4-1-1945

Plows Testify Again

R. A. Norton  
_Iowa State College_

G. M. Browning  
_Iowa State College_

C. A. Bower  
_Iowa State College_

J. B. Davidson  
_Iowa State College_

Follow this and additional works at: http://lib.dr.iastate.edu/farmsciencereporter

Part of the Agriculture Commons

Recommended Citation

Available at: http://lib.dr.iastate.edu/farmsciencereporter/vol6/iss2/2

This Article is brought to you for free and open access by the Iowa Agricultural and Home Economics Experiment Station Publications at Iowa State University Digital Repository. It has been accepted for inclusion in Farm Science Reporter by an authorized editor of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.
PLOWS Testify Again

Compared With Disk, Lister, Subsurface Cultivator to Prepare Seedbed for Corn

On this terraced field of the Soil Conservation Experimental Farm in Page County, furrows are being thrown uphill to counteract the forces of soil erosion. This requires the use of a two-way plow. With this machine, the positions of back furrows and dead furrows can be controlled.

By R. A. NORTON, G. M. BROWNING, C. A. BOWER and J. B. DAVIDSON

CAN THE Corn Belt farmer prepare seedbeds for corn more cheaply without plowing and still produce as good a crop as he can by plowing? Many attempts have been made in past years to substitute lighter draft implements for the plow. Listing has been used in the Great Plains for many years. More recent attempts to stir the soil without turning it have given pretty good results in Nebraska and other states in the Wheat Belt. And during the past 2 or 3 years a scheme to discard plows entirely and prepare seedbeds with a disk harrow has received wide publicity.

During the summer of 1944, we continued our study of tillage methods on the same areas as reported last year (FARM SCIENCE REPORTER, January 1944), and in addition new studies were started on 10 cooperating farmers’ fields, representing five important soil types at different locations in Iowa. We shall need studies for several years before we can give unqualified approval to any change in methods, but from the studies to the present time we have drawn the following conclusions:

1. On unfertilized fields, corn yields from listing, disked and subsurface tillage were similar but averaged 8 to 10 bushels per acre less than from plowing.
2. On fertilized fields, listed corn outyielded that on plowed land by 1.3 bushels per acre. Yields from disked and subsurface tillage were similar but were 6 bushels per acre less than from listing.
3. The application of 200 pounds of 5-10-5 fertilizer per acre increased the yield on listed areas nearly 11 bushels per acre. It improved the yields slightly on subsurface tilled plots and disked plots, but brought no increase on plowed areas. Yields on fertilized-listed, fertilized-plowed and unfertilized-plowed plots were about alike—considerably higher than for any other tillage treatment, fertilized or unfertilized.
4. Tillage practices definitely influenced the availability of plant food. Plants grown on soils which had been poorly managed in the past usually developed nitrogen or potash deficiencies, and yields of corn were reduced when seedbeds were prepared by disked or subsurface tillage.
5. Listing used less labor and power for growing the corn crop than any other method. This is particularly important now, with high costs and scarcity of farm labor.
6. Erosion control from listing on the contour was 16 times more effective; and subsurface tillage, with residues retained on the soil surface, three times more effective than plowing and surface planting.

The Iowa Agricultural Experiment Station and the Iowa State College Extension Service cooperated with the Soil Conservation Service and the district commissioners of several soil conservation districts in testing yields of corn on contoured fields where the seedbeds had been prepared by plowing, listing, subsurface tillage and disked.

Lister-Planter and Subsurface Cultivator

All farmers have two of the implements used in these tests—the plow and the disk harrow.

The subsurface cultivator, almost unknown to Iowa farmers, has large sweeps—20 to 45 inches from heel to heel— which loosen the soil 4 to 6 inches deep without turning it over. All residues from the previous crop are left on the surface.

The lister-planter is common
only in southwestern Iowa and is used to open furrows 40 to 42 inches apart and to plant the seed in the bottom of each furrow. The lister bottom which opens these furrows is shaped like a plow with a double moldboard. Any residue remaining from the previous crop is rolled into the ridges between the furrows. Listed corn may develop rather slowly at first because the seed is placed in comparatively cool soil. This may not always prove to be a handicap. Sometimes a corn plant which has not developed vigorously above ground early in the season but has a deep, well developed root system can withstand drouth in mid-season and produce a good ear where a luxuriant stalk will suffer.

How can the hard-ground lister be used where corn is to follow a crop such as sweetclover or alfalfa? Some of the modern listers can prepare a satisfactory seedbed on such land. Subsurface tillage sweeps may be obtained to attach to the shanks of practically any of the older type hard-ground listers. By operating the sweeps 2 or 3 inches below the surface of sod land, growth of the plants will be checked, and then the hard-ground listing may be done in the usual manner.

Yields, Fertilizer Effects

Our tests on outlying farms in 1944 included eight contoured fields on four important soil series—Monona, Tama, Fayette and Webster. On the areas where no fertilizer was used (graph, p. 5), corn yields from listing, diskng and subsurface tillage were all within 2 bushels per acre of each other but were 8 to 10 bushels less than from plowing. We observed that when the seedbed was prepared with the disk harrow or the subsurface cultivator, the corn plants in several fields were smaller, lighter green and yielded less than plants on plowed plots.

We found in the preliminary studies in 1943 that nitrogen and potash were often deficient where the land was not plowed. We also know (FARM SCIENCE REPORTER, July 1944) that the subsoil is often deficient in available nutrients and responds well to fertilizer. When corn is planted with a lister the seedlings are at the bottom of a furrow in the cool and often unproductive subsoil. To see if commercial fertilizer would help overcome these difficulties, we applied 200 pounds per acre of 5-10-5 fertilizer to half of each test plot with a planter fertilizer attachment.

On the fertilized portions of the test plots, the yield on the listed plots increased 10.7 bushels per acre, but there was no increase from fertilizer where the seedbed was prepared by plowing. Fertilizer increased the yields 3 or 4 bushels per acre on the disked and the subsurface tilled areas. In other words, when fertilizer was used, the listed plots and the plowed plots yielded considerably better than those prepared by either subsurface tillage or diskng.

The various tillage practices and the fertilizer did not act alike on all of the soils in various areas of Iowa. For recommendations with respect to different sections of the state see the accompanying map of Iowa. We'll now look at some of the results for southwestern Iowa where no fertilizer was applied.
Marshall Soils Results

The Marshall silt loam is a permeable soil, well adapted to hard-ground listing. At the Soil Conservation Experimental Farm in Page County, the average yield of corn for a 3-year period, 1942-44, was: Plowed, 84.2 bushels per acre; hard-ground listed, 80.9; loose-ground listed, 70.6; and subsurface tilled, 65.3. These figures are the average of 10 separate fields on five different types of residues. Disking alone and a combination of subsurface tillage and diskng were also included in the studies in 1944. The yields from these treatments were about the same as from subsurface tillage—17 to 20 bushels less than plowing. In general, hard-ground listing on the contour is advantageous on the Marshall soils as an aid to conservation of soil and water and, if considered over a period of time, would help maintain crop yields.

The loose-ground lister was included in the studies in Page County because this implement is commonly used in southwestern Iowa. It is simply a high-wheeled corn planter, each furrow opener equipped with a pair of 16-inch to 18-inch disks to open furrows which look much like those built with a hard-ground lister. The land must be plowed before this implement can be used, hence no advantage of power and labor saving is secured. We found that loose-ground listing gave yields 10.3 bushels per acre less than hard-ground listing.

Tillage—Plant Food

As mentioned before, we had observed in previous years that corn plants on some fields showed signs of too little plant food when the simpler tillage practices were used. To see what plant foods were lacking we determined the amount of nitrogen, phosphorus and potassium in plants taken from two fields where large differences in growth were observed just before tasseling time.

We found that plants grown on one field of Tama silt loam in Marion County contained the same amount of phosphorus and potassium under all tillage practices but that the percentage of nitrogen varied considerably. The plants from plowed areas contained 2.6 percent of nitrogen—about a normal amount—while those on subsurface tilled plots and disked plots had only about two-thirds as much. The soil of the plowed plots on July 12 contained 12 pounds of available nitrogen per acre in the plow layer, while only 3 pounds were found in the subsurface tilled and disked areas. The lack of nitrogen showed up in reduced plant growth—one-third as much on the subsurface tilled and disked areas as on the plowed. At harvest time we found yields as follows: Plowed, 56.1; listed, 42.9; subsurface tilled, 29.4; and disked, 40.9 bushels per acre.

Why was the available nitrogen in the subsurface tilled and disked plots low? We are not sure, but it probably is due to the more compact seedbed which did not provide enough air for rapid growth of soil microorganisms necessary to produce nitrates from organic matter. The plow loosened the soil more than the other tillage implements—the activity of the soil microorganisms was stepped up and more nitrate was produced. The plants on the listed plots did not show the characteristic nitrogen deficiency, as did the plants on the disked and the subsurface tilled plots, but they apparently did not get all the nutrients needed since 200 pounds per acre of 5-10-5

Subsurface tiller. Various sweeps offered to the farm trade range from 20 to 45 inches wide at the heel. The 3 sweeps shown here overlap, covering about 83 inches or about twice as much as a 2-bottom, 16-inch plow. Draft is lighter than a plow.
fertilizer increased the yields 17.3 bushels per acre—from 42.9 to 60.2.

At another location on a Fayette silt loam in Tama County, we found that the corn plants contained normal amounts of nitrogen and phosphorus but still showed definite symptoms of nutrient deficiencies. Here potassium was the limiting factor.

We didn't determine the nutrient content of plants on any field where growth appeared normal, but apparently plant food was deficient on several fields since the yields from disking and from subsurface tillage were lower than from plowing. On one field of Marshall silt loam, the plowed plots yielded 97 bushels per acre as compared to 69 for the subsurface tilled plots, a reduction of 28 bushels per acre.

Our studies to date indicate that tillage practices definitely influence the availability of plant food. In general, nutrient deficiencies develop and yields are lowered when the seedbed is not favorable for biological activity in the soil. It appears, therefore, that on soil of poor tilth it is especially important to use an implement that will mix and loosen the soil. Merely scratching the surface is not enough. We found that commercial fertilizers help to overcome nutrient deficiencies and increase yields, but they will not take the place of favorable soil tilth which is obtained when a legume meadow is included regularly in the rotation.

Power, Labor Savings

For several years the Bureau of Plant Industry, Soils and Agricultural Engineering cooperated with the Iowa Agricultural Experiment Station in investigating methods of corn production. Labor and power requirements for seedbed preparation, planting and cultivation of corn were studied. Plowing, listing, subsurface tillage and disking as primary tillage methods were all evaluated (graph, p. 5). Ordinary farm tractors of about 16-24 H.P. were used in all this work.

Note that when land is plowed for corn more labor and power are used than with any other method of seedbed preparation. If by adopting a new procedure a farmer can reduce his labor and power requirements, it may be to his advantage to grow his corn by some other than the established practice. In selecting such a practice he must be careful to consider the types of soil on his farm, and then choose a method which will not be likely to greatly reduce the yield.

Lister Ridges, Residues Conserve Soil

Losses of soil and water from areas prepared for corn by various methods were determined at the Experimental Farm in Page County in 1943. The total precipitation during the observations was 30.11 inches. Data from this study are shown in the accompanying graph.

The residues retained on the soil surface were effective in breaking the erosive force of rain and thereby reduced soil loss. The ridges of the contour listed area were effective too in preventing soil loss. Likewise, water loss from the listed area was only about one-twentieth as great as from the plowed and surface-planted area. On the basis of observations for a single year, a 6-inch layer of topsoil would be removed during the growth of about 25 corn crops with surface culture such as plowing. On the other hand, 380 corn crops might be grown by contour listing before suffering such a loss. Hence, contour listing should be very helpful in maintaining the fertility of erodible soil on a long-time basis.

Other Problems

Anyone considering using any of the simplified tillage methods should keep a few precautions in mind.

The corn borer is an ever-increasing menace in Iowa. We have not had an opportunity to study the new tillage methods on areas badly infested with this pest. The corn borer spends the winter in cornstalks and other plants with coarse stems. Some of the methods leave the residue on the surface where it might harbor these insects.

We've had difficulty preparing seedbeds in heavy sods of alfalfa and sweetclover by disking or subsurface tillage. With the disk harrow, so many trips must be made to subdue the heavy growth that labor and power requirements become unnecessarily heavy, and the structural stability of the soil may be impaired. With the subsurface cultivator, there may be sufficient uncut roots just below the soil surface to keep the plants green if rains are frequent. Under such conditions the remaining plants compete with the young corn plants and interfere with cultivation.

In trials using cracked soybeans as the protein concentrate in comparison with linseed meal as the protein concentrate for dairy cows, no significant differences in the flavor of the milk were found in tests at the Iowa Station. The kind of container in which the milk was placed did not seem to affect the flavor regardless of the ration fed the cows.

Double-disking, using tandem-disk harrow to prepare seedbed for corn on Agricultural Engineering Research Farm, Ames. About three trips are required with this implement to prepare an average seedbed. Heavy sod may need so many trips that its use is uneconomical.