Addition of Adjuvant to Improve Fungicide Efficacy on Hard Red Spring Wheat, Langdon 2008

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Materials and Methods

A study was conducted in 2008 at the North Dakota State University Langdon Research Extension Center, Langdon North Dakota. The principle objective of the study was to determine if an adjuvant included with fungicide could increase deposition on the grain head decreasing Fusarium head blight (FHB) disease and deoxynivalenol (DON) accumulation in the harvest sample. Several fungicide combinations and a biological treatment were included to complement the adjuvant portion of the study. The study was designed as a randomized complete block with four replicates. The previous crop was small grains. The soil type was a Barnes/Svea complex (fine-loamy, mixed superactive Frigid, Calcic Hapludoll/mixed superactive Frigid, Pachic Hapludoll). A block of 'Freyr', an awned hard red spring wheat type, was planted with a John Deere 9280 double-disk type drill, rows spaced 6-inches on 7 May. Freyr is moderately resistant to FHB. After emergence and weed control was completed, each block was divided into plots 12 x 30 ft. After delineation of the plots, a Fusarium inoculum was hand-broadcast on each plot to encourage development of disease. Initial fungicide treatments were applied with a tractor using a side-mounted spray boom. The tractor traveled 6 mph delivering a solution 10 GPA at 40 psi using Spraying Systems XR8002 nozzles angled 30 degrees downward from horizontal and oriented to spray forward or the same direction of travel as the tractor. The sprayer was equipped with a CO_2 type delivery system instead of a standard pump. After the fungicide was applied an impact type sprinkler irrigation system was installed (nozzles spaced on 30 x 40 ft centers) to modify the environment as needed and encourage the development of disease. Three treatments included sequential applications that were applied after the supplemental watering system was installed. A CO_2 backpack sprayer equipped with XR8001 nozzles mounted on a double swivel and oriented to spray forward and backward and 30 degrees downward from horizontal was used to apply the treatments. This method was used to avoid damage to the watering systems. These treatments were applied at 40 psi in 18.4 GPA. North Dakota State University Extension recommended production practices for hard red spring wheat in Northeast North Dakota were followed. A visual disease evaluation was made from 20 samples per plot collected 20 days after the first fungicide application. The estimate of (FHB) incidence (number of spikes infected) and FHB index (number of infected kernels per head divided by total kernels per individual spike) was determined for each plot. Head severity is the average severity of infected heads. Five leaves were also sampled and scored to determine foliar disease severity. A rotary mower removed the front and back five feet from each plot prior to harvest to minimize any chance of interference by inaccurate application from the tractor sprayer when stopping or starting. Each plot was

harvested with a Hege plot combine and the grain sample cleaned and processed for yield and test weight. A sub sample was ground and analyzed for deoxynivalenol (DON) by North Dakota State University. Data was analyzed with the general linear model (GLM) in SAS. Fisher's protected least significant differences (LSD) were used to compare means at the 95% probability level.

Discussion

Differences in yield and test weight were not determined (Table 1). Often, when small grains are rotated closely with small grains, conditions develop where yield is limited by pathogens affecting the rooting system. When environmental conditions favor moderate to high yield potential, yield differences among treatments can be difficult to measure because of these types of variabilities within the soil pathogen complex. We would theorize that these criteria affected our yields and test weights in this study. Incidence ranged from 97.5% on the untreated to 47.5% with a sequential treatment of Proline followed a week later with a treatment of Folicur. Four adjuvants combinations with tebuconazole reduced incidence compared to the untreated. Adjuvants included AG 07015, Preference, Induce and AG 08001. Metconazole, treatments that included prothioconazole (Proline or Prosaro) and sequential applications all had fewer incidences than the untreated. Prosaro with Induce and Prosaro with In-Place and Syl-Tac had lower incidence than the Folicur/Induce treatment which ranked eighth out of twenty. Head severity was reduced, compared to the untreated, by all treatments except the biological compound TrigoCor 1448 when applied alone. Similar reductions in head severity were determined. Treatments that included the chemistry prothioconazole as the initial treatment reduced severity by 50% or more. FHB disease index had even greater reduction than incidence and severity compared to the untreated. Several treatments reduced index in excess of 80%. Foliar disease levels were low and no differences were measured. Deoxynivalenol data is also reported in Table 1. Almost all treatments except for TrigoCor 1448 and Embrace and AG 08001 reduced DON levels compared to the untreated. Among the fungicides chemistries, the DON levels from the tebuconazole > metconazole > prothioconazole/tebuconazole blend ≥ sequential treatments. The lowest DON levels occurred from a sequential treatment of Prosaro at half the labeled rate at each application. The next four numerically best treatments included a sequential treatment including a full rate of tebuconazole as the first treatment and prothioconazole as the second treatment. Equally affective were single applications of Prosaro applied with the adjuvant Induce, In-Place or In-Place and Syl-Tac. The efficacy of tebuconazole, Embrace or Folicur, was greater, compared to the biological single application treatment when tank mixed with the adjuvants AG 07011 and AG 07010.

Table 1. Yield, Test Weight, Fusarium Head Blight Incidence, Severity Index, Head Severity, and Deoxynivalenol Concentration , Foliar Leaf Disease by Fungicide Treatment and Rate, Langdon 2008.

				Fusarium Head Blight				
Treatment	Treatment Rate	Yield	Test Weight	Inc.	Index	Head Sev.	DON	Foliar Sev.
		Bu/a	Lb/bu	%	%	%	PPM	%
Untreated		51.8	56.6	97.5	23.4	24.4	6.0	34.0
[1]TrigoCor 1448 at 10.54 (kernel watery ripe)		49.9	56.8	91.3	20.0	22.7	5.0	33.3
[2]Embrace + AG 07011	4 fl oz + 1 pt/a	56.6	57.5	86.3	12.8	17.3	2.3	35.3
Embrace + AG 02013 + [2]Preference	4 fl oz+ 2 fl oz/a + 0.25% v/v	57.0	57.6	85.0	11.4	15.8	3.7	35.8
Embrace + AG 06011	4 fl oz+ 6 fl oz/a	51.5	57.4	83.8	11.2	15.2	3.3	26.0
Embrace + AG 07010	4 fl oz+ 1 pt/a	51.5	57.6	83.8	11.6	16.5	2.5	28.7
Embrace + AG 07015	4 fl oz+ 1 pt/a	52.5	57.9	80.0	9.8	14.7	3.4	32.3
Folicur + [3]Induce	4 fl oz/a + 0.125% v/v	50.8	56.6	80.0	9.8	15.0	3.5	27.5
Embrace + Preference	4 fl oz+ 0.25% v/v	52.8	57.9	78.8	9.8	15.0	3.5	36.5
Embrace + AG 08001	4 fl oz+ 1 pt/a	51.1	57.2	77.5	10.4	16.1	4.1	25.6
[4]Metconazole + Tebuconazole + Induce	7 fl oz + 3 fl oz/a + 0.125% v/v	51.2	57.0	77.5	8.3	13.1	1.5	33.3
Folicur + Induce and [5]Proline + Induce	4 fl oz/a + 0.125% v/v and 5 fl oz/A+0.125%v/v	55.9	57.4	75.0	9.0	15.0	0.9	40.8
Metconazole	14 fl oz/a + 0.125% v/v	56.2	56.2	75.0	7.7	13.5	2.0	36.0
[5]Prosaro + [6]Syl-Tac	6.5 +1.8 fl oz /a	56.5	58.2	70.0	6.2	11.5	1.3	34.0
Prosaro + [6]In-Place	6.5 fl oz/a + 0.4 fl oz /a	48.4	57.4	68.8	5.4	11.6	0.8	28.7
Prosaro + Induce	6.5 fl oz /a + 0.125% v/v	55.4	58.1	58.8	4.2	11.2	0.8	36.0
Prosaro + In-Place + Syl-Tac	6.5 fl oz /a + 0.4 fl + 1.8 oz /a	51.6	57.9	58.8	4.8	13.6	0.9	30.3
Prosaro + Induce and Prosaro + Induce	3.25 fl oz/a+ 0.125%v/v both timings	62.0	57.0	56.3	3.5	10.5	0.5	36.0
Prosaro at 10.51 (beginning of anthesis) and Induce and TrigoCor 1448 at 10.54	6.5 fl oz/a + 0.125% v/v	57.6	57.1	56.3	3.7	11.5	1.2	31.6
Proline + Induce and Folicur + Induce	5 fl oz/a+0.125% v/v and 4 fl oz/a+0.125%v/v	48.8	56.0	47.5	3.7	12.9	1.3	36.5
LSD $_{(p=0.05)}$		NS	NS	17.0	5.9	5.0	2.0	NS
% C.V.		16.0	2.4	16.2	44.5	23.9	59.2	29.4

[1]TrigoCor 1448 has been identified as *Bacillus subtilis* and was provided by Dr. Gary Bergstrom from Cornell University, Ithaca NY .

[2]Embrace is tebuconazole and Preference is an adjuvant marketed by Winfield Solutions. The AG prefix compounds are experimental proprietary adjuvants and adjuvant blends.

[3]Induce is an adjuvant marketed by Helena Chemical Co.

[4]Metconazole is marketed by BASF under the trade name Caramba.

[5]Prosaro (50/50 blend of prothioconazole/tebuconazole) Proline (prothioconazole) and Folicur (tebuconazole) are manufactured by Bayer CropScience.

[6]Syl-Tac and In-Place are Adjuvants distributed by Wilbur-Ellis