
Ethylene Effects and the Benefits of 1-MCP

Sylvia Blankenship, Professor, Horticultural Science
North Carolina State University, Raleigh, NC

Ethylene is thought of as the “aging” hormone in plants. It is a small hydrocarbon gas. While naturally occurring, it can also occur as a result of combustion and other processes. Sources of ethylene include: ripening fruit, exhaust from internal combustion engines/heaters, smoke including cigarettes, welding, rotting vegetation, natural gas leaks, manufacturing plants of

some kinds. You can’t see or smell ethylene. Ethylene will cause a wide range of effects in plants, depending on the age of the plant and how sensitive the plant is to ethylene. Ethylene effects include: fruit ripening, induction of flowering, loss of chlorophyll, abortion of plant parts, stem shortening, abscission (dropping) of plant parts, epinasty

(stems bend), and dormancy. It can be produced when plants are injured, either mechanically or by disease.

Ethylene can be either good or bad, depending on what commodity you work with. It is used in a positive manner in fruit ripening for example. It can also cause damage

on crops such as yellowing of vegetables, or abscission in ornamentals (leaves, flowers drop off). Often two of the important things to know are:

1. if a crop naturally produces a lot of ethylene, and
2. if it is responsive to ethylene.

Responsiveness will depend on:

- a. the crop,
- b. the stage of plant development,
- c. the temperature,
- d. the concentration of ethylene,
- e. the duration of exposure.

Ethylene is used commercially to ripen tomatoes, bananas, pears and a few other fruits. Ethylene gas is used to do this and it is a postharvest use. There are commercial liquid products that release ethylene (Ethephon, Ethrel). These are only used preharvest. There are several anti-ethylene chemicals. Silver thiosulfate (STS) is used on flowers. AVG (trade name ReTain™) blocks ethylene synthesis. It is a liquid that is applied preharvest. The fruit (plant) will not produce much ethylene, so there is not an ethylene response. However, the plant can respond to ethylene from another source.

In contrast, 1-MCP blocks ethylene binding to its receptor (see below). It is applied postharvest. The fruit (plant) may still produce some ethylene but there is no response to any ethylene, regardless of source. In a normal plant response, ethylene attaches to a receptor molecule and a response occurs (Fig. 1). Ethylene attaching to the receptor is much like a “key” fitting in a “lock,” with ethylene as the

“key” and the receptor as the “lock.” When ethylene attaches to the receptor, it is like the lock turns and a door opens. A cascade of events then takes place such as the fruit begins to soften, leaves turn yellow, or flowers drop off. Another gas, 1-MCP, is also able to attach to the ethylene receptor. It also can act as a “key” that goes into the “lock,” but it is unable to turn the “lock” and “open the door.” When the 1-MCP “key” is in the “lock,” it is not possible for the ethylene “key” to go in the

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lock. The 1-MCP stops the “lock” from turning so the door can’t open. It is in this way, that 1-MCP acts as an ethylene inhibitor in plants.

Because gases are often difficult to handle, 1-MCP was put into a solid formulation. The powder, when mixed with water, will release 1-MCP gas into the enclosed area. Depending on temperature and other conditions, this will happen over the course of about an hour. It is expected that an easy-to-use, one-step kit will be provided with the commercial product when it becomes available.

A typical postharvest scenario might be to enclose a plant product

in an airtight container/room. 1-MCP gas would be released into the air in the container/room and penetrate the commodity. After a short period of time (6 to 24 hours), the commodity would be returned to air or controlled atmosphere. The product would then continue on the postharvest route. 1-MCP is a safe product that leaves no detectable residue. It can be used by small or large operations.

The success of 1-MCP treatment depends on a number of things. The concentration of the 1-MCP gas must be sufficient to saturate the receptors and compete with any ethylene present. The treatment time must be long enough for the gas to release and penetrate the plant tissue. The temperatures at which the treatment takes place will influence the length of time needed for treatment. Done properly, there is no problem in using 1-MCP to treat products in cold storage—it can also be used at room temperature, although this will not allow for optimum postharvest life. Monitoring the cold chain is a good idea. Maturity of the plant product will effect the results. If fruit is too ripe or flowers too old, 1-MCP will not work well. In some cases, the effect of 1-MCP is permanent. In other plant products, the effects of the 1-MCP treatment can wear off and this depends, in part, on the concentration of 1-MCP applied.

1-MCP can be a very valuable tool when incorporated into a good postharvest program.

Figure 1. Binding of ethylene molecule with the receptor “unlocks” the receptor and leads to a chemical reaction in the plant tissue (diagram by Jenny Bower, Dept. of Pomology, UC Davis).

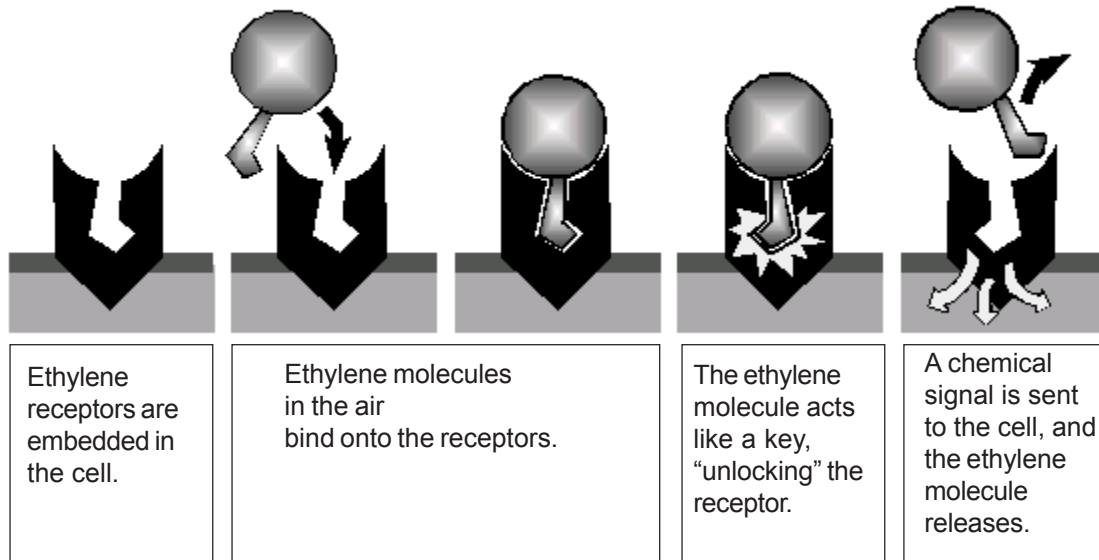


Figure 2. When 1-methylcyclopropene (1-MCP) binds to the ethylene receptor, it does not “unlock” the receptor and remains locked to the receptor preventing the binding of ethylene and the chemical reaction does not occur (diagram by Jenny Bower, Dept. of Pomology, UC Davis).

