NORTHWEST CROPS & SOILS PROGRAM

The Efficacy of Fungicide Application to Control Fusarium Head Blight Infection in Spring Wheat

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THE EFFICACY OF FUNGICIDE APPLICATION TO CONTROL FUSARIUM HEAD BLIGHT INFECTION IN SPRING WHEAT

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There is a high demand for locally grown wheat for baking purposes throughout the Northeast. Currently, there is not enough grown in the region to meet this demand. One major obstacle for growers is *Fusarium* head blight (FHB) infection of grain. This disease is currently the most important disease facing grain growers in the Northeast, resulting in loss of yield, shriveled grain, and most importantly, harmful mycotoxin contamination. A vomitoxin called Deoxynivalenol (DON) is considered the primary mycotoxin associated with FHB. The spores are usually transported by air currents and can infect plants at flowering through grain fill. Eating contaminated grain greater than 1ppm poses a health risk to both humans and livestock. Fungicide applications have proven to be relatively effective at controlling FHB in other spring wheat growing regions. Limited work has been done in this region on fungicide application to spring wheat specifically to minimize FHB and ultimately reduce DON mycotoxin production. In April of 2016, the UVM Extension Northwest Crops and Soils Program initiated a spring wheat fungicide trial to determine the efficacy of a conventional fungicide application to reduce FHB infection on cultivars with varying degrees of disease susceptibility.

MATERIALS AND METHODS

A field experiment was established at the Borderview Research Farm located in Alburgh, VT on 28-Apr to investigate the effects of cultivar resistance, conventional fungicide efficacy on FHB and DON infection in spring wheat. The experimental design was a randomized complete block, with a split-plot arrangement and 4 replicates. Cultivar was the main plot and fungicide vs. no fungicide treatment was the sub-plots. The cultivars planted, seed source, and FHB resistance rating are listed in Table 1.

Table 1. 2016 varieties planted, seed source and FHB resistance rating.

Variety	Seed Source	FHB resistance
Glenn	Albert Lea Seed. MN	Resistant
Magog	Semican Atlantic Inc., Canada	Susceptible
Prosper	Albert Lea Seed. MN	Moderately resistant

The seedbed at the Alburgh location was prepared by conventional tillage methods. All plots were managed with practices similar to those used by producers in the surrounding areas (Table 2). The previous crop planted at the site was corn. Prior to planting the trial area was disked and spike tooth harrowed to prepare for planting. The plots were seeded with a Great Plains Cone Seeder on 28-Apr at a seeding rate of 350 live seeds per m^2. Plot size was 5’x 20’.

Table 2. General plot management of the trial.

Location	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	corn
Row spacing (inch)	7
Seeding rate (live seed m^2)	350
Replicates	4
Planting date	28-Apr
Harvest date	8-Aug
Harvest area (ft)	5 x 20
Tillage operations	Spring plow, disk & spike tooth harrow

When the wheat reached 100% flowering (1-Jul), half of the plots were sprayed with the fungicide Prosaro (EPA#264-862) and the other half were not sprayed. The application was made using a Bellspray Inc. Model T4 backpack sprayer. This model had a carbon dioxide pressurized tank and a four nozzle boom attachment. It sprayed at a rate of 10 gallons per acre. The adjuvant 'Induce' was added at a rate of 0.125%. Information on Prosaro and a description of this product has been provided from manufacturer information.

Prosaro® (EPA# 264-862) fungicide provides broad-spectrum disease control, stops the penetration of the fungus into the plant and the spread of infection within the plant and inhibits the reproduction and further growth of the fungus.

When the spring wheat reached the soft dough growth stage (18-Jul), FHB severity was assessed by randomly clipping 60-100 heads throughout each plot, spikes were counted and a visual assessment of each head was rated for FHB infection. To assess the infection rate we used the North Dakota State University Extension Service's "A Visual Scale to Estimate Severity of Fusarium Head Blight in Wheat" online publication, https://www.ag.ndsu.edu/ndipm/publications/wheat/documents/pp1095.pdf.

Grain plots were harvested in Alburgh with an Almaco SPC50 plot combine on 8-Aug, and the harvest area was 5' x 20'. At the time of harvest grain moisture, test weight, and yield were calculated.

Following harvest, seed was cleaned with a small Clipper cleaner (A.T. Ferrell, Bluffton, IN). An approximate one pound subsample was collected to determine quality. Quality measurements included standard testing parameters used by commercial mills. Test weight was measured by the weighing of a known volume of grain. Generally the heavier the wheat is per bushel, the higher baking quality. The acceptable test weight for bread wheat is 56-60 lbs per bushel. Once test weight was determined, the samples were then ground into flour using the Perten LM3100 Laboratory Mill. At this time, flour was evaluated for mycotoxin levels. Deoxynivalenol (DON) analysis was analyzed using Veratox DON 5/5 Quantitative test from the NEOGEN Corp. This test has a detection range of 0.5 to 5 ppm. Samples with DON values greater than 1 ppm are considered unsuitable for human consumption.

All data was analyzed using a mixed model analysis where replicates were considered random effects. The LSD procedure was used to separate cultivar means when the F-test was significant ($P < 0.10$). There were significant differences among the two locations for most parameters and therefore data from each location is reported independently.

Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among varieties is real or whether it might have occurred due to other variations in the field. At the bottom of each table a LSD value is presented for each variable (e.g. yield). Least Significant Differences at the 10% level of probability are shown. Where the difference between two varieties within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two varieties. In the following example, variety A is significantly different from variety C, but not from variety B. The difference between A and B is equal to 725, which is less than the LSD value of 889. This means that these varieties did not differ in yield. The difference between A and C is equal to 1454, which is greater than the LSD value of 889. This means that the yields of these varieties were significantly different from one another. The asterisk indicates that variety B was not significantly lower than the top yielding variety.

Variety	**Yield**
A	3161
B	3886*
C	**4615***
LSD	**889**

RESULTS

Seasonal precipitation and temperature recorded at weather stations in close proximity to the 2016 site are shown in Table 3. The growing season this year was marked by lower than normal temperatures in April, and higher than average temperatures in May and August. Rainfall amounts were below average throughout the growing season resulting in 5.52 inches below seasonal norms. From April to August, there was an accumulation of 4536 Growing Degree Days (GDDs) in Alburgh which is 43.7 GDDs above the 30 year average.

Table 3. Temperature and precipitation summary for Alburgh, VT, 2016.

Alburgh, VT	April	May	June	July	August
Average temperature (°F)	39.8	58.1	65.8	70.7	71.6
Departure from normal	-4.92	1.84	0.01	0.13	2.85
Precipitation (inches)	2.56	1.53	2.81	1.79	2.98
Departure from normal	-0.26	-1.92	-0.88	-2.37	-0.93
Growing Degree Days (32-95°F)	291	803	1017	1201	1224
Departure from normal	-97.9	49.5	3.20	4.45	84.4

Historical averages are for 30 years of data provided by the NOAA (1981-2010) for Burlington, VT. Alburgh precipitation data from 8/17/16-10/31/16 was missing and was replaced by data provided by the NOAA for Highgate, VT.

Impact of Fungicide

There were no significant differences in the average FHB severity or average FHB infected head severity in the Prosaro verses the non-sprayed treatments (Table 4). Incidence of FHB infected heads between Prosaro and the non-spray treatments was significantly different. The Prosaro applied treatment had significantly lower incidence of FHB infected heads compared to the non-sprayed control (Table 4; Figure 1).

Table 4. The FHB incidence and severity following fungicide treatment or non-treatment of spring wheat at flowering, Alburgh, VT, 2016.

Treatment	**Average FHB severity**	**Average FHB infected head severity**	**Incidence of FHB infected heads**
	%	%	%
Non-sprayed, control	1.38	9.93	10.2
Prosaro (6.5 fl oz) 1-Jul	0.46	6.00	**4.57***
LSD (0.10)	NS	NS	4.56
Trial Mean	0.92	7.97	7.37

Values shown in **bold** are of the highest value or top performing.
* Treatments that are not significantly different than the top performing variety in a column are indicated with an asterisk**.**
NS - None of the treatments were significantly different from one another.

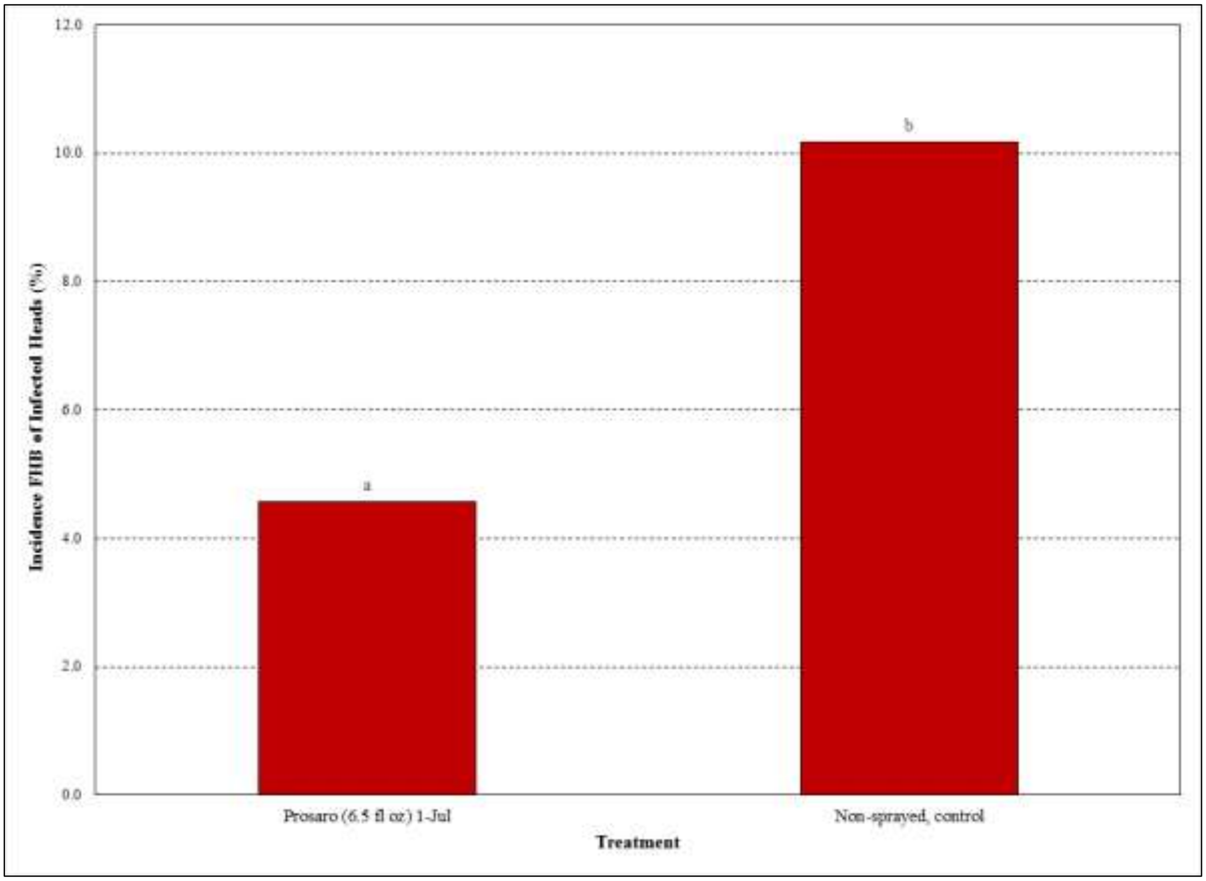

Figure 1. Incidence of FHB infected heads in the Prosaro applied plots compared to the non-sprayed control. *Treatments with the same letter did not differ significantly.*

There were no significant differences in yield, harvest moisture, and test weight between Prosaro and the non-sprayed control (Table 5). There was a significant difference between Prosaro applied and the non-sprayed treatments in DON concentrations. The Prosaro treatment had significantly lower concentrations of DON compared to the non-sprayed control (Table 5; Figure 2). Both the Prosaro and non-sprayed control had DON concentrations below the FDA 1 ppm recommendation (Table 5; Figure 2).

Table 5. The impact application timing and fungicide on barley yield and quality.

Treatment	Harvest moisture	Test weight	Yield @13.5% moisture	DON
	%	lbs bu^{-1}	lbs ac^{-1}	ppm
Non-sprayed, control	**16.8**	59.9	2378	0.13
Prosaro (6.5 fl oz) 1-Jul	17.0	**60.0**	**2520**	**0.05***
LSD (0.10)	NS	NS	NS	0.076
Trial Mean	16.9	60.0	2449	0.09

Values shown in **bold** are of the highest value or top performing.
* Treatments that are not significantly different than the top performing variety in a column are indicated with an asterisk**.**
NS - None of the treatments were significantly different from one another.

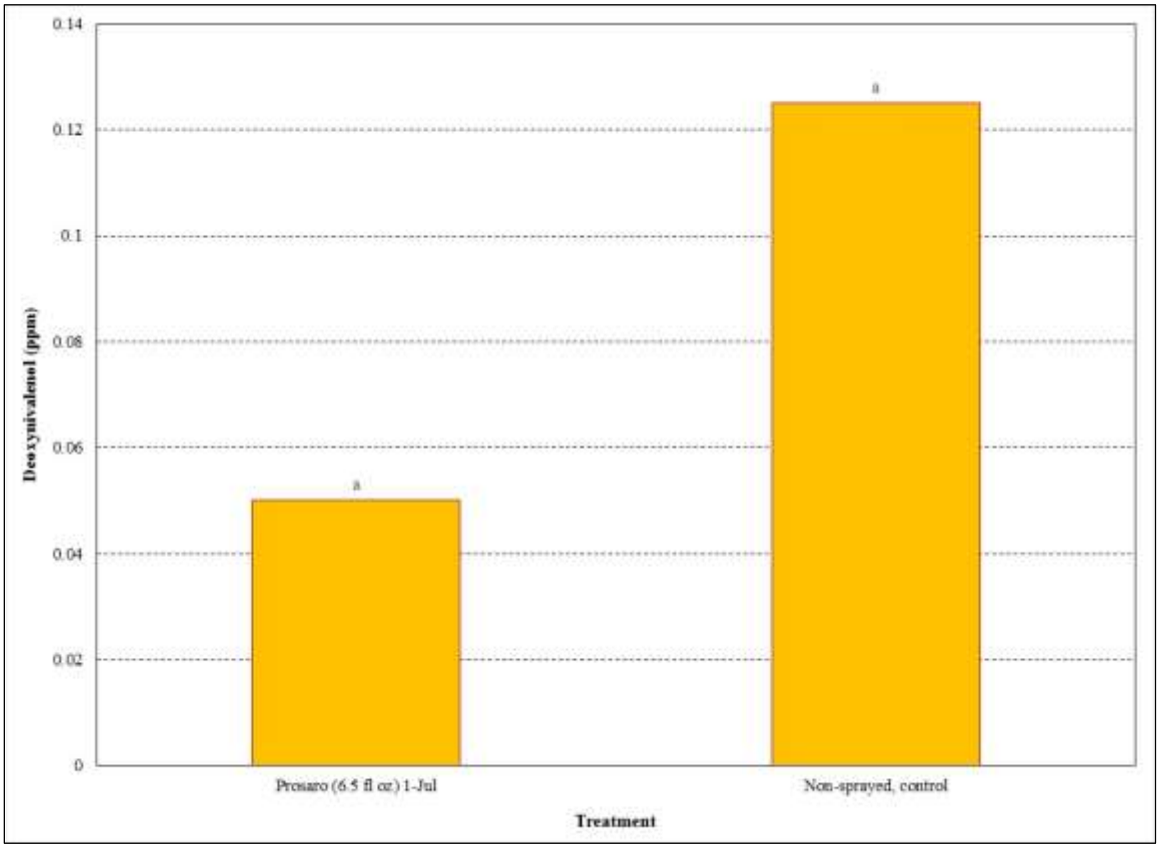

Figure 2. The impact of fungicide vs. non-sprayed control on spring wheat DON concentrations, Alburgh, VT. *Treatments with the same letter did not differ significantly.*

Impact of Variety

There were no significant differences in the average FHB plot severity, infected head severity, and incidence of FHB infected heads between spring wheat varieties (Table 6). Overall, disease severity and incidence was low regardless of variety.

Table 6. The impact of malting barley variety of FHB incidence and severity.

Variety	Average FHB severity	Average FHB infected head severity	Incidence FHB of infected heads
	%	%	%
Glenn	0.54	6.44	5.84
Magog	1.31	9.66	5.06
Prosper	0.91	7.80	11.2
LSD (0.10)	NS	NS	NS
Trial Mean	0.92	7.97	7.37

NS - None of the varieties were significantly different from one another.

Spring wheat varieties did not differ statistically for harvest moisture, test weight, or yield. The spring wheat varieties differed significantly in DON concentrations (Table 7, Figure 3). Glenn had the lowest DON concentration at (0.03 ppm). All of the varieties had DON concentrations below the FDA recommendation of 1 ppm. As expected resistant varieties had lower levels of DON concentrations.

Table 7. The impact of malting barley variety of quality and yield.

Variety	Harvest moisture	Test weight	Yield @13.5% moisture	DON
	%	lbs bu^{-1}	lbs ac^{-1}	ppm
Glenn	16.6	60.9	1978	**0.03***
Magog	16.7	59.3	2506	0.15
Prosper	17.4	59.7	2862	0.09
LSD (0.10)	NS	NS	NS	0.09
Trial Mean	16.9	60.0	2449	0.09

Values shown in **bold** are of the highest value or top performing.
* Treatments that are not significantly different than the top performing variety in a column are indicated with an asterisk**.**
NS - None of the treatments were significantly different from one another.

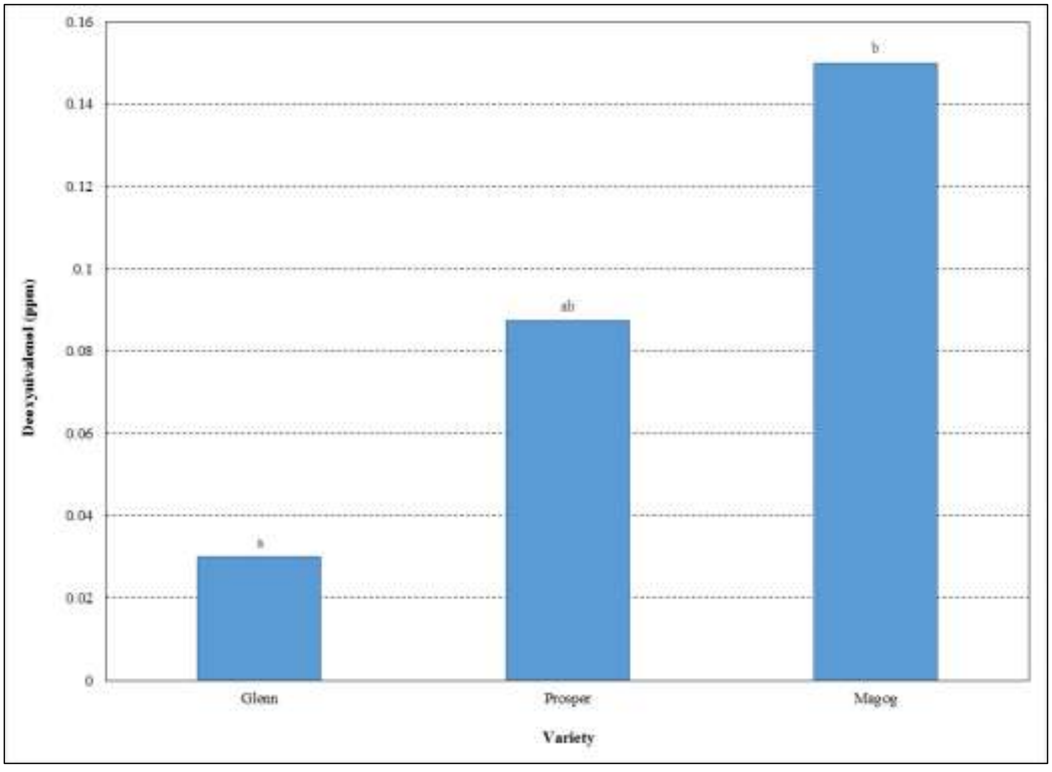

Figure 3. The impact of variety on DON concentration, Alburgh, VT.
Treatments with the same letter did not differ significantly.

DISCUSSION

Overall, the 2016 season was ideal for growing spring wheat. The warmer than average temperatures, along with below normal rainfall throughout much of the growing season, resulted in minimal fungal growth. This is evident in the low DON concentrations in all varieties. All of the treatments had DON concentrations below the 1 ppm threshold. Prosaro applied at flowering had lowest DON concentrations. By variety, Glenn had the lowest harvest moisture and DON concentrations. It is important to remember that the results only represent one year of data. The Northwest Crops and Soils Program will be repeating this trial again in 2017.

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