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148. What kind of insulation can be used on greenhouses? Bartok, J. W., Jr.
Greenhouse Management 31(9):84-85. 2011.



Q What kind of insulation can be used on greenhouses?

In doing energy audits on several hundred greenhouses, it has become apparent that there is considerable heat savings and a good payback to insulate the wall areas of a greenhouse that are not important for sunlight. Payback is usually less than two years.

Compared to the insulated wall in a house, a double wall glazed greenhouse wall loses more than 20 times as much heat. Heat loss is measured by R-value, the resistance to heat flow. The generally accepted R value for a standard 6-inch thick house wall with fiberglass insulation is R=30. The standard greenhouse wall with either double wall polycarbonate or air-inflated polyethylene film is about R=1.4.

The savings that can be obtained with insulation varies with the length of the heating season, the growing temperature and the interior layout of the greenhouse. In a typical 30- by 100-foot freestanding greenhouse, the amount of wall area to 3 feet height is 15.6 percent of the total surface area. Insulating this area can reduce fuel use significantly and lower the heating bill. If additional area such as headhouse or storage walls can be insulated the savings increases.

Types of insulation

Insulation is available in many forms and materials. The most common materials utilize the principle that air is a good

insulator. Air, trapped in foam bubbles or the tiny spaces in fiberglass insulation, creates many barriers to heat movement. Some materials also utilize gas other than air that has a higher insulating value.

The air film at a wall surface also provides insulation. The effectiveness of the air film depends on the surface conditions and the air velocity next to the surface. The air layer on the glazing inside the greenhouse is almost four times more effective than the air layer on the outside in a 15 mph wind.

As much as 35 percent of the heat loss from a greenhouse can be attributed to radiation. During the day, energy received from the sun is converted to

heat within the greenhouse. About 50 percent of this heat is converted to latent heat to evaporate water from plant surfaces. The remaining 50 percent is added to the plants, structure and soil. The use of glass or polycarbonate glazing that naturally traps radiation or polyethylene film with an infrared inhibitor reduces this loss.

Aluminum has low emissivity (high reflectivity) that reflects heat. It is frequently added to insulation to increase the R-value. It works best when the surface is bright and free of dust and dirt and there is an air space in front of it. Adding insulation to sidewall and endwall areas can provide good energy savings.

SMALL BUDGET SOLUTION

Low cost materials are aluminum foil or aluminumized polyester plastic. A 40°F decrease in greenhouse knee wall temperature occurred by adding a sheet of aluminum building paper behind the heat pipes. Aluminum foil is available with a kraft paper or poly

backing or polyester film with a reinforcing scrim to give greater strength. Cost is about 10 cents per square foot.

Installation can be attached to a kneewall, clipped to the frame or woven between the bows and the plastic on a hoophouse. If a greenhouse



Double-bubble insulation with a foil face is available in rolls of 500 or 1,000 square feet and costs about 40-50 cents per square foot.

? HAVE A QUESTION? You can write John at jbartok@rcn.com.

has rollup sides, the insulation material can be installed for the winter and then removed in the spring when ventilation is needed. The material should last

several years.

A better choice is to install a double-bubble insulation with foil faces. This provides additional insulation due to the air

space in the bubbles. It is available in rolls of 500 or 1,000 square feet in several widths. Cost is about 40-50 cents per square foot.

These insulation materials are available from home centers, lumber yards or Innovative Insulation Inc., (800) 825-0123; www.radiantbarrier.com.

LARGE BUDGET SOLUTION

For a more permanent solution and to achieve a greater R-value, rigid board insulation is commonly used. The material should be a closed cell material such as polystyrene or polyurethane. These materials are available in several thicknesses from ½ to 2 inches with R-values from 5 to 6 per inch. The addition of a foil face on one or both sides can increase the R-value some.

The insulation board can be attached to the sidewall with large head nails, tek screws or clips. The aluminum foil can break down after several years, but the insulation is still good. This material is readily available in home centers and lumber yards. Cost is about 50-70 cents per square foot for the 1-inch thick material. Based on a double polyethylene film or polycarbonate wall and fuel oil at \$4 per gallon, payback is about six months. With natural gas at \$1.50 per therm, payback is less than a year.

A permanent material commonly used for walls in gutter-connected greenhouses is Thermax Heavy Duty Insulation from Dow Chemical



Thermax Heavy Duty Insulation as a kneewall on a gutter-connected greenhouse. Cost is about \$1 per square foot.

Co. It consists of a glass fiber reinforced isocyanurate foam core with 4 mil aluminum on one side and 1.25 mil alumi-

num on the other. Available in 4- by 8-foot sheets it can be purchased with a joint closure system for easy installation.

R-value is 7.2 for 1-inch thickness. Cost is about \$1 square foot. This material will give good service for many years. GM