Check Your Furnace when Air Pollution Injury is Suspected

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Recently an Extension educator and I were called by a grower who complained that his plants were not growing as they should. They were in a poly covered greenhouse heated by two forced hot air furnaces.

Inspection indicated that the plants were not dying, but much of the foliage was spotted with yellowing and bleaching of the interveinal areas. The areas adjacent to the veins were green. This is typical of sulfur dioxide (SO_2) injury. The next step was to locate the source.

Because sulfur dioxide is a byproduct of combustion, the furnaces were a likely problem area. What did we look for?

Backdrafts

To get adequate draft for combustion and to reduce the potential for backdrafts, the top of the chimney must extend above the peak of the greenhouse and any nearby obstructions. The recommended height is two feet above the ridge or, if the chimney is located near the eave, two feet above a 10-foot horizontal line to any part of the structure. Greater heights may be needed if trees or other parts of the building are nearby or if additional draft is required for better combustion. A cap on the chimney can also reduce downdrafts and turbulent air patterns.

Tightness of Chimney Connections

Stovepipe or metal chimney connections should be securely fastened to prevent leaks. On stovepipe, sheet metal screws can be used at the joints.

Occasionally we see a grower who installs the stovepipe by attaching a tee rather than an elbow at the furnace collar. Stovepipe is connected to both sides of the tee with the bottom

section resting on a cement block on the ground. This area is frequently a source of leaks unless a plug is used to seal the end of the pipe.

Firebox Leaks

Continual expansion and contraction of the metal in the heat exchanger of a furnace can stress the welds resulting in cracks. These cracks are a prime source of pollution, especially in older units. A furnace can be checked by placing a furnace candle or smoke bomb inside the firebox and observing any escaping smoke.

An alternate method is to insert a trouble light into the firebox at night with the lights in the greenhouse turned off. Observation of any light rays in the heat exchanger area are an indication of cracked welds or perforated metal surfaces.

Some units can be repaired by cutting into the outside metal furnace enclosure and welding the split seam. In other cases the whole firebox should be replaced.

Makeup Air

With today's tight, energy efficient greenhouses, consideration should be given to providing adequate combustion air. Without enough air, complete combustion will not take place. Unburnt gases containing sulfur dioxide, ethylene and other chemicals can then enter through places such as the barometric draft control or inspection port. Incomplete combustion also creates carbon monoxide which is definitely unhealthy for the grower.

The minimum oxygen level for burners to operate properly is considered to be 18.9% oxygen (O_2) as compared to 20.9% in normal air. At 18.9%, most modern gas burners are supposed to shut off automatically. At 17% human discomfort is pronounced. On a cold night, with the temperature below 10 deg. F., oxygen can be depleted to 18.9% in two to three hours if the furnace operates continuously and there is no more air provided.

Outside air can be brought into the area of the burner using PVC drain pipe or galvanized stovepipe. Some growers have installed small motorized louvers connected so that they open only when the furnace burner turns on. Pipe size should be at least as large as the vent on the furnace. It should be placed through the side or endwall and extend above the expected

snow line. The inside end should be screened to keep out animals and the outside end covered with a cap to prevent rain and snow from entering. The pipe should be braced or supported to keep it in place.

One final suggestion. Always keep a live tomato plant in your greenhouse. Tomatoes are sensitive to many forms of air pollution and can serve as an indicator if anything is going wrong.

The grower we were visiting found two cracked seams in one of his furnaces. Since the welds have been repaired, the plants have been growing fine.