Crop Residues & No-till Stimulate a Spiral of Soil Regeneration

by Randy Anderson

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SCIENCE

(*The following is adapted from an article published in* Journal of Sustainable Agriculture, *2005, with some information updated here with approval of the author.*)

Soils in the central Great Plains of the U.S. were severely damaged by wind erosion during the Dust Bowl era and from the effects of decades of tillage. The damage is partially reversible with more intensive cropping, residue cover, and no-till.

Ten years into a rotational study at Akron, CO, we examined ecological trends associated with soil structure, nutrient cycling, and pest management as affected by rotations. We examined crop yield in relation to crop sequencing and interval. Also, we suggest crop rotations that may further enhance regeneration and sustainability of soil.

Photo by Doug Palen.

Research shows how critical stubble retention is to maintaining soil productivity.

Introduction

Winter wheat >>summerfallow has been the main rotation in the central Great Plains since the 1930s. Producers developed this rotation in response to the region's semiarid climate where yearly precipitation ranges from 350 to 500 mm (13.8 to 19.7 inches) per year. During fallow, neither crops nor weeds are allowed to grow; therefore, precipitation during fallow is stored in the soil. Soil water gained during fallow reduces yield variability and crop loss due to drought stress. (*Editors: The tilled summerfallow technique was developed prior to the widespread availability of commercial fertilizers, and its initial success may owe more to the supplying of nutrients from breakdown of soil OM than to the storage of water.*)

A consequence of winter wheat >>fallow is loss of soil organic matter due to accelerated decomposition and removal by wind (and water) erosion. Of the original organic matter present in soil, as much as 60% has been lost.[1] A second characteristic of winter wheat >>fallow is its inefficiency in using precipitation for crop growth. Generally, less than half of precipitation received during the 2 years is used by winter wheat.[2] The rest is lost to evaporation, runoff, or leaching below the rooting zone of winter wheat.

During the 1980s, producers started replacing tillage with herbicides to control weeds during fallow. Eliminating tillage during fallow increases precipitation storage 20% and winter wheat yield 14%.[3] Because no-till stores more precipitation in soil, producers began growing corn, sunflower, sorghum, or proso millet in sequence with winter wheat and fallow.[4] To help producers plan new rotations, scientists in the region initiated several cropping systems studies, including a study at Akron, Colorado. With the Akron study, land productivity (total grain produced divided by number of years in the rotation) was increased two-fold by rotations comprised of a diversity of crops compared with

Organic matter (OM) in soil occupies a pivotal role in semiarid crop production because of its large influence on resource availability and yield stability.

[1] R.A. Bowman, J.D. Reeder & L.W. Lober, 1990, Changes in soil properties after 3, 20, and 60 years of cultivation, *Soil Sci.* 150: 851-857.

[2] R.L. Anderson, 1998, Designing rotations for a semiarid region, in Proceedings: 10th Annual Meeting, Colorado Conservation Tillage Association (Sterling CO, 4-5 February 1998), Colo. Conserv. Tillage Assoc. H.J. Farahani, G.A. Peterson & D.G. Westfall, 1998, Dryland cropping intensification: a fundamental solution to efficient use of precipitation, *Advances in Agronomy* 64: 197-223.

[3] D.E. Smika, 1990, Fallow management practices for wheat production in the Central Great Plains, *Agron. J.* 82: 319-323. (*Editors: The most recent data from Akron indicate wheat yield increases of 20%. M.F. Vigil, 2005, PowerPoint presentation at the No-Till on the Plains Winter Conf. [Salina KS, 24-25 Jan. 2005].*)

[4] G.A. Peterson, A.J. Schlegel, D.L. Tanaka & O.R. Jones, 1996, Precipitation use efficiency as affected by cropping and tillage systems, *J. Prod. Agric.* 9: 180-186.

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