There may be a better tillage plan for you

These plowing depths and residue placements were tested by Purdue as possible future mulch-tillage systems. The placed residue is in green. Depths in 2 and 4 are 3 inches; others 7. No. 5, described in article, was best with 112 bushels of corn an acre. The special mulch-tillage machine (above), used in Illinois tests, does a once-over job of soil preparation, corn planting and fertilization in two 30″-wide slits through established sod.

COUNTRY GENTLEMAN FIELD REPORT

Do You Really Need to Plow?

"Stubble mulch" idea, coming from Great Plains to our cornfields and other great row crops, may when fully tested be the solution to high costs, labor and soil saving.

WOULDN'T it be better for your soil if you could till it in a way that would leave a mulch of crop residue or a blanket of sod on the surface? This would act as a blotter to absorb moisture, reduce evaporation, and almost eliminate runoff and erosion. It would be great for soil conservation and could be expected to do away with much of the need for expensive terraces.

Just such a system has proved highly successful in the semiarid Great Plains where "stubble mulch" is now practiced on something like 25 million acres. And, spurred on by these good results and the great need to find some better method than clean tillage for our great row crops—notably corn—crops and soils researchers now are eagerly seeking to adapt the method to other parts of the country.

These experimenters see many exciting possibilities. If you could grow corn without plowing, they reason, you would save more than soil—you would save operating costs too. You might use a "once over" machine to give your soil subsurface tillage, to plant your corn, and to fertilize it, too, all at the same time. And the soil between the rows would be held in place at all times by a mulch of stubble or a legume-grass sod.

But it wouldn't be smart to toss your moldboard plow onto the scrap pile just yet. True, the experimenters are impressed by the remarkable ability of crop residues and sod mulches to hold soil and water, but they are running into some mysterious effects which have them scratching their heads. The soil under the mulches seems to go through a somewhat different biochemical process than soil that has been turned over with a plow. It may look more mellow and friable, it may take in moisture faster—but it seems slower to give up its plant food to the growing crop. It reacts differently to fertilizer than does plowed soil. In some cases it has produced yields as high or higher than those on comparable plowed land—but in many other trials, yields have been depressed. There have been serious problems, too, with weed control.

Will scientists get the "bugs" worked out of the system? A number of researchers believe that in time they will. Some are confident that they are on the trail of a revolutionary new method of tillage. They have a hunch that plowing and clean tillage of row crops will become a thing of the past when they hit on the right techniques.

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Here are the high lights of the tests they now have under way:

Indiana—High-Yield Combination. A modified mulch tillage method which gives high corn yields along with excellent erosion control is the star among the many methods being tested in a long-range study by Purdue University and the SCS.

Eight different combinations of residue placement and depth of tillage are being compared with one another and with plowing in these tests on both sandy loam and silt loam soils. Results to date spotlight the problem of getting both maximum soil protection and maximum yields. The best protection of soil comes when the residue is left on the surface, but the best yields come either from plowing or from mixing the residue into well-worked soil. Surface residues have consistently resulted in lower yields—sometimes as much as 25 bushels lower than those from the most productive modified mulch.

Outstanding in the tests has been Treatment No. 5, which has given yields as high as 112 bushels an acre on sandy loam, and has at times exceeded those from plowed land. In this treatment, as in the others, the mulch consists of the plant residue from a preceding meadow crop of red clover, alfalfa, alsike and timothy in a rotation. A special plow is used, one with an upper moldboard-and-share and a lower subsurface tillage sweep. The meadow growth was killed by the upper share, cutting at a depth of three inches, just deep enough to cut off the grass roots below their crowns and to sever taproots of the legumes. Deep tillage was provided by the sweep, undercutting the soil at a depth of 7 inches. A disk harrow mixed the residue in the upper three inches of soil. The same treatment could be duplicated with an ordinary plow, a field cultivator and a regular disk harrow.

This system gave good protection to the soil, and prevented crusting over. Yet it also made a good seedbed and avoided the yield-depressing effect that has been the drawback of a surface mulch.

The Indiana researchers have observed that surface mulches often reduce the germination of the seed because there isn't enough loose soil to cover the seed thoroughly. Also, clumps of undecomposed vegetation often break loose and cover young plants during later cultivations. Another problem has been that the residues entirely on the surface are broken down very slowly by bacteria, as compared to residues well covered with soil. During the decomposing process these bacteria compete with growing plants for the supply of available nutrients in the soil, particularly nitrogen.

Weed control also has been difficult with the trashy surface residue. Some of the previous meadow continues to grow and a regular cultivator may not penetrate through it, and the weeds may not be completely cut off or pulled out.

Where the residue was mixed with the soil, seedbed preparation was much easier and weed control was more effective. While the mulch cover wasn't as effective, the soil absorbed water rapidly and runoff was substantially reduced. Loose, friable soil made it easier to cover the seed corn, and a more uniform stand was obtained than in the surface mulch plots.

In contrast, soil and water conservation on the conventionally plowed and disked plots was definitely inferior. The heavier soils had a tendency to crack and crust over. A thin layer usually becomes compacted and reduces water insoak, increasing runoff and erosion. However, the corn under this treatment consistently produced high yields in most years.

Iowa—"Once Over" Operation. Researchers here are looking for the day when putting in the corn crop will be a single operation, with one machine doing the following things all at the same time: Stirring the soil under the surface with sweep-type tillers, leaving a trashy mulch on the surface; working up the seedbed in strips just wide enough for corn rows with pulverizers or beaters; planting the corn; and putting down bands of fertilizer beside the corn rows. Space between rows would be left in the stubble mulch or planted to cover crops.

The stubble-mulch, skip-space system hasn't been perfected yet, but parts of it are being pieced together by hopeful researchers. Frank Schaller, of Iowa State College's agronomy department, puts it this way: "We're heading toward a one-operation system and we believe farmers will switch to it, even if it means taking a 5-bushel loss in yield. They'll save soil, water, time and labor. They may be able to eliminate the need for terraces in some fields, or to space terraces farther apart. Such a system would let us grow more acres of corn without losing our soil."

Leaving the crop residues on the surface has been found to reduce soil loss by as much as 80% where the previous crop left at least a ton of stubble. Skip-spacing holds soil too. In these tests a 24-inch strip is tilled with double sweeps, one cutting at 3 inches deep, the other at 6. A 16-inch completely undisturbed space is left between rows. Even if the ground is left bare, this method cuts down runoff, but if you have a cover crop it is much more effective.

But the yield problem still has researchers up a tree. Yields on stubble-mulched plots at the Ankeny, Iowa, substation have averaged 3 to 6 bushels per acre less than those for plowing on medium-textured, well-drained soils, and 10 to 15 bushels less on heavy soils. Schaller believes some of the trouble may be with the sweeps, which might be redesigned to do a better job of breaking up clods and getting rid of air pockets. He also points out that much remains to be learned about availability of plant foods and moisture under the stubble-mulch system and new methods of fertilizing may be developed.

This past dry year the mulched plots were particularly down in yield—10 to 20 bushels less than on plowed land, on a stand-corrected basis. Part of the trouble may have come from a poorer seedbed, as the trash interfered with the planting equipment and possibly with emergence of the plants.

There were big "fertility gaps," Schaller observed. The trash-mulch plots ran out of nitrogen when the corn started to shoot ears. They had received 80 pounds of nitrogen per acre, but apparently needed about twice that much, he believes.

The fact that the mulched plots ran out of nitrogen may be explained by increased populations of bacteria, working on the crop residue, and tying up much of the nitrogen in the soil. Certainly, something unusual happens when the mulch is on—not under—the ground. On some plots, researchers removed all the residue before plowing, and these plots yielded about the same as regularly plowed land. On certain other plots the residues were removed before plowing and then put back on top of the plowed ground—and down went yields by 16 to 20 bushels.

Illinois—"Sod Mulch." It may be possible to follow corn with corn for several years, yet maintain soil fertility through a new system of sod mulch or intertilled cropping, Illinois crops and soils men believe. The trick, they find, is supplying enough water and nitrogen.

In the Illinois work, corn has been planted in slits or strips in a sod of legumes or grasses. Before 1950 the seedbed strips were prepared with a special rotary tiller which caused uneven stands by leaving the surface too uneven and loose. Since 1950, however, a special mulch planter with subsurface sweeps and a rotary hoe has been used and stands have been regular.

There's been no doubt that this sod mulch is soil and water saving. Around 90% or more of erosion normally occurs in May and June after spring plowing and before the corn gets high enough to provide protection, but when there's a growing mulch on the ground at all times, the loss is practically zero.

The main problem with the intercrops has been competition. All of the intercrops, including the legumes, competed vigorously with the corn for nitrogen and moisture. While the living mulch helps the soil to take in moisture faster, and slows down evaporation, it can more than offset this by its demands for moisture in a dry season. Illinois tests showed that under intercropping, moisture available to plants at a depth of 10 inches increased more rapidly than under conventional cultivation; but during dry spells the soil became dry more quickly. In other words, intertilling might work well in years of normal rainfall, but without supplemental irrigation might fail miserably in drought years.

Much the same is true of nitrogen. Enough has to be supplied for the intercrops, as well as the corn, or nitrogen shortage will depress corn yields. When enough nitrogen was supplied, yields of corn in the intercrops ran around 80 to 100% of those under conventional systems. This extra nitrogen isn't lost, of course, as the residues of the intercrops eventually return to the soil.

The possibility of growing 100 bushels of corn year after year, with no erosion problem, keeps Illinois researchers enthusiastic for sod mulch. But they realize the system needs much testing and retesting before it is ready for the average farm. They point out that economically there's a chance to save much labor and gasoline in tillage, there's an advantage in having corn more often in the rotation—but whether these are enough to offset the possibility of lower yields and cost of heavier fertilizing remains to be seen.

Michigan—Disk-Mulch Promising. Researchers here are optimistic about the possibilities of a modified form of stubble mulch, involving disking the stubble into the soil, in preparation for corn. This method over a six-year test has produced corn yields averaging about 4 bushels an acre more than those from conventional plowing.

In the standout method for corn, the land was worked over with a double tandem disk, followed by a specially constructed rotary hoe with the wheels reversed to produce a packing action. This broke up and distributed the crop residue in the topsoil.

Like researchers elsewhere, the Michigan experimenters are impressed with the ability of stubble mulch to hold soil and water, but want to know more about just how crop residues should be placed, how finely they should be broken up and the best methods of fertilizing.

They admit that stubble mulch has problems. One of these is weeds, which have been difficult to control in mulched corn. They believe that with chemical weed control this problem may be licked. Michigan also ran into the nitrogen lag. As harvest approached the plowed crops looked greener and tests indicated nitrogen shortage in the stubble-mulched plants.

The Great Plains—Success. During the last ten years stubble mulch has become a common good-farming practice in the Great Plains wheat belt, but methods have changed toward a somewhat "modified" system. It has become a rather uniform practice, while leaving most of the residue on the surface, to work the soil down to six inches or so, and to mix some of the residue in it. However, the soil is *not* turned over.

The first tillage is performed with a one-way, a large disk implement that throws the soil in one direction, with disks set at an angle which leaves practically all of the stubble undercut and on the surface. Weeds are then controlled with a rotary-rod weeder or with shovel or sweep-type blades that give subsurface tillage and don't turn under the mulch. These implements develop a cloddy, rough surface, which, along with the mulch, aids in preventing soil blowing.

By seeding time the crop residues are sufficiently well worked into the seedbed so that they don't interfere with disk-type grain drills.

The practice was used on more than 13,000,000 of the 16,000,000 acres that were summer-fallowed on the Plains for the 1953 wheat crop. The same type of tillage is being used on some 12,000,000 acres of land in continuous wheat.

To get around the nitrogen lag that goes with decomposition of crop residue on or near the soil surface, many farmers are applying nitrogen at the time of seeding their wheat crop. A few are putting the nitrogen on the wheat stubble just before the first tillage.