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Making No-till Corn Succeed

Record no-till corn yields (616 bushel/acre, Dave Hula, Virginia) have been achieved by understanding what it takes to make no-till corn succeed! Nationally, no-till corn acres are less than 10% (average 5-7%). Corn needs nitrogen (N) and other nutrients at critical times to produce high yields. Scientist estimate that corn could potentially produce 1100 bushel/acre, but averages 200 bushels or less. The first 10-14 days after corn planting determines most corn yield. Factors that harm the corn seedling at this time may reduce the corn harvested.

Traditionally, tillage warmed the soil and created good seed-to-soil contact. Each tillage operation reduces soil moisture 0.5 to 1.0 inch. Water holds 10X the cold/heat as air, so reducing cold water improves corn germination. Spring tillage also aerates and stimulates microbes to release carbon and nutrients while killing some early germinating weed seed. Corn generally benefits from tillage, giving corn an extra boost during that critical 10-14-day time period. However, as soil structure declines (soils compact), carbon and soil organic matter (SOM) decline, and water starts to pond; the negative downward spiral of tillage may eliminate these early corn gains.

Why does no-till corn often lack early vigor? Poor soil structure, poor water infiltration, and anerobic (lack of oxygen) conditions causes no-till corn to suffer. The N loss due to denitrification (saturated soils) can be 40-60% in heavy clay soils with 20-40% N losses in sandy soils due to leaching. SOM has 1,000# of N for each 1% SOM. Most Ohio virgin soils had 6% SOM but now have only 2-3% SOM which is a loss of 3,000-4,000# N/acre. No-till soils with cover crops add 0.1 to 0.15% SOM each year, so these soils need an additional 100-150# N to compensate. Corn is a heavy N user but has to compete with soil microbes and decomposing organic residues for N. Poor soil structure is a major deterrent to no-till corn and until soil structure improves, no-till corn yields suffer.

Another deterrent to no-till corn is the soil microbial community. Tilled soils are dominated by bacteria (20-30% efficient at conserving carbon for SOM) and protozoa. These species tolerate tillage and can quickly reproduce in 30 minutes (bacteria) to 6 hours (protozoa). Long-term no-till and cover crop fields have a balance of fungus (40-55% efficient at carbon sequestration) and bacteria with more beneficial soil nematodes. Beneficial fungus and nematodes may take 2-3 or longer years to reproduce. Conventional tilled soils recently converted to no-till may have 10% yield losses and may take 3-7 years to make the conversion.

How can farmers reduce the no-till transition period? No-till corn planted into a 3-5-year old hay crop, old pasture, or Conservation Reserve Program (CRP) heal the soil with live roots, improve soil structure, and restore beneficial microbial communities. Planting wheat followed by a multi-species cover crop greatly improves no-till corn production. Adding manure and growing legumes (inoculated at planting) can compensate for the N deficit. Fully functioning healthy soils may accumulate up to 100#N from free living N fixing bacteria but most tilled soils (not fully functioning) only produce about 20# N/acre.

During the no-till transition period, farmers often say their soils are cold and wet while long-term no-tillers say their soils are warm and moist. No-till soils will stay cold/wet until the soil structure improves and cold winter water starts to drain away (improved soil structure). Later, as SOM builds and decays. SOM turns black absorbing heat, warming the soil. No-till soils become warm/moist once the biological activity improves like in a compost pile.

No-till corn farmers tend to follow these practices: First, they plant corn 2-3 inches deep to get deeper roots and consistent stands. By planting deeper, the soil temperature is more uniform and the corn comes up at the same time. Second, sharp planter opener disc blades are essential to reducing hair pinning and side wall compaction in the furrow trench. Third, most no-till corn farmers follow the 4R's of N. The right rate is 40-60# of N, right place is 2" by 2" or 2" by 4" placement below the soil surface, the right type is ammonium forms of N with a 10:1 ratio of sulfur (ammonium thiosulfate) and the right time is more early N at planting. The length of the transition time period and success is determined by how quickly soil structure improves and beneficial soil microbial community rebound.