Effect of Nozzles on Fungicide Efficacy for Control of Fusarium Head Blight on Barley

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OBJECTIVES

The study objective was to determine if nozzles with differing drop formation technologies, differing drop sizes, and differing orientations affected the efficacy of fungicide for control of Fusarium head blight (FHB) on barley.

INTRODUCTION

Fungicide applications to small grains for control of FHB have often given results that are inconsistent and need to be improved. Preliminary results from ongoing studies at the Langdon Research Extension Center have shown spray deposition on the grain head can be improved with certain spray volumes and angle orientations. Barley has been the most difficult crop to show consistent control of FHB with fungicide application due to the extensive and tight structure of awns when heading is complete which the recommended time for fungicide application is. The awns provide a filter to minimize the amount of spores that contact and infect the developing grain kernels, but also provide a structure that makes it more difficult to deposit fungicide on the lemma and palea to protect against infection from FHB.

MATERIALS AND METHODS

A study was initiated using ground application equipment to compare several nozzles with different type and size drop formation. The nozzles evaluated were Spraying Systems Co.® (Spraying Systems, 2005) Flat Fan, XR TeeJet XR8002 and XR8003 oriented forward (F), Turbo Teejet TT11001 and TT11002 oriented forward + backward (F+B) and F, respectively, Air Induction AI110015 and AI11002 oriented F, and AirJet 49880A (liquid orifice # 31) F+B at air pressure of 3.5,5.0,and 8.5 psi. An untreated plot was included as a control. The classification for the nozzles were XR8002 (fine), XR8003 (medium), Turbo Teejet 11001 and 11002 (medium), Air Induction 110015 (coarse) and 11002 (very coarse), and AirJet 3.5 (very coarse), 5.0 (coarse) and 8.5 (fine) (Spraying Systems, 2005). The study was arranged as a randomized complete block with four replicates. The site was established to 'Tradition' barley on a Barnes/Svea soil on the Langdon Research Extension Center in May of 2005. Previously the site was fallowed. A Fusarium barley inoculum was hand spread 21 and 14 days prior to heading at 122 grams per plot. The most commonly used method to evaluate spray technology is the use of water and oil sensitive paper (WSP Spraying Systems Co. ®, Wheaton, Illinois 60189). Water sensitive cards were placed on stands at grain head height in the center of two plots. The card data had not been compiled yet and will be presented in another manuscript at a later date. The tractor mounted sprayer traveled on the left side of the plots with a boom extending to the right of the tractor sprayed area measured 6 x 20 ft. The spray solution contained Bayer CropScience's Prosaro SC fungicide at 6.5 fl. oz. /Acre, Induce adjuvant at 0.125% v/v, and a dye (F D&C Blue #1) at 22 grams/acre. Additionally, barley heads were sampled after spray application from three replicates. Each sample consisted of 5 heads. The heads were shaken for 2 minutes to remove the dye in 80 ml of 95% ethanol and the absorbance determined by a Jenway spectrophotometer. A regression curve was established from a dilution of the original spray sample and the absorbance of the spectrophotometer is presented as dilution data for a comparison of head coverage among the nozzle treatments. The tractor traveled at 6 mph for the study and the spray volume was 10 GPA. North Dakota State University Extension recommended production practices for Northeast North Dakota were followed. . A visual estimation was made from 20 samples per plot collected 20 days after fungicide application to estimate the incidence (number of spikes infected) and field severity (number of FHB infected kernels per head divided by total kernels per individual spike) of FHB in each plot. Each plot was harvested with a Hege plot combine and the grain sample cleaned and processed for yield, protein, and test weight determination and plump on barley. 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 AND DISCUSSION

The North Dakota Agricultural Weather Network Weather Station recorded over 7 inches of precipitation in June. The total was more than double what is considered the 30 year normal. No additional misting was added to the trial. Disease levels were moderate to high considering the low levels of inoculum present in the area. Disease incidence was greater than 90% on all treatments but not different among treatments (Table 1). The greatest amount of dye on the head was with nozzles that produced fine or medium drops, dilution 4.3-Flat Fan XR8002, 4.9-Turbo Teejet 11001, and 4.3 AirJet 8.5 psi and smallest amount of coverage with coarse type drops. Yield, plump, and proteins were not different among treatments. Deoxynivalenol concentration was not different among fungicide treatments but coarse type drops trended toward less reduction in DON compared to the untreated. There were strong correlations between FHB incidence and severity, test weight and incidence and severity, plump and test weight, and dilution on protein. Weaker correlations were determined between DON and plump and dilution and incidence and test weight (Table 2). F+B facing nozzles offer no measurable advantage when travel speeds were 6 mph. Data trends indicate that coarse and very coarse drops may reduce fungicide deposition on the grain head and result in increased DON. A study conducted on hard red spring wheat in 2004 (unpublished) showed increased fungicide levels on the heads with small medium drop size (XR8002) nozzles, compared to fine drop size (XR8001) nozzles and large medium drop size (XR8003) nozzles.

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Table 1. FHB Incidence and Field Severity, Yield, Test Weight, Plump, Deoxynivalenol, Protein, and Dilution by Nozzle Type, Size, and Orientation on Tradition Barley, Langdon 2005.

Nozzle		FHB							
Class[Y] and Type	Size, Orient., or Air (Water) Pressure (PSI)	Incidence (%)	Field Severity (%)	Yield (Bu/a)	Test Weight (Lb/bu)	Plump (%)	DON (PPM)	Protein (%)	Dilution (x 10^{-4})
Fine									
Flat Fan	XR8002 (35) F	96	13.3	98.9	47.8	93	1.1	11.7	4.3
Air Jet	8.5 psi (21) F+B	98	9.2	99.5	47.6	95	1.2	11.8	4.3
Medium									
Flat Fan	XR8003 (13) F	90	8.0	103.7	48.6	96	1.0	11.7	3.2
Turbo Teejet	11001 (35) F+B	100	17.9	102.2	47.3	95	1.0	12.0	4.9
Turbo Teejet	11002 (35) F	96	11.7	96.5	47.8	95	1.0	12.0	3.9
Coarse									
Air Jet	5.0 psi (21) F+B	91	9.4	101.6	48.0	94	1.6	11.6	3.9
Air Induction	110015 (60) F	96	10.9	101.2	47.8	95	1.0	11.7	3.5
Very Coarse									
Air Induction	11002 (35) F	94	10.2	104.6	48.1	95	1.2	11.8	3.8
Air Jet	3.5 psi (21) F+B	96	13.0	99.6	48.3	95	1.7	11.8	4.0
Untreated		98	14.9	101.2	47.8	94	2.6	11.3	2.9
LSD $_{(0.05)}$		NS	6.1[z]	NS	0.8*	NS	0.8	NS	1.0
% C.V.		7	36	7	1	1	40	6	11

[Y]Spraying Systems Mobile Systems Products Catalog 49A. 2005. TeeJet Mid-Tech North 403 North Main Hartford, South Dakota 57033.

[z] P=0.1

Travel Speed 6 MPH and application rate 10 GPA on all plots.

Table 2. Pearson Correlation of Dependent Variables in Nozzle Study, Langdon 2005.

Dependent Variable	FHB Incidence	Severity	Yield	Test Weight	Plump	DON	Protein	Dilution
Incidence	1.0	0.4746 0.0020	-0.2335 0.1470	-.03217 0.043	0.0417 0.7985	-0.0251 0.8779	-0.0582 0.7213	0.3458 0.0613
Severity		1.0	-0.1473 0.3645	-0.3237 0.0416	-0.1720 0.2887	-0.0683 0.6754	0.1786 0.2702	0.2873 0.1237
Yield			1.0	0.2805 0.0800	0.2527 0.1156	0.0971 0.5510	0.0305 0.8517	0.0895 0.6381
Test Weight				1.0	0.3305 0.0372	0.0522 0.7489	0.0978 0.5483	-0.3483 0.0593
Plump					1.0	-0.3079 0.0533	0.0998 0.5401	0.1765 0.3508
DON						1.0	-0.1574 0.3322	0.3017 0.1051
Protein							1.0	-0.4004 0.0283
Dilution								1.0

Correlation Coefficient
Prob > |r| under H0: Rho=0