Organic Greenhouse Tomato Nutrition

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Most organic greenhouse tomatoes are grown in soil amended with organic residues, such as compost or manure, and organic fertilizers. Managing crop nutrition in this situation can be challenging since nutrient availability can vary widely depending on the materials applied and the environmental conditions.

That said, in-ground soil-based culture is highly buffered and can be forgiving in terms of nutrient management, since you only need to be 'in the ballpark' and then let soil microbes do the work. The flexibility provided by growing in a large volume of amended soil reduces the need to maintain precise levels of individual nutrients, but that really doesn't justify simply adding lots of compost or manure and hoping for good results.

<u>Organic residues</u> are not just a source of nutrients but are also added to maintain or enhance organic matter levels in greenhouse soils. It takes some thought to select a residue type and amount that will contribute sufficient organic matter to maintain tilth and support microbial populations while meeting, but not exceeding, crop nutrient needs. Common residue options include compost, manure, and peat moss.

It's a good idea to test compost or manure before adding to greenhouse soil because the nutrient content, pH, soluble salts, and C:N ratios can be highly variable. The use of fresh manure in greenhouses is risky since it can result in the release of ammonia (especially with poultry manure) if it has a low C:N ratio, and it can also introduce weed seeds. Note that organic standards prohibit application of uncomposted manure less than 90 days prior to harvest of a crop that does not come in contact with soil. (If greenhouse tomatoes are allowed to sprawl on the ground then the waiting period would be 120 days.)

Fresh or partially aged manure will contain more available nutrients than mature compost, which is a slow-release source of nutrients. Relatively fresh manure, and even some compost, can be high in soluble salts, so applying a large quantity could be harmful to plants. Application of manure or compost that contains a lot of undecomposed straw, sawdust, leaves or other high carbon material can tie up nitrogen as it continues to break down in the soil.

Compared to manure or compost, peat is relatively inert, as it does not contribute nutrients, weed seeds or diseases. Coarse peat is acidic, with a pH of about 4, so in most cases it needs to be added in combination with about 8.5 lbs of ground limestone per loose cubic yard (17 lb per compressed year) in order to neutralize its acidity. If nutrient levels are already high in a greenhouse soil, peat is a good option to add organic matter without additional nutrients. In new greenhouse situations, to supplement or replace compost additions, up to 5 cubic yards of loose peat (or 2.5 yards of compressed peat) per 1,000 square feet may be needed, depending on the condition of the soil.

Since soil organic matter decomposes rapidly under greenhouse conditions, an annual application of about 1 cubic yard of loose peat (or 0.5 cubic yard of compressed peat) per 1,000 square feet may be desirable. Broadcast peat and lime evenly, and incorporate thoroughly into the top foot or so of soil prior to making beds.

Organic fertilizers should be added to the soil based on the nutrient needs of the crop. That requires the growing medium to be tested. Prior to adding fertilizers, the saturated media extract (SME) test, often called greenhouse soil or potting test, should be performed. This test is offered by most Land Grant University testing labs. It uses water to extract nutrients prior to measurement, and it's typically used for soilless mixes that are high in fertility and organic matter. A regular field soil test uses a weak acid to extract nutrients, and the results for fertile greenhouse soils are often 'off-the- charts'. In addition, the SME test is more useful than a field soil test because it analyzes for soluble salts (conductivity) and nitrogen in the nitrate and ammonium forms.

Greenhouse soil should be tested early in the season, well before the crop is planted. That way, organic fertilizers can be added and incorporated as needed. Once the crop is in place it can be difficult to add nutrients since many organic fertilizers aren't very soluble so they don't go through a drip system well.

If a greenhouse soil has been well-amended in previous years, take the SME test before adding anything. If the soil is known to be relatively low in fertility from prior year's experience, or if the house is new to production, incorporate bulk organic amendments such as compost and/or peat, then take the SME test. The tables below can then be used to estimate the how much of what type of fertilizer to apply prior to planting.

Be sure that the greenhouse soil has been moist and warm for a couple of weeks before sending a sample in for a SME test. If necessary, take a sample and store it where it can incubate. Dry, cold soils have little microbial activity and that can affect the test results.

Commonly used organic fertilizers include: calcitic or dolomitic limestone (for Ca, Mg); greensand, potassium sulfate (for K) or sul-po-mag (for K and Mg); rock phosphate or bone meal (for P); blood meal or Chilean nitrate (for N). Note that the organic standards allow Chilean to meet no more than 20% of a crop's total N needs. Plant meals such as alfalfa, peanut and/or soy are a source of N, P, K with a moderate rate of release. Check with your certification agency as to their allowability.

Table 1: Optimal soil test ranges for greenhouse tomatoes using the SME test:

Available Nutrient or Measurement	
pH:	5.8 - 6.8
Nitrogen (as NO_3)	125 - 200 ppm
Phosphorus	8 - 13 ppm
Potassium	175 - 275 ppm
Calcium	over 250 ppm
Magnesium	over 60 ppm
Soluble salts	1.50 - 3.00

Trace elements are usually provided in sufficiency by compost and/or plant meals. Some synthetic compounds (iron and zinc chelates, solubor for boron, etc.) are allowed under organic standards if a deficiency has been demonstrated by soil or tissue testing.

Table 2: Estimated fertilizer rates to increase SME nutrient levels:

Pounds/1,000 sq. ft needed to raise N approximately 10 ppm	
Chilean nitrate 16-0-0	3.2
Blood meal 12-0-0	4.2
Alfalfa meal 2.5-2-2	20.1
Pounds/1,000 sq. ft needed to raise P approximately 2 ppm	
Bone meal 0-15-0	26.6
Rock phosphate 0-3-0	133
Pounds/1,000 sq. ft needed to raise K approximately 20 ppm	
Sul-po-mag 0-0-22-11Mg	2.6
Potassium sulfate 0-0-52	1.1
Pounds lime/1,000 sq. ft needed to raise soil pH ~1 full unit	
Sandy loam	40
Loam	80
Clay loam or peat	120

(Tables 1 and 2 adapted from 'Greenhouse Tomatoes, Lettuce & Cucumbers, by S.H. Wittwer and S. Honma. Michigan State Univ. Press. 1979.)

Leaf analysis. Once the crop is growing and flowering, leaf tissue samples taken at regular intervals are useful for monitoring nutrient levels in the crop and determining whether supplemental fertilization is needed. The cost is about $25 per sample. Proper collection of leaves is essential, since nutrient levels vary among leaves of different ages. Select recently mature, fully expanded leaves just below the last open flower cluster. Take at least eight to ten whole leaves from plants throughout the greenhouse to get a representative sample. Based on the results, apply soluble fertilizer as needed through the drip system, watered in by hand, or blended with a fresh application of compost spread along plant rows.

Table 3: Optimal nutrient ranges in greenhouse tomato leaves (dry weight):

Macronutrients (%)			Micronutrients
	Before fruiting	During fruiting	
N:	4.0-5.0	3.5-4.0	Fe: 50-200 ppm
P:	0.5-0.8	0.4-0.6	Zn: 25-60 ppm
K:	3.5-4.5	2.8-4.0	Mn: 50-125 ppm
Ca:	0.9-1.8	1.0-2.0	Cu: 8-20 ppm
Mg:	0.5-0.8	0.4-1.0	B: 35-60 ppm
S:	0.4-0.8	0.4-0.8	Mo: 1-5 ppm

(Table 3 from: Oregon State University Greenhouse Tomato Production Guide)