THE PREPARATION AND USE OF COMPOST

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Manure and yard waste as field amendments, peat moss in greenhouse production, the use of composted material is widespread in the nursery industry. However, quality of products is variable and there are frequent reports of crop damage from poor materials.

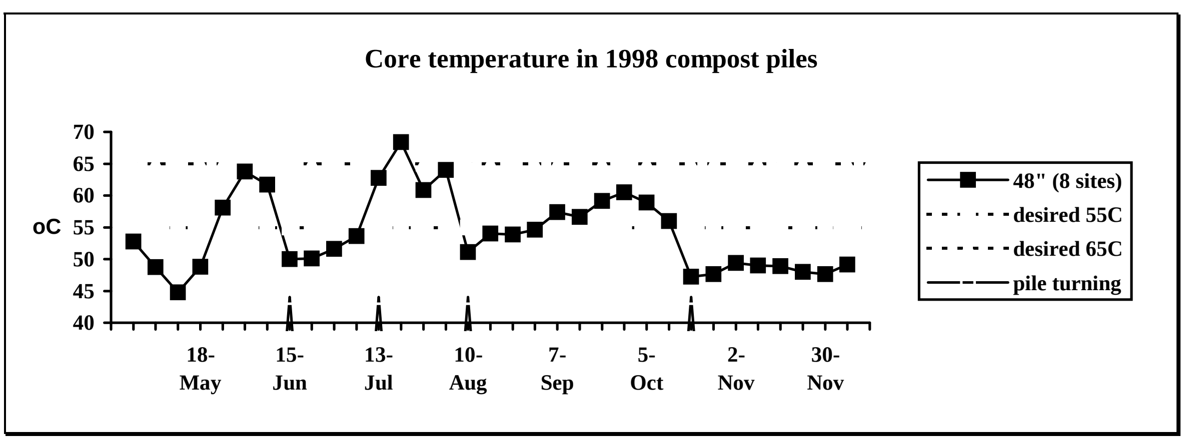
Since 1995, CropHealth Advising & Research has worked with the composting operation at Byland's Nurseries, in Westbank. Plants that are unsold or of lower quality are composted and 20,000 cubic yards of finished material are produced every year for use in containers and the field.

I. THE PHASES OF COMPOSTING

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 period of a few months when microorganisms degrade the material and keep the compost hot;
- A final curing phase when temperature decline and the material is colonized by other microbes.

Controlling temperature and moisture is very important to obtain 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 pile is turned 3 to 5 five times over a 4 to 8 month period to aerate the center and control the temperature.



Above: Typical start-up ingredients for compost piles.
Materials of high carbon content ("brown") include leaves, twigs and branches.
Materials of high nitrogen content ("green) include grass, food residue and manure.

Below: Passive windrows where compost is allowed to process for a long period of time.
Materials are placed in rows about 3 to 4 meters high and similar width.
Other methods work well, provided there is adequate oxygen diffusion into the materials.

II. 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. A 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.

The moisture should be 40 to 60% for optimum composting conditions. With the hand-feel method, the material should feel moist, ball up easily but not release water. 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
Adapted from "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 and 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.

III. TESTING FOR COMPOST MATURITY

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 and are affected by high salts. About 30 seeds are planted in each material and germination and growth is compared after 7 days.

The Solvita maturity test, which measures microbial respiration, is also very accurate. Much like a pH paper, this test provides a color rating of compost maturity with recommendations for container and field use.

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.

Above: The seed germination test is used to verify the finished quality of the compost.
Cress, radish or cucumber seeds are placed in the finished compost.
Germination rate and plant growth are compared to a standard commercial product.

Below: The commercial “Solvita compost maturity test”.
It measures microbial respiration and provides a rating of compost maturity.
This test is recognized around the world as fairly accurate.

IV. TESTING FOR NUTRIENT CONTENT

A laboratory analysis will indicate the nutrient value of the compost and the fertilizers to that should be added. Typically, a plant residue compost is rich in potassium, whereas manure based compost or sewage sludge are rich in nitrogen.

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. Water leaching immediately after potting will lower the EC level.

The compost material is then blended into the potting mix and tested for aeration porosity and water-holding. It is difficult to achieve a consistent quality with composts and the blend may need to be slightly altered to get the desired result. Aeration porosity should be at least 20% for most crops and 25% for crops sensitive to *Phytophthora* root rot.

V. THE USE OF COMPOST IN POTTING MIXES

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.

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 (one-inch thick layer when moist), the equivalent of 4 cubic yards per 1,000 ft^2.

VI. 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.
- Northeast Regional Agricultural Engineering Service, 1992. “On-Farm Composting Handbook”. Publication NRAES-54, edited by Robert Rynk. Excellent reference publication. Available on the internet.
- 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 nursery growers.
- H.A. Hoitink, M.A. Rose, R.A. Zondag, 1997. “Properties of Materials Available for Formulation of High-Quality Container Media”. Special Circular 154. Available at webpage of Ohio State University Extension.

THE “TOP 3” COMMON MISTAKES OF COMPOSTING

Common mistake #1:

The piles are started with an improper mixture.

Is your compost pile sitting there and not cooking? Is your compost pile generating an awful smell that triggers complaints by neighbours kilometres away? Welcome to our club, for those of us who made the big mistakes and learned the hard way about compost.

Slow composting is often caused by an imbalance in the start-up mixture, for example when using too much bark, a “slow-decomposing” material. As a rule-of-thumb, a slow compost pile can be “jump started” by adding grass clippings at 10 to 20% by volume, or poultry manure at 5 to 10 kg per cubic meter (roughly 10 to 20 pounds per cubic yard).

Smelly compost is usually caused by improper watering. A common mistake is to allow the piles to dry up then overwater them. Do not try this unless you want to be the center of attention in the neighbourhood. Good compost smells good, as long as ingredients are properly mixed and adequate moisture is maintained.

Common mistake #2:

Raw materials are constantly added to an active compost pile.

The compost is hot within days of starting, and these high temperatures help kill most weed seeds and plant diseases. So why do you add raw, sick plant material to an active pile? Why do you add plant diseases to clean finished compost?

Proper composting procedure requires at least 2 piles. Gather the raw materials in a “building pile” as they become available. Once there are enough raw materials, the “building pile” can be modified into an “active pile” to trigger hot temperatures and proper composting. This pile is turned and watered regularly. While the “active pile” is composting, start a new “building pile” with raw materials becoming available. Ensure no physical contact between the 2 piles!

Common mistake #3:

The compost piles are dry. Very dry.

Composting is done by microbes, especially bacteria and fungi. They are alive! They need water, just like humans and animals! So why is this compost pile bone dry? Why do you cover the piles with a tarp? Put water on those piles. Make sure the material is moist (but not wet!). Then you will get good compost.

Inadequate moisture is, by far, the most common mistake of composting everywhere. Water must be added to the piles with an irrigation hose or a sprinkler system. In British Columbia, rainfall is not enough to maintain adequate moisture, and barely sufficient during the non-stop rainfall of November to February in Coastal areas.

MAKING HIGH QUALITY COMPOST

Step #1: Prepare a mixture of slow-decomposing and fast-decomposing materials.

Slow-decomposing materials include leaves, twigs and bark. Fast-decomposing materials include grass clippings, kitchen residues, garden refuse and animal manure. Mixing the two ingredients will ensure good composting and usually result in a pile within the standard target of C:N ratio between 25:1 and 40:1.

Step #2: Place the materials in a pile for composting.

The materials should be chopped, shredded, split or bruised to increase their surface area. Place in a pile to trigger the "hot phase" of composting. For large sites, a pile 2 to 3 meters high and 2 meters wide will generate hot temperatures yet allow oxygen diffusion. For small sites, a wooden box 1 meter wide by 2 meters high gives good results. Other methods also work well.

Step #3: Water, water, water.

Water must be added to the pile with an irrigation hose or sprinkler, especially during the first month of composting. Aim for 40 to 60% moisture content: half the weight of the material should be water. A simple test is to dig a hole into the pile and take a small handful: moisture is adequate if the material can easily be squeezed into a ball.

Step #4: Turn, turn, turn.

The piles are turned to allow the outside, where composting is slow, to be mixed into the middle, where composting is rapid. Turning is also the best method to regulate temperature and moisture. Turning is done often at the start of composting to regulate the initial hot temperatures, and less often after 2 or 3 months as temperatures stabilize.

Step #5: Monitor the temperature.

A good quality temperature probe for composts is about $200. Place the probe into the pile to verify core temperatures. The best composting occurs at 45 to 60^{0}C, usually reached without effort with proper start-up materials and moisture. Lower temperatures indicate very slow composting, and higher temperatures indicate burning to charcoal.

Step #6: Test the finished product.

Simple recognized tests include growing radish seeds for 7 to 14 days and compare germination and growth to a "standard" commercial product, or laboratory analysis of Electrical Conductivity or CO_2 release over time. No testing is required for compost used months ahead of planting, or cured for 21 days with core temperatures remaining within 20^{o}C of air temperature.

Step #7: Use it!

When done properly, cured compost is a relatively stable material of high quality for nutrients and biological activity. It can be used safely to improve soil quality and provide a long-term supply of nutrients. Large commercial operations use compost as a soil amendment or mulch on the soil surface, or mixed with other ingredients for greenhouse production.

Soil biology to improve plant health

with Mario Lanthier
CropHealth Advising & Research

Friday November 27
Armstrong
Odd Fellows Hall
3005 Wood Avenue

Friday December 11
Langley
Kwantlen University College
20901 Langley Bypass

8:30 to 4:00

Cost $30 per person (includes lunch and coffee / tea)

For more information or to register, contact Cara Nunn
at the North Okanagan Organics Association, 250-540-2557

Proper manipulation of organic matter can make plants healthier.
How do we do it? Come find out.
We will discuss ideas and recipes you can implement immediately.

This intensive 1-day seminar will be of interest to organic growers, landscapers and persons working in horticulture.

Topics covered will include preparation and testing of compost, composts suppressive of plant diseases, and use of commercial microbial inoculants and mycorrhizal fungi.

Sponsored by Certified Organic Associations of BC through the Regional Seminar Series fund and by the North Okanagan Organic Association