Water the key profit driver

KATHERINE MAITLAND

US farmers can retain an extra 50 mm of water during the non-growing season by using no-till farming methods, keeping residues standing and effective water management practices

According to Paul Jasa, Extension Engineer, University of Nebraska-Lincoln, speaking at the SANTFA Conference, farmers using no-till farming methods and leaving residue in field are not only reducing water evaporation and building soil activity, they are often increasing wheat yields by an extra tonne a hectare.

"Standing wheat stubble can save 50 mm of water during the non-growing season if the soil profile can retain the water," Jasa said. "For US producers, saving 125 mm of water with no-till practices is worth at least 1.8 tonnes more wheat a hectare."

"When farmers park the tillage tools and stop stirring the soil, soil water evaporation is reduced immediately. Evaporation takes place any time the soil surface, residue and plants get wet, so the more residue they leave on the soil surface, the more evaporation is reduced. These savings can accumulate quickly in a season with light frequent rains and the results will be seen in the first year.

"Water saving improves over time as the soil structure builds with continuous no-till, letting more rain into the soil and reducing losses to runoff. The soil structure and biological activity improve slowly, over three to five years in severely depleted soils, but can occur much faster with diverse crop rotations, cover crops, and/or the addition of livestock manure. Many producers see benefits in the first or second year once they stop the tillage and stop the residue harvest and start treating the soil as a resource to be protected," he said.

PAUL JASA.

A GOOD COVER OF TALL STANDING STUBBLE MAXIMISES MOISTURE CONSERVATION.

For Australian farmers, wheat yields can increase 20 kg/ha for every extra millimetre of available soil moisture. Jasa advises Australian farmers to reduce tillage practices as much as possible because tillage leads to soil compaction and oxidisation, which reduces the soil's ability to store water.

"Compaction from tillage reduces pore spaces, meaning less water can be stored. Also, more water can be stored in soils with higher organic matter. By keeping the residue on the soil and by growing more roots into the soil, organic matter can be increased. Tillage oxidises organic matter and lowers the water storage capability of the soil. Growing cover crops and applying livestock manure increases the organic matter and helps build soil structure.

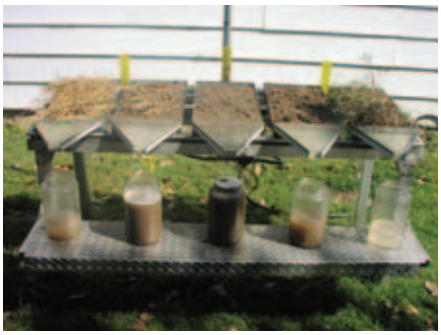
"Soils are roughly half there (the solid particles of sand, silt, clay, organic materials, microorganisms, nutrients, and more) and half not there (the pore spaces between the soil particles). When tillage occurs the soil is compacted because the pore spaces are squeezed out of the soil. With less pore space the soil is denser and there is less room for air and water.

"Ideally, pore spaces should contain about half air and half water. Air is needed for respiration by the plant roots and the microorganisms. Without water, the microorganisms would dry out and die and the plants would not be able to grow. Water is needed for the roots to move nutrients into the plants."

If they need the income from the sale of the residue they need to make sure they receive enough money for it to make up for the water lost when the soil is left unprotected.

Soil permeability is also reduced when there is a crust on the soil from raindrop impact, he said, and machinery can impact on soil's ability to conserve water effectively.

"In US conditions, disc opener seeders cause less soil disturbance and cause less damage than tyne or knife opener seeders. In the 1980s, many farmers were tilling their soils with long rippers and digging



THE RESULTS OF THIS RAINFALL SIMULATION LEAVE NO DOUBT ABOUT THE IMPACT OF CROP RESIDUE AND SOIL STRUCTURE ON EROSION AND RUNOFF. THE THREE TRAYS ON THE LEFT CONTAIN THE SAME TILLED SOIL WITH DIFFERENT AMOUNTS OF RESIDUE. THE TWO TRAYS ON THE RIGHT ARE A WELL-STRUCTURED NO-TILL SOIL WITH AND WITHOUT RESIDUE. RESIDUE ABSORBS RAINDROP IMPACT, REDUCING EROSION AND CRUSTING, SO LESS SOIL AND WATER RUNS OFF. GOOD SOIL STRUCTURE REDUCES RUNOFF BY LETTING MORE WATER SOAK IN. RESIDUE ALSO REDUCES SOIL WATER EVAPORATION AFTER A RAINFALL EVENT. (UNIVERSITY OF NEBRASKA EXTENSION)

deeper into the soil profile to open up the soil, but working deeper just meant they were chasing the hard pans deeper. "They soon discovered that you need to build the soil and work with the soil biology in order to keep water in the profile.

Jasa says growing a cover crop helps keep the sun and wind off the soil, thus reducing evaporation compared to bare soil.

"If the soil is sandy and cannot store all the off-season precipitation, a cover crop can be used to 'grow some of the water out', rather than lose it. The cover crop helps keep the sun and wind off the soil surface to reduce evaporation of later rains. The water storage ability of a soil is much greater with good soil structure and many pore spaces between the soil particles."

Jasa urges producers not to harvest their residue as this will result in them losing water from the unprotected soil. By keeping soils covered with stubble or other residue farmers can reduce evaporation and insulate the soil, which will help increase biological activity.

Wheat yields can increase 20 kg/ha for every extra millimetre of available moisture.

"I advise farmers not to harvest their residue because the mulch on the soil surface is critical for conserving water. If they need the income from the sale of the residue they need to make sure they receive enough money for it to make up for the water lost when the soil is left unprotected.

"If crop fields are grazed, livestock producers should manage their grazing so they leave the soil surface covered," he said.

"The income from the livestock offsets some of the water lost when the residue is reduced. Grazing is far less damaging than baling and removing g residue as with grazing, most of the nutrients in the residue are left in the field in the faeces and urine of the livestock. The trade-off is that some of the moisture-conserving mulch is lost.

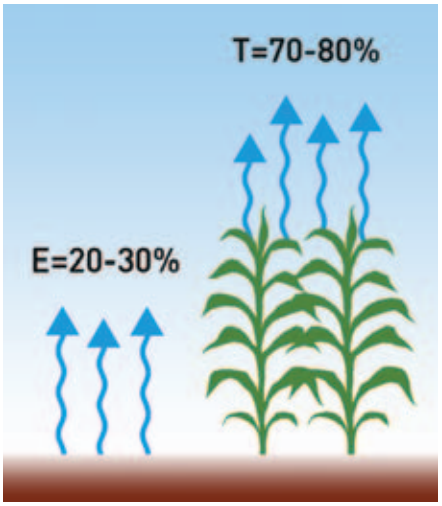
"Any rain occurring after the crop matures can be stored in the soil to be used by next year's crop, provided residue is left on the soil surface to reduce evaporation losses. Water is needed to grow the crops and feed the soil biology. When water is lost to runoff it carries away valuable top soil, nutrients, and pesticides. The good news is that most of the fertilisers and pesticides we use in the US bond to the soil, so if we can reduce runoff and keep the soil in place we keep those ag chemicals in place. When the soil stays in place and the water soaks in, productivity increases and environmental risks are reduced.

"Continuous no-till with low soil and residue disturbance makes the whole system work," he said.

Rainfall rate to create runoff (mm/hr)	
Disc	38
Ridge-till	81
Slot-plant	163

TILLAGE DESTROYS SOIL STRUCTURE AND REDUCES THE RATE AT WHICH WATER CAN SOAK INTO THE SOIL. A CONTINUOUS NO-TILL SOIL WITH GOOD SOIL STRUCTURE ALLOWS WATER TO SOAK IN QUICKLY, REDUCING RUNOFF DURING HEAVY RAINFALL EVENTS. (UNL RESEARCH FROM CENTRAL NEBRASKA, USA – UNIVERSITY OF NEBRASKA EXTENSION)

CROP WATER USE = EVAPOTRANSPIRATION (ET)



ON TILLED SOILS ABOUT A QUARTER OF RAINFALL IS LOST TO EVAPORATION AND THREE QUARTERS ARE USED FOR TRANSPIRATION AND CROP GROWTH. EVAPORATION TAKES PLACE FROM ANY WET SURFACE AND MUST BE ACCOUNTED FOR WHEN ESTIMATING HOW MUCH WATER A CROP WILL NEED. CROP RESIDUE REDUCES EVAPORATION AND MAKES MORE WATER AVAILABLE FOR THE CROP. (UNIVERSITY OF NEBRASKA EXTENSION)

WITHOUT RESIDUE, RAINDROP IMPACT CAUSES SOIL CRUSTING (LEFT) THAT REDUCES INFILTRATION AND, IN HEAVY RAINFALL EVENTS, LEADS TO RUNOFF AND EROSION (RIGHT) THAT WASHES PRODUCTIVE SOIL AWAY. (UNIVERSITY OF NEBRASKA EXTENSION)