Composting
FACTSHEET

BRITISH COLUMBIA
Ministry of Agriculture and Food

Order Number 382.500-15
Agdex: 537/727
September, 1996

USING COMPOST

INTRODUCTION

Compost is a homogenous and friable mixture primarily composed of stabilized (no longer decaying) organic matter. **Composting** is the biological decomposition of natural organic materials by soil organisms into stable organic matter. Compost improves the water-holding capacity, and stability of soils and allows for easier root penetration by plants. It may also reduce the need for commercial fertilizer.

Benefits

While composting reduces landfill waste volumes, the primary objective of any operation is to produce a high quality product in as cost-effective a way as possible, without creating a hazard or nuisance. This compost should be a rich humus that will benefit the soil and promote health in future crops.

The major reasons for applying compost are to provide plants with a supply of nutrients in a stable organic form; to make soil more porous, allowing water, air and plant roots to penetrate more readily; and to improve the water retention capability of soil. Compost can assist in the breaking up of heavy clay soils or binding together large particles in sandy soils. Compost should be well stabilized before use. Incompletely composted material can contain organic acids and other organic compounds which may be toxic to plants. Compost attracts earthworms that aerate the soil, improve drainage and bring up minerals from the subsoil for plants use.

Cautions

The presence of unwanted materials such as stones, glass, plastics, pathogenic bacteria, weed seeds, toxic compounds and heavy metals, detracts from high compost quality. More information on this subject is contained in Regulations Affecting Composting, Factsheet No. 382.500-12.

When using compost, particularly in potting mixes, several factors must be considered. These include:

- Salt Content;
- Nutrient Concentrations;
- C:N Ratio of Compost and Soil;
- Porosity;
- Metals Concentrations; and
- Maturity of Compost.

In most instances, compost should constitute no more than 50% by volume of potting soils.

Elevated levels of salt in composts can be toxic to plants. Addition of compost with a high salt content such as found in spent mushroom compost, should be applied with caution especially, to salt-sensitive plants.

Concentrations of plant nutrients in compost will also affect plant growth. Major elements (nitrogen, phosphorus and potassium) and minor elements are found in compost, usually at a low concentration.

The C:N ratio expresses the relative proportion of carbon (C) and nitrogen (N) in compost. For comparison, soil organic matter or humus usually has a C:N ratio of around 10:1. Table 1 shows the C:N ratios for a few finished products. A finished compost having a C:N ratio greater than its surrounding soil may use nitrogen from the soil, making this nitrogen unavailable for growing plants.

Stable organic matter, as found in finished compost, enables soil to hold more water through the enhanced

TABLE 1 C:N RATIO OF SOME FINISHED COMPOSTS	
Type	**Range**
Dairy Manure Compost	7:1 to 10:1
Fish Mortality Compost	25:1 to 35:1
Municipal Solid Waste Compost	7:1 to 25:1
Mushroom Media Compost	8:1 to 27:1
Pig on Litter Compost	23:1 to 43:1
Pig Manure Compost	12:1 to 35:1
Poultry Manure Compost	7:1 to 10:1

formation of soil aggregates, which provides more space for air. Lack of porosity reduces germination and increases surface crusting.

Concerns about heavy metals in compost are addressed in Regulations Affecting Composting, Factsheet No. 382.500-12. Refer to this paper for proposed metals concentration limits.

Ideally, several characteristics should be identified in finished or mature compost. These include:

- Freedom from pathogens and weed seeds.
- An adequate supply of at least some of the major nutrients and a variety of minor nutrients.
- A crumbly texture that allows air to penetrate, holds moisture, and allows excess water to drain away.
- Brown to black in colour.
- A sweet earthy odour
- Freedom from mould and rotten smells.
- Temperatures at ambient conditions without rising when restacked.
- A C:N ratio less than 25:1.
- A content of at least 30 to 50% organic matter.
- A pH between 5.0 and 8.0.

FERTILIZER

Composts contain little nitrogen (N), phosphorus (P) or potassium (K), meaning that the dry weight percentages of these elements are very low. Since most nitrogen is in an organic form, it is released gradually. This decreases the risk of immediate leaching and extends its availability during the growing season.

The ability of compost to supply nitrogen to crops will vary depending on the initial composition of the raw wastes, as well as on the type and duration of the composting process. Stabilization of wastes through effective composting reduces the carbon to nitrogen ratio. One way to assess the energy potential of organic residues is by looking at the ratio of carbon to nitrogen present in the residue. The higher the ratio, the greater the energy the materials contain, and the longer it will take microorganisms to digest. Fresh hay, fresh manure and compost have C:N ratios in the range of about 10:1 to 30:1, ideal for balancing the energy needs of the soil organisms with the nitrogen needs of the plants. Materials with C:N ratios less than 20 are considered to be fertilizers, while materials with ratios more than 30 are considered soil amendments.

Most of the plant nutrients in compost are not immediately soluble in water, but are released gradually. Composts allow for nutrients to be used more efficiently, reducing the amount of fertilizer that needs to be applied and the potential loss of soluble nutrients such as nitrate to groundwater. A typical breakdown of nutrients in manure derived compost is shown in Table 2. The pH of most solid waste compost ranges from 7.0 to 8.0, and its introduction to soil will have little or no effect on soil pH.

SOIL AMENDMENT

The beneficial effects of organic wastes on soil physical properties are evidenced by increased water infiltration, water-holding capacity, water content, aeration and permeability, soil aggregation and rooting depth, and by decreased soil crusting, soil bulk density and runoff by erosion.

Without regular addition of organic material to soils, there is a potential for increased leaching, erosion and gradual deterioration of soil physical properties. Moreover, as soil degrades, there is an accompanying decrease in crop use efficiency of fertilizer nutrients, especially nitrogen.

TABLE 2 TYPICAL NUTRIENT BREAKDOWN OF FINISHED COMPOST	
Nutrient	**Dry Weight**
Nitrogen	<1% up to 4.5%
Potassium	0.5% to 1%
Phosphorus	0.8% to 1%
Calcium	2% to 3%
Magnesium	2% to 3%

The C:N ratio of soil organic matter generally range from 12:1 to 20:1. Any compost or other organic waste material which has a C:N ratio greater than 30:1 may cause a reduction in plant-available nitrogen, and will supply carbon to the soil. Compost with C:N ratios below 20:1 will supply nitrogen to the soil.

Composts provide a more stabilized form of organic matter than raw wastes and can greatly improve the physical properties of soils. Addition of compost to sandy soils will increase their ability to retain water and render them less prone to drought. In heavy-textured clay soils, the added organic matter will increase permeability to air and increase its water infiltration capabilities, thereby minimizing surface runoff and increasing water storage. The addition of compost to clay soils may reduce soil compaction, lower its bulk density and increase rooting depth.

RATE OF APPLICATION

The amount of compost applied depends on crop nitrogen requirement, field topography, climatic region, soil type, and nutrient composition of the finished compost. Land application rates of compost must meet the *Code of Agricultural Practice for Waste Management*.

Farmers frequently apply organic wastes (including compost) to their fields at rates that are too low or too high for maximum economic returns. When the rate is too low, soil physical properties are not sufficiently improved and the plant nutrient level is inadequate to sustain optimum crop growth and yield. If applied at excessive rates, plant nutrients are not utilized efficiently and contribute to environmental pollution via runoff and leaching. Crop yield responses to additions of organic materials are highly variable and again, is dependent upon the crop, soil type, climatic conditions, management system and organic material used. For acceptable agronomic application rates, nitrogen application from compost should match crop nitrogen removal. Example 1 illustrates calculations and assumptions in determining the amount of nitrogen available in compost.

EXAMPLE 1

Determine: Compost application rate to supplying 200 kg of nitrogen. Given the following compost analysis:

Total nitrogen (TKN) 1.59% (or 15,900 ppm)
Mineral nitrogen (NH_4) 1562 ppm
(NO_3) 672 ppm
Bulk density of compost is 400 kg/m^3

Assume: 50% loss of ammonia (NH_4-N) (based on research with manures, composts and biosolids)
20% of organic nitrogen is available in year of application (based on a range of 10 to 30% from research on composts and biosolids)

Calculation: Total available nitrogen in the first year is: available organic + remaining ammonia + nitrate.
Total organic nitrogen = (TKN - NH_4) = 15,900 ppm - 1562 ppm =13,666 ppm
Available organic nitrogen = 13,666 ppm x 20% = 2733 ppm
Remaining NH_4 = 1562 x 50% = 781 ppm
Total available nitrogen = 2733 ppm + 781 ppm + 672 ppm = 4186 ppm (or 4.18 kg/tonne)

To obtain 200 kg N per ha apply (200 kg N/ha / 4.18 kg N/t) 47.8 tonnes compost per hectare or 47.8 tonnes/ha x 1000 kg/tonne x 1 m^3/400 kg = 120 m^3/ha

Answer: Therefore, 120 m^3/ha of compost can be applied to supply the 200 kg N/ha.

COMPOST IN A MIX

Finished compost is considered to be humus, and composts are often used as part of a standard potting soil media. Potting media should generally contain a maximum of 50% compost by volume. Compost will benefit soil and greenhouse media by increasing its moisture-holding capacity and buffering capacity, and by providing a small amount of nutrients and essential trace elements. Some potting mixes include equal proportions of compost, sand and soil.

Spent mushroom compost has been researched as a growing medium additive in nursery container culture for a wide assortment of woody species. Mushroom compost cannot be used alone because of its lack of stability, its low water availability, its high salinity level and its neutral pH. It can, however, be used as part of a total compost component in a mix.

EXAMPLES OF USE

Compost has many uses and provides a number of agronomic benefits. The demand for compost is a function of price, availability, quality and, to some extent, service, education and promotion on the part of the producer. In areas where compost has been produced and used for a period of time, various markets and applications naturally evolve. The potential uses for compost are primarily in agriculture, land development and horticulture.

Agricultural

Advantages of field applied compost include:

- its use as an organic fertilizer for organic farmers;
- increased aeration and organic matter content;
- improved moisture and nutrient retention;
- decreased soil erosion and soil crusting;
- plant disease suppression; and
- improved tilth.

Land Development

Compost in land development applications are mostly used for:

- landscaping and golf courses maintenance, renovation and establishment of turf; and
- land reclamation for landfills and gravel pits.

Horticulture

Horticultural enterprises making use of compost are:

- greenhouses and nurseries;
- field growers and sod producers; and
- home gardeners.

Compost has been used as a substitute for peat moss in the production of bedding plants in the greenhouse industry and has performed well in the production of woody ornamental plants.

Sod cultivated on compost is of greater strength, equal in density and quality to conventional sod, and weighs 20 to 25% less than soil-produced sod.

Compost can also be used as a mulch for ornamental plants. It conserves moisture, increases pH and nutrient levels, decreases soil temperature, resists packing or matting, and reduces weed growth. These effects can last for more than one year.

Compost can be also used with other media, such as soil, perlite, and vermiculite for potted plants, turf or home gardens.

Compost also serves as an excellent additive to soils that may be poorly suited for agriculture. The increase in organic matter improves the soil water-holding capacity and reduces erosion by increasing its structural strength.

Compost Use for "Organic Producers"

Compost use by organic producers is referred to in the B.C. Organic Agricultural Products Certification Regulation, Operation Policies and Farm Standards Manual, Sections 2.7 and 4.2.8. These standards require written documentation of sources of off-farm materials used in on-farm composting activities. Certain composts are regulated, particularly those containing organic waste material derived from an industrial process including; abattoir waste; yeast fermentation waste; whey; hatchery waste; fish farm waste; mushroom compost; and paper and wood products.

Producers participating in organic certification programs should consult with their respective Certification Committees to determine acceptable methods and materials.

Home Gardener Use

For home gardeners, compost can be used in flower and vegetable gardens. A layer up to 7.5 cm or 3 inches thick should be spread on and mix well with garden soil. For house plant media mixes, finished compost should be mixed with equal parts soil and sand to make a nutrient rich potting soil. Screened compost can be used as part of a seed-starting mix or lawn top-dressing.

Other benefits of compost include its use in:

- for forest fertilization. This provides beneficial solutions to two complementary problems by: 1) disposing of excess organic waste, such as woodwaste, and 2) sustaining and increasing the productivity of our forests;
- greenhouse vegetable and flower production;
- flower bulb production;
- city park, sports field and recreation maintenance;
- field and row crop production; and
- fruit farming.

This is one of a series of Factsheets on Composting. A list of references used in producing this series is included in the Composting Factsheet "Suggested Reading and References."

COMPOSTING FACTSHEET SERIES PREPARED BY:
Hog Producers Sustainable Farming Group;
Pacific Agricultural Research Centre (Agassiz),
Agriculture and Agri-Food Canada; and
Resource Management Branch, BCMAF

FOR MORE INFORMATION CONTACT:
RESOURCE MANAGEMENT BRANCH
Ministry of Agriculture & Food
1767 Angus Campbell Road
Abbotsford BC, CANADA V3G 2M3
Phone: (604) 556-3100 Fax: (604) 556-3099