

RYE CROP AND DISEASE MANAGEMENT TRIALS IN KENTUCKY, 2021-2022

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INTRODUCTION

Farmers and distillers are interested in growing and buying cereal rye for grain. Cereal rye fits into a winter crop rotation scheme. Consistency of yield and grain quality must be obtained for farmers to grow rye and for distillers to have confidence in a local supply chain. Previous studies have determined that hybrid rye yields better than lines; 750,000 to 800,000 seeds per acre is sufficient for hybrid rye; and nitrogen rates of about 75 pounds N per acre are adequate. However, nitrogen rate responses are more inconsistent. Hybrid rye in Kentucky is susceptible to *Fusarium* head blight. These studies are being conducted to identify rye response to foliar fungicides and crop response to fertilizer nitrogen and sulfur.

METHODS AND MATERIALS

Lexington

Rye was planted September 29, 2021 into a Bluegrass Maury silt loam at 2 to 6% slopes.

For the crop management trial, treatments included rye seeded at 600 and 800 thousand seeds per acre.

Fertilizer treatments included

1. 75 lb N/acre;
2. 75 lb N/acre + 20 lb S/acre;
3. 150 lb N/acre; and
4. 150 lb N/acre + 30 lb S/acre.

Muriate of potash (0-0-60) was applied to the field before planting according to soil test recommendations. No phosphorus was needed. Nitrogen fertilizer was applied at the specified rates at Feekes 3 growth stage on March 24, 2022. Miravis Ace fungicide (pydiflumetofen and propiconazole) was applied at anthesis (Feekes 10.51) on May 13, 2021 at 13.7 fluid ounces per acre (1.0 L per hectare). Rye was harvested with a Wintersteiger Delta combine on June 28, 2021, using a Harvest Master weighing system that measured grain weight, test weight, and seed moisture.

For the fungicide trial, five hybrids and one variety were planted at 800,000 seeds per acre on October 1, 2021. Fungicide treatments include:

1. Tilt fungicide was applied at flagleaf (April 22, 2022),
2. Miravis Ace applied at anthesis (May 13, 2022),
3. Tilt at flagleaf and Miravis Ace at anthesis
4. Untreated Check

Rye was harvested started on June 29, 2022 and completed on July 15, 2022 after combine failure and repairs.). Rye was harvested with a Wintersteiger Delta combine on June 28, 2021, using a Harvest Master weighing system that measured grain weight, test weight, and seed moisture.

Princeton

At Princeton, rye trials were planted on a Crider silt loam and a Zanesville silt loam (two locations). Fertilizer treatments included:

1. 75 lb N/acre;
2. 75 lb N/acre + 20 lb S/acre; and
3. 20 lb S/acre

Nitrogen was split-applied applied at Feekes 3 and Feekes 5 growth stages at Princeton. Miravis Ace fungicide was applied at anthesis. Rye was harvested with a Wintersteiger Delta combine using a Harvest Master weighing system that also measured moisture and test weight (seed density). Seed samples were run on a Dickey-John GAC to confirm seed moisture and test weight.

For the fungicide trial, five hybrids and one variety were planted at 800,000 seeds per acre. Fungicide treatments included:

1. Tilt fungicide was applied at flagleaf (April 15, 2022),
2. Miravis Ace applied at anthesis (SH3 on April 29, 2022; all others on May 10, 2022),
3. Tilt at flagleaf and Miravis Ace at anthesis
4. Untreated Check

Miravis Ace fungicide was applied at flagleaf, at anthesis, or at both timings. These treatments were compared with an untreated check for each hybrid or variety. Rye was harvested with a Wintersteiger Delta combine using a Harvest Master weighing system that also measured moisture and test weight (seed density). Seed samples were run on a Dickey-John GAC to confirm seed moisture and test weight.

RESULTS

Nitrogen and Sulfur Effects

At Lexington, yields were low at about 55 bushels per acre on average (Table 1). Yields were not affected by seed rate, by nitrogen rate or by the addition of sulfur fertilizer. Lodging was severe and freeze damage was erratic in the plots with average lodging ranging from 5.3 to 6.9. For references, rating of 9 means that every plant is fallen flat on the soil. Ratings above 5 suggest severe lodging across all treatments and suggest that lodging was not a result of the treatments imposed. Freeze damage was assessed as well. Heads and stems likely were compromised from that damage. In a separate planting date study, rye planted at the same time also lodged whereas rye planted later did not.

Table 1. Rye at the Higher Seeding Rate had less Lodging but Yield was not Affected by Seed Rate and Nitrogen or Sulfur Applications, Lexington, KY 2022.

| Treatment | Yield, bu/A | Lodging, 0-9 (9=all lodged) |
|----------------------------------|-------------|--------------------------------|
| Seed Rate Effect, seeds/A | | |
| 600,000 seeds/acre | 55.7 a | 6.8 a |
| 800,000 seeds/acre | 57.7 a | 5.4 b |
| Fertility Effect, lb/A | | |
| 75 N + 0 S | 59.5 a | 6.9 a |
| 75 N + 20 S | 51.9 a | 5.9 a |
| 150 N + 0 S | 56.5 a | 6.4 a |
| 150 N + 30 S | 59.1 a | 5.3 a |
| <i>LSD (0.10) SR</i> | 15.43 | 1.12 |
| <i>LSD (0.10) FERT</i> | 21.82 | 1.58 |
| <i>P value SR</i> | 0.8254 | 0.0374 |
| <i>P value FERT</i> | 0.9291 | 0.3500 |
| <i>P value SRxFERT</i> | 0.7969 | 0.5789 |

Means are compared within Seeding Rate and Fertility.

Means in the same column with different letters are significantly different ($p \leq 0.10$).

Table 2. Hybrid Rye Yield and Test Weight was Not Affected by Nitrogen or Sulfur Applications, Princeton, KY 2022.

| Soil | Fertility, lb/A | Yield, bu/A | Test Weight, lb/bu |
|-------------------|-------------------|-------------|--------------------|
| Crider | 75 N + 0 S | 86.2 a | 49.0 a |
| | 75 N + 20 S | 88.7 a | 50.5 a |
| | 0 N + 20 S | 86.6 a | 50.5 a |
| | <i>LSD (0.10)</i> | 14.6 | 2.1 |
| | <i>p value</i> | 0.9463 | 0.3503 |
| Zanesville | 75 N + 0 S | 51.3 a | 53.3 a |
| | 75 N + 20 S | 58.4 a | 53.1 a |
| | 0 N + 20 S | 41.9 a | 53.1 a |
| | <i>LSD (0.10)</i> | 11.1 | 2.1 |
| | <i>p value</i> | 0.0952 | 0.3503 |

Fungicide Effects

At Lexington, fungicide application did not affect grain yield (Table 3). Plant lodging was inconsistent across the trials and freeze damage occurred as well, likely causing the lodging. The yields are likely a reflection of freeze damage and lodging rather than fungicide. FHB Index was less than 10.2 for all treatments, indicating very low pressure from Fusarium Head Blight.

At Princeton, rye yields were generally better than at Lexington (Table 4). Plant lodging was greater for Aventino and Bono, while the other four hybrids had little or no plant lodging. Fungicides improved yields for some of the hybrids and varieties including Serafino, SH3, and Receptor. FHB Index was greater for the treatments that did not include Miravis Ace at anthesis. FHB Index was less than 11 for all treatments, indicating low pressure from Fusarium Head Blight.

Table 3. Rye hybrid/variety response to fungicide timing at Lexington, KY, 2022.

| Variety | Fung trt | Fungicide | 6/1/2022 FHB incidence (%) | 6/1/2022 FHB severity (%) | 6/1/2022 FHB index (0- 100) | Yield bu/A | Lodging, 0-9 (9=all lodged) |
|----------|-----------|---------------------|----------------------------------|---------------------------------|-----------------------------------|---------------|--------------------------------|
| Aventino | Flag leaf | Tilt | 3.2 | 16.0 | 0.6 | 44.1 | 8.5 |
| Aventino | Anthesis | Miravis Ace | 6.4 | 29.3 | 2.2 | 42.8 | 8.5 |
| Aventino | FL + Anth | Tilt fb Miravis Ace | 6.4 | 12.3 | 0.9 | 57.5 | 5 |
| Aventino | Untreated | Untreated | 10.4 | 33.1 | 3.2 | 49 | 9 |
| Serafino | Flag leaf | Tilt | 8.8 | 24.3 | 2.2 | 60.1 | 8 |
| Serafino | Anthesis | Miravis Ace | 3.2 | 21.0 | 0.8 | 68.8 | 5.5 |
| Serafino | FL + Anth | Tilt fb Miravis Ace | 7.2 | 21.3 | 1.4 | 53.7 | 3 |
| Serafino | Untreated | Untreated | 8.8 | 15.2 | 1.8 | 30.8 | 8 |
| Bono | Flag leaf | Tilt | 5.6 | 14.5 | 1.1 | 23.2 | 4.2 |
| Bono | Anthesis | Miravis Ace | 1.6 | 1.0 | 0.1 | 58.4 | 0.5 |
| Bono | FL + Anth | Tilt fb Miravis Ace | 8.8 | 34.5 | 2.5 | 65.2 | 1 |
| Bono | Untreated | Untreated | 11.2 | 46.7 | 5.2 | 42.2 | 4.5 |
| SH3 | Flag leaf | Tilt | 45.6 | 17.9 | 8.4 | 71.6 | 6.5 |
| SH3 | Anthesis | Miravis Ace | 21.6 | 20.7 | 4.7 | 48 | 6.5 |
| SH3 | FL + Anth | Tilt fb Miravis Ace | 32.0 | 17.3 | 5.6 | 61.5 | 5.5 |
| SH3 | Untreated | Untreated | 44.0 | 23.5 | 10.2 | 60.9 | 6.5 |
| Tayo | Flag leaf | Tilt | 13.6 | 40.4 | 5.0 | 65.1 | 1 |
| Tayo | Anthesis | Miravis Ace | 6.4 | 30.2 | 2.6 | 29.7 | 1.5 |
| Tayo | FL + Anth | Tilt fb Miravis Ace | 3.2 | 17.0 | 0.8 | 31.3 | 2 |
| Tayo | Untreated | Untreated | 6.4 | 19.3 | 1.9 | 22.2 | 0 |
| Receptor | Flag leaf | Tilt | 9.6 | 26.0 | 3.1 | 40.5 | 7 |
| Receptor | Anthesis | Miravis Ace | 6.0 | 26.9 | 1.9 | 62.8 | 2 |
| Receptor | FL + Anth | Tilt fb Miravis Ace | 9.6 | 11.6 | 1.0 | 55.1 | 2 |
| Receptor | Untreated | Untreated | 8.8 | 30.0 | 2.8 | 50.8 | 2 |
| | | <i>P > F</i> | 0.0001 | 0.0700 | 0.0001 | 0.5355 | 0.0007 |
| | | LSD 0.05 | 7.9 | NS | 2.9 | | |
| | | LSD 0.10 | 6.6 | 18.8 | 2.4 | 1.68 | 1.71 |
| | | CV % | 51.7 | 77.8 | 78.7 | | |

Table 4. Rye hybrid/variety response to fungicide timing at Princeton, KY, 2022.

| Variety | Fung trt | Fungicide | 5/26/2022 | 5/26/2022 | 5/26/2022 | 5/26/2022 | 5/26/2022 | 5/26/2022 | 5/26/2022 | 5/26/2022 | Lodging, 0-9 | Moisture | Yield | Test Weight |
|----------|----------------------|---------------------|------------------------|-----------------------|-------------------|------------------|-------------------|------------------|-------------------|----------------|---------------|---------------|---------------|-------------|
| | | | Leaf dis incidence (%) | Leaf dis severity (%) | FHB incidence (%) | FHB severity (%) | FHB incidence (%) | FHB severity (%) | FHB index (0-100) | (9=all lodged) | % | bu/A | lb/bu | |
| Aventino | Flag leaf | Tilt | 100.0 | 21.0 | 29.0 | 10.5 | 3.1 | 3.0 | 12.0 | 63.9 | 53.0 | | | |
| Aventino | Anthesis | Miravis Ace | 90.0 | 12.5 | 10.0 | 5.4 | 0.7 | 3.5 | 11.9 | 66.2 | 53.7 | | | |
| Aventino | Flag leaf + Anthesis | Tilt fb Miravis Ace | 100.0 | 13.5 | 8.0 | 9.2 | 1.0 | 4.0 | 11.8 | 58.6 | 53.5 | | | |
| Aventino | Untreated | Untreated | 100.0 | 34.8 | 25.0 | 15.3 | 3.5 | 4.8 | 11.8 | 55.4 | 52.3 | | | |
| Serafino | Flag leaf | Tilt | 100.0 | 19.8 | 22.0 | 7.9 | 1.8 | 0.3 | 11.9 | 88.8 | 52.1 | | | |
| Serafino | Anthesis | Miravis Ace | 85.0 | 14.3 | 8.0 | 6.9 | 0.6 | 2.5 | 11.4 | 91.3 | 52.9 | | | |
| Serafino | Flag leaf + Anthesis | Tilt fb Miravis Ace | 90.0 | 9.8 | 11.0 | 6.6 | 0.8 | 2.3 | 11.4 | 91.5 | 53.5 | | | |
| Serafino | Untreated | Untreated | 100.0 | 17.3 | 30.0 | 9.6 | 3.0 | 3.0 | 11.6 | 72.8 | 51.9 | | | |
| Bono | Flag leaf | Tilt | 100.0 | 37.5 | 22.0 | 15.3 | 2.4 | 6.0 | 11.2 | 57.5 | 50.5 | | | |
| Bono | Anthesis | Miravis Ace | 100.0 | 11.3 | 7.0 | 16.9 | 1.3 | 6.5 | 11.6 | 51.1 | 50.5 | | | |
| Bono | Flag leaf + Anthesis | Tilt fb Miravis Ace | 95.0 | 22.3 | 5.0 | 2.5 | 0.3 | 7.3 | 11.7 | 62.4 | 51.1 | | | |
| Bono | Untreated | Untreated | 100.0 | 31.5 | 26.0 | 14.4 | 3.8 | 4.5 | 11.8 | 50.9 | 49.6 | | | |
| SH3 | Flag leaf | Tilt | 100.0 | 28.5 | 51.0 | 20.1 | 10.4 | 0.0 | 11.9 | 56.8 | 51.0 | | | |
| SH3 | Anthesis | Miravis Ace | 90.0 | 39.8 | 19.0 | 11.1 | 2.5 | 0.0 | 11.6 | 83.3 | 52.0 | | | |
| SH3 | Flag leaf + Anthesis | Tilt fb Miravis Ace | 90.0 | 40.0 | 18.0 | 11.0 | 2.2 | 0.0 | 11.6 | 65.5 | 52.0 | | | |
| SH3 | Untreated | Untreated | 95.0 | 33.3 | 49.0 | 15.9 | 8.1 | 0.0 | 11.8 | 60.1 | 50.7 | | | |
| Tayo | Flag leaf | Tilt | 100.0 | 38.5 | 23.0 | 11.2 | 2.9 | 0.0 | 11.7 | 87.7 | 51.0 | | | |
| Tayo | Anthesis | Miravis Ace | 85.0 | 12.0 | 9.0 | 6.5 | 0.8 | 0.0 | 11.7 | 86.5 | 51.9 | | | |
| Tayo | Flag leaf + Anthesis | Tilt fb Miravis Ace | 95.0 | 15.0 | 10.0 | 9.8 | 1.0 | 1.0 | 11.6 | 77.2 | 51.9 | | | |
| Tayo | Untreated | Untreated | 100.0 | 15.0 | 32.0 | 9.7 | 3.1 | 0.0 | 11.6 | 74.9 | 50.5 | | | |
| Receptor | Flag leaf | Tilt | 100.0 | 19.3 | 10.0 | 11.0 | 1.3 | 2.0 | 11.4 | 65.6 | 51.3 | | | |
| Receptor | Anthesis | Miravis Ace | 95.0 | 9.8 | 8.0 | 6.3 | 0.5 | 2.8 | 11.6 | 57.8 | 51.7 | | | |
| Receptor | Flag leaf + Anthesis | Tilt fb Miravis Ace | 100.0 | 12.0 | 2.0 | 2.5 | 0.1 | 1.8 | 11.8 | 89.1 | 51.4 | | | |
| Receptor | Untreated | Untreated | 100.0 | 18.0 | 10.0 | 8.1 | 0.9 | 1.8 | 11.7 | 77.9 | 50.9 | | | |
| | | | P > F | 0.4746 | 0.0038 | 0.0001 | 0.0130 | 0.0001 | 0.0001 | 0.0592 | 0.0001 | 0.0001 | 0.0001 | |
| | | | LSD 0.05 | NS | 20.4 | 11.5 | 8.9 | 2.1 | 2.7 | NS | 20.7 | 1.2 | | |
| | | | LSD 0.10 | NS | 17.0 | 9.6 | 7.4 | 1.8 | 2.2 | 0.3 | 17.3 | 1.0 | | |
| | | | CV % | 10.3 | 62.8 | 44.0 | 61.4 | 63.8 | 78.6 | 2.4 | 20.6 | 1.6 | | |

FINAL OBSERVATIONS

The results at Lexington are confounded with lodging and freeze damage. The results suggest that rye did not respond differently to the nitrogen rates and sulfur rates applied. At Princeton, yields on the Crider soil were acceptable. Rye did not respond to fertilizer treatments at either location. Thus, 20 pounds of sulfur per acre was just as effective at producing rye yields as 75 pounds of N per acre in this season.

Rye roots are extensive. Rye needs nitrogen to produce grain yield. The yield responses suggest that rye obtained sufficient nitrogen from the soil profile and did not need additional fertilizer N at this site this season. We observed excellent grain yields with no nitrogen fertilizer in the 2021 harvest season at Lexington and Princeton. Perhaps we are missing measuring rye's ability to capture plant available nitrogen from the soil profile.

For reference, the 2021 rye report is linked here:

https://wheatscience.ca.uky.edu/files/2021_chad_lee_hybrid_rye_management_report_final_rr_0.pdf

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