

## Barley Cultivar Performance Following Canola, Corn, Field Pea, and Spring Wheat

Patrick M. Carr<sup>1</sup>, Richard D. Horsley<sup>2</sup>, Glenn B. Martin<sup>1</sup>, and Timothy J. Winch<sup>1</sup>

<sup>1</sup>North Dakota State University Dickinson Research Extension Center

<sup>2</sup>North Dakota State University Department of Plant Sciences, Fargo

### SUMMARY

Previous research indicated a grain yield advantage in some years when spring wheat followed field pea compared with spring wheat in southwestern North Dakota. Our objective is to determine if a rotation effect can be demonstrated for barley, and if cultivar selection affects the impact of previous crop on subsequent barley performance. Six barley cultivars were compared for grain yield and quality following canola, corn, field pea, and spring wheat in 2010. Spike density was reduced when barley followed corn compared with canola and field pea, and this translated into a lower grain yield after corn (70 bu/acre) than canola (90 bu/acre) and field pea (95 bu/acre;  $P < 0.05$ ). More grain also was produced when barley followed spring wheat (86 bu/acre) than corn, even though barley spike density was similar following both crops. We were unable to detect any influence of the previous crop on grain test weight of a subsequent barley crop. Cultivar ranking was unaffected by previous crop considerations for any barley crop parameter. Conlon, produced less grain (74 bu/acre) than the other five cultivars (range 84 to 90 bu/acre). In contrast, Conlon produced grain with a heavier test weight (48.8 lb/bu) than Conrad (46.6 lb/bu), Pinnacle (47.5 lb/bu), and Stellar-ND (46.2 lb/bu). Additional data will be collected in this ongoing study through 2012.

### INTRODUCTION

Crop-fallow has been replaced with more intensive cropping systems on many farms in western North Dakota. Barley is a popular small-grain crop in this portion of the state, and questions have been asked on how previous crop affects barley performance. Past research demonstrated that rotating spring wheat with field pea enhanced grain yield of a subsequent wheat crop compared with growing wheat continuously, but this rotation effect was not observed consistently across a 6-yr period (Carr et al., 2006). The objective of this research is to determine if barley performance is affected by the previous crop in a 2-yr sequence, and to determine if cultivar selection affects the rotation effect.

### MATERIALS AND METHODS

Three 2-rowed (Conlon, Conrad, and Pinnacle) and three 6-rowed (Lacey, Stellar-ND, and Tradition) barley cultivars were established following canola, corn, field pea, and spring wheat in a no-till system in

2010 at the NDSU Dickinson Research Extension Center. Plots were arranged in a randomized complete block in a split plot arrangement. Tillage system comprised whole plots and barley cultivar comprised subplots. Tillage by barley cultivar combinations were replicated three times. Data were analyzed using PROC GLM from SAS for balanced data.

### RESULTS AND DISCUSSION

Barley plant stand and days to heading were unaffected by the previous crop in 2010 (Table 1). However, spike density was greater following canola and field pea (17 spikes/ft<sup>2</sup>) compared with corn (15 spikes/ft<sup>2</sup>). Barley spike density following spring wheat was intermediate between those crops. These changes in spike density were reflected in grain yield differences following field pea at 95 bu/acre and canola at 90 bu/acre, compared with corn at 70 bu/acre. Spring wheat was intermediate between the two extremes in grain yield (86 bu/acre). Plant height failed to be a good indicator of grain yield differences in 2010, since barley plants following field pea were shorter than those following canola and similar in height to plants following corn. Differences in grain test weight for barley were not detected across the four different crops.

Barley cultivar rank was unaffected by previous crop consideration for any parameter considered in the field experiment in 2010 (data not presented). Spike density for Conrad was greater than for the other five barley cultivars included in the field experiment, but this did not translate into a grain yield benefit, except when comparing Conrad to Conlon (Table 1). Though relatively low yielding, test weight for grain produced by Conlon was heavier than that produced by other cultivars, except for Lacey and Tradition.

Results of these preliminary data indicate the profound effect that previous crop can have on subsequent barley grain yield in a 2-yr crop sequence. This study will be continued through 2012 to determine if the impacts of previous crop on subsequent barley crop performance are consistent across years. This study also will be continued to determine if cultivar ranking can be affected by previous crop choices in some years.

### REFERENCES

Carr, P.M., R.D. Horsley, and G.B. Martin. 2006. Impact of tillage and crop rotation on grain yield of

spring wheat II. Rotation effect. Online. Crop  
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Table 1. Previous Crop by Barley Variety Trial, NDSU Dickinson Research Extension Center, 2010

	Plant count	Days to heading	Spike density	Plant height	Yield	Test weight	Moisture
	-no./ft <sup>2</sup> -	-d-	-Spikes/ft <sup>2</sup> -	-in-	-bu/ac-	-lb/bu-	-%-
Previous Crop							
Canola	18	64	17	34	90	48.0	9.6
Corn	15	65	15	31	70	45.7	9.3
Field pea	17	63	17	32	95	47.9	10.2
Spring Wheat	17	64	16	33	86	48.3	10.0
LSD 0.05	NS	NS	1.8	1	7	NS	NS
Barley varieties							
Conlon	16	60	20	32	74	48.8	9.9
Conrad	16	74	24	31	90	46.6	9.4
Lacey	16	62	12	32	88	47.9	9.8
Pinnacle	16	65	18	33	86	47.5	11.1
Stellar-ND	15	62	12	33	89	46.2	8.6
Tradition	22	63	12	33	84	48.2	9.7
LSD 0.05	2	1	2	1	6	0.9	1

## Barley Cultivar Performance Following Corn in Clean-, Reduced-, and No-Till Systems

Patrick M. Carr<sup>1</sup>, Richard D. Horsley<sup>2</sup>, Glenn B. Martin<sup>1</sup>, and Timothy J. Winch<sup>1</sup>

<sup>1</sup>North Dakota State University Dickinson Research Extension Center

<sup>2</sup>North Dakota State University Department of Plant Sciences, Fargo

### SUMMARY

Previous research indicated a consistent advantage in spring wheat grain yield when tillage was eliminated across contrasting cropping systems in southwestern North Dakota. Our objective is to determine if barley is responsive to changes in tillage, and if cultivar selection affects barley performance. Six barley cultivars were compared for grain yield and quality across clean- and no-till management at Dickinson during 2009, and across clean-, reduced-, and no-till systems in 2010. Cultivar rank did not change across tillage systems. Similarly, reductions in tillage did not affect grain yield in either year, averaging 103 bu/acre in 2009 and 63 bu/acre in 2010. Grain test weight was affected by tillage system in 2010 ( $P < 0.05$ ), but not in 2009. Grain yield differed by 35 bu/acre across the six barley cultivars in 2009, and by 9 bu/acre in 2010. The two-rowed cultivar Pinnacle produced equal or greater amounts of grain compared with the other five cultivars in both years, while grain test weight of 'Conlon' was equal or heavier than that of other cultivars. These results indicate that tillage may not affect barley grain yield and quality consistently, if at all, under the environmental conditions similar to those encountered during the first two years of this 4-yr study.

### INTRODUCTION

Tillage has declined in western North Dakota (Carr et al., 2003a). Previous research at the NDSU Dickinson Research Extension Center indicated that reductions in tillage failed to affect grain yield and quality in a wheat-fallow system (Carr et al., 2003a, 2003b), but wheat grain yield and quality were enhanced by eliminating tillage in more intensive cropping systems (Carr et al., 2006). The objective of this research is to determine if barley performance and cultivar rank change across contrasting tillage systems in a barley-corn rotation.

### MATERIALS AND METHODS

Three 2-rowed (Conlon, Conrad, and Pinnacle) and three 6-rowed (Lacey, Stellar-ND, and Tradition) barley cultivars were established in clean-, reduced- and no-till plots in a field where corn previously was grown. The tillage systems were established in 1993. A tandem disk is used in both the fall and the spring so that less than 15% of the soil surface is covered with crop residue at seeding in clean-till plots. A single disking occurs in the spring so that between 30 and 50% of the soil surface is covered with crop residue in

reduced-till plots. Sixty percent or more of the soil surface is covered with crop residue at seeding in no-till plots, where soil is not disturbed except by a low-disturbance, no-till planting unit. Plots were arranged in a randomized complete block in a split plot arrangement. Tillage system comprised whole plots and barley cultivar comprised subplots. Tillage by barley cultivar combinations were replicated three times. Data were analyzed using PROC GLM from SAS for balanced data.

### RESULTS AND DISCUSSION

Close to 70% of the soil surface was covered by previous crop residue at seeding in no-till plots in 2009 and 2010, compared with less than 15% in clean-till plots (Table 1). However, differences in soil surface residue cover failed to impact barley plant stand establishment (data not presented). Average heading date was two days later under no-till than clean-till in 2010, whereas differences in heading date were not detected in 2009. Plant height was unaffected by tillage system in either year. Similarly, spike density and grain yield were unaffected by tillage system. Grain yield averaged 103 bu/acre in 2009 and 63 bu/acre in 2010. Grain with a heavier test weight was produced under no-till than under clean- and reduced till systems in 2010, but there was no difference in grain test weight across clean- and no-till systems in 2009.

Barley cultivar rank was unaffected by reductions in tillage for any parameter considered, except grain test weight in 2010 (data not presented). However, Conlon produced grain with equal or heavier test weight than that produced by other cultivars in all three tillage systems in 2010. Conlon also headed 3 to 6 days earlier than other cultivars included in the study in 2009, and 3 to 15 days earlier in 2010 (Table 1). Plant height was similar among all cultivars except Conrad, which was 4 to 5 inches shorter in 2009 and 2 to 3 inches shorter in 2010. The number of reproductive spikes/ft<sup>2</sup> was consistently greater among two- than six-rowed cultivars in both 2009 and 2010, and this translated into greater yields for the two-rowed cultivars Conrad and Pinnacle compared with all three, six-rowed cultivars in 2009. This was not the case in 2010, when differences in grain yield were not detected between two- and six-rowed cultivars, with one exception. Grain yield for Conlon was 58 bu/acre and

lower than the grain yield of both Lacey (65 bu/acre) and Pinnacle (67 bu/acre).

Heavier kernel weight was produced by Conlon than any other barley cultivar in 2010 (Table 1).

Differences in grain test weight were not detected between Conlon, Conrad, Lacey, and Tradition in 2009. Test weight was relatively light for grain produced by Stellar-ND in both years. This ongoing study will be continued through 2012.

## **REFERENCES**

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Carr, P.M., R.D. Horsley, and W.W. Poland. 2003a. Tillage and seeding rate effects on genotypes in wheat-fallow monoculture I. Grain production. Crop Sci. 43:202-209.

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Table 1. Tillage Systems by Barley Variety Trial, NDSU Dickinson Research Extension Center 2009-2010

Tillage system	Surface residue			Days to heading			Plant height		
	2009	2010	Average	2009	2010	Average	2009	2010	Average
	-%-			-d-			-in-		
Clean-till	8	14	11	55	57	56	30	29	30
Reduced-till	-	39	-	-	58	-	-	29	-
No-till	73	67	70	56	59	58	29	29	29
LSD 0.05	57	13	-	NS	1	-	NS	NS	-
Barley varieties									
Conlon	41	51	46	52	53	53	30	30	30
Conrad	45	50	48	58	68	63	26	27	27
Lacey	-	29	-	55	57	56	30	29	30
Pinnacle	-	-	-	56	56	56	31	29	30
Stellar-ND	-	29	-	56	57	57	30	29	30
Tradition	-	-	-	55	56	56	30	30	30
LSD 0.05	NS			1	1	-	2	1	-

Tillage system	Spike density			Grain yield			Grain test weight		
	2009	2010	Average	2009	2010	Average	2009	2010	Average
	-Spikes/ft <sup>2</sup> -			-bu/acre-			-lb/bu-		
Clean-till	42	33	38	107	58	83	49	44	46
Reduced-till	-	32	-	-	67	-	-	45	-
No-till	40	31	36	99	63	81	48	47	47
LSD 0.05	NS	NS	-	NS	NS	-	NS	1	-
Barley varieties									
Conlon	51	40	46	105	58	81	50	48	49
Conrad	56	40	48	121	62	91	50	45	48
Lacey	24	24	24	87	65	76	49	45	47
Pinnacle	51	35	43	121	67	94	48	45	46
Stellar-ND	30	23	27	86	60	73	46	44	45
Tradition	32	29	31	97	63	80	49	46	48
LSD 0.05	11	4	-	12	5	-	1	1	-

## **Organic Farming: Impacts on Soil, Food, and Human Health**

Patrick M. Carr<sup>1</sup>, Kathleen Delate<sup>2</sup>, Xin Zhao<sup>3</sup>, Cynthia A. Cambardella<sup>4</sup>, Pattie L. Carr<sup>5</sup>, and Joseph R. Heckman<sup>6</sup>

<sup>1</sup>North Dakota State University Dickinson Research Extension Center

<sup>2</sup>Iowa State University

<sup>3</sup>University of Florida

<sup>4</sup>USDA-ARS National Laboratory for Agriculture and the Environment

<sup>5</sup>Dickinson State University

<sup>6</sup>Rutgers University

### **RESEARCH SUMMARY**

The importance of responsible stewardship in managing soil is a central tenet of organic farming. Organic farmers believe that practices which stimulate biology and overall quality of soil enhance production of healthy and nutritious crops. Few involved in agriculture would argue this point. Nevertheless, disagreement exists among agriculturists about the relative importance that should be placed on organic farming for meeting global food needs in the 21<sup>st</sup> century. Organic farming proponents insist that careful management of on-farm ecological processes creates soil capable of supplying adequate amounts of nutritious food for a growing world population, with reduced need for off-farm inputs. Critics contend that organic farming can degrade soils and will contribute to the underproduction of food crops that are no more nutritious than foods grown using synthetic agrichemicals (i.e., conventional farming), if adopted on a large scale. This chapter was not written to settle the debate, but to provide a historical context for the belief that organic methods promote soil health, compare organic and conventional farming systems for impacts on soil quality and crop production, and summarize comparisons in food quality between the two farming systems. While detailed discussion of these three topics cannot occur in a single chapter, enough information is provided to give readers with limited knowledge of organic farming a better understanding of why consideration of this farming method is appropriate in a discussion about soil and its relation to human health. Although organic farming is practiced globally, space limitations restrict most of the focus in this chapter to organic farming within the USA.

This summary is from a chapter in an upcoming book entitled *Soils and Human Health* that will be published by CRC Press.