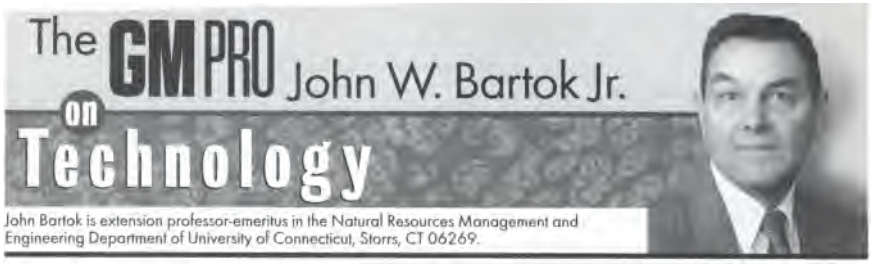
This article was listed in Forest Nursery Notes, Summer 2007

61. Understanding fan ventilation. Bartok, J. W., Jr. Greenhouse Management and Production 27(3):54-55. 2007.



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Understanding fan ventilation

Ventilation systems provide two main functions:

1. To replace the hot, moist, carbon dioxide-deficient air in the greenhouse with cooler, drier air with a higher level of carbon dioxide.
2. To distribute that air uniformly throughout the crop area.

In most greenhouses, the fan-ventilation system can be improved to be more efficient. Many greenhouses have inadequate fan capacity. Monitor the static pressure to help identify a problem. Maintenance, including cleaning the blades and adjusting belt tension, is also important for trouble-free operation.

In fan systems, fans provide positive air exchange by exhausting a certain number of cubic feet of air per minute (cfm). The intake shutters or vents control where the air enters the greenhouse and how it is distributed. The thermostat or controller integrates the equipment to provide the right amount of air needed to maintain the greenhouse environment at the desired level. For accurate control, locate the sensor at plant height near the center of the growing area.

Natural-ventilation systems

Natural-ventilation systems do depend on the buoyancy of the air and the wind speed to cause the air exchange between inside and outside air. These systems have become very popular in new construction mainly due to the savings in electricity to operate the fans and the greater uniformity of temperature in the greenhouse.

Large vent openings are required on both sides of the ridge and on both sidewalls. The combined sidewall vent area should equal the roof vent area and be 15-20 percent of the floor area. This requirement is often lacking in many structures.

In larger, gutter-connected ranges, limited sidewall vents can be installed and additional roof vent area is needed so that both intake and exhaust air can go through the same opening. Open-roof structures work well for this reason.

Even with natural ventilation, install at least one small fan per bay in gutter-connected greenhouses to provide ventilation when a grower doesn't want to open the vents. This might occur during inclement weather, at night to remove excess humidity or during winter when natural ventilation works poorly. The fan can operate on a thermostat or a humidistat.

Some growers wire the fan to a timer to turn on once an hour for a minute or two at night to lower humidity. It is best to install a relay in the circuit to prevent the heater from starting when the fan is on.

Fan selection and installation

Fan-ventilated greenhouses work the best with tight structures. When the fans turn on, a slight vacuum (negative pressure) is created that causes the air to enter through the ventilation inlets. Open doors, holes in the glazing and space under the foundation board, especially near the fans, disrupt this pattern and create a short circuit for the air. This can reduce airflow through the crop area.

Fan systems are normally sized to provide one volume air change per minute for summer cooling.

Fan capacity is measured in cubic feet of air per minute. This can be calculated by multiplying the floor area (length x width) by 8 or 10 feet of height.

For example, a 30-by-100-foot greenhouse requires a minimum fan capacity of 24,000 cfm (30 x 100 x 8 = 24,000 cfm). The installed fans should have this capacity at 0.06 inches of water static pressure. This rating can be found in the performance data usually listed in the manufacturer's catalog.

The fan has to overcome the air passing through the shutters and the safety screen over the fan opening. If evaporative cooling pads are used, fan capacity should be calculated at 0.12 inches water static pressure to overcome pad resistance.

To keep electricity costs down, select fans with a ventilation efficiency rating (VER) of at least 15. This is the number of cfm/watt of energy input. Fan VERs are listed in manufacturer's literature.

The normal location for the fans is on the endwall of houses less than 200 feet long and in sidewalls in longer houses. Fans give the best air movement through a crop when placed 4-5 feet above the floor so the air is drawn through the crop. Fans located in the peak of the house will draw out the air but may create hot spots at plant level.

Vents and shutters

Placement of the fans is not as critical as the location of the vents or shutters. The most uniform cooling is achieved with a continuous vent opening on the endwall or sidewall opposite the fans.

Hinged vents have been used for years but the guillotine vent is now common in new construction. It moves vertically and eliminates the vent arms that stick into the greenhouse growing area or outside along the sidewall.

A common design is to locate the bottom of the vent 4 feet above the floor. With a 4-foot-wide guillotine vent, the top is 8 feet above the floor and it opens from the top so cold air is tempered before it reaches the plants.

Shutters should also be located in the endwall or sidewall opposite the fans. They should be sized at 1.7 square feet per 1,000 cfm of fan capacity and motorized so that they are held open when the fan is operating.

Check fan effectiveness

Use a manometer to check fan system effectiveness. An inclined manometer should be installed with one port open to the inside air greenhouse and the other port connected by plastic tubing to an outside location.