Compost may contain enough micronutrients (trace elements) to meet the crop's annual requirements.

STEPS TO SUCCESS USING COMPOST:

- Compost must pass applicable federal and state law such as EPA regulation 40 CFR Part 503 for windrow composting of biosolids: temperatures of 55°C for 15 days and turned 5 times will eliminate pathogen and kill weed seeds.
- Meet "horticultural specification" based in crop requirement **(Table 1)**.
- Compost should be stable and mature, to avoid nitrogen "rob" and phytotoxic reactions to chemicals (acetic, propionic and butyric acids).
- Compost is not considered a fertilizer; however, significant quantities of nutrients (particularly N, P, K and micronutrients) become bio-available with time as compost decomposes in the soil. Amending soil with compost provides a slow-release source of nutrients, whereas mineral fertilizer is usually water-soluble and is immediately available to plants.
- Compost usually contains large quantities of plant-available micronutrients. Therefore is important to determine the nutrient content by a compost certified laboratory. Total N, P and K apply by the compost or manure should be deducted from the total fertilizer N, P and K annual application rate.

BENEFITS OF COMPOST AND MANURES:

Compost as a transplant medium: The transplant industry for the production of tomato and pepper plants relies on peat moss as a major ingredient in soilless media. Peat is an expensive, non-renewable resource. Seed emergence and seedling growth was similar to traditional peat:vermiculite media when peat was partially replaced with compost. Negative growth effects were reported when the medium was 100% compost, especially when immature, unstable compost was used **(Figure 1)**.

Figure 1. Compost as substitute for potting soil component. C1 = 18% compost; C2: 35% compost; C3= 52% compost; C4= 70% compost; and C5 = No compost. Photograph by: Monica Ozores-Hampton.

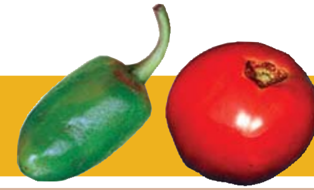
Compost as a soil amendment: Amending soils with composted materials has been reported to increase tomato and pepper yields. However, combining compost and inorganic fertilizer has generally been more effective in producing a positive plant response than separate application of either material alone **(Figures 2 & 3)**.

Figures 2 & 3. (Left) Reduction in fertilizer use and higher yields are a few of the benefits of long-term compost use. (Right) 0.8% organic matter in non-composted bed. Photographs by: Monica Ozores-Hampton.

After this 10 year study (to the right), the use of 3% organic matter from compost resulted in 50% less fertilizer.

Soilborne disease suppression: Compost can suppress plant diseases but not all composts and not all the time. The colonization of compost by beneficial microorganisms during the latter stages of composting appears to be responsible for inducing disease suppression, especially root-rot diseases and nematodes. Compost does not kill the pathogens that cause disease as fungicides do. Instead, compost controls the pathogens by keeping the beneficial microorganisms active and growing. Therefore, pathogenic agents will either not germinate or will remain inactive.

Prepared by: Dr. Monica Ozores-Hampton



More Benefits of compost:

Biological weed control: Weed growth suppression is an important attribute of surface-applied mulch. An organic mulch suppresses weeds by its physical presence as a surface cover, or by the action of phytotoxic compounds that it contains. Chemical effects of phytotoxic compounds (volatile fatty acids and/or ammonia) in compost can decrease weed seed germination. Inhibition of germination or subsequent weed growth may be attributed to both the physical effect of the mulch and the presence of phytotoxic compounds (fatty acids) in the immature compost **(Figure 4).**

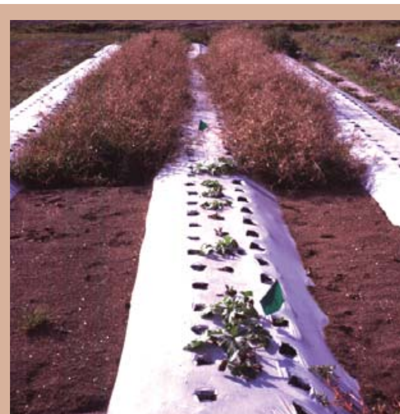


Figure 4. Application of 3 inches or more immature compost in the row middle in vegetable beds suppressed weeds significantly. Photograph by: Monica Ozores-Hampton.

Figure 5. Application of Municipal Solid Waste compost as a polyethylene mulch replacement in a pepper field. Photograph by: Monica Ozores-Hampton.

Polyethylene mulch alternative: Removal and disposal of polyethylene mulch has been a major production cost to Florida growers. Polyethylene mulch regulates soil temperature and moisture, reduces weed seed germination and leaching of inorganic fertilizer, and is a barrier for soil fumigants. In general traditional raised beds were covered with polyethylene mulch or replaced by composted materials bell pepper yields were higher on compost mulch plots than on un-mulched plots but lower than on polyethylene-mulched beds **(Figure 5)**.

Table 1. Horticultural Specifications for Composted Materials

Horticultural Parameter	Optimal Range	Effect
pH	5.5 – 7.0	In acidic soil, alkaline compost will raise pH
Moisture (%)	35 – 55	Higher moisture, increased handling and transportation costs
Bulk density (lb per yd^3)	800 – 1000	Higher moisture content means a greater bulk density
Inert and oversize matter (% dry wt)	<1	
Organic matter content	30-65 %	Higher organic matter lowers application rate
Water holding capacity (WHC) (%)	100 or above	Higher WHC leads to lower irrigation frequency
Particle size	1′ or less	Increase soil porosity
Stability or maturity index	Stable to highly stable	Instability can cause "N-immobilization"
Maturity growth	Must pass maturity screening test	GI lower than 60 indicates phytotoxicity
Soluble salts	Less than 6 dS	Higher than 6.0 means potential toxicity
C:N ratio	<20:1	Higher C:N ratio causes "N-immobilization"
Nitrogen	1 % or above	
Weed free	None	Uncomposted materials disseminate weeds
Heavy metals	Must pass USEPA, 40 CFR 503	
Fecal coliform	Must pass USEPA, 40 CFR 503	
Salmonella spp.	Absent	
Other (color and smell)	Should have an "earthy" odor that is not unpleasant	

[z] FDACS, 1995
[y] G.I = (% seed germination x root length growth in % of control) /100 (Zucconi et al., 1981a)

How to calculate compost application rates for tomatoes based on crop N requirements:

10 tons of compost x 60% dry weight = 6 tons compost dry weight

6 tons dry weight x 3 % N = 360 lb of N

360 lb of N x 10% mineralization rate

36 lb NO_3-N if the tomato requirements are 200 lb/acre we need to added 164 lb of N as a N fertilizer

NUTRIENT RELEASE:

It is important to know the mineralization (decomposition, or microbial break-down) rate of the compost before determining its application rate to tomatoes and peppers. The rate of nitrogen (N) release is especially important, since this nutrient moves readily through sandy soil.

Evaluations of N mineralization *in situ* can be used to improve N use efficiency. However, the direct, quantitative measurement of N mineralization *in situ* is very difficult due to the complex and dynamic nature of N transformations in the soil environment.

Compost mineralization rates will vary depending on compost characteristics, soil characteristics and environmental conditions. As general recommendations where N immobilization occurred, composts had initial C:N greater than 20:1 and N concentration less than 1.6%. Mineralization occurred where compost had C:N ratio lower than 20:1 and N concentration greater than 1.6%.

HOW AND WHEN TO INCORPORATE?

- Compost may be applied using a traditional manure spreader (flail/rear discharge or side discharge) or other specialized equipment.

- Compost is typically applied throughout an entire field, but may also be applied only in the rows. The product should be uniformly surface-applied, then incorporated to an approximate depth of 5 to 6 inches using a rototiller, disc, moldboard plow or other tillage equipment.

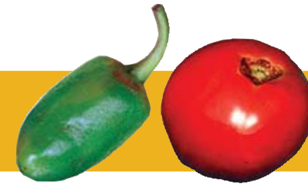
- Tomatoes have been cultivated using a wide range of compost application rates of 5 to 70 tons/acre. Lower rates of compost are typically being used as "maintenance applications." Appropriate compost application rates will be influenced by existing soil conditions, compost characteristics and the nutrient requirements of the crop.

Figure 6. Broadcast application using a manure spreader. Photograph by: Monica Ozores-Hampton.

Figure 7. Localized application of compost directly to bed. Photograph by: Monica Ozores-Hampton.

HOW TO CALIBRATE A COMPOST SPREADER:

- First load and weigh the contents of the spreader or weigh a 5-gallon bucket of manure and multiply the weight x 1.5 x length x width x height of the spreader. This will give you tons per load of compost or manure.
- Next determine the distance in feet that it takes to spread the entire load. Distance can be estimated or determined based on known field length or by counting fence posts along the length of the spread and multiplying by the average distance between posts.
- Then estimate the width of the spread in feet, allowing for a 10-20% pass overlap to ensure uniform coverage. Calculate the area covered and divide by 43,560 to convert to acres. Divide the weight or volume of manure in the spreader by the acres covered to determine the application rate for the given spreader setting (length x width of spread / acres covered = application rate in tons or gallons). Adjust the spreader settings and redo the calculations until the desired application rate is achieved.



AVOIDING PROBLEMS:

- Use of immature compost can cause detrimental effects on tomato and pepper growth **(Figure 8)**. Compost should be assayed for the presence of phytotoxic compounds using phytotoxicity test and seedling growth responses.
- Tomato and pepper crops are sensitive to high soluble salts, especially when they are direct-seeded. Measuring the soluble salts concentration of a saturation extract recommended. If the electrical conductivity (EC) is below 6.0 dS/m, no salt toxicity is expected. If EC is above 6.0 dS/m, the amended soil should be leached with water before planting seeds (only a few crops can tolerate this salt level).
- High C:N compost can result in N immobilization or "rob". Have the compost analyzed for C:N ratio. If it is above 20:1, some N fertilizer applied to the crop may be immobilized due to N immobilization, possibly causing plant N deficiency. When using compost with C:N ratios higher than 20:1, N fertilizer should be applied, or planting delayed for 6 to 10 weeks to allow the compost to stabilize in the soil.
- Lack of equipment to spread compost in vegetable fields is a concern. Composting facilities are encouraged to play an active role in developing spreading equipment.

Figure 8. Foreground: Pepper growth is stunted by phytotoxic chemicals in immature compost. In the background peppers with mature compost are thriving. Photograph by: Monica Ozores-Hampton.

SOURCES OF COMPOST AND MANURE:

Compost can be produced from a variety of feedstocks, including organic amendments from wastes produced by urban populations include municipal solid waste; yard trash/trimmings; food wastes from restaurants, grocery stores, and institutions; wood wastes from construction and/or demolition; wastewater (from water treatment plants); and biosolids (sewage sludge).

Agriculture produces other organic wastes that can be composted: poultry, dairy, horse, feedlot and swine manures; wastes from food processing plants; spoiled feeds, harvest wastes and mushroom media.

Figure 9. Interested in compost? Attend a compost field-day or training event to learn more about how compost can improve your production system. Photograph by: Monica Ozores-Hampton.

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