

Type of plastic film on high tunnels can filter sunlight, influence plant growth

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Researchers planting basil in a high tunnel, a growing system which has gained popularity for its ability to enhance growth conditions and extend the growing season of horticultural crops. Credit: Pennsylvania State University

High-tunnel growing systems, sometimes called hoop houses, have gained popularity for their ability to enhance growth conditions and extend the growing season of horticultural crops. Now, a team led by Penn State researchers has demonstrated that growers can select various plastic film coverings on the structures—depending on their desired light-filtering properties—to protect plants and enhance their health.

In experiments growing green and purple basil as test crops in 12 high tunnels at the Russell E. Larson Agricultural Research Center at Penn State University Park, the researchers evaluated the effect of four alternative polyethylene films with varying light diffusion and ultraviolet-transparency levels. They documented that the plastic coverings—with varying degrees of light transmission in the ultra-violet, visible or photosynthetically-active and near-infrared ranges—had major effects on the growth of both basil cultivars.

The researchers reported in [an article](#) published in *Horticulturae*, that leaf area, stem and total plant biomass were influenced by the plastic covers, with films that transmitted and diffused 80% of sunlight in the photosynthetically active range resulting in higher biomass production.

The plastic film coverings showed varying effects on the [mineral content](#), total chlorophyll, carotenoids, total phenolic compounds and antioxidant activity in the plants, the researchers found, with film type affecting nutritional quality.

Also, the team reported, the plastic film coverings significantly influenced the severity of a plant disease called downy mildew on both kinds of basil. The ultraviolet-transparent film that diffused light consistently limited the severity of the foliage disease, which simultaneously affects crop yield and quality, according to research team leader Francesco Di Gioia, assistant professor of vegetable crop science in the College of Agricultural Sciences.



The researchers selected purple and green basil—popular herbs grown worldwide that are known for their culinary and medicinal uses—for the experiments because they are valuable crops for high tunnel production. Credit: Pennsylvania State University

"The choice of plastic covering film in these systems can significantly impact crop productivity and quality while influencing pest and pathogen incidence," he said. "Overall, this study highlights the importance of selecting appropriate plastic film coverings with varying levels of ultraviolet light transparency in high tunnel production systems. High tunnels are important as crop-protection tools and are considered a

climate-smart technology because they can improve crop-production efficiency and mitigate climate risks."

The researchers selected basil—a popular and widely grown herb worldwide, known for its culinary and medicinal uses—for the experiments because it is a valuable crop for high tunnel production. Basil plants are known to respond to [ultraviolet radiation](#) by altering their physiological and metabolic processes, Di Gioia pointed out.

"The use of ultraviolet-transparent film coverings has been found to positively influence the accumulation of secondary metabolites such as phenolics, flavonoids and anthocyanins in basil, leading to improved flavor, aroma and pigmentation profiles," he said. "Increased levels of certain phenolic compounds, called flavonoids, have been reported in basil plants cultivated under ultraviolet-transparent films, compared to films that block some ultraviolet light."

The capability of high tunnels to limit plant disease is increasingly attractive to growers in regions like the Northeast, where more frequent severe rainstorms are making fruit and vegetable production more challenging, noted research team member Kathy Demchak, extension program specialist.

"With the increasing rains that we're experiencing now, things are really changing, and we are seeing more emerging diseases, invasive insects and new problems that we really can't manage," she said.

"And we're also seeing more resistance to fungicides we traditionally have used to control diseases such as downy mildew. We've been working with [high tunnels](#) here at Penn State for 25 years now, but their utility, I think, is going to be increasing for reasons we didn't consider in the past."

More information: Fritzner Pierre et al, Soiless-Grown Green and Purple Basil Response to High Tunnel Photo-Selective Covering Films, *Horticulturae* (2023). [DOI: 10.3390/horticulturae10010033](https://doi.org/10.3390/horticulturae10010033)

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