**Project FY22-IM-022:** Fungicide Combinations and Genetic Resistance for FHB and DON Management

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

In this funding cycle, the **goal** of this proposal is the continuance of integrated management (IM) and uniform fungicide (UFT) trials that would allow us to evaluate new combinations of AIs either as pre- or tank-mixtures or as sequentially applied treatments. For the wheat IM trial, we conducted inoculated experiments consisting of four cultivars with different levels of resistance to FHB subjected to at least five fungicide treatments, all applied at Feekes 10.5.1, plus two untreated checks. The **objectives and expected outcomes** of this FHB Management Coordinated Project (MGMT_CP) are to:

1) Evaluate the integrated effects of fungicide treatment and gene0c resistance on FHB and DON in wheat and barley, with emphasis on new combina0on 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 quan0fy the economic benefit of FHB and DON management programs.
4) Generate data to validate and advance the development of FHB risk predic0on models.

Two new fungicides, Prosaro Pro, a mixture of two DMIs (prothioconazole and tebuconazole) and an SDHI (Fluopyram, Pyridinyl-ethyl-benzamide), and Sphaerex, a mixture of two DMIs (metconazole and prothioxonazole) are being promoted for the control of FHB and other diseases of small grain crops. Both Sphaerex and Prosaro Pro were recently registered for use in wheat. As is commonly the case, these new products will likely be marketed at higher prices than Prosaro (tebuconazole + prothioconazole) and Caramba (metconazole), the current industry standards for FHB management, and are being developed as replacements for the latter two fungicides. Therefore, the obvious questions being asked by stakeholders and researchers are whether the efficacy of these new fungicides against FHB and its associated mycotoxins, particularly DON, will be high enough to justify the added cost, and whether they are just as or more effective than current industry standards. **Approach:** Designated fields for FHB screening and fungicide trials will be planted with wheat and barley trials at the Aberdeen R&E Center in a randomized complete block design to address the goals of both IM and UFT experiments. Appropriate fungicide treatments will be applied after inoculation with macroconidia of fungal isolates. Plots will be rated, harvested and assessed for effectiveness of treatments. **Mutual Interest:** Stakeholders will benefit by having efficacy data of the standard available fungicides compared to new fungicides, combinations and timing of applications.

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

We evaluated the integrated effects of fungicide treatment and genetic resistance on FHB and DON in wheat and barley, with emphasis on new combination fungicides, Prosaro Pro and Sphaerex for the IM trials. For the UFT, 14 treatments, including the inoculated check, were evaluated for FHB development, yield, test weight, grain moisture, DON and FDK.

**What were the major activities?**

Following standard protocol developed for the MGMT CP, we planted the wheat and barley trials and applied fungicides according to six different treatments to evaluate the efficacy of integrated effects of fungicide treatment and genetic resistance on FHB and DON in wheat and barley, with emphasis on new combination fungicides, Prosaro Pro and Sphaerex. Fungicides

were applied in hard red and white spring wheat of various resistance classes (susceptible, moderately susceptible and moderately resistant). Fungicides were applied at early anthesis with one treatment having an additional application 4-6 days after the first. There were two checks, one untreated and not inoculated and the other untreated and inoculated. Rating of disease occurred 21-24 days after inoculation, plots were harvested at maturity, and FDK and DON was determined from harvested grain samples.

**MGMT CP WHEAT**

**Table 1.** The following fungicide treatments were randomly assigned to experimental units
**Wheat:**

| Treatment[a] | Product | Rate | Timing |
|---|---|---|---|
| 1 | Untreated check | … | … |
| 2 | Untreated, non-inoculated | … | |
| 3 | Prosaro | 6.5 fl oz/A | Feekes 10.5.1 (early anthesis) |
| 4 | Miravis Ace | 13.7 fl oz/A | Feekes 10.5.1 (early anthesis) |
| 5 | Prosaro Pro | 10.3 fl oz/A | Feekes 10.5.1 (early anthesis) |
| 6 | Sphaerex | 7.3 fl oz/A | Feekes 10.5.1 (early anthesis) |

[a]**All treatments will be applied with NIS @ 0.125 v/v**

**What were the significant results?**

All fungicide treatments significantly reduced FHB incidence, severity and Index compared to the two checks (untreated inoculated and untreated non-inoculated check) when compared across varieties (Table 2). Test weight was improved, and DON was reduced with all fungicide treatments. There were no significant effects on yield or FDK. There were significant variety differences for all disease and agronomic traits measured except for yield (Table 3).

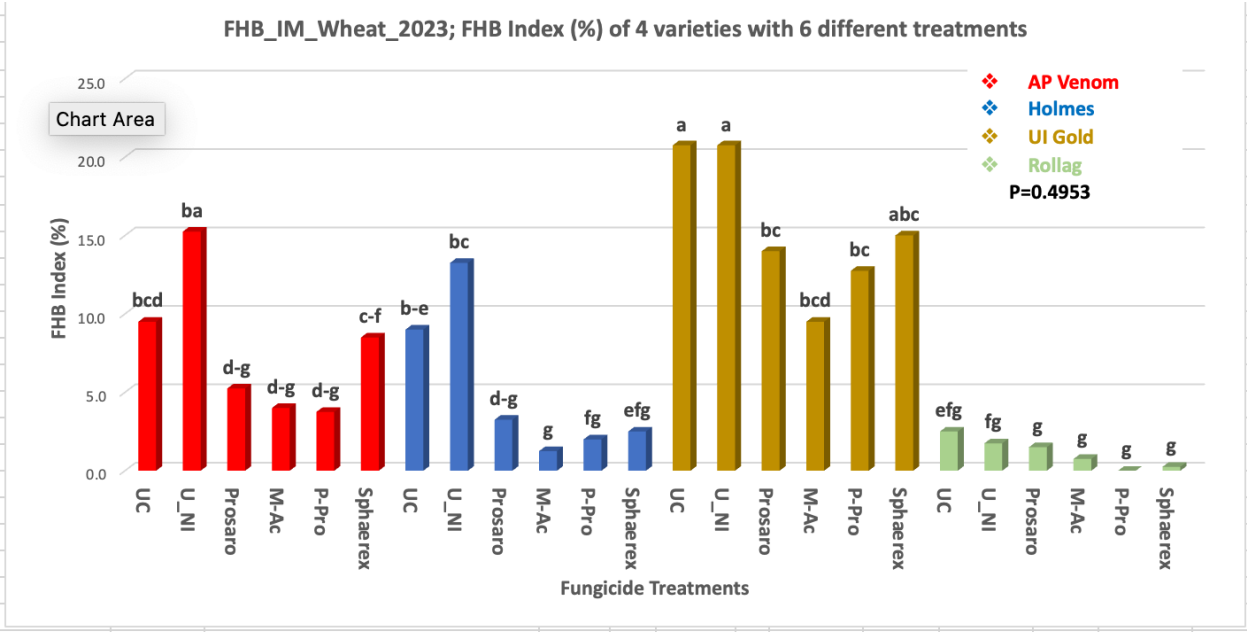
Table 2. Fungicide effects on disease, yield, test weight, FDK and DON results across four spring wheat varieties.

| Fungicide Treatment | DISEASE | | | Yield | Test Wt | FDK | DON |
|---|---|---|---|---|---|---|---|
| | Incidence (%) | Severity (%) | Index (%) | bu/A | (lb/bu) | (%) | (ppm) |
| 1 Untreated check | 42.9 a | 24.1 a | 10.4 a | 83.1 a | 56.5 cd | 14.1 a | 8.6 ab |
| 2 Untreated, non-inoc | 47.8 a | 23.6 ab | 12.8 a | 87.2 a | 55.6 d | 15.1 a | 10.5 ab |
| 3 Prosaro | 26.7 b | 18.1 bc | 6.0 b | 86.8 a | 57.6 abc | 8.9 a | 4.5 c |
| 4 Miravis Ace | 21.5 b | 13.8 c | 3.9 b | 80.4 a | 59.0 abc | 9.7 a | 3.6 c |
| 5 Prosaro Pro | 18.9 b | 18.4 abc | 4.6 b | 82.8 a | 58.3 ab | 9.6 a | 4.2 c |
| 6 Sphaerex | 27.1 b | 19.1 abc | 6.6 b | 83.9 a | 56.9 bcd | 9.6 a | 6.2 bc |
| P-value (Alpha = 0.05) | <.0001 * | 0.0055 * | <.0001* | 0.608 ns | 0.0002 * | 0.3463 ns | 0.001* |

Table 3. Variety effects on disease, yield, test weight, FDK and DON results across fungicide treatments.

| Variety | DISEASE | | | Yield | Test Wt | FDK | DON |
|---|---|---|---|---|---|---|---|
| | Incidence (%) | Severity (%) | Index (%) | (bu/A) | (lb/bu) | (%) | (ppm) |
| A AP Venom | 33.2 b | 20.9 b | 7.7 b | 83.5 a | 55.8 b | 15.7 ab | 9.2 a |
| B Holmes | 27.3 b | 16.8 b | 5.2 b | 85.1 a | 59.0 a | 8.9 bc | 5.1 b |
| C UI Gold | 52.0 a | 30.1 a | 15.5 a | 82.6 a | 54.4 b | 16.6 a | 9.5 a |
| D Rollag | 10.7 c | 10.3 c | 1.1 c | 84.8 a | 60.1 a | 3.4 c | 1.4 b |
| P-value (Alpha = 0.05) | <.0001 * | <.0001 * | <.0001* | 0.939 ns | <0.0001* | 0.0023* | 0.0002* |

Fig. 1. FHB Index of 6 fungicide treatments on two moderately susceptible (AP Venom and Holmes), one susceptible (UI Gold) and one moderately resistant variety (Rollag) of spring wheat.




**UC**: Untreated check ; **U_NI**: Untreated non-inoculated ; **M_Ac**: Miravis Ace ; **P-Pro** : Prosaro Pro
**Means followed by the same letter within a column did not differ significantly P-value (Alpha = 0.05)**

Table 4. Disease, yield, test weight, FDK and DON results for four spring wheat varieties.

| FACTOR | | | DISEASE | | | Yield | Test Wt | FDK | DON |
|---|---|---|---|---|---|---|---|---|---|
| Variety | | Fungicide | Incidence (%) | Severity (%) | Index (%) | bu/A | (lb/bu) | (%) | (ppm) |
| AP Venom | 1 | Untreated check | 39.25 bcd | 22.5 a-g | 9.5 bcd | 84.8 a-d | 55.0 f-i | 22.3 a | 11.5 a-d |
| AP Venom | 2 | Untreated, non-inoculated | 57.25 ab | 26.5 a-e | 15.3 ba | 74 d | 52.5 i | 16.5 a-d | 16.1 a-d |
| AP Venom | 3 | Prosaro | 26 cde | 18.8 d-h | 5.3 d-g | 92.8 abc | 57.0 c-g | 9.8 a-e | 4.9 d-g |
| AP Venom | 4 | Miravis Ace | 20.25 de | 16.0 e-i | 4.0 d-g | 74 d | 58.5 a-e | 14.8 a-e | 4.8 d-g |
| AP Venom | 5 | Prosaro Pro | 17.25 de | 21.5 b-h | 3.8 d-g | 86.8 a-d | 57.0 c-g | 11.8 a-e | 5.2 c-g |
| AP Venom | 6 | Sphaerex | 39 bcd | 20.0 d-h | 8.5 c-f | 88.8 a-d | 54.5 ghi | 19.3 abc | 12.5 abc |
| Holmes | 1 | Untreated check | 47.5 abc | 30.3 a-d | 9.0 b-e | 83.3 a-d | 58.0 b-f | 15.2 a-e | 8.1 c-g |
| Holmes | 2 | Untreated, non-inoculated | 55.5 ab | 24.3 a-f | 13.3 bc | 99.5 a | 56.5 d-h | 17.4 a-d | 12.9 abc |
| Holmes | 3 | Prosaro | 17.75 de | 13.5 f-i | 3.3 d-g | 84.3 a-d | 60.0 abc | 8.3 a-e | 2.6 efg |
| Holmes | 4 | Miravis Ace | 13 e | 7.5 i | 1.3 g | 79.8 bcd | 61.0 a | 3.9 de | 1.5 efg |
| Holmes | 5 | Prosaro Pro | 13.5 e | 11.5 ghi | 2.0 fg | 87.3 a-d | 59.5 a-d | 4.5 cde | 3.0 efg |
| Holmes | 6 | Sphaerex | 16.75 de | 13.8 f-i | 2.5 fge | 76.8 cd | 59.0 a-e | 4.3 cde | 2.4 efg |
| UI Gold | 1 | Untreated check | 65.75 a | 32.3 ab | 20.8 a | 86 a-d | 53.0 i | 14.7 a-e | 13.0 ab |
| UI Gold | 2 | Untreated, non-inoculated | 61.25 ab | 33.8 a | 20.8 a | 80.3 bdc | 53.5 ih | 22.0 a | 11.3 a-d |
| UI Gold | 3 | Prosaro | 52.75 ab | 28.3 a-d | 14.0 bc | 85.8 a-d | 53.5 ih | 12.5 a-e | 8.8 a-f |
| UI Gold | 4 | Miravis Ace | 45.75 abc | 20.8 c-h | 9.5 bcd | 81.3 bcd | 56.0 e-h | 17.1 a-d | 6.7 b-g |
| UI Gold | 5 | Prosaro Pro | 39.5 bdc | 33.8 a | 12.8 bc | 80 bcd | 56.5 d-h | 19.6 ab | 7.8 b-g |
| UI Gold | 6 | Sphaerex | 47.25 abc | 32.0 abc | 15.0 abc | 82.3 a-d | 54.0 ghi | 14.0 a-e | 9.2 a-e |
| Rollag | 1 | Untreated check | 19.25 de | 11.3 hig | 2.50 efg | 78.3 bcd | 60.0 abc | 4.2 cde | 1.87 efg |
| Rollag | 2 | Untreated, non-inoculated | 17.25 de | 9.8 hi | 1.75 fg | 95 ab | 60.0 abc | 4.7 b-e | 1.85 efg |
| Rollag | 3 | Prosaro | 10.25 e | 12.0 hig | 1.50 g | 84.3 a-d | 60.0 abc | 5.3 b-e | 1.56 efg |
| Rollag | 4 | Miravis Ace | 7 e | 11.0 hig | 0.75 g | 86.8 a-d | 60.5 abc | 3.0 de | 1.29 fg |
| Rollag | 5 | Prosaro Pro | 5.25 e | 7.0 i | 0.00 g | 77 cd | 60.0 abc | 2.5 de | 0.84 g |
| Rollag | 6 | Sphaerex | 5.25 e | 10.8 hig | 0.25 g | 87.8 a-d | 60.0 abc | 0.7 e | 0.90 g |
| P-value (Alpha = 0.05) | | | 0.6227 ns | 0.3 ns | 0.5 ns | 0.19 ns | 0.422 ns | 0.885 ns | 0.54 ns |

When results were split into variety and fungicide effects, there were no statistically significant differences between treatments. All fungicide treatments resulted in lower disease, DON and FDK compared to the two checks except Sphearex. DON content was lowest (0.84 ppm) on plots treated with Prosaro Pro applied on the moderately resistant variety Rollag. All untreated checks produced DON level higher than 1ppm on spring wheat (Tables 1 - 3).

None of the fungicides had significant effect on yield or FDK, but improved test weight compared to the untreated check for all treatments except Sphearex. Disease incidence and disease index was reduced for all fungicide treatments. DON averaged approximately 50% less for all treatments except Sphaerex.

**List key outcomes or other achievements.**

New fungicides have been added to the list of effective fungicides to reduce the impact of FHB and accumulation of DON. Sphaerex did not provide the level of control for DON and disease index on the susceptible variety UI Gold (spring wheat) compared to the other fungicides, but over all varieties (Fig.1) Sphaerex was as effective as the other fungicides in reducing disease incidence, severity and index. The most effective control of FHB occurred with the combination of resistant varieties and application of fungicides at applied at anthesis.

**What were the significant results?**

**Barley Treatments:**

**Table 5.** The following fungicide treatments were randomly assigned to experimental units: **Barley**

| Trt[a] | Product | Rate (fl oz/A) | Timing[b] |
|---|---|---|---|
| 1 | Untreated check | ... | ... |
| 2 | Prosaro | 6.5 | Feekes 10.5 (heading) |
| 3 | Miravis Ace | 13.7 | Feekes 10.5 (heading) |
| 4 | Prosaro Pro | 10.3 | Feekes 10.5 (heading) |
| 5 | Sphaerex | 7.3 | Feekes 10.5 (heading) |
| 6 | Sphaerex | 7.3 | 4-6 days after heading |

[a]All treatments will be applied with NIS @ 0.125 v/v

[b]Heading will be defined as when approximately 100% of the tillers with spikes are fully emerged.

Across fungicide treatments, yield, test weight and DON were not significantly different across treatments. Disease incidence, severity and index were reduced across all fungicide treatments (Table 6). **Sphaerex applied 4-6 days after heading was as effective for disease reduction as Sphaerex applied at heading.** LCS Odyssey was the most susceptible variety and FHB Index was highest for the untreated inoculated treatment (Fig. 2). There were no significant differences across varieties for yield, test weight, or disease measurements except for DON (Table 7).

Table 6. Fungicide effects on disease, yield, test weight, FDK and DON results across four spring barley varieties.

| Fungicide Treatment | | DISEASE | | | Yield | Test Wt | DON |
|---|---|---|---|---|---|---|---|
| | | Incidence (%) | Severity (%) | Index (%) | bu/A | (lb/bu) | (ppm) |
| 1 | Untreated check(inoculated) | 39.3 a | 10.4 a | 5.2 a | 124.8 ab | 49.7 a | 1.8 a |
| 2 | Prosaro | 20.3 b | 7.6 b | 1.7 b | 117.6 b | 49.0 a | 1.9 a |
| 3 | Miravis Ace | 17.9 b | 6.7 b | 1.4 b | 125.2 ab | 49.9 a | 2.5 a |
| 4 | Prosaro Pro | 22.6 b | 7.7 b | 2.0 b | 133.3 a | 49.5 a | 2.1 a |
| 5 | Sphaerex | 22.7 b | 7.6 b | 2.1 b | 123.9 ab | 49.3 a | 2.1 a |
| 6 | Sphaerex(4-6 days after heading) | 19.5 b | 6.4 b | 1.3 b | 126.7 ab | 48.9 a | 2.3 a |
| P-value (Alpha =0.05) | | <.0001 * | 0.0006 * | <.0001 * | 0.388 ns | 0.3693 | 0.8138 ns |

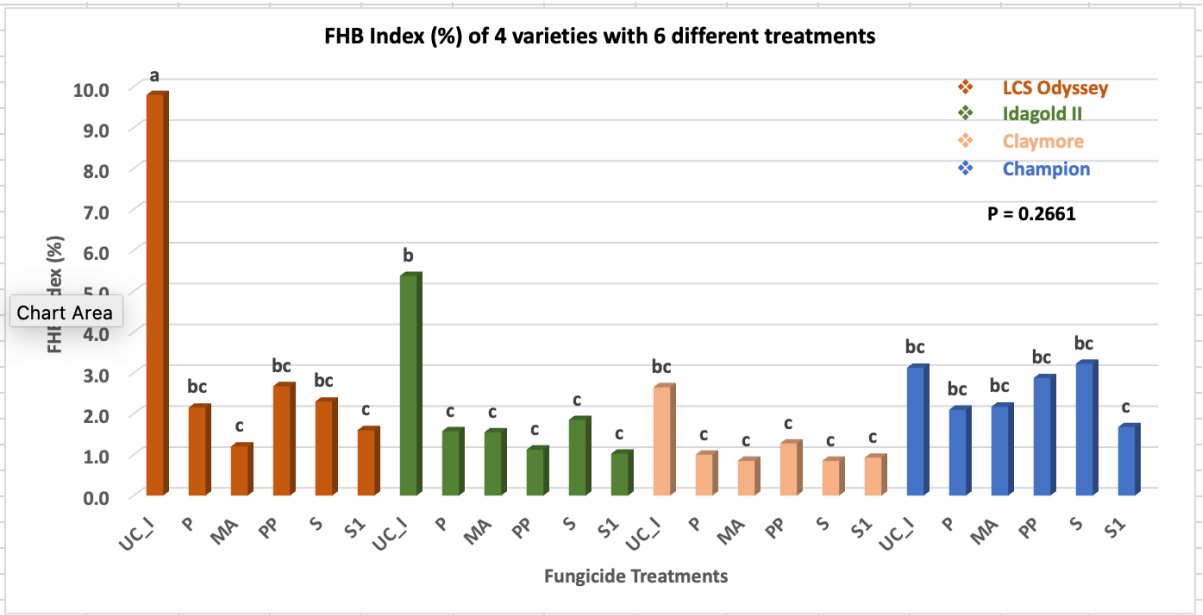
Table 7. Variety effects on disease, yield, test weight, FDK and DON results across fungicide treatments on spring barley.

| Variety | | DISEASE | | | Yield | Test Wt | DON |
|---|---|---|---|---|---|---|---|
| | | Incidence (%) | Severity (%) | Index (%) | (bu/A) | (lb/bu) | (ppm) |
| 1 | LCS Odyssey | 29.8 a | 8.9 a | 3.3 a | 127.6 a | 48.2 b | 3.4 a |
| 2 | Idagold II | 20.2 ab | 7.4 ab | 2.1 ab | 123.0 a | 49.3 ab | 1.6 b |
| 3 | Claymore | 18.7 b | 6.2 b | 1.3 b | 127.2 a | 49.9 a | 1.8 b |
| 4 | Champion | 26.2 ab | 8.3 ab | 2.5 ab | 123.3 a | 50.0 a | 1.6 b |
| P-value (Alpha = 0.05) | | 0.1073 ns | 0.1155 ns | 0.1135 ns | 0.8809 ns | 0.0813 | 0.0169* |

Table 8. Disease, yield, test weight, FDK and DON results for four spring wheat varieties. Fig. 1. FHB Index of 6 fungicide treatments on two moderately susceptible (Idagold II, Champion), one susceptible (LCS Odyssey) and one moderately resistant variety (Claymore) of spring barley.

| FACTOR | | | DISEASE | | | Yield | Test Wt | DON |
|---|---|---|---|---|---|---|---|---|
| Variety | | Fungicide | Incidence (%) | Severity (%) | Index (%) | bu/A | (lb/bu) | (ppm) |
| LCS Odyssey | 1 | Untreated check(inoculated) | 58.0 a | 14.7 a | 9.8 a | 117.0 ab | 48.5 c-f | 2.4 a-f |
| LCS Odyssey | 2 | Prosaro | 24.8 b-e | 8.9 bcd | 2.2 bc | 130.5 ab | 46.9 f | 3.5 abc |
| LCS Odyssey | 3 | Miravis Ace | 17.3 cde | 6.5 cd | 1.2 c | 121.3 ab | 49.5 a-f | 4.1 a |
| LCS Odyssey | 4 | Prosaro Pro | 30.0 bcd | 8.9 bcd | 2.7 bc | 134.3 ab | 48.9 b-f | 3.3 a-d |
| LCS Odyssey | 5 | Sphaerex | 25.3 b-e | 8.4 bcd | 2.3 bc | 125.8 ab | 48.2 def | 4.0 abc |
| LCS Odyssey | 6 | Sphaerex(4-6 days after heading) | 23.8 b-e | 6.4 cd | 1.6 c | 137.0 a | 47.4 ef | 3.2 a-e |
| Idagold II | 1 | Untreated check(inoculated) | 31.8 bc | 11.6 ab | 5.4 b | 124.3 ab | 48.9 b-f | 1.5 c-f |
| Idagold II | 2 | Prosaro | 18.5 cde | 6.8 cd | 1.6 c | 116.5 ab | 49.0 b-f | 1.1 ef |
| Idagold II | 3 | Miravis Ace | 16.8 ed | 6.7 cd | 1.6 c | 133.3 ab | 50.9 ab | 1.9 b-f |
| Idagold II | 4 | Prosaro Pro | 15.0 e | 6.7 cd | 1.1 c | 134.0 ab | 49.6 a-f | 2.6 a-f |
| Idagold II | 5 | Sphaerex | 21.5 b-e | 7.1 cd | 1.9 c | 106.0 b | 48.9 b-f | 1.1 f |
| Idagold II | 6 | Sphaerex(4-6 days after heading) | 17.5 ced | 5.9 cd | 1.0 c | 123.8 ab | 48.9 b-f | 1.5 c-f |
| Claymore | 1 | Untreated check(inoculated) | 31.5 bc | 7.4 cd | 2.7 bc | 131.8 ab | 49.8 a-e | 1.6 c-f |
| Claymore | 2 | Prosaro | 16.0 ed | 6.1 cd | 1.0 c | 107.3 b | 49.5 a-f | 1.2 ef |
| Claymore | 3 | Miravis Ace | 16.0 ed | 5.5 d | 0.9 c | 124.8 ab | 49.8 a-e | 2.3 a-f |
| Claymore | 4 | Prosaro Pro | 19.0 cde | 6.8 cd | 1.3 c | 141.8 a | 50.0 a-d | 1.4 def |
| Claymore | 5 | Sphaerex | 15.3 e | 5.5 d | 0.9 c | 128.8 ab | 50.0 a-d | 1.6 c-f |
| Claymore | 6 | Sphaerex(4-6 days after heading) | 14.5 e | 6.1 cd | 0.9 c | 128.8 ab | 50.5 abc | 2.9 a-f |
| Champion | 1 | Untreated check(inoculated) | 36.0 b | 7.9 bcd | 3.13 bc | 126.3 ab | 51.5 a | 1.93 c-f |
| Champion | 2 | Prosaro | 22.0 b-e | 8.8 bcd | 2.10 bc | 116.3 ab | 50.5 a-d | 1.78 c-f |
| Champion | 3 | Miravis Ace | 21.8 b-e | 8.0 bcd | 2.18 bc | 121.5 ab | 49.5 a-f | 1.58 c-f |
| Champion | 4 | Prosaro Pro | 26.5 b-e | 8.6 bcd | 2.88 bc | 123.3 ab | 49.5 a-f | 1.19 ef |
| Champion | 5 | Sphaerex | 28.8 b-e | 9.5 cb | 3.23 bc | 135.0 ab | 50.1 a-d | 1.70 c-f |
| Champion | 6 | Sphaerex(4-6 days after heading) | 22.3 b-e | 7.3 cd | 1.68 c | 117.3 ab | 48.8 b-f | 1.63 c-f |
| P-value (Alpha = 0.05) | | | 0.2978 ns | 0.1754 ns | 0.2661 ns | 0.6159 ns | 0.4145 | 0.856 ns |

Fig. 2. FHB Index of 6 fungicide treatments on two moderately susceptible (Idagold II, Champion) one susceptible (LCS Odyssey) and one moderately resistant variety (Claymore) of spring wheat.




Untreated check(inoculated) : **UC-I** ; Prosaro : **P;** Miravis Ace : **MA**; Prosaro Pro : **PP** ; Sphaerex : **S** ; Sphaerex (4-6 days after heading) : **S1**
**Means followed by the same letter within a column did not differ significantly P-value (Alpha = 0.05)**

## Uniform Fungicide trials:

## Table 1. Treatments:

Spray vol: 20 GAL/AC Mix Size: 1 L (total for 4 plots; minimum=0.3233 L)

| Trt No. | Treatment Name | Form Conc | Form Unit | Form Type | Rate | Rate Unit | Other Rate | Other Rate Unit | Appl Code | Appl Description | Amt Product to Measure |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Untreated Check | | | | | | | | | | |
| 2 | Prosaro | | | EC | 475 | ml/ha | 8.2 | fl oz/a | C | Anthesis | 3.2 mL/mx |
| | Induce 90 SL | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| 3 | Caramba | | | SC | 990 | ml/ha | 13.5 | fl oz/a | C | Anthesis | 5.292 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| 4 | Miravis Ace | | | SC | 1000 | ml/ha | 13.7 | fl oz/a | C | Anthesis | 5.345 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| 5 | Prosaro Pro | | | SC | 752 | ml/ha | 10.3 | fl oz/a | C | Anthesis | 4 mL/mix |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| 6 | Sphaerex | | | SC | 533 | ml/ha | 7.3 | fl oz/a | C | Anthesis | 2.9 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| 7 | Miravis Ace | | | SC | 1000 | ml/ha | 13.7 | fl oz/a | C | Anthesis | 5.345 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| | Prosaro Pro | | | SC | 752 | ml/ha | 10.3 | fl oz/a | C | Anthesis | 4 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| 8 | Miravis Ace | | | SC | 1000 | ml/ha | 13.7 | fl oz/a | C | Anthesis | 5.345 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| | Sphaerex | | | SC | 533 | ml/ha | 7.3 | fl oz/a | D | 4-6 days after anthesis | 2.9 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | D | 4-6 days after anthesis | 1.25 mL/mx |
| 9 | Miravis Ace | | | SC | 1000 | ml/ha | 13.7 | fl oz/a | C | Anthesis | 5.345 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| | Tebuconazole | | | SC | 290 | ml/ha | 4.0 | fl oz/a | D | 4-6 days after anthesis | 1.561 mL/a |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | D | 4-6 days after anthesis | 1.25 mL/mx |
| 10 | Prosaro | | | SC | 475 | ml/ha | 6.5 | fl oz/a | C | Anthesis | 2.539 mL/mix |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| 11 | Miravis Ace | | | SC | 1000 | ml/ha | 13.7 | fl oz/a | B | 50% Heading | 5.345 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | B | 50% Heading | 1.25 mL/mx |
| 12 | Miravis Ace | | | SC | 1000 | ml/ha | 13.7 | fl oz/a | C | Anthesis | 5.345 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| | Prosaro Pro | | | SC | 752 | ml/ha | 10.3 | fl oz/a | D | 4-6 days after anthesis | 4 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | D | 4-6 days after anthesis | 1.25 mL/mx |
| 13 | Prosaro Pro | | | SC | 993 | ml/ha | 13.6 | fl oz/a | C | Anthesis | 5.28 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| 14 | Miravis Ace | | | SC | 510 | ml/ha | 7 | fl oz/a | A | Herbicide Timing | 2.73 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | A | Herbicide Timing | 1.25 mL/mx |
| | Miravis Ace | | | SC | 1000 | ml/ha | 13.7 | fl oz/a | C | Anthesis | 5.345 mL/mx |
| | NIS | 100 | % | SL | 0.125 | % v/v | | | C | Anthesis | 1.25 mL/mx |
| 15 | Curezin | | | | | | | | | | |
| | NIS | | | | | | | | | | |
| 16 | K61 | | | | | | | | | | |

**[a]All treatments will be applied with NIS @ 0.125 v/v**

**What were the significant results?**

The spring was cool and wet, delaying maturation of the crop. FHB development was not optimum. No phytotoxicity was observed resulting from any of the fungicide treatments.

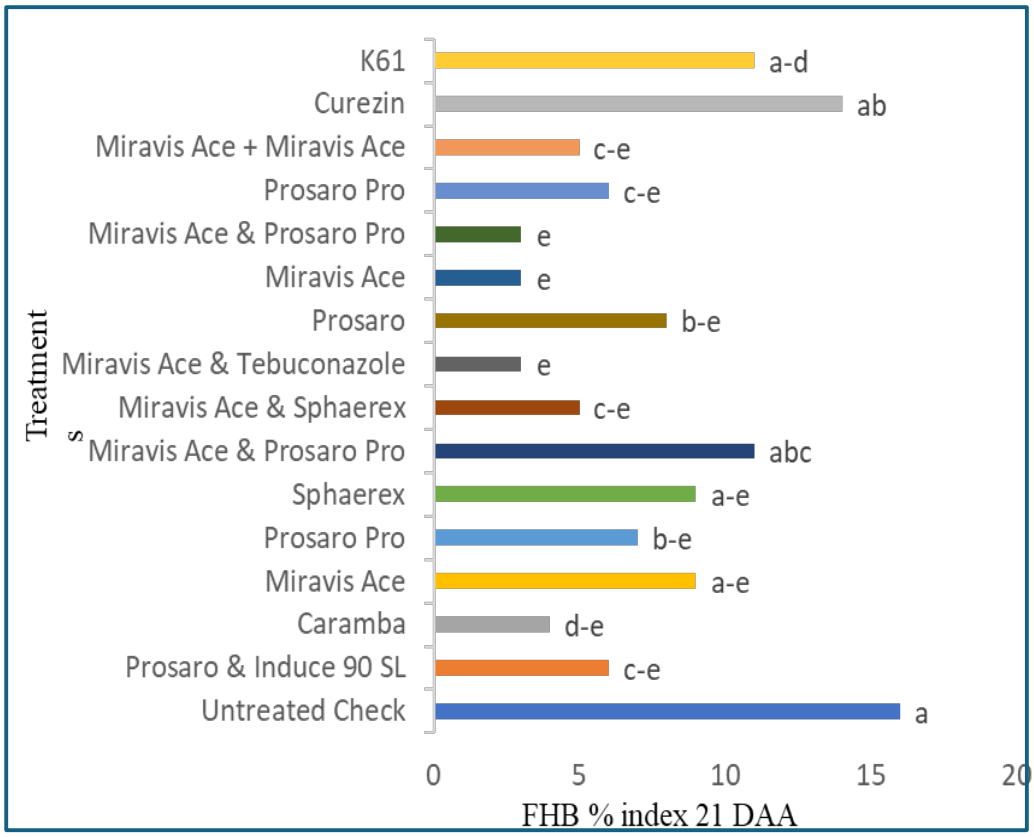
There were significant differences in grain yield (P<0.05). There were significant differences in disease ratings on FHB Incidence 21 days after application (P<0.01), for disease severity (P<0.05), and FHB index (P=0.01), (Table 2). Mean FHB incidence, severity and index per plot ranged from 26 to 72%, 10 – 24 % and 3 – 16%, respectively. The highest incidence, severity and index were recorded on untreated control plots (with the exception of Curezin, recording a slightly higher but statistically nonsignificant percent FHB severity). All other fungicide treatments reduced FHB incidence, severity, index and seed DON levels compared to the untreated check plots. The highest yielding treatment was treatment 12 @ 98 bu/A (Miravis Ace @ 50% flowering followed by Prosaro Pro). The next highest yielding treatments included treatment 11 at 89 bu/A (Miravis Ace with Induce at early flowering), then treatment 8 at 88u/A (Miravis Ace at early flowering compared to the untreated check at 60 bu/A. There were differences in FHB incidence, with the lowest incidence of FHB in treatments 3,9,11,12. The greatest reduction in FHB index came with treatments 3,9,11 and 12 (Caramba, Miravis Ace followed by Tebuconazole, Miravis Ace at HH, and Miravis Ace at early flowering or anthesis followed by Prosaro Pro). Samples were tested for ppm levels of DON where there were significant differences between treatments (P = 0.024).

Table 2. FHB incidence, severity, and index 21 after fungicide application on hard red spring

| Trt No. | Treatment Name | Appl Rate | Appl Code | incidence 21 daa C | Severity 21 daa C | Index 21 daa C | Yield (bu/A) | TstWt (lb/bu) | DON (ppm) | FDK (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Untreated Check | --- | | 72 a | 22 ab | 16 a | 60 e | 55e | 13.5 a | 22.3 a |
| 2 | Prosaro | 8.2 fl.oz/A | C | 40 b-e | 16 a-e | 6 c-e | 80 a-d | 57 a-d | 6.3 b-f | 8.9 b-e |
| | Induce 90 SL | 0.125 % v/v | C | | | | | | | |
| 3 | Caramba | 13.5 fl. oz./A | C | 28 cde | 13 c-e | 4 d-e | 73 b-e | 56 cde | 7.1 b-f | 10.4 b-e |
| 4 | Miravis Ace | 13.7 fl. oz./A | C | 47 bcd | 20 a-d | 9 a-e | 76 b-e | 56 cde | 10.6 abc | 14.8 a-e |
| 5 | Prosaro Pro | 10.3 fl. oz./A | C | 37 b-e | 20 a-d | 7 b-e | 78 bcd | 58 abc | 4.6 c-f | 11.8 a-e |
| 6 | Sphaerex | 7.3 fl. oz./A | C | 38 b-e | 21 abc | 9 a-e | 75 b-e | 57 a-e | 7.3 a-f | 20.7 ab |
| 7 | Miravis Ace | 13.7 fl. oz./A | C | 50 abc | 21 abc | 11 abc | 72 cde | 56 b-e | 9.1 a-e | 18.0 abc |
| | Prosaro Pro | 10.3 fl. oz./A | C | | | | | | | |
| 8 | Miravis Ace | 13.7 fl. oz./A | C | 33 b-e | 14 b-e | 5 c-e | 88 abc | 59 a | 3.0 ef | 8.3 cde |
| | Sphaerex | 7.3 fl. oz./A | D | | | | | | | |
| 9 | Miravis Ace | 13.7 fl. oz./A | C | 28 e | 12 de | 3 e | 75 b-e | 58 ab | 3.3 ef | 6.4 de |
| | Tebuconazole | 4 fl. oz./A | D | | | | | | | |
| 10 | Prosaro | 6.5 fl. oz./A | C | 43 b-e | 16 a-e | 8 b-e | 77 b-e | 57 a-e | 7.5 a-f | 16.9 a-d |
| 11 | Miravis Ace | 13.7 fl. oz./A | B | 26 d-e | 11 e | 3 e | 89 ab | 58 ab | 6.0 b-f | 13.8 a-e |
| 12 | Miravis Ace | 13.7 fl. oz./A | C | 26 d-e | 10 e | 3 e | 98 a | 59 a | 2.1 f | 3.4 e |
| | Prosaro Pro | 10.3 fl. oz./A | D | | | | | | | |
| 13 | Prosaro Pro | 13.6 fl. oz./A | C | 34 b-e | 18 a-e | 6 c-e | 80 bcd | 58 abc | 4.1 def | 8.8 cde |
| 14 | Miravis Ace | 7 fl. oz./A | A | 31 b-e | 15 b-e | 5 c-e | 82 abc | 58 abc | 6.1 b-f | 11.4 a-e |
| | Miravis Ace | 13.7 fl. oz./A | C | | | | | | | |
| 15 | Curezin | | | 54 ab | 24 a | 14 ab | 72 be | 55 de | 11.2 abc | 16.3 a-d |
| 16 | K61 | | | 50 abc | 20 a-d | 11 a-d | 64 de | 55 de | 9.5 a-d | 17.8 a-d |
| | | | Mean | **39** | **17** | **8** | **77** | **57** | **6.9** | **13.1** |
| | | | LSD P=.05 | **6** | **2** | **2** | **5** | **2** | **2** | **2** |
| | | | CV | **44** | **36** | **70** | **17.1** | **3** | **72.9** | **66** |
| | | | Treatment Prob (F) | **0.009** | **0.034** | **0.010** | **0.018** | **0.0103** | **0.024** | 0.0937 |

Note: Treatments with the same letter in a column are not significantly different (P<0.05)
Application Codes: A = 50% Flag leaf emergence, B = Half Heading, C =Early Flowering (Feekes 10.5.1). Days after fungicide application = daa.

Figure 3. Fusarium head blight of various fungicide treatments in comparison to the untreated control. Treatments with the same letter are not significantly different (at P<0.05)




**3. What opportunities for training and professional development has the project provided?**

We have trained two graduate students on these projects (one PhD candidate and one MS candidate) as well as additional training for a support scientist who have or will present the results at the USWBSI Forum.

**4. How have the results been disseminated to communities of interest?**

The results of all the IM and UFT fungicide trials are published with the results of the Coordinated Project, presented at various grower seminar and field events, and reported annually at the National FHB Forum.

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

There are no proposed changes to the trials.