NORTHWEST CROPS & SOILS PROGRAM

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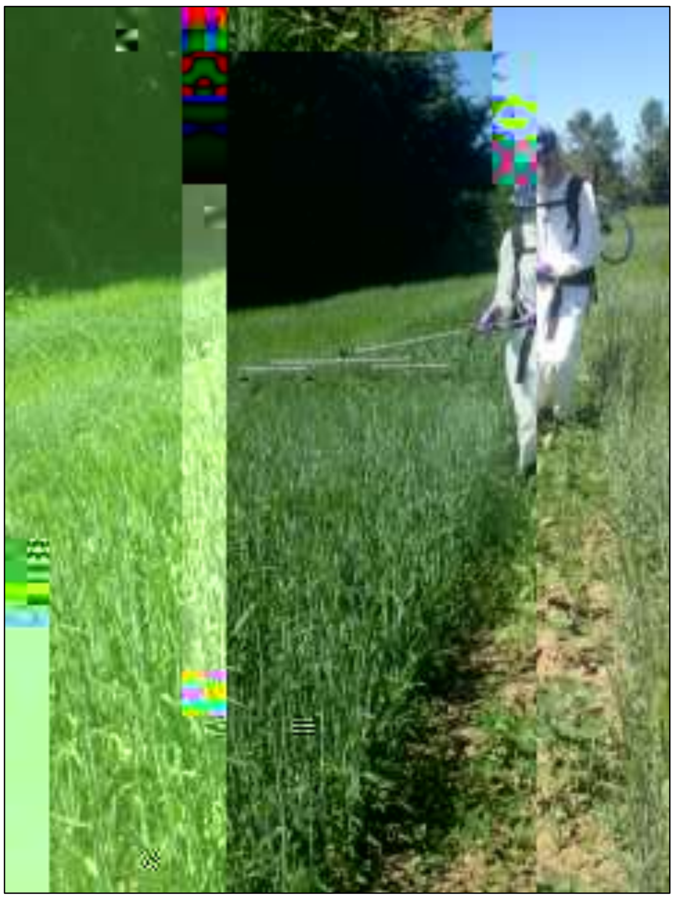

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THE EFFICACY OF SPRAYING FUNGICIDES TO CONTROL FUSARIUM HEAD BLIGHT INFECTION IN SPRING MALTING BARLEY

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Public interest in sourcing local foods has extended into beverages, and the current demand for local brewing and distilling ingredients is quickly increasing. One new market that has generated interest of both farmers and end-users is malted barley. This only stands to reason since the Northeast alone is home to over 175 microbreweries and 35 craft distillers. Until recently, local malt was not readily available to brewers or distillers. However, a rapid expansion of the fledgling malting industry will hopefully give farmers new markets and end-users hope of readily available malt. To date, the operating maltsters struggle to source enough local grain to match demand for their product. In addition to short supplies, the local malt barley that is available often does not meet the rigid quality standards for malting. One major obstacle for growers is *Fusarium* head blight (FHB) infection of grain. This disease is currently the most important disease facing organic and conventional grain growers in the Northeast, resulting in loss of yield, shriveled grain, and most importantly, 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 barley growing regions. Limited work has been done in this region on the optimum timing for a fungicide application to barley specifically to minimize DON. In addition, there are limited studies evaluating organic approved biofungicides, biochemicals, or biostimulants for management of this disease. In April of 2016, the UVM Extension Northwest Crops and Soils Program initiated year three of a spring barley fungicide trial to determine the efficacy and timing of 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 21-Apr to investigate the effects of cultivar resistance, fungicide efficacy, application timing on FHB and DON infection in spring malting barley. The experimental design was a randomized complete block, with a split-plot arrangement of cultivar as the whole-plot and fungicide+timing treatments as the sub-plots. The main plot of cultivar included Robust, a 6-row malting barley which is a FHB susceptible variety, and Conlon, a 2-row malting barley with moderate FHB resistance. The fungicide+timing treatments are listed in Table 2.

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 1). The previous crop planted at the site was sunflowers. 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 21-Apr at a seeding rate of 325 live seeds per m^2. Plot size was 5

Table 1. General plot management of the trial, 2016.

Location	Borderview Research Farm Alburgh, VT
Soil type	Benson rocky silt loam
Previous crop	Sunflowers
Row spacing (inch)	7
Seeding rate (live seed m^2)	325
Replicates	4
Varieties	Conlon and Robust
Planting date	21-Apr
Harvest date	4-Aug
Harvest area (ft)	5 x 20
Tillage operations	Spring plow, disk & spike tooth harrow

When the barley reached 50% spike emergence (16-Jun), plots were sprayed with the fungicide treatments (Table 2). 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

Prosaro and Caramba applications at a rate of 0.125%. All but one plot (Control) of each cultivar was inoculated 24 hours (17-Jun), after the heading treatment was applied, with a spore suspension (40,000 spores/ml) consisting of a mixture of isolates of *Fusarium graminearum* endemic to the area.

The *Fusarium graminearum* spores were multiplied and harvested using the Gz conidial suspension Four days after the heading application (20-Jun) plots not previously treated with a fungicide were sprayed with the fungicides treatments except for the control and *Fusarium graminearum* only plots (Table 2). Water was applied at the same rate as the fungicides to the control plots and to those that were only inoculated with *Fusarium graminearum.* Below is a list of the treatment materials evaluated in this trial. Descriptions have been provided from manufacturer information.

Actinovate® (EPA# 73314-1) is a biological fungicide (0.0371% Streptomyces lydicus WYEC 108) that suppresses and controls root rot, damping-off fungi and foliar fungal pathogens. Its active ingredient is a patented bacterium that grows around the root system (when soil drenched) and foliage of the plant (when sprayed on) while using several novel modes of antifungal action to protect plants.

Caramba® (EPA# 7969-246) fungicide is a highly effective fungicide containing the active ingredient metconazole, resulting in significant yield protection and reductions of deoxynivalenol (DON) levels in grain. It is not only effective on head scab, but provides control of late-season foliar diseases as well.

ChampION® (EPA# 55146 1) is a 77% copper hydroxide-based, broad-spectrum fungicide for disease control. When copper hydroxide is mixed with water, it releases copper ions, which disrupt the cellular proteins of the fungus. This product is approved for use in organic production systems.

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.

SONATA® (EPA# 69592-13) ungicide provides excellent control of powdery mildews and rusts. Based on a patented strain of Bacillus pumilus (QST 2808), SONATA is an excellent fit for integrated disease management programs. SONATA contains a unique, patented strain of Bacillus pumilus (QST 2808) that produces an antifungal amino sugar compound that inhibits cell metabolism. SONATA also creates a zone of inhibition on plant surfaces, preventing pathogens from establishing on the plant.

Table 2. Plot treatments-fungicide application dates and rates.

Treatments	Heading application	4 days after heading application	Application rate
	date	date	
Control	16-Jun	20-Jun	Water
Fusarium graminearum	17-Jun		40,000 spores/ml
Actinovate	16-Jun	20-Jun	6 fl oz ac^{-1}

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

Barley Variety x Fungicide+Timing Interactions:

There was a variety by fungicide treatment interaction for average FHB infected head severity. This interaction indicates that malting barley varieties respond differently to the fungicide treatments. The average FHB infected head severity of the Conlon plots spikes at the 4-days after application of Actin ovate (31.6%), and then varies little between the other fungicide + timing treatments (Fighahe incidence of FHB infected heads (3.47%) and the highest incidence was Caramba applied at heading (10.2%)

Table 4. The FHB incidence and severity following fungicide treatments at heading and four days after heading, Alburgh, VT, 2016.

Treatment	Average FHB severity	Average FHB infected head severity	Incidence FHB of infected heads
	%	%	%
Non-sprayed, non-inoculated control	0.73	8.75	7.72
Inoculated Fusarium spores 17-Jun	0.78	8.46	8.01
Actinovate heading	0.64	16.3	**3.47**
Actinovate 4 days after heading	0.70	19.5	5.53
Caramba - heading	1.09	12.7	10.2
Caramba 4 days after heading	0.72	10.8	6.91
ChampION - heading	1.09	12.7	8.59
ChampION 4 days after heading	1.25	9.32	8.53
Prosaro - heading	0.60	**7.14**	6.88
Prosaro 4 days after heading	**0.44**	8.75	5.03
Sonota - heading	0.71	8.89	6.71

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

Figure 2. The impact of application timing and fungicide on barley yield.
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

The malting barley varieties were significantly different in harvest moisture and test weight (Table 7).