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THE USE OF ETHYLENE GAS IN RIPENING TOMATOES

by

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The use of ethylene gas in hastening the coloring process of tomatoes is quite general where tomatoes are grown in sufficient quantities to warrant the use of the gas and where it is desired to decrease the time for the ripening of fruit and to improve the quality of the same. Under natural conditions tomatoes may take ten to twelve days to develop a red pigment. The use of ethylene speeds this process by increasing the red pigment called lycopin. In ripening on the vines, the red color usually develops first at the blossom end on the side of the fruit exposed to the sunlight. In ethylene treated fruit the red color frequently appears at the stem end, indicating the entrance of the ethylene gas into the fruit at that point.

Maturity of fruit. There are four definite stages recognized in harvesting field-grown tomatoes, immature-green, mature-green, pink and ripe. Mature green tomatoes, sometimes called "green-wraps" in the South, are fruits almost fully grown and the interior ripening processes are underway. When tomatoes have reached the proper maturity for green-wrapped harvesting, the content of the seed cavities is slightly moist and of a jelly or glue-like consistency, and distributed throughout the cavity instead of being dry and firm as in the case of the immature green fruit. If one cuts a cross-section of the fruit with a sharp knife the interior content will be sufficiently gelatinous to permit slicing the fruit without cutting the seeds. Green tomatoes will not have this jelly or glue-like consistency, but will be dry and firm. Tomatoes in this stage will not color under the influence of the ethylene, but the fruit which is mature green will color moderately slowly.

"Pink" tomatoes usually show a slight trace of pink or red color on the blossom end and when in this condition will color rapidly under the influence of ethylene.

Application of ethylene gas. Ethylene is a non-poisonous but slightly inflammable gas which can be purchased from chemical supply companies in cylinders containing various amounts of cubic feet of the gas, usually 14 or 25 cubic feet. The "style B" cylinder has a capacity of 100 gallons or 13.3 cubic feet, weighing ten pounds. The "style D," weighing 16 pounds,

has 200 gallon capacity or 26. $\frac{2}{3}$ cubic feet. In view of the small amount of gas necessary to be used, the smaller sized cylinders are more desirable. The 26 cubic foot size contains a sufficient amount of gas to ripen 5 or more carloads of fruit. In Portland a 200 gallon supply gas tank can be purchased at about \$5.50 together with an extra charge of \$8.00 for the cylinder.

The ethylene gas is under high pressure in a steel cylinder. In handling the cylinders care must be used not to drop them. The tanks should be kept away from stoves or boilers and not be allowed to lie in hot sunshine. Light from fires should be kept away from them in order to avoid the ignition of the gas which may leak from unclosed valves. During liberation of the gas from the tank, open light, cigarette, cigars or pipes should not be allowed in the room. Incandescent electric lights are safe and actually the danger in handling ethylene is about the same as allowing a very small jet on a gas stove to run unlighted for the same length of time.

Since the pressure on a full cylinder of ethylene is so high, a special expansion valve must be used for the measurement of the dose of gas required. This valve should be attached to the cylinder securely with a lead gasket to prevent leakage between the expansion valve and the cylinder. After attaching the expansion valve, see that the thumb screw on it is turned in the direction of "Close" until the pressure of the spring is released; then the valve on the cylinder should be completely opened. Always use the valve on the tank as the shut-off valve. Do not use the expansion valve to stop the flow of gas.

A constant low-pressure expansion valve discharging through a very small orifice is the most convenient means of measuring the gas, for at a constant low pressure a uniform number of cubic feet of ethylene will flow through the orifice per minute. A watch may then be used to find the flow in liberating the required volume of gas. The number of cubic feet of ethylene delivered per minute is stated on the dial face. The measuring device regulates the amount of gas released per minute, the dial registering the flow being calibrated to .2 of a cubic foot per minute. Thus, when the arrow is pointing to .2 it shows that the ethylene is passing out of the tube at the rate of .2 of a cubic foot per minute or 1 cubic foot in five minutes.

Amount of gas needed. To determine the dose of ethylene required for a certain room, measure its height, length and breadth and multiply these together to obtain the cubic feet of air contained in the room. Thus, a room 18 feet high, 20 feet long and 12 feet wide contains 1920 cubic feet, or a room 20 x 15 x 10 contains 3000 cubic feet. Since the usual dosage is 1 cubic foot of ethylene for 1000 cubic feet of air space, the amount of ethylene to be liberated in the case of the first room would be 1.92 cubic feet, or in the case of the second room 3 cubic feet.

Delivering a dose of 1.92 cubic feet of ethylene into a room at the rate of .2 cubic foot per minute, 9 minutes and 36 seconds would be required. Open the valve on the tank and screw in the thumb screw on the expansion

valve until the pointer on the gauge stands constant at the point marked to deliver .2 of a cubic foot per minute. As soon as the pointer reaches this mark note the exact seconds on the watch. Allow the gas to flow for the time necessary to release the required dose as determined beforehand, namely 9 minutes and 36 seconds for 1.92 cubic feet. Then quickly close the valve on the cylinder and place it with the pointer on the expansion valve at 0.

The next morning after the first application of gas the room should be well ventilated, then resealed and recharged as before, repeating this until the tomatoes are ripe.

The room for holding the gas in ripening fruit should be of reasonable construction, so that there may be little if any leakage of the gas. It is desirable to have a temperature of between 65 and 70 degrees F. for the ripening of tomatoes and a relative humidity at about 90 per cent.

One grower conceived the idea of building a cabinet which was first made, having a capacity of 400 pounds. Later, this grower built a cabinet which had a capacity of 1000 pounds, occupying 8 square feet of floor space, and having a cubical capacity of about 30 cubic feet. It was built air-tight of insulating material, and contains a hot water device necessary to bring the cabinet up to the desirable temperature of 70 degrees. The ripening capacity of this cabinet just mentioned is between 100 to 200 pounds of ripe fruit daily, with a gas consumption of about 1/15 of a cubic foot, costing less than 2¢ per application.

The tomatoes can be ripened in standard tomato crates for the gas will readily penetrate the average style of container.

Under ethylene treatment tomatoes take on a bright red color in from 4 to 6 days depending upon the state of maturity when treated. Fruits treated artificially with ethylene are said to have a better flavor and decreased acidity in comparison with those fruits ripening on the vines, or ripening naturally when picked in a green condition.

This method of increasing the red pigment of the fruit should be particularly useful for the treatment of tomatoes picked in a green state just after light frosts in the fall. Such fruits unfrozen, of course, should be picked carefully so as not to be bruised and put away in a cool room to be later treated with ethylene.

For further information in this regard, communications should be addressed to the Department of Horticulture, Vegetable Crops Section, Oregon State College, Corvallis, Oregon.