

# Change in Physical Properties of Pine Bark and Switchgrass Substrates Over Time

Switchgrass has been explored as an alternative substrate to pine bark in the greenhouse industry. Studies have shown that switchgrass can be processed to have optimum physical and chemical properties at the time of potting and this influences how the chemical properties of the substrate change over time. However, little is known about how physical properties change over time compared to pine bark, which is considered to be ideally stable over the production period of most containerized plants. The objective of this research was to document the change in physical properties of air space (AS), container capacity (CC), total porosity (TP), and bulk density ( $D_b$ ) of switchgrass compared to pine bark substrates.

Switchgrass (60%) and pine bark (80%) substrates were packed into 15 cm (6 in) tall aluminum

cores and placed in a production greenhouse with or without a single hibiscus plant (*Hibiscus moscheutos* L. 'Luna Red'). Physical properties of the substrates were measured at the beginning of the experiment and 9 to 10 weeks later. Air space decreased over time, container capacity increased slightly across all treatments over time, and bulk density changed very little over time (Table 1, 2, and 3). The switchgrass substrate was more prone to shrinkage than the pine bark substrate, although vigorous hibiscus root growth reduced shrinkage in switchgrass substrates. Switchgrass substrates may be a viable alternative to pine bark substrates when growing plants with vigorous root systems.

**Table 1. Initial physical properties of pine bark and switchgrass substrates measured in 15.2 cm tall porometers.**

| Substrate                        | Experiment 1    |      |      |                   | Experiment 2    |      |      |                   |
|----------------------------------|-----------------|------|------|-------------------|-----------------|------|------|-------------------|
|                                  | AS <sup>z</sup> | CC   | TP   | $D_b$             | AS <sup>z</sup> | CC   | TP   | $D_b$             |
|                                  |                 | (%)  |      | $g \cdot cm^{-3}$ |                 | (%)  |      | $g \cdot cm^{-3}$ |
| Pine bark                        | 35.1            | 43.8 | 78.9 | 0.16              | 32.4            | 48.5 | 80.9 | 0.16              |
| Switchgrass                      | 43.6            | 41.1 | 84.6 | 0.11              | 45.9            | 41.8 | 87.7 | 0.10              |
| LSD <sub>0.05</sub> <sup>y</sup> | 1.9             | NS   | 2.2  | 0.00              | 3.6             | 2.9  | 1.8  | 0.00              |

**Table 2. Physical properties of pine bark (PB) and switchgrass (SG) substrates after exposure to production environment with or without Luna Red hibiscus (*Hibiscus moscheutos* L.) growing within the container (Expt. 1).**

| Scenario                         | Substrate | AS <sup>z</sup> | $\Delta$ AS | CC   | $\Delta$ CC | TP   | $\Delta$ TP | $D_b$             | $\Delta D_b$ | Shrinkage | Shoot mass | Root mass |
|----------------------------------|-----------|-----------------|-------------|------|-------------|------|-------------|-------------------|--------------|-----------|------------|-----------|
|                                  |           |                 | (%)         |      |             |      |             | $g \cdot cm^{-3}$ |              | mm        | g          | g         |
| No plant                         | PB        | 35.9            | 0.8         | 47.2 | 3.4         | 83.1 | 4.2         | 0.16              | 0.00         | 1.3       | —          | —         |
|                                  | SG        | 41.6            | -1.9        | 45.4 | 4.4         | 87.1 | 2.4         | 0.09              | -0.02        | 4.5       | —          | —         |
| With plant                       | PB        | 32.2            | -2.8        | 45.1 | 1.3         | 76.4 | -2.5        | 0.17              | 0.01         | 0.5       | 7.84       | 1.66      |
|                                  | SG        | 40.9            | -2.6        | 44.4 | 3.4         | 85.3 | 0.7         | 0.10              | -0.01        | 3.5       | 4.52       | 0.70      |
| LSD <sub>0.05</sub> <sup>y</sup> |           | 2.5             | 2.5         | NS   | NS          | 3.1  | 3.1         | 0.00              | 0.00         | 1.65      | NS         | NS        |

**Table 3. Physical properties of pine bark (PB) and switchgrass (SG) substrates after exposure to production environment with or without Luna Red hibiscus (*Hibiscus moscheutos* L.) growing within the container (Expt. 2).**

| Scenario                         | Substrate | AS <sup>z</sup> | $\Delta$ AS | CC   | $\Delta$ CC | TP   | $\Delta$ TP | $D_b$             | $\Delta D_b$ | Shrinkage | Shoot mass | Root mass |
|----------------------------------|-----------|-----------------|-------------|------|-------------|------|-------------|-------------------|--------------|-----------|------------|-----------|
|                                  |           |                 | (%)         |      |             |      |             | $g \cdot cm^{-3}$ |              | mm        | g          | g         |
| No plant                         | PB        | 29.3            | -3.1        | 51.8 | 3.3         | 81.1 | 0.2         | 0.16              | 0.00         | 4.9       | —          | —         |
|                                  | SG        | 31.9            | -14.0       | 47.8 | 6.0         | 79.7 | -8.0        | 0.09              | -0.01        | 16.7      | —          | —         |
| With plant                       | PB        | 23.0            | -9.4        | 50.8 | 2.3         | 73.9 | -7.0        | 0.17              | 0.01         | -0.9      | 15.64      | 5.42      |
|                                  | SG        | 39.7            | -6.2        | 43.3 | 1.5         | 83.0 | -4.6        | 0.10              | 0.00         | 1.5       | 13.92      | 6.45      |
| LSD <sub>0.05</sub> <sup>y</sup> |           | 4.2             | 4.2         | 2.6  | 2.6         | 4.2  | 4.2         | 0.00              | 0.00         | 1.36      | NS         | NS        |

<sup>z</sup>AS, CC, TP, and  $D_b$  refer to air space, container capacity, total porosity, and bulk density, respectively. The symbol  $\Delta$  refers to change in the respective parameter from the initial measurement made at the beginning of the study until 62 days later when the experiment was harvested.

<sup>y</sup>Least significant difference according to Fisher's test. NS represents no significant difference.