

## Cropping Systems and Tillage Methods for Moisture Conservation and Wheat Production<sup>1</sup>

HARLEY A. DANIEL<sup>2</sup>

The problem of efficient use of water for winter wheat production has occupied the minds of farmers and students almost from the beginning of agricultural development in the plains. They have long recognized that cropping systems and cultural practices must be adequate through droughts as well as periods of abundant precipitation.

Weather conditions recur in some definite pattern and there will continue to be groups of wet and dry years in western Oklahoma. For best results, the moisture supply must be considered every year when making plans for wheat production. This conclusion is based on results of research, using stubble mulch and other tillage practices and cropping systems for moisture conservation and wheat production at the Wheatland Conservation Experiment Station near Cherokee, Oklahoma, since 1939. This station is located on rolling deep, permeable, fertile soil.

### CROPPING SYSTEMS AND FERTILIZATION

Many soils are responding to commercial fertilizers in western Oklahoma but water is the predominant limiting factor in crop production. In selecting the crops to be planted in a rotation, stress should be placed on the soil moisture relations and their value in maintaining a vegetative cover. Therefore the cropping systems, erosion control methods, and other farm practices must be designed for the maximum safe use of soil and water resources. It is also advisable for the land to be covered as much of the time as possible with close-growing, sod-like crops.

The use of fertilizer to improve ground cover and increase wheat production has been investigated on the Wheatland Station. The wheat responded only slightly to small amounts of nitrogen, but the greatest increase appeared to be on the stubble mulched plots. Best results, however, have been obtained from a combination of superphosphate and nitrogen and from superphosphate and winter legumes. Superphosphate alone increased the yield of wheat about 40 per cent and the combination of superphosphate and nitrogen increased it 58 per cent. Phosphorus fertilization was more important than nitrogen for early growth. The short supply of phosphorus limits fall growth on many soils which contain sufficient available nitrogen for more growth. This is important to those who depend on wheat pasture for livestock.

### FLEXIBLE TILLAGE

As these western soils begin to respond to fertilization, proper cultural practices for seedbed preparation become more important. Adequate tillage immediately after harvest includes the covering of shattered grain and weed seed and the control of weeds. Under average rainfall conditions, weed growth was controlled successfully with sweep tillers. However, during extremely wet seasons, crab grass and other weeds were difficult to kill with sweeps; while during extremely dry seasons, the surface soil became very loose and volunteer wheat and weeds did not sprout.

Due to normal seasonal variations, the method of tillage for seedbed preparation should apparently be flexible in order to take advantage of moisture conditions in the area represented by the Wheatland Station. When soil moisture conditions are favorable following harvest, the crop residue may be worked into the top soil. In the presence of ample moisture and high temperatures, prompt decomposition of residue is insured.

<sup>1</sup> Contributions from United States Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Branch, and Oklahoma A. and M. College.

<sup>2</sup> Project Supervisor, Guthrie, Oklahoma.

This results in a more favorable supply of available nitrogen during the spring period of crop growth and controls white heads or foot-rot.

If dry weather prevails, immediate one-way disking or other surface tillage after wheat harvest appears to be justified. If adequate rains come during the month of July, tillage designed to work the crop residue into the surface soil, and conducted on the contour, is usually the best preparation. Then, as later rains bring on the weeds and volunteer wheat, the land may be tilled with a disk or field cultivator. If the July rains do not wet the soil deep enough for working under the crop residue, but enough to start the weeds, the surface tillage should be adapted to the needs of the field.

#### WATER CONSERVATION

Runoff water was conserved at the Wheatland Station by mulches and rough surfaces during the period of seedbed preparation. It was also significantly reduced by contour cultivation, but a combination of contour cultivation and terracing reduced annual runoff water an average of 35.4 per cent. The actual per cent of precipitation lost in runoff from the land cultivated with the slope was 14.99, while that from the terraced and contour cultivated areas was only 9.69. No soil loss measurements were made, but observations showed that inter-terrace erosion occurred during heavy rains on clean-tilled land. There was no noticeably serious erosion, however, on the mulched plots between terraces with vertical intervals of six feet.

#### WHEAT PRODUCTION

The principal measure of effectiveness of different methods of moisture conservation is the production of wheat at the Wheatland Station. The moisture conserved by terraces for a ten-year period on this station was not sufficient to increase the yield of wheat significantly. Under continuous tillage of the same nature, the highest average yield of wheat was produced on plowed land and the lowest on stubble mulched plots. The amount of grain produced on the moldboard plowed plots was an average of 18.8 bushels of wheat per acre, while that on the mulched areas was only 14.8. The mulched land has consistently contained a heavy growth of cheat and weeds, and the wheat plants were attacked by an infestation of foot-rot.