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GREENHOUSE HEATER CHECKLIST

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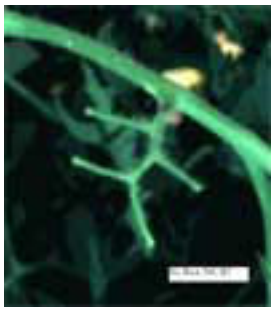
I received several calls, last fall and winter, about problems with greenhouse tomatoes related to heaters. Some symptoms described by growers were: "the plants are drooping but aren't wilted", "the flowers on a cluster are falling off", "the plants have a twisted appearance", and "the plants don't look like they did last year". These symptoms coupled with other factors such as: a new heater was installed, using a very old heater, and using an unvented heater could mean ethylene damage.



Sometimes present in the combustion gases from gas heaters (fired by natural gas or liquefied petroleum) is ethylene. Ethylene is a gas with no color or odor which can cause problems for tomatoes and other plants in a greenhouse environment. Symptoms of ethylene exposure can include epinasty (plants have a wilted look even though they are turgid), flower drop ("yellow knuckles" on a cluster), and/or twisting of upper leaves. Exposure to very small amounts (0.01 ppm) over several days or 1 ppm for a few hours can cause damage. After the problem is corrected, normal vegetative and reproductive plant growth will resume. However, an economic impact will be felt by the grower at the time any lost clusters would have been harvested. This supply "gap" will mean lower overall yields/sales and an inconsistent supply to the consumer.

Generally, heater issues (improper installation, cracked heat exchanger, chronic use of unvented heater, leaking gas lines, and improper flame adjustment) can cause ethylene exposure. With fall just around the corner, this is a good time to start thinking about heater maintenance and start-up. Keeping the heating system in good repair and operating condition will not only lessen the chance of ethylene exposure, but will also reduce operating costs and prolong the life of the unit. The following checks relate to unit heaters or forced air heaters. Remember to always refer to your particular installation/service manual and for in-depth repairs, rely on a licensed technician.

<u>Blower and Fan</u>

- Check lubrication of motor bearings if they are not the permanently lubricated type. Lubricate if necessary. Replace leaking sealed bearings.
- With the power turned off, check to see that the motor shaft turns freely and does not bind. This can be done by rotating the fan or blower wheel by hand.
- Inspect the fan or blower wheel to make sure they are not damaged. With the power off, clean off dirt accumulation with a soap/water mixture.
- Check to make certain the fan is not loose on the motor shaft.

- Check power connections to motor to ensure they are secure and have not vibrated loose over the past heating season.

Heat Exchanger

- Check heat exchanger for any signs of cracks or corrosion. It is best to use a flashlight and inspect the inside of the heat exchanger tubes as well as the outside.
- Check cleanliness of heat exchanger. If required, clean inside tube surfaces with a stiff brush. Don't use a wire brush, as it will scratch protected metal surfaces. Use steel wool attached to a pole device to clean outside and inside surfaces of the heat exchanger.
- Inspect heat exchanger for signs of overheating. Metal that has been overheated will have a dark discoloration at the areas of overheating. If discoloration is evident, it may mean that the gas pressure to the unit is incorrect, air movers are not properly adjusted, venting is inadequate, combustion air is inadequate, or obstructions are blocking the air inlet or air discharge vent of the heating equipment.

Gas Burner

- Inspect the burner for general cleanliness. If the burner requires cleaning, clean with a stiff brush or remove and clean with compressed air.
- Inspect the inside of burner tubes as much as possible. During the summer months it is not uncommon to find that spiders and mice have taken up residence inside the burner.
- Inspect the burner for proper location making sure that it is properly aligned and securely fastened.

Gas Control

- Inspect all gas connections for good tight fits. This includes pipe connections to the equipment as well as pilot tubing connections at the gas valve and the pilot burner.
- Inspect the main burner gas orifices to make sure they are not blocked with spider webs. Check the pilot (for standing pilot) orifice for obstructions if pilot cannot be lit or will not stay lit.
- After visual and physical inspection of the gas connection, turn on the gas and check for gas leaks using a soap/water solution.
- Check electrical connections to gas valve.
- Check thermocouple for cleanliness and tight connections. Replace as needed.

Thermostat

- Check thermostat for general cleanliness.
- Check wiring to and from thermostat.
- Check thermostat for proper temperature setting.
- Check to make sure the thermostat is in an appropriate location. The thermostat should be installed away from outside walls in a location free from drafts and shaded from the sun. The location should be varied for different crop heights so the thermostat senses the temperature at crop level.

Vent (Exhaust) System

- Check to make certain vent system is clear and free of any obstructions.
- Check to make certain all connections are secure and tight.
- Check vent support system to make certain it is secure and has not been damaged.
- Check joints of vent for signs of leakage.
- Water marks down the outside of the vent pipe may indicate inadequate venting and/or improper vent insulation in unheated spaces. Use double-walled vent pipe to reduce the likelihood of condensation in the vent pipe.

- Check vent pipe drip leg and clean-out cap, and clean if necessary. Use approved weather caps.

Gas Supply

- Check to make sure that gas mains are turned on.
- Check inlet pressure and manifold gas pressure to heating equipment to make sure it is properly set.
- Check gas regulators to be certain regulator vents are not plugged. Propane gas regulators should be vented to the outdoors if the regulator is located inside the building.
- If propane is being used, check the main regulators on tanks for proper pressure settings and check for damage to regulators.
- Check propane tanks for proper size and liquid propane levels. Performing checks like these, at least once a year and performing a start-up prior to the growing season, can save you from problems down the road. Have a good season.

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