Managing Fusarium Head Blight with Hard Red Spring Wheat Cultivar Resistance and Fungicides Langdon, 2011

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Objectives

The study objectives were to determine the effect of integrating fungicide treatment and cultivar resistance for managing the negative effects of fusarium head blight in hard red spring wheat.

Materials and Methods

A field experiment was planted on 18 May at the North Dakota State University Langdon Research Extension Center located at Langdon in NE North Dakota. The trial was conducted using best management practices for hard red spring wheat including seeding date and rate, fertility, weed control and harvest management. The experiment was a randomized complete block design with a split plot arrangement with four replications. The previous crop was canola. The soil type was Svea-Barnes loam. Four hard red spring wheat cultivars were selected for their different relative resistance to fusarium head blight (FHB), their potential use by growers in the region and their high yield and protein levels. The cultivars were seeded at a rate of 1.5 million pure live seeds/acre. Plots seven rows wide by 20 ft. long with 6-in row spacing were sown with an Almaco plot planter equipped with double disk openers and press wheels. A border plot was planted between treated plots to minimize interference from spray drift. Fusarium inoculums, consisting of several isolates, were hand-broadcast at a rate of 150 grams /plot three and two weeks prior to anthesis growth stage (GS) to encourage development of FHB. An overhead irrigation system was installed to provide supplemental water, after herbicide application was completed, to wet the inoculum and the grain heads to encourage the development of FHB. Fungicide treatments and application timings are listed in Table 1. The primary active ingredients for the treatments were tebuconazole (Folicur 4 fl. oz. /acre rate) and metconazole (Caramba 14 fl. oz. /acre rate). Induce adjuvant was included with both fungicides at 0.125% v/v rate. The fungicides were applied with a CO_2–pressurized backpack sprayer operated at 40 psi delivering 18.4 GPA. The sprayer was equipped with a three-nozzle boom with nozzles spaced 20 inches on center. The flowering treatments (Feekes GS 10.51) were made using Spraying Systems XR8001 nozzles mounted on a double swivel and oriented to spray forward and backward 30 degrees downward from horizontal. The fungicide applications were made by maturity at GS 10.51 on 15 July; Glenn (wind SE speed 3 MPH, temperature 71° F at 8:30 a.m.), 18 July; Prosper and Samson (wind none, temperature 75° F at 8:15 a.m.) or 21 July; Vantage (wind west, speed 4 MPH, temperature 78° F at 3:00 p.m.). The sequential timings were made on 21 July Glenn; 25 July Prosper and Samson (no wind, temperature 67° F at 9:00 a.m.) and 29 July Vantage (no wind, temperature 68° F at 9:00 a.m.). Fusarium head blight incidence (I), head severity (HS) and index (FS) were determined from a twenty grain head sample collected at Feekes 11.2 GS. Leaf severity was determined from a sample of ten leaves at the same growth stage. Plots were harvested 18 Sept with a small plot combine and yield, test weight and protein were determined. Deoxynivalenol accumulation (DON) was determined by the NDSU Toxicology Lab. Data were analyzed with the general linear model (GLM) in SAS. Least significant (LSD) were used to compare means at the $P \leq 0.05$ level.

Results

Cultivar. Yield was affected by cultivar selection, Table 1. Samson and Prosper had similar yield. Glenn had similar yield to Prosper and Vantage but Vantage yielded less than Prosper. Surplus early season soil water levels resulted in shallow root systems causing reduced yield potentials, compared to previous years, when later season soil moisture stress occurred. Test weight was also affected by cultivar. Test weight of Glenn > Vantage > Prosper and Samson. Fusarium head blight levels were generally less than expected for an inoculated and misted study and no differences among cultivars were determined. Vantage had less foliar disease than Samson. Foliar disease levels were quite low.

Fungicide treatment. The Folicur fungicide treatment did not increase yield compared to the non-treated, Table 1. Yields were not different for the three treatments that included Caramba but were much greater than the non-treated and Folicur. The sequential application treatment Folicur (10.51) + Caramba (7DA 10.51) increased test weight compared to other treatments. The Caramba treatment at GS 10.51 had greater test weight than Folicur but was not different from the later timing of Caramba. All fungicide treatments increased test weight compared to the non-treated. Folicur and Caramba early timing were equally effective for reducing FHB severity and index. Sequential treatments were as effective as early Caramba timing but not more effective for reducing severity and index. Folicur or Caramba late was not as effective as the sequential treatment for incidence but as effective for severity and index. There were no significant differences between treatments for foliar disease.

Cultivar x Fungicide Treatment Interactions.

Protein. Main effect comparisons indicate that Vantage had greater protein than all other cultivars while Glenn and Samson did not differ from each other. Samson protein was not different from Prosper, Table 1. Differences did occur between fungicide treatments within each cultivar, Table 2. The Folicur treatment reduced protein compared to the non-treated and sequential treatment in Prosper. In contrast all fungicide treatments reduced protein for Glenn while the late timing Caramba treatment had increased protein compared to the sequential treatment in Vantage. Fungicide treatments had no effect on Samson.

DON. Deoxynivalenol accumulation in seed was much greater in Samson but not different among other cultivars, Table 1. Deoxynivalenol accumulations varied between cultivars, Table 2. For Prosper and Samson, the early timing Caramba and the sequential timing treatments were improved and equally effective compared to the Folicur treatment. For Glenn only the sequential treatment was better than the Folicur treatment. All the fungicide treatments were equally effective for Vantage.

Summary

Yields were reduced by the environment compared to previous growing seasons. Distinct differences were measured between cultivars for yield test weight, protein, resistance to DON and foliar disease but not visual symptoms of FHB. Fungicide treatment had positive effect for all main effects except protein and foliar disease. Folicur was not as effective as Caramba. The late application timing of Caramba was as effective as the anthesis timing for reducing DON. The sequential timing was only equally effective as the anthesis timing for reducing negative effects of FHB. Cultivar selection and fungicide treatment can affect protein and DON differently.

Table1. Hard red spring wheat yield, test weight, protein, deoxynivalenol accumulation in seed (DON), Fusarium head blight incidence, severity and index and foliar disease by cultivar averaged across treatments and treatment averaged across cultivars and confidence interval by source of variation, 2011.

		Test			Fusarium Head Blight [z]			Foliar
	Yield	Weight	Protein	DON	Incidence	Severity	Index	Disease
Cultivar	(bu./acre)	(lb. /bu.)	(%)	(ppm)	(%)	(%)	(0-100)	(%)
Prosper	65.5	58.9	16.0	1.27	89.5	14.3	17.5	11.8
Glenn	62.3	62.4	16.3	0.92				
Vantage	58.9	61.4	17.5	1.02	88.8	11.8	15.7	5.2
Samson	68.3	58.5	16.2	3.37	87.5	12.4	14.2	15.3
LSD (0.05)	3.8	0.4	0.3	0.43	NS	NS	NS	7.2
Treatment (Timing)[Y]								
Non-treated	60.3	59.7	16.6	3.0	96.7	18.1	19.2	13.7
Folicur (10.51)	62.5	60.2	16.5	1.8	90.4	12.5	15.1	8.1
Caramba (10.51)	66.4	60.5	16.4	1.1	84.2	10.3	14.1	10.5
Caramba (7DA 10.51)	67.0	60.3	16.5	1.4	91.7	13.7	16.1	10.6
Folicur (10.51) + Caramba 7DA 10.51)	67.0	60.8	16.5	1.0	80.0	9.5	14.3	11.1
LSD (0.05)	2.9	0.3	NS	0.3	6.8	3.4	2.9	NS
Source of Variation								
Replicate	0.0069	<0.0001	0.0014	0.0010	0.9159	0.5652	0.2318	0.0789
Cultivar	0.0018	<0.0001	<0.0001	<0.0001	0.6546	0.1312	0.1098	0.0365
Replicate*Cultivar	0.1329	0.0152	0.0002	0.1109	0.6806	0.6638	0.2793	0.1474
Treatment	<0.0001	<0.0001	0.0960	<0.0001	0.0002	<0.0001	0.0066	0.4518
Cultivar*Treatment	0.6092	0.0822	0.0324	0.0017	0.9169	0.4704	0.3116	0.9854
%C.V.	6.5	0.6	1.1	28.1	9.3	32.1	22.4	66.2

[Z] A sampling error for Glenn cultivar made making the disease data unusable and the data was omitted form the analysis.

[Y] DA= days after Feekes' growth stage.

Table 2. Hard red spring wheat seed protein and deoxynivalenol accumulation in seed (DON) by cultivar and fungicide treatment. 2011.

Cultivar	Treatment (Timing)[x]	Protein (%)	DON (ppm)
Prosper	Non-treated	16.1	2.50
	Folicur (10.51)	16.0	1.48
	Caramba (10.51)	15.8	0.73
	Caramba (7DA 10.51)	16.0	0.93
	Folicur (10.51) + Caramba 7DA 10.51)	16.1	0.73
Glenn	Non-treated	16.6	2.00
	Folicur (10.51)	16.3	1.13
	Caramba (10.51)	16.2	0.48
	Caramba (7DA 10.51)	16.1	0.58
	Folicur (10.51) + Caramba 7DA 10.51)	16.3	0.43
Vantage	Non-treated	17.6	1.80
	Folicur (10.51)	17.4	0.93
	Caramba (10.51)	17.4	0.78
	Caramba (7DA 10.51)	17.6	1.00
	Folicur (10.51) + Caramba 7DA 10.51)	17.3	0.58
Samson	Non-treated	16.1	5.56
	Folicur (10.51)	16.2	3.60
	Caramba (10.51)	16.2	2.30
	Caramba (7DA 10.51)	16.3	3.28
	Folicur (10.51) + Caramba 7DA 10.51)	16.3	2.10

[z] DA= days after Feekes' growth stage.

LSD (0.05) = 0.28 Protein and 0.68 DON for comparing treatments within cultivars. 0.38 Protein and 0.74 DON for comparing treatments across cultivars.