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Comparison of Sensitivity to Fusarium Head Blight in Soft Red and Hard Red Winter Wheat Varieties

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Abstract

Fusarium head blight (scab) is a problem for wheat production in high rainfall areas. This is a report of research examining the response of wheat varieties on disease susceptibility and wheat yield and quality. Hard red wheat varieties had more disease than the soft red wheat varieties in 2021. Wheat yield was correlated with disease severity.

Keywords

wheat, fungicide, Fusarium Head Blight, fungal disease, soil microbial activity

Cover Page Footnote

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Comparison of Sensitivity to Fusarium Head Blight in Soft Red and Hard Red Winter Wheat Varieties

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Summary

Fusarium head blight (scab) is a problem for wheat production in high rainfall areas. This is a report of research examining the response of wheat varieties on disease susceptibility and wheat yield and quality. Hard red wheat varieties had more disease than the soft red wheat varieties in 2021. Wheat yield was correlated with disease severity.

Introduction

Fusarium head blight (FHB) is a problem for wheat that can result in severe reductions in yield and quality. Contamination of grain with FHB can result in formation of a mycotoxin, deoxynivalenol (DON), or vomitoxin, that can leave the wheat unfit for human consumption in extreme cases. Wheat contaminated with FHB must be segregated from non-contaminated loads, potentially making it practical to market as a feed grain.

High humidity or rainfall during the flowering period (anthesis) can lead to fungal infection of the wheat kernel. Southeast Kansas typically has high rainfall in the spring, leading to potentially challenging conditions for production of wheat due to fusarium infection. The best approach to control or limit infection is through a management system that integrates a multi-tiered approach: cultivar selection, fungicide application, residue management, and crop rotations (Wegulo et al., 2011, 2013). Farmers in southeast Kansas are considering soft wheat production because of its potential for greater resistance to disease, and the current price advantage. However, little is known about the relative resistance or susceptibility of soft wheat to FHB, or the correct fungicide control methods for soft wheat.

This report summarizes the results of FHB contamination in the wheat varieties grown in the wheat variety test (Sassenrath et al., 2022).

Experimental Procedures

Wheat varieties are tested yearly for comparison of performance in the Kansas State University Crop Performance Test (http://www.agronomy.k-state.edu/services/crop-performance-tests/). Establishment of variety trials are described in Sassenrath et al., 2022. This year, 13 hard red and 27 soft red winter wheat cultivars were tested. After

harvest, samples of each cultivar were collected and sent to the Kansas Grain Inspection Service in Topeka, KS, for determination of quality and presence of DON, an indicator of FHB infection.

Results and Discussion

Rainfall during the 2020-2021 water year (WY21) from October 1, 2020, through September 30, 2021, was 11.6 in. above the 11-year average (Figure 1). Following an unusually dry early October in 2020, several high rainfall events increased total rainfall amounts to above average (Hoffstetter, 2021). Rainfall during wheat flowering in the spring can lead to Fusarium head blight (FHB) or scab infection.

High humidity conditions during anthesis in 2021 led to high levels of FHB in wheat. The average DON level measured in all the hard red wheat varieties was 7.71 ppm, exceeding the allowable maximum of 5 ppm* (Figure 2). The most commonly planted cultivar in eastern Kansas, Everest, had levels very near 5 ppm. Two cultivars showed particularly high levels of DON, AM Eastwood and WB4699. The variety with the lowest levels of DON was Rockstar. Higher DON infection rates were correlated with reduced yield (Figure 3).

Soft wheat varieties had significantly lower DON levels, with an average across all cultivars of 3.4 ppm (Figure 4). Only 1 cultivar, the experimental variety from OCI, had DON levels that exceeded the allowable maximum. Because of the reduced disease load, the correlation between DON presence and yield was less (Figure 5). The one cultivar with high DON concentration had the lowest yield in the soft wheat variety test.

Although early spring rainfall increased the FHB in wheat in 2021, a dry period in late May/early June in 2021 helped with timely harvest of winter wheat, reducing vomitoxin levels in harvested wheat and limiting dockage at the elevators due to scab in 2021.

Conclusions

Cultivar selection has been identified as an important first step in control of fungal diseases in wheat. This is especially important in a high-rainfall environment such as southeast Kansas. Differences in variety susceptibility to FHB can be significant. While soft red wheat seems to have more resistance to the disease, some cultivars can be very susceptible.

Acknowledgments

This work is supported by the U.S. Department of Agriculture National Institute of Food and Agriculture, Hatch project 1018005, with partial funding from the Kansas Crop Improvement Association.

*Grain and grain products for poultry, beef, and feedlot cattle older than 4 months require a DOM level of 10 ppm or below. Grain and grain products for swine or other animals are limited to 5 ppm. Wheat products for human consumption must be below 1 ppm. From U.S. Food and Drug Administration. *https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-and-fda-advisory-levels-deoxynivalenol-don-finished-wheat-products-human*.

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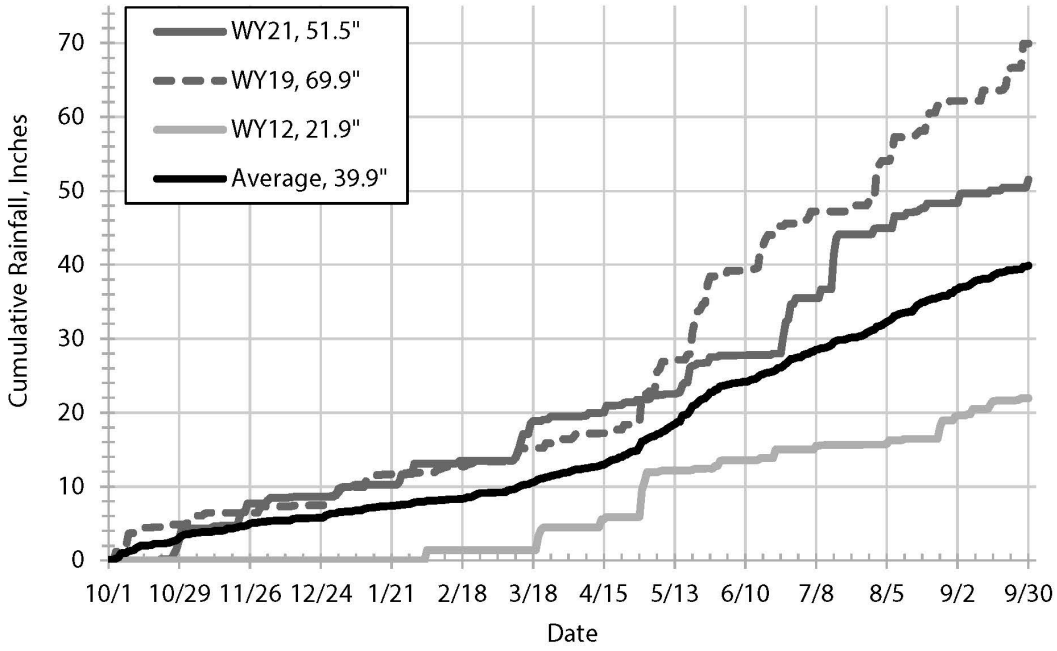

Figure 1. Cumulative rainfall on a water year (WY) basis for the 2021 winter wheat growing season (WY21) and the 11-year average cumulative rainfall. Excessive high (WY2019) and low (WY12) rainfall amounts are shown for comparison.

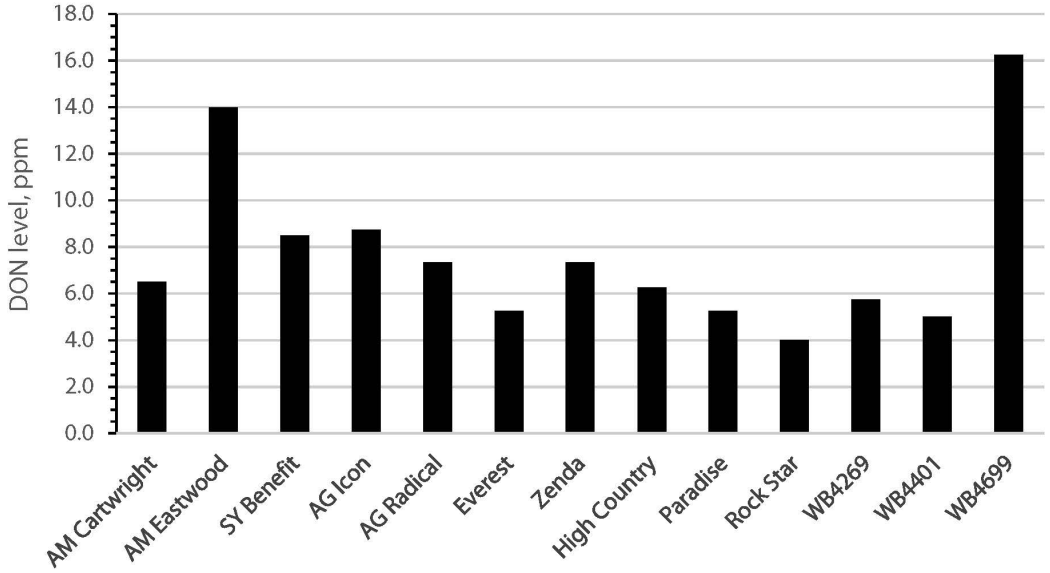

Figure 2. Deoxynivalenol (DON) levels in hard red wheat from the variety trials. Average levels across al hard red cultivars was 7.7 ppm.

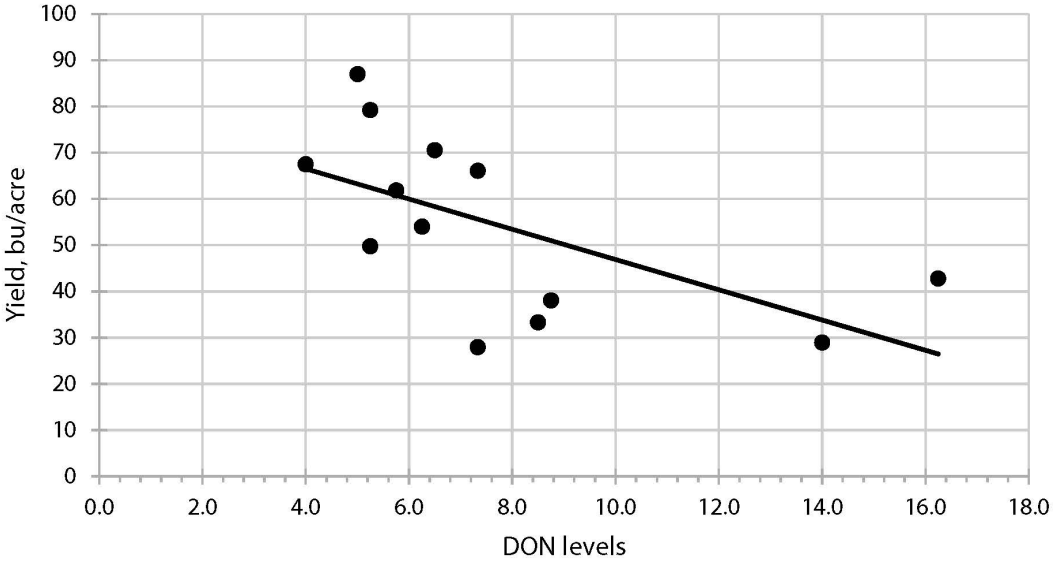

Figure 3. Correlation of deoxynivalenol (DON) levels in wheat to yield for the hard red varieties.

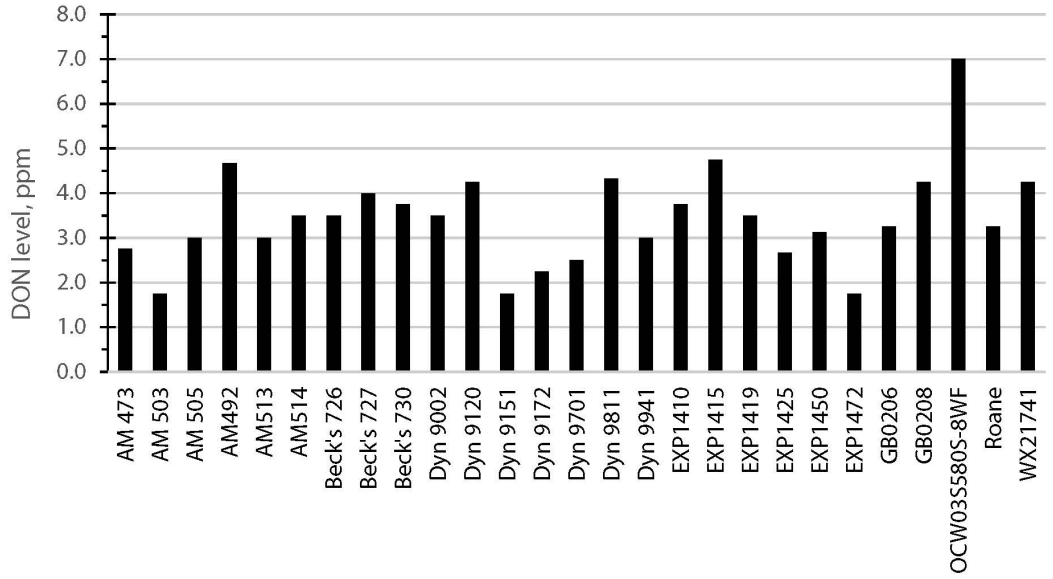

Figure 4. Deoxynivalenol (DON) levels in soft red wheat from the variety trials. Note change in y-axis range compared to hard red wheat.

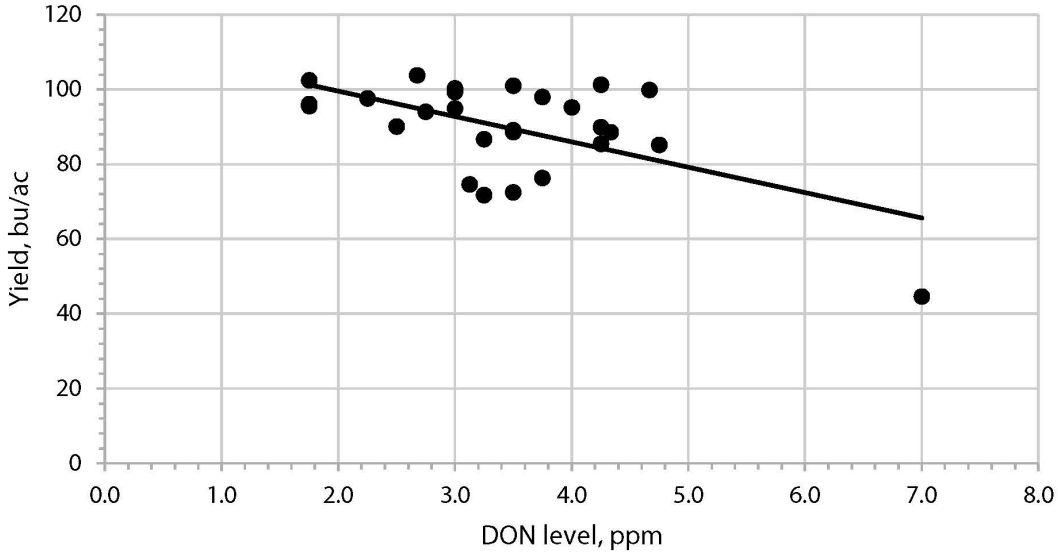

Figure 5. Correlation of deoxynivalenol (DON) levels in wheat to yield for the soft red varieties.