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Ethylene in Floriculture

Ethylene is a hormone that influences growth and development of plants throughout their life cycle. It is a colorless gas that is active at very low concentrations, even at parts per billion (which is 0.001 part per million). For most crops, ethylene inhibits extension growth, promotes branching, stimulates leaf senescence, and aborts flowers and flower buds.

Ethylene can be a harmful contaminant in greenhouses, as well as during shipping of young plants to greenhouses and finished (flowering) plants to the retail market. However, there are situations when ethylene can elicit desirable responses in greenhouse crop production. This article summarizes inadvertent and intentional ethylene exposure to floriculture crops.

Figure 1. If growth of plants is stunted, flowering is delayed, or leaves start to twist or curl, ethylene contamination may be the problem. Check unit heaters to ensure adequate oxygen is provided for complete combustion of fuels, and that the exhaust is sufficiently ventilated.

Unwanted ethylene in greenhouses. Plants naturally produce ethylene, but this alone is not a concern in greenhouses because concentrations are so low. Ethylene contamination usually occurs when there is insufficient oxygen provided to unit heaters (resulting in incomplete combustion of fuels), or when the exhaust is inadequately vented. The effects of ethylene depend on the concentration, duration of exposure, temperature, and species. At a relatively high concentration, such as 1 or 2 ppm, symptoms of ethylene exposure are quite pronounced, such as sudden abortion of flowers.

However, ethylene contamination from incomplete fuel combustion usually produces lower concentrations (such as less than 0.1 ppm) that, when provided for a long period (days), causes more subtle effects on growth. These long-term but very low concentrations of ethylene generally inhibit overall plant growth, can cause slight twisting of leaves, and can abort small flower buds. Among the more sensitive floriculture crops to ethylene are begonia, dianthus, fuchsia, geranium, hibiscus, impatiens, orchids, petunia, salvia and tomato. For more extensive information on long-term, low-concentration effects of ethylene, here's a good article from Cornell University: https://goo.gl/mCNDWd.

To test for ethylene, use a 5- to 10-mL glass (not plastic) syringe and fill it three-quarters full of air from the suspected location(s). Seal the open end of the syringe with a rubber septum, label it, secure the plunger with tape, and pack it in a sturdy box with packing materials to prevent motion during shipping. Contact an extension educator or land-grant university for assistance on sampling and where to send for analysis.

Application of ethylene in greenhouses. Ethylene can be applied to ornamental crops to stimulate branching, inhibit extension growth, and abort flowers and flower buds. Florel and Collate are labeled in the U.S. for application on ornamentals, and are usually applied as a foliar spray at 250 to 500 ppm. Higher rates are sometimes used, such as with flowering bulbs. Ethylene can also be effective when applied as a substrate drench. University research (including at Cornell, Iowa State and Michigan State) as well as by private consultants has shown that Collate is effective at lower drench rates, such as 20 to 40 ppm on bedding plants and 200 to 250 ppm on potted daffodils. These drench rates assume a standard drench volume, for example 2 ounces per 4-inch pot and 4 ounces per 6-inch pot. With lower volumes, higher concentrations may be appropriate, and vice-versa.

As with all plant growth regulators, application timing of Collate and Florel is critical. When applied too early, they can inhibit rooting and when applied too late, they can delay flowering. To inhibit extension growth and promote branching, with little or no flowering delay, make applications once plants are fairly well rooted. Small-scale trials are necessary to determine appropriate application concentrations and timings for each crop.

Inhibiting ethylene action during shipping. During shipping of floriculture materials, whether as an unrooted cutting, a cut flower or a flowering plant, the presence of ethylene should be avoided. However, because plants naturally produce ethylene, especially when stressed (and shipping conditions are often stressful), and because they are shipped at high densities, ethylene exposure is a common problem. Keeping plants cool (without causing chilling injury) will reduce ethylene generation, and ventilating rooms or trucks will limit ethylene build-up.

There are two types of products that can be applied to plants to inhibit ethylene action. The first is 1-MCP, which is available as EthylBloc and Ethylene Buster. These products provide short-term protection against ethylene, usually for a few to several days. The other type of product is silver thiosulfate (STS), which recently became available as Alesco, and is labeled in most states. STS is more persistent, typically lasting for a few weeks. Be sure to read the product labels and closely follow application guidelines to ensure human safety and product efficacy. gpn

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