METHODS FOR PREPARATION OF HIGH QUALITY COMPOST AND COMPOST TEA FOR HORTICULTURE PRODUCTION

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Peat moss and pine bark in container mixes, manure and yard waste as field amendments, the use of composted material is widespread in the horticulture industry. However, the quality of products is variable and there are frequent reports of crop damage from poor compost material.

Since 1995, CropHealth Advising & Research has worked with the composting operation at Byland's Nurseries, in Westbank. Plants unsold or of lower quality are composted and 20,000 cubic yards of finished material is produced every year for use in containers and the field.

This presentation will review our experience with composted products in a commercial nursery.

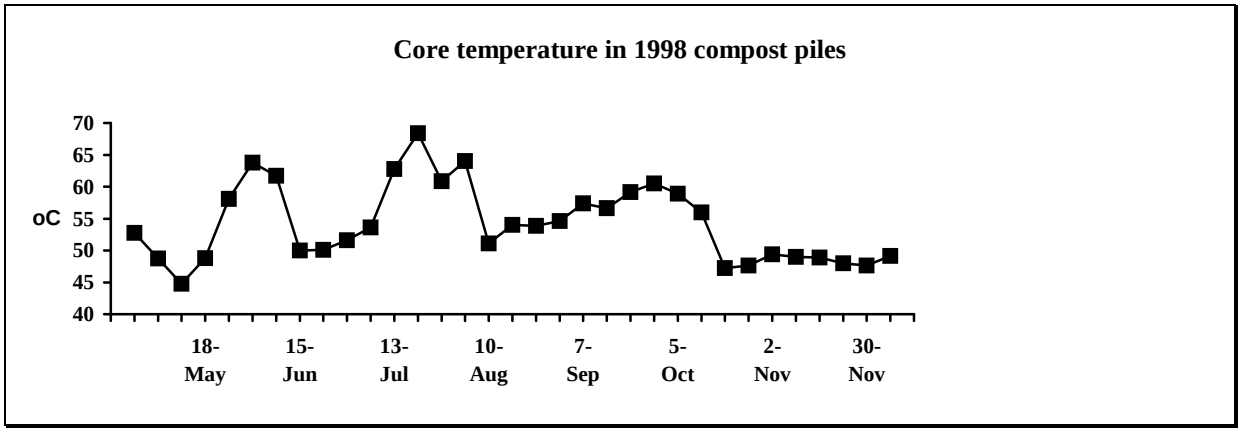
I. PREPARATION OF COMPOST

Composting is the biological decomposition of organic waste under controlled conditions. The large molecules are broken down into simple molecules that can be utilized for plant growth.

Plant residue can be composted in different ways, but one common method is to pile the material in windrows, about 10 feet high and 15 feet wide. Three phases usually occur:

- An initial hot phase of 1 or 2 days, during which the smaller material is rapidly degraded;
- A few months when micro-organisms degrade the material and keep the compost hot;
- A final curing phase when temperature decline and the material is colonized by microbes.

At Byland's Nurseries, we control the temperature and moisture to obtain a mature compost within a reasonable time. The temperature is maintained at 40 to 60^{o}C to stimulate microbial activity and to kill disease pathogens. The moisture should be 40 to 60% for optimum composting: a pile that is too dry or too wet will not compost properly, anaerobic microbes will flourish, and a foul odour will soon travel through the neighbourhood.



Optimum conditions for composting

There is a consensus among scientists that controlling the carbon to nitrogen ratio (C:N) is the key to quick composting, odour control and quality of finished product. At this point, the best method to calculate the C:N ratio is through a regular laboratory soil analysis.

Carbon is the main diet for the microorganisms responsible for composting, and they scavenge available nitrogen in the process. A high C:N, typical with dry leaves or sawdust, will result in a slow composting process. A low C:N, from grass clippings and tree trimmings, will result in a loss of nitrogen and an odour problem. The pile should have a balanced mix of rapidly decomposing materials and slowly decomposing materials to ensure good microbial activity.

OPTIMUM CONDITIONS FOR COMPOSTING
Adapted from B.C. Ministry of Agriculture, "B.C. Agricultural Composting Handbook", 1996.

- The materials should be chopped, shredded, split or bruised to increase their surface area.
- The initial C:N ratio should range from 25:1 to 40:1.
- The initial pH should lie between 6.5 to 7.5.
- The moisture content should be maintained at 40 to 60%.
- The temperature inside the pile should range from 32^{o} to 60^{o}C.
- The piles should be turned regularly to enhance aeration and regulate temperature.

Testing for compost maturity and quality

Once finished, it is important to test the compost to ensure it is a stable organic mass with reduced microbial activity. Compost that is biologically very active will hinder plant growth by tying-up nutrients or by releasing noxious gases.

The simplest and most accepted procedure is the germination test. Seed trays are prepared with the finished compost and, for control, with a standard potting soil. Cress or radish seeds are used since they germinate rapidly. The germination and growth of 30 seeds is compared after 7 days.

CANADIAN GUIDELINES TO ASSESS COMPOST MATURITY
Canadian Council of Ministers of the Environment, 1996

Finished compost shall conform to at least one test, but it is recommended to use 2:

1) The carbon to nitrogen ratio (C:N) is less than 25, *and*
   Using cress or radish, seed germination in the compost is at least 90% of control.
2) The compost is cured for 21 days *and* does not reheat to 20^{o}C above ambient temperature.
3) The compost is cured for 21 days *and* there is a 60% weight reduction of organic matter.
4) The material is cured for 6 months under aerobic conditions without reheating.

A laboratory analysis will indicate the nutrient value of the compost and the fertilizers that should be added. Testing for salt is also important: the composting of any product will generally result in a moderate to high EC level. High salts in a container mix can trigger root damage, water stress and poor plant performance.

II. THE USE OF COMPOST IN GREENHOUSES

Peat moss, for many years a standard in container mixes, is becoming scarcer and more expensive. It is replaced with less expensive composted materials such as bark, green waste or sewage sludge. Pine bark is now widely used in floriculture production since it provides good aeration porosity for root growth. Many growers use a 4:1 mixture of composted bark and peat as the organic component of their media.

When using composted green waste, each grower should design a potting mix that will provide the desired results. Some plants require more aeration porosity or an acidic pH. Some growers of bedding plants use a mix of 25% compost, 50% peat moss and 25% perlite, while growers of woody ornamentals report using an equal volume of compost, sand and peat moss or pine bark. Generally, many studies report that a mix including 25 to 50% composted yard waste results in excellent plant growth.

USING COMPOSTS IN CONTAINER MIXES
Adapted from Hoitink, Rose, Zondag, Ohio State University Extension, 1997

Material	Content in mix	Nutrient qualities
Sphagnum peat	Varies	Light and fibrous is better than dark and fine
Pine bark	20 to 65%	Add lime, starter fertilizer and micro nutrients
Hardwood bark	About 15%	Add micro nutrients and nitrogen
Yard waste	15 to 25%	Quality varies and high salt is frequent
Animal manure	Less than 15%	Varies with source but often rich in nitrogen
Sewage biosolid	Less than 20%	Rich in nitrogen and micro nutrients

Composts are also used in the field to supply organic matter, increase microbial activity and "revive" the soil. Of interest, researchers in vegetable and grain crops are finding that compost application will not give a higher yield unless supplemented with nitrogen fertilization. Compost is usually incorporated at 2 to 10 tons per acre or top-dressed at up to 50 tons per acre (1-inch thick layer when moist), the equivalent of 4 cubic yards per 1,000 ft^2.

Peat moss

Sphagnum peat moss is the material commonly used in the production of forest seedling trees. Sphagnum peat is a primitive plant growing in a bog. The place of the peat in the bog has a strong influence on the development of root diseases during production.

Dark fine peat, harvested from deeper layers in the bog, is low in microbial activity and often conducive to root diseases such as *Pythium*. On the other hand, light fibrous peat, harvested from the top 1.2 meter of the bog, has the potential to reduce root rots. Researchers have found the light peat comes with a microflora competing for nutrients with the pathogen *Pythium*.

The reduction in *Pythium* can be expected for 6 to 12 weeks, and up to 6 months in some cases. This disease suppression is dependent on the ligno-cellulosic substances: once they are decomposed, the beneficial microorganisms decline in activity and the pathogens can recover.

III. DISEASE SUPPRESSION

This is a new area of research and, so far, the results are impressive. Here are 2 examples:
- At Ohio State University, composted pine bark reduced *Phytophthora* root rot in container production and suppressed *Fusarium* wilt in cyclamen production.
- At the U.S. Department of Agriculture in Maryland, potting mixes amended with composted animal manure were suppressive to damping-off caused by *Pythium* and *Rhizoctonia*.

The ability of compost to suppress diseases is linked to the beneficial bacteria and fungi that colonize the material during the curing phase. The composting must be done properly to obtain a disease-suppressive product: a poorly composted product will actually increase the risk of disease, while an over-mature product has little microbial activity.

Different mechanisms appear to be at play to increase disease-suppression:
- In most composts, the beneficial microorganisms will compete for nutrients or produce antibiotics that suppress the growth of pathogens causing *Pythium* and *Phytophthora* root rot.
- Less frequently, other microorganisms will colonize the material and parasitize the pathogens causing *Rhizoctonia* damping-off.
- Finally, recent research indicates that "systemic acquired resistance" may be at play, where plants grown in compost have a higher level of an enzyme associated with disease resistance.

USING COMPOSTS TO MAXIMIZE DISEASE SUPPRESSION
Adapted from Hoitink, Zhang, Han, Stone, Krause, Dick, Ohio State University, 1997.

- *Container production:*
The compost must be stable but not over-mature, tested for nutrients and salts, and used in the right proportion. Uncomposted or nitrogen-rich material can trigger more disease.
- *Field production:*
Incorporate a fraction of the compost into the soil way ahead of planting, then apply most of the compost on the surface after planting (for example, 1 inch of slightly immature compost).
- *Spray solution:*
A water extract (or compost tea) is prepared by soaking mature compost in water (1:1 weight/weight) for 7 to 10 days. Efficacy varies with the compost, crop and disease.

V. FOR MORE INFORMATION

- Canadian Council of Ministers of the Environment, 1996. "Guidelines for Compost Quality". Available for $6 from the Manitoba Statutory Publications, 200 Vaughn St., Winnipeg.
- B.C. Ministry of Agriculture, Fisheries and Food, 1996. "B.C. Agriculture Composting Handbook". Detailed and very informative. Available for free from the Abbotsford office of the Ministry.
- Northeast Regional Agricultural Engineering Service, 1992. "On-Farm Composting Handbook". Publication NRAES-54, ed. Robert Rynk. An excellent reference publication. US$20 from 152 Riley-Robb Hall, Ithaca, NY.
- H.A. Hoitink, D.Y. Yan, A.G. Stone, M.S. Krause, W. Zhang, W.A. Dick. "Natural Suppression". American Nurseryman, October 1997. A good review of the topic written for growers.
- H.A. Hoitink, A.G. Stone, D.Y. Han, 1997. "Suppression of Plant Diseases by Composts". HortScience, 32(2): 184-187. A technical paper on the microbial activity in composts, including sphagnum peat.
- The internet Web site <http://www.cals.cornell.edu/dept/compost> provides information and links to other sites.

Compost Tea Workshop

The Kootenay Organic Growers Society (KOGS), is pleased to announce the presentation of a Workshop on Composting and Compost Teas. The Workshop, given by Mario Lanthier of CropHealth Advising & Research, is cutting edge information for professional growers, farmers and backyard gardeners, presented in an easy to understand and dynamic way.

Title:	**Composting and Compost Teas for Organic Farming**
Date:	Friday, 22nd September 2006
Time:	8 am. to about 4 pm.
Place:	Morning: Tarrys Hall, Highway 3A, 1 km past Kalesnikoff Lumber Mill.
	Afternoon: Mad Dog Farm, 1911 Irving Road (1 km further towards Castlegar.)
Cost:	**KOGS members: $15 / family Non-KOGS members: $30 / family.**

Agenda

8 am.	Doors open and Registration	
8.30 am. to 10 am.	Slide presentation	Natural Suppression of Plant Diseases - A Research Update.
10 am. to 10.30 am.	Refreshment break.	(Provided)
10.30 am. to 12 pm.	Slide presentation	Compost and Compost Tea - The Basics.
12 pm. To 1 pm.	Lunch break / Move	(Please bring your own Lunch.) Move to Mad Dog Farm.
1 pm. to 2.15 pm.	Outdoors demonstration	Compost tea - Hands-on demonstration
2.15 pm to 2.45 pm	Refreshment break	(Provided)
2.45 pm. To 4 pm.	Outdoors demonstration	Composting / Greenhouse potting mixes - Hands-on demonstration
4 pm.	Evaluation and exit.	

For further information, or to book a space, please call:
Jeremy Lack (250) 399 4809