

Soil Solarization Program Documentation

<http://uspest.org/soil/solarize>

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Soil solarization is a potential management practice for many soilborne plant pathogens and weeds. Solarization employs solar radiation to heat the soil under a transparent plastic film to achieve temperatures that are detrimental to the target organisms. This program was developed to help nursery growers decide how long to solarize soil to reduce weeds and soil-borne pathogens. The program integrates a mathematical model to predict soil temperatures at a selected location with another mathematical model to predict when the target organism will be killed.

Clear plastic is more effective than opaque or black plastic in achieving higher soil temperature. The minimum size of treatment is 8 feet × 8 feet (2.5 m × 2.5 m). A larger plot will achieve a higher soil temperature. Most weed seeds and soilborne pathogens can tolerate dry heat significantly longer than wet heat. However, a soil that is too moist cannot be worked with machinery. The standard procedure for soil solarization is to irrigate the field to achieve saturation, and then let it drain enough to work on, and lay the plastic. Soil moisture should be at least 70% of field capacity.

The model was established based on the measured soil temperature data and target organism mortality data from field experiments in container nurseries in CA, OR, and WA during the summer (June through September). It was established for use with a transparent 6-mil (0.15 mm thick) anti-condensation polyethylene film. Edges of the plastic sheets were ‘sealed’ and held in place by a 6-inch (15 cm) wide layer of gravel along the margin. The model was calibrated for compacted soil with various thicknesses of crushed rock (sieve size approximately $\frac{3}{4}$ ” [1.9 cm]) on the soil surface.

This model utilizes weather stations in western WA, western OR, and CA from the following networks: Agrimet, AgWeathernet, CIMIS and RAWS. To find the weather station closest to your nursery, check the Google map at the website here (<http://uspest.org/dd/model>), hover your pointing device over a station to see if it belongs to one of the above mentioned networks, or use the lists in the pull-down menus of the solarization program. A baseline soil temperature (average temperature at 20” depth) is needed for the model. You can input a measured value, or the model will estimate the value from the weather station data. The steps to run the model are listed on the model homepage when first loaded, and are repeated here with further comments:

1. Select all options starting with species (normally you can let this remain the default value which will be all available species)
2. For Start Date, default is today. You may want to run the model every few days during the solarization trial to update the real-time weather data and to obtain more accurate results.
3. For End Date, default is 50 days from today. You may want to decrease the interval to make output graphs more readable.

4. Select a prior year to be used as a forecast past the available 7-day forecast (subject to available data; default is last year's data). If you have selected a location for which prior data is not available, you may need to select a different station. If the extended forecast appears to match years earlier than the prior year, or you would like to check for a range of outputs, you may want to run the model multiple times using several prior years data.
5. Locations currently limited to Western OR, WA, CA stations with solar radiation data (RAWS, AGRIMET, AGWEATHERNET, and CIMIS networks). Most other networks lack solar radiation data and are therefore excluded from options. Contact us if you know of public weather stations that you believe have the appropriate data that we could add to the listing. NOTE: WSU AGWEATHERNET data is not available before 2015.
6. For Crushed Rock Depth, default is 0 inches (no crushed rock on surface of soil). We have not tested this program for crops other than nursery beds. Therefore, we cannot advise such usage and have no clear indication of the models usefulness in other settings.
7. For Lower Boundary Temperature, default is 80 degrees Fahrenheit. The model is very sensitive to this setting. We strongly recommend that you use a soil temperature probe, make readings in at least 3 spots at 20 inches below the surface, compute the average, and enter this value rather than use the default. Otherwise model results may be in error.
8. Click "RUN SOLARIZE MODEL" button to view graph results. The model should take between 5 and 10 seconds to run and generate outputs. If the model is successful, you should see graphs similar to those in Fig. 1 (see next page).
9. To re-run the model, change settings and click the RUN button again. You may want to vary the weather station, prior year, and lower boundary temperature, each time recording the date at which mortality is predicted at the desired soil depth. This will provide you with a "sensitivity analysis" showing you what range of outcomes can be expected for the conditions you used. This kind of analysis can add assurance that the solarizing effect is working for your site conditions. It may also show that the summer increase deep layer soil temperatures (e.g. lower boundary temperatures are higher in August than in June) should be taken into consideration when designing a solarization strategy in future years.
10. If graphs are blank, try a different weather station.

Examples of model output are shown on the **next page**.

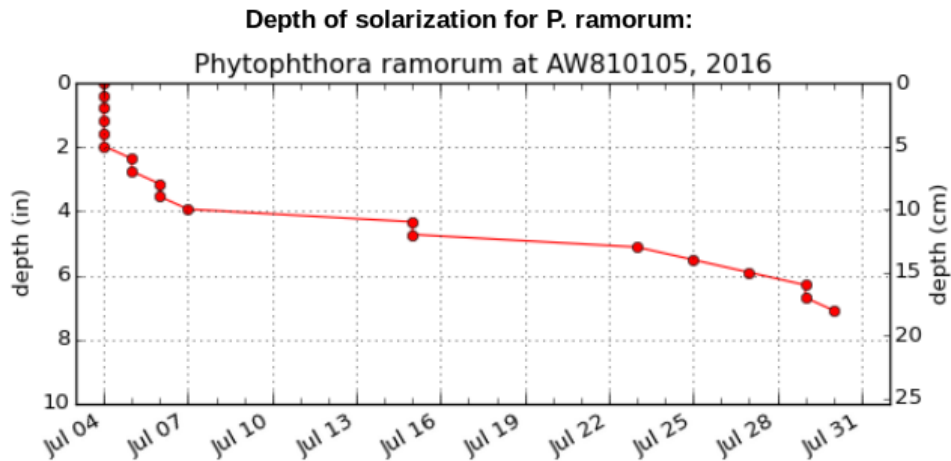
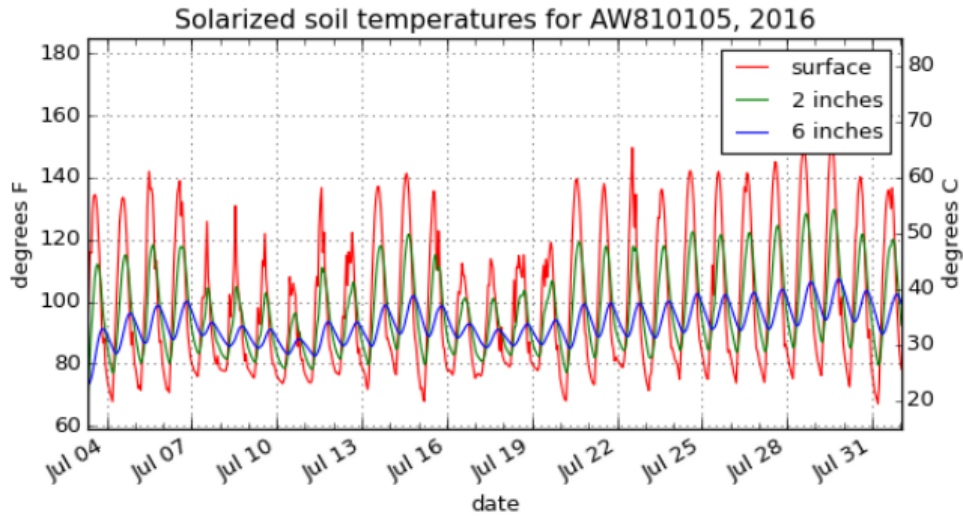


Fig. 1. Example model outputs. **Top graph:** Provides soil temperature regimes at the surface (0 cm), and at the 2-inch (5 cm), and 6-inch (15 cm) depths. **Bottom graph:** The output “Depth of solarization for target organisms” provides an estimate of the date when survival of target organisms is reduced by 99.9% of the initial population at each depth.

For additional information about the online model, please contact Len Coop at coopl@bcc.orst.edu.

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