Uniform Fusarium Head Blight Integrated Management Trials: A 2011 Update

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OBJECTIVE

To evaluate the integrated effects of fungicide and genetic resistance on FHB and DON in all major grain classes in different cropping systems.

INTRODUCTION

FHB and DON management options include genetic resistance, cultural practices, and chemical and biological control. However, when used individually, these control measures are not fully effective under environmental conditions favorable to disease development. Moderately-resistant wheat and barley cultivars may accumulate DON levels above critical thresholds for human and livestock consumption (2). Triazole fungicide efficacy varies among studies, with mean percent control between 40 and 60% for FHB index and 30 to 50% for DON accumulation (3). In general, more effective control is achieved when moderate resistance is combined with appropriate fungicide applications (1, 4). However, this control is variable among grain classes and cropping systems. From 2009 to 2011, coordinated, uniform trials were conducted in multiple states to evaluate the effects of grain class, crop rotation, cultivar resistance, and fungicide application on the reduction of FHB and DON. This report summarizes results from trials conducted during the 2011 season.

MATERIALS AND METHODS

Trials were established in fields following a host or non-host crop of *F. graminearum*. At least two commercial small grain cultivars, classified as susceptible (S), moderately susceptible (MS) or moderately resistant (MR), were planted in four to six replicate blocks in each trial. The standard experimental design was a randomized complete block, with a split-split-plot or factorial arrangement of cultivar (whole-plot), inoculation (sub-plot) and fungicide treatment (sub-sub-plot). Some trials used fungicide as whole-plot and cultivar as sub-sub-plot; while others did not include inoculation as a factor. Fungicide (Prosaro, 6.5 fl. oz/A + NIS) was applied at anthesis, using CO_2 powered sprayers, equipped with Twinjet XR8002 or paired XR8001 nozzles, mounted at a 30 or 60^o angle, forward or backward. For trials with artificial inoculations, either *F. graminearum*-colonized corn kernel were spread on the soil surface of plots prior to anthesis or plots were spray-inoculated with a spore suspension of the fungus approximately 24 hours following fungicide treatments. FHB index (plot severity) was assessed during the dough stages of grain development. Milled grain samples were sent to a USWBSI-supported laboratory for toxin analysis. Analysis of variance (linear mixed model) was used to evaluate the effects of fungicide, cultivar, (and inoculation, when appropriate) and their interactions on index, DON and yield (assuming a significance level α = 0.05). Percent control was calculated to compare the effect of control measures to the susceptible, untreated check.

RESULTS AND DISCUSSION

The goal of including artificial inoculum as a factor in these trials was to increase the number of trials with "useable" FHB and DON data. It is difficult to assess the efficacy of integrated management strategies in trials with very low FHB intensity, i.e. index < 5% and DON < 1 ppm. In 2011, 17 out of 24 trials with index data and 14 out of 23 trials with DON data had mean index and DON in the untreated susceptible check above 5% and 1 ppm, respectively (Table 1). In most trials, the use of a MS or MR cultivar reduced both index and DON, relative to the untreated, susceptible check (Table 2). The effect of fungicide was slightly more variable across trials, potentially due to interactions between fungicide efficacy and environmental conditions. In general, fungicide application increased percent control of index and DON, within each resistance category. Most frequently the combination of moderate resistance to FHB and an appropriately timed fungicide application resulted in the greatest level of control, across trials (Table 2).

AKNOWLEDGEMENT AND DISCLAIMER

This material is based upon work supported by the U.S. Department of Agriculture, under Agreement No. 59-0206-9-071. This is a cooperative project with the U.S. Wheat & Barley Scab Initiative. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

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Table 1. Study descriptions and trial-wide mean FHB index, DON and yield (averages across all treatments and reps) from twenty-nine coordinated integrated management trials, conducted in twelve states in 2011.

					Trial-wide mean			**Susceptible-untreated check**	
State	**Location**	**Grain Class**	**Previous Crop**	**Trial No.**	**Index (%)**	**DON (ppm)**	**Yield**	**Index (%)**	**DON (ppm)**
AR	Kibler	SRWW	.	1	32.78	0.16	.	41.50	0.29
IL	Dixon Springs	SRWW	host	2	12.67	0.25	62.26	34.34	0.52
	Monmouth	SRWW	host	3	4.44	2.16	97.27	9.88	3.26
	Urbana	SRWW	host	4	7.99	0.89	.	12.63	1.82
	Urbana	SRWW	non-host	5	5.99	0.62	.	17.38	1.28
IN	Tippecanoe	SRWW	host	6	11.01	.	87.99	11.98	.
KY	Princeton	SRWW	host	7	13.30	0.74	92.11	31.77	1.56
MD	Keedysville	SRWW	host	8	31.40	4.32	77.41	44.24	6.88
	Wye	SRWW	host	9	15.62	.	75.72	24.96	.
	Wye	SRWW	non-host	10	28.75	.	77.87	38.55	.
MN	StPaul	HRSW	.	28	5.03	1.04	.	9.15	1.70
	StPaul	6ROWB	.	29	1.82	1.13	.	1.02	0.17
MO	Columbia	SRWW	host	15	21.00	2.71	46.33	33.08	5.21
	Columbia	SRWW	non-host	16	17.78	0.37	64.99	24.57	1.14
ND	Fargo	HRSW	non-host	19	2.24	0.76	58.91	3.65	1.04
	Fargo	HRSW	host	20	4.69	0.82	59.39	7.10	1.43
	Fargo	2ROWB	host	21	5.14	0.46	46.18	5.24	0.56
	Fargo	2ROWB	non-host	22	3.47	0.25	46.20	4.85	0.31
	Fargo	6ROWB	host	23	4.20	0.50	43.12	4.28	0.27
	Fargo	6ROWB	non-host	24	4.26	0.84	50.69	3.71	0.47
	Langdon	durum	non-host	25	.	.	46.29	.	.
	Langdon	durum	host	26	.	.	42.70	.	.
NE	Mead	HRWW	host	27	5.51	1.11	45.19	6.98	1.58
NY	Aurora	SRWW	host	17	3.25	0.89	77.06	2.26	0.44
	Aurora	SRWW	non-host	18	2.18	0.38	61.72	1.32	0.12
OH	Wooster	SRWW	host	11	5.78	1.06	53.75	11.71	2.33
SD	Brookings	HRWW	host	12	.	0.95	39.39	.	1.87
	Brookings	HRSW	host	13	.	.	15.29	.	.
	Brookings	6ROWB	host	14	.	0.52	51.98	.	1.05

Table 2. Trial-wide means for index and DON and percent control for each management combination, relative to the untreated, susceptible check.

		Cultivar x Fungicide Means[2]						**% Control**				
	Trial No.[1]	**S_UT (check)**	**S_FUN**	**MS_UT**	**MS_FUN**	**MR_UT**	**MR_FUN**	**S_FUN**	**MS_UT**	**MS_FUN**	**MR_UT**	**MR_FUN**
INDEX (%)	**1**	41.50	25.75	45.25	35.75	30.00	16.75	37.95	-9.04	13.86	27.71	59.64
	2	34.34	14.72	15.31	3.13	9.56	2.27	57.14	55.41	90.90	72.15	93.39
	3	9.88	4.34	5.19	1.69	4.29	1.71	56.10	47.49	82.92	56.56	82.71
	4	12.63	12.44	5.88	10.25	6.83	3.04	1.52	53.48	18.84	45.90	75.92
	5	17.38	7.00	4.63	3.25	3.21	1.88	59.72	73.39	81.30	81.54	89.21
	6	20.79	11.98	13.92	11.67	7.94	6.75	42.38	33.06	43.88	61.82	67.53
	7	31.77	12.69	18.37	7.88	7.08	2.00	60.06	42.18	75.21	77.71	93.70
	8	44.24	34.63	25.37	18.43	31.00	21.57	21.73	42.66	58.33	29.93	51.25
	9	24.96	12.60	21.30	9.21	16.56	4.27	49.54	14.65	63.11	33.66	82.91
	10	38.55	31.03	34.52	18.47	30.32	16.50	19.50	10.45	52.10	21.36	57.20
	11	11.71	5.46	11.39	3.27	4.13	1.02	53.34	2.75	72.11	64.77	91.25
	15	33.08	21.76	21.18	14.10	18.52	11.20	34.23	35.99	57.38	44.02	66.14
	16	24.57	16.99	17.04	14.62	19.17	12.23	30.84	30.64	40.51	21.99	50.21
	20	7.10	4.59	5.03	3.43	1.63	4.10	35.39	29.23	51.76	77.11	42.25
	21	5.24	5.43	6.09	4.00	.	.	-3.60	-16.13	23.65	.	.
	27	6.98	3.60	.	.	5.91	5.55	48.42	.	.	15.29	20.49
	28	9.15	2.25	8.84	2.71	4.31	1.63	75.45	3.41	70.43	52.94	82.18

Table 2 *Continued*

	Trial No.[1]	Cultivar x Fungicide Means[2] S_UT (check)	S_FUN	MS_UT	MS_FUN	MR_UT	MR_FUN	% Control S_FUN	MS_UT	MS_FUN	MR_UT	MR_FUN
DON (ppm)	**3**	3.26	2.94	2.85	2.25	1.67	1.14	9.70	12.58	30.98	48.80	65.16
	4	1.82	1.20	0.87	0.60	0.65	0.40	34.07	52.34	67.03	64.19	78.16
	5	1.28	0.88	0.62	0.51	0.38	0.24	31.05	51.76	60.55	70.51	81.53
	7	1.56	0.44	1.25	0.44	0.54	0.19	71.63	19.63	72.04	65.63	87.58
	8	6.88	3.40	3.36	1.45	7.97	3.38	50.65	51.14	78.88	-15.79	50.92
	11	2.33	0.72	2.23	0.80	0.62	0.20	69.05	4.22	65.72	73.25	91.31
	12	1.87	1.30	0.82	0.52	0.32	0.90	30.48	56.33	72.37	83.07	51.87
	14	1.05	0.45	.	.	0.13	0.00	57.14	.	.	88.10	100.00
	15	5.21	3.63	2.28	1.29	1.27	1.03	30.42	56.33	75.21	75.69	80.17
	16	1.14	0.59	0.09	0.04	0.00	0.00	48.10	91.96	96.35	100.00	100.00
	19	1.04	0.70	0.93	0.63	0.55	0.45	32.69	11.06	39.90	47.12	56.73
	20	1.43	0.50	0.95	0.70	0.65	0.43	65.03	33.57	51.05	54.55	70.28
	27	1.58	0.96	.	.	1.33	0.58	39.08	.	.	16.14	63.61
	28	1.70	0.68	1.39	0.75	0.93	0.54	60.00	18.46	55.66	45.29	68.53

[1] Only trials with > 5% index and >1 ppm DON were included in this analysis.
[2] S_UT = susceptible, untreated check; S_FUN = susceptible, fungicide-treated; MS_UT = moderately susceptible, untreated; MS_FUN = moderately susceptible, fungicide-treated; MR_UT = moderately resistant, untreated; MR_FUN = moderately resistant, fungicide-treated.