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# Influence of Compost Aging and Fertilizer Regimes on the Growth of Bedding Plants, Transplants and Poinsettia<sup>1</sup>

Judith R. Purman<sup>2</sup> and Francis R. Gouin<sup>3</sup>

Department of Horticulture

University of Maryland

College Park, MD 20742

## Abstract

Rooted cuttings of poinsettia (*Euphorbia pulcherrima* Willd. ex Clotzsch 'Amy') and seedlings of bibb lettuce (*Lactuca sativa* L.), baldhead cabbage (*Brassica oleracea* L. var. Capitata), sweet william (*Dianthus barbatus* L.) and pansy (*Viola* × *Wittrockiana* Gams.) were grown in Sunshine Mix and 7 experimental media containing 30-day-old ("New") or 90-day-old ("Aged") co-compost (polymer dewatered sewage sludge composted with processed garbage), perlite or vermiculite, and peatmoss. Plants were fertilized biweekly with water soluble fertilizer of 25N-2.2P-16.6K (25-5-20) at 250 ppm of N applied at 0, 1 or 2 wks after transplanting. The growth of all species did not vary with compost age. Dianthus and pansy plants grown in 50% "New" compost and dianthus grown in 25% "New" compost produced significantly lower top dry mass than those grown in Sunshine Mix. All other treatments for cabbage, lettuce, dianthus and pansy showed no significant difference in top growth from those grown in Sunshine Mix. Poinsettia plants grown in Sunshine Mix produced greater total growth than all other treatments except those grown in equal portions of "New" compost, peat and perlite. Lettuce and cabbage leaf tissue contained cadmium levels less than 0.5 ppm regardless of compost level.

**Index words:** Co-Compost, compost, sewage sludge, fertilization, municipal solid waste

**Species used in this study:** poinsettia (*Euphorbia pulcherrima* Willd. ex Clotzsch 'Amy'); bibb lettuce (*Lactuca sativa* L.); baldhead cabbage (*Brassica oleracea* L. var. Capitata); sweet william (*Dianthus barbatus* L.); pansy (*Viola* × *Wittrockiana* Gams.)

## Significance to the Nursery Industry

Research results clearly indicate that processed municipal solid waste composted with polymer dewatered sewage sludge is safe for use in the production of bedding plants and flowering plants. When using compost-amended potting mixes, a regular fertilizer regime can be used without adverse effects on plant growth. Compost can also be easily blended with other ingredients commonly used in formulating potting mixes and, if a fully composted material is used, it does not result in excess shrinkage of growing media in containers.

## Introduction

Municipal solid waste is approximately 60–90% biodegradable. Utilization of this biodegradable fraction for composting with sewage sludge would delay the closing of landfills, provide bulking material to absorb excess water for composting sewage sludge, and supply a useful raw product for the horticulture industry.

At Delaware Solid Wastes in Wilmington, DE, garbage collected from Wilmington households is ground and separated magnetically and by density to remove glass and metals. The remaining waste is composted with polymer dewatered low metal sewage sludge in a process called co-composting. The final product, co-compost, is screened to remove noncompostable materials. The process requires between 30 and 60 days to complete.

The use of growing media amended with sewage sludge composted with woodchips for growing bedding plants and nursery stock has been demonstrated (1, 2, 3, 4). Studies on the nutrient supplying power of media amended with composted sewage sludge suggest initial fertilizer applications can be delayed (3). Preliminary studies using compost from Delaware Solid Wastes have demonstrated a plant growth response different from that of plants growing in a potting medium amended with material made from composted sewage sludge and woodchips.

The objectives of this study were to determine if fertilizer regimes developed for producing plants in potting media amended with compost made from sewage sludge and woodchips could be used for growing plants in a media amended with a compost made from processed garbage and sludge, and to measure the effect of compost aging on plant growth.

## Materials and Methods

Plants were grown in seven potting media with varying proportions of co-compost, peatmoss and perlite or vermiculite and in Sunshine Mix. Six replications were carried out for each of the eight treatments. The compost was processed for 7 days in a vertical site with continuous mixing by augers and controlled ventilation followed by 30 days ("New") or 90 days ("Aged") in windrows. Aging was staggered so that both "Aged" and "New" compost were ready for use at the same time. Nutrient concentration of "Aged" compost in mg/kg was: N 13.0; S 9.75; P<sub>2</sub>O<sub>5</sub> 1.71; K<sub>2</sub>O 2.10; Mg 3.81; Ca 20.0; Na 3.80; Zn 1.26; Mn 0.54; Fe 15.2; Cu 0.39; Al 18.2 and 5.0 ppm Cd and 0.06 ppm B. Nutrient concentration of "New" compost in mg/kg was: N 10.5; S 7.30; P<sub>2</sub>O<sub>5</sub> 15.7; K<sub>2</sub>O 1.36; Mg 3.54; Ca 17.0; Na 2.63; Zn 1.30; Mn 0.59; Fe 14.4; Cu 0.56; Al 29.4 and 6.8 ppm Cd and 0.08 ppm B (A&L Eastern Agricultural Laboratories, Inc. of Richmond, VA). Prior to aging, the

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<sup>2</sup>Graduate Research Assistant.

<sup>3</sup>Professor.

**Table 1. Total growth (stem height + branch length), number of inflorescences and bract diameter of poinsettia plants as influenced by age and concentration of compost in the potting media (n = 18).**

| Treatment composition (by vol) | Treatment composition (by vol) |              | Total growth (cm) | Number of inflorescences | Bract diameter (cm) |
|--------------------------------|--------------------------------|--------------|-------------------|--------------------------|---------------------|
|                                | compost                        | peat perlite |                   |                          |                     |
| Aged 1                         | 1                              | 2            | 48.5              | 1.8                      | 37.5                |
| Aged 1                         | 1                              | 1            | 54.4              | 2.2                      | 37.9                |
| Aged 2                         | 1                              | 1            | 50.8              | 2.4                      | 37.1                |
| New 1                          | 1                              | 2            | 59.1              | 2.6                      | 39.6                |
| New 1                          | 1                              | 1            | 72.2              | 3.2                      | 40.9                |
| New 2                          | 1                              | 1            | 59.2              | 2.5                      | 41.0                |
|                                | 0                              | 1            | 58.9              | 2.7                      | 35.8                |
| Sunshine Mix                   |                                |              | 89.8              | 3.9                      | 35.8                |
| LSD @ 5.0%                     |                                |              | 18.0              | 1.6                      | 3.5                 |

product was screened through a 1.25 cm (0.5 inch) mesh. Media ingredients (Table 1) for each treatment within each replication were measured by volume and blended before containers were filled. Prior to formulating each medium, the peatmoss was amended with dolomitic limestone at 2.4 kg/m<sup>3</sup> (4 lb/yd<sup>3</sup>) to raise the pH to near 6.0. Fritted trace elements (FTE 503) were added at 90 g/m<sup>3</sup> (3 oz/yd<sup>3</sup>) to the treatment which contained no compost.

Rooted cuttings of poinsettia were transplanted, 1 per pot, 3 pots per replication, into 15.2 cm (6 in) pots. Seedlings of lettuce, cabbage, Sweet William and pansy were grown in 804 cell packs, 1 seedling per cell, 3 cell packs per replication for a total of 12 plants per replication.

Water soluble fertilizer 25N-2.2P-16.6K (25-5-20) at 250 ppm N was applied immediately, 1 wk after, or 2 wks after transplanting and repeated at 2 wk intervals after initial application. Each of the 3 cell packs and pots within a replication received one of the described fertilizer treatments. The plants were irrigated with tap water as needed.

The treatments were randomly arranged and cell packs and pots were uniformly spaced on raised greenhouse benches in a glass greenhouse. Minimum night temperatures were 15.6°C (60°F) and the greenhouse was ventilated at 23.9°C (75°F). The experiment ran from September through December 1989.

Lettuce and cabbage plants were harvested after 6 wks of growth by pruning at the surface of the growing media. The tops of the plants were washed in deionized water containing 1 ml/l (0.06 fl. oz/qt) Aqua-Gro and rinsed twice in deionized water before drying in a forced draft oven for one week at 30°C (86°F). After weighing, the samples were forwarded to a commercial laboratory for preparation and analysis of nutrients. The tops of the Sweet William and pansy plants were harvested 9 and 10 wks after transplanting, dried in a forced draft oven for one week and weighed. Poinsettia plant height, length of branches and bract diameter were measured and number of bracts were recorded 16 weeks after transplanting.

Each medium within each replicate was tested for pH and soluble salt concentration at 0, 6 and 16 wks after transplanting by saturated paste using deionized water for soluble salts and 0.01 M calcium chloride for pH.

Treatment means were compared using LSDs at p = .05. Sample size was n = 72 for lettuce, cabbage, Sweet William and pansy; n = 18 for poinsettia.

## Results and Discussion

Since there was no significant difference between plants grown in media amended with vermiculite or perlite, the data were combined in the analysis of all other treatments. Fertilizer regime made no difference in growth response for any of the species. Poinsettia grown in Sunshine Mix produced more total growth than in all other media except those growing in the 1:1:1 "New" compost (Table 1). There was no significant difference for bract diameter with compost age. Plants grown in "Aged" 1:1:2 produced fewer inflorescences than plants in other treatments.

In general, total top growth of the vegetable transplants and bedding plants was as varied as the species tested (Table 2). The weight of cabbage and lettuce plants grown in all media containing compost was not significantly different from those grown in the Sunshine Mix but those grown without compost were smaller than all other treatments. There was no significant difference in dry mass of lettuce plants for any of the 8 treatments. Dianthus plants grown in 25% and 50% "New" compost produced significantly lower top dry mass than those grown in Sunshine Mix but were not significantly lower than all other treatments. Pansy plants grown in 50% "New" compost were significantly smaller than those in all other treatments.

**Table 2. Mean plant top dry weight as influenced by age and concentration of compost in the potting media (n = 72).**

| Treatment composition (by vol) | Treatment composition (by vol) |              | <i>Brassica</i> (Baldhead Cabbage) (g) | <i>Dianthus</i> (Sweet William) (g) | <i>Lactuca</i> (Bibb Lettuce) (g) | <i>Viola</i> (Pansy) (g) |
|--------------------------------|--------------------------------|--------------|--|-------------------------------------|-----------------------------------|--------------------------|
|                                | compost                        | peat perlite |  |                                     |                                   |                          |
| Aged 1                         | 1                              | 2            | 2.5                                    | 1.5                                 | 1.2                               | 2.3                      |
| Aged 1                         | 1                              | 1            | 2.5                                    | 1.6                                 | 1.0                               | 2.0                      |
| Aged 2                         | 1                              | 1            | 2.8                                    | 1.5                                 | 1.3                               | 2.1                      |
| New 1                          | 1                              | 2            | 2.6                                    | 1.4                                 | 1.3                               | 1.9                      |
| New 1                          | 1                              | 1            | 2.6                                    | 1.7                                 | 1.4                               | 2.0                      |
| New 2                          | 1                              | 1            | 2.5                                    | 1.4                                 | 1.3                               | 1.4                      |
|                                | 0                              | 1            | 1.8                                    | 1.6                                 | 1.1                               | 2.2                      |
| Sunshine Mix                   |                                |              | 2.4                                    | 1.9                                 | 1.3                               | 2.3                      |
| LSD @ 5.0%                     |                                |              | 0.3                                    | 0.2                                 | 0.2                               | 0.3                      |

**Table 3. Mean soluble salt concentration and pH of potting media and Sunshine Mix as influenced by age and concentration of compost (n = 6).**

| compost      | Treatment composition (by vol) |         | Soluble salts (dS/m)  |          |          | pH        |           |           |
|--------------|--------------------------------|---------|-----------------------|----------|----------|-----------|-----------|-----------|
|              | peat                           | perlite | Initial               | 6 weeks  | 16 weeks | Initial   | 6 weeks   | 16 weeks  |
| Aged 1       | 1                              | 2       | 08 (2.8) <sup>a</sup> | 02 (0.8) | 02 (0.8) | 6.3 (0.2) | 6.8 (0.2) | 6.6 (0.1) |
| Aged 1       | 1                              | 1       | 13 (2.7)              | 02 (0.0) | 03 (1.3) | 6.5 (0.1) | 6.7 (0.1) | 6.7 (0.1) |
| Aged 2       | 1                              | 1       | 14 (2.7)              | 04 (1.3) | 04 (0.8) | 6.3 (0.1) | 6.7 (0.1) | 6.5 (0.1) |
| New 1        | 1                              | 2       | 18 (2.9)              | 03 (2.6) | 03 (0.8) | 6.2 (0.3) | 6.6 (0.0) | 6.5 (0.1) |
| New 1        | 1                              | 1       | 21 (1.2)              | 03 (0.8) | 04 (2.4) | 6.1 (0.3) | 6.7 (0.1) | 6.6 (0.1) |
| New 2        | 1                              | 1       | 24 (6.5)              | 04 (1.7) | 04 (1.6) | 6.2 (0.2) | 6.5 (0.3) | 6.5 (0.1) |
| 0            | 1                              | 1       | 01 (0.5)              | 00 (0.5) | 01 (0.5) | 6.3 (0.3) | 6.7 (0.1) | 6.7 (0.1) |
| Sunshine Mix |                                |         | 08 (1.7)              | 00 (0.6) | 03 (1.0) | 5.4 (0.1) | 6.5 (0.3) | 6.6 (0.2) |

<sup>a</sup>(standard deviation).

**Table 4. Plant tissue analysis for *Lactuca* (Bibb lettuce) and *Brassica* (Baldhead cabbage) grown in a compost amended potting media and Sunshine Mix.**

| compost      | Treatment composition (by vol) |         | %           |             |             |             |             |             |             |           | ppm        |            |            |          |            |                |  |
|--------------|--------------------------------|---------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------|------------|------------|------------|----------|------------|----------------|--|
|              | peat                           | perlite | N           | S           | P           | K           | Mg          | Ca          | Na          | B         | Zn         | Mn         | Fe         | Cu       | Al         | Cd             |  |
| Aged 1       | 1                              | 2       | 3.04        | 0.48        | 0.45        | 3.47        | 0.55        | 1.33        | 1.03        | 31        | 108        | 65         | 146        | 12       | 140        | <0.5           |  |
|              |                                |         | <b>2.10</b> | <b>1.21</b> | <b>0.40</b> | <b>2.30</b> | <b>0.60</b> | <b>2.89</b> | <b>0.66</b> | <b>35</b> | <b>107</b> | <b>34</b>  | <b>251</b> | <b>8</b> | <b>443</b> | <b>&lt;0.5</b> |  |
| Aged 2       | 1                              | 1       | 3.13        | 0.49        | 0.48        | 4.10        | 0.50        | 1.39        | 0.94        | 31        | 118        | 71         | 124        | 12       | 87         | <0.5           |  |
|              |                                |         | <b>2.03</b> | <b>1.57</b> | <b>0.38</b> | <b>2.46</b> | <b>0.50</b> | <b>2.90</b> | <b>0.57</b> | <b>35</b> | <b>108</b> | <b>21</b>  | <b>284</b> | <b>8</b> | <b>337</b> | <b>&lt;0.5</b> |  |
| New 1        | 1                              | 2       | 3.08        | 0.48        | 0.51        | 3.23        | 0.53        | 1.31        | 1.29        | 34        | 110        | 111        | 123        | 12       | 57         | <0.5           |  |
|              |                                |         | <b>2.18</b> | <b>1.24</b> | <b>0.42</b> | <b>2.13</b> | <b>0.60</b> | <b>2.84</b> | <b>0.86</b> | <b>37</b> | <b>106</b> | <b>48</b>  | <b>172</b> | <b>8</b> | <b>297</b> | <b>&lt;0.5</b> |  |
| New 2        | 1                              | 1       | 3.00        | 0.49        | 0.55        | 3.65        | 0.49        | 1.34        | 1.00        | 36        | 121        | 225        | 149        | 12       | 77         | <0.5           |  |
|              |                                |         | <b>2.59</b> | <b>1.68</b> | <b>0.45</b> | <b>2.69</b> | <b>0.58</b> | <b>3.04</b> | <b>0.98</b> | <b>45</b> | <b>124</b> | <b>93</b>  | <b>162</b> | <b>8</b> | <b>290</b> | <b>&lt;0.5</b> |  |
| 0            | 1                              | 1       | 2.80        | 0.40        | 0.31        | 2.81        | 0.66        | 1.07        | 0.81        | 59        | 59         | 134        | 124        | 8        | 24         | <0.5           |  |
|              |                                |         | <b>2.31</b> | <b>0.45</b> | <b>0.30</b> | <b>2.14</b> | <b>1.00</b> | <b>2.36</b> | <b>0.50</b> | <b>38</b> | <b>87</b>  | <b>70</b>  | <b>360</b> | <b>6</b> | <b>450</b> | <b>&lt;0.5</b> |  |
| Sunshine Mix |                                |         | 2.96        | 0.39        | 0.48        | 2.84        | 0.57        | 1.11        | 0.60        | 26        | 55         | 190        | 93         | 6        | 57         | <0.5           |  |
|              |                                |         | <b>2.21</b> | <b>0.85</b> | <b>0.33</b> | <b>2.10</b> | <b>0.77</b> | <b>2.65</b> | <b>0.49</b> | <b>33</b> | <b>70</b>  | <b>114</b> | <b>109</b> | <b>5</b> | <b>180</b> | <b>&lt;0.5</b> |  |

Although media containing "New" compost and media containing 50% compost had higher initial soluble salt concentrations, differences were negligible after 6 and 16 weeks of growth (Table 3). The pH of all growing media containing compost was not affected by concentration of compost used. After 6 weeks of growth, media amended with compost had higher soluble salts than those without compost, but after 16 weeks of growth the soluble salt concentration and pH of all compost amended media were similar.

Leaves of lettuce and cabbage plants growing in media amended with one-third to one-half compost tended to have higher levels of N, S, K, Ca, Na, B, Zn, Fe, Cu and Al but lower levels of Mn, except for lettuce growing in 50% "New" compost (Table 4). There was no indication of Cd uptake in leaf tissues of plants growing in compost amended media.

Although there appears to be little difference in growth response between "Aged" and "New" compost, there were differences in handling and appearance of the media. The "Aged" compost had a more appealing color (dark brown) and lacked objectionable odors. The "New" compost had

a gray appearance and an odor. There also tended to be more shrinkage in containers filled with media amended with "New" compost than those filled with media amended with "Aged" compost. Excessive shrinkage would have an adverse effect on plants growing in large containers.

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