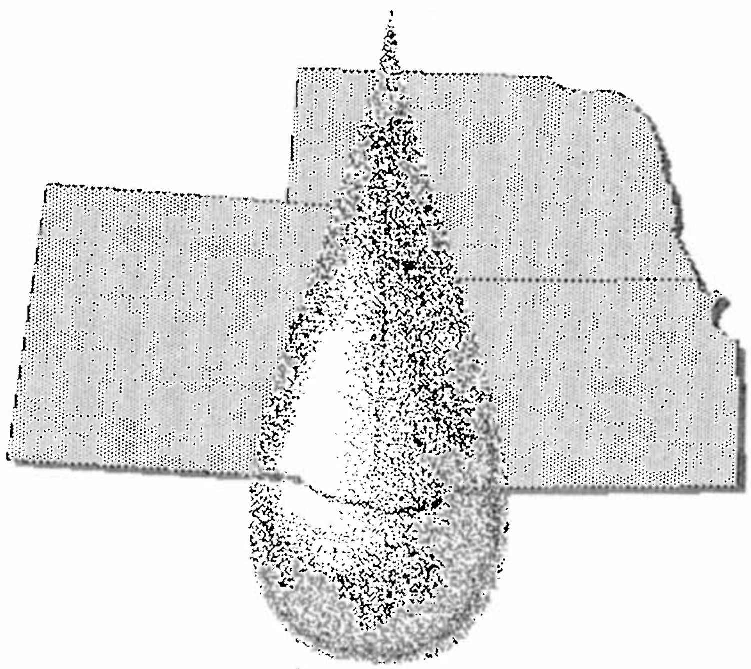
NIELSEN

19th Annual

Central Plains Irrigation Conference & Exposition

Proceedings



February 27-28, 2007
Holiday Inn
Kearney, Nebraska

University of Nebraska   Colorado State University   Kansas State University

Central Plains Irrigation Association

CROP RESIDUE AND SOIL WATER

D.C. Nielsen
Research Agronomist
USDA-ARS
Central Great Plains Research Station
Akron, CO
Voice: 970-345-0507 Fax: 970-345-2088
Email: David.Nielsen@ars.usda.gov

INTRODUCTION

Final crop yield is greatly influenced by the amount of water that moves from the soil, through the plant, and out into the atmosphere (transpiration). Generally, the more water that is in the soil and available for transpiration, the greater the yield. For example, dryland wheat yield is strongly tied to the amount of soil water available at wheat planting time (Fig. 1). In this case an additional inch of water stored in the soil at wheat planting time would increase yield by 5.3 bu/a. For wheat selling at $4.00/bu, that inch of stored soil water is worth over $21/a. Similar relationships can be defined for other crops. But the point is that in the Great Plains where precipitation is low and erratic, an important production factor is storing as much of the precipitation and irrigation that hits the soil surface as possible.

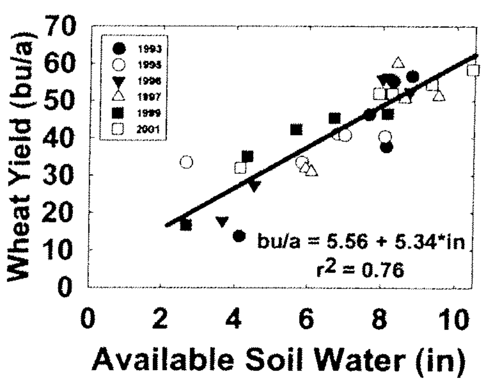


Fig. 1. Relationship between winter wheat grain yield and available soil water at wheat planting at Akron, CO.

FACTORS AFFECTING WATER STORAGE

Time of Year/Soil Water Content

The amount of precipitation that finally is stored in the soil is determined by the precipitation storage efficiency (PSE). PSE can vary with time of year and the maintaining surface residues reduce precipitation runoff, increase infiltration, and minimize the number of times moist soil is brought to the surface, thereby increasing precipitation storage efficiency (Fig. 4).

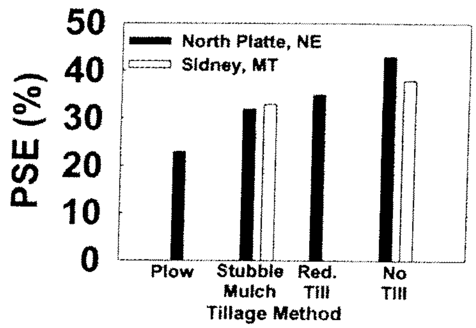


Fig. 4. Precipitation Storage Efficiency (PSE) as influenced by tillage method in the 14-month fallow period in a winter wheat-fallow production system. (after Smika and Wicks, 1968; Tanaka and Aase, 1987)

Snowfall is an important fraction of the total precipitation falling in the central Great Plains, and residue needs to be managed in order to harvest this valuable resource. Snowfall amounts range from about 16 inches per season in southwest Kansas to 42 inches per season in the Nebraska panhandle. Akron, CO averages 12 snow events per season, with three of those being blizzards. Those 12 snow storms deposit 32 inches of snow with an average water content of 12%, amounting to 3.8 inches of water. Snowfall in this area is extremely efficient at recharging the soil water profile due in large part to the fact that 73% of the water received as snow falls during non-frozen soil conditions.

Standing crop residues increase snow deposition during the overwinter period. Reduction in wind speed within the standing crop residue allows snow to drop out of the moving air stream. The greater silhouette area index (SAI) through which the wind must pass, the greater the snow deposition (SAI = height*diameter*number of stalks per unit ground area). Data from sunflower plots at Akron, CO showed a linear increase in soil water from snow as SAI increased in years with average or above average snowfall and number of blizzards. Typical values of SAI for sunflower stalks (0.03 to 0.05) result in an overwinter soil water increase of about 4 to 5 inches (Fig. 5).

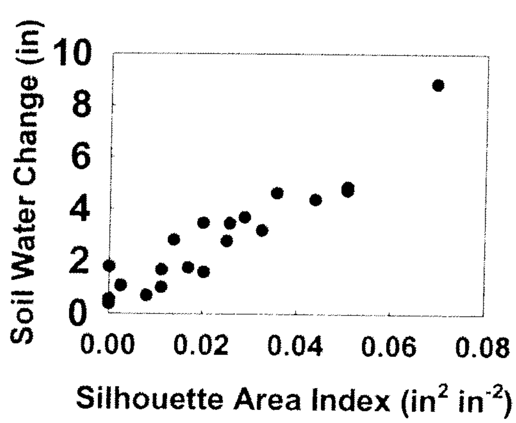


Fig. 5. Influence of sunflower silhouette area index on over-winter soil water change at Akron, CO. (after Nielsen, 1998)