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Cover Page Footnote

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Impact of Fungicide on Wheat

G.F. Sassenrath, H. Zhao, and X. Lin

Summary
This is a report of research to test the impact of fungicide and management on wheat yield and quality. Fusarium head blight (FHB), or scab, is a persistent problem in wheat production, especially in high rainfall areas such as eastern Kansas. Two cultivars of winter wheat varying in FHB sensitivity (Everest, moderately resistant, and KanMark, susceptible) were tested for control of FHB using fungicide treatments made to the seed prior to planting or to the wheat plant at heading, in tilled or no-tilled management. The wet spring of 2020 resulted in high FHB pressure, but dry conditions at harvest reduced contamination. Tillage had a larger impact on yield improvement than fungicide applications in 2020. Tillage also impacted test weight and protein content.

Introduction
Fusarium head blight is particularly detrimental to wheat, resulting in significant reductions in yield. The most damaging aspect of FHB is the reduction in wheat quality caused by the mycotoxins (deoxynivalenol, DON) associated with the disease, rendering it unfit for human consumption in extreme cases. Wheat contaminated with FHB must be segregated from non-contaminated loads, and possibly is good enough to market as a feed grain.

Southeast Kansas has potentially challenging conditions for production of wheat. High humidity and rainfall during the spring can result in high fungal infection rate in wheat. Research has documented the potential to control FHB or scab through a management system that integrates cultivar selection, fungicide application, residue management, and crop rotations (Wegulo et al., 2011, 2013). This report summarizes the results of testing FHB control in two wheat cultivars varying in FHB disease susceptibility (Everest, moderately resistant, and KanMark, susceptible), four fungicide application treatments (no fungicide; seed treatment; in-season fungicide; and seed treatment + in-season fungicide), and residue management (tilled or no-till) after corn harvest.

Experimental Procedures
Two cultivars of hard red wheat varying in FHB sensitivity were planted in the fall in tilled or no-tilled replicated plots using a Great Plains grain drill at 7-in. row spacing. The cultivars included Everest (moderately resistant) and KanMark (susceptible). Fungicide treatments included: control (no fungicide); seed treatment; in-season (heading); and seed treatment + in-season. Treatments are listed in Table 1. Seed were treated with Apron XL (Syngenta, Inc.) at 0.5 oz/100 lb seed. The fungicide Prosaro (Bayer

Crop Science, Inc.) was applied for the in-season treatment to the wheat near the time of heading (Feekes 10-10.1) at a rate of 6 oz/a. Plants were harvested at maturity on June 18, 2020. The harvested seed was tested at the Kansas Grain Inspection Service for test weight, protein content and DON contamination.

Results and Discussion

A very wet spring in 2020 (Sassenrath et al., 2021a) resulted in some FHB infection in the wheat. However, the dry conditions after May preserved the wheat quality and kept the scab damage to a minimum. Very low rates of DON were measured in the wheat samples, but results showed no consistent increase in DON with treatment.

Yields were higher in Everest than in KanMark across all treatments (Figure 1). Tillage was the factor that lead to the greatest improvement in yields for both cultivars and all treatments, potentially due to a decrease in soil moisture in tilled plots. Winter wheat tends to produce poorly in wet soil conditions. Tillage increased wheat yield in Everest by 11% and in KanMark by 21%, averaged across all treatments. Both seed and in-season fungicide treatments increased yields, but the effects were not additive. Seed fungicide treatment increased yield 2.6% in Everest and 4.9% in KanMark. In-season fungicide treatment alone or with seed treatment increased yields 4.3%. In-season fungicide treatment increased yields more in the treatments that did not receive seed treatment.

Seed quality was also affected by tillage. Test weight showed only a minor (1.2%) increase in KanMark with tillage, but did not change in Everest (Figure 2). However, protein was increased by 3% in Everest and 6.6% in KanMark with tillage across all fungicide treatments (Figure 3). Fungicide treatment did not consistently affect protein or test weight in any treatments or cultivars.

Conclusions

Selection of resistant cultivars is a key approach to improve wheat yields and reduce losses due to fungal infections, especially in high rainfall environments such as southeast Kansas. Implementing conservation tillage can improve overall productive capacity of fields by reducing soil and nutrient losses, but may result in lower wheat yield or protein. This subtle change in soil moisture with tillage may be especially important in high rainfall areas, where winter rains keep soil moisture high.

Acknowledgment

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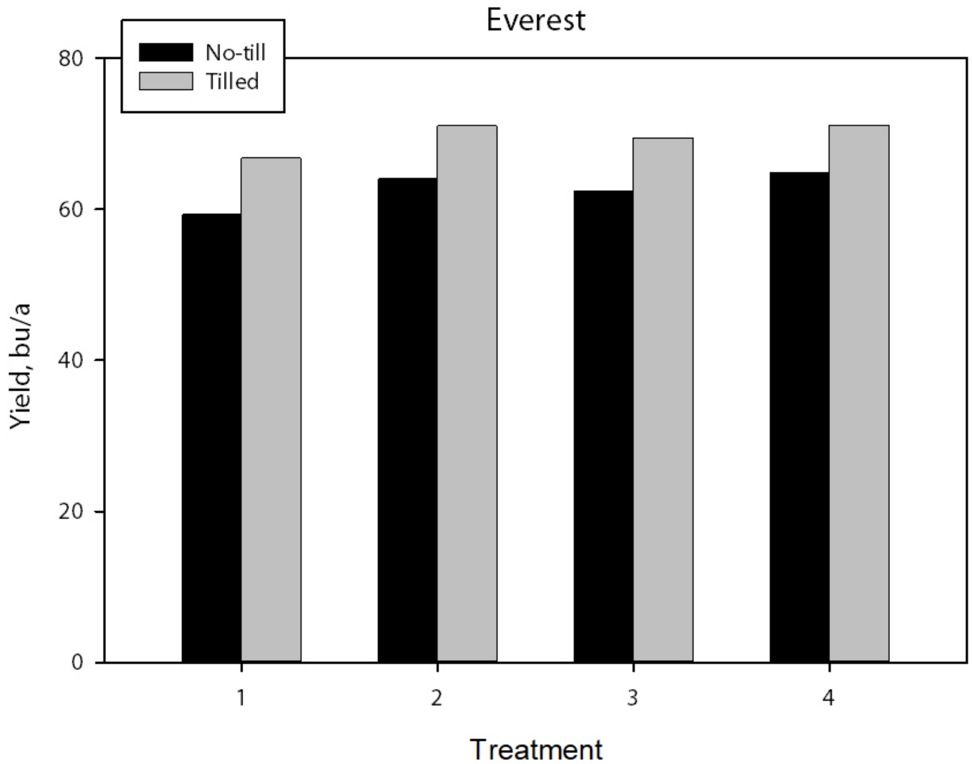
Wegulo, S.N., Bockus, W.W., Nopsa, J.F.H., Peiris, K.H.S., Dowell, F.E. 2013 Integration of fungicide application and cultivar resistance to manage fusarium head blight in wheat. Fungicides - Showcases of Integrated Plant Disease Management from Around the World, Dr. Mizuho Nita (Ed.), InTech, DOI: 10.5772/53096.

Table 1. Summary of fungicide treatments for Everest and KanMark wheat varieties

		Fungicide	
Cultivar	**Treatment #**	**Seed**	**In-season**
Everest	1	no	no
	2	no	yes
	3	yes	no
	4	yes	yes
KanMark	1	no	no
	2	no	yes
	3	yes	no
	4	yes	yes



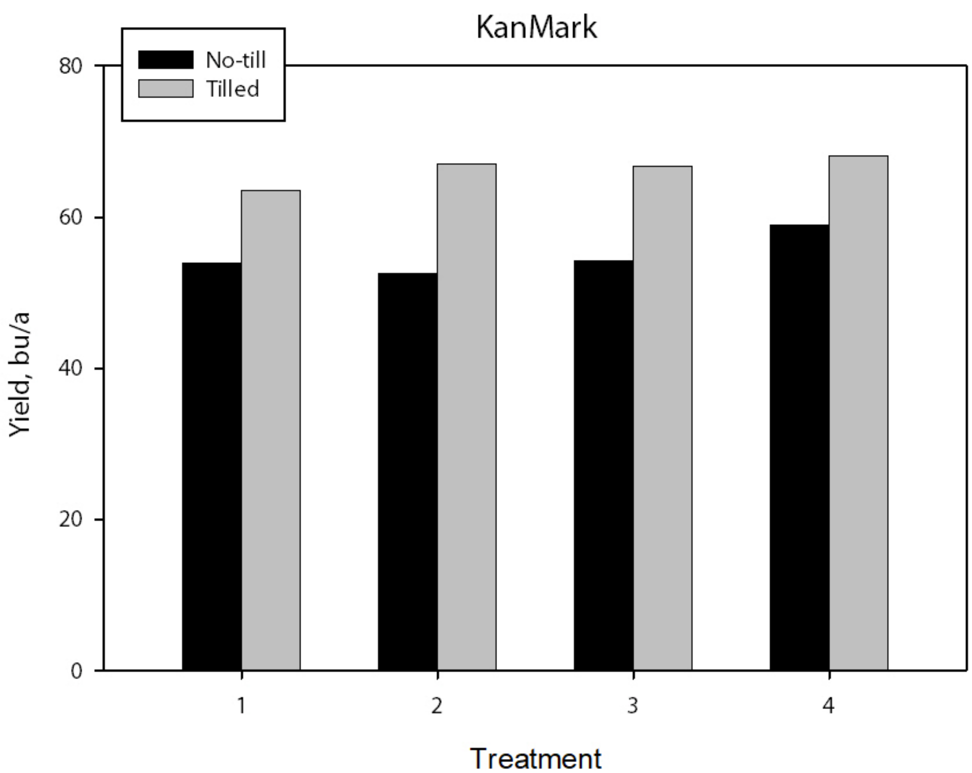


Figure 1. Wheat yield for Everest (top) and KanMark (bottom) under different management and fungicide treatments. Plots were no-till (black bar) or tilled (grey bar), and received no fungicide (1), seed treatment (2), in-season foliar fungicide (3), or both seed treatment and in-season fungicide (4).

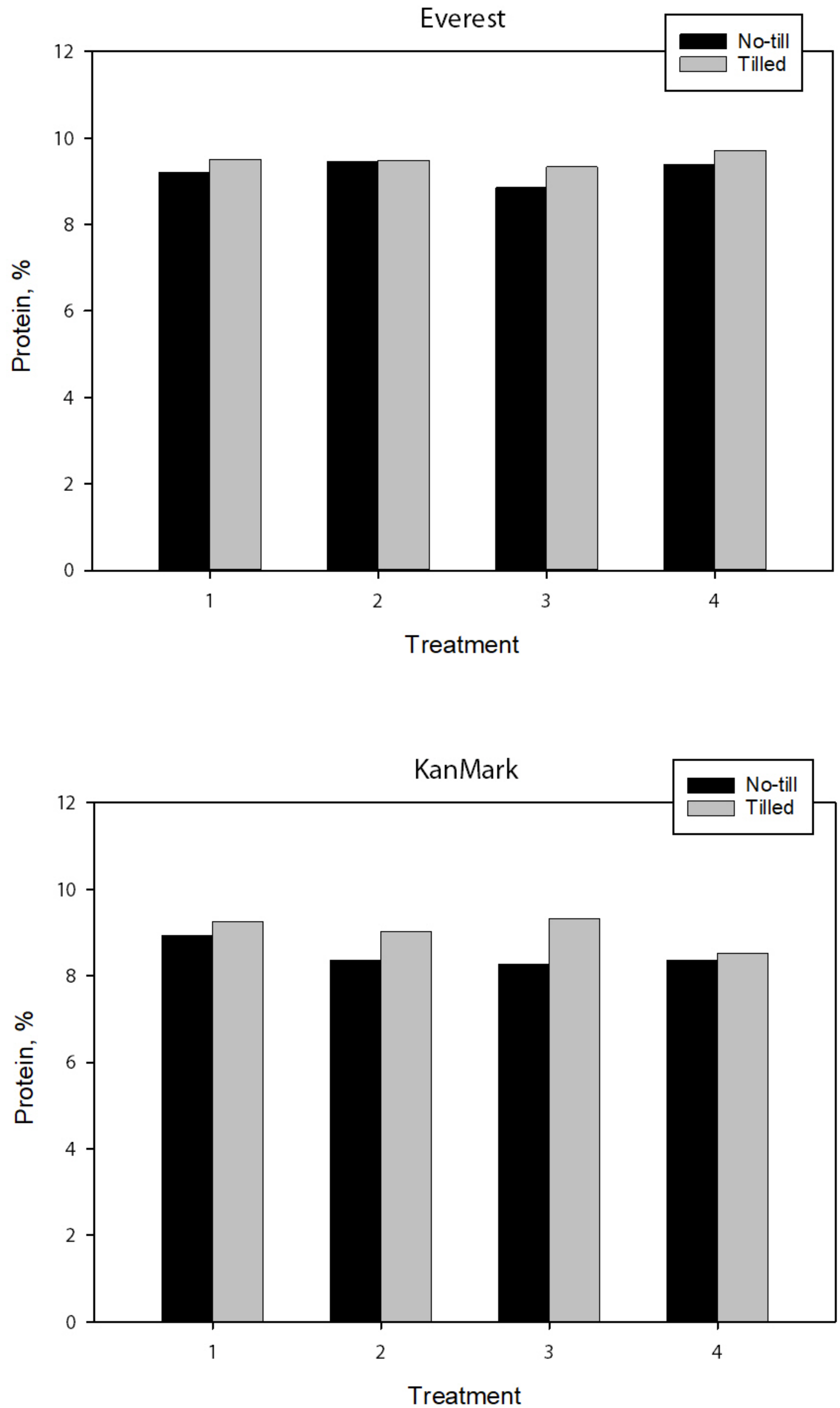


Figure 2. Wheat protein (%) for Everest (top) and KanMark (bottom) under different management and fungicide treatments. Plots were no-till (black bar) or tilled (grey bar), and received no fungicide (1), seed treatment (2), in-season foliar fungicide (3), or both seed treatment and in-season fungicide (4).

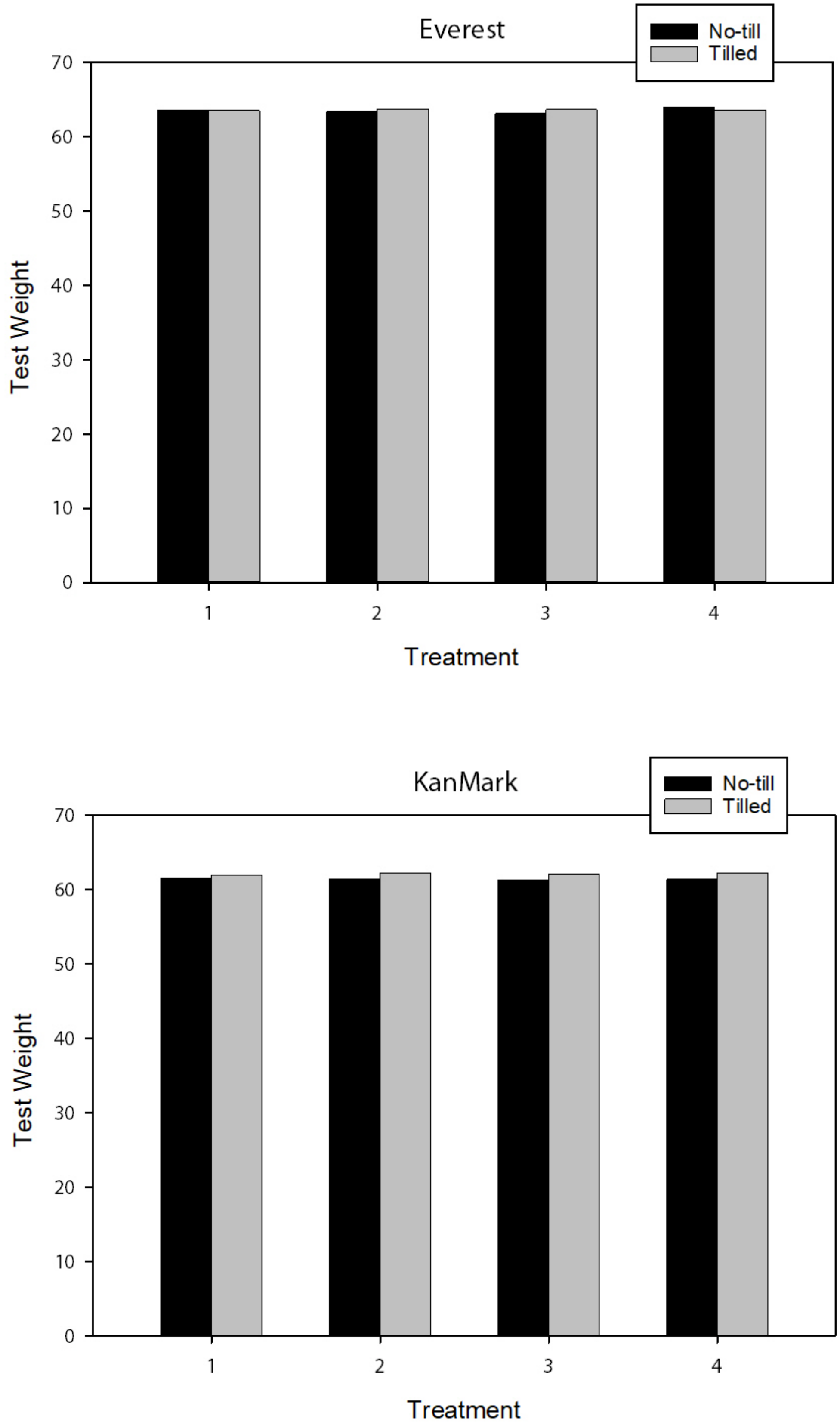


Figure 3. Wheat test weight (lb/bu) for Everest (top) and KanMark (bottom) under different management and fungicide treatments. Plots were no-till (black bar) or tilled (grey bar), and received no fungicide (1), seed treatment (2), in-season foliar fungicide (3), or both seed treatment and in-season fungicide (4).