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Compost Characteristics and their Rationale for Testing

Compost Parameters	Definition and Importance
pH	**Definition:** pH is the numerical measure of the acidity (or alkalinity) or hydrogen ion activity of the soil/media (soil amendments, etc.). **Importance:** pH testing is necessary for soil/plant management. The compost's pH will affect the pH of the soil/media to which it is added. Therefore, it may also effect or cause other potential pH adjustments. Plants possess an optimum pH range in which they will grow and thrive; this range relates to their ability to absorb nutrients in a soil/media.
Electrical Conductivity	**Definition:** Electrical conductivity (EC) is the measure of soluble salt or ion content in compost or soil/media. High electrical conductivity can also be an indication of high levels of available nutrients in a compost. **Importance:** Testing the EC of compost is necessary for soil/plant management. The compost's electrical conductivity will affect the electrical conductivity of the soil/media to which it is added. This may therefore affect a plant's watering or fertilizer regime. Each plant species possesses a specific level of salt tolerance. Going above this tolerance may injure the plant, reducing its productivity or killing it. It should be understood that certain salts (e.g., Na, Cl) are more damaging to plants than others (e.g., Ca, K), and EC levels can be an indicator of overall nutrient content.
Nutrient Content (N-P-K)	**Definition:** Nitrogen (N), Phosphorus (P), and Potassium (K) are the three nutrients (macronutrients) used by plants in the greatest quantities. **Importance:** Testing the nutrient content of compost is necessary for soil/plant management, and may include secondary (Ca, Mg, S) and micro-nutrient testing. Each plant species possess a specific nutrient requirement. These nutrients can be supplied through fertilization, innate nutrients found within the soil/media, or compost. Since the nutrients in compost can supply some of a plant's nutrient requirement, the addition of compost will affect subsequent fertilizer requirements. It should be understood that not all compost nutrients are readily or quickly available, and this is often viewed as advantageous. Research suggests that nitrogen and phosphorous are available over a 3 year period, while most of the potassium is available the first year.
Moisture Content	**Definition:** Moisture content is the measure of the amount of water in a compost product, expressed as a percent of the total solids. **Importance:** Moisture is primarily a product handling and transportation issue. Often, composts possessing a moisture content over 50% start to become difficult to handle and somewhat 'clumpy'. Since water is heavier than compost, excess moisture has a significant impact on the products bulk density.
Organic Matter Content	**Definition:** Organic matter (OM) content is the measure of carbon-based materials in compost, typically expressed as a percentage of dry weight. **Importance:** Testing for OM content is necessary for soil/plant management in some applications. Some agricultural soil test results

	specify the addition of organic matter on a *tons per acre* (or kilogram per hectare) basis. Therefore, knowing the OM content of a compost product would be relevant in determining its application rate. Some customers use OM content as a means to measure compost effectiveness and value. Composts are generally higher in OM then are soils, and for this reason are used to increase OM levels in soil. *Note: Composts possessing high OM contents (60% +) may not be adequately stabilized for many applications.*
Particle Size	**Definition:** Particle size is a measurement of the product's maximum particle size or the screen size through which it passes. Particle size distribution measures that percentage product passing through a series of screens. **Importance:** Although the particle size of a compost product may affect the porosity of the soil/media to which it is added, particle size typically determines the products usability in specific applications (e.g., finer compost in topdressing, coarser compost in mulching). In some applications (e.g., erosion control blanket, bioretention soil amendment, etc.) a full particle size distribution analysis is required to determine the suitability of a specific compost product.
Heavy Metals	**Definition:** Most heavy metals are trace elements whose concentrations are regulated due to their potential for toxicity to humans, animals, or plants. These substances do not degrade during the composting process. US EPA standards exist for heavy metals in compost (see Table 1). **Importance:** Testing for heavy metals is necessary to evaluate and monitor the health/safety risks of usage, and reduce consumer concerns. Testing may also be relevant for soil/plant management, as several heavy metals are also trace elements, needed by plants. However, excess trace elements (e.g., B, Mn) may be toxic to specific plant species. *Note: This type of toxicity has rarely been documented with compost. In fact, compost is used in some reclamation projects in order to bind heavy metals, reducing their mobility.*
Pathogens	**Definition:** Pathogens are living microorganisms, such as a bacteria or fungi that can cause plant, animal or human disease. US EPA standards exist for pathogens in compost (see Table 1). **Importance:** Necessary to evaluate and monitor health/safety risks of usage and reduce consumer concerns. Human pathogen content of compost is primarily tested for after the stabilization phase and before distribution. However, composting temperatures are monitored during composting (sanitization phase), and often after, in order to assure that adequate temperatures are being generated, and sustained, to assure pathogen kill. Typically, the time and temperature requirements for sanitization in composting are far exceeded.
Stability	**Definition:** Stability is the level of biologic activity in compost. This activity relates to the presence and proper degradation of available carbon during the composting and curing process. **Importance:** Stabilization of available carbon must occur during the composting process. If it doesn't, this degradation will occur once the product is applied to the soil/media. In these cases, nitrogen drawdown will occur, usually causing stunting or yellowing of plants. This occurs because soil/compost microbes will utilize nitrogen in the soil to degrade the excess carbon, stealing it from the plants. Therefore, compost stability must be known because it can have an effect on plant growth and fertilization practices (may have to apply additional nitrogen).
Plant Response (Maturity)	**Definition:** Plant response tests are known as bioassays. Bioassays are very practical tests (plant growth trials) that are done to determine if there is a presence of substances that can harm plants. Bioassays are typically used to measure the maturity of composts as well. **Importance:** Necessary for soil/plant management. Plant response tests evaluate the affect of compost on seed germination and plant growth. Substances in compost, such as volatile fatty acids, alcohol, soluble salts, specific heavy metals, or ammonia, if found in high

	enough concentrations can cause delayed seed germination, seed or seedling damage or death, or plant damage or death. In the early days of composting, these tests were used to determine if fatty acids created during composting have properly degraded. Today, poor maturity levels are related to higher levels of ammonia.
Physical Contaminants	**Definition:** Physical contaminants of compost are unwanted materials such as glass, plastic and stones. These materials cannot be broken down by the composting process. Often, regulatory standards regarding inerts relate to man-made materials and not those which are natural (e.g., stones). **Importance:** Although there may be some health/safety and environmental implications of using physically contaminated compost, especially during product handling and spreading (e.g. glass), aesthetic issues are considered to be a greater short-term issue as far as usage and marketing. Composts containing physical contaminants that can be readily seen, will possess a reduced market value.
Weed Propagules	**Definition:** Weed propagules are viable weed seeds and vegetative cuttings capable of regrowth in the compost or the soil/media in which it is added. **Importance:** Although the presence of weed propagules in compost will affect the management of the soil/media to which it has been added (effect on herbicide usage), their presence is simply seen by end users as unacceptable. It may also be a sign of poor composting or storage practices. The presence of weed propagules in compost is typically an issue of poor storage practices.

Table 1
The US EPA 503 Product Requirements

Contaminant Parameters	**Reported as (units of measure)**	**Acceptable Limits**
Chemical *(Heavy Metals, EQ Concentration Limits)*		
Arsenic (Ar)	mg/kg (ppm) dry matter	41
Cadmium (Cd)	mg/kg (ppm) dry matter	39
Copper (Cu)	mg/kg (ppm) dry matter	1,500
Lead (Pb)	mg/kg (ppm) dry matter	300
Mercury (Hg)	mg/kg (ppm) dry matter	17
Molybdenum (Mo)	mg/kg (ppm) dry matter	–
Nickel (Ni)	mg/kg (ppm) dry matter	420
Selenium (Se)	mg/kg (ppm) dry matter	100
Zinc (Zn)	mg/kg (ppm) dry matter	2,800
Biological		
Fecal Coliform, or Salmonella	MPN/g of TS MPN/4g of TS	<1,000 <3