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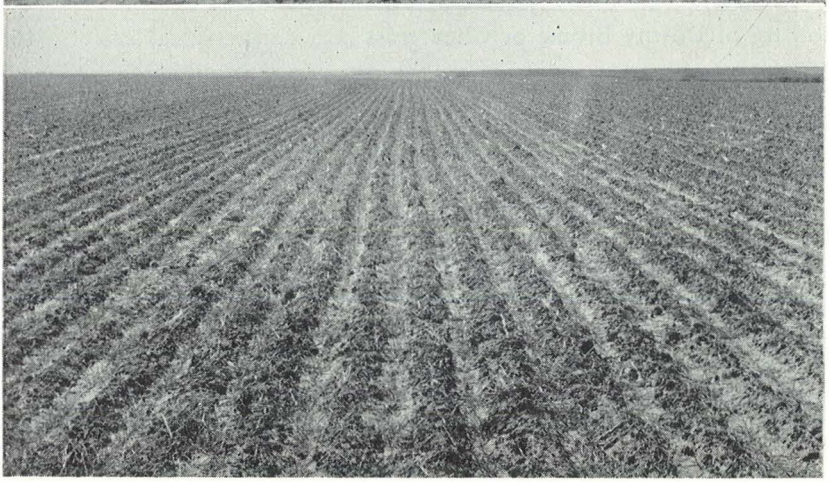
Stubble-Mulch Wheat Farming Methods for Fallow Areas



(Above) Wind erosion on bare land.

(Below) Wheat with enough mulch to protect it against wind erosion.

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Stubble-Mulch Wheat Farming Methods for Fallow Areas

F. L. Duley[1]

During recent years a new system of preparing wheat land for seeding has spread over millions of acres in the Great Plains. Commonly called stubble-mulch farming, this new method consists of leaving the residue from one crop on the land while the land is prepared for the next crop. The residue may consist of the stubble or the stubble and combine straw that is left on the land. Weed growth may also serve as residue, but care should be taken that the weeds do not deplete the soil moisture needed for the oncoming crop. The weeds should be killed before they produce seed.

Erosion Control

Wind erosion.—Maintaining straw and stubble on the surface in sufficient quantity is one of the simplest and surest ways of preventing wind erosion on wheat land. (See cover page and figure 1.) To be most

Figure 1.—High combine wheat stubble is effective in catching snow and does not permit soil blowing.

[1] Project Supervisor, Agricultural Research Service, Soil and Water Conservation Research Branch, U. S. Department of Agriculture, cooperating with the University of Nebraska, Lincoln, Nebraska.

The author is indebted to Professor J. C. Russel who has collaborated in all the research work on stubble-mulch farming done on this project.

effective, the straw should be left anchored in the soil. It is helpful if some roots are still attached to the stubble. As straw ages and is run over by tractors and machinery, it tends to become brittle and may break into short pieces. If it does not become too short it may be buried partially at the end of the season with some of the straw left sticking out of the ground. This will hold other loose pieces of straw which will stop soil movement by the wind.

In addition to the effect of residue, the structure of the surface soil may play an important part in protecting land against wind erosion. A cloddy fallow has been used extensively to reduce soil blowing. This is most effective on heavy soils that will form more stable clods.

Water erosion.—Water erosion as well as wind erosion is avoided as long as there is good residue cover on the land. The residue material on the surface breaks the fall of raindrops, so that the soil remains open and is not puddled, as happens with a bare soil. The intake rate remains high and there is little runoff from mulched soil.

Wheat is usually harvested in July. If possible, the stubble should be left undisturbed until the following May. This can be done if weeds are not too heavy. This gives nearly a 10-month period during which the soil is well protected against blowing or washing. The land should be fallowed in such a way that residue in considerable quantity is left on the soil. The residue should last until the next wheat crop begins to grow rapidly the following spring, or for about 11 months. The combination of the remaining residue and the growing wheat plants should protect the soil until harvest in July. Thus the soil is protected against erosion by both wind and water for a full two years. At this time the wheat-fallow rotation would be started over again. This makes it possible to protect land against wind and water erosion continuously by following a stubble-mulch system. Stubble-mulch farming is particularly well adapted to an alternate wheat-fallow method. (See figure 2.)

Conservation of Moisture

When properly managed, stubble mulch may serve to increase the moisture content of the soil compared with plowing. If allowed to stand on the soil through the winter, the residue will catch snow. Also, the mulch allows a high percentage of rainfall intake at all times. In the cool months of spring it reduces evaporation so that there may be little drying out between rains. This permits the next water that falls to penetrate deeper into the soil.

In summer the chief advantage of stubble mulch lies in reducing runoff during heavy rains. The additional water held by the mulch will push the moisture down deeper than on plowed land. Water in the second, third or fourth foot at seeding time does much to insure a good yield of wheat.

FIGURE 2.—(Top) A plowed field showing how small gullies have been cut in soil by a single heavy rain after wheat seeding.

(Bottom) A similar field on adjoining farm after the same rain where wheat was seeded with mulch cover. No gullies were formed here. High plains of western Nebraska.

Stubble Mulch in a Wheat-Fallow System

In regions where alternate wheat and fallow is a common practice the stubble-mulch system is well adapted. With the stubble-mulch system, yields of wheat have been as high or higher than with other methods of seedbed preparation. This has been shown by tests in both the southern and northern Plains states. After a year of fallow the wheat and straw yields are usually high. With a large amount of straw on the surface at harvest time, it is difficult to prepare a good seedbed by this method in the course of six weeks or two months, for fall seeding. However, if a year of fallow is to follow the heavy growth of straw there will be about 14 months to prepare the seedbed. This allows some of the straw to decay and to become shortened by machinery that passes over it. Also some of the straw will be buried during tillage.

If proper implements are used it is possible to leave about the desired amount of residue on the surface when the wheat is seeded.

It is not possible to state just how much straw is needed to protect the soil. This will vary with the structure of the soil, the type of drill used, and the surface condition attained in the final operation of seeding. In most cases 1 to 1¼ tons of residue on the soil at seeding time will give protection against wind or water erosion.

There must not be so much residue that a good job of drilling cannot be done, nor so little that protection for the crop and soil will be lost. During both tillage and drilling, attention must be given to the proper amount of straw to be left on the surface at seeding time. Experience will help in learning how much of the heavy straw to bury during seedbed preparation and how to protect a small amount in case the previous crop was light. It should be remembered that straw mixed slightly in the surface soil decays rapidly. Straw left entirely on the surface decays slowly.

Equipment for Stubble-Mulch Farming

The equipment used in preparing a wheat seedbed under a stubble-mulch system must be chosen carefully and used properly. It should be kept in mind that a good seedbed for wheat is one that is thoroughly tilled, well compacted, and weed-free, and that has enough residue left on the surface to protect the soil and the young crop against either wind or water erosion.

No one set of tools is best for all conditions. Many combinations of tillers, packers, weeders and drills may be used so as to result in a good job.

Several methods that may be followed to obtain a good job of fallowing with the stubble-mulch system are outlined here. Most farmers have some equipment that with minor adaptations can be used in the stubble-mulch system.

Method No. 1.—If there are few weeds in the stubble in the fall after harvest, the fallowing operation need not begin until spring. Unless there is an excessive amount of straw, the first operation should be delayed until weeds and volunteer have started.

The first operation may be with a one-way disk. It should be run at a shallow depth so as not to bury much straw. If the one-way is set at a long angle the disks will not need to go very deep to cut all the soil and kill volunteer and weeds. It is better to do this first operation when the weather is dry. This means a more complete kill of weeds and volunteer. (See figure 3.)

After this first one-way operation the land should be allowed to lie for a few weeks until the weeds start again. At this point one of several implements may be used. However, an implement that will undercut the soil and loosen it to about the depth of ordinary plowing is usually desirable. Several types of sweep machines will do this job well. One type is shown in figure 4.

FIGURE 3.—One-way disk operating in wheat stubble in spring. The object is to kill weeds by working soil to only a shallow depth. Very little straw should be covered by this operation.

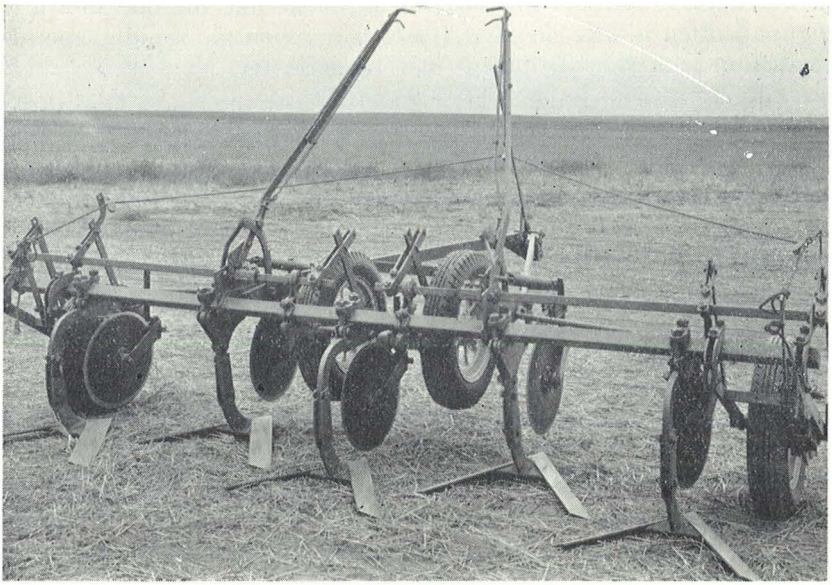

FIGURE 4.—A subtillage machine with 30-inch sweeps and a rolling coulter ahead of each sweep.

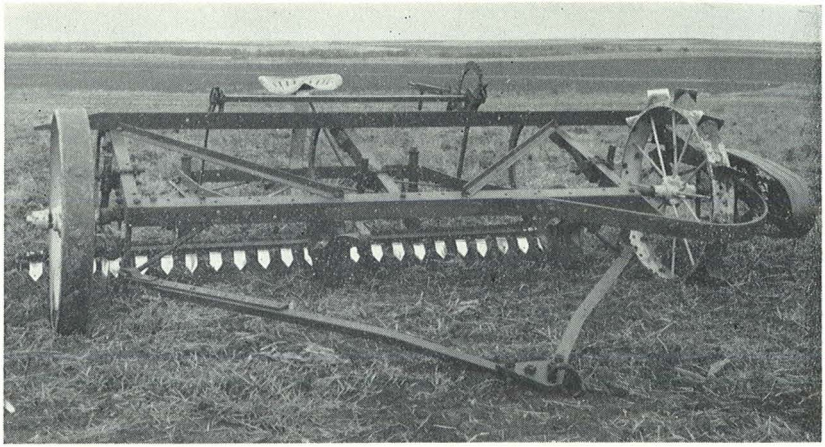

FIGURE 5.—Small shovel attachment to rod weeder. This makes it possible to operate rod in harder ground than where rod is used without shovels. In fact, it converts a rod weeder into a type of subsurface tiller.

When the weeds start again the next operation may be done with a rod weeder. A rod with shovel attachment like the one shown in figure 5 often is very effective. If weeds come on too rapidly, another operation with this equipment may be necessary.

Just prior to seeding wheat, it is well to give the land a final stroke with a plain rod weeder without the shovel attachment. This tends to kill all the small weeds, including downy bromegrass. Some of these weeds may have germinated since the last weeding. The rod also tends to pack the soil, making an ideal place in which to plant the seed.

Method No. 2.—If weeds have grown up in the stubble, it might be advisable to kill them in the fall. If the field were mowed to kill weeds, the stubble would be laid flat, allowing most of the snow to blow off the land. This can be prevented by tilling the soil with a subsurface tiller at a fairly shallow depth, allowing the stubble and weeds to stand and catch snow. If the operation is done at the proper time the weeds will be killed before the seed matures. If the stubble is heavy a one-way may be used in such a way that it does not lay the stubble flat. (See figure 6.) The straight blade tiller shown in figure 7 will also kill weeds and leave much of the stubble standing.

The land may be left over the winter in this condition. The procedure in the spring may then follow that outlined in Method No. 1. However, if there is little volunteer it may be desirable to omit the first operation with the one-way, and do all the tillage with sweeps, rod weeders and possibly some type of packer or treader.

FIGURE 6.—Combine stubble worked in fall with one-way disk. This has been left standing sufficiently to catch much snow.

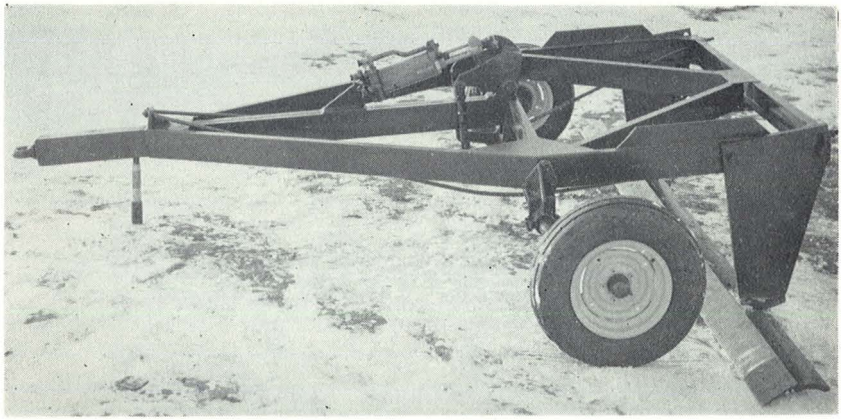

FIGURE 7.—A straight blade-type subsurface tiller. Penetrates hard ground well and leaves stubble and weeds standing.

Method No. 3.—Some of the most effective equipment for stubble-mulch farming has been of the heavier blade type. (See figure 8.) This is particularly good for the first or the deepest operation. One tillage operation with this or similar equipment should be done at about the depth the land would be plowed. This deepest working of the soil should be done at the first or second tillage operation during the fallow season, thus giving time for the soil to become well settled before seeding.

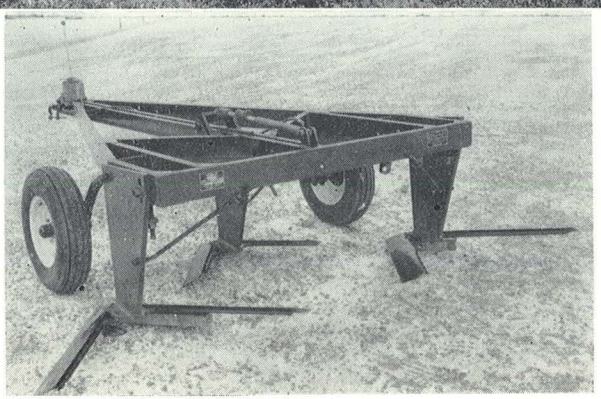

FIGURE 8.—Large V-blades.

(Top) Eight-foot V-blade subsurface tiller mounted on sturdy chassis. This machine can be equipped with an 18-inch rolling coulter.

(Bottom) Same type of machine as above, but having three sweeps with total width of 11 to 14 feet.

Following this operation the rod weeder, or special rods attached to the kind of tiller frame shown in figure 8, may be used. The one-way or disk would be used only in case of very heavy straw. Sometimes excessive straw in low areas may necessitate the use of disk tools on only part of the field. Whenever these are used, care must be taken that the straw is not completely buried. If much straw is turned under with a one-way it may affect the use of other implements. For example, a rod weeder cannot be operated satisfactorily through land that has much straw partly turned in below the surface.

The tiller shown in figure 8 may be used on a multiple hitch where large tractors are available. In figures 9 and 10, two or more 8-foot tillers are being pulled on a large multiple hitch by a single power unit.

Rod weeders of various types can be used to follow this type of equipment and complete the preparation of the seedbed as described in Method No. 1.

Method No. 4.—In case ground is dry or hard it may be desirable to use a chisel-type implement to do a breaking or ripping job. (See figure 11.) Some difficulty may result from clogging if the residue is heavy or if the chisels are spaced too close together. It is not advisable to use this chisel-type machine for all operations during a fallow

FIGURE 9.—Two large V-blade tillers making the first cut through a combine stubble field. Note that these single standards are passing through without clogging. However, under many conditions a rolling coulter ahead of the standard will result in a cleaner cut with less chance of straw hanging on the shank and making a furrow.

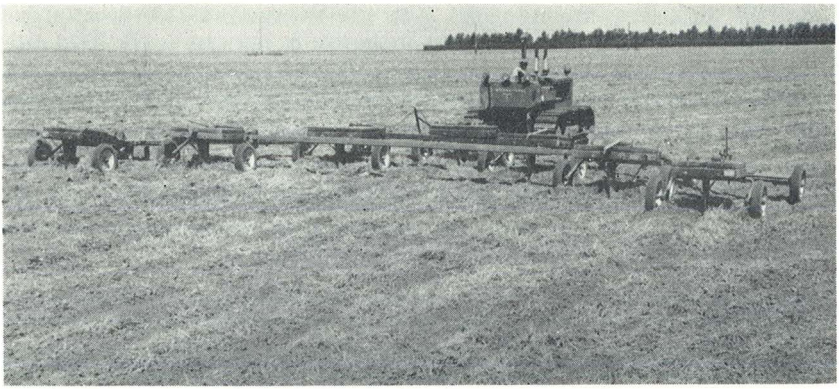

FIGURE 10.—Seven 8-foot subsurface tillers preparing land for wheat in the northern Great Plains. Note good cover of residue over surface of ground.

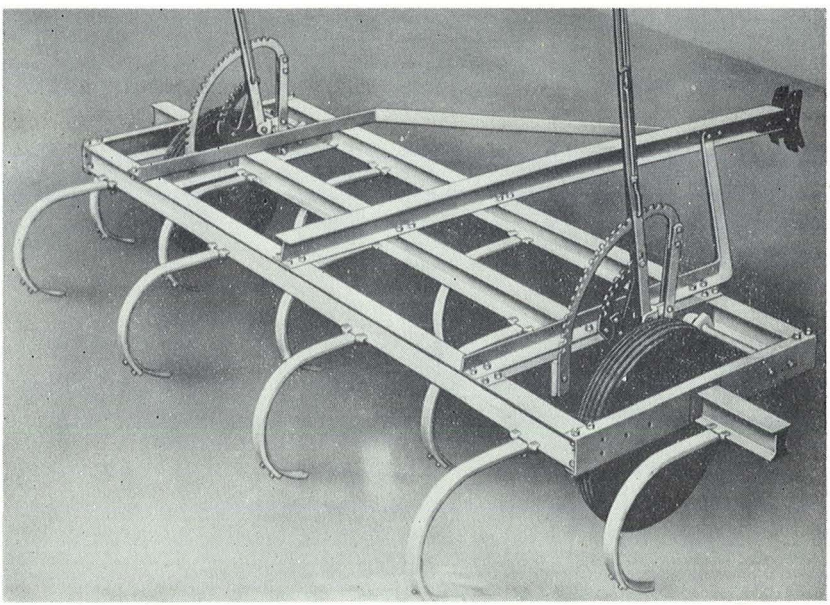

FIGURE 11.—Ripper-type machine equipped with 2-inch chisels. This implement should be followed with broader sweeps or a rod weeder to undercut the surface. If straw is heavy, shanks should be spaced farther apart than shown in this picture.

season. This usually dissipates too much residue. After the chisels have been used once the next operations should be with broader sweeps attached to this frame or with some other type of broad-sweep machine. This machine is also built with revolving rod attachment. The rod weeder with shovel attachment also works well after the chisels.

The use of straw spreaders.—Tillage equipment works best when the straw from the previous crop is spread evenly over the field. This is particularly true of subsurface tillers and other stubble-mulch farming equipment. It is important that the combine be provided with a good straw spreader. Care should be taken that no piles of straw are left on the field. Neither should the straw be permitted to concentrate in a windrow. Uneven distribution of straw will interfere with the operation of almost any tillage implement. A pile of straw may persist throughout the entire period of seedbed preparation and obstruct final drilling.

In some cases straw may be so heavy over parts of the field that no amount of tillage will reduce it to the point where good drilling can be done. In this case it may be advisable to remove some of the straw at the beginning of the fallow season. In most cases, however, the use of a heavy disk or one-way will reduce the straw to the desired amount and still leave enough on the surface to protect the soil.

Strip cropping.—In many areas of the Great Plains strip cropping has become a common practice. This method was developed to help in reducing wind erosion. It is made much more effective if the fallowing is done by the stubble-mulch system. (See figure 12.) The strip being fallowed should be kept well protected with residue while the adjoining strips are protected with growing wheat. If this is done the entire field can be kept safe from wind erosion at all times.

Drilling wheat on stubble-mulched land.—After land has been properly prepared using the stubble-mulch system, it is important that the right methods be used in seeding. In many cases farmers have a fair amount of residue on the land up to planting time. Then by improper methods of drilling, too much of the residue may be covered. This can be avoided by use of the proper drill or adjustments on the drill, and by operating the drill at the proper speed. The ordinary deep furrow drill with 12- or 14-inch row spacing as shown in figure 13, or the semi-deep furrow drill, can be made to operate satisfactorily through residue. Other drills of the shoe type designed especially for working through residue are shown in figures 14 and 15.

The objective in drilling through stubble mulch is to make a clean furrow in which to deposit the seed. A press wheel that will press the soil firmly down on the seed should be used. This aids in germination. There should be enough old straw on the surface and

FIGURE 12.—Strip-crop farming in western Nebraska. Stubble strip is being fallowed by the stubble-mulch system. This protects the land against wind and water erosion. The other strip is protected by wheat and the wheat stubble after harvest will continue the protection.

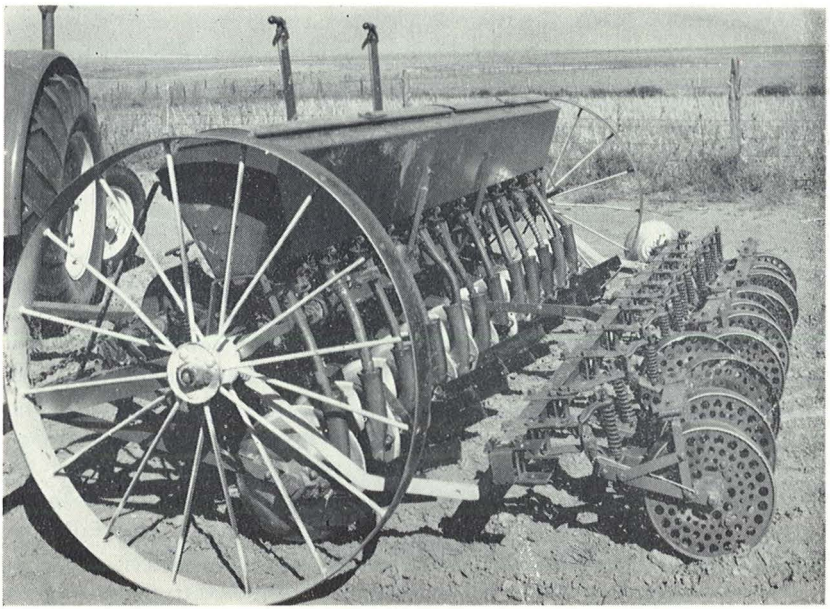

FIGURE 13.—Deep furrow drill. This drill will work through as much residue as is needed for crop and soil protection. Careful attention to the speed of travel and to adjusting disks so they do not throw enough soil to bury the residue is important in operating these drills.

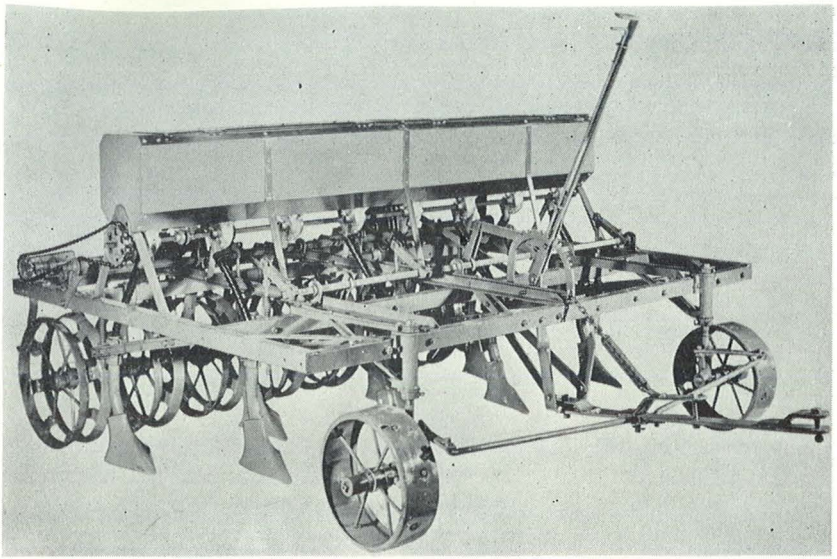

FIGURE 14.—A shoe-type drill with 14-inch spacing which works well in seeding through residue.

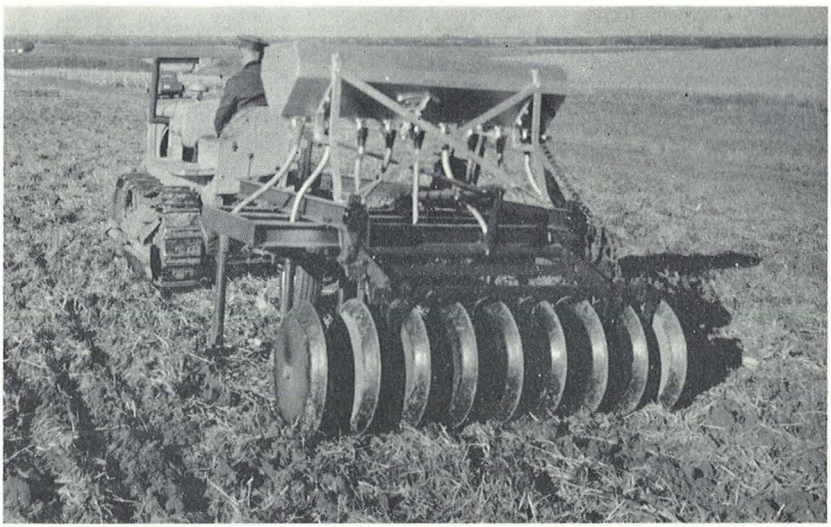

FIGURE 15.—Heavy press-wheel-type drill designed especially for seeding through crop residue. Additional drills can be pulled side by side to make a unit of any desired width.

sticking out of the surface on the ridges between the rows to prevent wind erosion. This straw will also give a high intake rate in case of heavy rain and will greatly reduce runoff and erosion. The drill should be operated so as to leave the land in the best possible condition to resist wind or water erosion.

Control of Downy Brome or Cheatgrass

Some growers using the stubble-mulch method have had difficulty in controlling downy brome or cheatgrass in wheat. It must be admitted that this is somewhat more difficult with the stubble-mulch system than where the moldboard plow is used. However, some of our best wheat growers are using the stubble-mulch method and are keeping the cheatgrass down to the point where they do not consider it a serious problem. In some cases they find it advisable to plow the land occasionally.

Every effort should be made to kill the cheatgrass along the edges of fields, in fence rows and along roadsides. It is from these places that much of the seed is scattered onto the fields. If care is taken to cause most of these weed seeds to germinate in the fall after harvest, the plants can be killed by the fallowing operations the next summer. A thorough weeding just before seeding should eliminate any plants that may have germinated before wheat sowing time. The use of chemical sprays and special cropping practices for the control of downy brome are being studied but definite recommendations cannot yet be made.

Insect and Disease Control

Wheat grown on stubble-mulched land has been no more subject to insects or disease than other wheat. By using the stubble-mulch system to control wind erosion, wheat seeding can be delayed. Hessian fly can usually be avoided by planting after the safe date. Late seeding also helps to control wheat mosaic.

Soil Nitrates

There is a tendency for nitrates to develop somewhat more slowly under stubble mulch than where land is plowed. However, since the time between crops is longer in a wheat-fallow system, there is enough time for nitrates to develop if the land is thoroughly tilled. For this reason land fallowed by the stubble-mulch system will usually have an abundant supply of nitrates for the wheat crop. On some of the more sandy soils the addition of nitrogen fertilizers may sometimes be beneficial. As the heavier soils are farmed for a longer time they may eventually reach the point where nitrogen fertilizers will prove profitable.

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