Use of 1-MCP on Floral Products

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Inhibition of the damage to ornamentals caused by ethylene was among the first spectacular benefits of 1-MCP to be documented. Ethylene is a natural senescence hormone in a number of cut flowers, of which carnation is a classic example. 1-MCP treatment of carnations and other flowers whose senescence is mediated by ethylene considerably extends their shelf-life. In many other ornamentals, where ethylene is not the natural senescence hormone, ethylene exposure nevertheless leads to a rapid reduction in product quality, principally as a result of accelerated shattering (loss of petals, florets, and/or leaves). Ethylene is a common air pollutant in areas where flowers are marketed and displayed, particularly in supermarket distribution centers and supermarkets themselves. Spray or dip applications of silver thiosulfate (STS) were long the only tools for overcoming the negative effects of ethylene in ornamentals. 1-MCP is an excellent replacement tool for overcoming the effects of exogenous ethylene, and we have demonstrated its efficacy in a wide range of cut flowers and potted flowering plants. For example, ethylene causes rapid and almost complete abscission of florets from snapdragon flowers, a response which is eliminated when the flowers are pre-treated with low concentrations of 1-MCP (Fig. 1).

Fig. 1

The response of potted lilies to ethylene was, if anything, more dramatic (Fig. 2). After exposure for 3 days to low concentrations of ethylene, the plants seem unaffected by the exposure. After 8 days of simulated shelf-life, however, the control plants had lost all of their buds and flowers, and their leaves were yellowed and necrotic (Fig. 2). Pre-treatment with 1-MCP completely eliminated the


Fig. 2

ethylene response, so that all the buds opened, and leaves remained green. This treatment was much more effective, for lilies that are destined for supermarket display, than 'Promalin,' a growth regulator cocktail that has been recommended for reducing leaf yellowing in lilies.

Now that 1-MCP has been registered for use with ornamentals there are a number of questions to be answered to ensure its most effective use in commerce. We have used a carnation petal model system to determine the effects of temperature, 1-MCP concentration, and 1-MCP treatment time on effectiveness of this new inhibitor. Because 1-MCP is a gas and might potentially disassociate from the binding site, allowing the plant to respond to ethylene once again, we also have studied the duration of effectiveness of a 1-MCP treatment.

1-MCP works better at room temperature

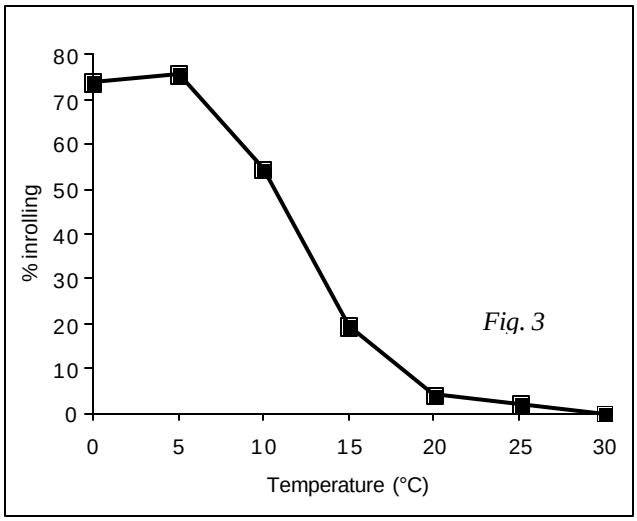
We treated carnations held at a range of temperatures with 1-MCP (50 ppb, 6 hours), then exposed individual petals from the different flowers to ethylene (1 ppm, 24 hours) and measured the ethylene response (inrolling). As can easily be seen (Fig. 3), the inrolling response was completely inhibited in flowers that were treated at room temperature (20°C; 68 °F) or above. In subsequent experiments we demonstrated that lower treatment temperatures worked well, only if the treatment concentration was higher, and the treatment duration was longer. Commercially, treatment is most commonly in refrigerated trucks. To ensure efficacy, treatment concentrations used in trucks are high (800 ppb) and the treatment time is often more than 24 hours.

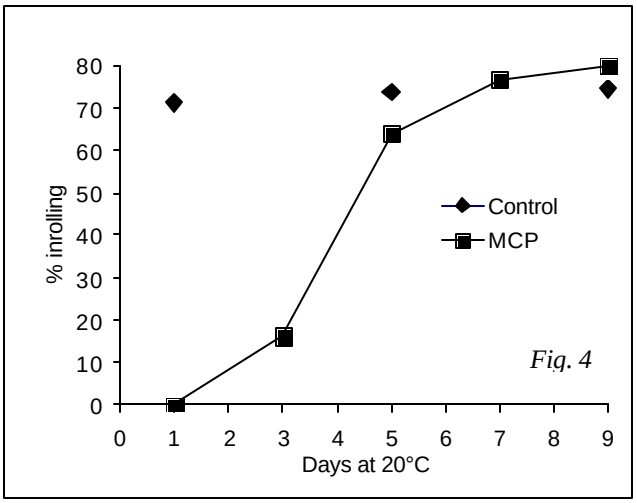
With time, 1-MCP may lose its effectiveness

We treated carnations with 1-MCP (50 ppb, 6 hours), then held the flowers at 20°C (68°F) and removed petals at intervals to test their response to ethylene. After about 4 days, the treated petals had recovered 50% of their responsiveness to ethylene (Fig. 4). It appears that the rate of loss of resistance to ethylene depends on the plant being treated. We recently found that pelargoniums (for which STS treatment has been a standard commercial treatment) barely benefit from 1-MCP treatment. Although 1-MCP treatment of pelargoniums initially inhibits the shattering caused by ethylene, the effect disappears within 1 – 2 days. In carnations and pelargoniums, we have shown that the loss of inhibition is greatly retarded by storage at lower temperatures. In carnations, for example, the time taken for the flowers to recover 50% of their response to ethylene, which is about 4 days at room temperature, is more than a month at 0°C (32 F).

Treatment times can be quite short

With isolated carnation petals, the full benefit of 1-MCP treatment is seen within 15 minutes of the start of treatment (Fig. 5). This suggests that at room temperature and with good ventilation, floral tissues,





which are thin and exchange gases readily, could be treated for times that are significantly shorter than those presently recommended on the registered label for floral crops (6 hours).

Presence of ethylene can interfere with 1-MCP

In some of our early pilot trials in supermarket distribution centers we found that 1-MCP had little effect on sensitive cut flowers. Further examination revealed that the presence of ethylene in the treatment atmosphere negates the beneficial effects of 1-MCP. If there is likely to be ethylene present in the treatment atmosphere, we recommend the use of higher concentrations of 1-MCP and longer treatment times (at least 12 hours). In similar experiments, we tested the effects of the presence of 2% CO_2 in the treatment atmosphere and found that there was no detectable reduction in the efficacy of 1-MCP. This indicates that accumulation of respired CO_2 in sealed treatment chambers will not reduce the efficacy of 1-MCP.

Conclusions

For many ornamentals, 1-MCP-treatment is an excellent alternative strategy to the use of STS in preventing the damaging effects of exposure to ethylene gas. Depending on the marketing system, a range of different treatment protocols is possible. Because the response to 1-MCP differs among species, it will be important that the response of each is tested, particularly to determine the duration of benefits obtained from the treatment.