Impact of Previous Crop and Tillage on Barley Variety Performance
NDSU Dickinson Research Extension Center

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RESEARCH SUMMARY

Previous research at Dickinson indicated that a yield advantage resulted when spring wheat was preceded by field pea in a rotation compared to growing wheat continuously. A study was established in 2009 to determine if a similar yield advantage results when barley is preceded by field pea compared with canola, corn, and spring wheat. Barley yield was equal or greater following field pea when preceded by the other three crops in this ongoing study. In a separate study, growing barley under no-till failed to result in a yield advantage compared with growing barley under clean- and reduced-till management, in contrast with previous research indicating a consistent yield advantage when spring wheat was grown under no-till. Barley cultivar recommendations were unaffected by previous crop and tillage systems in both studies which will be continued verify these preliminary results.

INTRODUCTION

Conservation-tillage has replaced conventional clean-till on many farms. Cropping systems have intensified because of this change and, because of the impacts this can have when small-grain crops are grown annually, there is a need to diversity cropping systems. It is unclear what impact changes in tillage systems and crop sequencing have on agronomic performance of barley. In addition, the dual impacts of tillage system and crop sequencing changes beg the question: can barley cultivar recommendations be extended across contrasting tillage systems and crop sequences or rotations? The objectives of research at Dickinson are to determine if different preceding crops affect grain yield and test weight of a subsequent barley crop, and to determine if eliminating tillage enhances agronomic performance of barley in southwestern North Dakota. Two field studies were established in 2009 to determine if interactions between barley cultivar and previous crop, or barley cultivar and tillage system, exist.

MATERIALS AND METHODS

A study was established in 2009 at Dickinson to compare barley cultivar performance when preceded by canola, corn, field pea, and spring wheat. Three six-rowed (Lacey, Stellar-ND, and Tradition) and three two-rowed (Conlon, Conrad, and Pinnacle) varieties were seeded in 2010 and 2011 in a no-till system, after each of the four crops mentioned previously were seeded the preceding year in an accepted experimental design for field studies. Grain yield and test weight were determined by harvesting plots using a research combine with an on-board weighing and grain-moisture system. A separate study compared grain yield and test weight produced by the same six barley cultivars under clean-till and no-till management in 2009, and under clean-, reduced-, and no-till management in 2010 and 2011. The tillage systems and barley cultivar plots were arranged in an accepted experimental design for field studies. Grain yield and test weight were determined as was done in the other study. Data were analyzed using the GLM procedure available from SAS for balanced data.

RESULTS AND DISCUSSION

We were unable to detect a difference that was different statistically for average yield of the barley varieties when following the four different crops in 2011 ($P=0.33$; Table 1). In contrast, higher barley yield was measured following field pea than following corn or spring wheat in 2010. Greater variability in grain yield within plots used to calculate average yield for each of the four previous crops occurred in 2011 compared with 2010; this variability explains our inability to detect yield differences statistically in 2011 between previous crop treatments, even though there was a range in mean yield from 57 bu/acre for barley following canola to 70 bu/acre for barley following field pea. The rank in barley yield across both years among the four crops was field pea>corn>canola≅spring wheat. Barley test weight was relatively light in 2011 (average TW = 37.9 lb/bu) and unaffected by previous crop, as also was the case in 2010.

Tradition produced equal or higher yields than other barley varieties in 2011 (Table 1). Conlon produced lower yields than other barley varieties in 2011, as also was the case in 2010. In 2010, Conrad (2-rowed) and Stellar-ND (6-rowed) were among the highest yielding varieties, but both produced lower yields than Tradition in 2011. Kernels with the

heaviest test weight were produced by Conlon (2-rowed) and Tradition (6-rowed) in 2010 and 2011.

We were unable to detect any impact of tillage system on barley yield across the six varieties in a separate field study in 2011 (Table 2). This is consistent with a lack in yield response to changes in tillage system in both 2009 and 2010. In contrast, a positive impact of tillage reduction on wheat yield was measured in these plots between 2000 and 2006, with a 40% higher yield under no-till compared with clean-till (i.e., conventional-till) and a 30% higher yield compared with reduced-till. Much of the wheat yield advantage was attributed to soil moisture conservation under no-till compared with tilled systems, particularly closer to the soil surface. Volumetric water content was greater under no-till than clean- and reduced-till at a 4-inch soil depth throughout the 2011 growing season in the present study (Fig. 1a), and on several dates at an 8-inch soil depth (Fig. 1b). However, this failed to translate into a barley grain yield advantage because seedbeds were adequately moist for good emergence across all tillage systems earlier in the season shortly after plots were seeded (data not presented). Interestingly, volumetric soil water content was less under no-till than reduced- and clean-till plots by 67 days after seeding at a 2-ft soil depth (Fig. 1c). These soil water differences between tillage systems did not translate into above-ground differences in barley grain yield in any year (Table 2). Test weight of barley grain also was not impacted consistently by tillage system in any year.

The 6-rowed varieties Lacey and Tradition produced greater amounts of grain than the other four barley varieties across the three tillage systems in 2011 (Table 2). In contrast, the 2-rowed variety Pinnacle produced grain yield equal or greater than amounts produced by other barley varieties in both 2009 and 2010. Relatively low yields were produced by Stellar-ND in each of the three years of this ongoing study.

The 2-rowed variety Conlon produced grain with a test weight that was equal or heavier than grain test weight produced by other barley varieties in 2009, 2010, and 2011 (Table 2). Among 6-rowed varieties, Tradition produced grain with a relatively heavy test weight. Conversely, light test weight grain was produced by Stellar-ND.

Results of the ongoing tillage study with barley and the previous study with wheat suggest that the yield advantage which typically occurs under relatively dry conditions (wheat) can disappear when more favorable moisture conditions develop, particularly during spring through mid-summer (barley). This is not surprising since much of the advantage in crop performance under no-till has been attributed to soil moisture conservation in southwestern North Dakota. We suspect that barley yield would be enhanced under no-till compared with tilled tillage systems if dry conditions developed and persisted in the Dickinson area. This study will be continued in an attempt to verify this hypothesis.

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Table 1. Previous Crop by Barley Variety Trial, NDSU Dickinson Research Extension Center, 2010-2011

	Grain yield			Test weight		
	2010	2011	Average	2010	2011	Average
Previous Crop	---------- bu/acre ----------			---------- lb/bu ----------		
Canola	90	57	74	48.0	38.1	43.1
Corn	70	65	68	45.7	38.0	41.9
Field pea	95	70	83	47.9	37.9	42.9
Spring Wheat	86	59	73	48.3	37.6	43.0
LSD 0.05	7	NS		NS	NS	
Barley varieties						
Conlon	74	53	64	48.8	40.0	44.4
Conrad	90	58	74	46.6	35.7	41.2
Lacey	88	66	77	47.9	37.6	42.8
Pinnacle	86	66	76	47.5	36.7	42.1
Stellar-ND	89	65	77	46.2	37.6	41.9
Tradition	84	69	77	48.2	39.7	44.0
LSD 0.05	6	3		0.9	0.7	

Table 2. Tillage Systems by Barley Variety Trial, NDSU Dickinson Research Extension Center 2009-2011

	Grain yield				Grain test weight			
	2009	2010	2011	Average	2009	2010	2011	Average
Tillage system	----------bu/acre----------				----------lb/bu----------			
Conventional	107	58	66	77	49	44	40	44
Reduced	-	67	65	-	-	45	41	43
No-till	99	63	56	73	48	47	40	45
LSD 0.05	NS	NS	NS		NS	1	NS	
Barley varieties								
Conlon	105	58	54	72	50	48	42	47
Conrad	121	62	57	80	50	45	40	45
Lacey	87	65	69	74	49	45	40	45
Pinnacle	121	67	62	83	48	45	39	44
Stellar-ND	86	60	62	69	46	44	39	43
Tradition	97	63	69	76	49	46	42	46
LSD 0.05	12	5	5		1	1	1	

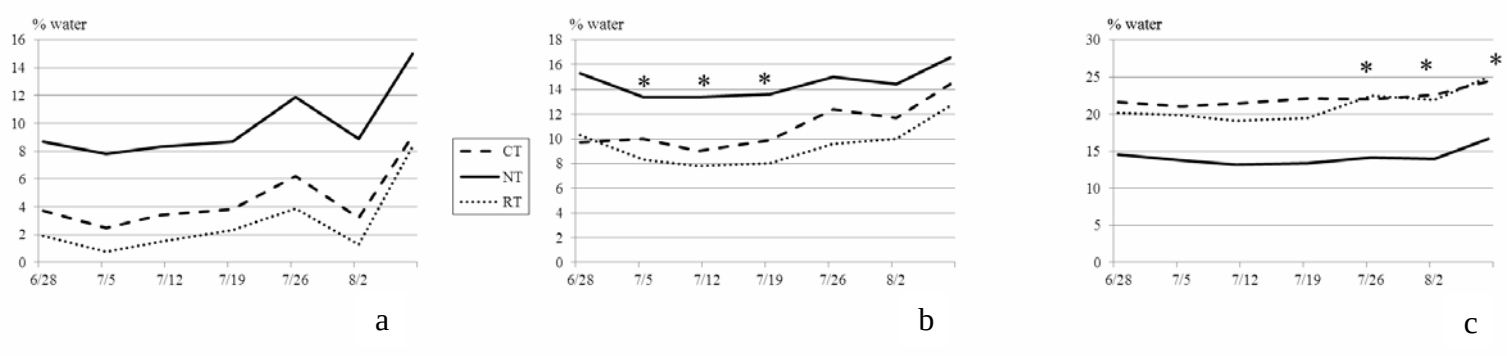

Figure 1. Volumetric soil water content at 4-inch (a), 8-inch (b), and 24-inch (c) depths in clean-till (CT), reduced-till (RT), and no-till (NT) plots at the NDSU Dickinson Research Extension Center in 2011. Differences were detected between soil water content in NT plots and other plots on each date at the 4-inch depth, and the dates indicated by the asterisk (*), at 8-inch and 24-inch depths ($P < 0.05$).