

# EFFECT OF FUNGICIDE AND HOST RESISTANCE ON FUSARIUM HEAD BLIGHT DISEASE DEVELOPMENT AND DON CONTAMINATION IN THREE SOFT RED WINTER WHEAT CULTIVARS IN KENTUCKY, 2010.

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As part of the multi-state, National 2010 Uniform Trial for Integrated Control of Fusarium Head Blight (FHB), a test was established to evaluate the benefits of combining host resistance and fungicide treatment for FHB/deoxynivalenol (DON) management. Three soft red winter wheat cultivars ('Cumberland', FHB-susceptible; 'Bess' and 'Pioneer 26R15' having partial resistance to FHB) were planted no-till following corn harvest on 19 Oct 09 on the Kevil Tract of the University of Kentucky Research and Education Center in Princeton, KY. Wheat plots, consisting of seven, 7-in rows (4.3 ft-wide) by 25-ft-long were planted at a rate that would achieve a final stand of approximately 36 plants ft<sup>2</sup>. Warrior insecticide was applied (3.5 fl oz/A) on 21 Nov 09 and again on 23 Mar 10 (green-up) to reduce the potential for barley yellow dwarf. Liquid nitrogen (28-0-0) was applied in a February/April split application at a rate of approximately 40 and 80 lbs/A on 20 Feb 10 and 1 Apr 10, respectively. Weeds were controlled by applying Harmony Extra herbicide (0.5 fl oz/A) on 23 Mar 10. On 2 Apr 10, wheat passes were "trimmed" into 20-ft plots by application of Round-up herbicide. The experimental design was a split plot randomized complete block with four

replications. The main plots were cultivars and sub-plots were non-treated or application of Prosaro (6.5 fl oz/A + 0.125% Induce v/v) at beginning anthesis (Feeke's stage (F) 10.51). Fungicide treatments were applied on 3 May with a hand-held CO<sub>2</sub>-powered backpack boom sprayer equipped with two Teejet 8002VS nozzles delivering approximately 20 gpa of spray solution at 40 psi. Plots were rated for leaf rust and Stagonospora blotch at late-milk-early dough stage (F11.1-2) on 27 May 10. Foliar ratings were made by visually estimating the percentage of leaf surface area diseased for flag and flag-1 leaves of 10 arbitrarily selected plants per plot. Fusarium head blight (FHB) incidence was based on visual estimation of infected spikelets on a total of 50 spikes per plot at late-milk (F11.1) on 25 May. FHB severity was visually estimated as a percentage of surface area affected on 5 total spikes per plot at late milk (F11.1) on 25 May. Plots were harvested on 15 Jun 10 using a Wintersteiger small-plot combine. Yields were adjusted to 13.5% moisture and 60 lb/bu. A hand-cleaned, 25-g grain sample from each plot was assessed for kernel health by counting the number of shriveled kernels (SK) per 100 kernel sample and submitted to the University of Minnesota, DON Analysis Laboratory, St.

Paul, MN for deoxynivalenol (DON) analysis. Percentage data were arcsine-transformed prior to analysis using ANOVA and Student-Newman-Keuls test ( $P \leq 0.05$ ). Although statistics provided are based on transformed data, arithmetic means are presented in order to provide a better indication of the level of disease control provided by each treatment, as well as the overall disease pressure in the trial.

FHB pressure was low to moderate in the test with mean FHB incidence reaching 17% with disease indexes ranging from 0.7 to 5.7%. DON levels and SK percentages were low and means ranged from 0.15-0.31 ppm and 4-11%, respectively. Conditions supported moderate levels of leaf rust and Stagonospora blotch throughout much of May (i.e., grain fill period). Many main

effects and interactions were significant ( $P \leq 0.05$ ) (Table 1). No significant differences were observed between the Prosaro-treated and non-treated plots for any FHB parameters (incidence, severity or index) and DON (Table 2). Prosaro-treated plots had significantly less leaf rust, Stagonospora blotch (flag and flag-1 leaves) and shriveled kernels than the non-treated plots which resulted in significantly higher yields (increase of 11.8 bu) and test weights (Table 2). Significantly less leaf rust ( $P \leq 0.1$ ) and Stagonospora blotch ( $P \leq 0.05$ ) was observed on both the flag and flag-1 leaves of non-treated plots of Pioneer 26R15 when compared to the non-treated plots of Bess and Cumberland indicating some level of host resistance (Table 3, 4). No phytotoxicity was noted in the test.

Table 1. Significance of *F* value from analysis of variance for leaf blotch, Fusarium head blight (FHB), deoxynivalenol contamination, yield and test weight for three soft red winter wheat cultivars varying in susceptibility to FHB, left untreated or treated with Prosaro (6.5 fl oz/A + 0.125% Induce v/v) at beginning anthesis (Feeke's stage 10.51).

Source of Variation <sup>z</sup>	DF	Leaf rust <sup>y</sup>	Stagonospora blotch <sup>x</sup>		Fusarium head blight			Shriveled kernel <sup>t</sup>	DON <sup>s</sup>	Yield <sup>r</sup>	Test weight
		Flag	Flag	F-1	Inc. <sup>w</sup>	Sev. <sup>v</sup>	Index <sup>u</sup>				
Cultivar (cv)	2	0.0650	0.2589	0.0149	0.0377	0.3704	0.0146	0.0049	0.1009	0.3843	0.0673
Treatment (t)	1	<.0001	<.0001	<.0001	0.1844	0.1412	0.0953	0.0108	0.1703	0.0462	0.0217
CV X T	2	0.0206	0.0673	0.0036	0.1350	0.9161	0.1109	0.8625	0.4428	0.1874	0.0783

<sup>z</sup>Rep\*cultivar was used as an error term in the *F* Test.

<sup>y</sup>Leaf rust, *P. triticina* was visually estimated on flag leaves of 10 plants per plot at late-milk-early dough stage (F11.1-2) on 27 May.

<sup>x</sup>Percent of leaf area affected by Stagonospora blotch, primarily *S. nodorum*, was visually estimated on flag and flag-1 leaves of 10 plants per plot at late-milk-early dough stage (F11.1-2) on 27 May.

<sup>w</sup>Fusarium head blight incidence was based on visual estimation of infected spikelets on 50 spikes per plot at late milk (F11.1) on 25 May.

<sup>v</sup>Fusarium head blight severity was estimated as a percentage of surface area affected on 5 total spikes per plot at late milk (F11.1) on 25 May.

<sup>u</sup>Fusarium head blight index = (% incidence x % severity)/100.

<sup>t</sup>Percentage of shriveled kernels in a 100 kernel grain sample.

<sup>s</sup>Deoxynivalenol (DON), Mean (N=8) DON level (ppm) for Cumberland = 0.31, Pioneer 26R15 = 0.21 and Bess = 0.15.

<sup>r</sup>Based on 13.5% moisture and 60 lb/bu.

Table 2. Effect of fungicide treatment on leaf rust, Stagonospora blotch (Flag, F-1), Fusarium head blight, shriveled kernels, DON, yield and test weight.

Treatment	N	Leaf rust <sup>z</sup>	Stagonospora blotch <sup>y</sup>		Fusarium head blight (FHB)			Shriveled Kernels <sup>u</sup>	DON	Yield <sup>t</sup>	Test weight
		Flag (%)	Flag (%)	F-1 (%)	Inc. <sup>x</sup> (%)	Sev. <sup>w</sup> (%)	Index <sup>v</sup> (%)	(%)	(ppm)	(bu/A)	(lb/bu)
Non-treated control	12	9.33a <sup>u</sup>	9.0a	70.2a	8.5	25.7	2.4	8.5a	0.25	99.9a	60.9a
Treated <sup>v</sup>	12	0.02b	0.2b	2.6b	5.5	18.3	0.9	4.8b	0.20	111.7b	62.0b

<sup>z</sup>Leaf rust, *P. triticina* was visually estimated on flag leaves of 10 plants per plot at late-milk-early dough stage (F11.1-2) on 27 May.

<sup>y</sup>Percentage of Stagonospora blotch, primarily *S. nodorum*, was visually estimated on flag-1 leaves of 10 plants per plot at late-milk-early dough stage (F11.1-2) on 27 May.

<sup>x</sup>Fusarium head blight incidence was based on visual estimation of infected spikelets on 50 spikes per plot at late milk (F11.1) on 25 May.

<sup>w</sup>Fusarium head blight severity was estimated as a percentage of surface area affected on 5 total spikes per plot at late milk (F11.1) on 25 May.

<sup>v</sup>Fusarium head blight index = (% incidence x % severity)/100.

<sup>u</sup>Percentage of shriveled kernels in a 100 kernel grain sample.

<sup>t</sup>Based on 13.5% moisture and 60 lb/bu.

<sup>v</sup>Fungicide Treatment, Prosaro 6.5 fl oz + Induce 0.125% at F10.51 on 3 May.

<sup>u</sup>Means in a column followed by the same letter are not significantly different, Student Newman Keuls test  $P \leq 0.05$  (columns are lettered only when the treatment effect was significant).

Table 3. Effect of cultivar on leaf rust, Stagonospora blotch (Flag, F-1), Fusarium head blight, shriveled kernels, DON, yield and test weight.

Cultivar	N	Leaf rust <sup>z</sup>	Stagonospora blotch <sup>y</sup>		Fusarium head blight (FHB)			Shriveled Kernels <sup>u</sup>	DON	Yield <sup>t</sup>	Test weight
		Flag (%)	Flag (%)	F-1 (%)	Inc. <sup>x</sup> (%)	Sev. <sup>w</sup> (%)	Index <sup>v</sup> (%)	(%)	(ppm)	(bu/A)	(lb/bu)
Bess	8	6.1a <sup>s</sup>	3.5	40.8a <sup>r</sup>	2.5b <sup>r</sup>	20.7	0.6b <sup>r</sup>	3.3b <sup>r</sup>	0.15	104.4	62.4
Pioneer 26R15	8	1.3b	2.9	21.3b	5.3ab	19.1	0.8b	8.3a	0.21	110.2	61.8
Cumberland	8	6.6a	7.3	47.0a	13.3a	26.3	3.6a	8.5a	0.31	104.5	60.3

<sup>z</sup>Leaf rust, *P. triticina* was visually estimated on flag leaves of 10 plants per plot at late-milk-early dough stage (F11.1-2) on 27 May.

<sup>y</sup>Percentage of Stagonospora blotch, primarily *S. nodorum*, was visually estimated on flag-1 leaves of 10 plants per plot at late-milk-early dough stage (F11.1-2) on 27 May.

<sup>x</sup>Fusarium head blight incidence was based on visual estimation of infected spikelets on 50 spikes per plot at late milk (F11.1) on 25 May.

<sup>w</sup>Fusarium head blight severity was estimated as a percentage of surface area affected on 5 total spikes per plot at late milk (F11.1) on 25 May.

<sup>v</sup>Fusarium head blight index = (% incidence x % severity)/100.

<sup>u</sup>Percentage of shriveled kernels in a 100 kernel grain sample.

<sup>t</sup>Based on 13.5% moisture and 60 lb/bu.

<sup>s</sup>Means in a column followed by the same letter are not significantly different, Student Newman Keuls test  $P \leq 0.1$  (columns are lettered only when the cultivar effect was significant).

<sup>r</sup> Means in a column followed by the same letter are not significantly different, Student Newman Keuls test  $P \leq 0.05$ .

Table 4. Effect of fungicide treatment and cultivar on Leaf rust, Stagonospora blotch (Flag, F-1), Fusarium head blight, shriveled kernels, DON, yield and test weight.

Cultivar	<u>Leaf rust<sup>z</sup></u>		<u>Stagonospora blotch<sup>y</sup></u>				<u>Inc.<sup>x</sup></u>		<u>Fusarium head blight (FHB)</u>		<u>Index<sup>v</sup></u>	
	Flag (%)		Flag (%)		Flag-1 (%)		Inc. (%)		Sev. <sup>w</sup> (%)		Index (%)	
	NT <sup>s</sup>	T <sup>r</sup>	NT	T	NT	T	NT	T	NT	T	NT	T
Bess	12.2a <sup>q</sup> A <sup>o</sup>	0.03B	6.9A	0.08B	77.9a <sup>p</sup> A	3.7B	3.5	1.5b <sup>p</sup>	23.8	17.6	0.7b <sup>p</sup>	0.5
Pioneer 26R15	2.6bA	0.03B	5.5A	0.40B	40.4bA	2.2B	5.0	5.5a	21.9	16.4	0.8b	0.9
Cumberland	13.2aA	0.00B	14.5A	0.03B	92.3aA	1.8B	17.0	9.5a	31.5	21.0	5.7a	1.5

  

Cultivar	<u>Shriveled Kernels<sup>u</sup></u>		<u>DON</u>		<u>Yield<sup>t</sup></u>		<u>Test weight</u>	
	NT	T	NT	T	NT	T	NT	T
Bess	4.0	2.5b <sup>p</sup>	0.17	0.14	105.2	103.8	61.6	63.2
Pioneer 26R15	11.0	5.5a	0.26	0.15	101.4B	116.8A	61.9	61.8
Cumberland	10.5	6.5a	0.31	0.30	94.8B	114.3A	59.4B	61.2A

<sup>z</sup>Leaf rust, *P. triticina* was visually estimated on flag leaves of 10 plants per plot at late-milk-early dough stage (F11.1-2) on 27 May.

<sup>y</sup>Percentage of Stagonospora blotch, primarily *S. nodorum*, was visually estimated on flag-1 leaves of 10 plants per plot at late-milk-early dough stage (F11.1-2) on 27 May.

<sup>x</sup>Fusarium head blight incidence was based on visual estimation of infected spikelets on 50 spikes per plot at late milk (F11.1) on 25 May.

<sup>w</sup>Fusarium head blight severity was estimated as a percentage of surface area affected on 5 total spikes per plot at late milk (F11.1) on 25 May.

<sup>v</sup>Fusarium head blight index = (% incidence x % severity)/100.

<sup>u</sup>Percentage of shriveled kernels in a 100 kernel grain sample.

<sup>t</sup>Based on 13.5% moisture and 60 lb/bu.

<sup>s</sup>Non-treated control.

<sup>r</sup>Fungicide treatment, Prosaro 6.5 fl oz + Induce 0.125% at F10.51 on 3 May.

<sup>q</sup>Lowercase letters compare means among the cultivars within each treatment; Means in a column followed by the same lowercase letter are not significantly different, Student Newman Keuls test  $P \leq 0.1$  (columns are lettered only when the treatment effect was significant).

<sup>p</sup>Means in a column followed by the same lowercase letter are not significantly different, Student Newman Keuls test  $P \leq 0.05$ .

<sup>o</sup>Uppercase letters compare means among the treatment within each cultivar, Student Newman Keuls test  $P \leq 0.05$  (columns are lettered only when the treatment effect was significant).