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Geothermal heat taps natural sources

THE SOIL AND WATER below the Earth's surface contain a vast reservoir of thermal energy. Geothermal heating systems can recover this energy and convert it to heat that can be used in greenhouses and other buildings. Geothermal heat can be classified into three temperature categories.

Category 1: Low temperature (50°F)

The soil temperature at the Earth's surface varies considerably over the year and closely follows the air temperature. At a 10- to 12-foot depth, the soil temperature is more uniform averaging about 50°F with a variation of about 6°F above and below this level. There is also a lag time of about eight weeks between the maximum surface temperature and the maximum soil temperature at the 12-foot level, which is helpful in winter heating and summer cooling. The highest soil temperature occurs around Dec. 1 when more heat is needed.

Groundwater can also be a good source of heat. Water in ponds and lakes at a depth of 12 feet or more and in deep wells maintains a temperature similar to the soil. Pumping from one well, removing the heat and returning it to a second well is becoming popular for residences and industrial use.

For the greenhouse production of perennials, herbs, nursery stock and some vegetables that require a temperature from 32°F-45°F, this low-grade soil-heated air or water can be used directly. For heating greenhouses to a higher temperature, a heat pump is necessary. These are available as air-to-air, air-to-water, water-to-water or water-to-air systems.

Category 2: Medium temperature (140°F-300°F)

Thermal wells and springs in some parts of the world provide hot water that can be used directly for heat. More than 40 greenhouse operations in Oregon, California and Washington are heated by geothermal energy. The heated water that comes from the ground is distributed through fin radiation or root-zone heating.

Category 3: High temperature (>300°F)

The steam from geysers in California, Nevada and Utah is being tapped for power generation. There are about 20 sites in operation with several more under construction. These produce power for 5 to 8 cents per kilowatt-hour.

Greenhouse application

In most sections of the United States, the only choice most growers have for geothermal heating is with low-temperature heat. Several systems appear to be feasible with a reasonable payback.

Before considering the installation of one of these systems, it is important to address energy conservation. Reducing infiltration, installing energy curtains, insulating sidewalls and the foundation perimeter, installing electronic controls and making good use of growing space should be done first. This will save considerable heat and reduce the size of the heating system needed.

Air systems

Earth tubes are pipes that are buried 6-12 feet below the soil surface. The simplest and least expensive systems gather heat during winter by drawing air through corrugated plastic tubes and directing it into the space to be heated. The air passing through the tubes is warmed by the soil that has a higher temperature than the air.

During summer, this system can be used to cool building space by circulating the heated air in the greenhouse through the buried tubes and then returning it to the building. The heat is absorbed by the cooler earth.

In this system, the air can be warmed or cooled to near the soil temperature. For example, the average soil temperature 8 feet below the Earth's surface in central Massachusetts varies between 60°F in early fall to 46°F in early March. To raise the temperature to 80°F-90°F for air heating ornamentals or bedding plants, an air-to-air heat pump could be used. This process is similar to what happens in a refrigeration system where the heat inside the refrigerator is absorbed by a refrigerant and then transferred into the room.

Water systems

Closed-loop systems circulate water or antifreeze solution through loops of small-diameter underground pipes. In cold weather, this solution absorbs heat from the ground and carries it to a heat exchanger in the greenhouse. It may also go to a heat pump that raises the temperature.