

2 Benefits and drawbacks of composting

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2.1 Introduction

Composting is the natural process of decomposing and recycling organic materials into a humus-rich soil amendment by the successive action of bacteria, fungi, actinomycetes, or earthworms. Many common materials can be composted on-site, including food wastes, leaves, grass clippings, plant trimmings, straw, shredded paper, animal manure, and municipal solid wastes. The final product is a stable dark-brown or black humus material with an earthy smell. Like other recycling efforts, composting has many benefits to agriculture, the environment, the economy, and the society. However, composts have some disadvantages to agriculture and the environment if they were processed or used under incorrect conditions. This chapter provides a brief introduction to the benefits and drawbacks of using composts.

2.2 Potential users and uses of finished compost

Prepared composts can be used by the following users:

- Agricultural and residential user group: used as soil amendment, fertilizer supplement, top dressing for pasture and hay crop maintenance, fertilizer substitute, mulch for fruit trees.
- Commercial user group: used as soil amendment for turf establishment, landscape planting and beds, potting mix component, peat substitute, topsoil substitute, mulch, fertilizer supplement.
- Municipal user group: used as landfill cover materials, topsoil for road and construction work, soil amendment, mulch for landscape planting.

2.3 The benefits of using composts to agriculture

Compost has been considered as a valuable soil amendment for centuries. Most people are aware that using composts is an effective way to increase healthy

plant production, help save money, reduce the use of chemical fertilizers, and conserve natural resources. Compost provides a stable organic matter that improves the physical, chemical, and biological properties of soils, thereby enhancing soil quality and crop production. When correctly applied, compost has the following beneficial effects on soil properties, thus creating suitable conditions for root development and consequently promoting higher yield and higher quality of crops (Figs. 1-3):

2.3.1 Improves the physical properties of soils

- Reduces the soil bulk density and improves the soil structure directly by loosening heavy soils with organic matter, and indirectly by means of aggregate-stabilizing humus contained in composts. Incorporating composts into compacted soils improves root penetration and turf establishment.
- Increases the water-holding capacity of the soil directly by binding water to organic matter, and indirectly by improving the soil structure, thus improving the absorption and movement of water into the soil. Therefore, water requirement and irrigation will be reduced.
- Protects the surface soil from water and wind erosion by reducing the soil-dispersion action of beating raindrops, increasing infiltration, reducing water runoff, and increasing surface wetness. Preventing erosion is essential for protecting waterways and maintaining the quality and productivity of the soil.
- Helps bind the soil particles into crumbs by the fungi or actinomycetes mycelia contained in the compost and stimulated in the soil by its application, generally increasing the stability of the soil against wind and water erosion.
- Improves soil aeration and thus supplies enough oxygen to the roots and escapes excess carbon dioxide from the root space.



Fig. 1. Spinach grown in the field applied with compost



Fig. 2. Maize grown in the field applied with compost



Fig. 3. Lettuce grown in the field applied with compost

- Increases the soil temperature directly by its dark color, which increases heat absorption by the soil, and indirectly by the improved soil structure.
- Helps moderate soil temperature and prevents rapid fluctuations of soil temperature, hence, providing a better environment for root growth. This is especially true of compost used as a surface mulch.

2.3.2 Enhances the chemical properties of soils

- Enables soils to hold more plant nutrients and increases the cation exchange capacity (CEC), anion exchange capacity (AEC), and buffering capacity of soils for longer periods of time after composts are applied to soils. This is important mainly for soils containing little clay and organic matter.
- Builds up nutrients in the soil. Composts contain the major nutrients required by all plants [N,P,K, calcium (Ca), magnesium(Mg), and S] plus essential micronutrients or trace elements, such as copper (Cu), zinc (Zn), iron (Fe), manganese (Mn), boron (B), and molybdenum (Mb).
- The nutrients from mature composts are released to the plants slowly and steadily. The benefits will last for more than one season.
- Stabilizes the volatile nitrogen of raw materials into large protein particles during composting, thereby reducing N losses.
- Provides active agents, such as growth substances, which may be beneficial mainly to germinating plants.
- Adds organic matter and humus to regenerate poor soils.
- Buffers the soil against rapid changes due to acidity, alkalinity, salinity, pesticides, and toxic heavy metals.

2.3.3 Improves the biological properties of soils

- Supplies food and encourages the growth of beneficial microorganisms and earthworms.
- Helps suppress certain plant diseases, soilborne diseases, and parasites.
- Research has shown that composts can help control plant diseases (e.g. *Pythium* root rot, *Rhizoctonia* root rot, chili wilt, and parasitic nematode) and reduce crop losses. A major California fruit and vegetable grower was able to cut pesticide use by 80% after three years of compost applications as part of an organic matter management system. Research has also indicated that some composts, particularly those prepared from tree barks, release chemicals that inhibit some plant pathogens (Hoitink and Fahy 1986). Disease control with compost has been attributed to four possible mechanisms:

- 1) successful competition for nutrients by beneficial microorganisms;
 - 2) antibiotic production by beneficial microorganisms;
 - 3) successful predation against pathogens by beneficial microorganisms;
 - 4) activation of disease-resistant genes in plants by composts;
 - and 5) high temperatures that result from composting kill pathogens.
- Reduces and kills weed seeds by a combination of factors including the heat of the compost pile, rotting, and premature germination.

2.4 Benefits of using composts to the environment

2.4.1 Pollution remediation

- Absorbs odors and degrades volatile organic compounds.
- Binds heavy metals and prevents them from migrating to water resources or being absorbed by plants.
- Degrades and, in some cases, completely eliminates wood preservatives, petroleum products, pesticides, and both chlorinated and nonchlorinated hydrocarbons in contaminated soils.

2.4.2 Pollution prevention

- Avoids methane production and leachate formation in landfills by diverting organics for composting.
- Absorbs odors and degrades volatile organic compounds. Prevents pollutants in storm water runoff from reaching water resources, and protects groundwater quality.
- Prevents erosion and turf loss on roadsides, hillsides, playing fields, and golf courses.
- Minimizes odors from agricultural areas.
- Composting raw manure can minimize any potential environmental or nuisance problems. Raw manure is one of the primary culprits in the pollution of waterways, and odor from farms is considered an increasing problem in the rural areas.

2.5 Economic and social benefits of composting

The economic and social benefits of composting include the following:

- Brings higher prices for organically grown crops.
- Composting can offer several potential economic benefits to communities:
 - Extends current landfill longevity and delays the construction of a more expensive replacement landfill or incinerator.
 - Reduces or avoids landfill or combustor

tipping fees, and reduces waste disposal fees and long-distance transportation costs.

- Offers environmental benefits from reduced landfill and combustion use.
- Creates new jobs for citizens.
- Produces marketable products and a less-cost alternative to standard landfill cover, artificial soil amendments, and conventional bioremediation techniques.
- Provides a source of plant nutrients and improves soil fertility; results in significant cost savings by reducing the need for water, pesticides, fungicides, herbicides, and nematodes.
- Used as an alternative to natural topsoil in new construction, landscape renovations, and container gardens. Using composts in these types of applications is not only less expensive than purchasing topsoil, but it can also often produce better results when establishing a healthy vegetative cover.
- Used as mulch for trees, orchards, landscapes, lawns, gardens, and makes an excellent potting mix. Placed over the roots of plants, compost

mulch conserves water and stabilizes soil temperatures. In addition, it keeps plants healthy by controlling weeds, providing a slow release of nutrients, and preventing soil loss through erosion.

2.6 Drawbacks of using composts

Agricultural use of composts remains low for several reasons:

- The product is weighty and bulky, making it expensive to transport.
- The nutrient value of compost is low compared with that of chemical fertilizers, and the rate of nutrient release is slow so that it cannot usually meet the nutrient requirement of crops in a short time, thus resulting in some nutrient deficiency (Figs. 4 and 5).
- The nutrient composition of compost is highly variable compared to chemical fertilizers.
- Agricultural users might have concerns regarding potential levels of heavy metals and other possible contaminants in compost,



Fig. 4. Mg deficiency induced by applying compost with low Mg content.



Fig. 5. Ca deficiency of cabbage grown in strongly acidic soil applied with compost.

particularly mixed municipal solid wastes. The potential for contamination becomes an important issue when compost is used on food crops.

- Long-term and/or heavy application of composts to agricultural soils has been found to result in salt, nutrient, or heavy metal accumulation and may adversely affect plant growth, soil organisms, water quality, and animal and human health (Figs. 6 and 7).

2.7 Why are so many farmers in Asia buying compost instead of making it by themselves?

Whatever composting system is used, farmers must have adequate land area and suitable equipment to manage a composting operation, and stable sources of raw materials for composting must be available. In addition, it usually takes a long time – perhaps years – to produce a stable compost product. Therefore, the requirements of raw materials, space, and equipment as well as the length of time required for composting usually discourage farmers from making compost by themselves.

A farmer's composting system costs include the annual fixed and variable costs attributable to the system. Capital investments include all composting system structures and equipment. Variable costs include labor, fuel, electricity, and maintenance charges. It is less economical and more expensive for farmers to make compost by themselves than to buy it from the market.

A successful composting operation should have appropriate background in and techniques for producing high-quality composts without creating odor and other environmental problems. Some negative effects on agriculture and the environment have been found when immature or low-quality composts, usually produced under an inadequate composting process, were added to the soil (Fig. 8). It is better to use high-quality composts bought from the market than to use immature ones produced by farmers if their knowledge of and/or techniques for composting are not proper.

If not carefully and properly controlled, the composting process can create a number of environmental concerns such as air and water pollution, odor, noise, vectors, fires, and litter that can be a cause of complaints from neighbors or nearby residents. In addition, the potential worker's health and



Fig. 6. Poor growth of tomato in soil with high EC value due to heavy application of animal compost.



Fig. 7. Poor seed generation of cabbage in soil with salt accumulation due to heavy application of animal compost.



Fig. 8. Use of immature compost generally reduces vegetable production.

safety problems must be dealt with and solved. It may be too difficult for farmers to manage these problems.

2.8 References

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