No-Till-A Conservation Tillage Method

In the United States in 2017, approximately 37% of the agricultural acreage was managed under a no-till (NT) system. The state-by-state variation is large, ranging from 79% for Tennessee to 6% for Minnesota.[1]

No-till cropping systems help protect fields from excessive soil erosion, reduce soil aeration from tillage, allow organic matter to accumulate by decreasing decomposition, and improve the overall health of the soil. The utilization of NT systems can also help reduce input costs which can help increase profitability.

What are some of the benefits with a no-till system?

No-tillage cropping systems are known to provide many benefits that can help enhance crop production.

- **Reduced soil compaction:** The multiple passes over a field in a conventional tillage system can compact the soil more than NT production practices. In addition, bare soil can easily become compacted by rainfall. The change in soil structure because of tillage (breaking down soil aggregates) makes soil more susceptible to compaction.
- **Reduced soil erosion:** NT systems reduce the amount of bare soil exposed to environmental conditions. The cover that's left behind in NT planting helps control the loss of topsoil on slopes from water and helps prevent wind erosion.
- **Less evaporation:** Plant residues that are left behind in NT systems help capture water (rain and snow), help keep the soil moist, and minimize the evaporative effects of the wind and sun.
- **Fertility improvement:** Because the soil isn't mixed as it is with tillage, phosphorus (P) fertilizers remain effective longer. The more mixing of P fertilizers, the more they react chemically with the soil particles and become fixed into forms that are not available to the plant.

Figure 1. No-till planter

- **Lower costs:** In NT systems only one trip across the field is needed to establish the crop, which drastically reduces fuel and labor costs. Additionally, there is less equipment needed.
- **Yield:** Crop yields in NT systems should equal or exceed those of conventional tillage. A 30 year study from Michigan State University indicated superior yields with NT systems.[2] A very large world-wide review of NT systems, found that yields for corn, wheat, and rice were lower than conventional tillage systems.[3] However, when partnered with crop rotation and cover crops, yields in NT systems increased. Yield benefits from NT cropping systems can be higher in drier growing conditions compared to years with more moisture.[3]

What are some of the disadvantages of a no-till system?

- **Equipment cost:** The initial investment in NT equipment can be one of the major deterrents to switching to a NT system.

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- **Increased use of chemicals:** While NT systems can help curb fast growing weeds, most types of NT still require the use of herbicides. However, NT can help reduce the weed seed bank by leaving weed seeds on top of the soil surface where they are prone to being eaten by insects, birds, and mice, or rotting away.
- Management of herbicide-resistant weeds: The main function of tillage was to control weeds and allow the crop to become established. Without tillage, the reliance on herbicides has resulted in resistance of some weed species that were previously managed with a tillage operation.
- No incorporation of crop residue: May allow increased survival of foliar pathogens and other pests that thrive in high residue situations (e.g., slugs).
- Slows soil warm-up in the spring: Warm up in the spring could be delayed particularly on poorly drained soils.

Specifically, what gains in soil quality can be expected with no-till?

- Quality gains include physical, chemical, and biological improvements.
- Physical improvements include better soil aggregate (groups of soil particles that bind to each other more strongly than to adjacent particles and the space between the aggregates provide pore space for retention and exchange of air and water) size and strength. That translates to better soil structure, better infiltration, better permeability, lower bulk density, better water holding capacity, decreases in erosion, and improved water quality.
- Chemical improvements include, higher cation exchange capacity (the total exchangeable cations that a soil can adsorb), which results in higher soil nutrient holding capacity and greater potential mineralizable nitrogen (N) resulting in an increased soil N bank.
- Biological improvements include increased carbon which serves as a food source for soil microbes. Soil microbes are responsible for the decay of organic matter and cycling of both macro- and micro-nutrients back into forms that plants can use. Increasing the biological activity in the soil is the key to maintaining or increasing soil productivity.

What other reasons are there to implementing a no-till system?

Crops grown under NT systems use water more efficiently: 1) more rainfall or irrigation water is captured in the soil, 2) the water-holding capacity of the soil increases, and 3) water losses from runoff and evaporation are reduced. Combined, these factors translate into higher yields and more profits. No-tillage cropping systems usually require less time, labor, fuel, and machinery cost per acre which can result in better whole farm profitability and sustainability. Crops grown under NT systems often have less in-crop weed emergence and allow safer use of herbicide for weed control. No-tillage system crop yields are very similar to tillage system yields.

What are some considerations if switching to a no-till system?

- **Planter modifications:** Attachments will most likely be needed such as row cleaners and stronger down pressure springs.
- **Surface drainage:** In cold wet soils, internal drainage is extremely important; needs should be assessed on a field-by-field basis to determine if NT will be successful. If the field is tiled to lower water levels, ensure that field drains are operating correctly.
- **Previous crop residue:** The increase of crop residue on the soil surface may reduce soil warm up in the spring and can result in planting delays. In well-drained fields, this will be less of an issue.
- Soil texture variability plays a significant role in crop performance, especially in dry conditions where moisture shortage can result in a variable plant stand across the field. Soil texture is a key

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factor in influencing a soil's water-holding capacity and drainage of excess water.

- Nutrient management: A starter fertilizer may be more beneficial under a NT system as cooler spring soils may delay mineralization of soil nutrients. The plant needs for N, P, and potassium (K) are essentially the same regardless of the tillage system, but timing is more critical and application method becomes more important.[4]

Sources

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