Tillage, Rotations, and Weed Populations

by Randy Anderson

SCIENCE

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Crop residue retention has changed rotational practices in the central Great Plains. Winter wheat >>summerfallow has been the prevalent rotation since the 1930s. However, maintaining crop residues on the soil surface improves precipitation storage in the soil such that producers can grow more crops in succession before fallow is needed.[1] Producers now grow corn (*Zea mays*), sunflower (*Helianthus annuus*), sorghum (*Sorghum bicolor*), or proso millet (*Panicum miliaceum*) in rotation with winter wheat and fallow.

The benefits of crop residues are closely related to their quantity on the soil surface. One study on the Great Plains found that precipitation storage during fallow increased 1 cm (0.4 inch) for every 1,000 kg/ha (892 lbs/a) of winter wheat residues,[2] while another study reported that corn grain yield increased 5 to 8% for each additional 1,000 kg/ha of winter wheat residues.[3] Because crop residues often improve crop performance, some producers seek to maximize residue quantity on the soil surface.

After 18 years, the weed community differed between the two tillage systems, with density of all species being less in no-till.

When winter wheat producers and scientists first recognized the value of residue preservation in the 1950s, they developed tillage implements such as the sweep plow or rod weeder, which led to the "stubble mulch" system. With stubble mulch, weeds are controlled during fallow with a sweep plow, which consists of V-shaped blades that sever plant roots at a tillage depth of 5 to 8 cm (2 to 3 inches). Each operation buries only 10% of crop residues because of low soil inversion, contrasting with tillage by a tandem disk or moldboard plow that buries 60 to 100% of crop residues. Crop residue management is further improved with no-till systems, where herbicides replace tillage for weed control during fallow. Some producers in the region now rely completely on no-till systems for crop production.

Photo by Doug Palen.

Prickly lettuce & marestail are two species difficult to control with glyphosate.

Producers, however, are concerned about herbicide-resistant weeds in the central Great Plains. When "eco-fallow" was first developed, producers relied on atrazine to control weeds during fallow. Now, biotypes of kochia (*Kochia scoparia*), green foxtail (*Setaria viridis*), redroot pigweed (*Amaranthus retroflexus*) and barnyardgrass (*Echinochloa crusgalli*) are resistant to atrazine.[4]

Glyphosate also is used for weed control during fallow because of favorable economics and cropping flexibility. However, weed population shifts have led to a greater prevalence of species that require higher rates for control. For example, horseweed (or marestail, *Conyza canadensis*), toothed spurge (*Euphorbia dentata*), tumble windmillgrass (*Chloris verticillata*), and wild buckwheat (*Polygonum convolvulus*) are increasing in some producer fields. These species require substantially higher rates of glyphosate for control.[5]

Because of resistant weeds and species shifts, input costs for weed control during non-crop periods are escalating,

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