# Fungicide Efficacy on Fusarium Head Blight of Hard Red Winter Wheat in Parsons, KS

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## Summary
In 2022, a field experiment was conducted to investigate the efficacy of fungicide programs on Fusarium head blight (FHB) and deoxynivalenol (DON) levels. Fungicide treatments were evaluated in plots of the hard red winter wheat cultivar 'KanMark' inoculated with *Fusarium graminearum* in Parsons, KS. Treatments consisted of a single application of Prosaro, Caramba, Miravis Ace, Prosaro Pro, or Sphaerex at early anthesis (Feekes 10.5.1), or dual application of Miravis Ace at early anthesis followed by (*fb*) Prosaro Pro, Sphaerex, or Folicur at 4 days after early anthesis. All fungicide programs numerically reduced FHB visual symptoms and resulted in increased yield compared to the untreated check, although differences were not statistically significant in all cases. The double application treatments (Miravis Ace *fb* Prosaro Pro, and Miravis Ace *fb* Spharex) resulted in the highest increase in test weight. Miravis Ace applied at early anthesis *fb* Prosaro Pro applied at 4 days after early anthesis resulted in the lowest DON levels (79% less than the untreated check).

## Introduction
Fusarium head blight (FHB), also called scab, is a serious disease of wheat caused by the fungal pathogen *Fusarium graminearum*. Over the last decade an average total yield loss of 1.14% has been attributed to FHB in Kansas, although in epidemic years, statewide losses > 3.0% have been reported (Hollandbeck et al., 2021). These losses amount to millions of dollars of lost revenue. Under favorable conditions (warm, wet weather with high relative humidity during flowering and early grain formation), FHB can reduce grain yield and test weight, and result in the production of mycotoxins (such as deoxynivalenol, DON, vomitoxin) which contaminate grain. Deoxynivalenol is harmful to both humans and livestock and can lead to vomiting, feed refusal, and adverse neurological symptoms. The U.S. Food and Drug Administration has established a 2-ppm threshold for DON in wheat grain, a 1-ppm limit for finished wheat products that humans may consume, and 5- to 0-ppm for grains and grain by-products destined for animals (FDA, 2018). Thus, harvesting grain with high levels of DON may lead to price discounts or rejections at the elevator.

Management recommendations for FHB include the selection of moderately resistant wheat varieties, avoiding planting wheat after non-till corn, tillage, and timely fungi-

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cide applications. In the past, the primary fungicide group labeled for the control of FHB was the demethylation inhibitor group (DMI, triazoles FRAC group 3). Previous work has found that the application of a single DMI fungicide at early flowering (Feekes 10.5.1) results in a 40–50% reduction in visual FHB severity (Paul et al., 2008). Recently, Miravis Ace (13.7% pydiflumetofen + 11.4% propiconazole) and Prosaro Pro (17.39% prothioconazole + 8.7% tebuconazole + 8.7% fluopyram) have been introduced to the market and contain an active ingredient from the succinate dehydrogenase inhibitor group (SDHI, FRAC group 7), along with DMIs. An additional product, Sphaerex (10.91% metconazole + 18.19% prothioconazole, FRAC group 3), has recently been labeled for use in Kansas. It is important to understand how these products compare to the products that are currently being used to control FHB by producers in Kansas. In addition, although single applications of fungicides are more common in Kansas for FHB control, there may be scenarios where two applications may be worthwhile. Thus, the objectives of this study were to 1) compare the efficacy of newer fungicide products (Sphaerex and Prosaro Pro) with industry standard fungicide products Miravis Ace and Prosaro; and 2) compare the efficacy of dual fungicide applications with single fungicide applications.

## Experimental Procedures

A field experiment was established at the Southeast Research and Extension Center of Kansas State University in Parsons, KS, on October 5, 2021. The FHB susceptible hard red winter wheat cultivar 'KanMark' was planted in 5 × 28 ft plots (5 rows/plot) with a seeding rate of 1.2 million seeds/a. Plots were arranged in a randomized complete block design with four replications.

Plots were inoculated with *F. graminearum* infested corn spawn (isolates X-3639 and Pt104) on March 31 and April 7, 2022, at a rate of 15 g per square meter per application. This location was mist irrigated regularly to the point of soil saturation to stimulate perithecia development (fungal fruiting bodies) on corn spawn.

Treatments consisted of single or double applications of fungicides (Table 1). Single application treatments included:

- Prosaro (19% prothioconazole + 19% tebuconazole; Bayer Crop Science);
- Caramba (8.6% metconazole; BASF Corporation);
- Miravis Ace (13.7% pydiflumetofen + 11.4% propiconazole; Syngenta);
- Prosaro Pro (17.39% prothioconazole + 8.7% tebuconazole + 8.7% fluopyram; Bayer Crop Science); and
- Sphaerex (10.91% metconazole + 18.19% prothioconazole; BASF Corp.) at early anthesis (Feekes 10.5.1).

Double application treatments included:

- Miravis Ace applied at early anthesis was *fb* Prosaro Pro, Sphaerex; or
- Folicur (38.7% tebuconazole; Bayer Crop Science) applied 4 days later.

Fungicide treatments were applied with a $CO_2$-powered backpack sprayer at a pressure of 30 psi calibrated to 20 gal/a. The sprayer was equipped with three flat fan

TT110015-VP nozzles spaced 50 cm apart on a 100 cm boom. Early anthesis treatments were applied on May 6 at early anthesis (Feekes 10.5.1) and second applications were made on May 10.

Visual disease severity (FHB index) was evaluated on May 23 by rating four clusters of 10–15 plants per plot (40–60 individual plants per plot). Plots were harvested with a small plot combine on June 29. After harvest, sub-samples of grain were visually rated for percent Fusarium damaged kernels (FDK) and shipped to the mycotoxin testing laboratory in the Department of Plant Pathology at the University of Minnesota, St. Paul. Yields were adjusted to 13% moisture.

Data were analyzed using the GLIMMIX procedure of SAS. Means were compared using Fisher's protected LSD at a 5% level of significance using the lsmeans statement. Prior to the analyses, FHB index and FDK data were arcsine-square-root transformed and DON data were log-transformed, as needed to stabilize variances.

## Results and Discussion

Mean yields were not statistically different between treatments (*P*-value = 0.11), although yields were numerically higher for all fungicide treatments than for the untreated check, except for Prosaro (Figure 1A). Grain test weight was greater for all fungicide treatments than for the untreated check (Figure 1B). Single applications of Prosaro, Caramba, and Prosaro Pro at early anthesis were less effective than Miravis Ace and Sphaerex. Miravis Ace *fb* Prosaro Pro and Miravis Ace *fb* Sphaerex had test weights 7% greater than the untreated check. Findings are consistent with data reported by Moraes et al. (2022) who found that test weights were higher when Prosaro *fb* Caramba compared to single Prosaro applications at early flowering. These results are particularly relevant for seed production.

The untreated check had the highest values of FHB index (*P*-value = 0.05) and DON (*P*-value = 0.02) when compared to Miravis Ace *fb* Prosaro Pro (Figure 1C and E). Miravis Ace *fb* Sphaerex and single application of Prosaro, Miravis Ace, and Sphaerex also resulted in lower FHB index than the untreated check, 57%, 61%, 63%, and 50%, respectively. The FHB index values for the treatment Miravis Ace *fb* Folicur were higher than expected, given the level of control observed in the Miravis Ace single application treatment. Future locations and years of this study will evaluate if this trend persists. Observed DON levels were 79% less in Miravis Ace *fb* Prosaro Pro than the untreated check, as well as Sphaerex and Miravis Ace *fb* Sphaerex, which resulted in a 55% and 61% reduction, respectively. The FDK values (*P*-value = 0.05) were similar among fungicide treatments (Figure 1D).

## Conclusion

All fungicide programs lowered both FHB index (visual severity) and DON accumulation and resulted in higher test weights when compared to the untreated check. The DON reduction is critical as elevated DON levels can result in discounts or rejections translating into an economic loss. Results from this single location-year experiment are preliminary. This experiment will be repeated in future years and additional locations.

## References

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**Table 1. List of fungicide treatments for Fusarium head blight in wheat**

| Product/Trade name | [a]FRAC/Code | Timing | Rate, fl. oz./a |
|---|---|---|---|
| Untreated check | --- | --- | --- |
| Prosaro 421 SC | 3 | Early anthesis | 6.5 |
| Caramba 0.75 SL | 3 | Early anthesis | 13.5 |
| Miravis Ace SE | 3, 7 | Early anthesis | 13.7 |
| Prosaro Pro 400 SC | 3,7 | Early anthesis | 10.3 |
| Sphaerex | 3 | Early anthesis | 7.3 |
| Miravis Ace *fb* Prosaro Pro | 3,7/3,7 | Early anthesis *fb* 4 days after | 13.7/10.3 |
| Miravis Ace *fb* Sphaerex | 3,7/3 | Early anthesis *fb* 4 days after | 13.7/7.3 |
| Miravis Ace *fb* Folicur 3.6F[6] | 3,7/3 | Early anthesis *fb* 4 days after | 13.7/4 |

[a]FRAC = Fungicide Resistance Action Committee.
Early anthesis = Feekes growth stage 10.5.1 or early flowering that is when yellow anthers (flowers) appear or extrude from the center of the wheat spike. *fb* = followed by.

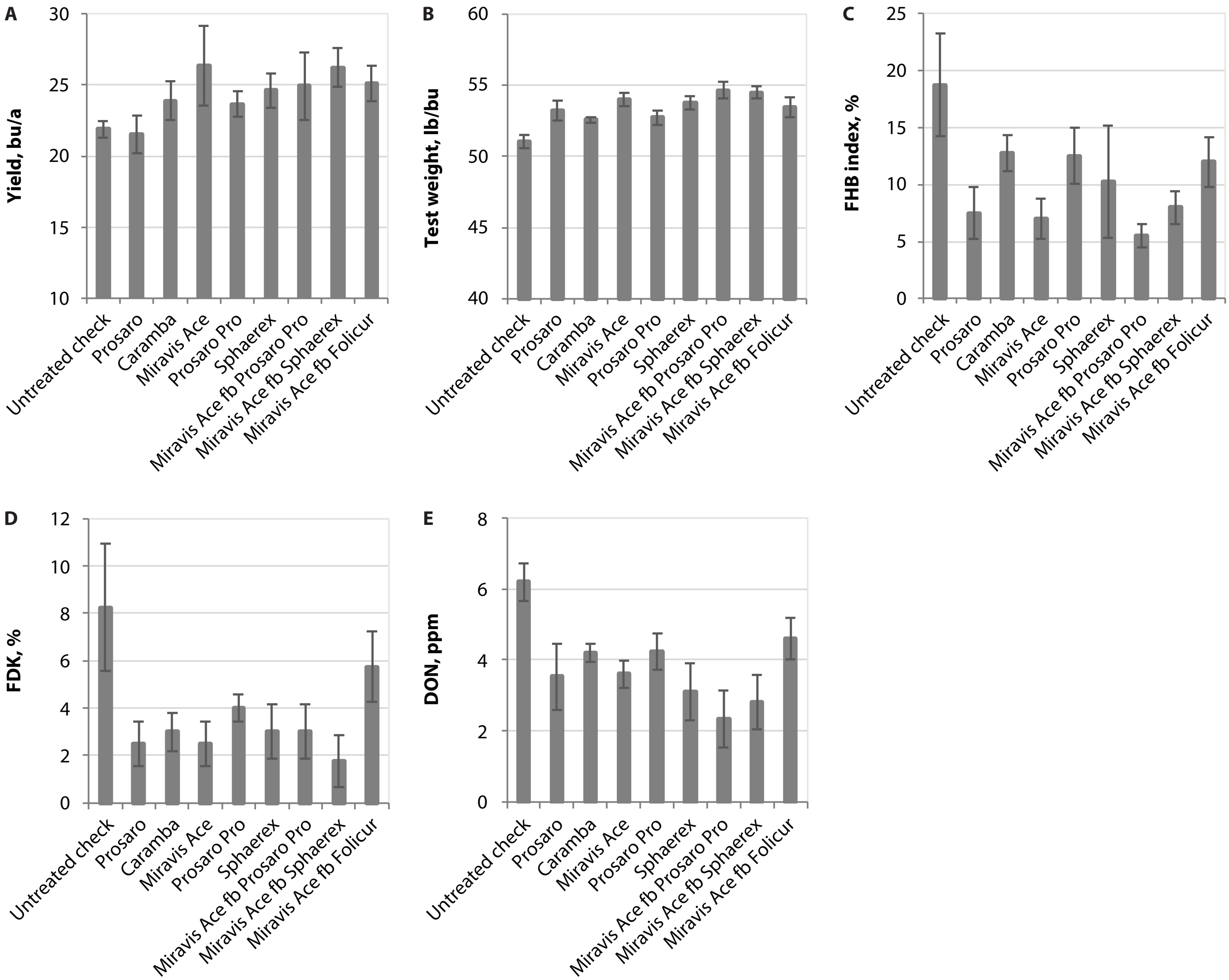


**Figure 1. (A) Mean yield, (B) test weight, (C) Fusarium head blight (FHB) index, (D) Fusarium damaged kernels (FDK), and (E) deoxynivalenol content (DON) for untreated check and fungicide treatments for hard red winter wheat cultivar 'KanMark' in Parsons, KS. Error bars represent the standard error of the mean estimates. *fb* = followed by.**