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FOR SUSTAINABLE AGRICULTURE

Winter grazing of corn residues: effects on soil properties and subsequent crop yields from a corn-soybean crop rotation

Abstract: Corn residues could be a good resource for winter cattle grazing. The study investigates whether winter grazing causes soil compaction and yield reduction in crops that are planted following grazing.

Question & Answer

Q: How and under what conditions can corn crop residue grazing affect soil properties and crop production?

A: While grazing of corn crop residues when soils were not frozen did increase penetration resistance in the upper 4 inches, the effects of subsequent crop production were minimal in crops planted with no tillage and non-existent in crops planted with disking. These results imply that producers may take advantage of the economic savings associated with grazing corn crop residues with little concern for subsequent crop production, particularly if grazing is done while soils are frozen or crops are planted with disking.

The objectives of this project were to:

- Quantify the effects of grazing corn residues on physical characteristics of the soil and subsequent crop production of fields,
- Determine the climatic conditions at which grazing of corn crop residues would affect soil physical characteristics and subsequent crop production,
- Identify physical measurements that could be used to quantify the effects of corn crop residue grazing on subsequent crop production, and
- Conduct an economic cost-benefit analysis comparing the effects of corn crop residue grazing on subsequent crop yield to the amounts of hay that would be saved by grazing corn crop residues.

Background

Stored feed costs represent the largest cost associated with beef cow-calf production. Allowing cattle to graze corn crop residues during the fall and winter would significantly increase the profit for cow-calf producers. In spite of this potential economic benefit, some producers limit the grazing of corn crop residues because of the perception that by causing soil compaction and roughness such grazing may have negative effects on subsequent crop production. Researchers for this project chose to study whether there were significant detrimental results stemming from winter grazing of corn residues.



Grazing corn stalks at .67 acres per cow for 28 days had minimal effects of residue cover and surface roughness.

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Budget:

\$30,874 for year one
\$27,819 for year two
\$28,819 for year three

Approach and methods

A farm field near Atlantic was split into two fields for a corn-soybean rotation. Following grain harvest each fall, the corn field was divided into four sub-fields containing six, 2-acre paddocks with a lane to the water site.

Beginning in October of each year, paddocks in each sub-field were grazed over five four-week intervals with the remaining paddock used as a non-grazed control.

Cows were offered hay as deemed necessary by a herdsman.

When the grazing was completed, soil bulk density, penetration resistance, aggregate stability, roughness, and surface cover were measured. Throughout the grazing period, measures were taken of soil temperatures and precipitation, crop residue mass and composition, as well as cow weights, body condition scores, and hay feeding. Each spring, following corn crop residue grazing, soybeans were planted with disking or no-tillage in replicate sub-fields. Soybean plant densities were measured post-emergence and soybean yields were measured at harvest.

Results and discussion

Corn crop residue grazing did not affect soil bulk density or aggregate stability. However, soil penetration resistance increased in paddocks grazed in November every year and in paddocks grazed in October in two of the three years studied. Soil penetration resistance decreased as the proportion of time that the soil was frozen during grazing increased.

Soil surface roughness increased in paddocks grazed in December and February in two of the three years, and was maximized when the soil was frozen for 50 to 60 percent of the time while the pasture was being grazed.

Post-planting residue cover was slightly decreased by crop residue grazing in fields planted with no-tillage crops in one year. In spite of these effects, soybean plant densities were not affected by corn crop residue grazing. Soybean yields were significantly decreased in only one of three years studied for those no tillage fields with paddocks grazed in November. The decrease was 3.5 bu/acre for the paddocks grazed in November, but when this was averaged with yields from other paddocks, yields for the entire sub-fields decreased by only 0.8 bu/acre. This drop in the yields of no-till planted soybeans

decreased as the proportion of time that the soil was frozen increased. Soybean yields from fields planted with disking were not affected by corn crop grazing in any of the three years.

The amount of hay saved by corn crop residue grazing in this experiment was 1204 lb/hay per cow, which is lower than the 3940 lb/hay cow that investigators expected from other experiments. This difference likely resulted from being cautious with the supplementation of the producers' cows in this on-farm experiment, which was demonstrated by their high body condition scores at the termination of grazing. In spite of the excess level of supplementation, this reduction in hay feeding would represent a reduction in production costs of \$30.10/cow/year with no reduction in soybean yield or a reduction in production costs of \$25.30/cow/year if the average reduction in soybean yield of 0.8 bu/acre observed in no-till planted soybeans in year three is considered at prices of \$50/ton hay and \$6/bu soybeans. Greater reductions in production costs would be expected if hay supplementation was limited to maintain cows at a lower level of body condition.

Conclusions

Cattle grazing on corn crop residue showed some negative effects on soil compaction and soil surface roughness. These negative effects were maximized when soil moisture content was adequate and soil was above freezing. However, overall effects of crop residue grazing on soybean yields were small, with only one instance of an 8 percent decrease for the no-tillage system where cattle were allowed to graze when soil temperatures were above freezing. Producers who want to adopt corn crop residue grazing, but are unwilling to sacrifice soybean production, should restrict grazing to periods when soil temperatures are below freezing or should implement a pre-plant tillage practice. However, overall effects of grazing corn crop residue on soybean yields were minimal and the added benefits of utilizing corn stover as a cheap feed source should be considered.

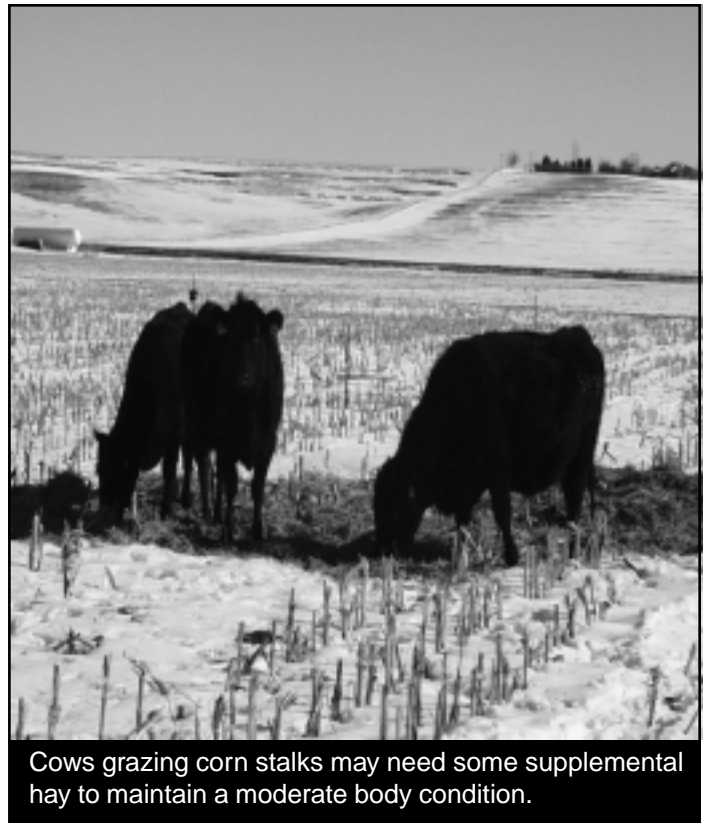
Impact of results

With many beef cow-calf producers not turning a profit in their operations, largely as a result of high stored feed costs, there is a need for more options in grazing. Allowing cattle to graze on corn crop residues offers one opportunity to cut costs, but producers have been concerned about possible damage to soil properties.

Results of this study have shown that grazing of corn crop residues when soils are wet and not frozen will increase soil penetration resistance and soil roughness. But these changes in soil properties had only minor effects on soybean yields planted with no tillage in one of the three years of the experiment and no effects on the yields of soybeans planted with disking. Therefore, corn stalk grazing can be used to reduce the costs of beef cow-calf producers by providing them with an inexpensive forage resource for winter grazing. Possible harmful effects of the grazing may be mitigated by grazing only during periods when the soils are frozen or by disking before planting the next crop.

While the results of this study are strongly conclusive, it is possible that the incidence and severity of soil compaction also is related to soil composition and environmental factors. Future research at other sites would provide more information about whether different soil types are more prone to compaction after grazing.

In addition, researchers observed that the rate at which crop residues lost nutrients due to weathering seemed to be dependent on the type of grain harvest equipment used and the timing of the harvest. In order for beef cow-calf producers to optimize use of corn crop residues as a resource for winter grazing, more information on the effects of harvest equipment and timing of the harvest on forage nutritive value would be worthwhile.



Cows grazing corn stalks may need some supplemental hay to maintain a moderate body condition.

Education and outreach

The project investigators produced a refereed journal paper, two invited papers, three published abstracts, and several reports in ISU-distributed research publications. In addition, public presentations about the project were made at two ISU research farm field days in 2000 and 2001. In 2002, researchers spoke about the project at conferences in Columbia and St. Joseph, Missouri, and Moline, Illinois. Eighty farmers heard about grazing corn crop residues at the Pasturing for Profit conference in Maquoketa in 2003.

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