

Research suggests foliar fungicides help increase soybean yield in some regions

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Research aided by a plant pathologist at Penn State examined the use of foliar fungicides in soybean to prevent fungal plant diseases such as frogeye leaf spot and brown spot. Credit: Pixabay

While previous studies have shown little economic benefit associated with using foliar fungicides in soybean as a preventive measure, new

research aided by a Penn State plant pathologist suggests otherwise, especially in southern regions.

The findings will help growers in the U.S. understand how foliar fungicides—applied to leaves—fit into overall [soybean](#) production practices, noted Paul Esker, associate professor of epidemiology and field crop pathology in the College of Agricultural Sciences, who collaborated with Denis Shah, associate scientist in the Department of Plant Pathology, Kansas State University.

Soybean is one of the major crops produced in the U.S., planted on an estimated 87.6 million acres in 2020. Esker explained that success in growing soybean depends on multiple management decisions, including choice of cultivar, sowing date, seeding rate, nutrient fertilization, irrigation, drainage, crop rotation and tillage.

Foliar fungicides—used to prevent fungal plant diseases such as frogeye leaf spot and brown spot—are another management consideration. These diseases can flourish when temperatures are warm with humid conditions, such as those that occur in regions known for producing soybean. These [fungal diseases](#) have the potential to impact crop health and yield.

Previous [field](#) trials have demonstrated that when there is little or no disease present, there is no [economic benefit](#) to using foliar fungicides, Shah and Esker explained. Despite that information, the use of foliar fungicides in U.S. soybean production almost tripled from 2005 to 2015.

"Foliar fungicides should not be applied indiscriminately, divorced from disease scouting or forecasting, integrated pest management, and environmental principles," Esker said. "The price to be paid in terms of environmental damage and loss of product efficacy due to the evolution of fungicide resistance within foliar pathogen populations should be

weighed against the yield penalty associated with not using foliar fungicides in high-yield environments."

To better understand the contribution of foliar fungicides to soybean yield from an economic standpoint, the team used a machine-learning algorithm to analyze soybean yields based on production practice information reported by growers in 2014–16.

The scientists used a database of 2,738 spatially referenced fields in the northcentral U.S., 30% of which had been sprayed with foliar fungicides. In addition to foliar fungicide applications, the team considered crop-management practices and soil properties.

The researchers, who recently reported their results in *Scientific Reports*, found that the two most important factors associated with soybean yield were latitude and sowing date. Foliar fungicide use ranked seventh out of 20 factors in terms of relative importance. Delayed sowing at higher latitudes decreased yield by about 15 bushels per acre compared to the highest-yielding fields sown early in the more southerly locations, mainly in Illinois and Iowa.

Further analysis of the interactions showed that the yield difference between sprayed and unsprayed fields increased with later sowing, demonstrating a greater fungicide benefit in later-planted fields. A more significant yield response also was connected with using foliar fungicides in higher-yield environments, but the yield loss resulting from not using foliar fungicides in such environments was less than a 1.5-bushels-per-acre.

"With respect to latitude, the global difference in yield between sprayed and unsprayed fields decreased as one moved farther north," Esker said. "This suggests that foliar fungicides were of more benefit when applied to the more southerly located fields, which do tend to experience more

or prolonged conditions conducive to foliar diseases than the northern fields."

While most previous studies have shown little economic benefit associated with foliar fungicide application in soybean, Shah and Esker said their analysis suggests that—except for a few production environments located in the northern fringe of the U.S., most notably North Dakota and parts of Michigan and Wisconsin—there was an economic benefit to using foliar [fungicides](#) in soybean production when prices are near or above average.

"Nevertheless, [foliar fungicides](#) should always be used judiciously in an integrated program that weighs their economic benefits against their environmental consequences," Shah said, adding that the research team is working on another project to help farmers better estimate the costs of different production and management tactics.

More information: Denis A. Shah et al, A machine learning interpretation of the contribution of foliar fungicides to soybean yield in the north-central United States, *Scientific Reports* (2021). [DOI: 10.1038/s41598-021-98230-2](#)

Provided by Pennsylvania State University

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