Crops under solar panels can be a win-win



Enlarge / “Agrivoltaics” studies like the one pictured here in Massachusetts are finding many crops that pair well with solar panels.

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Solar panels might seem like they’re in direct competition with plants. One is catching sunlight to do photosynthesis, the other wants to take it to push electrons. Surely Highlander rules apply, and *there can be only one* on a plot of land, right?

In reality, it’s not a zero-sum game. Some plants will burn in

direct sun, after all, and so there are plenty of food crops that would be happy to share their space with panels. And as a new study led by the University of Arizona's Greg Barron-Gafford shows, the combination isn't even necessarily a compromise—there are some synergies that can bring significant benefits to a solar-agriculture.

Everybody wins

Prof. Barron-Gafford *et al.* focused on dry areas like the American Southwest, where water for crops is limiting and things are projected to get drier. The shade provided by solar panels could lower soil surface temperatures and evaporation, the researchers thought, and vegetation could similarly keep the panels themselves a little cooler than a bare ground installation. Since solar panel efficiency drops at high temperature, that could mean more electricity generated.

To test this, the researchers set up three plots for the summer months: one only solar panels, one with only crops, and one with both. The solar panels, in this case, were built to stand a little over 3 meters off the ground—higher than a typical solar array. All three plots were irrigated the same, and temperatures, humidity, and soil moisture were tracked. Cherry tomatoes, jalapeños, and chiltepin peppers were chosen as the crops to test.

The results showed that combining things did alter temperatures, as expected. Air temperatures stayed a little over 1°C cooler during the day, on average, but they also stayed about 0.5°C warmer overnight. The temperature of the solar panels, though, was about 9°C cooler during the day because of the growth beneath them. The air was also a little less dry under the solar panels, and the soil dried out more slowly between waterings.

Top tomatoes

As for the crops, there were some significant differences. As the chiltepin peppers are shade-adapted, they were considerably happier with some solar panels overhead. Growth was calculated in terms of CO_2 uptake, and this was 33% higher in the combined plot. The water-use efficiency of the plants didn't change, so they also used more soil moisture as they grew. The mass of peppers they produced, however, *tripled* under the solar panels.

The jalapeños, on the other hand, took up 11% less CO_2 under the panels, showing that they missed the extra sunlight. Even so, their water efficiency increased in a big way, and they used 65% less water. The amount of peppers produced dropped slightly, but not beyond the error bars.

Finally, the cherry tomatoes saw a 65% increase in CO_2 uptake *and* a 65% increase in water-use efficiency. They produced twice as much fruit while using the same amount of water.

Based on the temperature-efficiency curves of these solar panels, the researchers calculated that the cooler temperatures should increase electricity generation by about 3% over the summer months, averaging out to a 1% gain for the whole year.

The researchers see potential here (and in similar "agrivoltaics" experiments elsewhere) that is worth investigating and optimizing. Solar panel installations may not be compatible with the machinery used to harvest many crops, and boosting the panels higher off the ground costs extra. But there are configurations for certain crops in certain areas that can make a lot of sense. Farmers could save water, make money from a solar lease, and might even find that workers are much more comfortable and safe working under some shade—all while allowing solar arrays to expand in those areas

without competing for land with agriculture.

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