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Abstract

Foliar fungicides can improve wheat grain yield in Kansas, but there is limited information on the efficacy of different products as well as the timing of application. We conducted a field study in five Kansas locations to evaluate the yield, test weight, and protein responses of WB-Grainfield to different commercial fungicides applied at different times during the growing season. The trial was conducted in a randomized complete block design to evaluate (1) a non-treated control; Topguard applied at 5 ounces per acre at (2) jointing, (3) heading, and (4) jointing plus heading; (5) Delaro applied at 6 oz/a at jointing; (6) Absolute Maxx applied at 5 ounces per acre at heading; (7) Delaro at jointing plus Absolute Maxx at heading at the rates previously specified; and (8) Nexicor applied at 13 oz/a at heading. The study was conducted near Conway Springs, Great Bend, two sites near Hutchinson (optimum- and late-sowing date), and Leoti. Grain yield across locations ranged from 36 to 72.9 bushels per acre. A significant fungicide by location interaction on grain yield resulted from two locations showing no response to fungicide; two locations resulting in the highest yield when fungicide at heading was presented in the evaluated treatment; and one location showing all fungicide treatments outyielding the control. Similar results were obtained for test weight, where fungicides at heading seemed to benefit test weight at all locations except at the driest one. There were no consistent effects of foliar fungicide management on wheat grain protein concentration. This research is an initial step in determining the benefits of foliar fungicide to winter wheat yield and to date, a preliminary conclusion highlights the usefulness of a heading fungicide application when precipitation is not a limiting factor to yields, without consistent differences among the evaluated products.

Keywords

wheat, fungicide, variety

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Winter Wheat Response to Different Fungicide Management (Products and Timing of Application) During the 2019–2020 Growing Season

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Summary

Foliar fungicides can improve wheat grain yield in Kansas, but there is limited information on the efficacy of different products as well as the timing of application. We conducted a field study in five Kansas locations to evaluate the yield, test weight, and protein responses of WB-Grainfield to different commercial fungicides applied at different times during the growing season. The trial was conducted in a randomized complete block design to evaluate (1) a non-treated control; Topguard applied at 5 ounces per acre at (2) jointing, (3) heading, and (4) jointing plus heading; (5) Delaro applied at 6 oz/a at jointing; (6) Absolute Maxx applied at 5 ounces per acre at heading; (7) Delaro at jointing plus Absolute Maxx at heading at the rates previously specified; and (8) Nexicor applied at 13 oz/a at heading. The study was conducted near Conway Springs, Great Bend, two sites near Hutchinson (optimum- and late-sowing date), and Leoti. Grain yield across locations ranged from 36 to 72.9 bushels per acre. A significant fungicide by location interaction on grain yield resulted from two locations showing no response to fungicide; two locations resulting in the highest yield when fungicide at heading was presented in the evaluated treatment; and one location showing all fungicide treatments outyielding the control. Similar results were obtained for test weight, where fungicides at heading seemed to benefit test weight at all locations except at the driest one. There were no consistent effects of foliar fungicide management on wheat grain protein concentration. This research is an initial step in determining the benefits of foliar fungicide to winter wheat yield and to date, a preliminary conclusion highlights the usefulness of a heading fungicide application when precipitation is not a limiting factor to yields, without consistent differences among the evaluated products.

Introduction

The application of foliar fungicides has been associated with increased wheat yields in Kansas (de Oliveira Silva et al., 2020a; Jaenisch et al., 2019; Munaro et al., 2020; Lollato et al., 2019; Sassenrath et al., 2019). However, most of the existing research has focused on a single fungicide application at flag leaf emergence (e.g., Cruppe et al., 2017), even though some intensive production systems maximizing wheat yield have used a dual-fungicide system (Lollato and Edwards, 2015; Lollato et al., 2019; Jaenisch et al., 2019).

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The most prevalent diseases causing yield losses to Kansas wheat are leaf and stripe rust (Hollandbeck et al., 2019), perhaps justifying the majority of the research focused on late-season fungicide applications. However, Hollandbeck et al. (2019) also suggested that early-season diseases such as tan spot and septoria might cause significant yield losses if the conditions are favorable for the development of such diseases. There is a need to better understand the effects of different timings of fungicide application on winter wheat grain yield in the state. Likewise, different products might offer different levels of protection (DeWolf et al., 2019); thus, testing the interaction between fungicide timing and product on wheat yield is warranted.

The objective of this study was to evaluate the response of winter wheat in terms of grain yield to different fungicide management strategies and products in Kansas.

Procedures

One field experiment was conducted in five Kansas locations during the 2019–2020 winter wheat growing season, including near Conway Springs, Great Bend, two sites near Hutchinson, and Leoti. The two locations near Hutchinson differed in their previous crop and sowing date, as one was sown under optimal conditions following a conventional tilled canola crop; and the other was sown late no-tilled after a soybean crop. The experiments were established in a randomized complete block design with eight treatments and anywhere from four to eight replications, depending on location. Treatments included (1) a non-treated control; Topguard applied at 5 oz/a at (2) jointing, (3) heading, and (4) jointing plus heading; (5) Delaro applied at 6 oz/a at jointing; (6) Absolute Maxx applied at 5 oz/a at heading; (7) applying Delaro at jointing plus Absolute Maxx at heading at the rates previously specified; and (8) Nexicor applied at 13 oz/a at heading. All treatments were applied with a non-ionic surfactant. The winter wheat variety evaluated at all locations was WB-Grainfield. A Massey Ferguson XP8 small-plot, self-propelled combine was used for harvesting. Plot ends were trimmed at harvest time to avoid border effect. Measurements included grain yield (corrected for 13% moisture content) and grain test weight, and grain protein concentration at harvest maturity (corrected for 13% moisture content). Statistical analysis was performed using a two-way ANOVA in PROC GLIMMIX procedure in SAS v. 9.4 (SAS Inst. Inc., Cary, NC) where treatment, location, and their interactions were considered fixed effects, and replication nested within location was treated as a random effect.

Results

Weather Conditions

The study locations had anywhere from 6.7 to 16.8 inches of precipitation during the growing season, with corresponding crop reference evapotranspiration of 30.8 to 41.7 inches (Table 1). These precipitation and atmospheric water demand values resulted in water supply:water demand ratios of 0.16 to 0.49, suggesting that water deficit was certainly limiting wheat yields in two locations (Leoti and Hutchinson late) and likely may have also limited yields at the other three locations (Patrignani et al., 2014; Lollato et al., 2017).

Grain Yield

Grain yield was affected by the interaction of fungicide and location ($P < 0.01$), suggesting that fungicide management ranked differently at each location evaluated (Table 2). The two driest locations studied were Great Bend and Leoti with average yields of 36 and 43 bu/a, where there were no differences among the treatments evaluated, even when compared to the untreated control. In Hutchinson—the trial sown at the optimum date after canola, with the highest yield potential (average 72.9)—the treatment receiving both Delaro at jointing plus Absolute Maxx at heading resulted in the highest grain yield (84 bu/a), which was statistically greater than any other treatment. For the late-planted trial in Hutchinson (average 57.9 bu/a), Topguard applied at heading or at jointing and heading had the greatest yields, which were statistically similar to those attained by Nexicor at heading and Delaro at jointing plus Absolute Maxx at heading (59.7 to 62.7 bu/a). In Conway Springs, all fungicide treatments yielded more than the control (52.4 versus 61.1 bu/a), with no statistical differences among fungicide treatments.

Grain Test Weight

Similarly to grain yield, the response of grain test weight to foliar fungicide management also depended on location as evidenced by the significant interaction between fungicide treatment and location ($P < 0.01$). In Great Bend, all treatments receiving foliar fungicides, regardless of timing or product, resulted in greater test weight than the untreated control (57.1 versus 55.9 pounds per bushel). For the trial in Conway Springs and for both trials in Hutchinson, the general trend was that treatments receiving foliar fungicide around heading, regardless of product, had greater test weight than those only receiving fungicide at jointing or than the control (62.9 versus 61.8 lb/bu in Conway Springs; 55.7 versus 54.0 lb/bu in the optimum sowing date; 61.1 versus 59.7 lb/bu in the late sowing date). There was no fungicide effect on wheat test weight in Leoti (Table 2).

Grain Protein Concentration

Grain protein concentration as affected by fungicide treatment showed a weaker interaction with location than grain yield or test weight ($P < 0.05$) (Table 2). This interaction resulted from a few random treatments having lower protein concentration in Great Bend (Topguard at jointing) and Hutchinson optimum (Delaro at jointing); or a few random treatments having greater protein concentration in Hutchinson late (Topguard at heading and Delaro at jointing), while there was no treatment effect on Leoti or Conway Springs (Table 2). These greater or lower protein concentrations didn't seem to follow a pattern. We note that the increase in grain yield resulting from fungicide application did not decrease grain protein concentration, perhaps due to an extended duration of nitrogen uptake and translocation into the grain, which determines protein (de Oliveira Silva et al., 2020b; Lollato et al., 2019b, 2021).

Preliminary Conclusions

Results suggest that the optimum fungicide management strategy depended on geographic location. In locations with limited precipitation, the application of foliar fungicides improved grain test weight in half of the cases; and showed no improvement in grain yield. For locations where precipitation amount was less limiting, fungicides applied at heading had the greatest yield two-thirds of the time; while the simple presence of fungicide (regardless of timing) resulted in the greatest yield in the remaining third. So far, we don't have enough data to conclude on the efficacy of different fungicide products and their efficiency in terms of grain yield, as the ranking of products changed depending on location.

References

Cruppe, G., Edwards, J.T. and Lollato, R.P., 2017. In-season canopy reflectance can aid fungicide and late-season nitrogen decisions on winter wheat. Agronomy Journal, 109(5), pp. 2072-2086.

de Oliveira Silva, A., Slafer, G.A., Fritz, A.K. and Lollato, R.P., 2020a. Physiological basis of genotypic response to management in dryland wheat. Frontiers in Plant Science, 10, p. 1644.

de Oliveira Silva, A., Ciampitti, I.A., Slafer, G.A. and Lollato, R.P., 2020b. Nitrogen utilization efficiency in wheat: A global perspective. European Journal of Agronomy, 114, p. 126008.

DeWolf, E. 2019. Foliar fungicide efficacy ratings for wheat disease management 2019. Kansas St. Univ. Agric. Exp. Stat. Coop. Ext. Ser. EP130.

Hollandbeck, G.F., E. DeWolf, and T. Todd. 2019. Kansas cooperative plant disease survey report. Preliminary 2019 Kansas wheat disease loss estimates. Kansas Department of Agriculture.

Jaenisch, B.R., de Oliveira Silva, A., DeWolf, E., Ruiz-Diaz, D.A. and Lollato, R.P., 2019. Plant population and fungicide economically reduced winter wheat yield gap in Kansas. Agronomy Journal, 111(2), pp. 650-665.

Lollato, R.P. and Edwards, J.T., 2015. Maximum attainable wheat yield and resource-use efficiency in the southern Great Plains. Crop Science, 55(6), pp. 2863-2876.

Lollato, R.P., Edwards, J.T. and Ochsner, T.E., 2017. Meteorological limits to winter wheat productivity in the US southern Great Plains. Field Crops Research, 203, pp. 212-226.

Lollato, R.P., Ruiz Diaz, D.A., DeWolf, E., Knapp, M., Peterson, D.E. and Fritz, A.K., 2019a. Agronomic practices for reducing wheat yield gaps: a quantitative appraisal of progressive producers. Crop Science, 59(1), pp. 333-350.

Lollato, R.P., Figueiredo, B.M., Dhillon, J.S., Arnall, D.B. and Raun, W.R., 2019b. Wheat grain yield and grain-nitrogen relationships as affected by N, P, and K fertilization: a synthesis of long-term experiments. Field Crops Research, 236, pp. 42-57.

Lollato, RP, Jaenisch, BR, Silva, SR. 2021. Genotype-specific nitrogen uptake dynamics and fertilizer management explain contrasting wheat protein concentration. Crop Science. Vol. 61, Issue 3.

Munaro, L.B., Hefley, T.J., DeWolf, E., Haley, S., Fritz, A.K., Zhang, G., Haag, L.A., Schlegel, A.J., Edwards, J.T., Marburger, D. and Alderman, P., 2020. Exploring long-term variety performance trials to improve environment-specific genotype× management recommendations: A case-study for winter wheat. Field Crops Research, 255, p. 107848.

Patrignani, A., Lollato, R.P., Ochsner, T.E., Godsey, C.B. and Edwards, J.T., 2014. Yield gap and production gap of rainfed winter wheat in the southern Great Plains. Agronomy Journal, 106(4), pp. 1329-1339.

Sassenrath, G.F., Farney, J. and Lollato, R., 2019. Impact of Fungicide and Insecticide Use on Wheat Production in a High-Rainfall Environment. Crop, Forage & Turfgrass Management, 5(1), pp. 1-10.

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Table 1. Average maximum (Tmax) and minimum (Tmin) temperatures, and cumulative precipitation, grass reference evapotranspiration (ETo), and the ratio of water supply (WS) to water demand (WD) during the growing season at the five study locations during 2019–2020

Location	Tmax	Tmin	Precip.	ETo	WS:WD
	------------ °F ------------		---------- inches ----------		
Conway Springs	61.9	39.4	16.4	35.9	0.46
Great Bend	60.9	36.0	16.3	36.3	0.45
Hutchinson (optimum)	61.7	37.2	16.8	34.5	0.49
Hutchinson (late)	59.4	34.6	13.6	30.8	0.44
Leoti	61.6	32.7	6.7	41.7	0.16

Table 2. Winter wheat grain yield, test weight, and protein concentration as affected by the interaction of fungicide management and location at the five study-sites conducted during the 2019–2020 growing season. Timing of fungicide application is referred to as growth stage in the Feekes scale of cereal development (FK6 = jointing; FK10 = heading)

Fungicide product	Timing	Great Bend	Hutchinson (optimum)	Hutchinson (late)	Leoti	Conway Springs
		-------------------------- Grain yield (bu/a) --------------------------				
No		33.8	62.9	51.8	42.4	52.4
Topguard	FK 6	34.2	66.4	53.9	42.3	**57.7**
Topguard	FK 10	34.3	72.3	**61.1**	44.3	**62.7**
Topguard	FK6+FK10	36.6	73.4	**62.7**	45.0	**62.3**
Delaro	FK6	38.4	68.1	53.9	44.7	**60.6**
Absolute Maxx	FK 10	36.2	77.3	57.9	42.3	**62.0**
Delaro + Absolute Maxx	FK6+FK10	37.8	**84.0**	**59.7**	42.6	**61.9**
Nexicor	FK 10	36.7	79.1	**61.9**	43.2	**60.3**
Treatment effect		ns	< 0.01	< 0.01	ns	< 0.05
		---------------------- Grain test weight (lb/bu) ----------------------				
No		55.9	53.4	59.8	56.3	61.6
Topguard	FK 6	**57.3**	53.7	59.9	56.1	61.9
Topguard	FK 10	**56.3**	54.9	**61.3**	55.9	**63.1**
Topguard	FK6+FK10	**57.3**	**55.5**	**61.1**	56.2	**62.4**
Delaro	FK6	**57.1**	54.3	59.4	56.0	62.0
Absolute Maxx	FK 10	**57.5**	**55.5**	**61.3**	56.4	**62.8**
Delaro + Absolute Maxx	FK6+FK10	**56.9**	**55.7**	**60.8**	56.4	**62.9**
Nexicor	FK 10	**57.0**	**56.1**	**61.3**	56.2	**63.0**
Treatment effect		< 0.05	< 0.01	< 0.01	ns	< 0.05
		---------------------- Protein concentration (%) ----------------------				
No		**13.2**	**12.0**	10.9	10.5	10.1
Topguard	FK 6	12.3	**11.8**	11.5	10.7	10.0
Topguard	FK 10	**12.9**	**12.1**	**11.9**	10.7	10.0
Topguard	FK6+FK10	**12.9**	**12.0**	11.7	10.5	10.0
Delaro	FK6	**12.8**	11.6	**12.3**	10.6	9.7
Absolute Maxx	FK 10	**13.3**	**12.1**	11.7	10.5	10.1
Delaro + Absolute Maxx	FK6+FK10	**12.9**	**12.2**	11.7	10.5	10.2
Nexicor	FK 10	**13.0**	**12.0**	11.5	10.5	10.3
Treatment effect		< 0.05	< 0.05	< 0.05	ns	ns