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Effect of Corn Stalk Grazing and Baling on Cattle Performance and Irrigation Needs

Simon van Donk
University of Nebraska-Lincoln, simon.vandonk@unl.edu

Adam L. McGee
University of Nebraska-Lincoln

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

L. Aaron Stalker
West Central Research and Extension Center

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Terry J. Klopfenstein
L. Aaron Stalker[1]

Summary

The effects of removing corn residue by grazing and baling on continuous corn production were investigated. Initial data showed a trend toward keeping more water in the soil in the treatment with the most residue left on the field (no grazing or baling), but there was no effect of either grazing or baling on subsequent corn yield. Water conservation resulting from maintaining residue on the field may help reduce pumping costs or increase yields when water is limited. However, this benefit is likely to be outweighed by feed cost savings or grazing rental income, and good cow performance.

Introduction

With high feed costs, the availability of ethanol co-products, and the potential for the bio-energy industry's use of corn residue as an input, residue removal is expected to increase. The goal of this study is to quantify the impacts from corn residue removal by grazing and baling. Specific objectives are to quantify effects of corn residue removal by grazing and baling on the performance of cattle, the water balance of the production system, and subsequent grain yield.

Procedure

One full center pivot (126 acres) under continuous corn management near Brule, Neb., was utilized. The pivot-irrigated field consists of loam, silt loam, and sandy loam soils, depending on the location within the field. The Brule area receives approximately 18.7 inches of precipitation annually. The study is in its third year and will be continued for several more years.

The impacts of corn residue removal are being investigated by applying the following treatments: 1) no residue removal, 2) light grazing (stocking rate of 1 AUM per acre), 3) heavy grazing (stocking rate of 2 AUM per acre), and 4) residue removal by baling (Figure 1). Treatments are replicated two times, for a total of eight pie-shaped paddocks fenced during the grazing season to maintain cows within the paddocks. Each paddock receives the same treatment each year.

Cattle were randomly assigned to each grazing treatment and BW and BCS were measured upon entry and exit from the paddock. Cattle entered the paddocks about mid-November and exited in January. Grazing treatments were achieved by placing twice as many cattle in the 2 AUM/acre treatment compared to the 1 AUM/acre treatment, and holding the number of acres and grazing days constant between the two grazing treatments.

In each of the eight paddocks, residue cover was measured several times a year using the line-transect method (USDA, Natural Resources Conservation Service. 2002. National Agronomy Manual, 3rd ed. Washington, D.C.). Soil water content was also measured several times a year, using the neutron scattering method. A neutron probe was used to measure soil water content at six depths, down to 6 feet deep. Corn grain yield was measured using a combine yield monitor. The corn crop was fully irrigated and no-till management is being practiced throughout this ongoing study.

Results

Initial BCS was similar for both grazing treatments (5.5 for both light and heavy grazing treatments), but the heavy grazing cattle lost 0.4 BCS units resulting in a final BCS of 5.5 and 5.1 ($P < 0.05$) for the light and heavy grazing treatments, respectively. The results demonstrate the importance of properly managing stocking rate when grazing corn residue. Because there are large differences in the nutrient content of the different parts of a corn plant (husks are better than leaves which are better than cobs and stems, *2004 Nebraska Beef Cattle Report*, p. 13), and because cattle preferentially select the more nutrient-dense parts first, stocking rate affects cattle performance.

Table 1. Mass of residue removed by baling.

	Residue mass	
Year	Tons/acre	lb/acre
2008/2009	2.29	4578
2009/2010	0.68	1366
2010/2011	1.96	3917

Area baled = 31.4 acres.

Baling removed approximately 2 tons/acre of corn residue in the first and third year of the study (Table 1). Much less was removed the second year. This may be due to less production of corn biomass in 2009 because of extensive damage from hail.

Residue cover was lowest on the baled treatment and greatest on the control (no removal) treatment (Table 2). Reasons for the decrease in residue cover between spring and summer in both 2009 and 2010 include 1) residue disturbance by the planting operation in May, 2) disturbance by an anhydrous application in June, and 3) some residue decomposition due to weather between spring and summer. In November 2010 there was no significant difference in residue cover among the four removal treatments, because this measurement was taken just after harvest and before grazing or baling. Not much residue disappeared between November 2010 and April 2011 in the control treatment.

For reducing evaporation of water from the soil, residue cover in a corn-

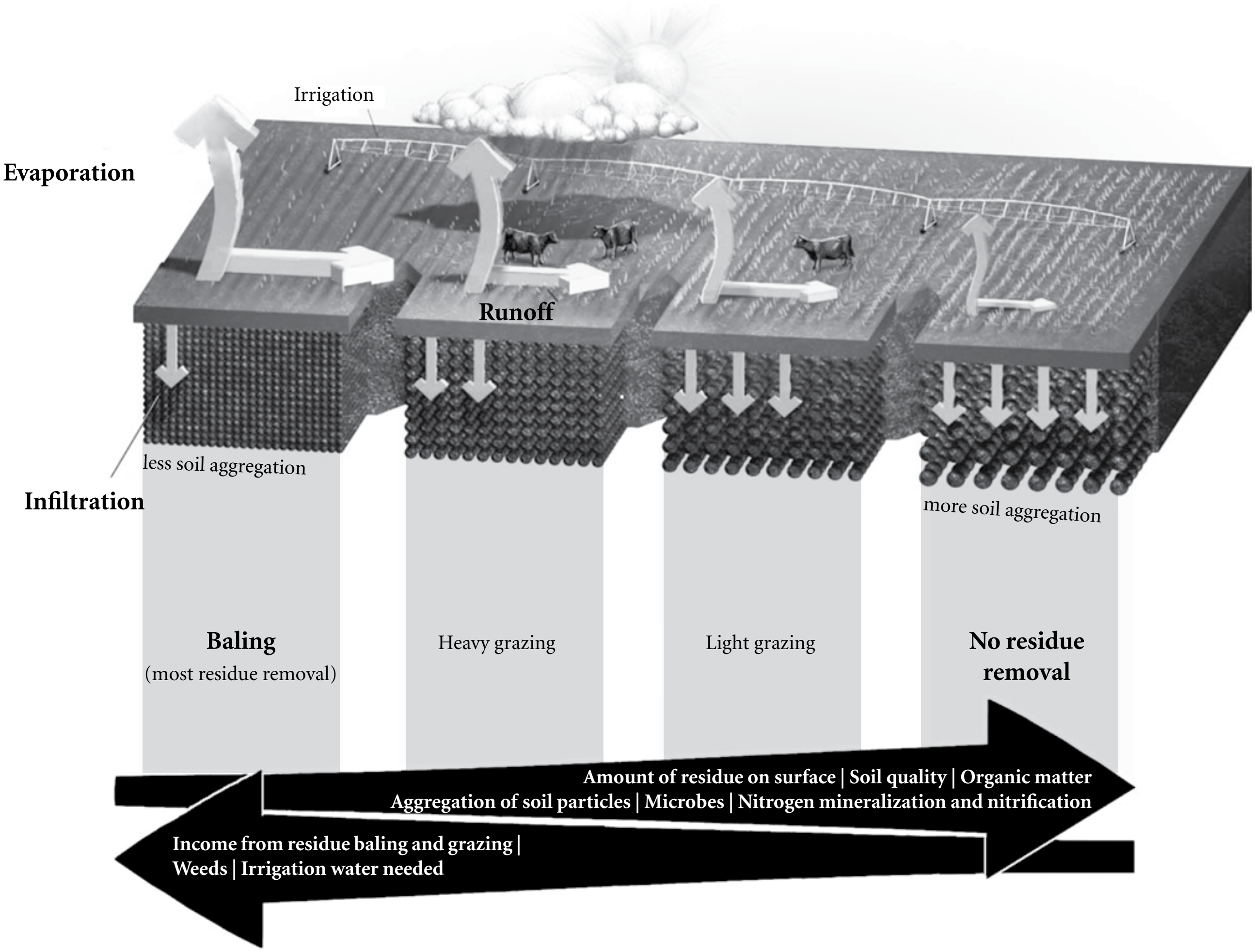

Figure 1. Depiction of the four treatments of the field study near Brule, Neb. Corn residue is removed by baling or grazing. Expected effects of residue removal are indicated in the figure. These effects include greater evaporation and runoff of water with increased residue removal. Other anticipated effects are: removing no or little residue increases carbon sequestration; baling removes nutrients from the field resulting in increased fertilization cost; cattle eat grain that is left in the field after harvest, reducing the amount of volunteer corn the following growing season; and more residue left on the surface can make planting of the next crop more challenging.

Table 2. Percent residue cover on the four residue removal treatments.

Date[a]	Baling[b]	Heavy grazing[b]	Light grazing[b]	No removal	*P*-value	MSE
April 14, 2009	30[a]	55[ab]	61[b]	79[b]	0.04	73
July 8, 2009	20[a]	38[b]	50[bc]	54[c]	0.02	22
April 30, 2010	53[a]	60[a]	80[b]	90[b]	0.01	15
Aug. 4, 2010	27[a]	44[ab]	47[ab]	67[b]	0.07	79
Nov. 2 2010	84	88	82	89	0.11	4
April 11, 2011	41[a]	76[b]	78[b]	88[b]	0.04	82

[a]For each date, different letters represent statistically significant differences between treatments at the 0.05 probability level.
[b]Baling and grazing treatments were applied in the winters of 2008/2009, 2009/2010, and 2010/2011.

field matters most in late spring and early summer when potential evaporation is high (warm, sunny weather) and the crop canopy is not yet closed. The baled treatment (with the least residue cover) lost 4.3 inches of water in the top 6 feet of soil between April 5 and Aug. 4, 2010. The heavy grazing, the light grazing, and the no removal treatments lost 2.9, 1.4, and 1.4 inches, respectively. However, there is variability in soil composition and topography on this pivot, which makes it more difficult to know whether detected differences were caused by this variability or by the residue removal treatments.

Yield differences were not evident among the four residue removal treatments in either 2009 or 2010. Two likely reasons for this include 1) the corn crop was fully irrigated, so it is unlikely it suffered from water stress, including the corn crop in the treatment with the least residue (the baled treatment); 2) it is expected that more than two years are needed to create sufficient differences in soil quality to cause yield differences.

Results from a related residue removal study at North Platte are more conclusive. This four-year study showed a water savings of 2.5 – 5.5 inches/year in plots where residue was left in place compared to plots

(Continued on next page)

with a residue cover of 5% or less. Residue grazing, and even baling, will not remove this much residue (Table 2). However, grazing and baling do remove residue, and some effect on water can be expected, albeit less than found in the North Platte study.

The economic benefits of the water savings discussed in this report can be estimated. Less irrigation water needs to be pumped when water is saved through leaving more residue on the field. This translates into a savings in pumping cost. For example, when pumping 1 inch of water less on a 130-acre field, the pumping cost savings is $1,632 for a dynamic pumping lift of 200 feet, a pump discharge pressure of 50 psi, and diesel at $3.50 per gallon. A calculator was developed to make the above calculations using one's own input data. It is available at *http://water.unl.edu/web/cropswater/reduce-need* (scroll down to the bottom of the page to access the calculator).

When water is limited, economic benefits from water savings due to residue cover can be expected in the form of higher yields. For example, corn yield may be 25 bu/ac higher when residue remains undisturbed compared to complete removal, as was the case in 2007 in the North Platte study. Again, baling and especially (light) grazing remove much less residue than was removed in the North Platte study. Thus, the yield penalty with limited water would be less when baling and especially when grazing. If the yield penalty were only 5 bu/ac, for corn at $4.00/bu, this would be $20/acre and $2,600 for a 130-acre field.

The benefits associated with retaining residue on the field need to be weighed against the benefits associated with using the residue. In our study near Brule we removed about 2 tons/acre in baled cornstalks. At $50/ton this represents a gross income of $13,000 for a 130-acre field. Obviously there are costs associated with baling but the income may be enough to offset the increased irrigation costs (or the decreased yield) caused by residue removal. Another consideration is the value of grazed cornstalks. Because cornstalks are such an inexpensive feed for wintering cattle, it is conceivable to save as much as $1/ cow/day if the cow grazes cornstalks compared to feeding in a drylot. A 130-acre pivot would be expected to maintain 100 cows for about two months. At a savings of $1/ cow/ day, that represents a savings of $6,000.

The decision about how to manage corn residue is complex and involves factors not discussed in this report. For example, baling results in nutrients contained in the residue being taken off the field with the residue. The cost of replacing these nutrients is discussed in NebGuide G1846, *Harvesting Crop Residues*. Other factors include soil compaction, soil particle aggregation, erosion by wind and water, weed pressure, volunteer corn, and agronomic practices such as planting. Each effect of removing residue, discussed in Figure 1, has its own associated economics. Some are more easily quantified than others, and continued research and analysis are needed.

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[1]Simon van Donk, assistant professor, Biological Systems Engineering, West Central Research and Extension Center, North Platte, Neb.; Adam McGee, graduate student; and Terry Klopfenstein, professor, Animal Science, Lincoln, Neb.; Aaron Stalker, assistant professor, Animal Science, West Central Research and Extension Center, North Platte, Neb.