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FROM THE GROUND UP

Agronomy News

Crop Production with Limited Water

During years with low water availability, a number of management adjustments are needed to best utilize available water for crop production.

Recent near record snowfall in some areas of Colorado has greatly improved mountain snow pack conditions with NRCS SNOTEL sites reporting from 72 to 108 percent of average snow water equivalents, while other parts of the state have recently received much needed rain. These conditions in late March are certainly an improvement over our winter precipitation last year. However the other side of the water story is the record low reservoir levels, below average surface and subsoil moisture in many locations, and moderate to severe drought still lingering throughout Colorado. Adding to this water dilemma will be the curtailed pumping of many alluvial wells along the S. Platte River, sold or leased water rights to municipalities, and decreasing well capacities on the High Plains and San Luis Valley. So, Colorado producers are most likely going to face another year of growing crops with less water. The articles in this issue are intended to provide information on a variety of topics that affect crop production during a drought. Hopefully, more snow will continue to improve our snow pack this spring and our skies will bring timely rains this summer. If not, information on farming with less water should be useful, and remain so as drought is certain to hit our state again.

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Knowledge to Go Places

Stubble Management Effects on Available Soil Water in Dryland Cropping Systems

As we head into what might potentially be another year of drought, dryland growers should consider how much residue they leave in their summer fallow operations.

The extreme and widespread drought of 2002 has caused all of us to reconsider the importance of water. Yet dryland crop production on the semi-arid plains of eastern Colorado faces water shortages of some degree every year. Consequently, it is important for farmers to use production methods that keep every drop (or flake) of precipitation that falls from the sky. Good stubble (crop residue) management will aid in that goal.

Good stubble management through reduced tillage production systems maintains crop residues remaining on the soil surface after harvest, and increases non-crop-period precipitation storage efficiency and soil water content at planting through decreased evaporation. This reduction in evaporation also continues during the early portion of the crop growing season when crop canopy closure is incomplete.

Evaporation from the soil surface is a three-stage process (Fig. 11). During the first stage, when the soil surface is wet, evaporation proceeds at a linear, high rate controlled by atmospheric conditions (dry, warm air and windy conditions increasing evaporation rate). Evaporation from a bare soil during this stage occurs at the same rate as evaporation from a water surface. The second stage is curvilinear as the soil surface becomes dry and the evaporation rate slows down. Third stage evaporation occurs when the soil surface is dry and water vapor diffuses slowly through the soil to the soil surface. As the amount of residue left on the soil surface increases, the rate of first stage drying decreases allowing more time for water to infiltrate and move deeper into the soil profile. Additionally, crop residues on the soil surface also reduce raindrop impact, thereby maintaining high soil surface infiltration rates.

Studies conducted in Sidney, MT, Akron, CO, and North Platte, NE have shown the increase in precipitation storage efficiency that occurs with increasing amount of crop residue left on the soil surface (Fig. 12). Those studies showed that precipitation storage efficiency was about 16% during the period between wheat harvest and wheat planting in the fall of the next year when there were no residues left on the soil surface. Precipitation storage efficiency over that same time period increased to 34% when 9000 lb/a of wheat residues were left on the soil surface after harvest.

No-till production systems also eliminate the "soil stirring" that occurs with conventional tillage weed control. With fewer tillage events and less soil stirring, there is less opportunity for stimulated evaporation from moist soil being brought to the soil surface. Data collected at Akron, CO following wheat harvest in 2001 (Fig. 13) demonstrate the much lower soil water storage that occurred when the soil was tilled four times (W-F, CT) between wheat harvest and the spring of the following year compared with no-till management (W-F, NT; W-C-F, NT).

Wheat yields respond dramatically to available soil water at planting, so the efficient storage of precipitation is extremely important to wheat yield. At Akron, we have found that for most years (April-June), wheat yields increase by about 5.4 bu/a for every inch of water stored in the soil (Fig. 14). In the years with extremely

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dry conditions during April, May, and June (10-13% of the time), wheat yields increase by 1.7 bu/a for every inch of water stored in the soil. The kind of predictive relationship shown in Fig. 4 for wheat does not exist for corn, as dryland corn yield is much more determined by precipitation falling in July and August than by stored soil water. However, within a given year, corn yield does increase with increasing amount of stored soil water. The rate of increase in yield with available soil water changes from year to year depending on timing of precipitation.

No matter what the crop is, producers should be encouraged to efficiently store precipitation with good stubble management methods. The better the stubble management, the higher the precipitation storage efficiencies and crop yields will be.

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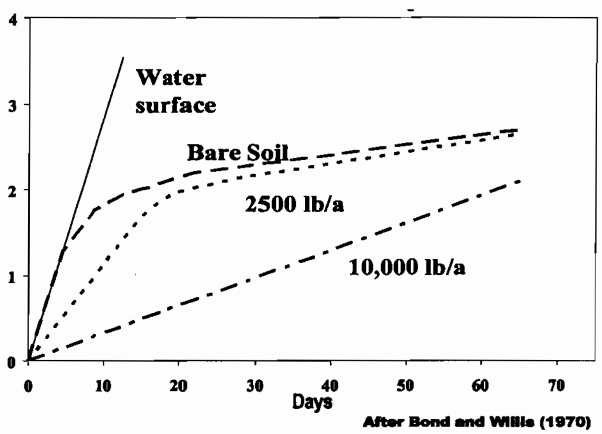

Figure 11. Wheat straw effect on evaporation

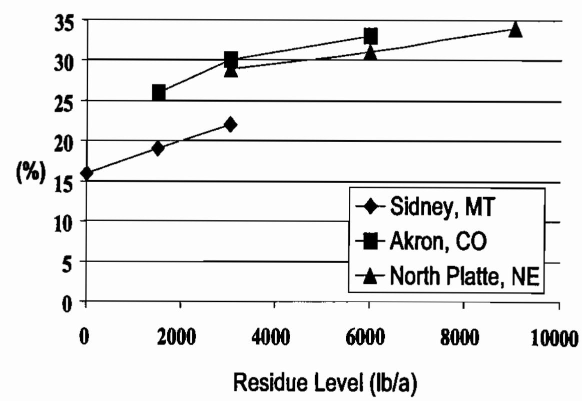

Figure 12. Precipitation storage efficiency

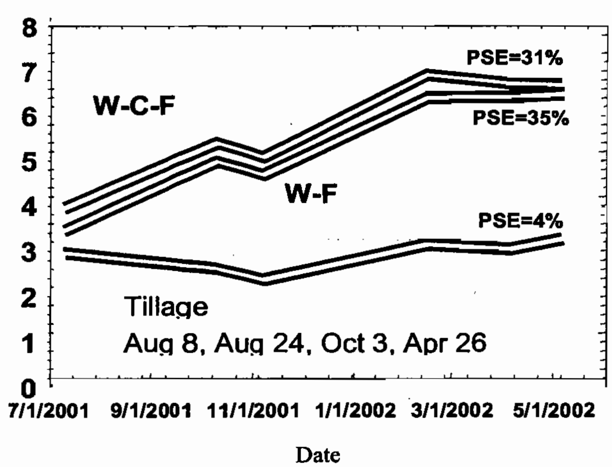

Figure 13. Precipitation storage following wheat harvest

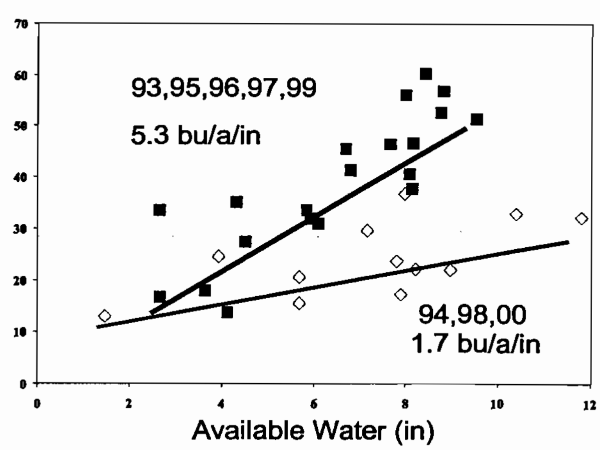

Figure 14. Wheat yield vs. starting soil water