CONSERVATION TILLAGE

FACTS

Managing Residue & Storing Precipitation

THE FACT

No practice other than conservation tillage offers as many ways to save soil, water, energy, labor and wear and tear on equipment.

Summer fallowing is a notoriously poor water conservation practice. Commonly, less than 25°/0 of the precipitation received during the 14-month fallow period is stored in the soil. In northeastern Colorado, this means 75% or over 15 inches of water is wasted every crop-fallow cycle. However, the choice of fallow method can greatly affect precipitation storage, in part due to greater residue levels maintained on the soil surface,

Fallow Methods

Fallow methods have changed over time. Methods used in the 1920s and '30s did not control weeds in the% fall after wheat harvest; instead, they used intensive tillage (plow and disk) for weed control the following summer. Precipitation storage efficiency (percentage of precipitation stored in the soil profile) averaged 24% with this method using a one-way disk, which leaves a dust mulch on the soil surface, but virtually no crop residue *(see Fig. 1)*. In the 1940s, the rodweeder replaced some disking operations, and storage efficiency reached 27%. During the 1950s and '60s, stubble mulching was developed, in which the sweep plow controlled after-harvest weeds as well as the following-summer weeds. This method improved storage efficiency to 33%.

Herbicide availability has led to the development of new fallow methods: reduced-till and no-till. The reduced-till method consists of application of residual herbicides after wheat harvest, followed by tillage for weed control during the second summer, resulting in a storage efficiency of 40%. The no-till method is similar to reduced-till, except that foliarly-active herbicides replace tillage operations in the second summer. Its storage efficiency is largely due to no soil stirring during the second summer. Both methods store more

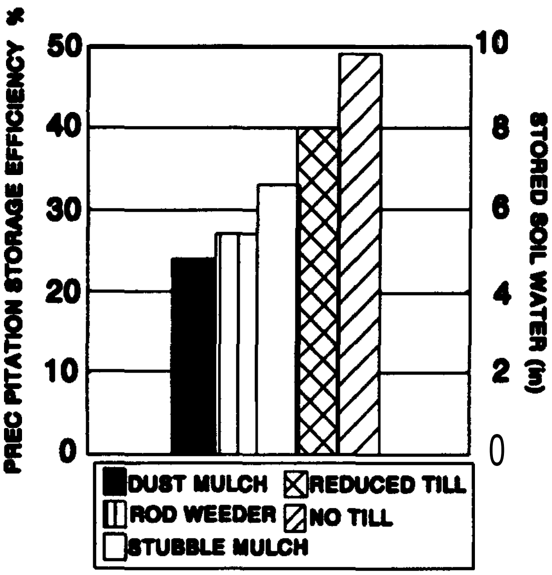

Figure 1

precipitation than stubble mulch because residual herbicides control fall weeds without disturbing the position of wheat stubble. Upright stubble catches snow over winter and reduces water evaporation from the soil surface during the summer.

Fig. 1 dramatically demonstrates that reducing fallow tillage operations increases stored soil water. For example, with average precipitation conditions during the fallow period, approximately 4.5 inches more water would be stored in the soil using no-till methods than using the dust mulch method.

Precipitation Storage

Storage of precipitation varies during the fallow season. For example, when storage efficiencies are compared for the foIlowing segments: after-harvest (July 15-Nov. 1); over-winter (Nov. l-April 1); and

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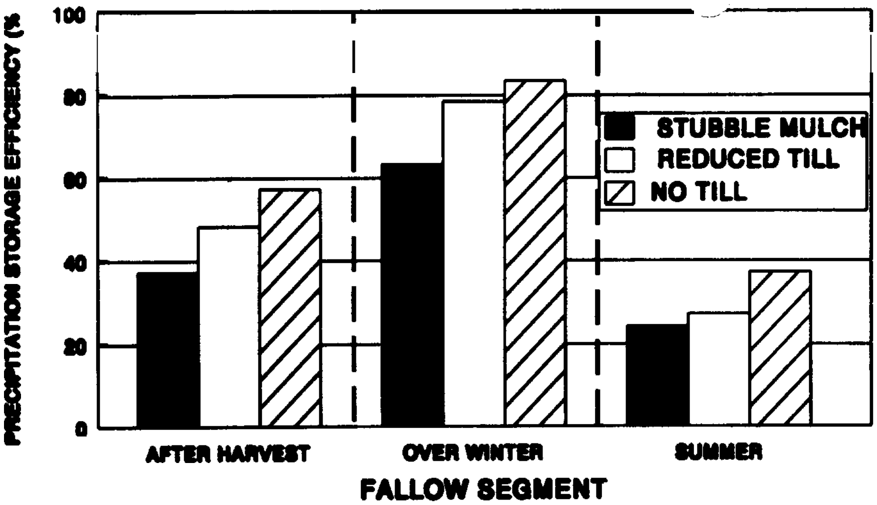

Figure 2

summer-fallow (April 1-Sept. 15), the highest storage efficiencies for all methods occur during the over-winter segment, ranging from 60-75% *(see Fig. 2).* The lowest storage efficiencies occur in the summer-fallow segment, when evaporation rates are the highest.

Note that stubble mulching stores less water than the other methods during the after-harvest segment. Tilling the soil during this segment reduces storage efficiency for the stubble mulch method. This effect continues for the duration of the fallow period, resulting in reduced precipitation storage because of soil stirring and the loss of surface residue cover. A long-term benefit in continuous no-till fallow is the build-up of crop residue, which increases precipitation storage during the after-harvest and over-winter segments when compared to the reduced-till method.

Cropping Implications

More intensive cropping systems can and must be employed if the increased available water from reduced tillage systems is to be used efficiently. We can estimate the average production of three cropping systems varying in residue management and cropping intensity by using the precipitation storage efficiencies shown in Fig. 2 in conjunction with long-term average precipitation amounts and yield-water use production functions from Akron, CO (Fig. 3). The figure shows that over a six-year period (the time necessary for both two-year and three-year rotations to complete full cycles), wheat production in a wheat-fallow system is approximately 30% greater under no-till conditions than under stubble mulch. However, these yield increases are not observed in the field, indicating that the extra stored soil water was not used by the crop. Increasing the cropping intensity to two crops in three years (the wheat-corn-fallow rotation) potentially doubles production compared to wheat-fallow. This result has been validated in the field. In fact, under no-till conditions, more intensive cropping systems will be required to avoid potential problems such as saline seep development or groundwater contamination due to nitrates and pesticides moving below the root zone. An equally important consideration is the improved economic returns associated with more intensive cropping.

Summary

Replacing tillage operations with herbicides enables producers to increase the amount of crop-residues on the soil surface and the amount of water available for crop production. Improved precipitation storage allows producers to crop their fields more often and also increases the probability of successful crop production during drought years.

More diverse cropping also benefits producers from a weed-control perspective. Diversity in crop life cycles (such as a spring-planted crop following winter wheat) helps the producer control jointed goatgrass, downy brome and volunteer rye--three weeds prevalent in winter wheat-fallow systems.

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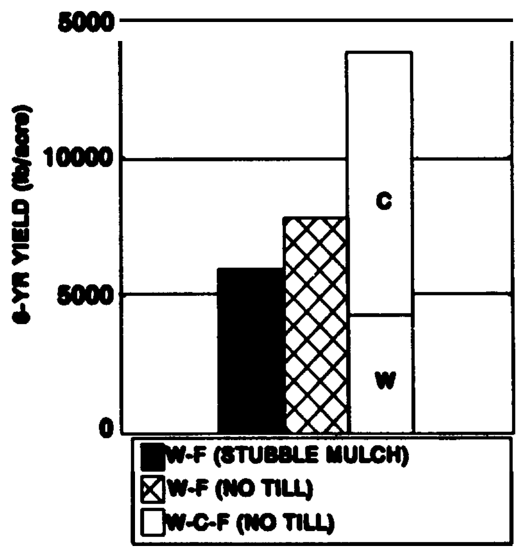

Figure 3