Special Research Report # 433 Postharvest Physiology

Ethylene Sensitivity of Unrooted Cuttings from 28 Genera and Effectiveness of 1-MCP to Prevent Ethylene Damage

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BACKGROUND

Exposure to ethylene in the post-harvest environment results in accelerated senescence of many horticultural products. Researchers at Clemson University have measured relatively high ethylene concentrations (0.5 to 3 ppm) in packages of cuttings following 2 to 3 days storage. The competitive inhibitor of ethylene, 1-MCP (Ethylbloc), has been used to reduce leaf senescence of many species, such as parsley, geranium, and poinsettia; however, 1-MCP also reduced rooting of chrysanthemum and hibiscus cuttings.

Objectives for the project were to determine which species are sensitive to external ethylene, document the effects of ethylene on unrooted cuttings, and evaluate the effectiveness of 1-MCP in preventing ethylene damage.

MATERIALS AND METHODS

Cuttings of 55 taxa (Table 1) were harvested by 9 am, placed in open glass jars and treated with 0 or 700 nL L^{-1} 1-MCP for 4 hours. Jars were lined with a paper towel moistened with DI water and covered with a moist paper towel to maintain humidity during 1-MCP treatment. After treatment was completed cuttings were be placed in 0, 0.1 or 1.0 ppm ethylene overnight for 20 hours. The 0 ppm ethylene treatment contained activated charcoal to absorb extraneous ethylene. Initial and final air samples were be collected and analyzed for 1-MCP, ethylene, O_2 and CO_2 concentration using gas chromatography. Six cuttings were placed in each jar for each treatment combination.

After treatment cuttings were propagated into flats and placed under mist. Cuttings were observed daily for symptoms of ethylene. Root development was recorded at three weeks after propagation:

0=presence of more than five roots longer than 2 cm.
1= presence of more than five roots shorter than 2 cm.
2= callus development or presence of one to five roots.
3= no callus or root development.

Table 1. Genus, species and cultivar (if appropriate) of taxa tested.

Abutilon megapotamicum
Alternanthera New Burgundy, Party Time, Red
Angelonia Lavender Carita
Bacopa Abunda Blue Improved
Begonia Anita Louise, Frosty, Miss Murry, Snowcap, Tom Ment
Calibrachoa Terra Cotta
Centradenia Purple Showers
Coleus Aurora, Dark Copper, Rustic Orange
Impatiens Fiesta Pink Ruffle
Fuchsia Honeysuckle
Geranium Blues, Charleston, Kardino, Rocky Mountain White, Tango
Graptophyllum pictum
Hemigraphus alternata
Iresine Purple Lady
Ivy Geranium Amethyst, Beach, Lambada, Mandarin, Picasso, Ragtime, White Blizzard
Lantana Sunbeam Patriot
New Guinea impatiens Fanfare

Orange, Sonic Red, Sonic White, Super Sonic Peach, Super Sonic Red, Super Sonic White
Perilla Magilla
Petunia Suncatcher Coral Prism
Plectranthus Gold Coin, Mona Lavender, Nicollet, *P. amboinicus,P. madagascarieis*
Poinsettia Christmas Star
Portulaca Fairytales Sleeping Beauty
Sage Tricolor
Scaevola Blue Wonder
Streptocarpella species
Strobilanthes dyerianus
Torenia Summer Wave Blue
Tradescantia zebrina
Verbena Aztec Wild Rose

RESULTS

Unrooted cuttings of 55 taxa representing 28 genera were tested for sensitivity to treatment with 0.1 or 1.0 ppm exogenous ethylene for 24 hours. Cuttings of lantana (Photo 1), portulaca, and begonia showed leaf abscission when treated with ethylene.

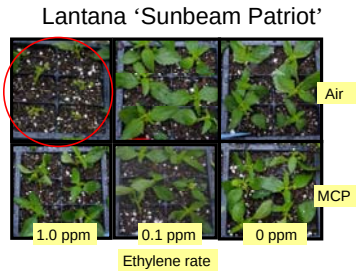

Photo 1. Note leaf abscission due to 1.0 ppm ethylene on cuttings untreated with 1-MCP. With all affected species the defoliation due to ethylene was prevented by 1-MCP treatment.

We were surprised that ethylene did not have a visible effect on geraniums. However, recent work by Clemson showed that ethylene affects in unrooted geranium cuttings are related to carbohydrate levels. When cuttings have been stressed by storage or shipping, ethylene results in leaf yellowing and poor performance. In this study cuttings were harvested and immediately treated with 1-MCP for 4 hours and ethylene for 20 hours; resulting in only 24 hours of storage, which was apparently not long enough to sufficiently reduce carbohydrate levels. Certainly other species in this study make have a similar interaction between storage and ethylene.

Ethylene produced other effects on alternanthera 'Party Time' in that the ethylene treated cuttings were shorter than those not treated with ethylene. Due to the relatively low number of cuttings tested, other species may have been similarly affected by ethylene but symptoms were too subtle to be detected.

Previous work has shown that MCP may slow rooting of hibiscus, chrysanthemum and geranium cuttings. In the current study most species were unaffected by MCP. However, the rooting of angelonia 'Lavender Carita', begonia 'Miss Murry', and begonia 'Snowcap' cuttings may have been reduced by MCP. The rooting of geranium 'Rocky Mountain White' was reduced by ethylene exposure and that of fuchsia 'Honeysuckle' was increased by ethylene. In all of these instances, however, the actual change in rooting was slight and should be investigated further.

CONCLUSIONS

Only three genera out of 28 tested showed sensitivity to ethylene and 1-MCP was able to prevent damage form the ethylene. 1-MCP is a viable tool for preventing damage due to ethylene during shipping and storage.

IMPACT TO THE INDUSTRY

The results of this project will allow us to develop "best management practices" for the shipment of unrooted cuttings. The result will be an improvement of cutting survival during shipment and a reduction in subsequent crop losses in propagation. We will also determine the cause of various physiological disorders.

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