# EFFECTS OF CATTLE GRAZING CROP RESIDUES ON SOIL BULK DENSITY [1]

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## Summary

Effects of cattle grazing on soil bulk density were measured at two sites in central Kansas. Samples were taken at depths of 0 to 3 in. and 3 to 6 in. from grazed and ungrazed areas at five locations in each field. No statistical difference ($P>0.01$) between bulk densities of the two areas occurred at the 3 to 6 in. depth for either site. However, soil in the grazed areas had significantly higher ($P<0.01$) bulk density than that in the ungrazed areas at the 0 to 3 in. depth at both sites.


(Key Words: Soil Compaction, Stocker Cattle, Grazing, Forage.)

## Introduction

Grazing cattle on crop residues can be economical for producers. However, the impact of cattle on soil properties can affect subsequent crops planted in fields that have been grazed. In a Texas study, trampling during rotational grazing reduced water infiltration rate and increased sediment production, resulting in a silty clay surface devoid of vegetation.

In a 3-year study, cattle grazing wheat pastures in late fall and winter resulted in soil bulk densities greater than 1.5 g/cm$^3$ and soil cone penetrometer readings greater than 290 psi at 2 to 4.8 in. below the soil surface at planting time in the following year. This compaction may have been associated with reductions of forage and grain yields in the following year's wheat crop.

Our objective was to evaluate the effects of stocker cattle grazing grain sorghum stalks on soil bulk density.

## Experimental Procedures

This study was conducted on two fields in central Kansas, one in Rice County (near Lyons) and one in Smith County (near Smith Center). The Rice County field consisted primarily of Crete silt loam and Smolan silty clay loam, was planted to grain sorghum in the spring of 1998, and was harvested in late October. The stocker cattle had access to approximately 75 acres of winter wheat pasture as well as the grain sorghum stalks. The Smith County field consisted of Harney silt loam, was planted to grain sorghum in the spring of 1998, and was harvested in early November. Table 1 shows the stocking rates and durations of grazing for each of the two fields.

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[1]K-State Forages Task Force Project. The authors appreciate the cooperation of Todd Whitney, Rice County Extension Office; Sandra Wick, Smith County Extension Office; Knight Feedlot, Lyons, KS; and Gary Gerstenkorn, Smith Center, KS.

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**Table 1. Field Sizes, Stocking Rates, and Grazing Duration**

| County | Field Size (acres) | Starting Date | Ending Date | Animal Units |
|---|---|---|---|---|
| Rice | 108[a] | 11/17/98 | 3/30/99 | 83[b] |
| Smith | 45 | 11/11/98 | 12/26/98 | 37[c] |

[a]The field consists of 33 acres of grain sorghum stubble and 75 acres of wheat pasture.
[b]83 stocker calves weighing approximately 600 lbs each.
[c]33 weaned cows, 2 bulls, and 2 yearling calves.

To facilitate a comparative analysis of bulk density between grazed and ungrazed soil, sets of three 16-ft livestock panels were erected to form triangles (110 sq ft) at five randomly selected locations in each field before the fields were stocked. At the conclusion of the grazing period, soil samples were taken at the five locations in each field prior to tillage in the spring of 1999. A slide hammer, double ring, 3-in.-diameter core sampler was used to take five samples each from the grazed and ungrazed (protected by the livestock panels) areas at each location in the field. Each sample was divided into depths of 0 to 3 in. and 3 to 6 in. This resulted in 100 samples per site. The soil samples were transported to a laboratory, weighed, oven dried at 100°C for 24 hours, and then weighed again to determine bulk density.

## Results and Discussion

Soil samples were composited for each location within a field for both treatments (grazed and ungrazed) and depths. Textural analyses were run on the composited samples (Table 2). The soil texture was very similar across each field.

**Table 2. Soil Texture Analyses from the Five Sample Locations of the Two Sites**

| County | Location | Sand % | Silt % | Clay % |
|---|---|---|---|---|
| Rice | A | 20 | 30 | 51 |
| | B | 17 | 33 | 51 |
| | C | 23 | 37 | 41 |
| | D | 26 | 26 | 49 |
| | E | 26 | 28 | 47 |
| Smith | A | 19 | 62 | 19 |
| | B | 23 | 59 | 18 |
| | C | 22 | 51 | 28 |
| | D | 21 | 60 | 20 |
| | E | 18 | 62 | 21 |

Table 3 shows soil bulk densities and water contents for grazed and ungrazed areas by depth. Bulk density was greater for the grazed areas at both depths in both fields. The magnitude of variation was significant ($P<0.01$) at the 0 to 3 in. depth, but not statistically significant at the 3 to 6 in. depth. Higher bulk density indicates a more compacted soil. Soils with a higher bulk density have less pore space for air and water to occupy, which is confirmed by the higher water content in the ungrazed areas. Comparatively, water content was greater at both depths in the ungrazed areas. The water content differences were significant ($P<0.01$) at the 0 to 3 in. depth for both sites and significant ($P<0.01$) at the 3 to 6 in. depth in Rice County.

These results suggest that compaction by cattle was confined to the 0 to 3 in. depth, as was the depleted water content. Compaction in this zone is manageable for producers, because it is easily removed with spring tillage. In northern areas of the state, a freeze/thaw cycle may eliminate this shallow compaction. This study dealt only with the effects of cattle grazing on soil compaction as measured by soil bulk density. It made no attempt to quantify subsequent impact on grain or forage yield.

**Table 3. Bulk Density and Water Content Data Separated by Site and Depth**

| | | Bulk Density, gms/cm$^3$ | | Water Content, gms/gm | |
|---|---|---|---|---|---|
| County | Depth | Grazed | Ungrazed | Grazed | Ungrazed |
| Rice | 3 inches | 1.43[a] | 1.35[b] | 0.189[a] | 0.212[b] |
| | 6 inches | 1.52 | 1.51 | 0.220[a] | 0.228[b] |
| Smith | 3 inches | 1.51[a] | 1.41[b] | 0.217[a] | 0.249[b] |
| | 6 inches | 1.61 | 1.60 | 0.238[a] | 0.244[a] |

[a,b]Bulk density and water content values within each row that are followed by different letters are significantly different ($P<0.01$).