

1-2013

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Recommended Citation

Wright, David; Al-Kaisi, Mahdi; and Lenssen, Andrew W., "Influence of Tillage on Soybean Production in Iowa" (2013). *Agriculture and Environment Extension Publications*. 195.
http://lib.dr.iastate.edu/extension_ag_pubs/195

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Influence of Tillage on Soybean Production in Iowa

Tillage has been a key component of crop production for centuries. It helps manage residue left by the harvest of previous crops, controls weeds that compete with the current crop, incorporates amendments such as fertilizers and manure, and is used extensively to prepare a seedbed for planting. However, research shows that tillage has little effect on soybean yields.

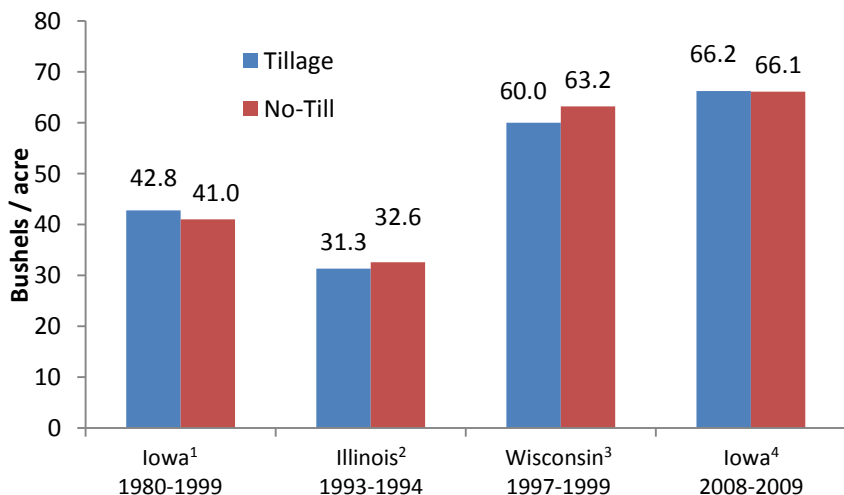
Management decisions such as variety selection, planting date, seeding rate, and weed and insect control have a greater influence on yield and yield stability of soybean than does tillage.

Studies conducted at six locations across Iowa in 2008 and 2009 comparing conventional tillage to no-till production practices found that tillage, or the lack of tillage, did not have a major influence on soybean yield (8). Similar results were reported from another long-term tillage study conducted from 2001-2012 at 7 Iowa locations (2) as well as studies in Wisconsin (10) and Illinois (13). Furthermore, research conducted in Nebraska suggested that adapted soybean varieties would be high yielding regardless of the tillage system used (5,6,7). However, not all studies report similar results.

A 20-year study in Indiana concluded that soybean yielded eight percent less when grown in a no-till production system (11).

The idea that producing high yielding soybeans in Iowa has little to do with the type of tillage system is not new (3,12). Yin and Al-Kaisi (12) conducted their research on six soil types ranging from poorly-drained to well-drained, between 1978 and 2001. They reported that soybean yield was stable over the length of the study regardless of tillage system. No-till production practices in this study had less than a five percent yield decrease and had greater economic returns compared with other tillage systems on well-drained soils. However, no-till yields were less competitive when soybean was grown on poorly

Figure 1: Influence of tillage on yield of soybean in trials from Iowa, Illinois, and Wisconsin.



Source: ¹Yin and Al-Kaisi (12); ²Yusuf et al. (13); ³Pedersen and Lauer, (10); ⁴Kiszonas (8).



drained soils. They concluded that different producers may obtain different yields and economic returns from no-till because they have different production environments and may adopt different crop and soil management practices.

Soil texture and drainage class play a major role in how soybean responds to tillage. Soybean emergence and early-season growth is often slower in fine-textured, poorly-drained soils (4,9). These soil types are common in certain areas in Iowa especially in the Des Moines lobe. Many farmers are successfully utilizing no-till production practices on these soils despite the soils being poorly drained. A key factor in having a successful no-till system whether for soybean or corn production in wet conditions is the presence of properly installed field drainage tile.

Profit is a major driver in the decision to adopt no-till. No-till production practices can reduce fuel, labor, and machinery expenses. The lower input costs coupled with the ability to consistently achieve high soybean yields was the likely driver behind the rapid adoption of no-till by Iowa farmers.

The advantages of no-till to the farmer may be much greater than reducing input costs. In addition to reducing water runoff, improving water and soil quality, and reducing soil erosion, no-till creates resiliency in the production system. No-till increases water infiltration rate and water holding capacity of soil through the improvement of soil organic matter, improving the likelihood that more water will be available to soybean during dry periods. Organic matter is known to hold six times its weight in water.

The improvement in soil structure and reduction in soil compaction with no-till leads to a better root growth environment by reducing restricting layers that are generally created by conventional tillage. These soil conditions under no-till will enable roots to develop freely and access sub-soil moisture deeper in the soil profile.

Improving the resiliency of soil doesn't stop with building soil structure and organic matter. Al-Kaisi and Yin (1) found that adopting less intensive tillage practices would reduce CO₂ emission and improve soil carbon sequestration in soils using a soybean-corn rotation. They suggested that soil can function as a net sink for sequestering atmospheric CO₂ through improved crop management.

SUMMARY

Research conducted in Iowa and surrounding states over many years clearly documents that tillage system typically has little effect on soybean yield. No-till production can improve the profitability and operational efficiency of a farm operation because fuel, labor, and other input costs are less than for conventional tillage systems.

No-till improves the resiliency of soils to environmental stress by improving soil structure, increasing organic matter, improving water

infiltration rate, and increasing water holding capacity.

No-till promotes a healthy environment. It improves the quality of Iowa's streams and rivers by reducing sediment and nutrient pollution.

Building a soybean and corn production system that is resilient to climate change and moisture stress begins with taking a systems approach to management. High and stable soybean and corn yields are the result of having a better understanding of how cultural practices and management decisions influence each other. As Iowa's climatic conditions continue to change, a better understanding of soybean-pathogen, soybean-insect, and even soybean insect-soybean pathogen interactions will also be needed to achieve maximum yields and yield stability.

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