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MINIMUM TILLAGE ON IRRIGATED SOILS IN UTAH ¹ /

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In Utah, the soils in most areas of the state are fine textured and silty in nature. The problem of soil compaction or tillage-pan development is especially acute on these soils. Therefore, minimum tillage is needed and applicable in Utah.

In Arizona, according to Harris, Aepli and Pew ² /, a limited amount of soil compaction causes a decrease in the water intake rate of soils and inhibits normal root growth. They found that breaking up the compacted zone and aerating the soil are essential in seedbed preparation. Minimum equipment operations have given good results and increased yields. They also found that when soil is powdered, irrigation water tends to puddle the soil, making seedbed preparation difficult and retarding plant growth.

In Utah we consider "minimum tillage" as the working of the soil the least number of times necessary to prepare a seedbed for the crop to be grown and to control weeds.

This practice has been called rough tillage, proper tillage and limited tillage at various locations within the state. The idea of minimum tillage has been accepted by many farmers and is being applied in various parts of the state. In all irrigated areas of Utah, farmers have a problem of soil compaction or tillage-pan development.

¹ / Paper presented at the annual meeting of the American Society of Agronomy, Purdue University, Lafayette, Indiana, August 4-8, 1958. Appreciation is expressed to Soil Conservation Service employees in Utah, who have given me data for this paper. I especially wish to express my appreciation to SCS employee Clifford Merrill, of Delta, for his slides and data. The help in the field, of Karl Harris, Agricultural Research Service, Phoenix, Arizona, has been greatly appreciated.

² / The work done by Karl Harris, D. C. Aepli and W. D. Pew in Arizona is recognized in their bulletin #257, dated June, 1954, and entitled "Tillage Practices for Irrigated Soils," published by Agricultural Experiment Station, University of Arizona, Tucson, Arizona.

The weight of a cubic foot of silty clay loam soil should be approximately 85 to 90 pounds, but under the number of tillage operations normally practiced by farmers, a cubic foot of soil has been known to weigh 110 or more pounds.

Minimum tillage has been one means of assisting in correcting this problem. This system of tillage reduces soil compaction, increases water penetration and soil aeration, and consequently creates a more favorable atmosphere in the soil for bacterial activity.

At Delta, Utah, considerable work with minimum tillage has been done. This area is noted for its fine-textured soils, and has drainage and salt problems. It is irrigated from the Sevier River system, and the water contains a considerable amount of salt (1600 ppm - average).

In a minimum tillage program, as practiced at Delta, the essential steps are:

1. Plow in the fall when the soil is relatively dry. Plowing is done to a depth below the plowpan. Depth is varied year to year to prevent creating another compacted layer. Chiseling is done where plowpans are deeper than can be broken economically by plowing.
2. Let the soil aerate for 30 to 60 days after plowing before further tillage or irrigating.
3. Irrigate in the fall to wet the soil profile; or, if water is not available then, wet the profile with a spring irrigation. At Delta, fields are left over winter in a cloddy condition. The air, moisture, and frost mellow and loosen the soil.
4. Plant the crop. It may be necessary to give the land a light harrowing before drilling if irrigation and weathering over winter have not mellowed the soil sufficiently for a seedbed. Also, it is usually necessary to harrow lightly when seeding alfalfa, beets, grass or other small seeds.
5. Cultivate row crops only when necessary to control weeds. Spraying may be more economical than cultivating for weed control.

Farmers who have used minimum tillage have:

Increased crop yields from 25% to 100%. One farmer increased his corn yield 25%. Yields of barley were increased more than 40 bushels with some fields yielding as high as 120 bushels per acre. Land given minimum tillage yielded two truck loads of corn silage per round of field, compared to one truck load per round on an adjacent field given conventional tillage. (These fields were of equal size, and the loads were comparable, with the

same truck being used). On an irrigated field, a border-strip planted to barley after plowing and harrowing yielded 110 bushels per acre; the adjacent border, which was plowed, disked, harrowed twice, and floated before planting, yielded 35 bushels per acre. This is in the ratio of 3:1 in favor of the minimum-tilled land.

We have found at Delta that after two years of minimum tillage on a heavy clay soil, the intake of the soil was 4 inches per hour. Similar fields, where conventional tillage was practiced, had water intake rates of only 1/2 to 1 inch per hour,

Leaching of the soil, of harmful salts, has been more effective on minimum-tilled soil because water percolates more readily through the soil profile.

Soil structure has been improved so that hard, tight spots have been reduced in size or eliminated.

Young plants show less strain for water between irrigations, and plant roots have been found deeper in the soil profile on minimum-tilled land.

Less labor is required to produce a crop with minimum tillage. Equipment operating time is less since some tillage operations are eliminated.

Minimum tillage, along with grasses or grasses and legumes, has proved very effective in loosening or mellowing compacted soils. The quickest results have been obtained on soils that have moderate to good soil structure.

Tall wheatgrass is one of the best soil-improving crops we have. It has proved the most effective of the grasses for opening up the soil and forming good soil structure.

If minimum tillage is used, large heads of water are necessary to properly irrigate the land and fill the soil profile with water.

Evidence in some cases has tended to show that on some soils permeability may be increased beyond a practical limit by minimum tillage. Research on this will be needed to determine the practical limits for using this system of tillage.

In conclusion, I wish to emphasize the following points which we have found to be necessary for successful minimum tillage in Utah:

After fall plowing, never spring-till land more than necessary to prepare a seedbed. Usually, one harrowing, drilling and laying off or bordering, are the maximum amount of tillage needed.

Powdering the soil destroys structure; leave land cloddy, if possible.

Let the soil aerate before irrigating or tilling. A 30 to 60-day aerating period is usually advisable.

Irrigate in the fall or spring to fill the soil profile with water and leach out salts.

Cultivate row crops only to control weeds; spraying may be used instead of cultivation.

Return all possible organic residues to the soil.

Finally, remember that tillage operations cost money, and that implements and tractors compact the soil.

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