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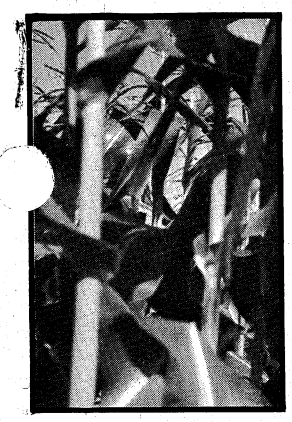

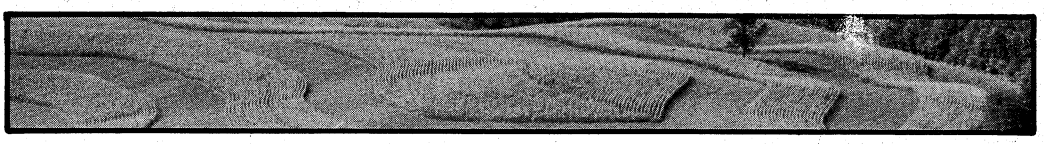

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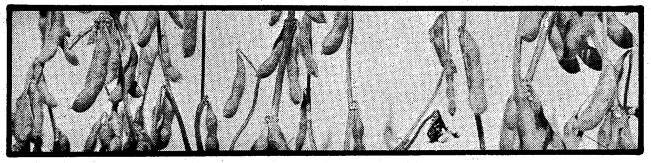

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Tillage

Where is no-plow tillage adapted in Indiana?

D.R. Griffith and J.V. Mannering, Agronomy Department

No-plow tillage for corn is no longer a novelty. A few farmers in all parts of Indiana have had outstanding success with some form of no-plow tillage. However, others have failed. Purdue research also shows proven benefits, but many problems with the new systems.

The question then for the farmer becomes "Which tillage system is best suited and most profitable for my particular soil and farming operation?" To find out, tillage systems must be compared in a number of different ways -- equipment cost, timeliness at planting, weed control, plant germination and growth, fertilizer incorporation and uptake, and, of course, yield, which reflects all the other factors. These factors have been studied for three years in a Purdue research project which compares several plow and no-plow systems on five soils in Indiana.

So that we are all thinking in the same terms, let's discuss some of the no-plow equipment available and the associated production practices needed to form a good tillage-planting system in a corn after corn operation.

Chiseling

Chisel plows have been around for many years and are used with several types of planting systems in Indiana. They are usually used for deep tillage in the fall, eight to 10 inches or more, with chisel points set 15 to 20 inches apart. Deep chiseling in the spring is not recommended on moderate or poorly drained soils.

Fall chiseling leaves the soil rough with about one-third of the previous corn residues on the surface. This provides good wind and water erosion control. The fall pass also provides an opportunity to break up plow pans, since soils are usually drier in the fall than in the spring. Anhydrous ammonia can be applied at the same time, running a hose down behind chisel points, once the soil temperature gets down near 50°F.

Spring tillage operations may involve a disc, sweeps for shallow tillage, or strip tillage attachments. Often, spring tillage and planting are combined in one pass.

When only sweeps are used ahead of the planter, the soil surface is left rough and cloddy, providing good water management, but sometimes the soil-seed contact needed for good germination is limited. Insecticides may be incorporated with the sweeps, but not as well as with a disc. Herbicides should be used after the planter, since incorporation with sweeps could leave weed control streaked.

Using a disc ahead of the planter provides better incorporation of chemicals

and germination but leaves the soil more subject to erosion.

Rotary Tillage

Powered rotary tillers are versatile tools that can be used for full-width or strip tillage and on plowed or unplowed ground. Some farmers also use them for cultivation after planting.

In our Purdue research, we have tilled only an eight-inch-wide strip about four inches deep for each row. Stalks need not be chopped before the one-trip tillage-planting operation. The rotary tiller seems to do a satisfactory job of chopping and incorporating with the planting pass. Insecticides that need incorporation can be applied ahead of the strip tillers and worked into the eight-inch strip. Herbicides may be broadcast either in front (for band incorporation) or behind the tillage-planting equipment. Volunteer corn is especially troublesome with one-pass rotary tillage. If ear losses from the previous year have been heavy, volunteer corn can be serious enough to reduce yields.

Till Planting

This system has been used successfully in the western corn belt for several years. A wide sweep is used to knock the top from a pre-formed ridge, while corn stubs and clods are pushed between rows. Then the seed is pressed into firm moist soil and covered with two to two and one-half inches of loose soil by covering discs. Normally the six- to eight-inch ridge is formed at cultivating time but may be formed in the fall, after harvest, if necessary.

Fall or winter stalk chopping lets the residues settle between rows. Then the ridge warms up to planting temperature sooner in the spring. Special disc hiller or rolling type cultivators are needed for ridging, since they will be working in residues.

Insecticide is limited to a band application over the seed at planting or a band application at cultivating. Since at least one cultivation is usually considered part of the system, a band, rather than broadcast, herbicide should be sufficient.

"No-Tillage"

No-tillage planting, to most of us, means tilling a very narrow strip, about two and one-half inches wide and three or four inches deep, for each row with a fluted coulter. Stalks are usually chopped for no-tillage planting, though some farmers are successful without this operation.

Since the coulters need a uniform soil surface to operate in, ruts made from harvesting, fertilizer trucks, etc. should be avoided. It may be necessary to keep all wheel tracks between rows and operate the coulters near the old rows.

After two or three years of no-tillage, soils become so dense that extra weight must be added for good penetration of the coulters. From one hundred to two hundred pounds per row may be needed.

Insecticide is limited to a row band, and herbicides should be broadcast. If weeds are already growing at planting time, and they often are, a contact herbicide must be added to the preemergence herbicides normally used.

Sod Planting

Planting in a chemically killed sod is proving to be successful in certain areas of southern Indiana. Most of the equipment already discussed can also be used, with some modification and ingenuity, for sod planting. The main advantages for sod planting--better late summer soil moisture and excellent erosion control--depend on leaving the surface covered. So, it seems reasonable that narrow strip tillage is best suited to sod planting.

In this system, both contact and preemergence herbicides are used two to four weeks before planting. Rate and kind of herbicide must be matched to soil

type, kind of vegetation, and amount of growth, if sod planting is to be successful.

After the first crop of sod-planted corn on erosive soils. Farmers must decide whether to reseed a perennial sod or to continue with corn. If corn is grown again, rye is established as a winter cover and killed chemically the next spring before planting.

System Combinations

Many combinations of the basic tillage systems just discussed are now used in Indiana. An example is the combination of discing with fluted coulter planting in plowed or unplowed ground. Looking at performance characteristics of the basic systems should help fit a combination of these systems to a particular farming operation.

Lower Cost and Timely Planting

Production costs are usually lowered by going to no-plow tillage, but the savings are often less than farmers anticipate. Purdue Agricultural Economists use the following example in corn production workshops. All field equipment connected with the corn enterprise was included.

Equipment for a 600-acre corn enterprise

Tillage System	Cost/Acre
Fall plow, disc twice, plant	$37.38
Fall plow, field cult.-plant	34.63
Chisel planting (2 passes)	34.32
Strip rotary - plant	32.62
Till planting in ridge	32.05
Strip coulter planting	32.29

In this example, a yield reduction of five bushels per acre would offset equipment cost advantages of even the "once-over" systems.

But there is another, more important, reason for considering no-plow tillage. Research all through the corn belt has shown a yield advantage for early planting. In central Indiana, farmers can expect a yield drop, on the average, of one and one-half bushels per acre per day when planting is delayed after May 10.

With larger farms and labor in short supply, timeliness at planting becomes all important. This is especially true on slow-draining soils that often delay plowing until planting time. In this situation, a ridged soil, or one that has been fall chiseled, would be ready to plant before the narrow strip tillage systems, which leave the soil surface covered with residues.

Erosion Benefits

All of the no-plow systems we have discussed are excellent in controlling soil loss due to wind or water erosion. Many farmers have gone to no-plow tillage especially for this reason and have not been disappointed. In a Purdue study on a silt loam in southern Indiana, soil loss was cut by 75 per cent or more with ridged and narrow strip tillage across a 10 per cent slope. However, water intake was reduced on narrow strip tillage plots in this study. Using a rainfall simulator, five inches of water was applied in a two and one-half-hour period. With less severe storms, more porous soils, and on more gentle slopes, runoff should be lowered with narrow strip tillage, also.

Weed Control

Weed control becomes crucial with several no-plow systems. As tillage decreases, difficulty in weed control increases. If weeds are already growing at planting time, a contact herbicide must be used where most of the soil surface is untilled. Herbicide combinations have shown more potential for effective control than single herbicides.

Stand, Growth and Maturity

Some no-plow systems have germination trouble on problem soils. These two-year averages are from a friable sandy loam, a crusting silt loam, and a poorly drained silty clay loam. Spring weather was wet and cool both years.

Percent Stand, 1968-69

Tillage System	Sandy loam	Silt loam	Silty clay loam
Conventional	91	86	82
Chisel plant	87	76	62
Strip rotary	93	86	69
Till plant	96	87	64
Strip coulter	89	79	73

Experience and management play a big part in getting stands with the new systems. Of the no-plow systems studied, we found that till planting most often gave the best stands, while chisel planting usually had the lowest stands.

Corn tends to grow more slowly in all the no-plow systems than it does where the ground has been plowed. With little deep tillage at planting and residues on or near the surface, soils stay cool and wet. This is a benefit in late summer but slows growth in May and June.

On poorly drained soils, narrow strip tillage corn is sometimes eight to 10 inches shorter than conventional corn eight weeks after planting. Maturity then may be delayed four or five days at tasseling and two or three days at harvest. These are the extremes. Systems which incorporate some of the residues are less affected. On well drained upland soils, the delay is not as important. Also, the effect of cool, wet spring soils becomes less important as you move south in Indiana and the growing season lengthens.

The effect of surface residues on yield, then, may depend on many things--soil texture and drainage, percent of the soil covered, length of growing season, rainfall distribution, planting date, and the vigor and drouth tolerance of hybrids used.

What About Fertility?

Farmers who bulk spread most of their fertilizer often question how the plants can use it with a no-plow system. The following soil tests from the Purdue Agronomy Farm show what happens to applied phosphorus and potassium. One hundred pounds per acre each of P_2O_5 and K_2O were top dressed annually.

Soil tests after 6 years of no-tillage planting

Depth, inches	P	K
0-1	314	615
1-2	175	503
2-3	76	394
3-6	44	263

Obviously, most of the applied P and K stayed in the top two inches of soil. Chiseling, rotary tillage, discing and ridging give some incorporation to three or four inches but much less than deep plowing. Researchers do not agree on how well corn plants use this shallow incorporated fertilizer. When most of the soil is covered with residues, soil tends to stay moist, and root growth is encouraged near the surface. Other research shows that total root growth is often inhibited in the dense untilled soil.

Results to date do not show a yield decrease that can be attributed to the shallow placement where soil tests were medium or higher when no-plow tillage was started. In low fertility fields, an extra supply of fertilizer should be plowed down before switching to the new system, and periodic plowing may be necessary to maintain yields.

In Summary

It seems obvious that no single form of no-plow tillage will be universally adopted. It seems just as obvious that farmers, with larger acreage, less time and less labor, will continue to try new, quicker ways to plant corn. Briefly, this is where the no-plow systems have the best chance for success.

Chiseling may be adapted on light or medium textured soils, especially when wind erosion is a problem. Chiseling may be used on fine textured soils if done in the fall. Secondary spring tillage must be adapted to produce a satisfactory stand and maintain erosion control benefits.

Till planting appears to be widely adapted on level or gently rolling soils. Ridges are an advantage over other no-plow systems on poorly drained soils. Flexible planter units are needed on steeper slopes.

Narrow strip tillage (either with fluted coulter or rotary tiller) may be adapted to well drained, upland soils in central and northern Indiana or for sod planting in southern Indiana. This system is not adapted on poorly drained soils.

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