**Evaluation of Organic Copper Fungicide Applications Plus Cultivar Resistance to Reduce FHB and DON Infection of Barley in Vermont.**

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**OBJECTIVE**

To evaluate the individual and interactive effects of moderately resistant cultivars and application timings of an organic copper fungicide on barley yield and the integrated management of Fusarium head blight (FHB) and deoxynivalenol (DON) in Vermont.

**INTRODUCTION**

Public interest in sourcing local foods has extended into beverages leading to a rapid expansion of the northeast malting industry. This has provided farmers with new market opportunities and many of these markets are interested in purchasing certified organic barley. However, all farmers are struggling to produce barley that is not infected with FHB and DON.Hence integrated management strategies are essential for managing yield and quality losses from FHB. Most farmers in New England have experienced significant crop loss from FHB and some farmers have already stopped growing barley. At present, few farmers are specifically selecting varieties for resistance to FHB and even fewer are combining host resistance with fungicide applications. There has been little to no research conducted to evaluate organic approved fungicides. Other regions have shown that the use of a well-timed fungicide is an important management tool when suppressing FHB in barley production. In Vermont during 2022 we observed the disease and yield impact of cultivar susceptibility, inoculation with *Fusarium graminearum*, and treatment with an organic copper fungicide at two timings.

**MATERIALS AND METHODS**

The trial was conducted in Alburgh, VT during 2022. The soil type was a Benson silt loam soil. The plot size was 5 x 20 ft including seven rows with 7-in spacing. Planting occurred on April 23, 2022. Main plots were sown with barley at 125 lb ac-1 with a Great Plains grain drill (Salinas, KS). The experiment was set up as a completely randomized block design with a split-plot arrangement, with cultivar as the main plot and the fungicide treatments as subplots, randomized in four replicated blocks. The two spring barley varieties were ‘Robust’ (susceptible to FHB) and ‘ND Genesis’ (moderately susceptible to FHB). Fungicide treatments are shown in Table 1. The first fungicide application (with surfactant at 0.125% V/V) was applied at heading (Feekes growth stage, FGS 10.1). After the fungicide had dried, plots were spray-inoculated with a conidial suspension of *F. graminearum* (40,000 conidia/ ml) to augment the development of FHB. The second fungicide application occurred four days after heading, and inoculated with a conidial suspension of *F. graminearum* (40,000 conidia/ml) after the fungicide had dried. Fungicide and *F. graminearum* treatments were applied with a CO2 backpack sprayer with paired TJ-60 8003vs nozzles mounted at an angle (30o from horizontal) forward and backward, 20-in. apart, pressurized at 30 psi, and calibrated to deliver 20 gal/A. Grain was harvested using an Almaco plot combine (Nevada, IA). Grain plot yield and test weight were recorded. Yield and test weight were adjusted to bushels ac-1 at 13.5% moisture. Analysis of DON concentration in grain was conducted at the University of Vermont Cereal Grain Testing Laboratory located in Burlington, VT. Treatment means were calculated, subjected to analysis of variance, and separated by Fisher’s protected LSD test (P = 0.05).

**RESULTS AND DISCUSSION**

There were no variety by fungicide treatment interactions indicating that the treatments responded similarly regardless of variety (Table 2). As expected, the barley varieties differed significantly in DON concentrations (Table 3). The moderately susceptible variety had 56% less DON compared to the susceptible variety. When results were combined across cultivars, the fungicide treatments did not significantly influence DON concentrations compared to the control (Table 4). The certified organic treatment of two applications of ChampION did not improve DON concentrations compared to one application. The barley yields did increase when ChampIon was applied to the barley compared to the control (Table 4).

For organic producers, these results indicate that selection of varieties that have moderate susceptibility to FHB should help growers mitigate some of the risk associated with this disease. The application of the organic fungicide ChampION at heading and 4 days after heading did not reduce DON concentrations compared to the inoculated control. Overall, DON concentrations were low due to hot and dry conditions during flowering. Additional research should be conducted to assess the efficacy of multiple applications of copper-based fungicide on FHB and DON concentrations.

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**Table 1.** Fungicide treatments, active ingredients and rates applied.

|  |  |  |  |
| --- | --- | --- | --- |
| **Fungicide treatments** | **Company** | **Fungicide active ingredient** | **Application** **rates** |
| Control |  |  | Water |
| *Fusarium graminearum* |  |  | 40,000 spores/ml |
| Champ ION++ | NuFarm | Copper hydroxide | 1.5 lbs ac-1 |

**Table 2.** Statistical significance of treatment effects on DON, test weight, and yield of barley.

|  |  |  |  |
| --- | --- | --- | --- |
| **Source of variation** | **DON** | **Test weight** | **Yield** |
|   |  |  |   |
| Variety  | \*\*\* | NS | \*\* |
| Fungicide + timing | NS | NS | \* |
| Variety x fungicide + timing | NS | NS | NS |
|  |  |  |  |

**†statistical significance - \*\*\*, p=0.001; \*\*, p= 0.01; \*, p= 0.05; NS, not significant.**

**Table 3.** Main effect of cultivar on deoxynivalenol (DON) concentration, grain yield, and test weight at Alburgh, VT.

|  |  |  |  |
| --- | --- | --- | --- |
| **Cultivar** | **DON** | **Test weight** | **Yield** |
|  | **ppm** | **lb bu-1** | **bu ac-1** |
| ND Genesis (moderately resistant) | 0.53 | 44.2 | 84.9 |
| Robust (susceptible) | 1.21 | 43.8 | 71.2 |
| LSD (p=0.05) | 0.244 | NS | 8.50 |

**Table 4.** Main effect of fungicide and timing on deoxynivalenol (DON) contamination and grain yield at Alburgh, VT.

|  |  |  |  |
| --- | --- | --- | --- |
| **Fungicide + timing** | **DON** | **Test weight** | **Yield** |
|  | **ppm** | **lb bu-1** | **bu ac-1** |
| Non-sprayed, non-inoculated control | 0.66 | 44.3 | 70.6 |
| Inoculated FGS 10.1 | 0.85 | 43.4 | 69.6 |
| Champ ION (1.5 lbs) at heading | 1.10 | 44.5 | 89.0 |
| Champ ION (1.5 lbs) at heading & 4 days after heading | 0.87 | 44.4 | 83.1 |
| LSD (p=0.05) | NS | NS | 12.0 |