

## Effect of Grazing Double-Cropped Annual Forages on Soil and Crop Yields

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Incorporating grazing of double-crop annual forages is a way for producers to increase revenue from crop acres while capturing the soil benefits of cover crops. This publication discusses the impacts of grazing double-cropped forages on soil compaction and soil organic matter.

Many of the species promoted and used as cover crops can be excellent forage crops (*Figure 1*). Obtaining animal production by grazing double-cropped forages (cover crops used for forage) has the potential to significantly improve the diversity, productivity, and economic viability of cropping systems while reducing erosion potential and increasing soil organic matter concentrations. The potential of double-crop forage production is less in northern (colder with fewer growing degree days) and southwestern (drier soil and higher evapotranspiration rates) Nebraska than in south eastern and south central Nebraska. Nevertheless, opportunities exist for double-crop forage production across Nebraska. Planting the forage crops from mid-summer to early autumn usually provides enough growth to support grazing by late autumn and early winter, depending on cropping system, location, and soil water availability.

Due to the greater number of growing degree days, fields that are harvested for wheat or corn silage can be ideal candidates for planting suitable summer/fall forage crops to produce abundant forage. Rapid growth and high biomass production of forages will be, however, important after corn silage, which leaves the soil vulnerable to water and wind erosion (*Figure 2*).

Planting winter hardy forage crops (such as cereal rye or triticale) in late summer or early fall can also provide forage in the spring but their forage production in the fall is often less than cold-sensitive species (such as oats, turnips, and radishes). Late planting of cold-sensitive cover crops following fall-harvested crops like soybeans typically does not provide enough time to accumulate sufficient biomass to support grazing animals prior to the onset of winter. As a result, it is best to plant winter hardy species that can be grazed or harvested in the spring prior to planting of a summer crop.



**Figure 1.** Calf grazing an oats/turnip/radish mix in December. The mix was planted after corn silage near Clay Center, Neb. When planted in late August or early September, the yield can be 1 to 2 tons of DM /acre of high-quality forage, and calves often gain 1.5 to 2.0 lb/d when stocked at one calf per acre for 60 days.



**Figure 2.** Side-by-side comparison in November of ground not planted after corn silage or planted to oats near Mead, Neb. Planting a cover crop after corn silage can reduce erosion by intercepting the impact of raindrops on the bare soil surface and slowing down the speed of runoff. Additionally, cover crops can take up nutrients from the soil, decreasing leaching losses. Likewise, cover crops can also reduce wind erosion by providing a protective cover and enhancing aggregation.

## Impacts of Grazing of Double-Cropped Forage on Soil Compaction

Many crop producers have concerns that cattle trampling will adversely affect soil physical properties and subsequent crop productivity. Soil compaction, measured as an increase in bulk density or penetration resistance, influences the ability of a plant to acquire water, nutrients, and oxygen because of restricted soil water movement, oxygen and nutrient diffusion to roots, and root growth, consequently reducing crop yield. Grazing in late fall, winter, or early spring can result in detectable compaction. However, the effects are usually confined to the upper 0-2 inch soil depth and can be short-lived due to the natural processes of wetting-drying cycles, freezing-thawing cycles, root growth, and the activities of soil organisms. Therefore, grazing generally has no impact on subsequent crop yields. Compaction due to grazing may be greater under wet soil conditions or in soils with low organic matter content, or when intensive tillage is used.

**Soil organic matter** — Soils with higher levels of organic matter are more resistant to compaction because of greater capacity for soil particles to bind and maintain intact soil aggregates and the lower bulk density of organic materials. Soil organic matter provides elasticity and improves soil resilience. For example, accumulation of soil organic matter through long-term manure applications can significantly reduce soil's susceptibility to compaction. Overall, soils with higher organic matter are considered to be less affected by grazing than those that are less well aggregated and low in organic matter.

**Tillage** — Conservation tillage systems (such as no-till) that cause little soil disturbance and maintain aggregate stability are less prone to subsequent compaction compared with deep disking and other intensive tillage. Animal traffic is mostly between rows and planting over or near the previous row further reduces concerns of compaction. In exceptional compaction cases, such as in areas of animal congregation, reduced tillage to a depth of 4 inches may be used to reduce soil bulk density and increase the water infiltration rate after grazing. Multi-tined coulters and residue row cleaners on no-till planters slightly disturb the soil to at least 4 inches and are likely to alleviate any livestock-induced compaction near the soil surface.

**Soil water content** — Research data is limited regarding the effects of soil moisture conditions when grazing double-cropped forages; however, there is some data available looking at the effect of grazing crop residues. In the few studies that have shown reductions in crop yield, cattle grazed the crop residue when the soil was wet and particularly susceptible to structural degradation. Animal traffic under dry — compared with wet— soil conditions is less likely to cause compaction and to reduce yield of the following crop. A wet soil has less bearing strength and is more prone to both compaction and structural degradation.



**Figure 3. Signs of pugging caused by cattle traffic during wet soil conditions in a corn field.**

Signs of pugging (deep hoof imprints) are a good indication that the soil is susceptible to compaction (*Figure 3*). Soil compaction risks can be reduced if grazing occurs when the soil is frozen. A long-term study (16 years) in Nebraska has found that late fall, winter, or even early spring grazing of corn residue did not result in reduced yield of the following soybean crop. In fact, grazing of the residue in this study improved the subsequent soybean yields.

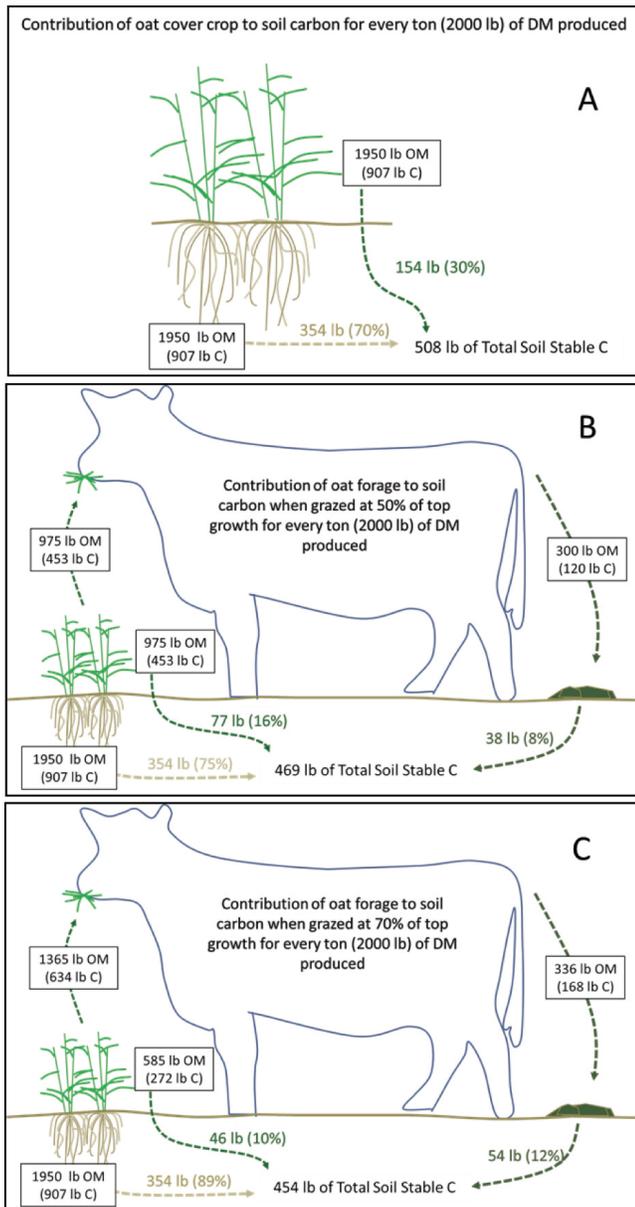
## Impacts of Grazing Double-Cropped Forage on Soil Organic Matter

Much of the soil organic matter benefits of cover crops are derived from the retention of root carbon (C). For example, one study found that root-derived C inputs can be 2.3 times greater than aboveground biomass (leaf and stem) contributions for oats grown under no-till. Another 50 year study found that about 17 percent of aboveground biomass C is captured in soil stable C pools, but about 39 percent of root C is captured.

Based on these long-term measurements of the soil C captured from roots, shoots, and manure input, grazing may not substantially reduce soil organic matter benefits of cover crops. For every ton of top growth produced, around 508 lb of C would be contributed to the stable soil pool (*Figure 4A*). If 50 percent of the top growth was grazed, 92 percent of the cover crop's potential soil stable C would still be captured (*Figure 4B*). If grazing is increased to remove 70 percent of the biomass, the potential capture of soil stable C would still be 89 percent of the ungrazed cover crop (*Figure 4C*). Thus, grazing of double-cropped annual forages can be a part of a system that enhances soil resources. However, grazing must be managed such that adequate soil cover is maintained to prevent erosion.

## Summary

Late fall, winter, and/or early spring grazing of forage crops produced after harvest of the main crop can be profitable while providing benefits of cover crops such as erosion control and increased soil organic matter. The limited research information indicates that grazing of annual forages may not be detrimental to soil properties or reduce crop yields of the following crop. Therefore, based on information available to this point, crop producers may have an opportunity to increase revenue from crop acres and capture soil benefits of cover crops by incorporating grazing of double-crop annual forages into their system.



**Figure 4. Potential effect of 2000 lb of oat cover crop on soil C when not grazed (A), grazed to remove 50 percent of the top growth (B), or 70 percent of the top growth (C).**

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