Project FY22-IM-019: Evaluation of FHB Management Strategies in DE following the MGMT Protocol

1. **What are the major goals and objectives of the research project?**

1) Evaluate the integrated effects of fungicide treatment and genetic resistance on FHB and DON in all major grain classes, with emphasis on new combination fungicides, Prosaro Pro and Sphaerex.
2) Compare the efficacy of Prosaro Pro and Sphaerex to that of Prosaro, Caramba, and Miravis Ace.
3) Generate data to further quantify the economic benefit of FHB and DON management programs.
4) Generate data to validate and advance the development of FHB risk prediction models.

2. **What was accomplished under these goals or objectives?** *(For each major goal/objective, address these three items below.)*

What were the major activities?

As part of this project, four trials were conducted following the MGMT_CP. A malting barley trial with two cultivars and a winter wheat trial with two cultivars were planted to assess fungicide performance on susceptible and moderately resistant varieties (objective 1). Using a susceptible variety of wheat and a susceptible malting barley cultivar, two additional trials were established to analyze fungicide efficacy of designated products (objective 2). Plots were inoculated with corn spawn and misted prior to anthesis. After fungicide application, plots were monitored and rated for FHB incidence and severity, flag leaf disease severity, yield, test weight, kernels damaged by FHB, and DON level. Trial results were shared with Dr. Pierce Paul for further analysis in support of objectives 3 and 4. State results were also disseminated through extension programming, plant disease management reports, and at winter meetings.

What were the significant results?

Environmental conditions in 2024 were very conducive for disease leading to higher pressure than 2022 or 2023, particularly for malting barley. In the variety trial, DON ranged from (8.9- 18.9 ppm) in treatments planted in Violetta and (21.4 – 40.7 ppm) in Avalon. Avalon is becoming the dominant malting barley variety in the region and was anticipated to have better tolerance to FHB, unfortunately this trial did not show differences. FHB severity was consistent averaging 10.7 in the Violetta control and 10.3 in Avalon, but DON accumulation was much higher with 37.5 ppm in the Avalon non-inoculated control and 18.5 ppm in the Violetta non-inoculated control. This will need to be considered as Violetta production expands. In the malting barley fungicide trial planted in Avalon, differences did not separate for yield or DON, but were present for incidence, severity, and % FDK kernels (Table 1). Due to the high level of disease, yields were lower than recent previous years. DON values were also very high in this trial ranging from 5.2-18.4 ppm. In this trial we were able to preview Miravis Era, not yet labeld for use in the US. All fungicides reduced FHB incidence and severity, Miravis Era was the only treatment with %FDK lower than the control. Numerically, the lowest DON level was observed with Miravis Ace fb Prosaro Pro.

Table 1: Barley Fungicide Efficacy Trial Results

Treatment and Rate/A[z]	Growth stage at application (Feekes)	FHB incidence, %[y]	FHB severity, %[x]	FDK, %[w]	DON (ppm)[v]	Yield (bu/A)[u]
Non-Treated Control	--	78.0 a	9.9 a	31.4 a	18.4	69
Prosaro 421 SC, 6.5 fl oz	10.5.1	36.0 b	1.9 b	25.6 ab	16.7	67.6
Miravis Era, 10.3 fl oz	10.5.1	22.0 b	1.5 b	16.4 b	8.4	77.9
Miravis Ace 2.3 SE, 13.7 fl oz	10.5.1	27.0 b	1.5 b	17.6 ab	9.3	77.4
Prosaro Pro 400SC,10.3 fl oz	10.5.1	39.0 b	2.5 b	28.8 ab	12.7	68.6
Sphaerex 2.5SC, 7.3 fl oz	10.5.1	27.0 b	1.5 b	18.8 ab	10.4	75.6
Miravis Ace 2.3 SE, 13.7 fl oz fb Prosaro Pro 400SC, 10.3 fl oz	10.5.1 5 DAA	10.0 b	0.5 b	20.2 ab	5.2	76.6
Miravis Ace 2.3 SE, 13.7 fl oz fb Sphaerex 2.5SC, 7.3 fl oz	10.5.1 5 DAA	15.0 b	1.0 b	24.2 ab	8.0	72
Miravis Ace 2.3 SE, 13.7 fl oz fb Tebuconazole 3.6 F,4 fl oz	10.5.1 5 DAA	22.0 b	2.5 b	20.6 ab	10.7	72.7
p-value	--	0.0001	0.0001	0.0164	0.07	0.3548

[z] Applications were made at anthesis (22 Apr 2024) and 4 days after anthesis (DAA) (26 Apr 2024); fb = followed by. All treatments included 0.125% non-ionic surfactant, Induce 90SL.

[y] Fusarium head blight (FHB) incidence was visually assessed as the % of 20 barley heads per plot displaying symptoms.

[x] Fusarium head blight (FHB) severity was visually assessed as the average amount of symptomatic glumes per head on 20 barley heads per plot.

[w] Fusarium Damaged Kernels (FDK) were visually assessed as % out of 100 kernels showing tomb-shaped, shriveled, pinkish, or bleached symptoms.

[v] DON= deoxynivalenol, ppm= parts per million, ND= none detected.

[u] Yield adjusted to 13.5% Moisture.

An interesting aspect of the 2024 trials was that the variety trial was planted behind corn fodder and due to space limitation, the fungicide trial had to be moved to a field following vegetable rotation. In DE, the primary sequence for wheat is to plant following corn. These trials were planted on the same day and still located within a few hundred feet of one another. Both trials received the same inoculation and misting protocols. DON in the Shirley variety trial planted into corn fodder was significantly higher than the DON in the inoculated non-treated control plot planted into vegetable fodder (Figure 1). While all fungicides reduced DON compared to the control, the residue present had a major impact on DON levels reached. Yield potential, particularly in the control plots, was also impacted by residue present (Figure 2). These results were shared during winter meetings to try to aid with the message that if growers have ability to plant behind anything other than corn, it could have strong benefits for disease risk and reducing DON. Due to the location outside of corn residue, disease levels were lower in the fungicide efficacy trial. Differences were present in incidence, severity, and DON (Table 2). Yield potential was lower than previous years due to dry conditions around grain fill. Lowest severity was observed in the Sphearex at anthesis treatment and lowest DON in Miravis Ace at anthesis fb Prosaro 5 DAA.

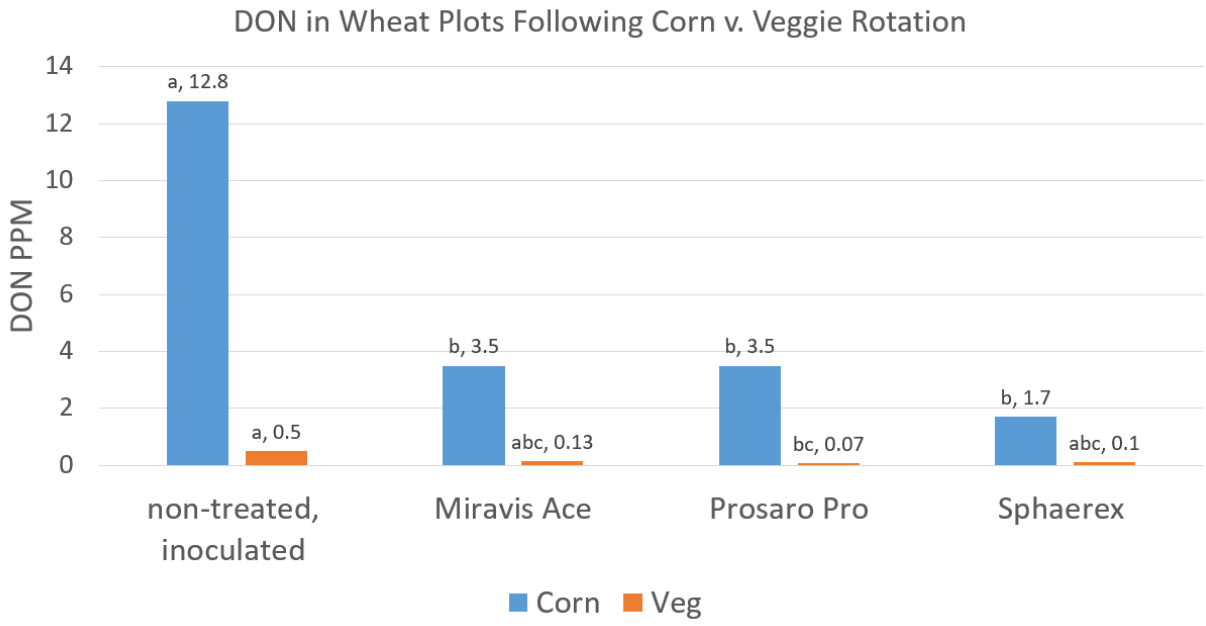

Figure 1: DON accumulation in wheat plots planted into corn or vegetable residue

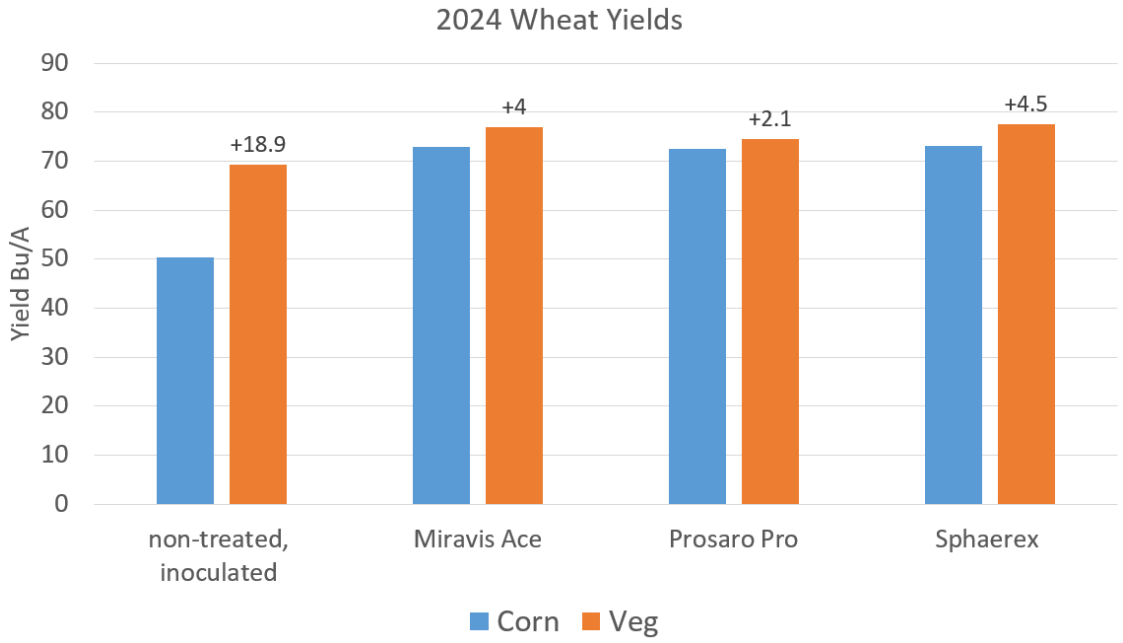

Figure 2: Yield differences in wheat plots planted into corn or vegetable residue

Table 2: 2024 Wheat Fungicide Efficacy Trial Results

Treatment and Rate/A[z]	Application timing[y]	FHB incidence,%[x]	FHB severity,%[w]	FDK, %[u]	DON (ppm) [t]	Yield (bu/A)[s]
Non-Treated Control	--	20.7	4.7 a[v]	13.2	0.47 a	69.3
Prosaro 421 SC 6.5 oz	Anthesis	12.3	1.1 ab	11.0	0.30 abc	70.2
Miravis Era 10.3 oz	Anthesis	10.7	1.2 ab	9.6	0.10 abc	71.3
Miravis Ace 2.3 SE 13.7 oz	Anthesis	11.0	1.0 ab	7.8	0.13 abc	77.0
Prosaro Pro 400 SC 10.3 oz	Anthesis	5.0	1.3 ab	10.2	0.07 bc	74.6
Sphaerex 2.5 SC 7.3 oz	Anthesis	3.7	0.2 b	8.8	0.10 abc	77.6
Miravis Ace 2.3 SE 13.7 oz fb Prosaro 421 SC 10.3 oz	Anthesis fb 5 DAA	7.4	0.8 ab	9.8	0.00 c	70.7
Miravis Ace 2.3 SE 13.7 oz fb Sphaerex 2.5 SC 7.3 oz	Anthesis fb 5 DAA	5.3	0.3 b	8.2	0.11 abc	69.1
Miravis Ace 2.3 SE 13.7 oz fb Tebuconazole 3.6F 4 oz	Anthesis fb 5 DAA	5.1	0.3 b	7.0	0.14 abc	72.7
Prosaro Pro 10.3 oz	50% heading	19.8	2.8 ab	11.8	0.38 ab	73.3
Miravis Ace 13.7 oz	50% heading	9.8	1.9 ab	11.0	0.20 abc	76.6
Prosaro Pro 10.3 oz	5 DAA	7.5	0.5 b	8.6	0.10 abc	74.3
Sphaerex 7.3 oz	5 DAA	9.1	0.8 ab	9.8	0.09 bc	72.2
Miravis Ace13.7 oz	5 DAA	11.2	0.9 ab	9.8	0.14 abc	70.5
p-value	--	0.03	0.0016	0.28	0.003	0.83

[z] All treatments included 0.125% non-ionic surfactant Induce 90SL; fb= followed by.
[y] Applications were made at 50% heading (Feekes 10.3) on 26 Apr 2024, Anthesis (Feekes 10.5.1) on 3 May 2024, and 5 days after anthesis (DAA) on 8 May 2024.
[x] Fusarium head blight incidence was visually assessed as the % of 20 wheat heads per plot displaying symptoms.
[w] Fusarium head blight severity was visually assessed as the average percent of symptomatic glumes present per head on 20 wheat heads per plot.
[v] Means followed by the same letter are not significantly different based on Tukey's Honest Significant Difference (p=0.05, Tukey's HSD).
[u] Fusarium Damaged Kernels (FDK) were visually assessed as % out of 100 kernels showing tomb-shaped, shriveled, pinkish, or bleached symptoms.

List key outcomes or other achievements.

Expected Outcome: Regional product performance for the effects of fungicide treatment and genetic resistance on FHB and DON, with emphasis on new combination fungicides, Prosaro Pro and Sphaerex.

Actual Outcome: Data on new combination fungicides was generated and shared at winter meetings.

Expected Outcome: Regional performance on efficacy of Prosaro Pro and Sphaerex to that of Prosaro, Caramba, and Miravis Ace.

Actual Outcome: Products were assessed in a moderate disease environment and observations were added to national dataset. Higher disease levels in barley allowed for improved recommendations for malting barley. With the phase out of Caramba, future product Miravis Era was tested to gain preliminary observations.

Expected Outcome: Contribute data to further quantify the economic benefit of FHB and DON management programs.

Actual Outcome: Data was contributed to a pooled national data set for continued economic analysis.

Expected Outcome: Contribute data to validate and advance the development of FHB risk prediction models.

Actual Outcome: Data was contributed and interactions of relatively moderate to high disease pressure will be used to help improve model development. Winter 2024 was very wet and the weather combination and resulting disease pressure will contribute to improve model training and understanding of environmental interactions.

3. **What opportunities for training and professional development has the project provided?**
Data from the project was presented at a Maryland Grain Improvement Meeting in January 2025 and parts of the national data set were shared at DE Ag Week in January 2025. Delaware Ag Week provides training and pesticide certification credit to hundreds of stakeholders. Funding currently supports a research technician, but a graduate student was also able to assist with aspects of the trials and attend the 2024 Scab Forum to build professional networks and increase familiarity with the FHB system. Multiple lab members participate in the rating, harvesting, and grain assessment portions of the project allowing undergraduate and graduate students to learn about the project and the implications of mycotoxins in grain production.

4. **How have the results been disseminated to communities of interest?**
Updates on disease risk, efficacy of new products, and optimal application periods were disseminated through articles in the University of Delaware's Weekly Crop Update, which reaches over 700 growers, consultants, and stakeholders and provides a platform to discuss disease concerns and other production issues. Small grain research updates, including the results from this project were presented in the small grains session of Delaware Ag Week held in January 2025. Updates were also shared via social media platforms and two Plant Disease Management Reports will be submitted in 2025. Nationally, these results were used in support of three posters at the 2024 Scab Forum and the wheat fungicide efficacy guide that is updated annually through the NCERA-184 working group and published through the Crop Protection Network.
https://cropprotectionnetwork.org/publications/fungicide-efficacy-for-control-of-wheat-diseases

5. **What do you plan to do during the next reporting period to accomplish the goals and objectives?**

We plan to follow the field protocol to replicate this trial for year 4 data. This replication will strengthen previous data and we anticipate beginning writing of a manuscript on the malting barley results to fulfil local need to fungicide recommendations.