

Emerging technology with potential to replace chemical fungicides

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The development of fungicide resistance along with the rapidly growing organic market sector has seen a push for alternatives to traditional chemical fungicides. One such alternative is the use of ultraviolet light, specifically the UV-C band of ultraviolet light.

It has been well known for several years now that ultraviolet light will kill fungal pathogens, but the problem has been that the effective dose also had the potential to damage the plant. Recent breakthrough research from the USDA and Cornell University has shown that if a plant is treated with ultraviolet light at the UV-C wavelength for short periods, then left in total darkness for 2 to 4 hours, fungal pathogens die, and no damage is caused to the plant.

The dark period following UV-C irradiation stops the activation of a DNA repair mechanism in the pathogen, which needs sunlight to become active. Without the ability to repair the damaged DNA, the pathogen cannot replicate itself and eventually dies.

Studies using low-dose UV-C on strawberries have confirmed no damage to the plant and good control of fungi such as grey mould (*Botrytis*), black spot, and powdery mildew.

“In more than three years of trials, UV light applications worked as well as or better than available fungicides, killing 95 percent of powdery mildew in field strawberries. We’ve seen similar results in field and greenhouse trials of basil, roses, grapes, strawberries, rosemary and cucumbers,” David Gadoury, Senior Research Associate in the Section of Plant Pathology and Plant Microbe-Biology, Cornell University.

Researchers at the USDA Agricultural Research Service found that they could achieve results as good as weekly fungicide sprays by exposing strawberry plants to 60 seconds of UV-C at night twice per week. They also found that they were able to successfully manage two-spotted spider mite, greenhouse whitefly, and spotted wing drosophila with UV-C treatment.

In their most recent trials, USDA researchers have identified better lighting systems (using 222 nanometre lamps and better reflective surfaces) that allow for much shorter exposure times, meaning that robots can travel faster and cover more ground at night while applying UV-C.

Now all you need to do is wave your magic ultraviolet wand around and all your fungi problems are solved right? No. For one thing, UV-C light can cause sunburn on human skin and it’s best not to look at the light for prolonged lengths of time. In addition, the best way to apply the UV-C light to plants is at night in total darkness.

Teams around the world are conducting research and development into autonomous robots that can deliver UV-C for the control of pests and diseases. The USDA are collaborating with TRIC Robotics to develop a system for in-ground growers (Figure 1). Here in Western Australia, Outback Robotics is working on a system for tabletop strawberries (Figure 2).

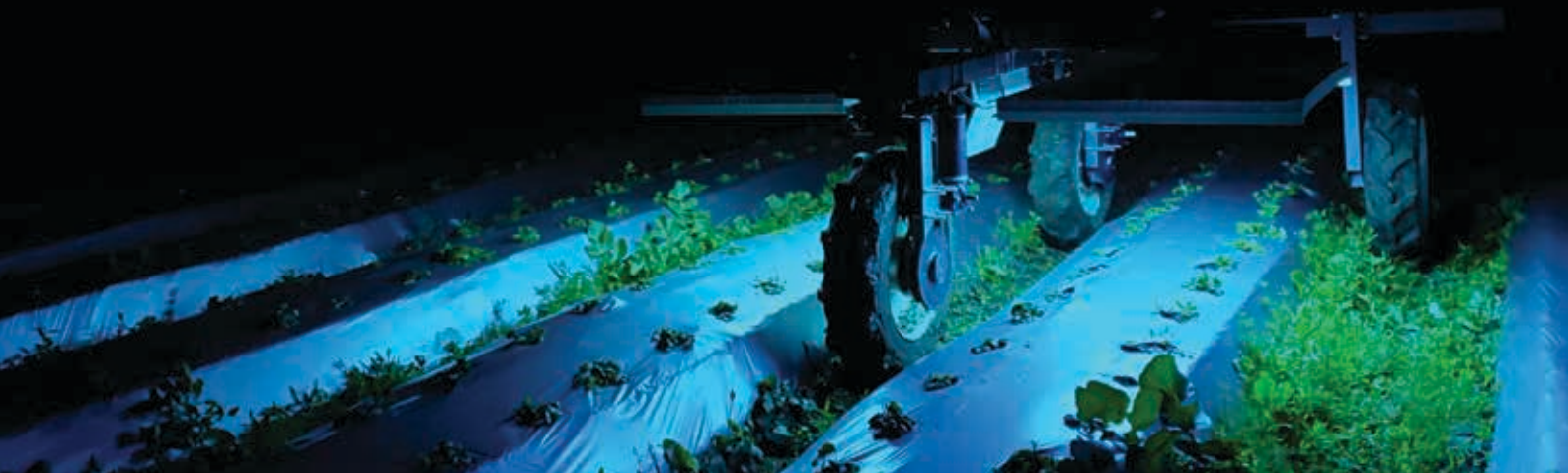


Figure 1. The USDA machine is still under development as testing of different UV-C wavelengths and array configurations continues.

The prototype pictured is currently being used in a two-spotted spider mite research trial on Albion at a certified-organic farm. The field is being treated at night with 254 nanometre wavelength UV-C lamps. The robot is programmed to irradiate each plant for 30 seconds every 3 days. As of late April, mature mite counts in conventionally managed sections of the field (where predatory mite *Phytoseiulus persimilis* was released) were exceeding 20 per leaflet. In the UV-C treated sections, mite numbers were around 5 per leaflet. A video of this robot applying UV-C treatments in the field can be accessed on YouTube by searching "TRIC Autonomous UV-C Treatment". Photo credit: Fumiomi Takeda, Research Horticulturist, USDA-ARS Kearneysville



Figure 2. Testing of the Outback Robotics prototype is currently underway in Western Australia. The prototype is the size of a person and can move up and down rows of tabletop strawberries with ease. The system is adaptable to different tabletop configurations. Photo credit: Robert Walker, Outback Robotics

Trials looking at the effectiveness of the Outback Robotics system are currently underway in Perth. The aim is to deliver small, low-cost machines that can be leased to growers and quickly swapped out on-farm if there are breakdowns.

References

Janisiewicz, W., Takeda, F., Glenn, M., Camp, M., & Jurick, W. (2016). Dark Period Following UV-C Treatment Enhances Killing of *Botrytis cinerea* Conidia and Controls Gray Mold of Strawberries. *Plant Disease*, 106(4), 386-394. Retrieved from <http://dx.doi.org/10.1094/PHYTO-09-15-0240-R>

Janisiewicz, W., Takeda, F., Nichols, B., & Glenn, M. (2016). Use of low-dose UV-C irradiation to control powdery mildew caused by *Podosphaera aphanis* on strawberry plants. *Canadian Journal of Plant Pathology*, 38(4), 430-439. doi:10.1080/07060661.2016.1263807

Onofre, R., Gadoury, D., Stensvand, A., Bierma, A., Rea, M., & Peres, N. (2021, February 22). Use of Ultraviolet Light to Suppress Powdery Mildew in Strawberry Fruit Production Fields. *Plant Disease*. Retrieved from <https://doi.org/10.1094/PDIS-04-20-0781-RE>

Short, B., Janisiewicz, W., Takeda, F., & Leskey, T. (2018). UV-C irradiation as a management tool for *Tetranychus urticae* on strawberries. *Pest Management Science*(74), 2419-2423. doi:10.1002/ps.5045

Takeda, F., Janisiewicz, W., Leskey, T., & Stager, A. (2020, November/December). Ultraviolet-C Light and Robotics for Autonomous Control of Strawberry Diseases, Insects and Mites. *Progressive Crop Consultant*, pp. 10-15.

Takeda, F., Janisiewicz, W., Smith, B., & Nichols, B. (2019). A new approach for strawberry disease control. *European Journal of Horticultural Science*, 84(1), 3-13. Retrieved from <https://doi.org/10.17660/eJHS.2019/84.1>.

If you are interested in participating in WA trials of this technology, contact **Outback Robotics**

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