



## **RESIDUAL LIME IN COMMERCIAL MEDIA DURING CROP PRODUCTION**

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### **Executive Summary**

We evaluated the initial residual lime contents of 7 different media sources. The initial residual lime content varied from 0.10 to 3.80 g CaCO<sub>3</sub> equivalent (CCE) per liter of substrate, with initial substrate pH varied from 5.14 to 5.82.

*Verbena* (Tukana White) plants were grown in those media for three weeks. *Verbena* plants were fertigated at each irrigation at 100 ppm N using GreenCare 9-45-15 acid fertilizer.

pH and residual lime dropped in all treatments. We therefore did show that a change in residual lime could be tracked in a crop using our gasometric method, indicating that it may be a useful soil testing tool.

Plants grown in several of the media developed severe foliage damage and reduced plant growth, possibly a result of low pH and Fe/Mn toxicity.

Plant damage and a low initial pH meant that this study has just preliminary and inconclusive results in terms of the relationship between pH buffering and residual lime. More controlled experiments will follow.

### **Introduction**

Residual lime of the media plays a key role in pH management and pH buffering. We aimed to test our hypotheses that the media have high residual lime content would normally have high pH buffering and maintain a higher media-pH during the crop production under acid conditions.

Our specific objectives were to evaluate whether (a) we could measure differences in residual lime in commercial and research media using our gasometric method; (b) residual lime drops over time under acidic growing conditions; and (c) media containing high residual lime had more pH buffering than media containing little residual lime.

Past experience in commercial greenhouses has shown that broad-leafed 'Tukana' verbena is susceptible to iron/manganese toxicity at low media-pH. pH buffering (and residual lime) could therefore potentially benefit growth of this cultivar.

## Research Methods

The experiment was conducted from July 20, 2006 through August 10, 2006 (3 weeks) at UNH Research Greenhouse. This study tested seven media sources (Table 1). In two cases, we had 2-year-old batches (2004) and new batches (2006) from the same suppliers (Sun Gro and Greenway). Initial media residual lime was measured using the gasometric method. Substrate pH and EC were tested using saturated paste method (SME).

*Verbena* (Tukana White) plug seedlings were planted in 4-inch-diameter azalea pots. For each media type, 12 pots were planted with one plant per pot. The experiment was a completely randomized design with 12 replications and one pot per replication.

GreenCare 9-45-15 acid fertilizer was applied at 100 ppm N rate with each irrigation, starting immediately after planting. Plants were harvest 3 weeks after planting. At that time, plant showed severe foliage damage for some media treatments.

Each plant was rated for damage in percentage of total area of foliage and was assigned to a injury index as follows: 0 (0-10% foliage damage), 1 (10-25% foliage damage), 2(25-50% foliage damage), 3 (50-75% foliage damage), 4 (75-100% foliage injured) to 5 (dead). Plants were then harvested for fresh weight, further dried for dry weight.

Substrate pH and EC were immediately tested with four replications (three pots per replication). Residual lime was also measured after plants were harvested with two replications per substrate. Plant leaves were sampled for complete tissue analysis using the most recently matured foliage with four replications per substrate.

## Results

Media residual lime content varied from almost zero (0.10 g/L) up to 3.80 g/L as of CaCO<sub>3</sub> equivalent (CCE) (Table 2). The media blended with hydrated lime (Media No.7) had very low initial residual lime (CCE 0.1 g /L). The initial substrate pH varied from 5.10 to 5.82 (Table 2). The amount of residual lime in the media did not directly correlate to substrate initial pH but was probably caused by differences in lime types, particle sizes, and incorporation rates.

pH dropped over time in all media (Table 2) in response to acid conditions. Residual lime also dropped except in media No. 5 and 7 which had the lowest initial residual lime (Table 2). Final pH tended to be higher in growing media with higher initial and final residual lime levels, but there was not a large difference in final pH between substrates.

When *Verbena* plants were grown in the media with acid fertilizer, plants showed symptoms of foliage necrosis around the

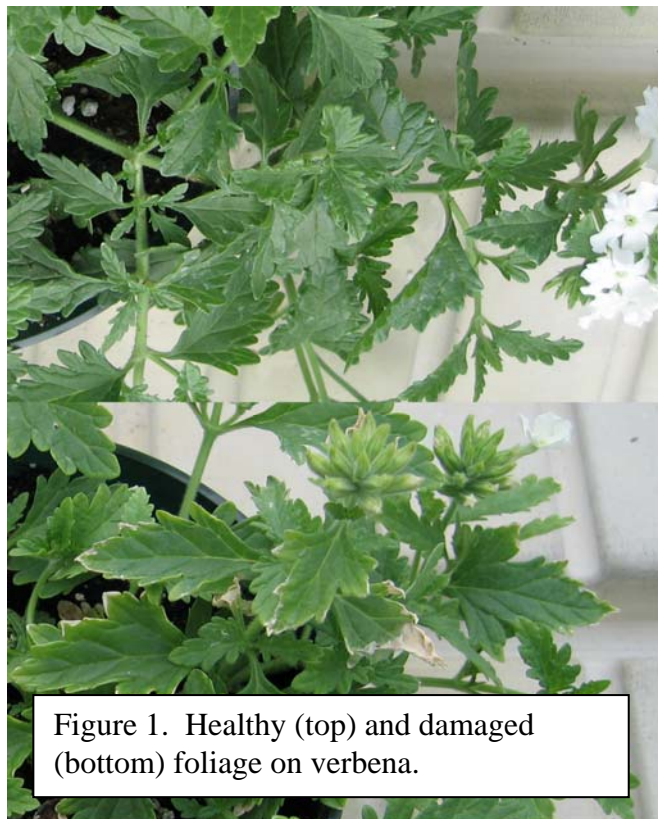


Figure 1. Healthy (top) and damaged (bottom) foliage on verbena.

leaf margins, starting 2 weeks after planting. Plants first showed the symptoms in Media No. 4, No.5 and No. 7, which were blended with hydrated lime either partially (No.4 and No.5) or totally (No.7). Those media had very low residual lime (0.1 to 0.97 g/l) and low substrate pH (5.14 to 5.48). Plants grown in other media showed similar foliage injury as time progressed (Figure 2 and Table 3).

Plant injury may have been associated with Fe and Mn toxicity resulting from low substrate pH. Tissue analysis showed no significant differences for macronutrients (Table 4).

Plants in media where more damage occurred (Media No.4, No. 5 and No.7), based on Tables 2, 3 & 5 and Figure 2, tended to have

- Media with a lower overall pH and lower residual lime
- Higher combined tissue Fe and Mn (although these levels were not particularly high)

**Table 1. Seven media sources in the experiment and their composition.**

| Media Sources                               | Media Composition                       |
|---|---|
| 1. SUNGRO SUNSHINE® No.4 (2004)             | 55-65% peat + 45-35% perlite            |
| 2. SUNGRO SUNSHINE® LA4 (2006)              | 55-65% peat + 45-35% perlite            |
| 3. Premier PRO-MIX® HP<br>w/Mycorise (2006) | 65-75% peat + 35-25% perlite            |
| 4. Greenway (2004)                          | 60% peat +15% perlite + 25% vermiculite |
| 5. Greenway (2006)                          | 60% peat +15% perlite + 25% vermiculite |
| 6. UNH Standard (dolomite, 2006)            | 70% peat + 30% perlite                  |
| 7. UNH Standard (hydrated, 2006)            | 70% peat + 30% perlite                  |

**Table 2. The residual lime content (CCE kg/m<sup>3</sup>) and substrate pH for the seven tested media sources.**

| Media No.                                   | Residual Lime (CCE kg/m <sup>3</sup> ) |            |                    | Initial pH | Final pH | Change in pH |
|---|--|------------|--------------------|------------|----------|--------------|
|   | Initial                                | After Crop | Change in Residual |            |          |              |
| 1. SUNGRO SUNSHINE® No.4 (2004)             | 2.42                                   | 2.24       | -0.18              | 5.82       | 5.02     | -0.80        |
| 2. SUNGRO SUNSHINE® LA4 (2006)              | 3.80                                   | 3.62       | -0.18              | 5.64       | 5.17     | -0.47        |
| 3. Premier PRO-MIX® HP<br>w/Mycorise (2006) | 2.67                                   | 1.75       | -0.92              | 5.62       | 5.06     | -0.56        |
| 4. Greenway (2004)                          | 0.97                                   | 0.60       | -0.37              | 5.48       | 4.79     | -0.69        |
| 5. Greenway (2006)                          | 0.84                                   | 0.93       | 0.09               | 5.29       | 4.85     | -0.44        |
| 6. UNH Standard (dolomite)                  | 2.31                                   | 1.83       | -0.48              | 5.78       | 4.99     | -0.79        |
| 7. UNH Standard (hydrated)                  | 0.11                                   | 0.31       | 0.20               | 5.14       | 4.65     | -0.49        |

**Table 3. Media initial EC and final EC at harvest time, plant fresh weight (Fwt), dry weight (Dwt) and plant injury index.**

| Media No.                                | Initial EC (ms/cm) | Final EC (ms/cm) | Fwt (g/L) | Dwt(g/L) | Injury index (per plant) |
|--|--------------------|------------------|-----------|----------|--------------------------|
| 1. SUNGRO SUNSHINE® No.4 (2004)          | 2.00               | 3.82             | 26.20     | 3.96     | 2.25                     |
| 2. SUNGRO SUNSHINE® LA4 (2006)           | 2.82               | 4.33             | 25.75     | 3.94     | 0.42                     |
| 3. Premier PRO-MIX® HP w/Mycorise (2006) | 2.30               | 3.73             | 26.58     | 4.30     | 0.17                     |
| 4. Greenway (2004)                       | 1.85               | 3.11             | 24.82     | 3.72     | 2.00                     |
| 5. Greenway (2006)                       | 1.47               | 3.76             | 22.88     | 2.81     | 4.00                     |
| 6. UNH Standard (dolomite)               | 1.12               | 2.75             | 25.27     | 3.79     | 2.42                     |
| 7. UNH Standard (hydrated)               | 1.09               | 2.15             | 21.00     | 3.36     | 3.83                     |

**Table 4. Verbena tissue macro-nutrient content (%).**

| Media No.                                | N (%) | P (%) | K (%) | Ca (%) | Mg (%) | S (%) |
|--|-------|-------|-------|--------|--------|-------|
| 1. SUNGRO SUNSHINE® No.4 (2004)          | 4.10  | 1.32  | 3.97  | 1.16   | 0.70   | 0.22  |
| 2. SUNGRO SUNSHINE® LA4 (2006)           | 4.32  | 1.43  | 3.85  | 1.23   | 0.77   | 0.25  |
| 3. Premier PRO-MIX® HP w/Mycorise (2006) | 4.46  | 1.24  | 3.69  | 1.59   | 0.42   | 0.21  |
| 4. Greenway (2004)                       | 4.44  | 1.34  | 3.48  | 1.65   | 0.69   | 0.25  |
| 5. Greenway (2006)                       | 4.04  | 1.18  | 3.65  | 1.50   | 0.60   | 0.26  |
| 6. UNH Standard (dolomite)               | 4.31  | 1.37  | 3.49  | 1.37   | 0.80   | 0.15  |
| 7. UNH Standard (hydrated)               | 4.23  | 1.34  | 3.57  | 1.40   | 0.74   | 0.13  |

**Table 5. Verbena tissue micro-nutrient content (ppm).**

| Media No.                                   | Fe (ppm) | Mn (ppm) | B (ppm) | Cu (ppm) | Zn (ppm) | Mo (ppm) |
|---|----------|----------|---------|----------|----------|----------|
| 1. SUNGRO SUNSHINE® No.4 (2004)             | 83.18    | 100.34   | 45.95   | 7.19     | 37.74    | 1.40     |
| 2. SUNGRO SUNSHINE® LA4 (2006)              | 107.06   | 90.52    | 42.56   | 7.32     | 43.57    | 1.38     |
| 3. Premier PRO-MIX® HP<br>w/Mycorise (2006) | 75.64    | 102.22   | 47.71   | 4.39     | 43.36    | 1.14     |
| 4. Greenway (2004)                          | 169.68   | 124.61   | 39.43   | 5.95     | 35.86    | 1.16     |
| 5. Greenway (2006)                          | 117.08   | 106.92   | 34.25   | 7.35     | 34.50    | 1.20     |
| 6. UNH Standard (dolomite)                  | 104.80   | 109.09   | 37.33   | 5.42     | 41.36    | 1.90     |
| 7. UNH Standard (hydrated)                  | 124.03   | 154.90   | 37.10   | 5.00     | 42.15    | 1.56     |

**Figure 2. Verbena plant injury index rated 3 weeks after planting (0 = healthy to 4 = 75-100% of foliage affected) and the corresponding plant dry weight (Dwt). The higher the injury index, the greater the degree of plant foliage injury. The number of each growing medium can be matched with the names in Table 5 above.**

