The Effect of Previous Crop Residue, Chaff Management, and Tillage System on Fusarium Head Blight of Barley

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OBJECTIVE

The study objective was to determine if cultural management strategies, crop rotation, tillage system, or chaff management, could reduce Fusarium head blight (FHB) in barley.

Trial After Planting

INTRODUCTION

Resistance to Fusarium head blight (FHB) in barley is controlled by many genes making complete resistance impossible to obtain while maintaining desirable agronomic traits. In the short term, control of FHB in areas with high disease potential will require use of some combination of resistant cultivars, chemical control, biological control, and cultural control methods to provide control acceptable to producers. Dill-Macky and Jones (1) found greater yield of wheat following corn and wheat but not soybean with a moldboard plow tillage system compared to chisel plow or no-till system. FHB incidence and severity were reduced by moldboard plowing corn in wheat following corn but were not different on wheat following wheat or wheat following soybeans (1). Historically, livestock producers have collected the chaff discarded from the rear of combines for use as winter feedstuffs.. Khonga and Sutton (3) found that most of the *Fusarium* perithecia development and thus a major source of inoculum was on residues associated with the grain kernel and associated material. They also reported for straw residue from wheat and corn a reduced potential to develop perithecia after the first season in the field. Ascospores are the principle mechanism for initial FHB infections but the distance the spores can travel and infect has still not been adequately determined. Fernando et al. (2) reported a distinct gradient with spore numbers decreasing in the air as distance from the inoculum source increased which suggests that in-crop inoculum sources are important in providing inoculum. The objective of this study was to determine the effect of previous crop (durum or barley) on FHB on barley. Durum is the most susceptible crop grown extensively in northern North Dakota and is sometimes grown in rotation with barley. The second objective was to determine if the practice of collecting and removing the chaff could reduce FHB in the subsequent season. The final objective was to determine if tillage system had an effect on FHB.

Table 1. Residue and Yield by Tillage System in 2004 and 2005

Year	Tillage System	Residue (%)	Yield (Bu/A)
2004	Conventional	37	96.0
	Notill	78	102.1
	Rototill	26	107.7
2005	Conventional	32	106.2
	Notill	92	87.9
	Rototill	31	103.6
$LSD_{(0.05)}$		0.8	5.7

MATERIALS AND METHODS

The study conducted in 2004 and 2005 at the Langdon Research Extension Center, Langdon ND, was a randomized complete block design arranged as a factorial and replicated four times. Treatments were, 1) conventional till, notill, and rototill (to bury the residue), 2) chaff retained or removed and 3) previous crop durum or barley. Each plot was spaced to allow a 5 ft. tilled area on all sides of the plot with a 5 ft. wide border planted to barley to reduce interference by inoculum from adjacent plots. North Dakota State University Extension recommended production practices for Northeast ND were followed. Infection was by natural inoculum. Plots were harvested and the chaff and grain were either dropped out the rear of the combine or collected on a tarpaulin dragged behind the combine. The grain and chaff was shaken from the straw and the straw component of the residue replaced on the plot. A gross harvest weight was recorded. Following harvest, plots were notilled, rototilled, or cultivated with a spring tooth cultivator equipped with 9-inch sweep plow shares and attached harrows. Prior to sowing, the tillage treatments were repeated. The plots were planted to 'Robust' barley with a notill drill.. At mid dough growth stage, grain heads were clipped for evaluation of FHB. A visual estimation was made from 20 samples per plot collected to estimate the incidence (number of spikes infected) and field severity (number of FHB infected kernels per head divided by total kernels per individual spike) of FHB in each plot. Each plot was harvested with a Hege plot combine (Wintersteiger AG, Ried AT.) and the grain sample cleaned and processed for yield, protein, and test weight determination and plump on barley. Grain samples were analyzed for the toxin deoxynivalenol (DON) at the Department of Veterinary Diagnostic Services, North Dakota State University using the gas chromatography - electron capture (GC-EC) method . Data was analyzed with the general linear model (GLM) in SAS. Least significant differences (LSD) were used to compare means at the 5% probability level.

Table 2. FHB incidence by chaff management and previous crop

Previous Crop	Chaff Management	FHB Incidence
Barley	Collected	74.6
	Dropped	75.4
Durum	Collected	77.7
	Dropped	74.8
$LSD_{(0.05)}$		0.7

Table 3. Yield by previous crop in 2004 and 2005

Year	Previous Crop	Yield (Bu/A)
2004	Barley	102.9
	Durum	101.0
2005	Barley	93.7
	Durum	104.8
$LSD_{(0.05)}$		7.0

Conventional

No-till

Rototill

RESULTS AND DISCUSSION

The North Dakota Agricultural Weather Network Weather Station at Langdon recorded over 7 inches of precipitation in June in 2005, double the 30 year average and this may account for differences between results in 2004 and 2005.

The amount of area covered by residue after planting was significantly higher when the previous crop was barley (52%) compared to after durum (47%) (data not shown).

Yields were affected differently by tillage system in each year (Table 1). In 2004 there was no differences between notill and rototill but both had significantly higher yield than conventional. In 2005, there was no difference between rototill and conventional, but both had significantly higher yields than notill. Yield differences are unlikely to be associated with percent cover by residue, as in both years notill had the greatest residue cover with rototill, with conventional more than 50% less cover. In 2004 conventional had a small but significantly greater amount of residue cover than rototill but there was no difference between the two treatments in 2005.

In 2004 the previous crop had no effect on yield, but in 2005 yield was lower when the previous crop was barley than when the previous crop was durum.

No significant differences in DON accumulation, FHB incidence or FHB severity were recorded between previous crops, chaff management systems or tillage systems.

Based on two years, 2004 with a mean DON of 0.3ppm, mean incidence of 53% and mean severity of 2.1% and 2005 with a mean DON of 1.3ppm, mean incidence of 94% and mean severity of 13.5%, there was no indication that FHB in small plots was affected by tillage system, chaff management or previous small grain crop. However, results show that tillage system and crop rotation can affect barley yields in some years.

Table 4. Yield, Deoxynivalenol, and FHB incidence and field severity by previous crop, chaff management and tillage system in 2004 and 2005.

						FHB	
Year	Previous Crop	Chaff Management	Tillage System	Yield (Bu/A)	Deoxynivalenol (PPM)	Incidence (%)	Severity (%)
2004	Barley	Collected	Conventional	108.3	0.4	46	1.6
			No-till	103.0	0.3	65	2.7
			Rototill	103.2	0.4	58	2.2
		Dropped	Conventional	91.8	0.3	55	1.9
			No-till	100.0	0.3	64	2.2
			Rototill	111.2	0.3	50	1.6
	Durum	Collected	Conventional	92.4	0.3	58	2.4
			No-till	105.2	0.3	60	2.7
			Rototill	98.2	0.4	63	2.2
		Dropped	Conventional	91.4	0.3	50	1.3
			No-till	100.4	0.4	60	2.6
$LSD_{(0.05)}$			Rototill	118.5	0.4	60	1.7
2005	Barley	Collected	Conventional	103.5	1.1	94	14.3
			No-till	80.8	1.6	93	11.9
			Rototill	98.7	1.1	93	15.1
		Dropped	Conventional	101.2	1.5	96	14.8
			No-till	76.3	1.9	90	11.7
			Rototill	101.4	1.4	98	13.6
	Durum	Collected	Conventional	111.5	1.2	94	15.0
			No-till	98.2	1.6	96	14.5
			Rototill	108.3	1.1	96	13.7
		Dropped	Conventional	108.7	1.1	90	9.9
			No-till	96.3	1.0	93	12.0
$LSD_{(0.05}$			Rototill	106.0	1.4	96	15.1

REFERENCES

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