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Effect of Crop Residue Grazing on Crop Production-Update of Research Activities

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Crop residues provide an inexpensive feed source during the winter months. Cattle grazing them during this period will not impact subsequent crop yields if managed carefully.

Summary

Three years of data indicate no significant effect from fall and winter grazing on subsequent crop yields. Residue cover was significantly reduced from grazing compared to ungrazed plots.

Soil bulk density has increased in tracked areas in the top (0 to 6") depth of soil following grazing for many years. In a ridge-till system, the ridge height has been maintained following grazing for corn residues for four years. Spring grazing of corn stalks showed a significant decrease in water infiltration rates in tracked areas following grazing compared to ungrazed areas. Residue cover was reduced while soil bulk density increased.

Introduction

In the *1996 Beef Cattle Report,* research results were reported on experiments conducted to evaluate the effect of cattle grazing crop residues on crop production. This is long-term research that was initiated on the Integrated Crop/ Livestock Farm at the Agricultural Research and Development Center. This research is being continued to evaluate long-term effects of grazing on crop productivity and soil characteristics. Previous research conducted on the Integrated Farm has shown no significant effect on crop yields from fall and winter grazing of crop residues. Information on the spring grazing of crop residues and the subsequent effect on crop yields and soil compaction is limited. Research was initiated in 1996 to investigate these issues further.

Procedure

Research was continued on established crop residue grazing experiments in 1995 and 1996. Specific information on these experiments was reported in the *1996 Beef Report*. In these crop residue grazing experiments, calf stocking rate generally ranged from 1 to 1.2 head/acre for a 60-day grazing period from December to February, depending upon residual forage and grain. Stocking rate for beef cows was approximately .7 head/acre. In 1995, crop yields were recorded following grazing in the fall and winter of 1994-95. In the spring of 1996, % residue cover and bulk density measurements were taken on the crop residue grazing experiments. A brief summary of the experimental procedure of each crop residue grazing experiment is listed below.

Experiment 1

Cows grazed corn residue under 1/4 of a center pivot irrigation system in December and January of 1994-95. This was compared to 1/4 of the center pivot that was ungrazed. This experiment was replicated on an adjacent center pivot. Irrigated soybeans were planted in the spring of 1995 and yields measured on the grazed and ungrazed fields in the fall of 1995.

Experiment 2

Calves grazed irrigated corn stalks under a ridge-till or conventional (disk-plant) tillage system for 58 days, from December 5, 1995 through February 1, 1996. In the fall of 1995, corn yields were recorded on grazed and ungrazed plots of both tillage systems. Any differences in yields between grazed and ungrazed plots were a result of previous years' grazing, which in 1994-95 was 78 days, from December 12, 1994 through February 27, 1995. Prior to and following grazing in the winter of 1995-96, soil bulk density and % residue cover were measured. Ridge heights were measured following grazing in the spring of 1996. Cattle performance was also measured and is reported in another article in this report.

Experiment 3

This experiment was reported in an additional article in the *1996 Beef Report* on winter calf grazing and windbreaks. In the winter of 1994-95, exclosures were erected to enclose anemometers to measure wind speed on the three protected fields and two unprotected fields. In the spring of 1995, bulk density measurements were taken in grazed areas in cattle hoof tracks and in ungrazed exclosures for comparisons. Percent tracking was also recorded in these fields by using the line-transect methods as described by Shelton et al., NebGuide G92-1133. Cattle tracks were measured instead of residue cover. In the fall of 1995, corn yields were recorded by hand harvesting 2-15' rows in paired grazed and ungrazed plots in the protected and unprotected fields.

This experiment was continued in the winter of 1995-96 in three corn fields protected by windbreaks and four unprotected corn fields. Calves grazed cornstalks for 58 days, from December 5, 1995 through February 1, 1996. Percent residue cover and soil bulk density were measured following grazing. Cattle performance is reported in a corresponding article of this report.

Experiment 4

This experiment was initiated in 1992 on a 27-acre strip-cropped field of corn, grain sorghum, and soybeans. Four replications of four grazing exclosures, (4 ft. × 5 ft.) were placed in strips of each crop. These plots have been ungrazed since 1992. Cattle graze the crop residue periodically from late November until late February or early March when the forage residue is gone or conditions are too muddy. In the fall of 1995, crop yields were measured in two to five foot rows of paired grazed and ungrazed comparisons for each crop. In the spring of 1996 following grazing of the crop residues, % residue cover, soil bulk density, and % tracking were recorded on these plots.

Experiment 5

This is a continuation of experiments initiated to evaluate the effect of grazing under irrigated conditions. Exclosures have been placed on irrigated continuous corn strips to compare grazed and ungrazed plots on a sandy loam site. Corn yields were measured in the fall of 1995, with harvest procedures similar to those described in Experiment 4. Cattle were allowed to graze this area throughout the winter and were removed in February in 1996. Following grazing, similar measurements were taken as in Experiment 4.

(Continued on next page)

Experiment 6

A new experiment was initiated in 1996 to evaluate the effect of late winter and early spring stalk grazing on crop production. Three head of cattle grazed three acres for 55 days, from February 26, 1996 through April 20, 1996. Five sets of exclosures were placed in different positions on the hill, to provide a good representation of the different soil types. Measurements taken following grazing on the grazed and ungrazed plots included: soil bulk density, water infiltration rates, and % residue cover. Percent tracking was also recorded in the grazed areas. In the fall of 1996, crop yields will also be measured in the grazed and ungrazed plots.

Results

Experiment 1

Results of experiment 1 indicate no effect on soybean yields from grazing corn stalks during the fall and winter of 1994 and 1995. Soybean yields were 51 bu/acre for both grazed and ungrazed fields. For the three years of the experiment, soybean yields were similar for grazed and ungrazed fields, averaging 55 bu/acre for both.

Experiment 2

Corn yields in 1995 were 79, 82, 90, and 89 bu/acre for grazed ridge-till, ungrazed ridge-till, grazed conventional, and ungrazed conventional treatments, respectively. Grazing had no effect on corn yields in 1995. The lower yields on the ridge-till compared to the conventional tillage may be a result of greater phosphorus availability from feedlot manure compost applied to both treatments in a separate study. Compost was applied 10 tons/acre during the winter of 1994-95 and disked in prior to planting in the spring, while compost on the ridge-till treatment was just top dressed on the surface. Phosphorus soil tests were low to very low (3 to 10 ppm) for this field. Yield results of check strips which received no compost compared to strips where compost was applied on the two tillage systems showed only a 3% yield response on the ridge-till and a 19% yield increase on the conventional system.

The three-year yield averages (1993-1995) for these systems show little difference between treatments. Corn yields averaged 96, 101, 96, and 98 bu/acre for grazed ridge-till, ungrazed ridge-till, grazed conventional, and ungrazed conventional, respectively. Corn yields will continue to be measured on these grazed and ungrazed strips in subsequent years with these tillage systems to determine if any long-term effects on crop yields are occurring.

Results reported in the *1996 Beef Report* showed higher bulk densities in the 0 to 3" depth for the inter-row of the grazed ridge-till system compared to the row, probably due to compaction caused by cattle walking in the inter-row during muddy conditions. Measurements taken in both the fall of 1995 and spring of 1996 show this relationship is still true, but is not changing significantly. Bulk densities were (1.23 vs 1.07 gm/cm^3) and (1.28 vs 1.17 gm/cm^3) for the ridge-till grazed inter-row and row in the fall of 1995 prior to grazing, and the spring of 1996 following grazing, respectively. Differences in bulk densities between the fall and spring are due to seasonal variability.

Percent residue cover measurements taken in the fall prior to grazing and the spring following grazing on the ridge-till system showed a 17% reduction in residue cover for the grazed ridge-till system compared to a 4% reduction on the ungrazed ridge-till, indicating a 13% reduction due to grazing. The conventional system showed a 7% reduction for the grazed system, with no reduction in residue cover for the ungrazed. Over the three-year period from 1993-1995, residue cover was reduced an average of 13 and 7% from grazing for the ridge-till and conventional tillage systems, respectively. The higher residue cover reduction on the ridge-till is attributed to most of the corn stalks falling in the furrow, and the ridges being left bare except for the corn stubble. The reduction in residue cover from grazing in this experiment is generally lower than for the other experiments. This is due to this field being in continuous corn for several years, being under irrigation, and the cattle not grazing on the stalks as long as some of the other experiments.

Ridge height measurements taken in the spring of 1996 following grazing were (6.5 and 6.8") for the grazed and ungrazed treatments, respectively. This is consistent with previously reported results and confirms that ridges can be maintained following crop residue grazing. This field has been grazed for four years and corn was planted on the ridges in the spring of 1996 without difficulty.

Experiment 3

In the spring of 1995 following grazing, bulk densities were similar for the top (0 to 6") depth for grazed and ungrazed plots (1.38 vs 1.35 gm/cm^3). Percent tracking measurements indicated that cattle tracks covered 37% of the field as a result of grazing. This was not biologically important though as corn yield measurements taken in the fall of 1995 showed no difference between grazed and ungrazed plots (109 vs 110 bu/acre).

Percent residue cover measurements taken following grazing in the spring of 1996 showed an 11% reduction in residue cover on grazed compared to ungrazed plots (77 vs 87%). Bulk density measurements (0-6") taken in the spring of 1996 following grazing were similar for grazed and ungrazed plots (1.38 vs 1.34 gm/cm^3). Crop yields will be measured in the fall of 1996 on these plots to continue to evaluate the effect of grazing crop residues on subsequent crop yields over time.

Experiment 4

Effect of grazing crop residues on subsequent crop yields for 1995 and the three-year average (1993-95), plus % residue cover and soil bulk density (0-6") for 1996 are shown in Table 1. It was very dry throughout the 1995 growing season with approximately 4.2 inches of precipitation from early June through mid-September. Despite muddy condi-

Table 1. Effect of grazing crop residues on subsequent crop yields, % residue cover, and soil bulk density.

Treatment	Crop	Yield (bu/acre) 1995	3-year av.	Residue cover[a] %	Bulk density (gm/cm^3)
Grazed	Soybean	27	39	43	1.33
Ungrazed	Soybean	33	42	65	1.23
Grazed	Grain sorghum	103	106	78	1.44
Ungrazed	Grain sorghum	108	107	98	1.29
Grazed	Corn	148	185	56	1.33
Ungrazed	Corn	135	175	68	1.26

[a]Residue cover was measured using the line-transect method as described by Shelton et al., NebGuide G92-1133.

tions during the winter grazing season of 1994-95, and the dry conditions of the summer, yields were similar in grazed and ungrazed plots. The three-year crop yield average was similar for grazed and ungrazed crops. Residue cover measurements for the spring of 1996 were reduced 18% (68 vs 56%), 20% (98 vs 78), and 34% (65 vs 43%) for grazed corn, grain sorghum, and soybeans, respectively. Corn residue cover reduction was similar to 1995, while grain sorghum and soybeans were significantly higher in 1996 compared to 1995. This may be a result of the lower crop yields in 1995 compared to 1994. Soybeans yielded only 49%, and grain sorghum only 71% of 1994 yields. Soil bulk density measurements were 6,12, and 8% higher in tracks from grazed corn, grain sorghum, and soybean residue, respectively. The bulk density on the grain sorghum residue plots may be higher because they have not been treated with a subsoiler yet, while corn and soybean were treated in previous years. Percent tracking for corn, soybean, and grain sorghum were 34, 31, and 39%, respectively.

Experiment 5

Irrigated continuous corn yields in 1995 were not affected by corn residue grazing during the winter of 1994-95. Corn yields were 223 bu/acre for grazed compared to 209 bu/acre for ungrazed plots. Percent residue cover measurements taken following grazing in the spring of 1996 showed a 19% reduction due to grazing (98 vs 79%). Soil bulk density measurements (0-6") taken in the spring of 1996 on this sandy site showed no difference between grazed and ungrazed plots (1.58 vs 1.56 gm/cm^3). Percent tracking was similar to other corn plots at 33%.

Experiment 6

Soil types in the spring cornstalk grazing study ranged from sandy loam to a clay loam soil. Following grazing, soil bulk density measurements (0 to 6") in cattle tracks were increased 7% (1.58 vs 1.48 gm/cm^3) compared to ungrazed plots. Average percent tracking in this field was 49%, which was over 40% greater than the average for winter stalk grazing. Water infiltration rate measurements, taken following grazing in cattle hoof prints compared to ungrazed plots, showed an 89% decrease in water infiltration rate following one inch of water applied (.94"/hr vs 8.39"/hr). With approximately 50% of the field tracked, the average infiltration rate was 4.74"/hr on the grazed plots. Residue cover measurements following grazing showed a reduction in residue cover of 24% (90 vs 68%) compared to ungrazed plots. Corn yield comparisons between grazed and ungrazed plots in the fall of 1996 will show if there is an impact of this spring stalk grazing on crop production. While observations indicated considerable runoff following an intense spring rainfall occurrence, the high density of corn stalks minimized soil erosion substantially.

Conclusion

Under the conditions of the past three years at the Integrated Crop/Livestock Farm, grazing has had no significant effects on crop yields compared to ungrazed areas. Corn, soybean, or grain sorghum yields were not adversely affected following the grazing of the previous crop. Residue cover was significantly reduced from grazing compared to ungrazed plots. In no-till cropping systems, additional tillage was not required following fall and winter grazing of crop residues. In the ridge-till system, grazing of cornstalks did not adversely affect the integrity of the ridges, but soil bulk density in the top (0 to 3") depth was increased in the inter-row following grazing under muddy conditions. Other measurements showed soil bulk density may increase in tracked areas following grazing. Spring grazing indicated a significant decrease in water infiltration rate compared to ungrazed areas. Spring grazing of stalks also showed a decrease in residue cover and increase in bulk density.

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