Science Societies

Understanding the corn fungicide yield response

Application timing shown to prolong corn grain fill

By Vicky Boyd

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Photo courtesy of Adobe Stock/ kocsisanyi78.

New research at Purdue University clarifies why corn fungicides often boost yields, showing they can reduce disease and extend the grain-fill period by several days. Based on multi-year field trials, researchers found that especially well-timed R1 foliar fungicide applications led to heavier kernels and higher yields by preserving green leaf area and photosynthesis. This article provides practical takeaways for CCAs and their growers, including the importance of disease pressure, timing, integrated pest management, and weighing fungicide costs against potential returns.

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Following the advent of tar spot in the mid-2010s, fungicide applications to Midwestern corn have more than doubled from 2010 to 2021 nationally. While producers frequently have seen yield bumps from fungicides, depending on application timing, product, and disease pressure, little information was known about the mechanisms behind the response.

To bridge the knowledge gap, Purdue University Extension Corn Specialist Daniel Quinn led a two-year research project that compared an untreated check to a subsurface-banded fungicide application or a foliar fungicide application at R1. As part of the multi-location study, the team measured the effects of fungicides on leaf disease severity, grain fill duration, final kernel weight, and ultimately yields.

Tar spot lesions on a corn leaf. As the disease progresses, the black lesions will increase in size and coalesce. Photo courtesy of Harkirat Kaur.

In addition to answering scientific questions, Quinn says the results also should be meaningful to growers.

"This gets growers to realize there's still quite a bit of yield to be made later in the season," says Quinn, who along with co-authors Malena Bartaburu, Lia Olmedo Pico, and Darcy Telenko, published the research in the September–October 2025 issue of *Crop Science*.

One reason why this type of research has rarely been conducted is because of the tedious plant tagging and sampling involved, he says.

"Sometimes we had to conduct sampling every week and be careful how we sampled the kernels," says Quinn, who is also an assistant agronomy professor at Purdue. "People have done this before with nitrogen and temperatures. It seemed like we thought we were seeing similar responses with fungicides, but we also were diving into

the why, and it was trickier doing that."

The methodology used in the studied was developed by co-author Pico during her Ph.D. studies that examined the effects of various nitrogen levels on corn kernel weight and grain fill.

Putting fungicides to the test

The studies were conducted during 2022 and 2023 at three locations within Indiana. At each site in both years, the researchers planted the same hybrid that was popular with area growers. They established small-plot trials at the Agronomy Center for Research and Education, or ACRE, in West Lafayette. There they only sampled corn kernel dry matter accumulation and duration due to data collection intensity and time constraints.

At the Northeast Purdue Agriculture Center (NEPAC) in ColumbiaCity and the Southeast Purdue Agricultural Center (SEPAC) in Butlerville, the researchers established field-scale trials. From those, they collected harvest kernel numbers, kernel weight, grain moisture, and yield data.

All of the trials included an untreated control; an at-planting treatment of flutriafol (Xyway LFR) banded about 2 inches to the side and below the seed; and a foliar application of a prothioconazole, trifloxystrobin, and fluopyram premix (Delaro Complete) at R1 or silk emergence.

Daniel Quinn says at-plant fungicide applications are uncommon in his area because growers are spending money up front without knowing whether disease will be present later in the season. Photo courtesy of Adobe Stock/sementsova321.

Quinn says at-plant fungicide applications are uncommon in his area because growers are spending money up front without knowing whether disease will be present later in the season. The researchers chose a foliar premix with three different modes of action because it offered broader-spectrum disease control, particularly for tar spot, than a single chemistry. Year in and year out, he says the R1 timing tends to be the most effective because it is close to the appearance of fungal disease symptoms and protects the plant as it enters a critical development period.

At all locations, the same person visually assessed disease severity on ear leaves at the dent, or R5, growth stage. For each disease—tar spot, gray leaf spot, northern corn leaf blight, and southern rust—they quantified the affected area as a percentage of the total green ear leaf area.

To minimize observer bias, the researchers randomly selected and tagged 25 plants at the V8 growth stage before ear formation at ACRE. Beginning with the R2 growth stage, two ears were selected from the tagged plants weekly for 10 consecutive weeks.

From the center of each ear, 15 intact kernels were collected and weighed immediately after sampling for fresh weight. The kernels were then dried for 24 hours at 212 °F for dry weight.

Weather conditions during the 2022 and 2023 corn growing seasons also varied widely in temperature compared with the 30-year average. Overall, 2023 had cooler temperatures compared with 2022. Precipitation also deviated widely from historic averages with 2022 receiving significantly less, potentially affecting corn development at ACRE.

In addition, disease severity varied across the locations and years with higher disease pressure observed at SEPAC in both years and at NEPAC consistently. At ACRE, disease severity was lower in 2022, possibly limiting treatment effects, compared with 2023.

An extended grain-fill period

During both years and at all three sites, the at-planting and R1 foliar fungicide applications showed a potential to decrease foliar disease severity by 27–78% and 47–84%, respectively. At the same time, the fungicide treatments extended the grain-fill period by three to five days, depending on the environment.

The extension, in turn, translated to heavier kernel weights and ultimately increased grain yield from the fungicide treatments compared with the untreated checks.

The researchers found heavier kernel weights and ultimately increased grain yield from the fungicide treatments compared with the untreated checks. Photo courtesy of Adobe Stock/ Mykola Mazuryk.

Of the two fungicide treatments, the R1 foliar fungicide application showed the greatest improvement in grain-fill duration, kernel weight, and grain yield. Quinn says the findings coincide with observations of the lowest disease severity percentages in

the R1 foliar treatments compared with the at-planting treatments at ACRE during both 2022 and 2023. The results also backed up previous research that found fungicide control of foliar diseases may preserve leaf area and chlorophyll content, leading to prolonged photosynthesis during grain fill.

“We’re maintaining that green leaf area, and we’re maintaining the yield potential of the plant because we’re controlling disease, so we’re able to see grain fill continuing for a couple more days.”

With the plant not having to allocate as much energy defending against pathogens because of fungicidal control, it could allocate more resources to grain fill, according to previous studies.

While the effects of diseases may differ based on the year and the fungicides chosen, Quinn says overall results will likely be similar across many production areas.

“The idea is if we can control disease, regardless of what disease it is, the response itself will be similar,” he says. “We’re maintaining that green leaf area, and we’re maintaining the yield potential of the plant because we’re controlling disease, so we’re able to see grain fill continuing for a couple more days.”

Conversely, Quinn says he wouldn't expect to see the same results in the absence of disease.

Follow IPM and weigh the costs

Despite the positive research results, Quinn says growers and consultants should still follow the tenants of integrated pest management (IPM) to determine whether fungicides are needed.

Growers and consultants should follow the tenants of integrated pest management to determine whether fungicides are needed, including scouting weekly just before tasseling. Photo courtesy of Adobe Stock/Serhii.

"There's still a risk of resistance if we make applications every year and on every single acre," he says. "We don't want to get into the area where fungicides stop working."

Integrated pest management includes considering corn hybrid disease resistance, scouting weekly beginning just before tasseling, anticipating environmental conditions, considering planting dates, rotating effective modes of action, and properly timing fungicide applications.

Based on current commodity prices, Quinn recommended growers and consultants also take a hard look at fungicide return on investment before pulling the trigger.

"[With $4 corn], you need to get a 10-plus bushel increase, so there will be some times when it doesn't pay for itself."

"With the commodity prices we have today, you still have to be cautious and just spray when you have indicators to spray," he says.

Some fungicides may cost $30 to $40 per acre. In 2022 and 2023 when the trials were conducted, he says the fungicide applications paid for themselves because corn prices were better.

But with $4 corn, "You need to get a 10-plus bushel increase, so there will be some times when it doesn't pay for itself."

To help growers and CCAs determine whether a treatment is cost-justified, the Crop Protection Network has developed a Corn Fungicide ROI Calculator.

Dig deeper

View the original research in the journal *Crop Science*:

Bartaburu, M., Pico, L.O., Telenko, D.E.P., & Quinn, D.J. (2025). Fungicide program impacts on corn grain fill duration, kernel weight, and grain yield. *Crop Science*, *65*, e70172. https://doi.org/10.1002/csc2.70172

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1. Which fungicide application method showed the greatest improvement in grain-fill duration and yield?

a. No fungicide application.

b. At-plant subsurface-banded fungicide.

c. Late-season R5 foliar fungicide.

d. R1 foliar fungicide.

2. How much did fungicide applications typically extend the grain-fill period in the study?

a. One to two days.

b. Three to five days.

c. Six to eight days.

d. More than 10 days.

3. Which factor most directly explains why fungicides increased kernel weight in this research?

a. Increased nitrogen uptake.

b. Faster kernel development.

c. Reduced plant height.

d. Preserved green leaf area and photosynthesis.

4. Why are at-plant fungicide applications less common among growers, according to Daniel Quinn?

a. They are less effective against tar spot.

b. They are more expensive than foliar treatments.

c. Disease presence later in the season is uncertain.

d. They cannot be combined with fertilizer.

5. What major disease emergence cited in the article helped drive increased fungicide use in Midwestern corn since the mid-2010s?

a. Tar spot.

b. Southern rust.

c. Gray leaf spot.

d. Northern corn leaf blight.

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