Fungicide Efficacy for FHB and Leaf Disease Control on Barley by Spray Volumes with Preference and Interlock Adjuvants

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OBJECTIVES

To determine if the efficacy of Folicur fungicide can be enhanced by Preference and Interlock adjuvants at various spray volumes.

MATERIALS AND METHODS

A site, previously cropped with small grains, was tilled and planted with a double disk drill (7 inch row spacing), and spring tooth harrowed in early May. The soil type was Svea-Barnes complex at the Langdon Research Extension Center. Planted areas were divided to plots 12 ft wide by 20 ft long. The spray treatments were applied by tractor. The study was arranged in a randomized complete block design with six replicates. Competing weeds were controlled with an application of Achieve 40 DG, Wide Match, and ammonium sulfate (.44 lb + 1 pt/acre + 7 lb /100 gal, respectively) to barley at the 2.5 to 3 leaf stage. A second herbicide application of Starane, Harmony GT, and Bronate Advanced (0.5 pt, 0.3 oz, and 0.8 pt/acre, respectively) was applied at the 5 to 6 leaf stage on 16 June. A Fusarium barley inoculum was hand spread on 6 June and 15 June at 122 grams per plot.

The sprayer was mounted on a tractor and equipped with one row of XR8001 nozzles oriented forward at 30 degrees from the vertical delivering 5 GPA or two rows delivering 10 GPA. Another configuration used one or two rows of TJ8002 nozzles oriented downward to deliver 10 and 20 GPA. Target spray pressure was 40 psi. Each boom was configured with 4 nozzles at 20-inch nozzle spacing. The tractor operated on the left 6 feet of each plot to minimize drift to adjacent plots. Travel speed for all treatments was 6 MPH. The fungicide treatments consisted of Folicur fungicide at 2 fl. oz/acre tank mixed with adjuvant Preference at 0.25% v/v and Interlock at 2 fl oz/acre. Control treatments included untreated plots and plots sprayed with Folicur and Induce adjuvant at 0.125% v/v which is the recommended adjuvant for use with Folicur. Bayer CropScience is the manufacture of Folicur. The spray treatments were applied on 9 July from 1:00 to 3:15 p.m. with heads at greater than 50% emerged growth stage. North Dakota State University Extension recommended production practices for Northeast North Dakota were followed.

A visual estimation of disease incidence (number of spikes infected) was made from 20 heads per plot at early dough stage. Field severity rating is the number of FHB infected kernels per head divided by total kernels per individual spike in each plot. Severity of leaf diseases was based on a visual estimate of the percent leaf necrosis from five leaves per plot. All plots were harvested with a Hege plot combine on 10 August and the grain sample was cleaned and processed for yield, plump, test weight and protein. A sub sample was ground and analyzed for the toxin deoxynivalenol (DON) by North Dakota State University. Data was analyzed with the general linear model (GLM) in SAS. Least significant differences (LSD) were used to compare means at the 5% probability level.

RESULTS

Precipitation was excessive in June. More than 7 inches of rain was recorded for the month. Soil moisture levels were adequate and the environment was conducive to achieve moderate levels of Fusarium head blight. Temperatures were above average for the later stages of crop development. Foliar disease levels were very low and crop lodging did not occur. Average wind speed during fungicide application was 15.4 to 17 MPH from south to southeast (163-165 degrees). Travel direction was from south to north and temperature varied from 85-88 °F. FHB Incidence was reduced by all fungicide treatments. FHB field severity was also reduced by all fungicide treatments. The 10 and 20 GPA treatments with the TJ8002 nozzles had the greatest amount of FHB field severity among the treatments. The lowest FHB field severity was obtained with a 10 GPA XR8001 treatment with Preference/Interlock adjuvant combination followed by the 5 GPA XR8001 with the Preference/Interlock combination. Although leaf disease levels were very low, leaf disease was also reduced by all fungicide treatments. Interestingly, the greatest reduction occurred with the 20 GPA volume and TJ8002 nozzle which was significantly less than the Folicur/Induce control treatment. Yield, test weight, plump, and proteins were not significantly different. However, deoxynivalenol (DON) concentrations were reduced by all fungicide treatments except the 5 GPA treatments.

Water sensitive cards were placed in the plots to measure spray drop size. Cards were placed horizontal and back to back both in the line of sprayer travel and back to back perpendicular to sprayer travel. Spray drop size was measured with the WRK Droplet Scan system. Information in tables 2 and 3 include Volume Median Diameter (VMD), 0.1 VD and 0.9 VD and percent coverage of the card. Volume median diameter indicates that one half (0.5) of the spray volume is in drops smaller than this value and one half of the spray volume is in drops larger than this value. The 0.1 and 0.9 VD (Volume Diameter) indicates that 10% (0.1 VD) of the spray volume is in drops smaller than this size and the (0.9 VD) indicates that 90% of the spray volume is in drops smaller than this size. This also indicates that 10% of the spray volume is in drops larger than this size. The 0.1 and 0.9 VD information is useful as it indicates the span of drops sizes produced. Drop span is determined by subtracting the 0.1 value from the 0.9 value and dividing this by the VMD. The horizontal VMD is the best indicator of the drop size that is being applied to the crop.

The front/back and right/left mounted cards provide an indication of the spray drops that deposit on the sides of grain heads. The horizontal mounted cards that were sprayed with 20 GPA do not have a value as the spray volume overloaded the cards and the analysis system was not able to be read the intense coverage. The spray cards were covered almost 100% with spray and the individual drops could not be separated. The untreated plots indicate large drops were collected in both the horizontal and vertical positions. This was due to the strong breezes and the small drops that were produced from the nozzles and the proximity of the plots near the sprayed plots. The VMD for the horizontal cards varied from 505 to 634 microns. Most of the VMD values for the vertical spot cards indicate a similar size drop. The 0.1 volume diameter (VD) on the front facing card was less with the 5 GPA treatments. Approximately equal size drops were deposited on the 10 GPA horizontal cards and all vertical mounted cards when the TJ8002 nozzle applied 10 and 20 GPA. This is due to the orifice size of the twin jet nozzle being the same size as the XR8001. The twin jet contains two orifices of equal size with one pointing forward 30 deg. and the other facing back 30 deg. The larger drops for the 10 and 20 GPA rates are due to spay drops depositing on top of other drops which produced a larger drop measured by the scanning system. The 0.9 VD are larger as they are at the large end of the drop spectrum. The drop span for this trial was slightly over 1.0 which is usually considered a good drop spectrum. Horizontal and backside coverage increased when spray volume increased. Almost no coverage was measured on the left/right card. This was probably due to the strong breeze at the time of spraying. Spray coverage showed considerable variation which was probably due to the wind at the time of spraying. Spray coverage on cards is only a relative value and may not be exactly like what is collected on grain heads. The coverage values tend to indicate that wind would cover the upwind side of the head and the back side of the head received much less.

CONCLUSIONS

The TJ8002 nozzles in combination with the increased spray volume did not improve FHB control but provided additional benefit for leaf disease control compared to lower volume treatments with XR8001 nozzles. Reduction in FHB did not translate into increased yield, test weight, plump, or protein level but significantly reduced DON concentrations over the untreated and the 5 GPA treatments. One wonders if the strong wind speed positively effected movement from the awns down to the lemma and palea. Field severity, though not significantly different, was reduced with Preference/Interlock adjuvant combination compared to the Induce. While water sensitive cards function to characterize the spray nozzles and drop size, they do not appear to effectively correlate with disease control.

TABLE 1. Fusarium head blight incidence and field severity, leaf disease, yield, test weight, plump, DON, and protein by spray volume and nozzle at Langdon, 2005.

Adjuvants[x]	Spray Volume[y] (GPA)	Nozzle	FHB Incidence (%)	FHB Field Severity (%)	Leaf Disease (%)	Yield (Bu/A)	Test Weight (Lb/bu)	Plump (%)	Protein (%)	DON (PPM)
			87.5	5.8	18.5	109.4	48.8	92.0	11.5	3.1
Preference+Interlock	5	XR8001	65.8	3.4	8.8	112.2	49.2	92.4	11.8	2.2
Preference+Interlock	10	TJ8002	70.8	3.9	6.0	107.6	48.9	92.2	11.5	1.6
Preference+Interlock	20	TJ8002	69.2	4.3	4.2	110.4	49.2	93.6	11.8	1.6
Preference+Interlock	10	XR8001	67.5	2.7	8.5	106.9	49.2	94.0	11.5	1.4
Induce	10	XR8001	72.5	3.7	9.5	102.7	48.9	94.8	11.7	1.0
LSD[z]			14.2	1.4	4.9	NS	NS	NS	NS	1.3
% C.V.			16.5	30.4	44.6	6.5	1.0	2.5	2.8	56.1

[x] Folicur fungicide applied with adjuvants as treatments at 2 fl oz/acre.
[y] Spray volume was increased by adding additional booms and nozzles approximately two feet behind the first boom.
[z] Tested at 0.05 probability level for mean comparisons.

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Table 2. Volume median diameter drop size on horizontal, front, back, left and right placed cards and 0.1 VD (volume diameter) drop size on horizontal, front, back, left, and right placed water sensitive cards compared by spray volume and nozzle, 2005.

	Spray [z]		Vol. Median Dia.(VMD)					0.1 VD				
Adjuvants	Volume	Nozzle	Hori.	Front	Back	Left	Right	Hori.	Front	Back	Left	Right
Untreated			371	.	240	476	348	177	.	67	235	143
Preference+Interlock	5	XR8001	505	573	103	526	405	238	168	62	295	202
Preference+Interlock	10	TJ8002	513	533	406	479	574	257	233	254	244	295
Preference+Interlock	20	TJ8002	.	571	601	537	511	.	259	304	275	221
Preference+Interlock	10	XR8001	526	549	215	528	468	238	298	106	317	177
Induce	10	XR8001	634	510	179	485	468	230	245	86	191	151

[z] Spray volume was increased by adding additional booms and nozzles approximately two feet behind the first boom.

Table 3. The 0.9 VD (volume diameter) drop size on horizontal, front, back, left, and right placed water sensitive cards and percent spray coverage on horizontal, front, back, and combined left/right water sensitive cards by spray volume and nozzle, 2005.

	Spray		0.9 VD					Coverage (%)			
Adjuvants	Volume [z]	Nozzle	Hori.	Front	Back	Left	Right	Hori.	Front	Back	Left/Right
Untreated			576	.	432	796	581	13.80	0.00	0.13	0.19
Preference+Interlock	5	XR8001	766	1029	213	767	710	16.44	43.69	0.05	0.27
Preference+Interlock	10	TJ8002	846	888	570	715	889	38.62	56.67	6.51	0.30
Preference+Interlock	20	TJ8002	.	901	903	759	831	91.11	49.45	31.52	0.43
Preference+Interlock	10	XR8001	871	792	394	803	711	23.64	70.22	0.44	0.14
Induce	10	XR8001	1042	777	451	798	840	53.68	40.69	0.28	0.34

[z] Spray volume was increased by adding additional booms and nozzles approximately two feet behind the first boom.