BY ERIK RUNKLE

Greenhouse Energy Efficiency Tips

Fortunately, the cost of natural gas and other fuels used to heat greenhouses has remained fairly steady, or slightly decreased during the past five years. However, energy bills for heating and electricity are still high for many commercial growers who produce crops during the winter. This article provides a short summary of what actions or investments can be made to improve the energy efficiency of greenhouse operations.

Use and maintain horizontal air flow (HAF) fans. HAF fans are an important, but often undervalued component of a greenhouse. They serve several functions, including mixing air horizontally as well as vertically, creating a more uniform aerial environment. As a result, crops grow more homogeneously with HAF fans than without. HAF fans also help prevent condensation of water on plants, which can occur at night with cool temperatures. Use highly efficient, low-horsepower fans designed specifically to serve as HAF fans; check them periodically to ensure they are working; position them so they blow parallel to the ground (not downward toward the crop); occasionally clean the blades and guards to improve efficiency; and have them turn off automatically when vents open.

Grow cold-sensitive crops warmer than cold-tolerant ones. Crops with a low base temperature tolerate cool temperatures (e.g., 50 to 60° F) well, but those with a high base temperature (cold-sensitive crops) develop very slowly or not at all. Energy can potentially be saved by growing cold-sensitive crops in a separate, warmer greenhouse than the others. Examples of cold-sensitive crops include angelonia, basil, blue salvia, browallia, celosia, hibiscus, pentas, pepper, portulaca, torenia and vinca.

Use IR poly. Some polyethylene films block some of the infra-red (IR) radiation. When installed as the inside layer of a double-poly greenhouse, less heat is lost through the glazing at night. While IR film is slightly more expensive, the energy savings is often significant enough that it can pay for itself within a few months. Also consider an IR film with an anti-condensation coating so that water droplets run down the film, rather than forming drops that fall onto crops below.

Reduce air leaks. Walk through your facility and ensure doors, vents, and fan openings are weather stripped and close completely. Patch holes in plastic coverings, and replace cracked, slipped or missing glass panes. Shut off some of your exhaust fans in late fall, then insulate them to reduce air infiltration. If you have double poly, ensure the space between the two layers is inflated with outside air.

Check and maintain boilers and unit heaters. An annual fall inspection can identify cracks and leaks, and ensure they are running efficiently. Ensure fresh-air (inlet) and exhaust vents are not obstructed. A blocked inlet vent can cause incomplete combustion, while a blocked exhaust vent can prevent discharge of any noxious gasses (such as ethylene) generated when fuel is burned.

Install and maintain energy curtains. Retractable internal greenhouse energy curtains can significantly reduce heating costs, but only when they are maintained and fully functional. To realize their potential, they may need to be installed with stationary skirts around the edges so that the greenhouse is well sealed when the curtain is closed. The material and retracting mechanisms need to be periodically inspected for tears and complete opening and closing. In addition to serving as insulation, an often overlooked benefit of closing energy curtains at night is that plants can be at least 2 to 4° F warmer than if grown at the same air temperature but without a curtain.

Provide supplemental lighting to young plants. Many young plants are grown during the winter and early spring, when light is limiting [(daily light integral (DLI) less than 10 $mol \cdot m^{-2} \cdot d^{-1}$] in temperate regions. Delivery of high-intensity lighting, typically at 60 to 90 $\mu mol \cdot m^{-2} \cdot s^{-1}$ for up to 18 to 20 hours per day, increases plant growth and decreases propagation time (Figure 1). Since young plants are grown at very high densities, the cost to light each seedling or rooted cutting is low. High-pressure sodium (HPS) fixtures may be more economical in situations when lighting only for a few months of the year and when electricity prices are cheap. Light-emitting diodes (LEDs) are more compelling the more hours they are used each year and when electricity is more expensive.

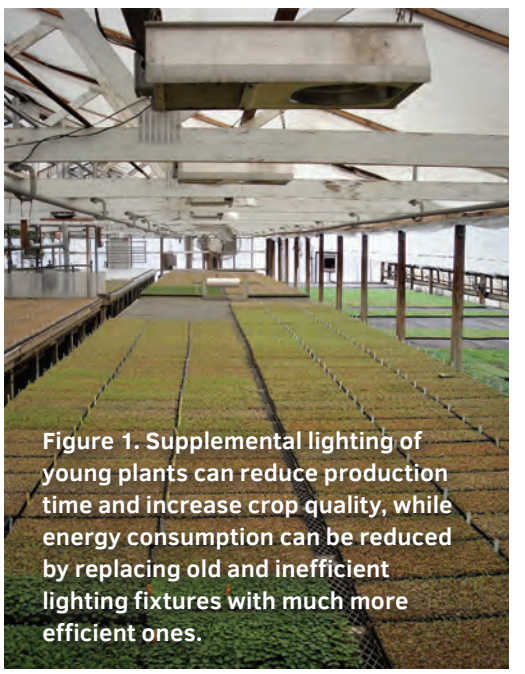

Figure 1. Supplemental lighting of young plants can reduce production time and increase crop quality, while energy consumption can be reduced by replacing old and inefficient lighting fixtures with much more efficient ones.

Convert to LEDs. The first types of bulbs to replace with LEDs are incandescent and compact fluorescent. These have been used to regulate flowering, but they are inefficient and have a short life span. White (especially warm white) LEDs can be used to delay flowering of short-day plants, and when the DLI is high, to promote flowering of long-day plants. When the DLI is low, horticultural LEDs that emit both red and far-red light are more effective.

Many greenhouse growers still use 400- and 600-watt HPS fixtures with magnetic ballasts. These are relatively inefficient, especially when they aren't maintained. Switching to 1,000-watt HPS fixtures with double-ended bulbs can decrease energy consumption by 40 to 50%, while replacing these old fixtures with the most efficient LEDs can cut energy consumption by 65 to 75%. gpn

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