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Ethylene Contamination: Symptoms and Sources in the Greenhouse

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Most people that work with plants have heard of ethylene. It is a gas that is produced by plants and causes fruit to ripen and flowers to wilt. It is biologically active at very low concentrations. The negative impacts of ethylene gas on plant quality during handling, shipping, and storage (i.e. postproduction) are well known, but what most people do not think about is that ethylene can damage plants during production. During this time of year when there is less ventilation and you are working hard to winterize your facilities to save on fuel costs, ethylene can build up in greenhouses to levels that are harmful to plant growth and development. This article is in no way meant to discourage you from tightening that greenhouse up to save on rising energy costs. It is meant to remind everyone that ethylene can be a problem in greenhouses, and to make sure people are aware of the sources of ethylene gas, can recognize symptoms of ethylene damage, and know what to do to minimize crop loss if you have an ethylene problem.

Sources of ethylene in the greenhouse:
An improperly functioning heating unit is the most common source of ethylene contamination in the greenhouse. Other sources of ethylene include:

- Exhaust from combustion engines
- Cigarette smoke
- Leaky gas lines or contaminated fuel
- Ripening fruits
- Senescing flowers
- Dying and decaying plant material
- Wounded plant tissues

Figure 1. Ethylene damage on geranium.

Symptoms of ethylene damage:
The extent of ethylene damage depends on the sensitivity of the plant species to ethylene, the concentration of ethylene, the exposure time (i.e. duration), the temperature at the time of exposure, the tissue type, and the developmental stage. Some plants are very sensitive to ethylene and exposure to 100 ppb (parts per billion) or less over a few hours can cause damage. In less sensitive species exposure to 100 ppb over days or weeks can result in damage. Ethylene can easily build up to ppm (parts per million, 1 ppm = 1000 ppb) levels if there is a source of ethylene and inadequate ventilation to let that ethylene escape. Mature flowers and buds are more susceptible to damage than young buds or leaves so symptoms will appear first on these tissues. At warmer temperatures ethylene damage is more severe.

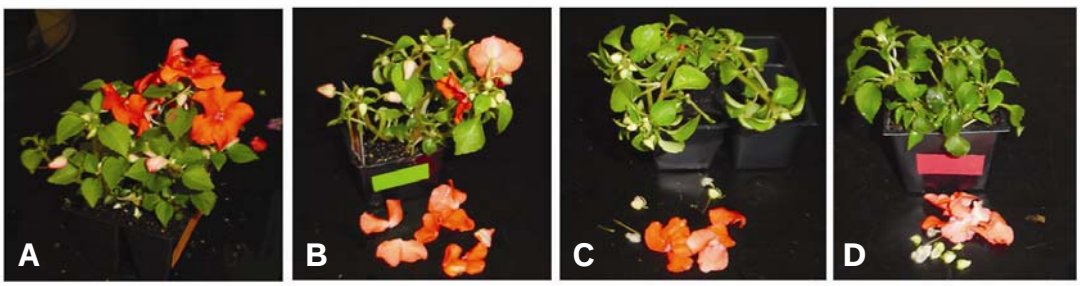

Figure 2. The dosage effect of ethylene on impatiens. Plants not exposed to ethylene (A). Plants exposed to 2 ppm ethylene for 1 day (B), 2 days (C), and 3 days (D). Initially only open flowers abscised, then buds began to abscise. After 3 days of exposure all flowers and buds had been shed.

General symptoms of ethylene damage include:

- Shedding or shattering of petals
- Bud, flower or leaf drop
- Rapid flower aging and wilting (i.e. senescence)
- Epinasty or drooping of the leaves and bracts
- Flower bud abortion
- Leaf yellowing or chlorosis
- Malformed leaves of flowers
- Stunted growth

Specific symptoms for plant species can be found at the Chain of Life Network website (www.chainoflifenetwork.org) or in the NC State Horticulture Information Leaflet 530 (www.ces.ncsu.edu/floriculture/hils/HIL530.pdf). These resources identify those species that are sensitive or relatively insensitive to ethylene. One thing to keep in mind is that for some species, like petunia, ethylene sensitivity can be cultivar specific so it can be difficult to generalize and classify an entire species. Table 1 lists some plant species that are classified as very sensitive to ethylene. Other plants are also sensitive to ethylene, but the plants in Table 1 are those that should show the first visual symptoms if you have ethylene contamination in your greenhouse. Some visual symptoms of ethylene damage on geraniums (Figure 1) and impatiens (Figure 2) are shown on the previous page.

Table 1. Some floriculture crops that are sensitive to ethylene.

Crop	Visual symptoms
Achimene	Flower and flower bud abscission
Begonia, wax	Flower and flower bud abscission
Boston fern	Defoliation
Carnation	Accelerated flower wilting, sleepiness
Delphinium	Accelerated flower senescence
Geranium	Flowers do not open, petal shattering, leaf chlorosis
Impatiens	Bud, leaf and flower abscission
Impatiens, New Guinea	Bud and flower abscission
Kalanchoe	Buds do not open, petal fading and drying, open florets close
Lily, Easter and Hybrid	Floral bud abscission, flower numbers reduced.
Orchid, Cattleya	Accelerated flower wilting and senescence
Petunia	Accelerated flower wilting and senescence
Primula	Flower wilting
Snapdragon	Flower abscission
Tomato	Epinasty, no fruit set

How to prevent ethylene damage

The proper maintenance and use of heating units is the best way to prevent ethylene damage in the greenhouse. Regular maintenance can identify leaks or cracked heat exchangers that may result in harmful levels of ethylene in the greenhouse. Incomplete combustion can result in the production of harmful gases including ethylene and carbon monoxide. These products should be vented outside of the greenhouse. Adequate ventilation is also needed so that the heaters have enough oxygen for complete combustion to reduce the production of these byproducts. Other things you can do to prevent ethylene damage in the greenhouse include:

- Use electric carts or bicycles rather than modes of transportation that utilize gasoline or propane
- Clean up all dying and damaged plant materials

How do you determine if you have ethylene contamination in your greenhouse?

The best way you can determine if you have ethylene in your greenhouse is to carefully monitor plants that are sensitive to ethylene for the symptoms listed above. These plants are referred to as indicator plants. Some good indicator plants are geranium, which will have both flower (abscission) and leaf (yellowing) symptoms (Figure 1) and tomato which will show downward bending of the leaves. This is termed epinasty and it looks as if the plants need water but they will be completely turgid. If you observe these symptoms you must act to remove the source of ethylene and ventilate the area to remove the ethylene gas. Ethylene damage may easily be confused with other types of stress that cause similar damage. If you suspect you may have an ethylene problem of you would just like more information please feel free to contact me. We can also use an instrument called a gas chromatograph to determine if ethylene levels in your facility are high.

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