# Organic Tomato Transplant Production in Compost-Amended Substrate

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## Abstract

**There is limited information available about organic fertilization of vegetable transplants. The availability and release of the mineral nutrients from organic fertilizers is not fully understood. The objective of this study was to determine the effect of compost rate and chicken manure on the growth of tomato transplants. Tomato transplants were grown in an organic peat-based substrate (Garden Safe® Organic Potting Mix) amended with six rates of either compost (0% to 50%, by weight) or chicken manure (0% to 40%, by weight). The results showed that plant dry weight was minimally affected by compost rates, suggesting that compost provided only a minimal amount of nutrients to the plants. However, since transplants produced with compost-amended substrate were of similar quality compared to those produced exclusively with the substrate, it suggests that compost may be used to partially replace peat-based substrates used for transplant production. Shoot, root and plant dry weight increased with increasing rates of chicken manure (applied prior to seeding) reaching a maximum at 10%-20% (by weight) and then declined at 40% rate. Thus, chicken manure mixed with the substrate appeared to provide enough nutrients to tomato transplants.**

## INTRODUCTION

Organic vegetable growers are increasingly faced with reduced supply and poor quality transplants (plugs). Vegetable transplants produced organically are often of low quality because of poor fertilization management. There is limited information available on fertilization of organic production of vegetable transplants. A major challenge in organic production is the uncertainties in bio-availability of macro and micro nutrients contained in organic fertilizers or amendments. In most instances the essential nutrients are in unavailable forms or need to be chemically modified to be available to plants. Thus, it is usually difficult to determine optimum application rates of organic fertilizers based only on the chemical composition of organic amendments. Chicken manure has a higher mineral nutrient content and higher rates of N mineralization compared to compost (Eklind et al., 2001). The objective of this study was to determine the effect of compost rate and chicken manure rate on growth and development of tomato plugs grown organically.

## MATERIALS AND METHODS

The study was conducted in a greenhouse at the Horticulture Farm, Coastal Plain Experiment Station, Tifton, Ga, during the fall of 2006. Tomato (*Solanum lycopersicum* L.) ‘Florida-47’ transplants were grown in organic substrate (Garden Safe® Organic Potting Mix) amended with different rates of either compost or chicken manure. The design was a randomized complete block with four replications (replication = one 200-cell tray) and six treatments (rates of compost or chicken manure). In the compost trial, the treatments were 0%, 10%, 20%, 30%, 40%, or 50% (by weight). Compost (Longwood Plantation, Newington, Georgia) was prepared from cotton gin waste, chicken litter, and a small amount of peat humus, mixed, and composted for a minimum of 10 weeks. In the chicken manure trial, the treatments were 0%, 2.5%, 5%, 10%, 20%, and 40% (by weight) pasteurized chicken manure (4N: $2P_2O_5$: $3K_2O$; MicroSTART 60, Perdue AgriRecycle, LLC, Delmarva, Delaware, USA) pellets. Prior to planting, compost treatments received 10% (by weight) chicken manure as base preplant fertilizer mixed in the substrate. In both compost and chicken manure trials, after germination plants received no additional fertilizer. Tomato plants were grown for five weeks. At the end of the five weeks, 20 plants per replication were dried at 70°C for 48h and the shoot and root dry weights were determined. Data were analyzed using the General Linear Model of SAS (SAS OnlineDoc Version 8, SAS Institute Inc., Cary, NC).

## RESULTS AND DISCUSSION

### Compost

Shoot, root and plant dry weights and root/shoot ratio were not affected by compost rates, although root and plant dry weights tended to be reduced at 0% compost (Table 1). Our data showed no relationship between transplant dry weight with compost rate, although they suggested that compost utilization (rate ≥10%) may enhance transplant growth. These results suggest that compost provided a reduced amount of nutrients to the plants. Composts can be used alone or in mixtures with other materials as horticultural potting substrates in organic production systems (Clark and Cavigelli, 2005). Although the mineral nutrient composition and the rate of N mineralization in composts are low (Eklind et al., 2001), composts may benefit plants by providing other elements (e.g., organic matter or microorganisms) that enhance plant growth (Raviv et al., 1998; Roe, 1998a, b, Russo, 2005). Although compost did not improve transplant growth and quality, our results show that compost may be used in combination (at ≤50% rate) with a commercial peat substrate and produce transplants of similar quality as that produced using only commercial peat substrate. Thus, there is potential for utilization of compost for transplant production.

### Chicken Manure

Shoot, root and plant dry weights increased with increasing rates of chicken manure reaching a maximum at 10%-20% rate and then declining at 40% rate (Table 2). The lowest values of shoot, root and plant dry weights were at 0% rate. The root/shoot ratio was highest at 0% chicken manure and it declined and remained about constant at higher rates of chicken manure. Thus, chicken manure appeared to provide enough nutrients to tomato transplants. There was a delay in seed germination as well as in the rate of plant growth at 40% chicken manure during the first two weeks after sowing, but after that time no more growth inhibition was observed. It is possible that the apparent reduction in growth at 40% chicken manure compared to 10% or 20% may be due to high salinity conditions or poor aeration at 40% rate (Castillo et al., 2004; Sánchez-Monedero et al. 2004). Lettuce has also been found to be sensitive to high rates of chicken manure (Eklind et al., 2001).

In conclusion, tomato transplants produced with compost-amended substrate were of similar quality compared to those produced exclusively with the substrate. There was no effect of compost rate (from 0% to 50%, by weight) on transplant dry weight. Chicken manure mixed with the substrate at 10%-20% rate (by weight) resulted in transplants with the highest values of shoot and root dry weights, while transplant dry weight was reduced at 40% rate of chicken manure.

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## Tables

Table 1. Effect of compost rate on growth of tomato transplants.

| Rate (%)[z] | Shoot DW (mg) | Root DW (mg) | Plant DW (mg) | Root/shoot ratio |
|---|---|---|---|---|
| 0 | 111 | 22 b[y] | 133 b | 0.20 |
| 10 | 110 | 27 a | 137 ab | 0.25 |
| 20 | 136 | 29 a | 164 a | 0.21 |
| 30 | 118 | 27 a | 145 ab | 0.23 |
| 40 | 125 | 25 ab | 149 ab | 0.20 |
| 50 | 122 | 26 ab | 148 ab | 0.22 |
| Linear | 0.378 | 0.284 | 0.342 | 0.619 |
| Quadratic | 0.477 | 0.312 | 0.424 | 0.523 |
| *Significance* | | | | |
| Compost rate | 0.140 | <0.001 | 0.004 | 0.148 |

[z] Percent (by weight) in the substrate.
[y] Means separated within columns by Fisher's protected LSD test ($P \leq 0.05$).

Table 2. Effect of chicken manure rate on growth of tomato transplants.

| Manure rate (%)[z] | Shoot DW (mg) | Root DW (mg) | Plant DW (mg) | Root/shoot ratio |
|---|---|---|---|---|
| 0 | 13 e[y] | 4 d | 17 d | 0.34 a |
| 2.5 | 50 d | 12 c | 62 c | 0.24 b |
| 5 | 97 bc | 23 ab | 120 ab | 0.24 b |
| 10 | 121 a | 24 ab | 145 a | 0.20 b |
| 20 | 117 ab | 27 a | 144 a | 0.23 b |
| 40 | 85 c | 20 b | 105 b | 0.23 b |
| Linear | <0.001 | <0.001 | <0.001 | 0.029 |
| Quadratic | <0.001 | <0.001 | <0.001 | 0.057 |
| *Significance* | | | | |
| Manure rate | <0.001 | <0.001 | <0.001 | 0.049 |

[z] Percent (by weight) in the substrate.
[y] Means separated within columns by Fisher's protected LSD test ($P \leq 0.05$).