SMARTGARDEN™—Harnessing Solar Power

Powerful forces in nature can be tapped to work to your garden's advantage.

Plants are adept at using solar energy: It fuels their manufacturing of food in the form of carbohydrates from water and carbon dioxide. We gardeners have to contrive a bit to put the power of the sun to work for us, but it is well worth the effort.

Solar energy can be captured and stored during the day to run small recirculating fountains or illuminate our garden paths at night with solar powered light fixtures. Greenhouses, which depend on the sun for heat during the day, can be outfitted with collectors that hold the sun's heat to temper cold nights.

The Cheyenne Botanic Gardens in Cheyenne, Wyoming, which has pioneered many techniques in solar greenhouse gardening, operates a conservatory that is heated using only solar energy: The passive solar heating system supplies 100 percent of the heat to three separate 28-foot-by-45-foot greenhouse sections. Additionally, the photovoltaic system generates 30 to 50 percent of the Botanic Gardens' other electrical needs, including the paddle fans, irrigation controls, lights, computers, and office equipment.

While black plastic absorbs the sun's heat, clear plastic is preferred for solarization because it allows more of the sun's heat to penetrate the soil and kill weeds.

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KILLING WEEDS AND DISEASES

Soil solarization traps the sun's heat beneath a plastic covering, raising the soil temperature beneath the plastic to a level that reduces or kills many weeds, plant parasitic nematodes, and disease causing microorganisms. It is an economically viable and environmentally friendly alternative to pesticides, particularly soil fumigants. The U.S. Environmental Protection Agency (EPA) cites a benefit beyond solarization's immediate control of weeds and diseases. It has also been shown to increase crop yields.

Soil solarization should be done during the warmest, sunniest part of the year. Depending on location and weather conditions, it generally takes four to eight weeks. That means the bed being treated is out of commission during this time—the only drawback to the technique. The benefits of weed and disease control, higher crop yields, and reduced need for pesticides, however, generally outweigh the inconvenience.

The degree of control achieved by solarization depends on the particular weeds and diseases present, and the level, duration, and depth of the elevated soil temperatures. Beds should be at least two-and-a-half feet wide; sufficient heat build-up for effective weed and disease control is difficult to attain in narrower beds.

Solarization is more successful in controlling annual weeds than perennial weeds, although growth of the latter is often suppressed. Studies at Louisiana State University have demonstrated that solarization offers effective control of such common weeds as goosegrass, annual bluegrass, annual sedges, and crabgrass, among others.

Solarization may be the best available control for many plant-infecting nematodes—wormlike microscopic soil organisms. Species that cause significant damage to a wide range of plants, including root knot, lesion, and cyst nematodes, are among those effectively controlled by solarization. The bacteria and fungi responsible for diseases such as crown gall, fusarium and verticillium wilts, phytophthora root rot, and many others are killed by solarization. Populations of other disease-causing microbes are often reduced to non-damaging levels.

PROCEDURE

Before spreading the plastic over the soil surface, prepare the bed for post-solarization planting to minimize soil disturbance after treatment, which can recontaminate the soil. Cultivate, removing clumps of weeds, and add soil amendments such as lime and compost if necessary. Rake the surface smooth to ensure close contact between the soil and plastic, and water to a depth of 12 inches. This stimulates germination of weed seeds and the activity of disease causing organisms, making them more vulnerable to destruction by heat. The moisture also helps conduct the heat through the soil.

Clear polyethylene is preferred because it permits more heat to pass through it and enter the soil; black or colored plastics tend to absorb heat. Although thinner plastic (one to two mil) allows more heat to penetrate, it tears easily. Thicker plastic (two to four mil) is sturdier, and can often be reused. To increase effectiveness, a second layer of plastic can be placed over the first, using blocks of wood

or empty soda cans as spacers. Air trapped between the layers helps prevent soil heat from escaping.

Dig a six- to eight-inch trench around the bed and cut the plastic so that it will extend beyond the bed by about 18 inches on all sides. Place it over the bed, smoothing out air pockets, stretching it as you go to keep it taut, and burying the edges in the prepared trench. If the bed is large, you can further secure the plastic by weighting it with smooth stones or small plastic bags filled with sand.

To kill harmful pests and weeds, the top six inches of soil need to reach a temperature of at least 110 to 125 degrees Fahrenheit and maintain that temperature for several weeks. To monitor temperatures, place one or more soil thermometers under the plastic, inserting the probe about five inches deep. At least four to six weeks is generally recommended for solarization, although greater control may be possible with longer treatment, as long as warm temperatures and sunny skies prevail.

When removing the plastic and planting the bed, avoid disturbing the soil too much. Bringing to the surface soil from below the level that was solarized can reintroduce weed seeds or disease-causing organisms.

SOLARIZING POTTING SOIL

Extension plant pathologist Tony Keinath of Clemson University recommends another application of solarization: to disinfest potting soil. Moist, pre-used potting soil should be sealed in clear plastic bags, one gallon size or larger, and placed in a sunny location on a cement surface for three or four weeks, turning the bags halfway through the treatment. Because the volume of soil is limited in this case, solarization can be extremely effective.

ADDED BENEFITS

Interestingly, many researchers have found that plants grown in solarized soil perform even better than might be expected simply from the reduction in weed and disease organisms. Beneficial soil microbes are apparently more heat tolerant than those responsible for diseases, and often increase in numbers after solarization, partly the result of reduced competition from destructive species. Researchers term this a "microbial shift," and in this case, it works to the crop's advantage. Another theory for the improved performance and increased yields that follow solarization is the heat-induced release of soluble mineral nutrients from organic matter and heat killed microbes.

Furthermore, the effective control of many diseases and weeds using solar heat reduces the need for chemical pesticides.

Rita Pelczar, Associate Editor