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UV Light Used To Control Crop Diseases

Germicidal ultraviolet light (UV-C) applications have been helping to manage diseases in grapes and strawberries. However, trials conducted by Cornell researcher Kerik Cox and his team have determined that UV-C can also be an effective alternative to antibiotics and fungicides in apple crops.

This method exploits the unique properties of pathogens that have evolved alongside light, namely their inability to repair DNA damage caused by UV-C exposure during nighttime operations. The exposure disrupts the ability of organisms to replicate, breaking the DNA helix and making different

base pairs bind to themselves. Organisms can't grow or make protein, which initiates cellular death.

Given that the fungus causing powdery mildew on grapes grows almost entirely on the surface of the grapevine's green tissue, it can also be a prime target for UV-C-based treatments.

"The trick is that many organisms can repair this damage in blue light. The pathogens that cause fire blight and apple scab have the same repairs, but if you apply it within four hours of darkness, they can't repair," Cox explains.

The team built a UV-C device collaboratively with their colleague, David Gadoury. The towable arch on wheels is lined with UV-C bulbs emitting germicidal ultraviolet light. An array of reflectors causes a reflective light cloud to reach the underside of the leaves and the canopy interior.

The 8-ft. tall contraption is powered by an attached generator and pulled by a small tractor. Its design allows it to treat a wide range of plants without harming them. The arch is powered up and pulled very slowly (about 1.75 mph) through the fields.

The UV-C light must contact the fungal pathogens to damage them. Application frequency needs to be between three and seven days.

"We need the organisms to love dry weather and be on the leaf surface, such as in grapes and strawberries, to go after powdery mildew," Cox says. "They should be exposed and transparent to the environment so that the UV light can penetrate and kill the spores. The key is trying to balance the dose to kill the pathogen but not harm the host."

Over multiple years and many different crops, the apples have not been harmed. While antibiotics and yeasts have been used to control disease, they can be expensive. The UV-C device isn't energy-intensive. Additionally, the bulbs are durable and only fail when struck by a stray branch.

The unit costs about \$15,000, including the setup, wiring and coding. In comparison, a streptomycin application over 500 acres is approximately \$25,000.

Cox says the system should also work well in vegetables and nurseries. So far, they've given away the documents for free to any interested growers. He hopes a company will commercialize the process to help further reduce pesticide use.

Contact: FARM SHOW Followup, Kerik Cox, Ph.D., Cornell Agritech, 322 Barton Lab, 15 Castle Creek Drive, Geneva, N.Y. 14456 (ph 315-787-2401; kdc33@cornell.edu).

Trailer eliminates the need for infrastructure investments at the originating farm.



Trailer Boosts Biogas Potential

The Liquid Slurry Semi-Trailer can make biogas production a reality for dairy and swine operations without their own biogas facilities. The 80,000-lb. tandem axle trailer can pick up liquid manure quickly, unload

even faster, and return the finished digestate to the originating farm for use as fertilizer.

"We partnered with VM Tarm, a Danish firm, to access liquid manure handling technology developed over the past 30

years," says Mike Frombach, Advance Tank Production (ATP). "There are quite a few biogas companies coming into the Canadian and U.S. markets."

Traditionally, the cost of moving manure has been a barrier to profitability for non-site-specific biogas systems. Adding Tarm's pumping systems to the back end of ATP's tanker trailer reduces time and costs.

"With our on-board pumping system, we can load at 3,300 gal./min. and unload at 4,100 gal./min.," says Frombach. "It takes roughly 8 min. to load and unload versus 20 to 30 min. at each facility with a conventional system."

In addition to speed, the new trailer eliminates the need for infrastructure investments at the originating farm. It also offers biosecurity and labor-saving features. The load/unload boom arm is remotely controlled from the cab.

"We've eliminated the driver or helpers climbing down from the cab to position heavy arms or heavy hoses," says Frombach. "We've eliminated a biohazard of traveling farm to farm and made the operation more operator-friendly."

Most existing biogas systems have been designed around the manure production of a single operation. Frombach says that's changing.

"Building a central biodigester for multiple livestock operations is gaining steam," he reports. "Commercial operators and co-ops of multiple farms are seeing an opportunity. Farmers like getting the digestate back as a clean fertilizer."

Biogas systems are most commonly associated with large dairy operations. However, that may be changing.

"I'm working with one customer who's locating a biogas facility in an area surrounded by hog farms," says Frombach. "Most such facilities are looking at purchasing from 5 to 10 trailers."

The trailers start at around \$395,000 to \$400,000 for the 80,000-lb. trailer. Frombach notes that many variations are available based on maximum weight and other factors.

Contact: FARM SHOW Followup, Advanced Tank Products, (ph 800-332-8385; Mfrombach@aep1.ca; https://advanceengineeredproducts.com).

Vertical Carousel Towers Boost Greenhouse Production

A Dutch father and son transformed their greenhouse by moving from horizontal production to vertical production. Now they're changing how other greenhouse operators grow, as their system is being adopted in the U.S. as well as in the Netherlands.

Chris and Vincent van der Gaag's Dutch Lion system uses vertical towers on a monorail carousel. Each double-sided tower is composed of panels that are automatically seeded and then raised into a vertical position.

"The towers can be up to 6 m in height (nearly 20 ft.)," says Steinar Henskes, Dutch Lion. "Introductory crops were lettuce and other greens, but we're also working with strawberries and developing the system for them."

Towers first move to the germination room and later to their scheduled lane in the greenhouse. When it's time to harvest the plants, the towers move down their monorail to be emptied, cleaned and reseeded.

A system was installed this past fall at the World Horti Center in Naaldwijk, Netherlands. It consists of four monorails, each

supporting 30 cultivation towers. Each tower held 42 heads of lettuce, but had the capacity for up to 60.

The automated system eliminates pathways. The towers automatically move apart as plants grow. As a result, it reduces the needed footprint for a given production level by 90%. This reduces capital expenditure on infrastructure costs by 40% compared to conventional greenhouses.

"As little as 20 sq. m (215 sq. ft.) can be economically efficient," reports Henskes. "Because the system is modular, it's custom-designed for every customer."

Ambient light is diffused from above and supplemented with dynamic LED lighting as needed. Sensors measure light levels and adjust the LEDs to ensure adequate light reaches lower plants. This reduces energy consumption compared to fully enclosed, indoor farms.

Water is also conserved as the growth cycle can be split into multiple irrigation phases. Drippers deliver specific amounts of water and nutrients for optimal growth.

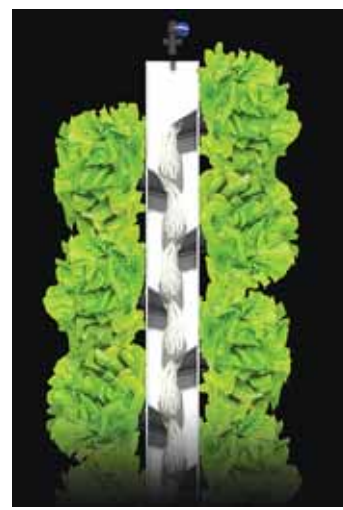
The drippers are positioned at the top of the towers, with excess liquids recovered at the base for recirculation. The company reports up to 70% less water used compared to horizontal mobile guttering systems.

Advanced airflow injection ensures even temperature distribution. Air hoses maintain balanced temperatures between the top and bottom sections of the towers. The high circulation rate, air filters, and positive pressure reduce the risk of disease and remove the need for pesticides.

The system is quickly proving itself with initial installations, notes Henske.

"We have had significant interest in the U.S. with more projects being commissioned later this year," he says. "We're currently looking for partners to help us grow in the North American market."

Contact: FARM SHOW Followup, Dutch Lion, Katwijkerlaan 67b, 2641PD Pijnacker, The Netherlands (ph +31 85 800 8801; info@dutchlionag.tech; www.dutchlionag.tech).



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