GROWING KNOWLEDGE

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Seeing the light on powdery mildew

Testing the efficacy of using ultraviolet spectral lights to protect greenhouse tomatoes

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WIDESPREAD OUTBREAKS OF powdery mildew have been occurring in fresh market tomato crops in western Oregon over the past decade.

Disease incidence and severity tend to be greater in tomatoes produced in greenhouses or hoop houses. Growers in the Pacific Northwest often raise tomatoes in greenhouses or hoop houses to extend the growing season. Tomatoes are a high-value cash crop for many farms, with heirloom and specialty tomato varieties bringing in the highest revenues.

There has been a tremendous effort made to breed resistant varieties; however, high market value tomatoes, such as heirloom or Roma types, are currently very susceptible to powdery mildew. Both organic and conventional producers are choosing minimal (or no) pesticide use due to concerns for worker safety in enclosed areas such as hoop houses. The high cost and low efficacy of current sulfur control methods, commonly relied on in organic production, is also a factor.

New technology in the form of ultraviolet (UV) light treatments may provide a solution to help control powdery mildew.

Symptoms, effects and control

Powdery mildews can cause serious damage to a diverse host of crops, causing the deformity or death of leaves. Entire plants eventually may die if left untreated.

Light green to bright yellow, irregular-shaped blotches first appear on upper leaf surfaces and are typically accompanied by the development of whitish, powdery fungal growth on the upper and lower leaf surface (Photo 1). The fungus can be spread through the air, especially when in close contact with infected plants.

To control a pathogen, you must understand the conditions that foster its growth. The same warmer temperatures that make using a greenhouse for tomato production desirable can also lead to higher relative humidity levels that can fuel the spread of powdery mildew.

Ambient light conditions also play a critical role in the survival of powdery mildew pathogen. The fungus has evolved to thrive in low light conditions, such as dense canopies or on the undersides of leaves. Hoop house plastic generally reduces

Photo 1. Tomato plant with extensive leaf damage from powdery mildew. PHOTO COURTESY OF C.M. OCAMB.

Using ultraviolet lights for powdery mildew control in greenhouses

Top: UV-B treatment of tomato with light positioned horizontally above the canopy.
PHOTO COURTESY OF K.R.BUCKLAND

Bottom. A late season greenhouse tomato, variety Caiman.
PHOTO COURTESY OF OSU EESC.

incoming UV light, and many farms use shade cloth in summer as well to help moderate greenhouse temperatures, which also significantly reduces incoming UV light.

Cultural controls such as increased plant spacing and ventilation can help to reduce powdery mildew severity and are important management tools for limiting disease build-up. Plant spacing and pruning can reduce leaf shading and result in thicker plant cuticular waxes on leaf surfaces, which can, in turn, reduce powdery mildew infection rates.

Due to the high incidence and lack of effective control options for powdery mildew, and the importance of tomato crops for farm income, additional management strategies for powdery mildew control are needed.

Researchers in other areas of the country working in other crops like strawberry or cucumber have shown that exposing powdery mildew to short intervals of UV light can also reduce populations (Suthaparan et al. 2014, Janisiewicz et al. 2016, Suthaparan et al. 2016).

We tested the efficacy of UV light treatment to help reduce powdery mildew in greenhouse tomato production. It is important to note that just like the sun's rays, UV light from a lamp source can cause serious harm to skin and eyes. The use of protective equipment such as UV blocking goggles and clothing is therefore essential. Even short periods of exposure from a UV light source can cause burns or other harm.

Seeing the light

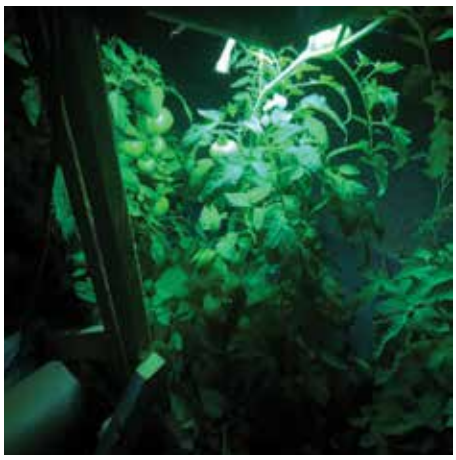
In the first year of a two-year trial, we compared the effects of UV spectral lights, with no treatment and with an organically certified fungicide. We hope to find options for use in an integrated approach to reducing powdery mildew in tomato high tunnel production within our region.

The tomato variety 'Caiman' (Vitalis Seeds) was transplanted on June 6, 2019 into a double-walled poly hoop-house located on the North Willamette Research and Extension Center near Aurora, Oregon (Photo 2). The hoop house had no supplemental lighting or environmental control systems.

Transplants were arranged in two rows with two feet between rows and one foot between plants within each row. UV-B treatments were made using an off-the-shelf light system that has six 9-watt bulbs emitting 0.005 W per cm^2 over the 525 cm^2 treatment area at 311-312 nm wavelength. We mounted the light on an adjustable stand and positioned the light as close as possible to the top part or sides of the tomato canopy.

We applied UV-B treatments to the plants from either the side of the canopy (positioning the light vertically) or from the top (positioning the light horizontally above the canopy — see Photo 3). UV-B treatments were applied in the evening between 5:30 p.m and 10 p.m. on three- to four-day intervals, beginning on August 24 and continuing through September 17.

Applying UV treatments has been shown to be most effective and least likely to damage plants when applied at night (Suthaparan et al. 2017). Each plot received four 7-minute applications of UV light per treatment, distributed over the plot. The UV treatments were compared with the potassium bicarbonate fungicide formulation Kaligreen, which was applied on a weekly basis per the labeled directions. Plots were examined weekly for disease and the percentage of leaf area colonized by powdery mildew was determined by visual observation.



As is common in western Oregon, powdery mildew developed on tomato plants in late August. The disease was detected at initially low levels (1.2% or less of the leaf area) on at least one leaf of 39 percent of the plants on the first evaluation date, August 23. Rapid spread of powdery mildew occurred, fueled by the hoop house growing conditions and the dense tomato canopy.

By the second evaluation date (September 3), powdery mildew was detected on all but one plant of the 128 plants evaluated. Disease severity on this date was greater in the nontreated control as well as plants receiving UV-B as an overhead treatment relative to plants treated with Kaligreen.

On the third evaluation date (September 10), plants receiving Kaligreen had a lower disease severity compared to the other treatments; nontreated plants and plants in both UV-B treatments began to exhibit premature defoliation due to the severity of powdery mildew.

By the fourth and final evaluation date (September 17), defoliation was severe enough on the UV and nontreated plants that no further evaluations were made due to the impending severe loss of leaves. Under the conditions of our study, Kaligreen was a more effective disease management tool relative to the UV-B treatments utilized for tomato powdery mildew.

This preliminary study showed a small window of efficacy of the UV treatments when powdery mildew was less severe. We think the limited range of UV light coverage with our off-the-shelf lamp was not adequate to effectively treat the whole canopy.

Next year's trial will include a larger

UV treatment area to increase the light coverage. We also will need to look carefully at the costs associated with each treatment to understand if employing UV lights on-farms is reasonable.

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