that crop production appeared to be the same or maybe slightly better with the compost (compared to previous experience with manure). The benefits of the compost relative to manure, according to Mike, are:

- few weeds (composting has evidently been effective in eliminating viable weed seeds)
- better uniformity of organic material application
- less soil compaction (compost application wagons throw a 30-foot swath vs. a 10-foot swath for manure wagons).

Mike reported that the compost treated fields had healthy soil for crop production. In potatoes, with no fungicide seed treatment, seed pieces remained intact (no evidence of decay) for a long period in the spring, promoting vigorous early vine growth. Soil tests from the compost-amended fields show 2 to 3% organic matter, considerably greater than typical levels in the area (usually 1 to 1.5% organic matter).

Although there are some compost success stories being told, it's a tough time for farmers in the Magic Valley, with commodity prices for grains and potatoes at low levels. This year, only sugar beets and some specialty crops are likely to be consistently profitable. Thus, although compost benefits are being seen in the local area, and the number of farmers using compost is increasing, many can't afford the up-front cost of fall compost application ($60 to $65/acre) this year.

Compost research is ongoing in a field study at Kimberly, ID (east of Twin Falls). We visited with Dale Westerman, a USDA-ARS soils researcher involved in the study. The compost research, initiated in 1996, is evaluating the Compost West dairy manure compost as a component of a sustainable agriculture production system using a 4-year crop rotation. Researchers have documented that about 15 pounds of plant-available nitrogen per ton of dry compost are released in the field during the first growing season after application. This is

equivalent to about 30 to 50% of the total compost N applied. The remainder of the N is apparently held in slower-release forms that will probably enhance long-term N availability.

The most profitable application plan for compost, according to Westerman, is a 3 dry ton per acre annual application. At this compost application rate, supplemental nitrogen fertilizer is added to meet crop requirements. The combination of compost plus commercial fertilizer nitrogen application (at a reduced N application rate) has provided superior results in comparison to fertilizer N application alone for potatoes and malting barley. For Russet Burbank potatoes grown for french-fry processing, compost application increased tuber dry matter (higher specific gravity) relative to that produced with commercial N application alone. The boost in tuber solids attributed to compost application was worth about $100 per acre in increased income to the grower.

For malting barley, compost plus N fertilizer improved grain yield with acceptable grain plumpness, and decreased protein relative to N fertilizer alone. In malting barley, there are industry standards to assure grain plumpness and low protein. If grain doesn't meet the more rigorous malting barley specifications, it is sold at a much-reduced price as feed barley. Thus, the compost application also had an economic advantage for the grower by providing greater assurance of meeting malting barley specifications.

In summary, we learned that compost production and marketing to the farm is moving forward in southern Idaho as a viable enterprise. In the short-term, cost of the compost appears to be a major factor. The transportation cost from the compost production site to the field is still a significant barrier to widespread adoption of compost use on farms. University and USDA-ARS field researchers have provided credible test results that encourage further use of compost by growers and thus expanded markets for compost producers.

Dan Sullivan is an Extension Soil Scientist at Oregon State University, Corvallis, OR, specializing in management of organic wastes. ✷

Fish Manure As A Potential Feedstock for Vermicomposting

by Robert Rynk, Kristy Grabenstein, Tom Hess, and Gary Fornshell*

Vermicomposting is a process in which earthworms digest organic materials and produce a stable compost-like material (vermicompost). In the process, the worms grow and reproduce. Vermicomposting can potentially improve the handling and value of fish manure. While the worms can be used as protein source for fish feed, the bait market is a more immediate and realistic opportunity for revenue. At least conceptually, using fish manure to produce worms which might serve as feed or bait for fish epitomizes a sustainable food production system.

We investigated the feasibility of using manure from aquaculture facilities for vermicomposting. The primary objective of the research was to determine if fish manure can support the growth and reproduction of earthworms. The species of earthworm used in the research was *Eisenia foetida* , a species common to commercial vermicomposting. The general procedure involved placing worms in manure from three different trout farms. On a weekly basis, the worms were counted and weighed. As a control, worms were also placed in dairy manure, a proven vermicomposting feedstock.

The research produced inconsistent results. First, our inexperience in working with worms led to several mistakes and experimental "dead ends." Despite theoretically ideal conditions, the majority of worms died in the initial trials, even those placed in the dairy manure. It became apparent that the worms must be acclimated to the materials. A holding bin for each type of manure was established for this purpose.

Results from subsequent experiments suggest that fish manure is not a good feedstock for worms. Few of the worms placed in any of the trout manures remained after 5 weeks. Worm losses were least in dairy manure followed by "aged" trout manure. Fresh trout manure was essentially intolerable to the worms. However, several contrasting positive results

also occurred. Individual worms that survived in the trout manure generally gained weight and even reproduced. Also, the worms remaining in the larger holding bins containing trout manure, even fresh manure, appeared to thrive, gain weight, and reproduce.

The positive results offer the hope that worms can potentially be used to create compost from fish manure. It is possible that the conditions of our experiments (e.g. handling, shallow containers) added stress which impaired the worms' health. We will continue experiments using the acclimated worms and experimental conditions more like those of an operating vermicomposting system. If continued research shows promising results, a pilot-scale trial on a cooperating farm will be conducted. Eventually, we will determine how efficiently the worms convert fish manure into vermicompost.

**Bob Rynk is the Extension Waste Management Engineer, Dept. of Biological and Agricultural Engineering, University of Idaho, Moscow, ID 83844-0904.* *The research was supported by USDA-CSRS Agreement No. 94-34123-0684.* ✷

FARM POLLUTION & SUSTAINABLE PRODUCTION

The USDA and EPA are taking public comments on a Draft Unified National Strategy For Animal Feeding Operations (AFOs). This Draft Strategy is the overall blueprint for dealing with surface water pollution from all AFOs. Public hearings are being held in several cities around the country. This process is a chance to provide input, and it may create new opportunities for composting and compost use. Submit comments on the draft to the website at: http://www.epa.gov/cleanwater/afo/

Compost Resources

Compost courses on-line . Courses on composting are taught at both Washington State University (Dave Bezdicek) and the University of Washington (Chuck Henry). The curriculum for both courses is available on the web at the following addresses: http://cru38.cahe.wsu.edu/css490/ http://weber.u.washington.edu/~clh/ESC418.html

Earthworm Information web site. University of California Sustainable Agriculture Research and Extension Program. Contains articles on earthworms, profiles of 8 key species, images, and links to other resources. Find it at: http://www.sarep.ucdavis.edu/worms/ ✷

American Phytopathological Society web site. Abstracts from the recent annual meeting are available on-line and include a number of studies on disease suppression from compost and compost tea. Go to: http;??www.scusoc.org, click on Abstracts, and then search for "compost." ✷

Compost Calendar

January 14, 1999. **Compost: A Resource for Western Agriculture.** CERWA Satellite Broadcast workshops. Contact Cinda Williams, 208-885-7499 for more information.

January 14, 1999. **Compost Use Workshop.** U.C. Bay Area Research and Extension Center (BAREC), Santa Clara, CA. 8 a.m. to 3 p.m. Includes CERWA satellite broadcast and speakers Maria de la Fuente (the effect of compost on plant disease suppression) and Ralph Jurgens (the role of compost in soil building and plant nutrition). Cost is $30. For more information, contact Delma Sled, U.C. BAREC, at (408) 296-1672.

January 20, 1999**. Forum on developing a pilot compost project.** Recycling Association of Guam, Park Hotel, Guam. Contact Erin McDonnell for more information: tel. (671) 653-9280; email: mcjoe@ite.net

January 21, 1999. **Compost Making by and for Farmers: the Basics and Then Some** . A workshop session of the 1999 Eco-Farm Conference. Asilomar, CA. Speakers include David Blume, International Institute for Ecological Agriculture, Woodside, CA; Don Cranford, Cranford Inc., Spreckels, CA; Pat Herbert, Herbert Ranch, Hollister, CA. For

information, call 831-763-2111, or check the web site at: www.csa-efc.org
March 8-10, 1999. **BioCycle West Coast Conference**. San Francisco, CA. Contact BioCycle at 610-967-4135 for more information.

April 7-9, 1999**. "Growing with Compost" conference.** Olds College Composting Technology Centre, Olds, Alberta, Canada. Current Call for papers (deadline 11/30/98). Contact Kelly MacKinnon, 403-556-4683, for more information.

May 17-19, 1999**. BioCycle 29th Annual National Conference**. Albuquerque, NM. Contact BioCycle at 610-967-4135 for more information.

October 28-29, 1999**. Composting for Home and Industry**. American Society of Testing Materials symposium, New Orleans, LA. Contact Keith Hoddinott at 410-671-5209 for more information. ✷

Comments and submissions for this newsletter are welcome ! Contact the Editor.

Newsletter Editor:
David Granatstein
Washington State University Cooperative
Extension / Center for Sustaining Agriculture
and Natural Resources
1100 Western Ave. N.
Wenatchee, WA 98801
Tel. 509-663-8181 x.222
email: granats@wsu.edu

Past issues of this newsletter can be found on the CSANR web site at:
http://csanr.wsu.edu/compost/

Funding for this issue comes from grants from the western region USDA-SARE program.

The Compost Connection
WSU TFREC
1100 N. Western Ave.
Wenatchee, WA 98801