Preventing Corn Stalks in Surface Water

James J. Hoorman, Assistant Professor, Ohio State University Extension Educator
Curtis E. Young, Assistant Professor, Ohio State University Extension Educator

Introduction

After heavy rains and extensive flooding, a common complaint in rural areas is the movement of corn stalks and crop residue off agricultural fields into roadways, surface ditches, and streams; causing drainage problems. Major questions include why farmers are increasingly using no-till and what can farmers do to prevent corn stalks and corn residue from clogging drainage outlets and ditches and from becoming a hazard on roadways. This factsheet will explain why 1) farmers are using no-till and 2) offer some strategies to reduce corn stalk and corn residue removal from agricultural fields. Some common farm myths are discussed which may be preventing farmers from reducing the corn stalk/corn residue issue.

According to the Putnam County Soil & Water Conservation District 2015 transect, approximately 67% of corn acres are planted to no-till soybeans and only 6-7% of soybean acres are planted to true no-till corn. The corn residue including corn leaves, corn stalks, and corn cobs and chaff may float off any field if the field once it becomes saturated with water. The practice of no-tiling soybeans into corn stalks followed by conventional tilled corn is called rotational tillage. Rotation tillage is not "true no-till" and may be a major problem with corn stalks moving offsite due to a layer of soil compaction that occurs under each tillage operation.

Farmers have found that there are economic benefits to no-tilling soybeans into corn stalks. It takes less fuel for no-till, the corn residue conserves moisture in a dry summer, reduces weed growth, increases water infiltration, and improves drainage. Environmental benefits of no-till soybeans into corn residue include less soil erosion and sediment losses, less nutrient runoff, and improved soil productivity. Negative side-effects of rotational tillage include corn residue that is slow to decompose and may float away during heavy rainfall events. An understanding of soil ecology is needed to explain why corn stalks are slowly decomposing. Farmers have three tillage production systems to consider: conventional tillage, no-till, and no-till plus cover crops (Ecological or ECO Farming).

Soil Function and Soil Ecology of Different Tillage Systems

In conventional tillage, the soil is disturbed which changes how the soil functions and changes the soil ecology. Tillage is a destructive process that oxidizes the soil organic matter and releases nutrients to the soil. In the short-term, crops benefit from the increased nutrient availability, but long-term, soils lose their structure, get harder and denser and the environmental consequences may be severe. Advantages of tillage include about 0.5 to 1.0 inches of water removed from the soil profile. Soils in the spring tend to warm up faster because it takes 10 times more energy to warm up cold water than it does air. Disadvantage of tillage include decreased soil structure, increased soil compaction, decreased water infiltrate, decreased soil organic matter levels due to excess oxidation, and decreased soil-water storage. Ecologically, a tilled system is dominated by bacteria and the soil functions less efficiently than a healthy soil. Bacteria tend to decompose soluble nutrients and sugars but are not as efficient as fungus at decomposing corn stalks high in lignin.

In no-till systems, the soil is not disturbed; however; the soil is still left bare in the winter. Advantages of this system include increased water infiltration, some improvement in soil organic matter levels, some improvement in soil structure, and some increased soil-water storage capacity which increases yields under dry conditions. The soil is cooler in the summer and may be wetter due to increased surface crop residue. Disadvantages include colder soils in the spring because soils that hold more soil moisture also take more energy to warm up in the spring. In reality, there are very few long-term no-till fields. Most farmers practice rotational tillage where soybeans are no-tilled into corn stalks and then the soybean stubble is chiseled or turbo-tilled in the fall to create a stale seed bed for conventional corn the next year. Turbo-tilling increases soil warming in the spring and increases faster nutrient release. However it also creates a zone of surface compaction which limits water infiltration. To make no-till work efficiently, it takes 5-7 years to transition to long-term no-till and most farmers are not that patient. Ecologically, true long-term no-till soils have a better balance of bacteria and fungus in the soil because fungal populations recover due to less tillage.

The third system is ecological farming or ECO Farming which includes both long-term no-till and cover crops. The advantage of this system is similar to no-till except that the improvements are more dramatic. Increased soil organic matter levels due to increased root turnover and improved soil structure result in decreased soil compaction, increased water infiltration and increased soil-water storage. These soil changes decrease surface water ponding and increase water storage in the soil profile which may decrease flooding potential. With the increased pore space, in the spring, soils tend to be warmer due to increased porosity and higher aeration and live roots keep the soil warmer. Ecologically, the soil is alive with healthy bacteria and fungus populations which decompose high lignin crop residues like corn stalks quicker. Each system has an impact on how long it takes for corn stalks and corn residues to decompose.

Possible Solutions & Dispelling Common Farm Myths

An immediate solution is to keep corn stalks firmly attached to the soil at harvest by raising the corn headers. Excess corn residue flowing through the combine gets chewed up, is less likely to be spread evenly, and unattached residue may float off the field when saturated soil conditions occur with heavy rainfall events. New harvest innovations are strippers which strip corn ears and soybean pods from the plant yet leave the stalks firmly attached to the soil. Some simple adjustments or adoption of new technology offer some possible solutions to reducing corn stalks or residue issues.

A farm myth is that GMO (genetically modified organism) corn decomposes slower than Non-GMO corn. A study by Dr. Peter Thomison, OSU Corn specialist, shows that there is no difference in the rate of decomposition between GMO and Non-GMO corn. Farmers chop, turbo-till, or disk corn stalks to increase decomposition and these practices have little or no effect on corn stalk decomposition. Chopping, turbo-tilling or disking corn stalks may actually increase the removal of corn residue from the field by decreasing soil attachment, increasing surface compaction, decreasing water infiltration and increasing surface water ponding and field flooding.

Corn stalk decomposition is dependent on three major factors: soil temperature, soil moisture, and fungal decomposition. Why are corn stalks so difficult to decompose? There are four major reasons: 1) Conventional fields are dominated by bacteria microbial communities rather than a healthy balanced mix of bacteria and fungus, 2) Soil that are compacted and too wet for optimal decomposition, 3) Farmers may be overusing fungicides which decrease fungus populations, and 4) Late maturing corn harvested late in the year results in lower soil temperatures and decreases the time for corn stalk decomposition. Ecological or ECO Farming systems use fewer fungicides and have a healthy balance of bacteria and fungus to decompose corn stalks rapidly if soil temperatures are warm, soil moisture is adequate, and there is adequate time for decomposition before winter. The real solution is higher soil temperatures and adequate moisture to stimulate fungal populations to quickly decompose the lignin in corn stalks before winter.

A major change that farmers need to adopt is to plant earlier maturing corn and soybeans so that the soil temperature is warmer at harvest for faster corn stalk decomposition. Harvesting early maturing corn and soybeans allows cover crops to be planted in a timely basis in September which allows the crop to become firmly established before winter. Most cover crops need 60 to 90 days of growth before winter. Live covers promote healthy microbial communities and maximize invertebrates (earthworms, beneficial beetles, springtails) for optimal corn stalk decomposition.

OSU research by Dr. Peter Thomison and Dr. Laura Lindsey, Soybean Specialist shows that optimal corn and soybeans yields are related to the timing of soil moisture more so than crop maturity. Early maturing corn planted in early May benefits from timely late May and June rains while corn that begins tasseling in July and August may be hurt by dry or hot soil conditions. There may be a slight advantage to later maturity corn and soybeans due to increased photosynthesis, but this advantage may be small compared to improved weather conditions from early planting, early harvest, and optimal soil conditions.

The benefits of early maturing corn (<102 days) and soybeans (< group 2.0 maturity) are 1) lower crop moisture at harvest (1-3% points), 2) easier dry down (warmer temperatures) due to harvesting in September versus cold air in November/December/January, 3) less chance of wet soil conditions and soil compaction, and 4) possible crop premiums for early harvested corn or soybeans. If the yield is the same or comparable for early and late maturing corn and soybeans, early maturing crops offer many benefits to farmers. Currently, most seed companies are pushing late maturing crop varieties and often even advertise early maturing crop varieties that are actually late maturing. In addition, most seed companies have a much larger selection of crop varieties that are late maturing. To maximize yields from early maturing corn and soybeans, pick the highest yielding early maturing crop varieties based on current agronomic research. By picking the best of the best in each maturity, crop yields are maximized and the difference between maturity groups is minimal.

Using ecological or ECO Farming methods increases the microenvironment for maximum crop decomposition. Increased microbial life along with healthy invertebrates and earthworm populations increases decomposition. If heavy rains occur, the increased water infiltration and increased water storage decreases water runoff and flooding potential, and if water is ponding in a field with cover crops, the cover crops act like a dam to reduce corn stalks from floating off the soil surface.

Farmers have several options to decrease corn stalks and corn residue from floating off fields. Some options are relatively simple to implement while other options require a long-term management plan to implement. However, corn stalks and crop residue in surface ditches does not necessarily have to be an issue with some changes in farm management.

Summary

Corn stalks and corn residue in surface ditches has become a major problem on many fields. This problem has increased in recent years because farmers are using rotational no-till (not true no-till), they are chopping, turbo-tilling, and disking corn stalks which detaches the stalk from the soil and reduces water infiltration and increases ponding and flooding, they fail to raise the corn header to minimize corn fodder in the harvester and the corn residue is shredded but often not evenly spread across the field. In addition, conventional tilled fields are low in fungus and high in bacteria and do not have optimal soil moisture or soil temperatures to speed up corn stalk decomposition. Harvesting corn late in the growing season contributes to increased soil compaction, lower soil temperatures, and little time for corn residues to decompose before winter.

The four major factors for optimal corn stalk decomposition are warm soil temperatures, adequate moisture, a balanced and healthy microbial populations including fungus for lignin degradation and bacteria, and avoiding management practices that reduce fungal populations like excessive use of fungicides and tillage which create soil conditions that harm fungal growth. Farmers may need to start using earlier maturing corn and soybean varieties to maximize soil conditions for optimal residue decomposition while not sacrificing yields. Ecological or ECO Farming practices that optimize long-term no-till with cover crops also maximize soil conditions that increase water infiltration and soil-water storage, increase stalk decomposition through promoting a healthy balance of bacteria and fungus populations, and cover crops that tie up corn residue and prevent clogged drains and/or residue that floats to surface ditches.

References

Anonymous (2014) *Midwest Cover Crops Field Guide*, 2nd Edition, (2014), ID-433, www.mccc.msu.edu

Clark, A. (2007) *Managing Cover Crops Profitably*, 3rd Ed., Handbook Series Book 9, Sustainable Agriculture Research & Education, United States Department of Agriculture.

Hudson, B. (1994) Soil Organic Matter and Available Water Capacity, Journal of Soil & Water Conservation 49(2) 189-194.

Magdoff, F. and H. Van Es. (2009) *Building Soils for Better Soil: Sustainable Soil Management*, Chapter 4: The Living Soil, 3rd eds. Sustainable Agriculture Network, Handbook Series Book 10. SARE Sustainable Agriculture Research & Education, Beltsville, Maryland.