



Agricultural Research Division
 University of Nebraska Extension
 Institute of Agriculture and Natural Resources
 University of Nebraska–Lincoln

2015 Beef Cattle Report



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Effect of Corn Residue Removal on Subsequent Crop Yields

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Procedure

Experiment 1

This study was designed to evaluate the long-term impacts of grazing corn residue in the fall or spring on soybean and corn yields when an annual corn-soybean rotation was used. A 90 acre irrigated crop field located at the Agriculture Research and Development Center located near Mead, Neb., was used. The soil in this field was Tomek (0-2% slope) silty clay loam, Yutan (2-5% slope) silty clay loam, and Filmore (0% slope) silty loam and contained 2-2.5% soil organic matter. Half of the field (east or west) was planted to corn and the other half was planted to soybeans each year, and crops were alternated yearly so that corn was grown in the portion of the field that grew soybeans the previous year and soybeans were grown in the portion of the field that grew corn the previous year. An irrigation access road that ran east to west in the middle of the field served as the separation between the two replications of each crop. Each quarter had three grazing treatments that were maintained on the same ground since 1997: 1) fall/winter grazed (November through January), 2) spring grazed (February to the middle of April), and 3) ungrazed.

Corn residue was the only residue that was grazed, thus the immediate impact of corn residue grazing on grain yield would be reflected in the soybean yields, whereas long-term effects would be measured in both grain crops. The fall/winter grazing is the time that most cattle graze crop residues in Nebraska. The field is typically frozen, and the mud and compaction associated with cattle grazing should, therefore, be minimized. The spring grazing treatment was designed to look at the effects of allowing cattle to remain on crop fields, after

the fields thaw, until spring planting. Stocker cattle (500 to 700 lb BW) supplemented with distillers grains were used to apply grazing treatments and were stocked at 1.2 head/ac in the fall/winter (1.8 to 2.5 AUM/ac) grazing treatment and 1.2 head/ac in the spring grazing (0.9 to 1.3 AUM/ac) treatment up until 2000 (five years). At this point calves were stocked at 3 head/ac in the spring grazing treatment (2.3 to 3.1 AUM/ac).

The stocking rates utilized were consistent with UNL grazing recommendations, which result in removal of half the husks and leaves produced (8 lb of leaf and husk per bushel of corn grain produced). The corn yields ranged from a low of 186 bu/ac in 2004 to a high of 253 bu/ac in 2009, with a median over the 16 years of 203 bu/ac. Recommended stocking rates would have ranged from 2.1 to 2.9 AUM/ac with a median of 2.3 AUM/ac. The area harvested for determination of yield ranged from 0.40 to 0.65 acres per treatment per replicate and was measured on the same strips of land each year. Grain was harvested using a combine, and corn was weighed using a weigh wagon and soybeans were weighed in a 550 bu grain cart with load cells. Each year, samples were collected at harvest to determine DM, and yields were adjusted to 13% moisture for soybeans and 15.5% moisture for corn grain.

For the fall/winter grazing areas, no-till planting was utilized throughout the 16 years. However, yield data in the fall grazed area are only available from the harvest of 2004 through the 2013 harvest (10 years). Within the spring grazed and ungrazed treatment, three tillage treatments: no-till, ridge-till, or spring disk till, were imposed during the corn rotation with no-tillage being used following the soybean crop. These tillage treatments were maintained on the same

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Summary

Two studies were conducted to evaluate the effects of corn residue harvest on subsequent crop yields. In a long-term study (16 years), cattle grazing corn residue in the spring (February to the middle of April) or the fall (November through January) slightly improved subsequent soybean yields and had no effect on corn yields in an irrigated field maintained in an annual corn-soybean rotation at Mead, Neb. In a five-year study, fall grazing (December through January) or baling of corn residue had no effect on subsequent corn grain yields in a field maintained in continuous corn production at Brule, Neb. These data suggest that the grazing of corn residue in the fall or spring at or below UNL recommended stocking rates will have slightly positive or no impacts on subsequent soybean or corn yields.

Introduction

Grazing cornstalks offers producers an inexpensive feed source and helps minimize purchased feed costs during the winter. Although corn crop residue grazing can reduce feed costs, some crop producers are concerned that it will have an adverse effect on subsequent crop yields, especially if cattle are grazed during the spring when the ground is thawed and muddy. These studies were designed to evaluate impacts of harvesting corn residue through grazing or baling on subsequent crop yields.

strip of land until the spring of 2007, at which time only the no-till treatments were continued. Therefore, the comparison of spring grazing vs. no grazing under no-till management is available for 16 years, the split plot comparison of spring grazing vs. no grazing under three tillage strategies (no-till, ridge till, or spring till) is available for nine years, and the comparison of the effects of spring, fall/winter and no grazing under no-till management is available for 10 years.

Data were analyzed using the GLIMMIX procedure of SAS (SAS Institute, Inc., Cary, N.C.). Corn and soybean yields were analyzed separately. Each strip of land within field was considered the experimental unit. For all of the analyses, year was considered a random effect using an autoregressive (AR1) covariance structure to account for correlation among measures within each strip measured over repeated years. For the nine years of data in which different tillage methods were used, the analyses included the fixed effects of tillage and grazing and their interaction. In addition, the possible spatial correlation of the strips was accounted for with an autoregressive (AR1) covariance structure. For the 16 years of data in which spring grazing was conducted on land that was managed under no-till, the analyses included the fixed effect of grazing. For the 10 years of data in which both spring and fall grazing is available under no-till management, the analyses included the fixed effect of grazing season (spring grazed, fall grazed, or not grazed).

Experiment 2

This study was designed to evaluate the effects of corn residue harvest with fall grazing at two stocking rates or baling on subsequent corn grain yield in a continuous corn system. A center pivot (130 acres) irrigated corn field (consisting of loam, silt loam, and sandy loam soil, with the

Table 1. Effect of grazing corn residue in the spring over a 16-year period (1997-2013) on corn and soybean yields¹ from a field managed in an annual corn-soybean rotation at Mead, Neb.

	Ungrazed	Spring grazed	SEM ¹	P-value ²
Corn, bu/ac	214	214	2.6	0.96
Soybean, bu/ac	57.8 ^b	59.3 ^a	0.54	0.03

¹Yields are based on 13% moisture for soybeans and 15.5% moisture for corn grain.

²Means with differing superscripts in a row are different ($P < 0.05$).

majority of the soil being classified as a fine-loamy, mixed, superactive, mesic Aridic Argiustoll) at the West Central Water Resources Field Laboratory near Brule, Neb., was divided into four treatments starting in 2008, grazed at 1 AUM/ac, grazed at 2 AUM/ac, baled, or ungrazed. Corn yields ranged from a low of 128 bu/ac in 2009 to a high of 162 bu/ac in 2011, with a median of 155 bu/ac. At these levels of production, UNL grazing recommendations would have been to stock at 1.5 to 1.8 AUM/ac with the median being 1.8 AUM/ac.

The field was divided into eight 16.25 acre paddocks and had two replications per treatment. Paddocks were assigned randomly initially and the same treatments were applied to these paddocks throughout the study (six-year period). The field was maintained in a continuous corn rotation and no-till management was used.

Beef cows (900 to 1,250 lb BW) were used to apply grazing treatments (0.5 cows/ac for the light and 1.1 cows/ac for the heavy) and were supplemented with 1 lb per cow of a 32% crude protein cube daily. Grazing occurred from December to February. Rows were planted east to west across the field such that they crossed all four treatments. Corn grain yield over five years of harvest (2009-2013) was measured using the yield monitor on the combine and adjusted to 15.5% moisture.

Yield data were analyzed using repeated measures in the MIXED procedure of SAS. Paddock was considered the experimental unit and the effect of year was considered random.

Results

Experiment 1

No interaction ($P \geq 0.55$) between tillage and spring grazing was observed for either soybean or corn yield over a nine-year period (1997-2006), suggesting that spring grazing had the same effect regardless of whether no-till, ridge till, or spring till was used. Across all tillage treatments, spring grazing of corn residue increased ($P < 0.01$) soybean yields (58.5 vs. 57.0 bu/ac for spring grazed and ungrazed, respectively) and had no effect ($P = 0.58$) on corn yields (210 vs. 210 bu/ac for spring grazed and ungrazed, respectively). Similarly, over the 16-year period (1997-2013) spring grazing of strips managed under no-till increased soybean yields and had no effect on corn yields (Table 1). Over a 10-year period (2003-2013), fall grazing improved soybean yields over both spring grazing and no grazing (Table 2), whereas spring grazing tended ($P = 0.07$) to increase soybean yields when compared to no grazing. No effects of grazing in either season were observed on corn yields.

Experiment 2

Removal of residue did not affect corn grain yields over the five-year period (2009-2013) in the continuous corn rotation (Table 3). However, it is interesting to note that corn grain yields in the grazing treatments were numerically increased by 4-7 bu/ac than the ungrazed treatment.

In summary, in the long-term study (16 years) at Mead, Neb., grazing

Table 2. Effect of grazing corn residue in the fall/winter or spring on corn and soybean yields¹ over a 10-year period (2003-2013) from a field managed in an annual corn-soybean rotation at Mead, Neb.

	Ungrazed	Spring grazed	Fall grazed	SEM	<i>P</i> -value ²
Corn, bu/ac	207	209	211	3.9	0.55
Soybean, bu/ac	62.1 ^b	63.5 ^b	65.5 ^a	0.54	< 0.01

¹Yields are based on 13% moisture for soybeans and 15.5% moisture for corn grain.

²Means with differing superscripts in a row are different (*P* < 0.05).

Table 3. Effect of corn residue removal on corn grain yield¹ over a five-year period (2009-2013) from a field used for continuous corn production at Brule, Neb.

	Ungrazed	Fall grazing 1 AUM/ac	Fall grazing 2 AUM/ac	Baled	SEM	<i>P</i> -value
Corn, bu/ac	148	152	155	147	6.7	0.16

¹Yields are based on 15.5% moisture.

corn residue in fall or spring resulted in an improvement in subsequent year soybean yields and had no effect on corn yields when an annual corn-soybean rotation was used. In the medium term (five years) study at Brule, Neb., in a continuous corn rotation, fall grazing or baling of corn residue had no effect on corn yields.

Many crop producers have concerns that cattle trampling will adversely affect soil physical properties and subsequent crop productivity. Soil physical properties influence the ability of a plant to acquire water, nutrients, and oxygen. Although some studies have shown that presence of cattle on cropland in winter/early spring can compact soils, effects

of grazing are usually short-lived due to amelioration through natural processes such as wetting/drying or freezing/thawing cycles and the biological action of roots or soil biota that create pores and break down compacted layers. In the current studies, grazing did not cause negative impacts on crop yield, suggesting that any compaction caused by cattle did not negatively impact crop growth, even when fields were managed under no-till.

With high corn yield an excessive amount of residue can be produced and can have negative impacts on the subsequent crop by impeding seed placement and insulating the soil such that it remains excessively cold and wet in the spring, causing poor

germination and slow emergence. Grazing of corn residue can be used to manage residue levels without tillage and its resulting loss of soil structure and soil organic matter (resulting from oxidation by soil bacteria when exposed to air).

Implications

These data suggest that the grazing of corn residue at UNL recommended stocking rates in the fall or in the spring will have slightly positive or no impacts on subsequent soybean or corn yields. Thus, grazing of corn residue can be an economical source of winter roughage for cattle producers as well as provide an extra source of income for corn producers. Further, grazing offers an alternative to tillage to manage residue levels on fields.

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