

Shall WE Discard Our Plows?

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One of the live topics of the day is whether the plow is ruining our land, whether farmers to save the soil for this and future generations must stop the age-old practice of plowing in preparing their land for cultivated crops.

In this article the authors discuss the results of experiments conducted here in Iowa in which plowing is compared with other means of preparing seedbeds for corn. In general, we think many of you Iowa farmers who read the results of these tests will decide — if you haven't already — that perhaps you are not quite ready to junk your plows. — Editor.

4. It is easier to plant and cultivate corn on plowed ground, but machines have been developed in these studies that will operate satisfactorily through trash. (Studies are being continued to develop machines that will include the desirable features and discard the undesirable ones of our present machines.)

5. Weed control is more of a problem on subsurface tilled than on plowed land. We cannot be sure, however, that weed control will be more or less of a problem until the same system has been used on a field for several years.

6. Several of the methods that we have tried offer promising possibilities of cutting labor and power costs and conserving soil and water in production of row crops, but they cannot be recommended generally in Iowa until we have been able to solve the problems such as decreased yields, weed control and nutrient deficiencies.

Used Elsewhere

The question of whether plowing is desirable has recently become a live topic. Several years ago wheat farmers in areas of limited rainfall changed from the moldboard plow to machinery that will operate through trash, because they found that it was more economical to prepare a satisfactory seedbed with the new machines and that the residue left on the surface controlled soil blowing and reduced the loss of soil and water.

Practices which leave crop residue on the surface are not new even in the Corn Belt — for years we have disked stalks down for oat seeding instead of plowing. An increasing number of farmers are using the disk to prepare a seedbed for corn on land that was in soybeans the year before. Some farmers have reported disked second-year sweet

In general these are the conclusions we have drawn to date from our experiments (later and additional experiments may bring different results, different conclusions):

1. Subsurface tillage with residues on the surface is helpful in conserving soil and water.

2. The yield of crops was generally considerably less where the seedbed was prepared with subsurface tillage implements as compared with plowing (Clayton soil was an exception).

3. A satisfactory seedbed cannot be prepared with our present tandem disks in heavy sods of sweet clover and alfalfa. It is possible that a subsurface tillage implement to cut the main roots of alfalfa and sweet clover, followed by the disk or other implement to dislodge the plants and weeds so that they will not continue to grow, will do the job of the plow and still leave the residue on the surface to help control erosion.

IOWA FARMERS, like those of most other states, generally plow their land with a moldboard plow in preparing a seedbed for corn. This places the residues — weeds, stubble, manure and the like — at the bottom of the furrow.

New machines have been developed over a period of years that were supposed to replace or supplement the moldboard plow. Some of these machines have met the needs of certain types of farming and in semi-arid regions are rapidly replacing the plow. Most of the new machines are built to take advantage of the fact that crop residues, weeds or other material, if left on the surface, are very helpful in controlling wind erosion and in conserving soil and water. We wanted to find out whether plowing under this residue was necessary and desirable in Iowa, and so have conducted experiments with different types of machines over a period of 5 years.



Top: Preparation of land for corn by means of two 45-inch sweeps attached to a mounted hard ground lister frame. Residues from the previous corn crop had been chopped with a stalk cutter. Just before planting the sweeps were operated a second time in such a way as to split the original path of travel. Below: A section of rotary hoe, pulled backwards, was used to break clods.

clover land instead of plowing, but, in general, this has not been satisfactory because the ground is too hard for the disks now available.

In sections of the country where wheat and barley are seeded in the fall following a soybean hay crop, the disk or field cultivator is generally used in place of the plow.

The Missouri system of small grain-lespedeza which is so popular in that state is a "trashy" system of farming, in that the seedbed is prepared with a

disk or a field cultivator, leaving most of the residue on the surface or mixed with the first few inches of the surface soil.

Light mulches or "trashy" material on the surface are especially helpful in getting good stands of grasses and legumes.

Recently there has been considerable interest in the possibilities of retaining crop residues on the surface in the production of corn and soybeans under the more humid conditions found in the

Corn Belt. This interest arises from the fact that keeping crop residues on the surface helps conserve soil and water.

The Iowa Station, in cooperation with the Bureau of Plant Industry, Soils and Agricultural Engineering and the Soil Conservation Service, has been studying this problem since 1939 on the Clarion and Webster soils at the Agricultural Engineering Farm near Ames, and on the Marshall silt loam soil at the Soil Conservation Experimental Farm near Clarinda in 1942 and 1943. In these studies we were trying to find the effect of different methods of preparing the land on the yield of corn, the cost of operation and the loss of soil and water.

Clarion, Webster Studies

The Disk and Plow. At Ames in 1939 yields and seedbed and planting costs on corn plots prepared with a tandem disk were compared with those on plowed plots. The field had been in soybeans the previous year. The yield on the plowed plots was 60.9 bushels per acre and on the disked plots 58.2 bushels an acre. It required about two-thirds as much labor and power to prepare the seedbed and plant corn on the disked plots as on the plowed plots.

But there was a "fly in the ointment" — the soybean straw left on the surface of the disked plots interfered with the corn planter, and some bunches of straw were hauled off the field after planting in order to avoid cultivation trouble.

The Lister and Plow. A new machine called a subsoil lister was tried on the Webster soil in 1940. By using this machine, we hoped to accomplish four things: (1) Leave the residue near the surface, but move it out of the corn row so that it would not interfere with early cultivation; (2) plant the seed not so far below the surface and therefore in more fertile soil than with ordinary lister planting; (3) prepare a better seedbed in the furrow than is done with an ordinary lister; (4) reduce the cost below the amount required for plowing and surface planting.

The yield on the plowed plots was 82.2 bushels and on the listed plots 82.8 bushels an acre. About two-thirds as much labor and half as much power were required to prepare a seedbed and plant corn on the listed as on the plowed plots. The lister was used again in 1941, but was not satisfactory because

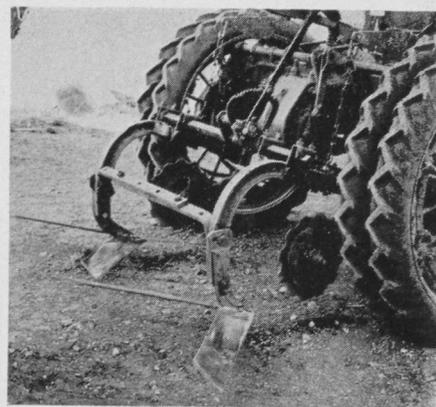
corn on the listed plots was seriously damaged by an extended wet period early in the season and, as a result, yields on the listed plots were 15 bushels less than on the plowed plots.

In general, we do not think listing on the Webster and other soils that are slowly drained is dependable because of damage from too much moisture during wet periods. The lister is being used successfully, however, in western Iowa, and we are conducting tests to see if it is suitable on other soils at different locations in the state.

Subsurface Cultivator vs. Plow. Another machine, the subsurface cultivator, was tried at Ames in 1941. Several of the subsurface tilled plots were

damaged, owing to wet soil. Under these conditions we found the yields from different methods of subsurface tillage were 7 to 13 bushels below those of plowed plots.

In 1942 we started a long-time experiment on the Clarion and Webster soils at Ames to compare different cultural treatments and methods of handling crop residues. On the Clarion soils in 1942 and 1943, the subsurface tilled plots planted to corn following corn yielded 41.3 bushels and the plowed plots 40.1 bushels. On the other hand, the Webster soil when subsurface tilled averaged 33.1 bushels to the acre compared with 48.9 bushels for the plowed plots. The increase in favor of plowing was 15.8 bushels to the acre.



Lister bottoms were replaced by 45-inch sweeps for preparation of land for mulch culture of corn. The sweeps operated at a depth of 3 to 5 inches.

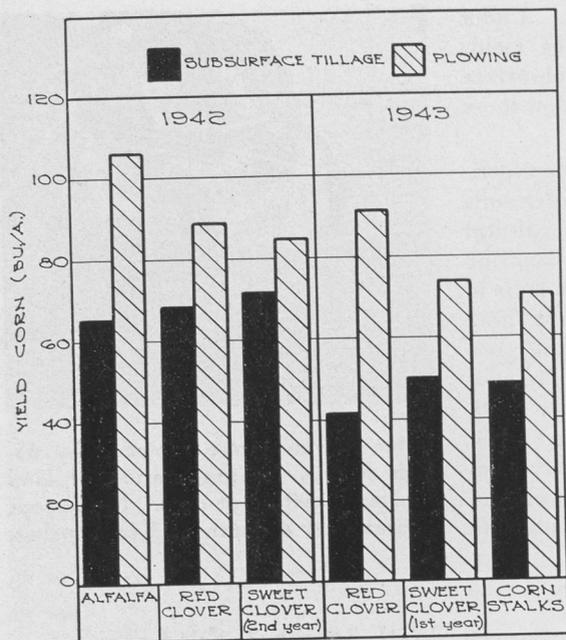


With Marshall Silt Loam

Subsurface Cultivator vs. Plow. Our tests in 1942-43 at the Soil Conservation Experimental Farm near Clarinda included residues of alfalfa, red clover, cornstalks, and first and second year sweet clover. In all tests for both 1942 and 1943 the stand and yield were reduced by subsurface tillage as compared with plowing (Chart p. 10). The average yield on the plowed plots for all experiments was 85.8 bushels as compared to 57.5 bushels on the subsurface tilled plots, or an increase of 28.3 bushels in favor of plowing. A part of this difference was because of the stand — the number of stalks on the plowed plots was 143, while the number on the subsurface tilled plots was 110.

The corn on the plots prepared with the subsurface cultivator showed symptoms of nitrogen deficiency early in the season. The plants were lighter green in color and smaller than those on adjacent plowed plots. Some of the residue was mixed with the soil during cultivation. The late summer rains made conditions favorable for the organic matter to decompose, liberating nitrogen for the plants. Later in the season the plants had a normal green color but

Front view of cultivator equipment used for tillage of corn under mulch culture. Weed control was more of a problem when the soil had not been plowed. The residues on the surface also caused some trouble during planting and the cultivation of the crop. Plowing materially increased yields in comparison with subsurface tillage.



At Clarinda the yields of corn in plowed plots were larger than for surface tillage.

matured later than plants on plowed plots as shown by the higher moisture content at harvest time.

Residues Decrease Erosion. Measurements were made of the amount of soil that washed off of plots that had been prepared by plowing, listing and subsurface tillage. The corn rows were all on the contour. During the period Jan. 1 to Nov. 30, 1943, the subsurface

tilled plots lost 9 tons of soil per acre, the plowed plots 34 tons, and the listed plots 2 tons per acre. The cornstalk residue on the surface reduced the soil loss to about one-fourth of that for the plowed plot but allowed a greater loss than contour listing.

Need More Studies

In general, subsurface tillage with residues on the surface, was found helpful in conserving soil and water. Under the conditions of these experiments, however, the yields have been materially reduced by subsurface tillage when compared with plowing. Of course, it should not be concluded, on the basis of these studies, that subsurface tillage will not

work. By introducing new practices and machines or modifying the present ones, it may be possible to overcome the problems that we found.

Insect Problem

One of the problems that we wonder about is what effect leaving residue on the surface may have on insect control. About half of Iowa's counties now have

corn borers. The borer winters in corn-stalks, weeds or other plants with coarse stems. Disposing of residues by plowing is one of the measures of control recommended. Would subsurface tillage, or other practices which leave the residue on the surface, intensify the corn borer problem? The same question may be asked about the control of chinch bugs, grasshoppers and other insects which need trash for protection.

Tests will need to be conducted over a number of years to see how the new practices stand up under different weather conditions. A practice or machine may be well suited to a particular soil or crop and not suitable under another set of conditions. That is the reason why we should not put too much confidence in studies that are not carefully conducted or that have been developed under entirely different farming conditions than we have in the Corn Belt.

Studies are being continued and new developments will be reported as soon as they are completed.

More acres of improved varieties of field crops were inspected for certification of seed during the summer of 1943 than in any previous year.

Lists of Iowa growers of certified seed may be obtained from County Extension Directors or from the Farm Crops Dept., Ames.

Preparation of seedbed on second year sweet clover land. In this operation a stalk cutter was used ahead of the subsurface tillage machine. Immediately before planting the corn, the subsurface tillage machine was operated a second time.

