# Special Research Report # 434: Postharvest Physiology

## Modified Atmosphere Use in Extending Unrooted Cutting Quality and Viability

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## BACKGROUND

Cuttings are increasingly being produced offshore for shipping to rooting stations in the United States. Specialization makes economic sense, but the shipping of cuttings over long distances can pose new problems.

Cuttings are harvested, packed, and shipped within a few hours. During peak demand this creates problems for packing orders accurately and scheduling labor as all activity is coordinated to the shipping schedule. In particular, high amounts of labor are needed during only parts of the week. In addition, work at Clemson University has shown that for some species harvesting cuttings in the afternoon improves stress tolerance. Short-term storage of cuttings would allow cuttings to be harvested when it is best to do so.

Modified atmosphere (MA) storage is simply an adjustment in atmospheric gas composition such that cuttings can be stored for several days without harm. MA has long been used to study postharvest respiration, and to extend the shelf life of a broad category of produce. In fact, researchers at Michigan State University found that sweet basil stored in 1.5%:0% $O_2$:$CO_2$ had an average shelf life of 45 days compared with 18 days for the air control. As fresh cut herbs are similar to cuttings, the technology looks promising for extending herbaceous unrooted cutting storage time.

## MATERIALS AND METHODS

**Plant material.** *Impatiens hawkerii* 'Sonic Red' and 'Sonic White' stock plants were maintained at an EC (Pour-Thru) of 1.0 to 1.5 dS · $m^{-1}$ and pH of 5.8 to 6.5.

Geranium (*Pelargonium ×hortorum*) 'Kardino' stock plants were maintained at an EC of 3 to 4 dS · $m^{-1}$ and ph of 5.6 to 6.0.

Stock plants of both species were fertilized with 20-10-20 and pH was adjusted with flowable lime as needed during stock plant production.

**Treatments.** Cuttings with one mature leaf each were harvested by 10 am. After cuttings were sealed in glass jars, they were flushed with nitrogen at 10 mL · min-1 for 10 minutes. The jars were then flushed with the treatment gas (Table 1) for the same duration and volume. The cuttings were stored at 20°C for 7 days in the dark.

| | $O_2$ (%) | | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 5 | 10 | 21 |
| $CO_2$ (%) | 0 | X | X | X | X | X* |
| | 5 | | X | X | X | |
| | 10 | | X | X | X | |
| | 20 | | X | | | |

Table 1. Gas combinations used for cutting storage. *Atmosphere 21% $O_2$, 0.03% $CO_2$

**Equipment.** Accuracy of modified atmosphere treatment and ethylene accumulation during storage was verified by use of gas chromatography. Ethylene is a major contributor to loss of cutting quality during shipment and strong indicator

of cutting stress.

**Data.** During storage cuttings were monitored for leaf yellowing, necrosis, watersoaking or abscission. The quality of the cuttings after storage and propagation was measured on a scale from 5 to 1 with 5 being commercially acceptable. Data on rooting performance was collected for geraniums only.

## RESULTS

**Performance During Storage.** Symptoms of storage effects did not vary by cultivar and cuttings remained largely unchanged during storage. Geranium cuttings, however, responded dramatically to some treatments, appearing water soaked within 24 to 36 hours (Photo 1). Ethylene levels were no higher than control for both impatiens and geranium.


Photo 1. Geraniums cuttings labeled 5A show a marked darkening and water soaked appearance after 24 hours in a 1% oxygen 20% carbon dioxide atmosphere.

**Performance During Propagation.** The propagation environment revealed unseen damage in the impatiens cuttings. Although cuttings appeared okay after storage, some rapidly declined during propagation (Table 2). For example 1% oxygen, 20% carbon dioxide cuttings collapsed within 48 hours. However, cuttings stored in relatively balanced carbon dioxide and oxygen ratios remained healthier during and after propagation than those stored in atmospheric air.

| | $O_2$ (%) | | | | |
|---|---|---|---|---|---|
| $CO_2$ (%) | 0 | 1 | 5 | 10 | 21 |
| 0 | 4 | 5 | 3 | 3 | 3* |
| 5 | | 4 | 5 | 5 | |
| 10 | | 5 | 5 | 5 | |
| 20 | | 1 | | | |

Table 2. Impatiens overall quality after propagation. *Atmosphere 21% $O_2$, 0.03% $CO_2$

Geranium cuttings stored in balanced concentrations of oxygen and carbon dioxide produced first roots more quickly and had a superior overall appearance compared to those stored in air (Table 3).

| | $O_2$ (%) | | | | |
|---|---|---|---|---|---|
| $CO_2$ (%) | 0 | 1 | 5 | 10 | 21 |
| 0 | 4 | 5 | 3 | 3 | 3* |
| 5 | | 4 | 5 | 5 | |
| 10 | | 3 | 5 | 5 | |
| 20 | | 1 | | | |

Table 3. Geranium overall quality after propagation. *Atmosphere 21% $O_2$, 0.03% $CO_2$

## CONCLUSIONS

Modified atmosphere storage has a positive effect on the storage life of impatiens and geranium cuttings. In general, balanced concentrations of oxygen and carbon dioxide appear to be most effective at preserving cutting quality during storage.

Future work will include testing on poinsettia (*Euphorbia pulcherrima*) cuttings and will establish ideal gas concentrations for each of these species.

## IMPACT TO THE INDUSTRY

The ability to store cuttings will allow producers to schedule labor according to when it is best to harvest cuttings, not according to shipping schedules. Also, producers will have a much better idea of what plant material is available at the time the order is placed. The result will be increased cutting quality and reliability.

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