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BUILDING AND MAINTAINING A COMPOST PILE FOR THE HOME GARDEN

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Abstract. **Increasing numbers of home gardeners are making their own compost from yard trimmings and other available organic materials. A wide variety of composting configurations can be used. Some gardeners make their own compost piles in conical, cylindrical and rectangular shapes. Commercially available composting systems are popular, although the capacity of many of these systems is too small for the average garden trimming output. Regardless of the configuration chosen, optimum composting takes place when the pH ranges between 6.5-8.5, carbon to nitrogen ratio ranges between 20:1-40:1, moisture content ranges between 40%-65%, pile core temperature ranges between 110°F to 150°F and particle size ranges between 1/8"-2". Effective composting can be done if values occur outside of these ranges, although the time required for the compost to mature will be longer.**

Making and using compost in home gardens are practices that are as old as agriculture itself. The earliest known reference to using manure composts is believed to be the clay tablets of the Akkadian Empire, dated approximately 2,300 BC (Rodale *et al.*, 1960). There are numerous references to compost use in the great books of antiquity, including the Bible, the Koran and the Talmud. Since those early days, there have been numerous accounts of the use of composts in horticultural production. Use of natural organic materials in the production of horticultural crops, both at the commercial level, and by home gardeners, is a practice that is thousands of years old, although during the past century these practices have been eclipsed to some degree by the advent and expansion of use of agri-chemicals in horticulture.

During the thousands of years that composts have been made and used by gardeners, there have been numerous written guides providing advice on the best methods. Some of the more recently published guidelines (Christopher and Asher, 1994; Roudac, 1992; Rynk *et al.*, 1992; Will *et al.*, 1989) contain practical advice that can be useful to commercial scale, farm scale and backyard composters.

The Composting Process

Composting is a biological process by which non-living organic matter undergoes decomposition from less stable to more stable forms. The process is caused and controlled by microorganisms, such as bacteria and fungi, that use organic matter as a nutrient source for their own metabolic functions. While composting can technically be conducted in anaerobic environments which lack oxygen, the vast majority of all composting systems utilize aerobic microorganisms. Aerobic microbes, those that require oxygen, are much more efficient than anaerobic microbes. Since most composting systems are aerobic, the oxidation reactions release tremendous amounts of energy. It is not unusual to measure temperatures in the core of well managed compost piles in the range of 130-150°F or higher. The by-products of the intense metabolic activity of these microbes form much of the compost end product. During the composting process, organic matter undergoes substantial physical and biochemical transformation. At the completion of composting: (1) the particles in the pile are reduced in size, (2) the mix has become more uniform, (3) the amount of humus has increased, (4) the material has become dark brown or black in color, (5) there is little trace of the original parent material, (6) carbon to nitrogen ratio has decreased, (7) biological activity, primarily bacteria and fungi, has decreased, (8) pH usually has shifted toward neutrality, (9) the original volume has reduced 25 - 50%, and (10) the original weight has reduced 40 - 80%.

Composting Procedures

Many composters simply form organic matter such as leaves, pruning debris, wood waste and similar material into piles and allow these piles to gradually decompose. When such piles receive no significant care, such as water addition or turning, the composting is said to be passive composting. Depending upon the size of the passive compost pile and the nature of the material in it, this type of composting should yield a stable, horticulturally useful end product in 1-3 years.

Some composters desire a useful end product more quickly, so they manipulate the compost pile to make its environment more hospitable for the microbes responsible for the composting process. Optimum values of important composting parameters are listed in Table 1. The most common manipulation procedure is pile turning. The composting microbes consume oxygen, and oxygen levels in the center of active compost piles frequently becomes depressed. As the oxygen concentration lowers to critical levels, composting rate lowers. Pile turning restores oxygen levels and can therefore speed up the composting rate. Composters tending small to medium sized piles frequently use manure forks or pitch forks for pile turning.

Pile turning is also important in regulating compost pile moisture levels. If the pile is too wet, turning the material can help reduce its moisture. If the pile is too dry, water should be added by spraying with a hose as the pile is being turned. A composter can monitor compost moisture levels by squeezing a handful of composting material. If the material does not hold its shape after squeezing, its moisture content is probably lower than optimum. Conversely, if liquid flows from the material while it is being squeezed, its moisture content is probably higher than optimum.

Table 1. Process parameters for composting.

Parameter	Optimum level	Typical range
pH	6.5 - 8.0	5.0 - 9.0
Oxygen level	5% - 21%	0% - 21%
Moisture content	40% - 65%	20% - 80%
Particle size	1/8" - 2"	Variable
C:N	20:1 - 40:1	8:1 - 200:1
Core temperature	110° F - 150° F	Ambient - 175° F

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Pile temperature can be easily monitored using a bimetallic thermometer, sold in many garden centers for prices less than $20. Pile temperature is a good indication of the status of the other parameters listed in Table 1, several of which are difficult for the home gardener to accurately measure. If the pile temperature is too low. the other parameters, such as moisture or oxygen levels, should be investigated. Low oxygen levels are frequently indicated by a sour odor, or, in extreme cases, an objectionable sulfurous odor.

Composters who actively manipulate their compost piles to ensure optimum composting conditions can significantly shorten the time required to produce a stable end product. If the composting mass contains a balance of leafy and woody material, a well-managed composting pile can produce a stable end product in just a few months.

An Economical Compost Pile

There are many different designs and approaches used in backyard composting. Gardeners can purchase ready-made compost bins from garden centers and other horticultural suppliers. Many gardeners prefer to make their own from the wide variety of designs and specifications available. Since most of these designs and approaches produce equally good quality compost, many composters choose a system design based on cost. A very economical design is pictured in Fig. 1. It is made of a single piece of wire fencing, 3 feet or 4 feet wide, and 15 feet long. The piece of fencing is turned into a cylinder and held together with wire twist ties. The composter should select the width based on the volume of material to be composted and the height of the composter. When the pile is to be turned, the composter merely unfastens the twist ties, removes the wire fencing from around the piled organic matter, repositions the cylinder adjacent to the original pile position, and refills the cylinder with the contents of the original pile. Composters with large amounts of material can make additional piles.

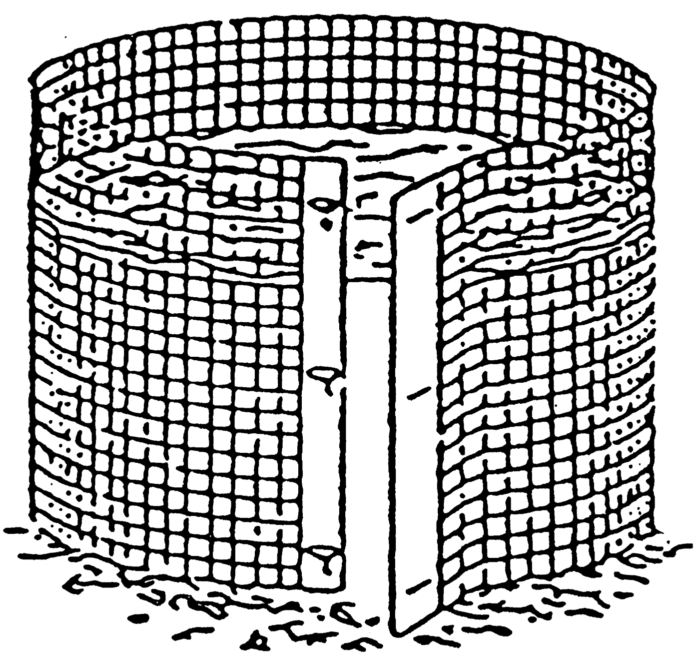

Figure 1. An economical compost system can be made by turning a piece of wire fencing into a cylinder and fastening it with wire twist ties. A piece of fencing 3 feet by 15 feet will make a cylinder approximately 54 cubic feet (2 cubic yards) in volume, suitable for small yards (or shorter people). A piece of fencing 4 feet by 15 feet will make a cylinder approximately 72 cubic feet (2.7 cubic yards) in volume, suitable for larger yards (or taller people).

Table 2. Quality parameters for a growing medium for use with floricultural crops.

Parameter	Desired range
pH	5.5 - 6.5
Soluble salts	400 - 1,000 ppm *or* 0.6 - 1.4 dS/m
Total pore space	5 - 30% after drainage
Water holding capacity	20 - 60% volume
Bulk density	0.30 - 0.75 g/cm^3 (dry) *or* 0.60 - 1.2 g/cm^3 (wet)
Cation exchange capacity	10-100 meq/100 cm^3

Using Compost in the Home Garden

A high quality compost can: (1) reduce bulk density of many soil types, (2) increase aeration of dense soils, (3) improve drainage of dense soils, (4) increase water holding capacity of sandy soils, (5) increase exchange capacity of many soil types, (6) contain nutritional sources (depending upon the kind of material used in making the compost), (7) have plant disease suppression or blockage properties, and (8) promote growth of mycorrhizae.

When the composter takes material out of the compost pile before all of the material has been thoroughly decomposed, the compost is said to be immature. Immature composts may contain phytotoxic organic acids that can stunt or even kill plants. These phytotoxic materials are made for brief periods of time by certain microbes early in the composting process. Since these composts are present for only a very short time period and are volatile, they do not constitute a problem in mature composts. Composters frequently test compost products for presence of phytotoxic compounds by using a small amount of material to grow a rapid maturing crop, such as radishes. If phytotoxic compounds are present, the seedlings will have symptoms, such as yellowing of leaves or deformed roots, that can be seen and used by the composter as an indication that the composting is not finished.

Horticulturists use composts for a variety of purposes. Composts can be used for landscape plant establishment and maintenance, as a soil amendment, as a mulch, or as an ingredient in container potting mixes. Specific guidelines for compost utilization vary depending upon the use and the quality of the compost. The most stringent quality guidelines would be for use as a foliage plant container medium, because these plants are frequently grown in small containers and their roots are in direct contact with the medium for the entire life of the plant (Table 2). If other uses are envisioned, then the parameters listed in Table 2, for foliage plant container media, should be considered as very conservative.

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PLANT STRESS AS A PREDISPOSING FACTOR IN OUTBREAKS OF BACTERIAL LEAFSPOT

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Abstract. **Soil moisture (SM) and electrical conductivity (EC) studies were carried out on five pepper farms in Palm Beach County, FL during the late summer of 1991. Weekly evaluations of SM and EC were made over a 6 - 7 week period. SM's were maintained uniformly at each site during the study period although considerable differences were found among the farms. EC's of soil taken from the center band of fertilizer, in the plant row and near the shoulder of the bed generally showed rapid and continuous loss of fertilizer from the center band and considerable variability in the quantity of fertilizer present at the other two locations. Fertilizer leached from the center band moved generally downward in the bed. Bacterial leafspot (BLS), *Xanthomonas campestris* pv. *vesicatoria* (Doidge) Dye, occurred at several sites. In every instance, plants first infected with BLS showed both extensive damage to the primary root system and significant stunting of vegetative growth as compared to healthy plants. Fertilizer burn of the apical meristem of the tap root was evident. There was a 100% correlation between root damage and occurrence of BLS among diseased plants. We propose that plant stress, induced by salt damage to the primary root system, is a major predisposing factor in the epidemiology of BLS. Epiphytic bacteria appear to be heavily involved in initial outbreaks of BLS. Current grower fertilizer practices are both wasteful and appear to be causal in effects on BLS outbreaks. Remedies for these problems are discussed.**

Of the several infectious diseases which affect production of bell pepper (*Capsicum annuum* L.) in Palm Beach County, FL (PBC), none causes more damage than bacterial leafspot (BLS), caused by *Xanthomonas campestris* pv. *vesicatoria.* Chemical control is mainly by means of copper sprays, the benefits of which are questionable when conditions for disease spread are favorable.

For decades, conventional wisdom among growers and researchers has held that spread of BLS was closely associated with environmental conditions favorable for development and spread of bacteria—warm, wet and windy weather. And we also saw evidence of this occurring. But we also observed *initial outbreaks* of BLS developing very uncharacteristically—in patterns which defied explanation using conventional wisdom. Some of these observations have been reported earlier (Simons, 1987).

Our observations in PBC pepper fields were made over a 10-15 year period, often on the same fields for several consecutive years, and have revealed several consistent patterns of disease development. These include:

1.) Pepper plantings made in late July and early August remained free of BLS until September or later in spite of the occurrence of numerous thunderstorms, frequent temporary flooding of fields, and the persistent hot, humid weather during the first 6-8 weeks of growth.
2.) Pepper plants were in the flowering and early fruiting stage when symptoms first appeared. Later plantings of young plants growing near the diseased plantings remained free of BLS even though they were subjected to the same weather stresses.
3.) Plants which were initially affected were always stunted compared to noninfected plants.
4.) Examination of roots of diseased and adjacent healthy plants revealed a 100% correlation with respect to damage to roots of the diseased plants. The injured roots had lost the tap root and associated secondary roots with development limited to the top 2-3 inches of the bed. Roots of healthy plants were always normal in appearance with a well developed tap root and secondary system which extended some 8-10 inches down in the bed. Roots of both diseased and healthy plants were clean and white with no evidence of soilborne disease. It appeared that the lack of root growth in the diseased plants was the result of killing the apical meristem of the tap root, probably by salt injury associated with use of large amounts of fertilizer.
5.) Diseased plants occurred in patches which were randomly distributed in the field. There were no gradients of infection present. Occasionally, isolated plants were observed with BLS. When gradients of infection occurred they were associated closely with soil moisture gradients in the field.
6.) In some cases BLS occurred in the same areas of the same fields year after year. The troubled locations were consistently in areas where there were significant drainage problems, either too wet or too dry.
7.) Plantings which developed BLS at flowering recovered from the disease over a period of time and never manifested a recurrence even though weather conditions favorable for disease development recurred many times. Young plantings of peppers on the same farm did develop BLS during the period in which the old plantings remained healthy.