Effect of Sorghum and Cornstalk Grazing on Crop Production

Gary Lesoing
University of Nebraska-Lincoln, glesoing2@unl.edu

Mark A. Schroeder
University of Nebraska-Lincoln, mschroeder1@unl.edu

Drew Shain
University of Nebraska-Lincoln

Terry J. Klopfenstein
University of Nebraska-Lincoln, tklopfenstein1@unl.edu

James A. Gosey
University of Nebraska-Lincoln, jim@gosey.net

Effect of Sorghum and Cornstalk Grazing on Crop Production

Gary Lesoing
Drew Shain
Terry Klopfenstein
Jim Gosey
Mark Schroeder[1]

Summary

Effects of cattle grazing crop residues on subsequent crop yields and residue cover was evaluated. Also, grazing of crop residues in ridge-till and conventional disk-plant irrigated corn production systems were compared. Cattle performance, residue cover, ridge height, soil compaction, and crop yield were measured. Grazing corn residue by cows reduced residue cover 25% and produced no effect on subsequent soybean yields. Cattle performed comparably for ridge-till vs conventional systems. Ridge heights were maintained, residue cover was reduced an average of 13% on the ridge-till and 7% on the conventional, and soil compaction was not affected by grazing in 1993-94. The effect of grazing on subsequent corn yields was inconsistent. In other studies, subsequent crop yields following grazing were not affected by the grazing of crop residues and residue cover was reduced 19 and 13% for corn and grain sorghum residue, respectively.

Introduction

Crop residues remaining after harvest are an important feed resource for the cattle. While many of the 1.8 million head of beef cows and many calves in Nebraska graze harvested fields during the winter months, little information is available on the effect of grazing on subsequent residue cover or crop yields. Beginning in the fall of 1992, experiments were begun at several different sites on the Integrated Crop/Livestock Farm at the Agricultural Research and Development Center to study the effect of cattle grazing crop residues on subsequent crop yields, residue cover, and soil compaction.

Procedure

Experiment 1

An experiment was initiated in the fall of 1992 in cooperation with the Biological Systems Engineering Department and the Cow/calf Unit. Two adjacent center pivots were used in each of the two years of the study. Soil type under each center pivot is a silty clay loam. Each center pivot was in a corn/soybean rotation, with one half in corn and one half in soybeans each year. Following harvest, one quarter of each pivot was fenced for grazing cornstalks, while the cornstalks on the other quarter of each pivot were left ungrazed. Twenty-one head of beef cows grazed 29.2 acres of corn residue for 60 days, from December 3, 1992 through February 3, 1993. The following spring residue

cover was measured on the grazed and ungrazed areas using the line-transect method as described by Shelton et al., *NebGuide G92-1133*. In the fall of 1993, soybean yields were compared between previously grazed and ungrazed areas. This experiment was repeated in 1993-1994 on the alternate half of each center pivot. Twenty head of beef cows grazed twenty-nine acres of corn residue for 69 days, from November 5, 1993 through January 13, 1994. Residue cover and soybean yields were measured in the spring and fall of 1994, respectively.

Experiment 2

An experiment was conducted during the fall and winters of 1993-1994 and 1994-1995 to evaluate the performance of calves grazing cornstalks, the effect of grazing on crop yields, residue cover, and soil compaction in ridge-till and conventional disk-plant irrigated corn production systems. This experiment was conducted on a silty clay loam soil site. A 100-acre irrigated corn field under a linear move irrigation system was divided into six fields, three for each corn production system. Six rows in each tillage system were fenced out and left ungrazed in each field so comparisons could be measured on the previously mentioned variables, between grazed and ungrazed cornstalks. The fields were established during the fall of 1992 and cattle were allowed to graze. Data were not measured on soil compaction, residue cover, or ridge height until the fall of 1993. Each year, before machine harvest, 15 ft. of row in four areas of each field were hand harvested to determine yield estimates of stalks, leaves, husks, and corn grain. Following machine harvest, the residual corn in each field was estimated.

In 1992-93, calves grazed cornstalks for 56 days, from November 17, 1992 through January 11, 1993. In 1993-1994 calves grazed cornstalks for 58 days, from December 4, 1993 through February 2, 1994. In 1994-1995, calves grazed for 78 days, from December 12, 1994 through February 27, 1995. Stocking rate for this experiment was 1.2 calves/acre. Daily gain was recorded for calves on the different systems each year. Before grazing in the fall of each year, residue cover, ridge height, and soil bulk density were measured in the grazed and ungrazed areas of each field for each system. Soil bulk density was measured in the row and in the interrow for the top 3 in. of soil for both systems. Cattle walked between the rows in the ridge-till system, so we wanted to determine if this had any effect on soil compaction (bulk density). In the spring of each year following grazing, these measurements were repeated. Corn yields were measured in the fall of 1994.

Experiment 3

An experiment was initiated in the fall of 1992 to evaluate the effect of calves grazing corn, grain sorghum, and soybean residue on subsequent crop yields in a dryland strip cropping system on a silty clay loam soil site. These crops were planted in 8, 30-in. row alternating strips in a north-south orientation in a 27-acre field. The crops were rotated each year, with corn following soybeans, grain sorghum following corn, and soybeans following grain sorghum. Four replications of four grazing enclosures (4 ft. x 5 ft. each) were placed in strips of each crop. Eighty-one head of calves were allowed to graze the crop residue for 30 days, from December 4, 1992 through January 4, 1993. The following fall, yields of corn, soybeans, and grain sorghum were measured. Paired comparisons were made by hand harvesting two 5-ft. rows of each crop in the grazed and ungrazed plots. The location of these enclosures was maintained during the winters of 1993-94 and 1994-1995 so yield comparisons could continually be measured. In the winter of 1993-94, different groups of calves grazed the field in November and December. Ewes grazed the field throughout the winter. In 1994-95, calves grazed the field in early December, and then again in February and March. Crop yields were taken in the fall of 1994, similar to that previously described. Residue cover measurements were also taken following grazing in the spring of 1995.

Experiment 4

Several other enclosures were placed in fields before stalk grazing in 1992 and 1993, to measure the effect of grazing crop residues on subsequent crop yields. Enclosures were placed in grain sorghum and different corn fields to measure yields of soybeans following grain sorghum or corn, or corn following corn for grazed and ungrazed plots. Yields of soybeans and corn were measured by hand harvesting plots. In the fall of 1994, more enclosures were placed in fields, and in the spring of 1995 residue cover was measured for grazed and ungrazed plots.

Results

Experiment 1

In both 1992-93 and 1993-94, soybean yields were not affected by grazing. Soybean yields were 51 and 53 bu/acre following grazing in 1992-93 for the grazed and ungrazed treatments, respectively. Following grazing in 1993-94, soybean yields for the grazed and ungrazed treatments were 62 and 61 bu/acre, respectively. In 1992-93, cows were turned out on stalks later in the season, so much of the time the ground was frozen. In 1993-94, cows were on the corn stalks earlier when it was relatively dry, and then later after precipitation occurred, it became very cold and the ground froze. This would reduce the amount of compaction that would be caused by the tracking of cows. It may also be possible that freezing and thawing over the winter may alleviate any effect cows may have had on soil compaction. Shelton et al., *1995 ASAE Technical Paper*, reported that residue cover was reduced an average of 25% by grazing in this study. Residue cover as measured in the spring of the year averaged 83.1% for the

((Continued on next page)

ungrazed fields and 61.9% for the grazed fields for the 2-year period. It should be noted that soybeans were no-till planted into the corn residue following grazing the previous fall and winter, and no additional tillage was required in grazed areas.

Experiment 2

Daily gain of cattle was .09 lb less on the ridge-till system compared with the conventional system (Table 1). This was attributed to muddy conditions during the 1992-93 grazing season that resulted in much of the corn residue being trampled into the mud. In a ridge-till system, the residue generally falls into the furrows between the rows where the cattle tend to walk. Ultimately this resulted in a shorter grazing period, as cattle became short of feed. In 1993-94, yield estimates for the corn residue and residual corn were higher for the ridge-till compared to the conventional system (Table 2). The lower dry matter production on the conventional system was due to lower plant populations and a severe infestation of grassy weeds. The lower yields on the conventional system were reflected in poorer cattle performance in 1993-94 (Table 1). The cattle on the ridge-till system also benefitted from the ground being frozen for most of the grazing period. The frozen ground prevented cattle from trampling the residue into the mud in the furrows as occurred in 1992-93. In 1994-95, yield estimates were similar for both systems, which is reflected in comparable cattle performance. Cattle were removed from the cornstalks before mud was a problem in the ridge-till system.

Corn grain yields were measured in the grazed and ungrazed areas of each system. Yields were inconsistent between grazed and ungrazed plots and are not reported. Soil bulk density measurements taken before grazing 1993-94 indicated a 15% higher ($P<.05$) bulk density (1.32 vs 1.15 gm/cm^{-3}) for the inter-row compared with the row in the grazed ridge-till system. In the ungrazed area, there was no difference between the row and inter-row. These higher bulk densities

Table 1. Performance of cattle grazing corn residue in a ridge-till or conventional production system in 1993-94 and 1994-95.

Treatment	Year	ADG lb/hd/day	Standard deviation
Conventional	1992/93	.63	.38
Ridge-till	1992/93	.54	.32
Conventional	1993/94	0.40	.29
Ridge-till	1993/94	0.61	.37
Conventional	1994/95	0.45	.33
Ridge-till	1994/95	0.47	.28

Table 2. Yield estimates of corn stalks, husks, leaves, grain and residual grain for ridge-till and conventional tillage systems for 1993 and 1994.

		Yield estimates lb dm/ac			bu/ac	Estimate bu/ac
Treatment	Year	Stalks	Leaves	Husks	Corn	Residual corn
Conventional	1993	2045	1082	582	94	2.0
Ridge-till	1993	2777	1501	548	123	4.9
Conventional	1994	3201	1259	812	157	2.3
Ridge-till	1994	3188	1202	691	150	1.9

Table 3. The effect of grazing on % residue cover in a ridge-till and conventional production system.

Treatment	Date of measurement	% residue cover
Ridge-till Grazed	Fall 1993	81
Ridge-till Ungrazed	Fall 1993	79
Conventional Grazed	Fall 1993	97
Conventional Ungrazed	Fall 1993	96
Ridge-till Grazed	Spring 1994	53
Ridge-till Ungrazed	Spring 1994	67
Conventional Grazed	Spring 1994	77
Conventional Ungrazed	Spring 1994	81
Ridge-till Grazed	Fall 1994	99
Ridge-till Ungrazed	Fall 1994	99
Conventional Grazed	Fall 1994	100
Conventional Ungrazed	Fall 1994	100
Ridge-till Grazed	Spring 1995	84
Ridge-till Ungrazed	Spring 1995	90
Conventional Grazed	Spring 1995	86
Conventional Ungrazed	Spring 1995	95

Table 4. Effect of grazing crop residues on subsequent crop yields in a strip cropping system.

Treatment	Year	Crop	Yield (bu/ac)
Grazed	1993	Soybean	36
Ungrazed	1993	Soybean	41
Grazed	1993	Grain Sorghum	71
Ungrazed	1993	Grain Sorghum	72
Grazed	1993	Corn	187
Ungrazed	1993	Corn	180
Grazed	1994	Soybean	55
Ungrazed	1994	Soybean	51
Grazed	1994	Grain Sorghum	145
Ungrazed	1994	Grain Sorghum	141
Grazed	1994	Corn	219
Ungrazed	1994	Corn	209

of the inter-row of the grazed ridge-till system may be due to grazing the previous fall and winter when conditions became very muddy. In the conventional system, there was no difference between the row or inter-row or grazed or ungrazed and bulk densities ranged from 1.19 to 1.24 gm/cm^{-3}. Cattle in this system generally walked in the rows and between the rows because the ridges were very small and did not affect the cattle. Soil bulk density measurements taken during the spring of 1994 following grazing showed no changes in bulk densities compared to the previous fall for the different systems. The soil was generally frozen while the cattle were grazing during the fall and winter of 1993-94, so grazing did not affect soil compaction.

Ridge heights were not affected by grazing in either year for the ridge-till system. Following grazing in 1992-93 and 1993-94, ridge heights were 6.6 and 6.3 in. for the grazed compared to 6.7 and 6.1 in. for the ungrazed treatment, respectively. A concern of the ridge-till system was that cattle may destroy ridges during grazing; but following three years of grazing, ridges have been maintained and it has caused no problems in planting on the ridges. Initial residue cover measurements were lower (P<.05) on the ridge-till compared with the conventional in the fall of 1993 (Table 3). This may be due to the conventional system having more grassy weeds as cover and the ridge-till system having residue concentrated between the row and not as evenly distributed. Measurements in the spring of 1994 following grazing showed a 35% reduction in residue cover for the grazed ridge-till system compared to the fall of 1993. The ungrazed ridge-till was reduced 15%, indicating a 20% reduction due to grazing. The conventional grazed system showed a 21% reduction in residue cover compared to the fall of 1993, with the ungrazed conventional system reduced 16%. Grazing only reduced residue cover 5% in this system. In the fall of 1994, residue cover measurements were very high (99-100%) for both systems due to higher yields and some grass cover in the plot measurement areas. Residue cover for the ridge-till grazed system was reduced 15%, compared to 9% for the ridge-till ungrazed, attributing only 6% from grazing. The conventional grazed system reduced residue cover 14% through the winter, compared to a 5% reduction for the conventional ungrazed, a 9% reduction from grazing alone.

Table 5. The effect of grazing crop residues on subsequent corn and soybean yields.

Treatment	Year	Previous crop	Crop	Yield (bu/ac)[a]
Grazed	1993	Corn	Corn	127
Ungrazed	1993	Corn	Corn	132
Grazed	1994	Corn	Corn	206
Ungrazed	1994	Corn	Corn	204
Grazed	1994	Corn	Soybean	43
Ungrazed	1994	Corn	Soybean	41
Grazed	1994	Grain Sorghum	Soybean	47
Ungrazed	1994	Grain Sorghum	Soybean	45

Experiment 3

The effect of grazing strip crops was minimal (Table 4) and varied from year to year. Soybeans followed grain sorghum in the rotation, so this area was subject to possible compaction from cattle grazing the residue. In the spring of 1994, compost was applied on all the strips. This added organic matter to the soil and may have helped alleviate any compaction problems due to grazing, as yields of all crops were comparable. Corn followed soybeans in the rotation so tracking from grazing was probably less compared to the other crops. Residue cover for the grazed and ungrazed areas measured in the spring of 1995, only showed a significant (P<.05) reduction of 19% (100 vs 81%) for grazed corn.

Experiment 4

In two fields where irrigated corn residue was grazed (Table 5), corn crop yields the following year were unaffected by grazing. Soybeans following grazed corn or grain sorghum residue yielded similar to ungrazed areas. Residue cover measurements taken in the spring of 1995 showed grazing significantly (P<.05) reduced residue cover 14% (93 vs 80%) and 18% (98 vs 80%) for grazed grain sorghum and corn residues respectively.

Conclusions

Results of these experiments indicate corn residue cover will be reduced from grazing cornstalks 5 to 25%, averaging 15%; grain sorghum residue was reduced 11%. The amount of the residue reduction was influenced by several factors: size of cattle (cows vs calves), amount of residue present before grazing, tillage system (no-till, conventional, or ridge-till), condition of field (muddy or dry), and length of time on the field. The effect of grazing crop residues on subsequent crop yields has been minimal. A management plan that removes cattle from the fields under very muddy conditions would probably alleviate any detrimental effect on soil compaction and crop yields the following year, and increase the grazing season on the stalks, particularly in a ridge-till system. The grazing of cornstalks in a ridge-till system appears to be successful as ridges have not been affected and the performance of cattle has been comparable to a conventional disk-plant tillage system. Long-term effects on soil physical properties and crop yields should be measured under a wide range of environmental conditions for the ridge-till and other cropping systems to determine the best management strategy.

---

[1]Gary Lesoing, Research Assistant Professor, Center for Sustainable Agricultural Systems; Mark Schroeder, Research Farm Manager, Biological Systems Engineering; Drew Shain, graduate student; Terry Klopfenstein, Jim Gosey, Animal Science.