

Growing Berries Without Bromide

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Researchers test a new alternative to a controversial chemical

The scarecrows perched in Santa Cruz strawberry fields do little to scare away the birds, much less the insects and fungi harbored in the soil. Everything likes to eat strawberries, which makes growing them a risky business.

This predicament led UC Santa Cruz professor Carol Shennan to take an unconventional approach to pest management. Nine years ago, the fatal plant disease Verticillium wilt was wiping out strawberry plants at the university farm. Chemicals hardly phase the pathogen, and Shennan saw little improvement with crop rotation, which is typically used to treat infested fields. A visiting plant

pathologist from the Netherlands recommended a little-known organic technique called anaerobic soil disinfestation, and, with so few other options, Shennan decided to give it a try.

"After the first treatment we almost entirely eliminated Verticillium from the soil," says Shennan. The number of disease spores dropped from 20 per gram of soil to zero or one—a success story that earned Shennan and her collaborators a \$725,000 grant from the U.S. Department of Agriculture in 2007.

Shennan is currently compiling nearly a decade of results comparing anaerobic soil disinfestation to chemical fumigation. The results, which will be submitted for publication this summer, show that after disinfestation, the number of Verticillium disease spores consistently drops by 80 to 100 percent. "This is similar to the levels we have achieved with fumigation," says Shennan.




Kill-all fumigants like methyl bromide have been a staple of the local berry industry for decades. Twenty years ago most California strawberry crops were treated with methyl bromide, and after the ozone-depleting chemical was banned by the Montreal Protocol, the United States lagged behind other nations in the phase-out process. This year, with the Environmental Protection Agency starting to crack down, only 8,000 acres of California berries will be treated with methyl bromide, and next year critical use exemptions will permit only 5,000 acres.

"Farmers have tried other fumigants, but there aren't a lot of good options," says Carolyn O'Donnell, of the California Strawberry Commission. Methyl iodide could have been used on berry farms, but it was pulled from the market last year after national environmental campaigns raised concerns over toxicity. Many of the few remaining fumigants have been criticized for increasing plant disease.

"The early adopters of alternative fumigants have seen the emergence of new varieties of soil disease," says O'Donnell. Pathogens like *Macrophomina* and *Fusarium* were not a problem in strawberry fields when methyl bromide was used, but after farmers changed their fumigation practices, the diseases were identified in several fields in Santa Barbara, Ventura and Orange counties. Chemical fumigants are criticized for wiping out good bacteria as well as disease organisms. After treatment, many microbial communities are severely diminished. This eliminates the competition for invading pathogens, and kills the beneficial microbes that help fight plant diseases.

Determining best practices for growing strawberries is a vital question for California, where there are more than 40,000 acres of strawberries. Half of the state's crop is grown in Watsonville and Salinas, where the average berry farm spans 80 acres. In Santa Cruz County's agriculture-driven economy, the sweet red berries

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remain the highest valued crop, raking in more than \$198 million in 2011.

The problem has turned the spotlight to fumigant-free alternatives like anaerobic soil disinfestation. While disease organisms decline after treatment, the total number of soil bacteria increase. Disinfestation appears to alter microbial communities, but it likely does not kill as many organisms. Disinfestation is also less toxic to humans than chemical fumigation as the active ingredients are inert.



As part of the treatment, carbon sources like rice bran, molasses and grape skins are mixed into the soil. A tarp is placed over the field, and drip irrigation is used to saturate the planting beds. This triggers the growth of anaerobic bacteria. "We don't know the exact mechanism by which this kills pathogens, but it likely involves the organic acids produced by anaerobic bacteria," says Shennan.

While disinfestation uses more water than fumigation, the technique is primarily criticized for being new—no one knows which pathogens the method kills, or whether treatment will work on a large, industrial farm.

So far, treatment has been limited to much smaller plots. This growing season, Watsonville-based Farm Fuel Inc. treated more than 130 acres in Santa Cruz and Monterey with the disinfestation method. The largest treated plot was 25 acres, but Farm Fuel Inc. CEO Stefanie Bourcier says she isn't afraid to treat bigger sites. "We started offering treatments as a commercial service in 2011, and each year we have done larger and larger plots," she says.

Bourcier looked into the technique after Fusarium wilt infected perennial herbs at an affiliated farm. She and her colleagues treated two sites with anaerobic soil disinfestation, and results were promising. "The plants did really well after treatment, and we didn't see big die-offs," says Bourcier. "However the neighboring block of plants was not treated, and it had significant disease."

According to Bourcier, the treatment is also cost effective. It currently costs \$3,900 per acre to treat strawberries with methyl bromide, while anaerobic soil disinfestation totals \$2,700 an acre. While other fumigants are a little cheaper, disinfestation will enter the market at the middle-range price.

"This is very important in the berry industry because you have to invest a lot of money before you can make money," says Shennan. A farmer can earn \$50,000 an acre growing berries, but they will likely spend \$25,000 to plant.

This is why the California Strawberry Commission has contributed \$3 million to fumigant-free programs over the last five years; a third of this has gone to anaerobic soil disinfestation research.

"There is no silver bullet, and we aren't going to find a replacement for methyl bromide overnight," says O'Donnell. "But anaerobic soil disinfestation shows a lot of promise, and it's one of a few techniques that might really help."

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Paralegal

written by Abby , May 22, 2013

Verticillium responds to fumigation, but not always. I'm glad there is an alternative in the works.

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