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# RESOURCE

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## NO-TILL PLENTY OF POSITIVES



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# No-Till

## Plenty of Positives

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Imagine an agricultural production system that functions as a conservation program, keeping land in production while providing potentially high yields, all at a relatively low cost. Say hello to no-till.

No-till, the practice of leaving crop residue on the soil surface instead of plowing it under, is considered one of the most important innovations in the history of U.S. agriculture. Fifty years ago, plowing was *the* tillage system, but now no-till is changing the way that farmers manage the land.

No-till is a conservation system that provides environmental benefits without having to take the land out of production. Such benefits include increasing wildlife habitats, storing carbon, increasing soil organic matter, improving soil quality, preventing runoff and erosion, increasing infiltration, conserving soil water, and reducing fuel consumption. No-till goes by many names, including zero-till, direct seeding, and never-till. Strip-till is also considered a no-till system, and ridge-till, which is even older than no-till, is closely related.

### For many U.S. farmers, no-till is a must

“Planting in continuous no-till gets easier every year,” said Ohio farmer Bill Richards, who served as chief of the USDA Natural Resources Conservation Service and has been farming no-till in central Ohio for more than 40 years. “Water infiltration has increased dramatically, and soil quality has improved beyond our dreams.”

John Aeschliman farms in the Palouse region, one of the most fertile areas of the country, where Washington, Oregon, and Idaho meet. Growing wheat and other crops on steep (45 to 60 percent) slopes is common on the deep, loess soils. Aeschliman recalls, “When I was a boy, erosion was horrible. Every spring, mud and water filled the ditches and covered the roads.”

But no-till has changed all that. Aeschliman has been no-tilling for more than 35 years, growing crops annually on less than 500 mm (20 in.) of precipitation, and he has witnessed how the practice has restored the soil structure. “No-till eliminates the need for summer fallow because the water soaks in and the residue cover conserves moisture. Yields are high because roots go deep into the moist soil. I’ve pulled soil cores and found earthworm holes 3 m (10 ft) deep with corn roots in them,” said Aeschliman. “Wheat every other year used to be the standard cropping system, but now no-till allows a variety of crops to be grown annually. Remember the roadside ditches that always filled with sediment? We don’t even need ditches now, because there’s no runoff.”

Ken Rulon and his family have been farming continuous no-till in central Indiana since 1993, and their yields are about 8 percent higher than the county average. “Our cost of production is far less per bushel with no-till,” said Rulon. “The soil is healthier, and organic matter and earthworm populations are increasing.”

### No-till as a conservation practice

Farmers’ accounts of successful no-till practices are a testament to what no-till can do in place of long-standing tillage practices.

Common conservation practices tied to tillage have included terraces, grassed waterways, and vegetable buffer strips. Terraces have been a prominent conservation practice in the United States since the 1930s. They are useful in catching runoff from tilled slopes and slowing the water so that most of the eroding topsoil settles out. Grassed waterways and vegetative buffer strips at the lower edges of fields help move excess surface water while catching sediment to keep it out of streams.

Researchers have found that no-till can do the same thing as these other conservation practices, only better. In fact, because no-till can cut runoff in half, and reduce erosion by 85 to 95 percent, the value of installed conservation practices is greatly reduced. Eroded topsoil caught in a terrace or buffer strip has no value to a growing crop, but no-till tends to keep soil in place and retain precipitation where it lands, which greatly benefits crop yields.

ASABE member Mark Hanna, an Iowa State University Extension agricultural engineer, assisted with an erosion study on a small watershed in east central Iowa that supports this fact. “No-till reduced sediment yield by 85 percent compared to chisel plowing. When the Water Erosion Prediction Project (WEPP) computer model was used to simulate the effect of terraces, grassed waterways, and buffer strips, the sediment lost with the combination of chisel plowing, terraces, and grassed waterways was still two and a half times greater than with no-till by itself.”

### **No-till with cover crops**

By adding cover crops to a continuous no-till system, a farmer adds soil benefits that enhance the performance of the field crop, potentially leading to higher yields. Growing a cover crop is nothing new for farmers, who have routinely plowed cover crops under as “green manure.” But cover crops today are seen as having more value, especially in a continuous no-till system.



Some advantages of including cover crops in a no-till system include year-round plant material covering the soil surface; protection of the soil after crops with fragile residue, such as soybeans or cotton; addition of nitrogen to the soil, reducing the need for commercial fertilizer; and deep roots that help break up soil compaction and improve air and water infiltration.

Rafiq Islam, an Ohio State University soil scientist, offers some additional benefits of cover crops: they have almost a 15:1 carbon-to-nitrogen ratio, essential for maintaining soil quality, and they produce chemicals that are antagonistic to soilborne diseases and pests. A cover crop means there are living roots in the soil more months of the year, which also helps soil quality. The Midwest Cover Crops Council (<http://mccc.msu.edu>) is compiling information to help farmers select the appropriate cover crops for their situation.

### **No-till and agrotechnology**

From a crop production standpoint, the evolution of agricultural equipment and technology has helped increase the likelihood of success of no-till. The first no-till planters had wavy coulters and extra weight to help keep the row opener in the ground. Today, a wide range of seeder designs and optional equipment means that a farmer can choose equipment that places the seed in an ideal growing environment, anywhere in the world.



Oilseed radish planted accurately about 10 cm (4 in.) apart in rows grows big and deep into the soil to improve soil structure. (All photos, unless otherwise credited, courtesy of the author)



**No-tilling the steep slopes of the Palouse Region prevents the severe erosion that has historically caused environmental and economic problems. (Photo courtesy of John Aeschliman)**

Additional technological advances, such as herbicide applications, genetic enhancement, and precision agriculture, have also contributed to the success of no-till, including a technique known as controlled traffic. Controlled traffic is a method of managing soil compaction in which all farm equipment is the same width (or multiples of that width), so traffic can be confined to specific paths year after year and the remainder of the soil is untouched. With controlled traffic, 50 to 80 percent of the field is never driven on.

### **Making no-till work**

No-till sounds like an attractive production system, but planning, implementation, and management of any agricultural production system can be a challenge, and no-till is no exception. No-till takes more management, especially in the beginning and especially with corn. “In our colder climate, corn stalks don’t decay, so pure no-till is very challenging,” said Jodi DeJong-Hughes, a University of Minnesota Extension educator. “No-till soybeans with strip-till corn is a

common rotation. Strip-till or ridge-till works in continuous corn.”

Added Rulon, “On about a fourth of our soils—the heavy, poorly drained soils—the no-till yield lags a bit. But the difference is not enough to justify plowing. Currently, we strip-till our continuous corn. We install tile to improve drainage, add necessary attachments on the planter, and use other technologies to improve yields.”

Farmers who use no-till are quickly finding that it’s a multi-step process. If a farmer buys a good planter but neglects the other steps, then the system won’t work. But if a farmer follows all the essential steps, the success rate is much greater.

A century of tilling the soil, destroying the organic matter, losing precious topsoil to erosion, and impacting soil quality make it challenging to implement a production system that attempts to restore the soil to its previous state. However, the benefits of no-till justify this effort. For example, research has proven that no-till increases the organic matter in the soil; with conventional tillage, this is nearly impossible to do. Increase the organic matter (which is almost 60 percent carbon), and crop yields will increase.



**Uniform emergence and growth of no-till corn following corn leads to good economic returns.**



**Wheat planted in 37-cm (15-in.) rows emerges uniformly in soybean stubble.**

“If every farmer who grows crops in the United States would use no-till and adopt management practices such as crop rotation and planting cover crops, we could sequester about 300 million tons of soil carbon each year,” said Rattan Lal, an Ohio State University soil scientist who studies the application of no-till on a global scale.

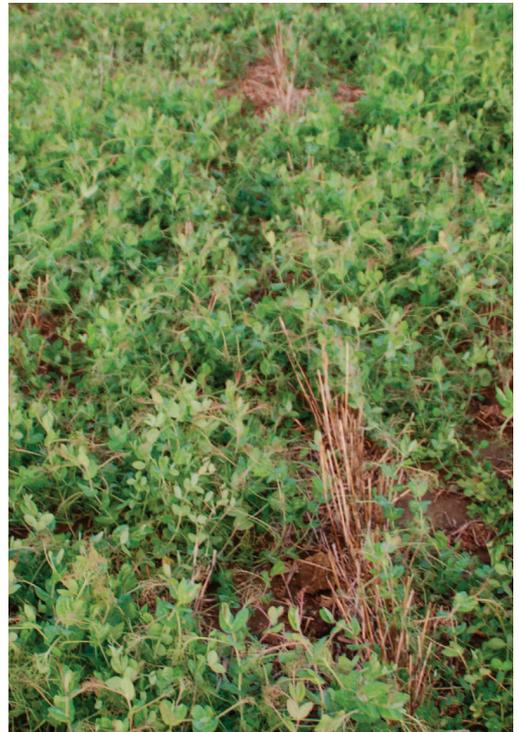
On a global scale, if soil carbon content were increased by one ton per ha (roughly 800 lbs per acre), then grain yield would increase substantially. “What that means for countries in sub-Saharan Africa, whose food deficit will be 22 million tons in 2010, is that if farmers adopt carbon-storing practices, then food production could increase by 32 million tons a year, basically eliminating that food deficit,” said Lal. “In situations where no-till is ideal, it’s a sustainable practice that saves time, money, and wear on machinery, and its profit margin is much higher than plowing.”

Currently, Lal and his colleagues estimate that no-till farming is practiced on only 5 percent of all the world’s cultivated cropland. The USDA-NRCS estimates that U.S. farmers use no-till methods on about 25 percent of the cropland at any one time, but only about 6 percent is continuous no-till.

Farmers and researchers agree that a cropping system that protects the environment while producing food, fuel, and fiber cannot be ignored, and opportunities exist to make no-till management practices more successful for the farmer. The future looks good for no-till. As research continues to demonstrate its environmental and economic advantages, no-till can become *the* tillage system around the world.

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**Hairy vetch (left) and Austrian winter pea (right) are legume cover crops that capture nitrogen from the air and protect the soil from erosion.**