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Fungicides Use in a Lower Price Environment

Carl Zulauf

Department of Agricultural, Environmental and Development Economics
Ohio State University

Gary Schnitkey and Nick Paulson

Department of Agricultural and Consumer Economics
University of Illinois

Eric Richer

Agriculture and Natural Resources
Ohio State University Extension

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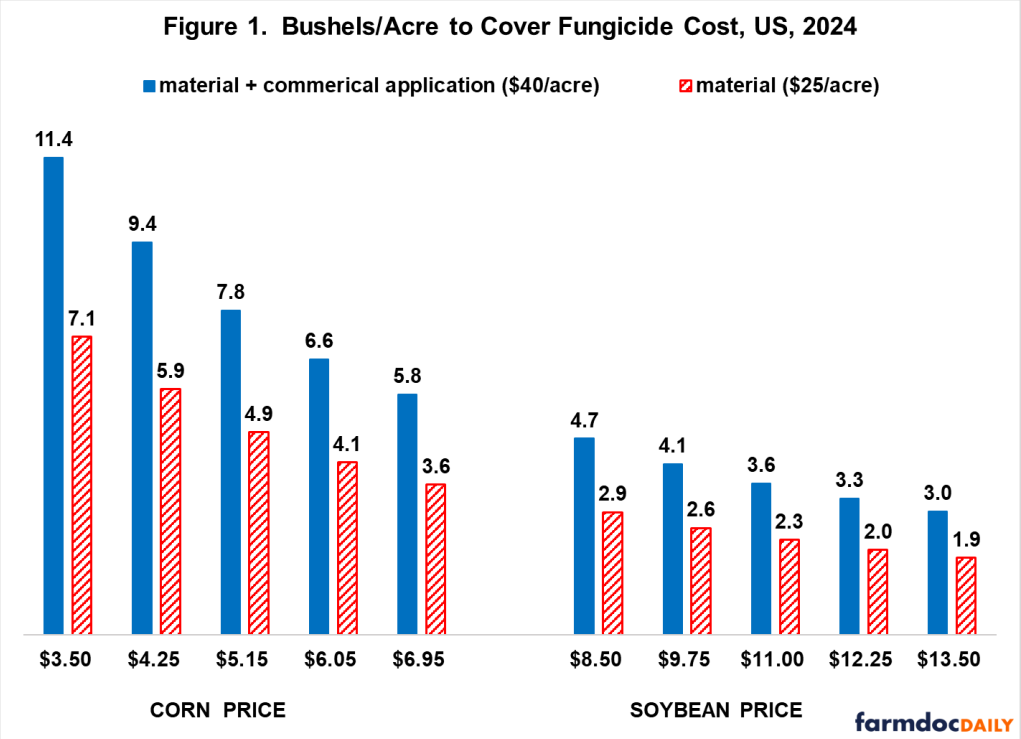
The advisability of applying fungicides may change this year with lower corn and soybean prices and given recent increases in spending on pesticides (*farmdoc daily*, April 30, 2024). While the cost of applying fungicides is known, their application introduces two uncertainties: 1) the yield response from using fungicides, and 2) the additional drying cost associated with higher moisture due to fungicide use. These issues are explored in this paper. Overall, average yield responses from fungicide yield trials do not suggest that fungicide use is economical at likely commodity price levels for this year.

Yield Response to Cover Application Costs

Fungicides need to increase yield enough to at least cover material and application costs. This increase also depends on the price of the crop. Using a $40/acre material and application cost based on likely 2024 prices, corn yield needs to increase by 5.8 bushels when corn price is $6.95, close to the 2021 harvest price. At a $4.25 price, near current cash forward bids for 2024 harvest; yield needs to increase 9.4 bushels (see Figure 1). For soybeans, an increase of 3.6 bushels per acre is needed at today's cash forward bid of $11.00. The yield increase needed to cover only the material cost ($25) is also presented in Figure 1.



Uncertain Yield Response

Studies find a positive but highly variable corn and soybean yield response to the use of fungicides. Paul, et al. reported an overall average corn yield response of +3.7 to +6.2 bushels per acre that varied across four fungicide products. Kandel, et al. reported an overall average soybean yield response of +1.6 bushels per acre. These average yield responses are below break-even yield responses at current crop prices.

Both of these studies are meta (i.e. summary) analyses of a large number of individual studies: 212 corn studies and 240 soybean studies. Individual studies found yield responses that ranged from negative to large positive.

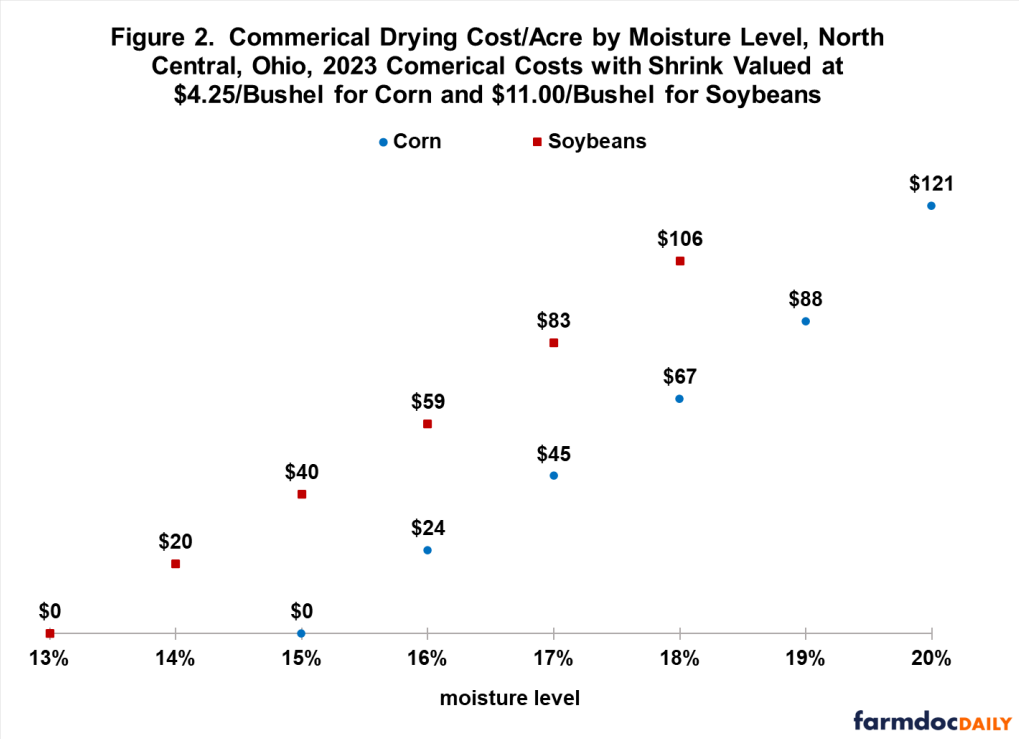
Other consistent findings from field trials include a higher yield response:

1. the more severe the fungal infection (if infection is low, average response is smaller but still positive),
2. the less resistant the seed variety, and
3. the higher is precipitation.

While statistically important, fungal infection, variety resistance, and precipitation explain only a small share of the variation in yield response, implying much more is unknown than known.

Uncertain Cost – Drying

An unknown cost when applying fungicides is drying cost. This potential cost arises because fungicides keep the crop greener longer, thus extending its reproductive fill period. The importance of drying cost is magnified because the entire crop is impacted and because drying costs are not trivial. Each one percentage point increase in moisture above the no-drying maximum increases corn and soybean drying cost by $20 to $25 per acre (see Figure 2). Figure 2 is derived using commercial drying charges during the 2023 harvest in North Central, Ohio, but with the percent shrink (i.e. reduction) applied to a crop's bushels for excess moisture valued at $4.25 for corn and $11.00 for soybeans. To summarize, the bushels needed to cover the total cost from using fungicides can increase notably if fungicides increase moisture at harvest above the no-drying maximum.



Other Costs

Each added bushel needs to be harvested and transported. Using the Ohio State University custom rates for 2022 (Ward, Barker, and Richer), harvest cost is $38.60 per acre for corn, or $0.19 per bushel at a 200 bushel yield, and $37.10 per acre for soybeans, or $0.62 per bushel at a 60 bushel yield. Harvest costs include charges for the combine, grain cart, and on-farm transport. Transport cost from the farm to market is $0.18 per bushel based on hauling 27 miles one way. While small, these two costs add up and should not be ignored. For example, if fungicides increase yield 10 bushels, added corn harvest and transport cost total $3.74 per acre, not far from the value of one bushel at current 2024 cash forward bids.

Discussion

Current cash forward bids of $4.25 for corn and $11.00 for soybeans require yield responses of 9.6 bushels for corn and 3.6 bushels for soybeans to cover a $40 per acre cost of commercial fungicide application plus the cost of harvesting and transporting the increased bushels.

Average yield response from agronomic small plot trials are generally less than these yield increases.

Yield response is generally larger when fungal infection is high and seed is more susceptible. These findings underpin the common recommendation to practice integrated disease management including crop scouting and cultivar selection.

Yield response to using fungicides is highly variable. Individual field trials find negative, zero, and very large yield responses. This variability favors larger farms. Larger farms have more fields to capture the highly variable but on average positive fungicide yield response.

A major unknown when using fungicides is its impact on moisture at harvest. Drying costs are expensive. It takes only a few years of higher moisture due to fungicides to materially raise the bushels needed to cover the total cost incurred by applying fungicides. On the other hand, Tenuta and Hooker (2009) and Mahoney et al. (2015) found that using fungicides improved corn stalk quality and reduced lodging, which can produce savings by reducing harvest yield loss or allowing later harvest at lower moisture. The farm management implication is that harvest conditions can materially impact returns to using fungicides.

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