Combine Harvesting in Minnesota

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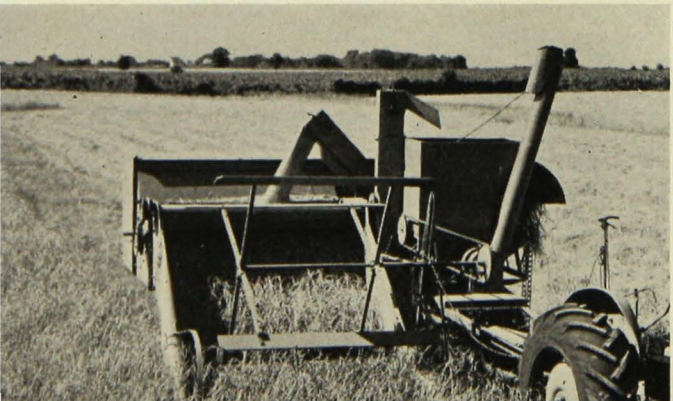
THRESHING small grains in the same operation with cutting the crop or picking it up from the windrow is spoken of as "combining." Machines used for this purpose are usually called "combines" or "combine harvesters."

Combining was first practiced in Minnesota in 1927. During the following three or four years, about 250 machines were put into use by farmers in the state. Although few machines were purchased during the depression, they have been sold in comparatively large numbers during the past few years.

The first combines were large, ranging in size of cut from 10 feet to 20 feet. Later most combine manufacturers built smaller machines, with a capacity equivalent to that of a grain binder. The width of cut ranged from 5 to 8 feet. At present machines are being built with cutter bars 3½ and 4 feet long. The capacity of the threshing mechanism is in proportion to the width of cut.

With the availability of small size combines a farmer with an average acreage of small grain can buy one at an investment no larger than that represented by the ownership of a grain binder and a part interest in a stationary thresher.

Farmers are interested in machines that save time and labor. This is the chief advantage of the combine. The large threshing crew is not necessary. With the completion of cutting, the grain is already threshed and in the bin instead of waiting to be shocked and later hauled to the machine for threshing. The cost of twine has also been saved. The time required for harvesting is shorter than with the binder and stationary thresher.



Combining Saves Time

Under favorable crop and seasonal conditions direct combining is feasible and practical. Direct combining saves time and labor.

Successful Use of the Combine

Combining differs in many respects from the customary use of the grain binder and stationary thresher. The use of the combine introduces new problems and, if it is to be successful, the practice must be adjusted to provide a solution for these problems.

Moisture Content

Threshed grain that has too much moisture will not keep well in storage. This becomes important when harvesting with a combine. At normal binder harvest time, grain has a moisture content of 20 to 30 per cent. For safe storage, the moisture content of threshed grain should not exceed 14 per cent. A high moisture content in grain harvested with a combine may be due to the fact that it is not sufficiently ripe. Some fields ripen unevenly, parts of the field being green while other parts are ripe enough for combining.

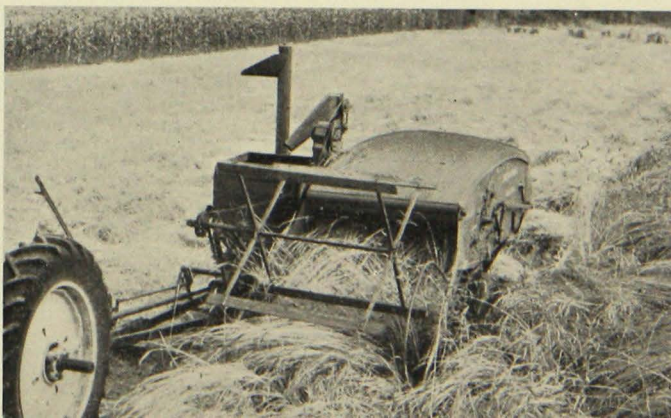
The presence of green weeds usually results in a high moisture content in the grain. Weed seeds are often less ripe than the grain. Small pieces of green weed plants are difficult to separate from threshed grain and when mixed with it will raise the moisture content of the grain. Harvesting should not be started too early in the morning after heavy dews or too soon after rains.

Behavior of the Crop After Binder Harvest Time

When direct combining is practiced, it is desirable not to harvest until the moisture content of the grain is sufficiently low for safe storage. The length of time to delay harvesting after normal binder harvest time varies with crop and weather conditions. It may be only 3 or 4 days, or it may be considerably longer.

During the harvest seasons of 1938 and 1939, tests were conducted on plots at University Farm, St. Paul, and the Southeast Experiment Station, Waseca, to determine how soon after binder harvest time grain will be ready for combining and to what extent losses are incurred by permitting the crop to remain uncut until it is sufficiently ripe for direct combining. The results obtained in 1938 are shown in table 1.

For conditions obtaining in these trials, there was no serious loss during the period necessary for the grain to become sufficiently ripe for combining.



Combining Lodged Grain

Lodged grain may be harvested effectively with the combine, but if it is allowed to remain unharvested for some time, weed growth and shattering will result.

The period between binder harvest and combining ranged from 4 days for the oats at Waseca to 15 days for the wheat. There was a slight decrease in the yield of wheat at both locations during that period. In the case of both barley and oats at Waseca, considerably more of the crop was harvested with the combine several days after binder harvest time than was realized by the binder-thresher method. This was due largely to the fact that the barley was slightly lodged and the oats badly so even before cutting with the binder. Under these conditions, there is always a large loss with the binder-thresher method. With the combine, on the other hand, lodged grain is more effectively recovered because there are no losses due to binding, shocking, and subsequent handling of poorly made bundles. The cutter bar of the combine will do as good a job of picking up lodged grain as that of the binder.

There are, however, other factors that must be considered. It is not possible with the combine, because of its limited capacity, to harvest all of the crop as soon as it is ready. Some must remain uncut for a week or 10 days, and sometimes longer, after it is ready.

During the harvest season of 1939 tests were made to determine the practicability of combining at varying periods after the crop is ready. The yield will vary with the degree of lodging, amount of damp weather and rainfall, and growth of weeds during the intervening period. It was found in the case of Thatcher wheat and Gopher oats at Waseca that there was no significant decrease in the amount of grain harvested during a period of 18 days following the first combining. On two fields of Anthony oats near University Farm, however, there were decreases of 21 per cent and 14 per cent during a 14-day period. The yield of Minrus oats at Waseca decreased 19 per cent during 18 days after first combining, and that of Oderbrocker barley decreased 14 per cent during a 7-day period. Generally, as shown in table 1, the yield of the first combining may be expected to be about the same as that of the binder-thresher method.

Table 1. Comparison of Combine and Binder-Thresher Harvesting on the Same Fields in 1938

Crop	Method of harvest	Date cut	Per cent moisture when cut	Date threshed	Per cent moisture when threshed	Test weight (pounds per bu.)	Yield (bu. per acre)	Per cent increase when combined	Days between binder harvest and combining
Barley*	Binder	July 20	17.5	Aug. 3	12.43	38.0	22.7		
	Comb.	July 27	11.1			36.0	27.9	+23.0	7
Wheat*	Binder	July 19	21.0	Aug. 3	13.46	50.4	13.6		
	Comb.	Aug. 3	14.0			46.9	13.3	−2.2	15
Oats*	Binder	July 23	13.0	Aug. 3	12.39	22.5	35.0		
	Comb.	July 27	12.0			19.6	47.2	+34.9	4
Barley†	Binder	July 25		Aug. 12	12.8	37.25	41.1		
	Comb.	Aug. 3	11.83			33.5	43.9	+6.8	9
Wheat†	Binder	July 25		Aug. 12	14.2	51.5	27.0		
	Comb.	Aug. 3	12.35			50.5	25.1	−7.0	9

* Grown at Waseca.
† Grown at University Farm.

Quality and Grade

The quality of the grain appears to be affected in some respects by delaying harvest for two or three weeks after it is ready for combining. The weight per bushel of both oats and barley was about the same for combined grain as for that harvested with the binder. The weight per bushel of wheat, however, was higher for that harvested with the binder. A high percentage of damaged grain appears to be at least partly responsible for this.

It appears that the use of the combine at the early part of the harvest period gave a better quality oats on an average than that harvested with the binder or combined later. Harvesting with the combine a week or more after the crop is ready permits weeds to develop. This results in grain with a high percentage of foreign material, and sometimes the grain becomes musty because of moisture transmitted by weed seeds present in the threshed grain. Under weedy conditions, early harvesting is desirable. The binder-harvested grain is usually cleaner than that harvested by the combine. Where the grain is not very weedy, this difference is less likely to occur.

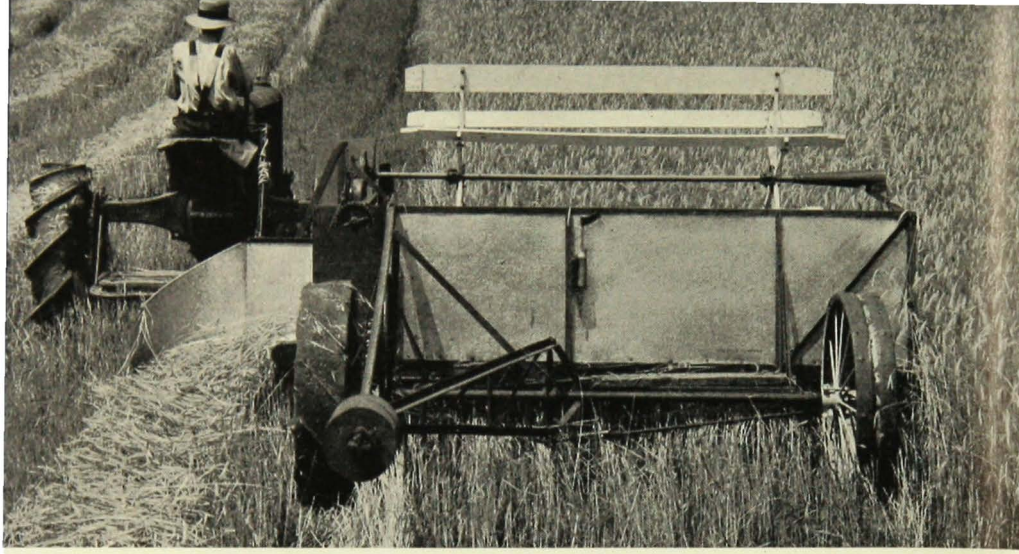
Barley harvested with the combine was slightly superior to that harvested six days earlier with the binder. Later harvests gave a lower grade of grain owing largely to a greater percentage of skinned and broken grains—a factor of great importance in malting barley. It would appear from these data that early combined barley was equal, if not superior, to that harvested with the binder.

The results of these tests indicate that there is considerable advantage to cutting the crop at regular binder harvest time or soon afterwards. This may be done if the grain is first windrowed and then picked up with the combine as described later. If left for direct combining, lodging and shelling are likely to occur, and some crops will crinkle. Weeds will grow rapidly after the crop stops growing. The weed situation becomes especially bad in fields where the grain has lodged, and during rainy periods. The difficulty of such a situation increases from day to day. It is necessary to run the cutter bar of the combine close to the ground to obtain as much grain as possible. This results in large quantities of green weed plants being taken into the combine.

Presence of Weeds

Weeds are detrimental to direct combining. Most weeds are still green when the grain is harvested, and the seeds of many of them have a very high moisture content at that time. Parts of green weed plants are hard to separate from the grain because of their weight. These, together with green weed seeds that get into the grain, transmit moisture to the grain and reduce its keeping quality.

Threshing difficulty is increased by the presence of green grass and weeds. It is increased still more if the grain has lodged or crinkled in a growth of green material. Under such conditions, it is desirable to cut close to the ground to pick up as much of the grain as possible. While doing so, however, large quantities of straw and grass go through the thresher, and this reduces the efficiency of the machine. For most efficient threshing, it is best to leave a long stubble and keep the amount of straw going through the machine as small as possible.



For proper windrowing the stubble should be 8 to 10 inches high, and the windrow should not be laid in a wheel track.

Windrowing

WINDROWING consists of cutting the crop and laying it on the stubble in a windrow in which the stems are laid parallel with the direction of travel and are lapped over each other so that the heads are on top and the butts of the stems are beneath and covered. When this practice is followed, the crop is cut at about the same stage of maturity as it would normally be cut with the binder. It is then allowed to remain in the windrow for several days. The moisture content of the grain is reduced more rapidly in the windrow than when the grain is left uncut. There is also less danger of losses from wind, hail, and rains.

Pick-up Device Used

Grain that has been windrowed is later harvested with the combine which has a "pick-up" device attached to the cutter bar. By means of the pick-up, the windrow is raised off the ground and deposited on the conveyor of the combine from where it is handled in the same way as grain cut with the combine and threshed at the same time.

Windrowing may be done with a machine made especially for that purpose consisting essentially of a cutter bar with a platform and canvas so arranged that the cut grain is deposited on the stubble at the end of the platform. It may also be done with a binder, which most farmers have. When the binder is used, it is only necessary to remove the trip hook from the binder deck, or if an old binder is to be used permanently as a windrower, it is better to remove the binding attachment and the packers.

Make Trough of Sheet Iron

A piece of sheet iron should be attached to the lower end of the binder

deck so as to form a trough that catches the grain as it drops from the deck. As the binder moves forward, the grain slides out of the trough and is deposited lightly on the stubble. Grain handled in this way will not settle into the stubble as it would if permitted to drop freely from the binder deck. The bottom of the trough should be about 10 inches wide, the outside piece high enough to prevent grain from going over it, and the front end somewhat higher than the rear end.

Lay Windrow Loosely

The windrow should be laid on the standing stubble as loosely as possible and must not be laid in a wheel track previously made by the tractor or binder. The exact position of the windrow, therefore, with respect to the binder will depend on the width of cut of the binder and the tread of the tractor. This must be worked out for each outfit, and the trough attached so that the windrow will lay on standing stubble.

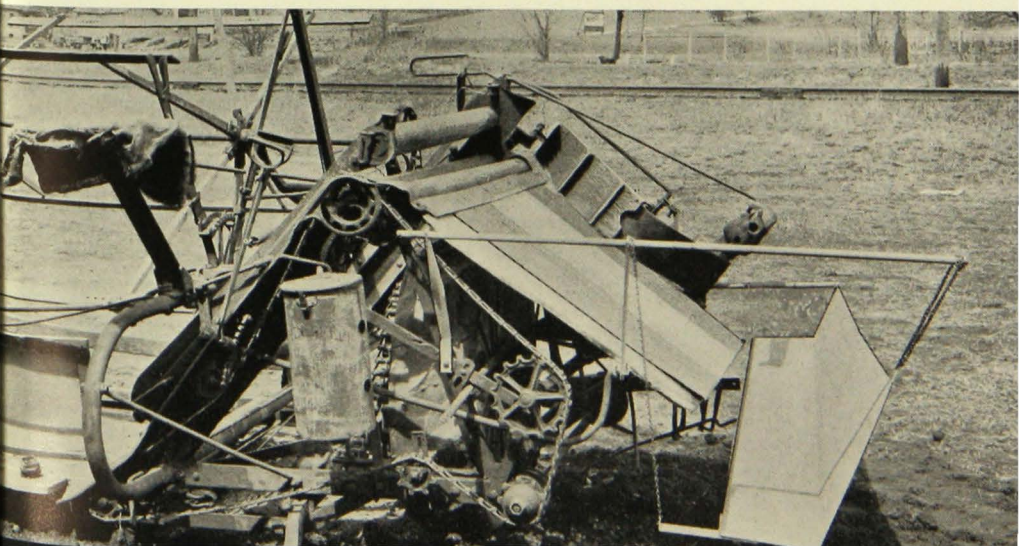
Preferably the machine that is used for windrowing should have the cutter bar on the same side as the pick-up attachment is located on the combine.

For example, a windrower with a left-hand cut goes around the field counter-clockwise. The windrow which it makes has the heads pointing in the direction opposite to the direction of travel. It is necessary to pick up the windrow while traveling in the same direction that the windrower traveled when making it. It is obvious that a combine with a left-hand cut must be used if one is to start around the outside of the field and follow the same course that was followed by the windrower.

Corners Often Rearranged

If a combine with a right-hand cut is used for picking up the windrow that has been made by a windrower with a left-hand cut, it will be necessary to start in the middle of the field and work toward the outside. When following this practice, the tractor must

To windrow with the binder, the binder head should be removed, sheet iron placed on the deck, and a trough attached to catch the grain.



Combining From Windrow

When combining from the windrow, a pick-up device is attached to the cutter bar in place of the knife.

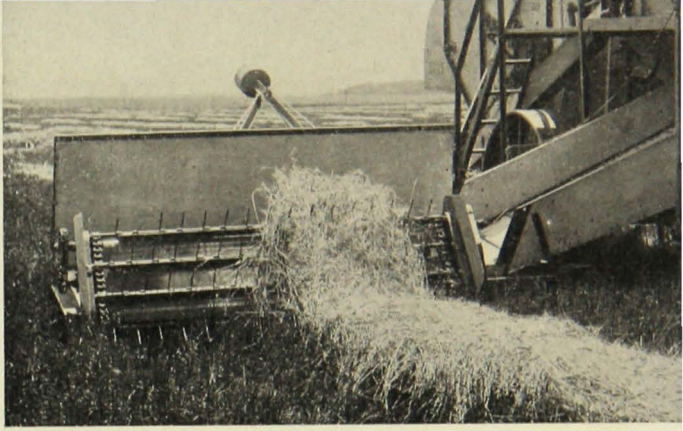
travel over the windrow at each corner before that portion of the windrow is picked up. The corner must be rearranged to facilitate picking up the grain.

Comparative Size of Windrower and Combine

When the windrow method is used, it is advisable to use a machine that has a width of cut which is the same or nearly the same as that of the combine. The threshing and separating parts of the combine are designed to handle the quantity of straw that will normally be obtained by the cutter bar of that combine. If, for instance, with a normal stand of grain, a 10-foot windrower is used to cut a crop which is later to be picked up and threshed with a 6-foot combine, it is obvious that the thresher will be seriously overloaded. Such overloading will result in a poor job of separation and cleaning, permitting large quantities of grain to go out with the straw.

A windrow made from a swath wider than the cutter bar of the combine is permissible in a light stand or

Left—In a properly made windrow, the heads are at the surface.
Right—Medium length stubble will hold the windrow up.



A Well-made Windrow

If the windrow is properly laid on the stubble, very little grain will be lost when picking it up with the combine.

when the combine is pulled at a low speed. Such a combination of circumstances, however, is the exception rather than the rule. It is best, as a regular practice, to keep the size of the swath cut by the windrower about equal to the width of the cutter bar on the combine.

Handling straw

When the combine is used, the threshed straw from the separator is deposited on the ground. On most machines, there is a device for spreading the straw if the operator does not wish to use it. If the straw is to be used, it may be deposited in the form of a windrow and may then be picked up with a hay loader and hauled to the farmstead, or it may be picked up from the windrow and baled automatically with the pick-up baler. Some combines have attachments by means of which straw may be deposited in bunches.

Machine Operation and Adjustment

PROPER adjustment of the machine is necessary for good results. One should be familiar with the functions of the various parts of the machine and should know the purposes of the adjustments. The combine may be adapted to the handling of a variety of crops under many conditions by the use of proper sieves, air blast, adjustment of concaves and speed of the various parts as well as the speed at which it is drawn over the ground. Tests conducted on small combines indicate that while losses of grain in the threshing operation have, in some cases, run as high as 22.5 per cent, they need not be high. In fact, some combines were operating with threshing losses of less than 1 per cent, and many had losses within the range of 1 to 3 per cent. In practically all cases it is possible to reduce the losses due to threshing and separating to 1 per cent or less by proper adjustment and operation.

Each crop requires certain machine adjustments. The best way to find out

what these are is to study the service manual furnished by the firm making the machine. Besides the regular adjustments required for any particular crop, judgment must be exercised for the most successful handling of any particular situation.

Don't Overload Racks

When straw is heavy and when for some reason it is necessary to cut close to the ground, it is easy to overload the straw racks. This can be controlled by the rate of travel. While the rate of travel may be relatively high (3 or 4 miles an hour) where the crop is light, it must be reduced when a large quantity of straw is to be handled. In a series of tests recently made, the rate of travel of most machines varied from 2.25 to 3.5 miles per hour. One traveled 1.38 and another 5.25 miles an hour. The average was 2.82.

Setting Concaves Important

Setting the concaves or threshing bar with respect to the cylinder is also important. There should be a sufficient number of concaves, and they should be set close enough to the cylinder to insure all of the grain being removed from the heads. It is unwise, however, to have them set so that the straw breaks smaller than is necessary. Too much chaff interferes with the proper functioning of the cleaning shoe.

Barley that is to be used for malting must be threshed carefully. Not more than 5 per cent may have mechanical injury to grade "malting." The skin is easily broken or damaged in threshing. Injury may result from concaves being set too close to the cylinder or from cylinder speeds that are too high. The sieve and air blast adjustment should be such that not much grain is allowed to go into the tailings to be returned to the cylinder.

Losses Need Not Be High

All of the grain is not recovered by the cutter bar or pick-up attachment. The losses resulting from these operations vary with conditions. They should be added to the losses resulting from the threshing operation to obtain the total loss of grain in the combine method of harvesting. The losses at the cutter bar on machines that were tested ranged from a trace to as high as 15.3 per cent. The average of all machines tested was 3.73 per cent. This loss need be no higher than similar losses with a grain binder. In fact, they should be lower because when cutting lodged grain with the combine bundles are not made and the only concern is to get the grain on the platform of the combine.

Total losses with combine harvesting are usually less than losses with the binder and stationary thresher method of harvesting under similar conditions.

Capacity and Rate of Performance

THE NUMBER of acres that may be harvested per hour or per day depends on the width of cut, the rate of travel, and the amount of time lost in stopping. A formula that will give approximately the daily capacity of a machine is the following: Acres per 10-hour day = width of machine in feet times speed in miles per hour. A machine that cuts a swath of 5 feet traveling at the rate of 3 miles per hour might be expected to do 15 acres in a 10-hour day if the only time lost is that which would normally be lost in turning.

The number of hours per day during which combining may be done varies with weather conditions. If there is dew during the night, it will be necessary to delay starting in the morning until the dew has dried off. This may be 9 or 10 o'clock or even later. When there is no dew and the crop is sufficiently dry and ripe, combining may be started early in the morning. After rains or on damp days, grain must be allowed to dry well before harvesting.

To prevent unnecessary losses, it is advisable to harvest the crop as soon as possible after it has become sufficiently ripe. Enough machine capacity should be available so that the harvest may be completed without too much delay.

The number of acres that may be harvested in a year will depend on the range in the ripening dates of the crops to be harvested as well as on weather conditions.

Charge on Acre Basis

If the investment in the machine is to return most profits, the combine should be used to harvest as many acres as possible during the season. In many communities, combine owners harvest crops for their neighbors. The charge is usually on the acre basis and varies in different communities. It varies from $2.00 to $3.00 an acre for the use of the combine, tractor, and operator for direct combining. The cost of windrowing depends on such factors as the size of machine used and the number of men needed. The minimum cost is about 50 cents an acre.

Facts About Combine Harvesting

Farmers are interested in machines that save time and labor. This is the chief advantage of the combine.

The use of the combine introduces new problems and, if it is to be successful, the practice must be adjusted to provide a solution for these problems.

When direct combining, it is best not to harvest until the moisture content of the grain is low enough for safe storage. This may be from four days to two weeks after binder harvest time.

There is considerable advantage in cutting the crop at regular binder time or soon afterwards. This may be done if the grain is first windrowed and then picked up with the combine.

Weeds are detrimental to direct combining. Because many of them are still green when the grain is harvested, they transmit moisture to the grain and reduce its keeping quality.

The windrow should be laid on the standing stubble as loosely as possible and must not be laid in a wheel track previously made by the tractor or binder.

It is possible in most cases to keep the losses due to threshing and separating down to one per cent or less by proper adjustment and operation of the combine. It is best to follow closely the instructions in the service manual furnished by the firm making the machine.

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