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SOIL SOLARIZATION IN TENNESSEE:

A PESTICIDE-FREE METHOD FOR CONTROLLING SOIL-BORNE PESTS IN HOME GARDENS

Craig Canaday, Former Associate Professor
Steve Bost, Professor
Department of Entomology and Plant Pathology

Soil solarization is a pesticide-free method for controlling many of the common soil-borne plant pathogens, weeds, nematodes and insects. It has been used for many years in many parts of the world where summer temperatures are quite warm and solar radiation is abundant. It involves covering the surface of bare soil with a layer of clear plastic to allow sunlight to pass through to heat the soil, then subsequently trap the heat. During this period, soil temperatures are frequently raised to 120-125 F. This environmentally friendly procedure may be an effective method for managing soil pests in home gardens or small field plantings.

STEPS FOR SUCCESSFUL SOIL SOLARIZATION IN TENNESSEE

1. Plan to solarize when solar radiation is optimal, from June through August.

2. Avoid areas with shadows or north-facing slopes. Best results will be obtained in open, unshaded gardens.

3. Loosen the soil by rototilling to a depth of 6 inches to improve heat penetration. It is helpful to first clear the area of plant debris (weeds, crops, mulch, etc.), as it may interfere with heat conduction. Remove any sticks, sharp stones or other objects that could puncture the plastic.

4. If the soil is dry, moisten it. Water helps conduct heat, but avoid excessive soil wetting as it can be detrimental.

5. Cover the soil with a clear, 2- to 4-mil plastic sheet or strip. The plastic sheet must be clear. Other types of plastic reduce the amount of sunlight transmission.

6. Stretch the plastic tight and bury the edges with soil. It is important that the edges are well-sealed to prevent loss of heat and loosening of the plastic by the wind. Covering the edges with soil in a trench, about 6 inches deep, helps to hold the plastic in place and minimizes spread of the soil across the plastic.

7. To achieve the highest solarization temperatures, cover the first sheet with another sheet of clear plastic (Figure 1). (The first sheet may be black if the top sheet is clear.) The top sheet provides an insulating layer of warm air, maintaining higher soil temperatures during the night. If you use two layers, create an air gap between the layers of sheeting with strips of foam insulation, small blocks of wood, old garden hose, etc, every 2 feet. Avoid materials with sharp edges. The edges of both sheets should be buried.

Figure 1. Installing two layers of plastic sheets with foam insulation strips.

8. Keep the plastic in place for at least six weeks. Also, keep the plastic relatively clean during the solarization period. An occasional dusting with a dust mop may be all that is necessary. Ponding of water in low spots is a common problem. Clear water does no harm, as sunlight can penetrate it. However, soil in the puddle will block light and should be removed, especially if the area is large. Holes in the plastic should be sealed with duct tape to prevent hot air from escaping. If any of the edges of the plastic come out of the ground, it is important to re-bury the edges as soon as possible.

9. After the plastic is removed, the soil is ready for a fall garden to be planted. Do not leave the plastic in place after summer, as it can encourage growth of surviving soil pests in cool weather.

Avoid rototilling soil deeper than 2 to 3 inches or digging deep holes. Doing so would reduce, but not totally negate, pest control, as non-solarized soil from greater depths would be mixed with the solarized soil.

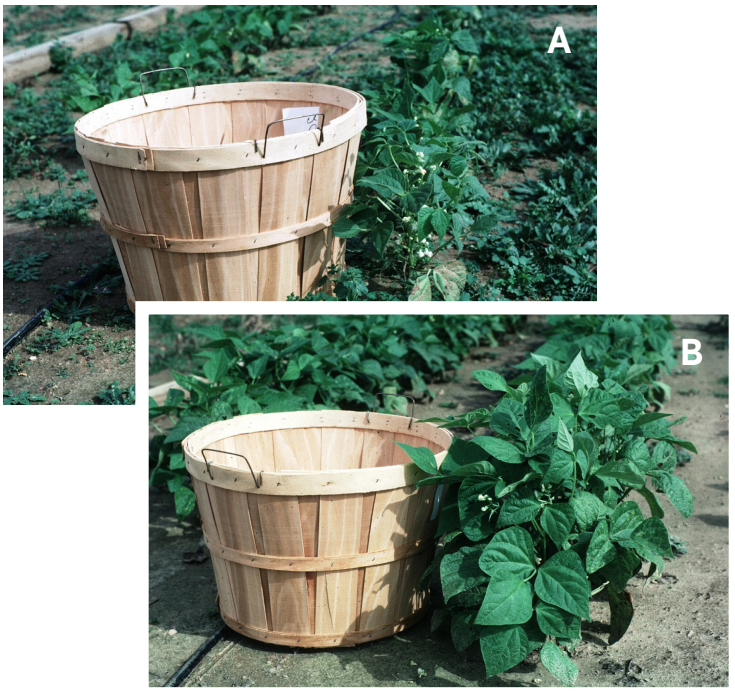

Figure 2. Fall snap beans in non-solarized (a) and solarized (b) garden plots. Note the difference in plant height compared to the height of the bushel basket.

WHAT TO EXPECT

A successful job of solarization will practically eliminate most types of soil-borne plant pathogens and weed seeds from the top 2 to 3 inches of soil, with some reduction of these pests at greater depths. Garden activities may bring some of the pests to the top of the soil profile. Strict attention to the guidelines described above can produce results such as those obtained in research at the West Tennessee AgResearch and Education Center in Jackson:

When soil was subjected to solarization for only four to five weeks using two layers of clear plastic separated by a 1-inch gap, the yield of fall snap beans harvested two months after solarization was increased by over 90 percent (Figure 2). The yield of fall spinach harvested four months after solarization was increased tenfold (Figure 3). Significant benefits lasted for over 12 months: The yield of spring spinach harvested nine months after solarization was increased fourfold, the yield of summer lima beans harvested 12 months after solarization was increased by over 50 percent, and the yield of summer squash was increased by over 300 percent (Figure 4).

There was also a measurable reduction in the population of a common soil-borne pathogen in the upper two inches of soil 16 months after solarization. Perhaps the most tangible benefit of soil solarization to the home gardener is the improved weed control. Compared to non-solarized soil, the number of weeds was reduced by over 99 percent three months after solarization and by 50 percent one year after solarization.

Figure 3. Fall spinach in non-solarized (a) and solarized (b) garden plots. Note the differences in the number of spinach seedlings and the number of emerging weeds.

Figure 4. Summer garden vegetables in non-solarized (a) and solarized (b) garden plots one year after solarization. Note the differences in the size of the plants and the number of weeds.

The high temperatures caused by solarization will kill beneficial organisms as well as pest organisms. Fortunately, beneficial bacteria and fungi seem to recolonize solarized soil quickly, so they will still be available to break down organic materials and recycle nutrients.

The degree of pest control success by solarization will vary depending on the amount of sunny weather that occurs during the solarization period and adherence to the guidelines. Effectiveness may improve with practice.

REFERENCE

McSorley, R. and H.K. Gill. 2013. Introduction to soil solarization. ENY-062. Entomology and Nematology Department, Florida Cooperative Extension Service, IFAS, University of Florida, Gainesville, FL. http://edis.ifas.ufl.edu/in856.

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