CONSERVATION TILLAGE FACTS

Crop Rotation, Soil Water Content & Wheat Yields

Using These Relationships Can Help You Estimate Wheat Yields Before You Plant

Cropping systems in the central Great Plains are diversifying and intensifying from the traditional wheat-fallow system. But winter wheat remains the major crop grown in this region. Adding additional crops in rotation with winter wheat can influence the amount of soil water available at wheat planting. This note describes those crop rotation effects on soil water and the subsequent effect on winter wheat yields.

Crop Rotation and Tillage Influence Soil Water and Yield

The amount of soil water available at wheat planting time in late September is determined by how much water was left at the time the previous crop was harvested, how much rain fell between the previous crop harvest and the time of wheat planting, and how efficiently the precipitation was stored in the soil. The efficiency of precipitation storage during the non-crop period prior to wheat planting is affected primarily by weed control method and the amount of crop residues left on the soil surface. More crop residues on the surface lead to greater precipitation storage efficiency as the soil surface is shaded and remains cooler than bare soil, and as wind speeds near the soil surface are slowed. Both effects reduce evaporation. Tilling the soil destroys residues and stirs the soil surface which leads to increased soil water loss.

Data averaged over a 9-year period at Akron, CO show that weed control by tillage (CT) during the fallow period resulted in nearly 3 inches less available soil water at wheat planting than when no-till (NT) methods were employed (Fig. 1, compare W-F (CT) with W-F (NT)). When corn and proso millet were added to the NT cropping system, there were small decreases in available soil water at planting. Available water following millet and fallow is probably lower than when following corn and fallow because of lower capacity of millet stubble to trap snow. When the fallow period was replaced with proso millet (Fig. 1, compare W-C-F with W-C-M), available water was reduced by nearly 4 inches.

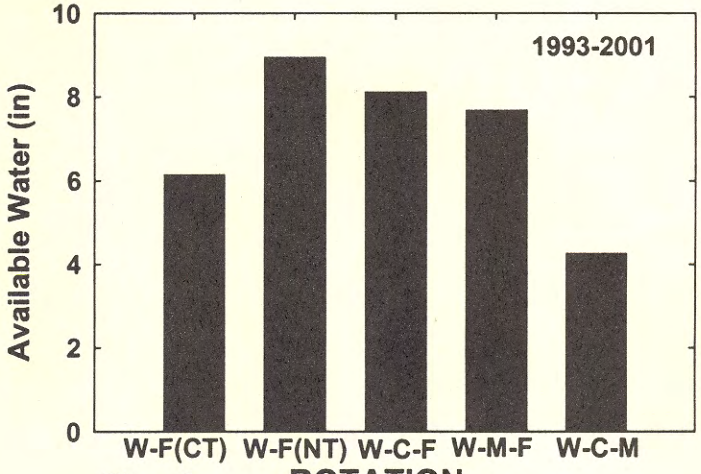

Fig. 1

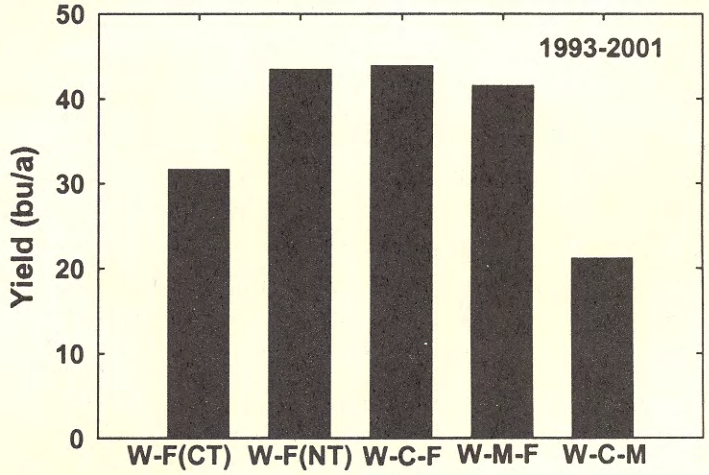

Fig. 2

The average wheat yield from W-F (NT) was 12 bu/a greater than from W-F (CT) (Fig. 2). There was no

Conservation Tillage Fact Sheet #1-02. Published by USDA-ARS Central Great Plains Research Station, 40335 County Road GG, Akron, CO 80720. By D.C. Nielsen Research Agronomist (e-mail dnielsen@lamar colostate edu; website www akron ars usda gov)

reduction in yield when corn or proso millet were added to the no-till system. When millet replaced fallow in the W-C-F rotation (Fig. 2, compare W-C-F with W-C-M), wheat yield was reduced by half. In these yield comparisons it is clear that yield differences are related to available soil water differences.

Quantifying Soil Water Influence on Yield

Wheat yield is related to available water at wheat planting according to two relationships (Fig. 3). The high response relationship (Fig. 3a) occurs when environmental conditions in April, May, and June are dry, average, or wet. Years that fall into this broad range of moisture conditions are identified by the difference between pan evaporation and rainfall during April, May, and June being less than 25 inches. This situation occurs in 87% of the years at Akron. In these years wheat yield increases 5.3 bu/a for every inch increase in available soil water at planting. For example, 6.5 inches would be required for a yield of 40 bu/a, while a yield of 60 bu/a would require 10.2 inches of available soil water at planting.

When the difference between pan evaporation and rainfall during April, May, and June is greater than 25 inches, conditions are very dry. This situation occurs in about 13% of the years at Akron. Under these conditions there is not enough rainfall during the growing season to support a plant that can make efficient use of the stored soil water, and the low response relationship between soil water and yield applies (Fig. 3b). In these years wheat yield increases only 1.5 bu/a for every inch increase in available soil water at planting, with 6.5 inches of soil water producing only 23 bu/a, and 10.2 inches yielding only 29 bu/a.

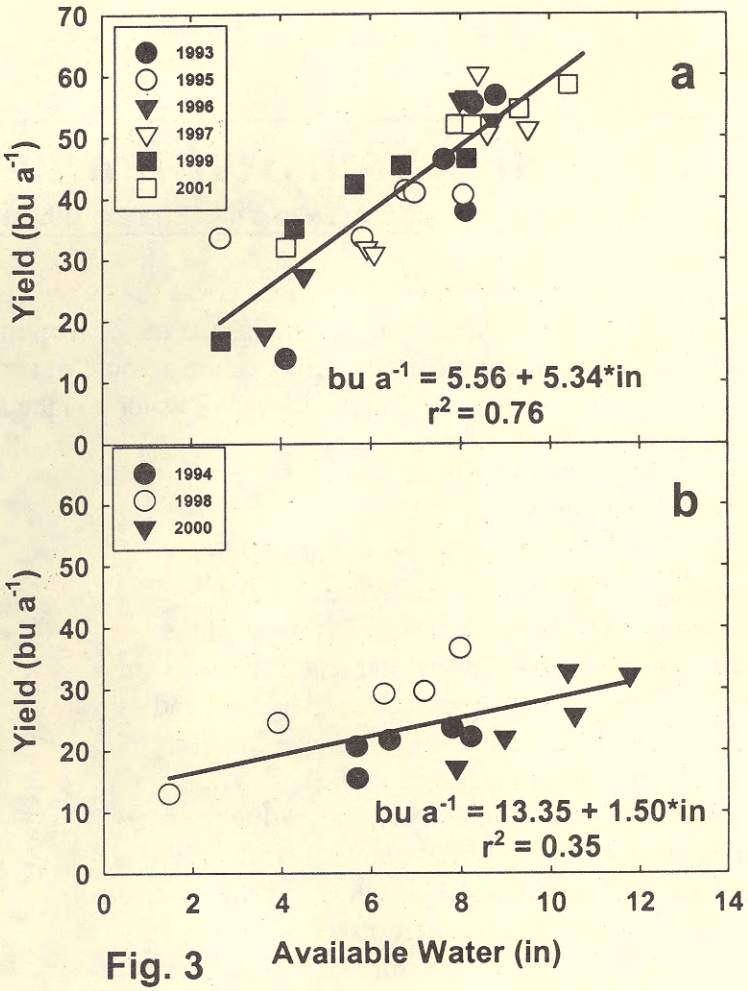

Fig. 3

Conclusion

Moving from conventional tillage to no-till fallow season weed control results in an average of 2.8 inches more stored soil water which can produce nearly 15 bu/a more yield in an average or wet precipitation year and 4 bu/a more yield in a very dry year. Adding corn or proso millet to a no-till W-F rotation will not significantly reduce wheat yield. However, substituting millet for the fallow period (W-C-M vs W-C-F) will markedly reduce available soil water at planting, resulting in a 20 bu/a yield decrease in most years and a 6 bu/a yield decrease in a very dry year. Monitoring soil water at wheat planting can provide producers with a projected wheat yield which may assist with crop choice decisions in flexible cropping systems.