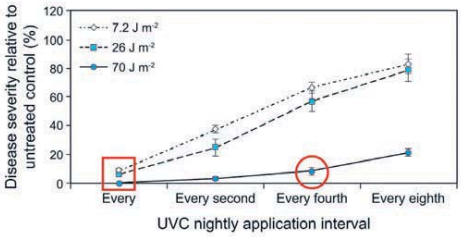
# Science enlightening agriculture: Helping growers improve crops with UV light

**by Nicholas P. Skinner, John D. Bullough and Mark S. Rea, Lighting Research Center, RPI**

Numerous crops are impacted by powdery and downy mildew, fungi that have had large impacts on growth and pest management by growers throughout the country. Powdery mildew is estimated to account for nearly three-quarters of total pesticide applications by grape growers in California, costing 3% to 7% of total gross production value. Losses in wheat yield due to powdery mildew have been estimated to be almost as much as half the total crop harvest in some cases.




The use of chemical fungicides is the most common technique for dealing with these pests, but concerns with fungicide application include the development of increased fungicide resistance, management of various chemistries, reentry and pre-harvest intervals, and preventing drift or runoff of pesticides have generated interest in alternative approaches. One alternative being investigated by the Lighting Research Center (LRC) is the controlled application of germicidal ultraviolet (UV) light to reduce powdery and downy mildew in various crops. This research is supported by the USDA, the New York State Farm Viability Institute (NYFVI) and the Northeast Sustainable Agriculture Research and Education (SARE) program and with cooperation from Cornell AgriTech, the University of Florida Gulf Coast Research and Education Center and the Norwegian Institute of Bioeconomy Research.

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The UV spectrum consists of a wide range of wavelengths, broken up into three bands: UV-A, UV-B and UV-C. Both UV-B (the cause of sunburn) and UV-A (commonly known as black light) are present in sunlight at ground level. UV-C is fairly well known for effectively killing pathogens on surfaces, in air and in liquids and is known as the "germicidal" portion of the UV spectrum. (While UV-C is emitted by the sun, it is filtered out by the atmosphere, and the only terrestrial sources of it are human-made.)

UV is theorized to work against pathogens on crops in two ways. The first is stimulating an immune response within the crop to either prevent or reduce the severity of an infection. It's believed this mode of action may help to combat pathogens like downy mildew in crops like cucumber. The second way, effective against powdery mildew, is by the direct germicidal effect of UV-C. It damages the pathogen's DNA, either killing it or preventing it from reproducing. Some pathogens, including powdery mildew, have a mechanism which allows them to repair damaged DNA in the presence of short-wavelength (blue) visible light present in daylight. Therefore, it's recommended that UV treatments be applied after sunset and with at least four hours of darkness to prevent DNA repair, maximizing their effectiveness.

As initial lab work investigating treating plant disease with UV began to show promise, field trials investigating its use on crops such as strawberries, squash and cucumbers were undertaken. The most work to date has been completed in strawberries. Trials have taken place on commercial farms in California and Florida over the course of multiple growing seasons. A twice per week treatment was found to be highly effective at controlling powdery mildew, keeping foliar disease severity at about 5%, while untreated plants were in excess of 50% severity.

Field work investigating the use of UV-C to prophylactically combat cucumber downy mildew was also undertaken this year on both organic and conventional farms. One of the cooperating farmers was Jim Ward of Ward's Berry Farm in Sharon, MA, who decided to participate as an "opportunity to gain knowledge about the pathology and culture of the crops." He reported they "definitely saw some delay in the onset of downy mildew from the application of the UV-C and think that a combination of varietal resistance and the UV-C could really work." Data analysis from both cucumber trials is expected to be completed this autumn.

Since the concept of using germicidal UV to treat crop diseases is relatively new, there are very few if any commercially available implements designed to produce and apply UV. To address this, the LRC has teamed up with agriculturalists, engineers and lighting experts to develop several basic designs of tractor-mounted implements that are readily adapted to various row-crop applications. The designs were developed to enable farmers interested in integrating UV to do so more easily by providing a design to use as-is or to modify slightly to better fit their individual operations. All designs incorporate safety measures and utilize readily available materials, allowing construction in a modest farm shop.

Like the use of pesticides, care must be taken to ensure the safety of personnel applying UV. Excessive exposure of the skin to UV-C can cause sunburn and the surface of unprotected eyes can result in a very painful condition called photokeratitis (commonly known as "welder's flash" or "arc-eye"). The glass windows of a tractor cab block UV-C and this exposure hazard is easily mitigated on open station tractors by covering exposed skin and wearing a face shield.

There are many benefits to the use of UV on crops; however, it shouldn't replace a spray program, but rather be used as another option in a farmer's "toolbox" by marrying UV with a conventional pesticide/fungicide program. Research in this area will continue in the coming growing seasons. To learn more about our research or what is involved in building your own unit, visit lightandplanthealth.org.

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