Dual and Single Fungicide Application for Increasing Winter Wheat Grain Yield in Oklahoma

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Introduction:

- Winter wheat (*Triticum aestivum* L.) is the largest production crop in Oklahoma with 5-6 million acres planted annually.
- Fungal diseases represent a significant yield-limiting factor to winter wheat in the state.
- Little information is known whether another fungicide application made earlier in the season provides additional yield benefit to the typical application timing.

Objective:

- Determine if a dual foliar fungicide application approach results in increased grain yield compared to a single application for winter wheat.

Material and methods:

- Trials were established at Stillwater, OK and Apache, OK in 2016 as the first year of a two-year project.
- The Stillwater trial was established using conventional tillage following winter wheat whereas the Apache trial was established using no-till following winter canola.
- Experimental design was a randomized complete block with treatments arranged in a 2 × 4 factorial with 4 reps.
- Two wheat varieties were used: Gallagher and Bentley
  - Chosen on susceptibility to leaf-spotting diseases (Gallagher = susceptible & Bentley = resistant)
- Four foliar fungicide treatments were applied:
  1. Control (no fungicide)
  2. Application at Feekes 6 (jointing)
     - 658 mL ha^{-1} rate of Headline® SC (pyraclostrobin)
  3. Application at Feekes 9 (ligule of flag leaf visible)
     - 292 mL ha^{-1} rate of Tebucure (tebuconazole)
  4. Application at Feekes 6 and Feekes 9
- Disease incidence (DI: 0-100) and severity (DS: 1-5) ratings for all diseases present were collected prior to each fungicide application and two weeks after each application. A disease index score (DX) was then calculated (DX = DI × DS/5).
- Area under the disease progress curve (AUDPC) was calculated using the DX scores.
- Plots were 1.52 m wide and 7.62 m long and were later shortened to 6.09 m for harvest.
- Grain weight, test weight, and moisture were collected from each plot, and yield was adjusted to 13% moisture content.
- Yield, test weight, and AUDPC data were subjected to analysis of variance (ANOVA) using PROC GLIMMIX within SAS v. 9.4. Analyses were performed for each location separately. The square root and natural log transformations were used for the AUDPC data at Stillwater and Apache, respectively.
- Means were separated using Fisher's Protected LSD at the 5% significance level. The SLICE option was used to compare means of significant interactions.

Results:

Table 1. Analysis of variance results (ANOVA) for yield and test weight at Apache and Stillwater in 2016-2017.

	Apache		Stillwater	
Effect	Yield	Test weight	Yield	Test weight
Variety (V)	0.0283	<0.0001	<0.0001	<0.0001
Fungicide treatment (F)	0.0258	0.0043	<0.0001	<0.0001
V × F	0.1046	0.2530	0.0039	0.0004

Figure 1. Yield and test weight results for the variety × fungicide interaction at Stillwater.

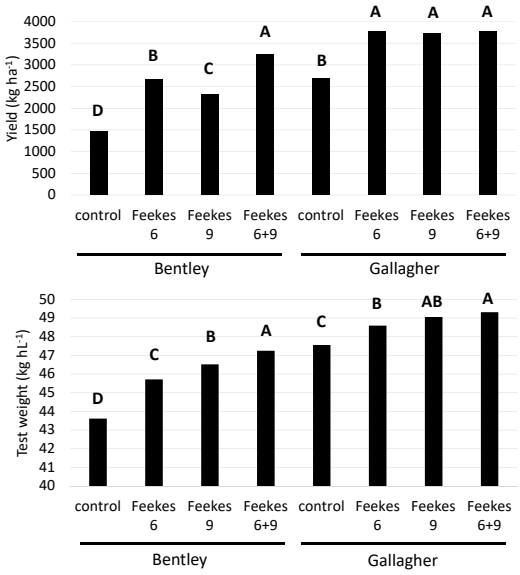


Figure 2. Yield and test weight results for the fungicide treatment main effect at Apache.

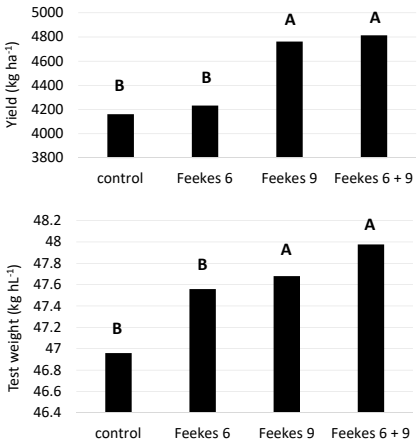


Figure 3. Yield and test weight results for the variety main effect at Apache.

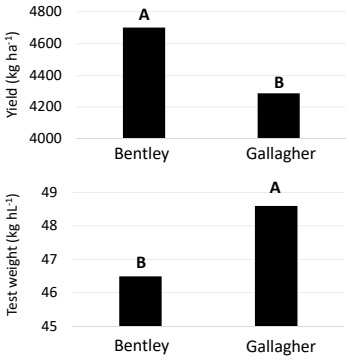
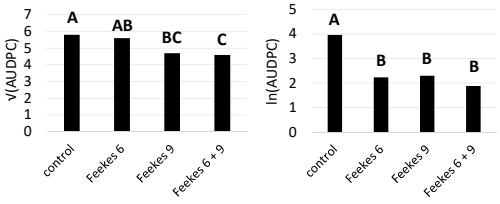


Table 2. Analysis of variance results for AUDPC at Apache and Stillwater in 2016-2017.

Effect	Apache	Stillwater
Variety (V)	0.6363	<0.0001
Fungicide treatment (F)	0.0317	<0.0001
V × F	0.8432	0.6792

- The ln(AUDPC) for Bentley at Stillwater was significantly greater (3.74) than Gallagher (1.46).

Figure 4. AUDPC results for the fungicide treatment main effect at Apache (left) and Stillwater (right).



Discussion:

- A significant yield increase for the dual-fungicide application approach compared to a single application was location and variety dependent.
- A significant yield increase to a single fungicide application was also location dependent.
- A greater amount of leaf rust was found at Apache compared to Stillwater, but it did not develop until Feekes 10.1 (beginning heading)
- Leaf rust was present at Stillwater prior to the Feekes 6 application, but levels did not progress much as the growing season continued.
- The onset of leaf rust development, coupled with the susceptibility of each wheat variety to leaf rust (Gallagher = resistant & Bentley = susceptible at early infections), helps explain most of the yield response to the fungicide treatments.

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