

# Impacts of Biomass Removal on Soil Quality

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Are you thinking about how to get more from your crops? Maybe you're looking into residue removal? This article will provide the pros and cons of residue removal and how it influences soil sustainability. Currently, there is great debate between researchers about the benefits and drawbacks of harvesting biomass for energy production. For this review we will be focusing on biomass from harvested feedstock crops (in particular corn stover) not energy crops which are specifically grown for energy production. Addressing all the pros and cons is necessary before you make a decision about residue removal.

First, understanding how removal of corn biomass affects the soil is critical. One benefit of removing corn biomass, and the stover in particular, includes a possible reduction in diseases or insects that can overwinter in plant tissue. Also, removal of chunks of stalk can allow for a nicer seedbed. There may be fewer chances that seeds would be impeded by leftover residue. Linden et al. (2000) indicated that seed germination was better in colder climates when residue was removed because the seedbed warmed up faster. Swan et al. (1987) and Dam et al. (2005) have noted that yields can be reduced when residue is left on the surface due to colder soil and excessive moisture. Removing the residue would increase evaporation and soil warming which means fewer planting delays in the spring and better seedbed conditions. Early planting has been shown to have clear yield advantages over late planting. The extent of how residue influences the soil in the spring would be dependant on the soil texture. Finally, some producers may plow under the residue. If not done properly, tillage can breakdown soil structure and result in soil loss. In addition, tillage can result in plow pans or soil compaction.

There are also drawbacks associated with removing crop residue from a field. Residue can influence everything from organic matter to drought resistance. Leaving residue on the soil surface can help build soil organic matter levels. Once microbes break down the residue, carbon is returned to the soil. In conjunction, removing a high percentage of crop residue can lead to higher rates of erosion which would also remove organic matter and topsoil. Furthermore, a corn crop requires a substantial amount of nutrients to grow. Some of these nutrients are extracted from the soil nutrient reserves. If harvesting silage, all nutrients in the crop will be removed. In the case of grain corn, many of the nutrients are removed with the grain, but some will also be in the corn residue that is baled off the field. Although information on the amounts of N, P, K and micronutrients in corn stover that are leached back into the soil is lacking, there is definitely deletion of nutrient reserves with stover removal (Table 1). Hoskinson et al. (2007) have provided some costs associated with residue removal. The short term replacement cost of the N ( $42 \text{ kg ha}^{-1}$ ), P ( $4 \text{ kg ha}^{-1}$ ), and K ( $34.3 \text{ kg ha}^{-1}$ ) removed from the residue (cut 40 cm above ground) averaged \$54/ha. Including compensation for Ca, Mg, and micronutrients (Cu, Fe, Mn, and Zn) would increase these costs even more. As you can see, removing nutrients is unavoidable and it is going to cost you to re-fill the nutrient bank.

As mentioned previously, residues can result in a wet soil in spring. On the flip side, that moisture is retained throughout the growing season and can come in handy during low rainfall periods. When talking about compaction there are two sides to the coin. Removing stover may

reduce the need for tillage in the spring and therefore reducing traffic when the soil is particularly vulnerable to compaction. However, baling and collecting the stover would also result in extra traffic in the fall.

Table 1: Nutrient content of corn stover.

N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
-----lb/dry ton-----		
19	5.7	32

(Fixon, 2007)

Finally, there are economics that need to be considered. If you need to make ends meet then perhaps harvesting your stover for \$35/ton and selling it to ethanol companies may mean farming again next year or having a little extra cushion or ‘short-term gain.’ However, the long-term impacts seem to point towards soil degradation. Nutrient depletion, loss of organic matter, and loss of soil structure are issues that will cause ‘long-term pain.’ In conclusion, there is no cut and dry answer as to whether residue removal is ‘good’ or ‘bad’. However, you need to carefully consider your soil properties and the effects of removal over time before trying to get a little more out of your corn crop.

