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Wheat Variety Response to Seed Cleaning Method and Pesticide Seed Treatment Following a Growing Season with Severe Infestation of Fusarium Head Blight

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Wheat Variety Response to Seed Cleaning Method and Pesticide Seed Treatment Following a Growing Season with Severe Infestation of Fusarium Head Blight

Abstract

Fusarium head blight (scab) is a common concern in eastern and central Kansas. Wheat seed quality might be compromised following a growing season with severe infestation of scab. Our objectives were to evaluate the effects of variety, seed cleaning method, and seed treatment, on wheat stand establishment and yield following a growing season where scab was severe. A trial was established during the 2015-16 growing season using seed harvested from the 2014-15 growing season, which was characterized by severe infestation of scab. Three commonly grown wheat varieties with differing levels of scab resistance (Everest, SY Wolf, and WB Grainfield) were submitted to three different seed cleaning methods (unclean, air screened, or top-gravity table) and two different pesticide seed treatments (no seed treatment versus Gaucho XT fungicide and insecticide). Plots were 30 feet long by 5.6 feet wide and sown at 1.2 million seeds per acre. Seed cleaning method affected wheat seed size, with top-gravity table resulting in larger seed size, approximately 3,000 fewer seeds per pound compared to unclean seed. Seed cleaning method also increased stand establishment from 10.4 emerged plants per row foot resulting from the unclean seed to 11.9 emerged plants per row foot resulting from the top-gravity table. Notwithstanding, there was no effect of variety or seed treatment on stand establishment. Grain yield, on the other hand, was increased from 55.6 to 61.3 bushels per acre in response to seed treatment and was significantly different among varieties. The variety WB Grainfield yielded 68.4 bushels per acre, which was statistically greater than the 53 bushels per acre achieved by both Everest and SY Wolf. There was no effect of seed cleaning method on grain yield.

Keywords

Wheat, head blight, scab, Fusarium, seed treatment, seed cleaning

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Summary

Fusarium head blight (scab) is a common concern in eastern and central Kansas. Wheat seed quality might be compromised following a growing season with severe infestation of scab. Our objectives were to evaluate the effects of variety, seed cleaning method, and seed treatment, on wheat stand establishment and yield following a growing season where scab was severe. A trial was established during the 2015-16 growing season using seed harvested from the 2014-15 growing season, which was characterized by severe infestation of scab. Three commonly grown wheat varieties with differing levels of scab resistance (Everest, SY Wolf, and WB Grainfield) were submitted to three different seed cleaning methods (unclean, air screened, or top-gravity table) and two different pesticide seed treatments (no seed treatment versus Gaucho XT fungicide and insecticide). Plots were 30 feet long by 5.6 feet wide and sown at 1.2 million seeds per acre. Seed cleaning method affected wheat seed size, with top-gravity table resulting in larger seed size, approximately 3,000 fewer seeds per pound compared to unclean seed. Seed cleaning method also increased stand establishment from 10.4 emerged plants per row foot resulting from the unclean seed to 11.9 emerged plants per row foot resulting from the top-gravity table. Notwithstanding, there was no effect of variety or seed treatment on stand establishment. Grain yield, on the other hand, was increased from 55.6 to 61.3 bushels per acre in response to seed treatment and was significantly different among varieties. The variety WB Grainfield yielded 68.4 bushels per acre, which was statistically greater than the 53 bushels per acre achieved by both Everest and SY Wolf. There was no effect of seed cleaning method on grain yield.

Introduction

Head scab is a recurring issue in the central and eastern portions of the wheat-producing regions of Kansas. Producers in the region often use genetic resistance to suppress the development of this disease by making extensive use of the wheat variety Everest, which offers the best levels of resistance available among current wheat varieties. Additionally, some producers opt to perform one additional fungicide application around anthesis, when the infection by this disease generally occurs. Still, genetic resistance only provides partial control of the disease, and even varieties with high resistance ratings might become infected in years when the weather is conducive to high disease incidence and severity. Furthermore, fungicide applications targeted specifically to control head scab are challenging. These applications require near perfect timing as well as the use of particular active ingredients, such as Metconazole or Prothioconazole, given that other active ingredients can in fact enhance the development of the disease instead of controlling it. Therefore, product selection becomes an important factor in the success of scab control. The wheat seed available in years following a growing season with severe infestation of Fusarium head blight is often of low quality, and understanding the best strategies to manage Fusarium-induced low-quality seed is warranted. The objectives of this research were to test the effects of wheat variety, seed cleaning method, and seed treatment, on wheat stand establishment and grain yield following a growing season where head scab was predominant across many portions of Kansas.

Procedures

A research project was established in Manhattan, KS, with the objective of understanding the effects of seed cleaning method, pesticide seed treatment, and variety selection on wheat stand establishment and grain yield following a growing season with severe head scab infestation. Wheat seed was collected from three commonly grown wheat varieties (Everest, WB Grainfield, and SY Wolf) following the 2014-15 growing season, when head scab was a major issue across most of eastern and central Kansas wheat growing regions. Genetic diversity to scab resistance existed among varieties, with Everest presenting the greatest levels of resistance to head scab. Seed was sourced from three different timings within the seed cleaning process with Ohlde Seeds, near Palmer, KS: unclean seed, air-screened seed, and top of gravity table seed. Seed size was measured by weighting three one-thousand kernel samples per variety per seed cleaning process. The seeds were then divided in two cohorts, one of which received Gaucho XT insecticide and fungicide seed treatment at 3.4 fluid ounces per hundred weight of seed, and the other which received no pesticide seed treatment.

The project was established in a 3-way factorial treatment structure in a randomized complete block design with 4 replications, with the objective of evaluating three seed cleaning processes, two seed treatment factors, and the three aforementioned varieties. The trial was sown on October 9, 2015 at 1.2 million seeds per acre. Plots were 30 ft long by nine 7.5-inch spaced rows wide. No-tillage practices were adopted, following a maize crop. Weeds and insects were controlled according to the recommendations of Kansas State University for best management practices, and a foliar fungicide was applied at flag leaf emergence so fungal diseases were not a confounding factor. Nitrogen (N) fertility ensured sufficient N was present for a yield goal of 70 bushels per acre, using a total 2.4 pounds of N per bushel per acre yield goal between applied mineral fertilizer and residual soil nitrate-nitrogen credits. Stand count was performed approximately 3-4 weeks after sowing, and grain yield was measured at harvest maturity, using a small plot combine.

Results

Seed Size as Function of Seed Cleaning Process

There was a clear effect of seed cleaning process and variety on seed size, measured in 1000-kernel weight and converted to seeds per pound prior to sowing (Figure 1). Adopting no strategy to clean the seeds resulted in the smallest seed size, ranging from

15,400 seeds per pound for SY Wolf to 17,300 seeds per pound for WB Grainfield. The average size of seeds increased when smaller than average seeds were screened out, or eliminated by gravity when running the seeds through an air screen, and selecting the seeds from the top of the gravity table resulted in even larger seeds. Seed sizes ranged from 12,400 seeds per pound for SY Wolf to 14,100 seeds per pound for WB Grainfield. Everest consistently resulted in average seed size as compared to SY Wolf (larger seed) and WB Grainfield (smaller seed). Performing the entire cleaning process (air screening followed by gravity table) increased seed size an average 3,000 seeds per pound (Figure 1).

Stand Establishment

There was no significant interaction between variety, seed cleaning process, or seed treatment on final wheat stand establishment; thus, the individual effects of each factor are discussed in this report. There was no effect of variety on stand count, as all varieties ranged between 10.9 to 11.4 emerged plants per row foot (Figure 2). On the other hand, seed cleaning significantly affected stand establishment, as the unclean seed lot resulted in 10.6 emerged plants per row foot while the top gravity table resulted in 11.9 emerged plants per row foot (Figure 2). When analyzing these data, it is important to consider that plots were sown in seeds per acre rather than pounds per acre, possibly explaining these results. Had the plots been sown in pounds per acre, the resulting number of emerged plants per area might have differed from these results, once there were more seeds per pound in the unclean seed lot. While seed treatment did not result in significant differences in stand count (Figure 2), there was a trend of increased stands when a fungicide and insecticide seed treatment was applied as compared to no pesticide applied (11.4 vs. 10.7 emerged plants per row foot).

Grain Yield

Similarly, to our measurements of stand establishment, there was no significant interaction between variety, seed cleaning process, or seed treatment on wheat grain yield; thus, the individual effects of each factor are discussed in this report. Notwithstanding the results obtained for stand establishment, the opposite trend was measured on grain yield as affected by the different treatments evaluated: there were significant variety and seed treatment effects, and no significant effect of seed cleaning method. The variety WB Grainfield yielded statistically more than did Everest or SY Wolf (68.4 vs. 53 bushels per acre for the latter two varieties) (Figure 3). Additionally, the average of all treatments receiving a Gaucho XT seed treatment was 61.3 bushels per acre, which was statistically greater than the 55.6 bushels per acre achieved without a pesticide seed treatment. This yield gain from seed treatment was most likely observed due to the low quality of the scab-infected seed used as seed source in this study. The lack of response to seed cleaning process is, on the other hand, likely a response to plant population. The wheat crop has a very high tillering capacity, and the difference in plant population as a result from seed cleaning (10.6 plants per row foot in the unclean versus 11.9 plants per row foot in the top gravity table) were most likely masked by the wheat's tillering capacity.

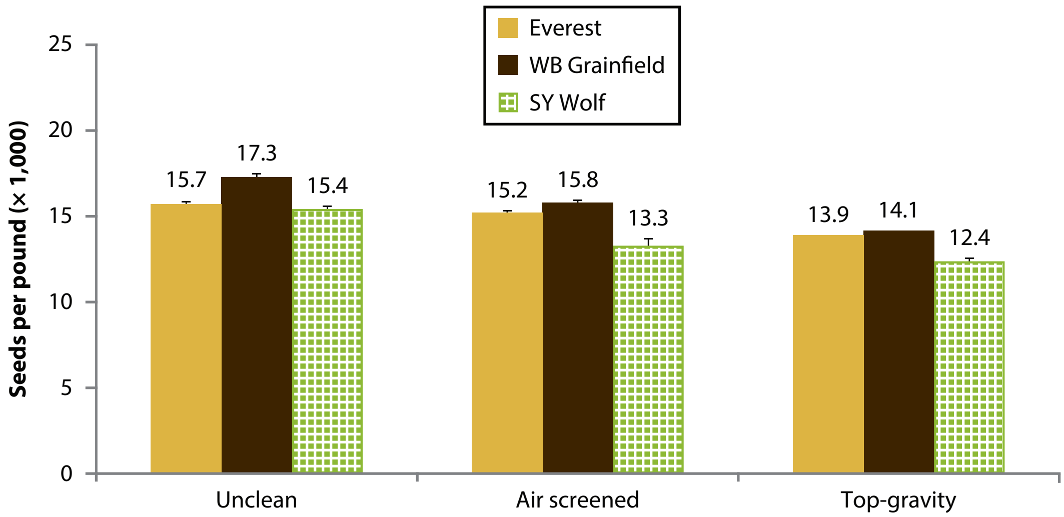

Figure 1. Wheat seed size (seeds per pound) as affected by wheat variety and seed cleaning process following a growing season with severe infestation of Fusarium head blight.

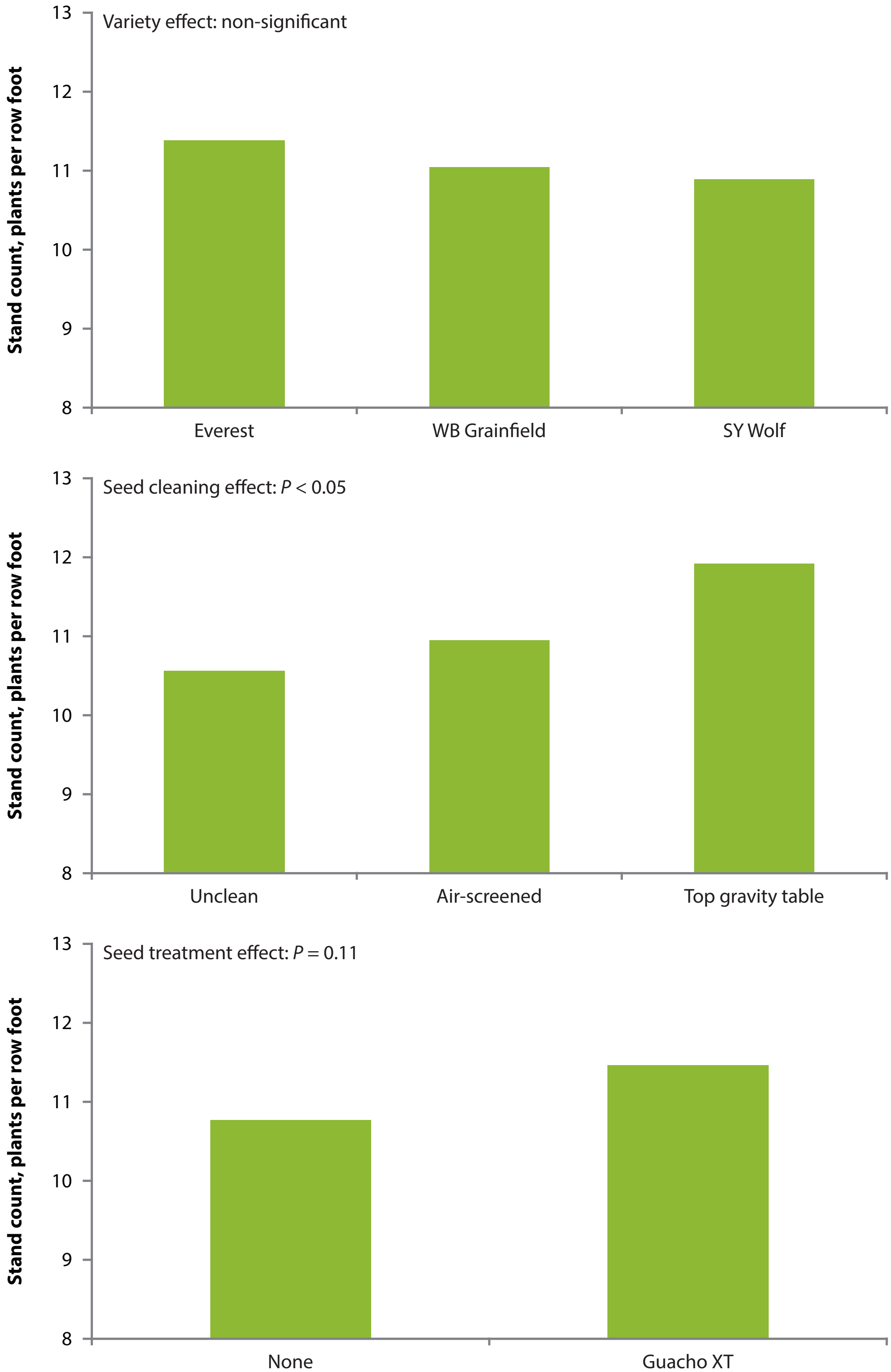

Figure 2. Effect of variety (top panel), seed cleaning (middle panel), and seed treatment (bottom panel) on wheat stand establishment measured 3-4 weeks after sowing in Manhattan, KS, during the 2015-16 growing season.

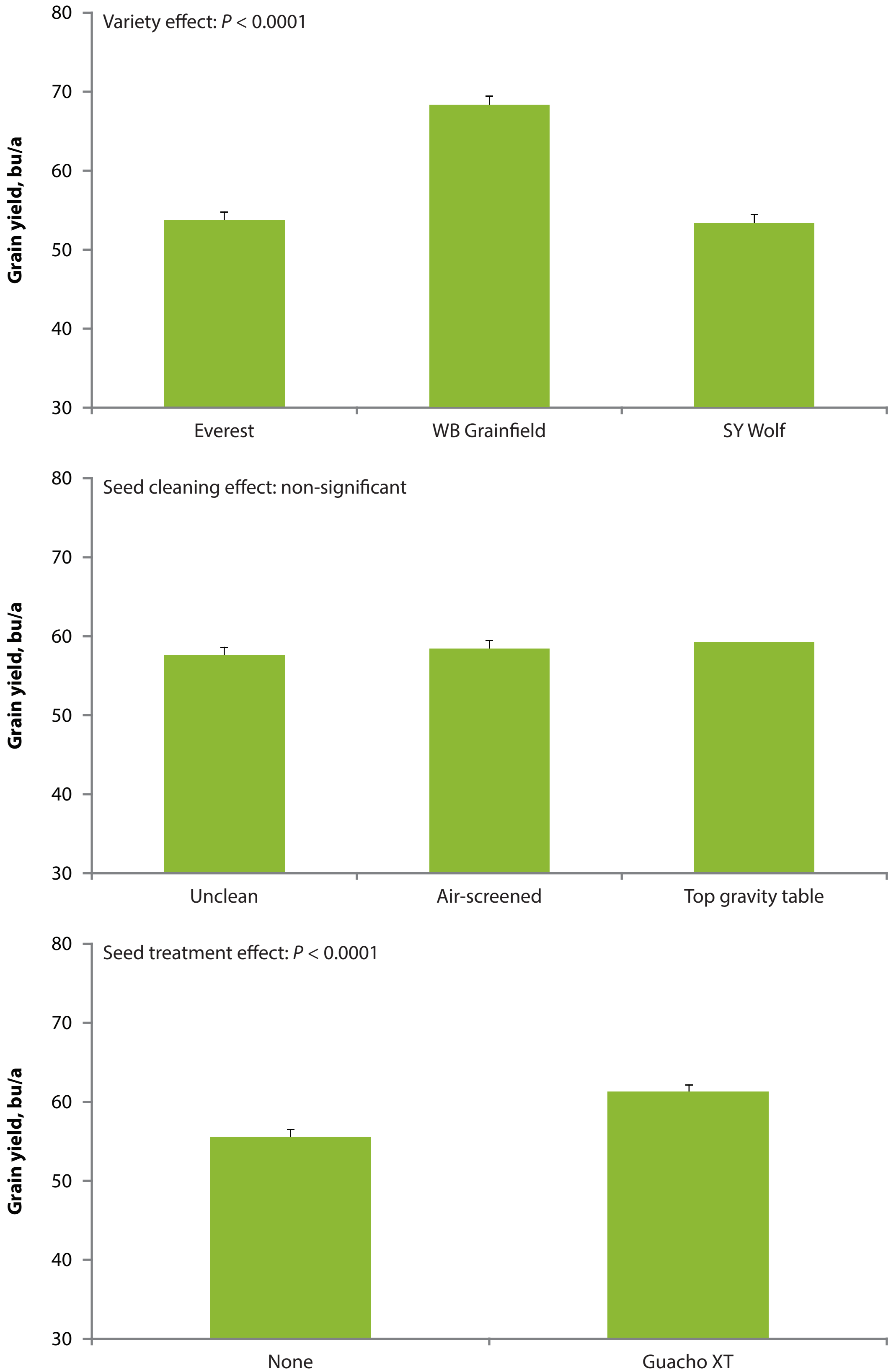

Figure 3. Effect of variety (top panel), seed cleaning (middle panel), and seed treatment (bottom panel) on wheat grain yield in Manhattan, KS, during the 2015-16 growing season.