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## EC54-100 Revised Stubble–Mulch Farming Methods for Fallow Areas

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Wind erosion on black fallow wheat field.



Wheat with enough mulch to protect it against wind erosion.

# Stubble-Mulch Farming Methods For Fallow Areas

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# Stubble-Mulch Farming Methods for Fallow Areas

F. L. Duley and C. R. Fenster<sup>1</sup>

## INTRODUCTION

A protective cover of residues will insure protection of the land from wind erosion and, at the same time, aid in the control of water erosion. This system of using residues is known as stubble-mulch farming.

Stubble-mulch farming is a year-round system of managing plant residues. All tilling, planting, cultivating and harvesting operations are performed to keep a sufficient amount of residue on the surface at all times for soil protection. The residue may consist of stubble, combine straw, cornstalks, or sorghum residues 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



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

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wind erosion on wheat land (Cover page and Figure 1). To be most 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 it tends to become brittle, and may break into short pieces when run over by machinery. If it does not become too short it may be partially buried 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 and 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 retarded 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 such as downy brome are not a problem. 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 anchored on the soil. The residue should last until the next wheat crop begins to grow 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 (Figure 2). When downy brome or volunteer wheat is a problem in the fall of the year, a tillage operation may be necessary. A shallow tillage operation with a subsurface tiller will give a good kill and at the same time leave residues standing to catch snow.

### Conservation of Moisture

When properly managed, a protective cover may serve to increase the moisture content of the soil. If allowed to stand on the soil through the winter, the residue will catch snow. 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.





Figure 2. (Top) A plowed field showing how small gullies have been cut in soil by a single heavy rain. (Bottom) A similar field on adjoining farm after the same rain with much 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. The amount of straw needed to protect the soil will vary with the structure and texture of the soil, the type of drill used and the surface condition attained in the final operation of seeding. The amounts generally needed to protect the land will be approximately 1000 pounds per acre on moderately fine-textured soils, 1500 pounds on the medium-textured soils (Figure 3), and 2000 pounds on sandy soils.



Figure 3. Fifteen hundred lbs. of residue per acre prior to seeding. Ideal amount for medium-textured soils.



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 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, firmed, 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, weeders and drills may be used so as to result in a good job.

Most, if not all, tillage operations tend to reduce the amounts of residue initially present on the soil surface. This reduction of residue varies markedly with the type of equipment and the kind of operation being performed, as illustrated in Table I.

Several methods may be followed to obtain a good job of fallowing with the stubble-mulch system. 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 after fall 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.

Some of the most effective equipment for stubble-mulch farming has been the V-sweep machines equipped with sweeps 30" or more in width (Figures 4, 5 and 6). These machines are particularly good for the first operation or two. 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

Table I

Type of equipment	Reduction in each tillage operation
	%
Sweeps, 30 inches or larger	10
Chisel plows—shanks spaced 9 to 12 inches apart	25
Rodweeder	5 to 10
Rodweeder with shovels	15
One-way disk, 2 to 3 inches in depth	30
One-way disk, 6 to 7 inches in depth	70
Tandem disk	50



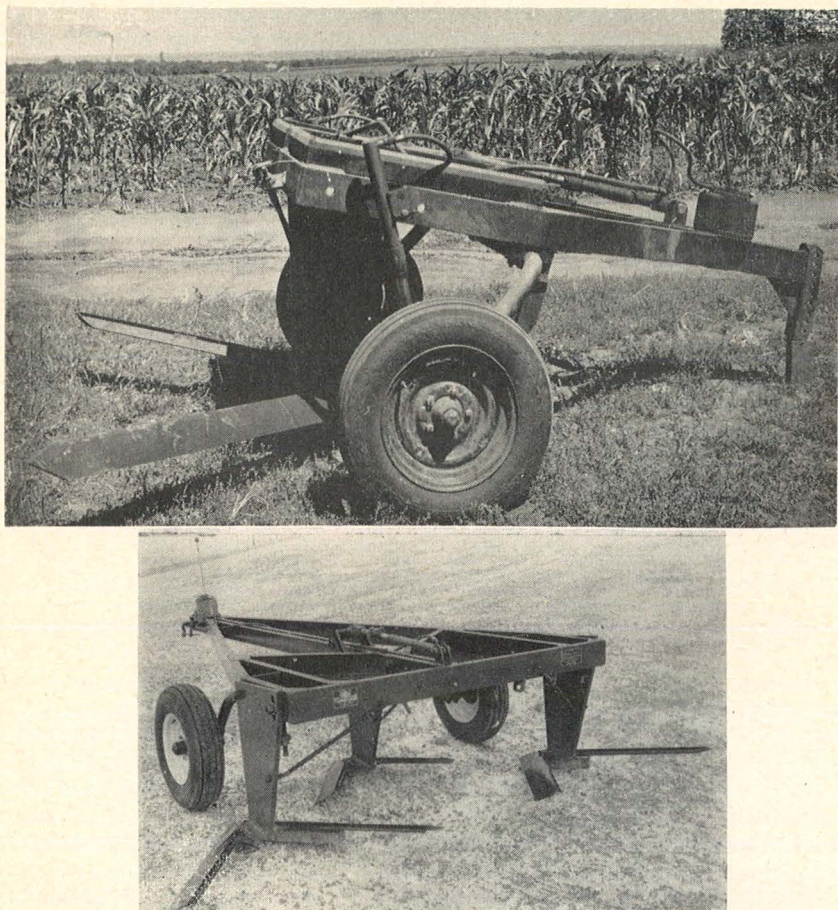


Figure 4. Large V-blades. (Top) Eight-foot V-blade subsurface tiller mounted on sturdy chassis. This machine can be equipped with a 24-inch rolling coultter. (Bottom) Same type of machine as above, but having three sweeps with total width of 11 to 14 feet.

or second tillage operation during the fallow season, giving time for the soil to become well settled before seeding.

When the weeds start again, the next operation may be done with a rodweeder. A rod with shovel attachment like the one shown in Figure 7 is very effective. If weeds come on too rapidly, another operation with this equipment may be necessary.

Prior to seeding wheat, it is well to give the land a final operation with a plain rodweeder without the shovel attachment. This tends to kill all the small weeds, including downy brome grass. 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.





Figure 5. A subsurface tillage machine equipped with 32-inch sweeps working in 40 bushel wheat stubble.

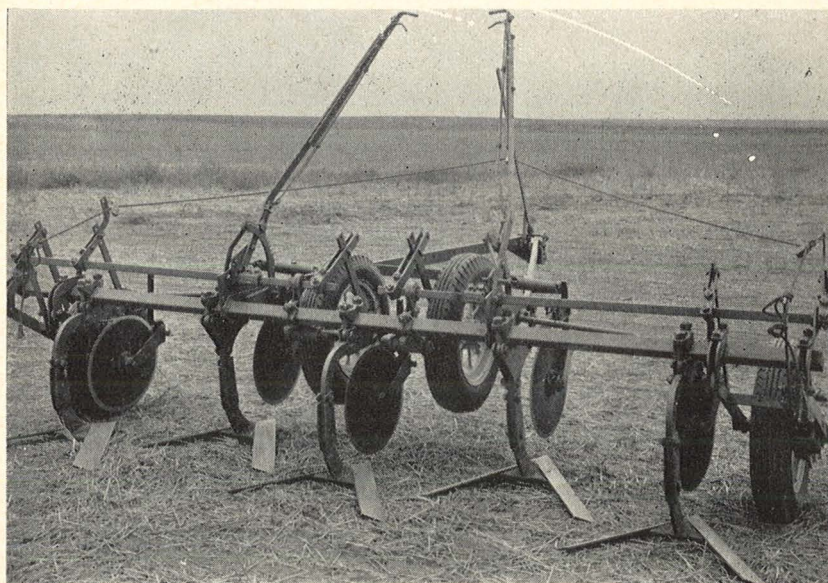


Figure 6. A subsoil tillage machine with 30-inch sweeps and a rolling coultter ahead of each sweep.



The large V-blade tillers shown in Figure 4 may also be used on multiple hitches where larger tractors are available. In Figures 8 and 9 two or more 8-foot tillers are being pulled on a large multiple hitch by a single power unit. Flexible units are more desirable on uneven or terraced land.

**Method No. 2**—If weeds have grown up in the stubble, especially downy brome and volunteer wheat, it is advisable to kill them in the fall. If the field were mowed to kill broadleaf 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 manner that it does not lay the stubble flat (Figure 10).

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



Figure 7. Small shovel attachments to rodweeder. This makes it possible to operate rod in harder ground than where rod is used without shovels. If fact, it converts a rodweeder into a type of subsurface tiller.





Figure 8. 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 coulters ahead of the standard will result in a cleaner cut with less chance of straw or weeds hanging on the shank and making a furrow.

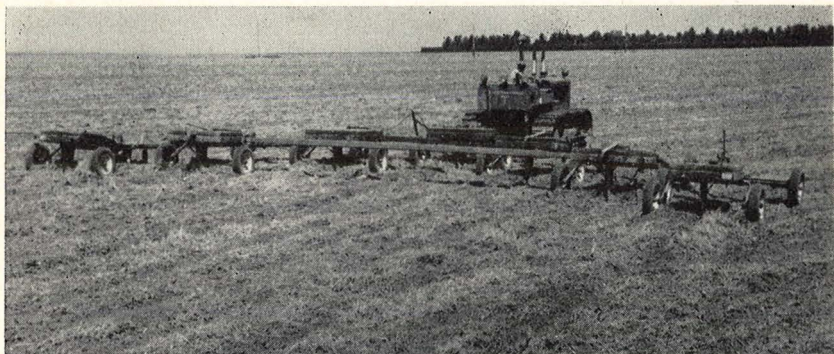


Figure 9. Seven 8-foot subsurface tillers preparing land for wheat in the northern Great Plains. Note good cover of residue over surface of ground.



Figure 10. Combine stubble worked in fall with one-way disk. This has been left standing sufficiently to catch much snow.



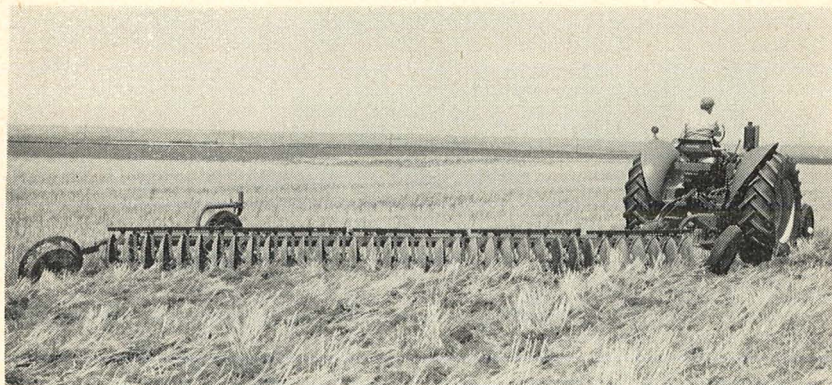


Figure 11. One-way disk operating in heavy wheat stubble. The machine was giving good tillage action on the soil and yet leaving a good quantity of residue anchored on the soil surface.

**Method No. 3**—If residues are moderately heavy in the spring, the first operation may be with a one-day disk or tandem 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 wheat 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 (Figure 11).

No tillage is necessary for a few weeks after this first one-way operation. When weeds start again one of several implements may be used. An implement that will undercut the soil and loosen it to about the depth of ordinary plowing is usually desirable. Sweep machines or rod-weeders with shovels (Figure 7) will do this job well.

Following this operation the rodweeder 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.

**Method No. 4**—Chisel machines with 2-inch spikes spaced 9 to 12 inches apart may be used on the first operation (Figure 12). They may be desirable to use in case the ground is dry and hard to do a breaking and ripping job. Only small weeds can be controlled by this operation. 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 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 can also be equipped with a revolving rod attachment. The rodweeder with shovel attachment also works well after the chisels.



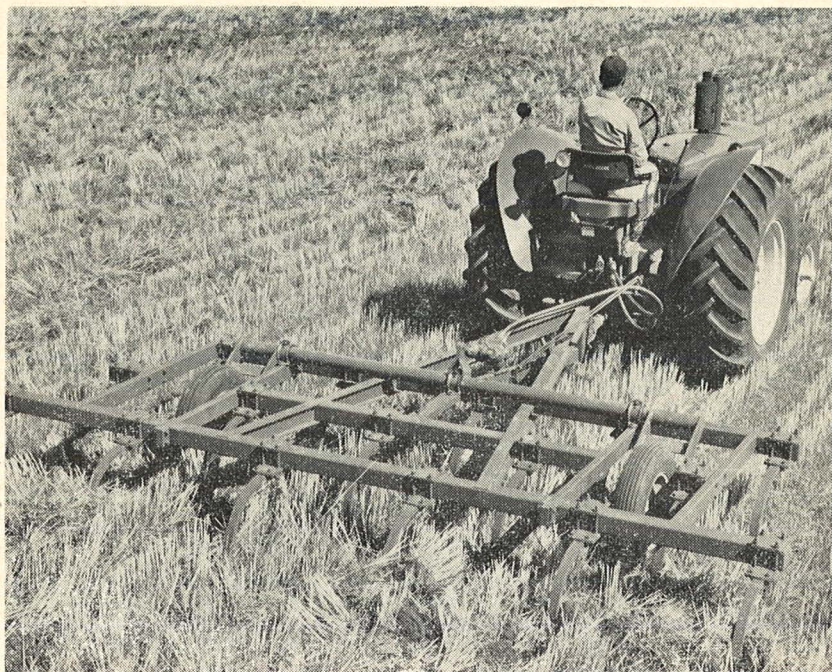


Figure 12. Chisel plow equipped with 2-inch chisels working in moderately heavy residue.

**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.

If, prior to the time of drilling, residues are exceedingly heavy or bunched, several things can be done. They are:

1. **Rotary hoeing** (Figure 13) at fairly high rates of speed when the residue is dry will break up the residue as well as distribute it more uniformly over the area. Adjustable rotary hoes should be set so that



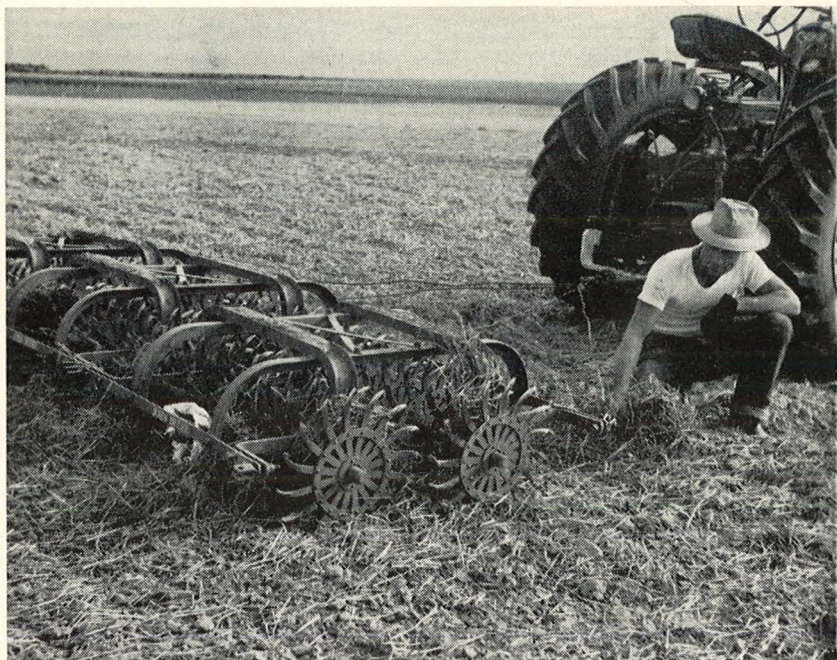


Figure 13. Rotary hoe being used to spread and anchor residues prior to drilling.

the teeth interlock several inches. Rotary hoes with the larger sprockets or hoe wheels are satisfactory for this operation. If the residues are extremely heavy, the farmer may have to pull the rotary hoe backwards for trash clearance, but this will not be nearly as effective in chopping or distributing the residues as when pulled forward. On a number of rotary hoes the rear gang or hoe wheels can be reversed. These hoe wheels can be operated in a treader fashion to keep the front gang of hoes free of residue. This will give an intermediate action on distributing and chopping of residues.

2. A **single disk** or **tandem disk**, pulled straight when the residues are dry, will chop and punch a lot of the residue into the soil. Weight on the disk will be needed.

3. **Stubble punchers** such as a series of rolling coulters bolted together, similar to a single disk, will chop and anchor residues. Weight may be needed on these machines.

4. **Skew treaders** will help considerably to distribute and anchor some of the residues into the soil. One should be careful of these implements so as to not dry out the surface soil to the seeding depth.

**Strip cropping.**—In many areas of the Great Plains strip cropping has become a common practice. This method was developed to help reduce wind erosion. It is made much more effective if the fallowing is done by the stubble-mulch system (Figure 14). The strip being fal-



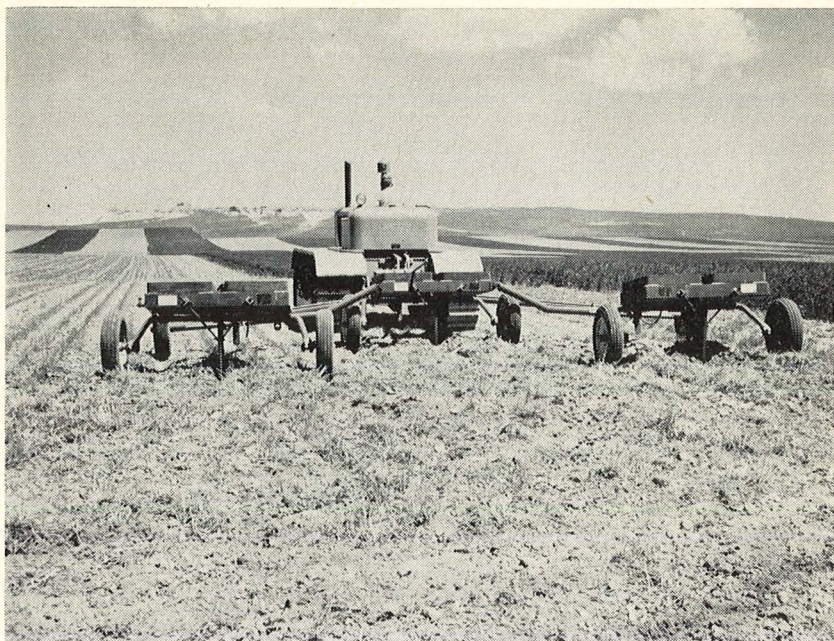


Figure 14. Strip-crop farming in western Nebraska. Stubble strip is being fallowed by the stubble-mulch system. This protects the land against wind and water erosion. The other strip is protected by wheat and the wheat stubble after harvest will continue the protection.

lowed 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 and adjustments. The mulch hoe drill with 7- to 14-inch row spacing, as shown in Figures 15 and 16, can be made to operate satisfactorily through residue.

The objective in drilling through stubble mulch is to make a clean furrow in which to deposit the seed (Figure 17). 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 sticking out of the surface on the ridges between the rows to prevent wind erosion. This straw will also give a high water 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 and water erosion.



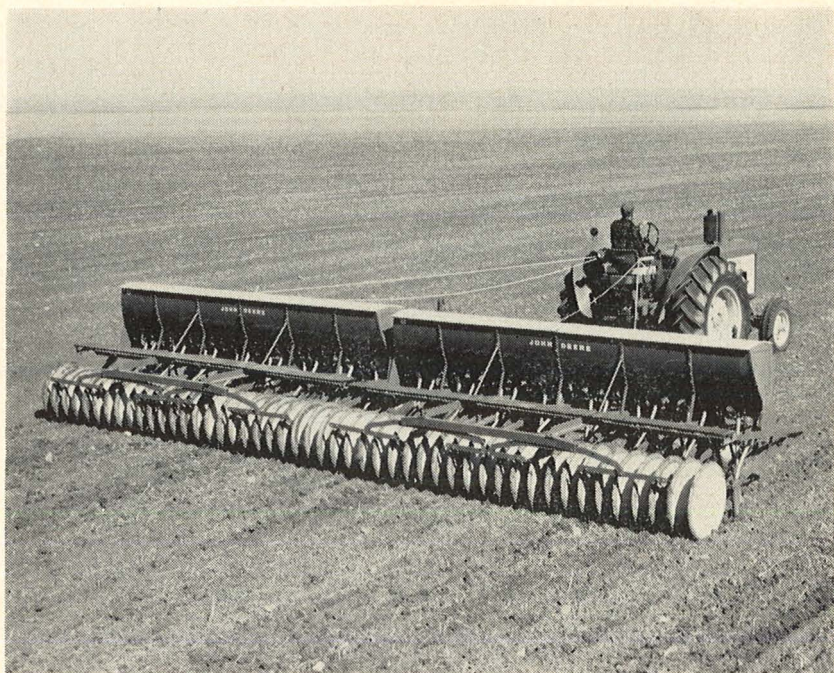


Figure 15. Mulch hoe drill equipped with  $1\frac{1}{2}$ " shoes spaced seven inches apart, seeding in residues.



Figure 16. Heavy press-wheel type drill, designed especially for seeding through crop residues. Units are in 7-ft. sections for flexibility.





Figure 17. Good stubble mulching. Residues are anchored securely between the rows.

### **Control of Downy Bromegrass or Cheatgrass**

Some growers using the stubble-mulch method have had difficulty in controlling downy bromegrass or cheatgrass in wheat. This is somewhat more difficult with the stubble-mulch system than where the moldboard plow is used. However, some of the best wheat growers are using the stubble-mulch method and are keeping the downy brome-grass down to the point where they do not consider it a serious problem.

Timeliness of the first tillage operation is essential for good weed control. Control of downy bromegrass with stubble mulch tillage equipment can be done if the soil is dry at the time of tillage. Control measures must be effective before the 10th of May. Otherwise, the downy bromegrass will set a seed crop and will likely be a bigger problem in future years.



Every effort should be made to kill downy brome grass 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.

Using a three-year rotation, which includes a row crop or a crop which is seeded after the 1st of May, is very beneficial in the control of downy brome grass.

### **Chemical Control of Downy Brome grass**

The use of chemicals for the control of downy brome grass is being studied. At the present time, recommendations can only be made for areas not used for cropland or pasture, such as roadside ditches, fence and turn rows. On these areas, chemicals such as Atrazine, Simazine, Monuron, Diuron, Dalapon and Amitrole can be used.

### **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. Later seeding helps to control wheat streak mosaic as well as giving most efficient use of water stored in fallow operations.

### **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 long 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 finer-textured soils are farmed for a longer time they may eventually reach the point where nitrogen fertilizers will prove profitable. An appropriate soil test may serve as a reliable guide to profitable use of fertilizer on fallow wheat.

### **Can Row Crops be Stubble Mulched?**

Yes, stubble-mulch farming can also be used for row crops (Figure 18). The land may be prepared with the mulch tillage equipment, then planted with a lister. The furrows should only be deep enough to provide a clean furrow free of residues and weed seed.

Residues should be anchored between the rows for a protective soil cover. Initial cultivations as necessary can be performed with a rotary hoe to control weeds. Later cultivations can be done with a cultivator equipped with large sweeps.





Figure 18. Row crops planted in heavy residues. Residues are providing a protective cover between rows.