Ridge Farming for Soil and Water Control

W. F. Buchele, E. V. Collins and W. G. Lovely
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System of farming holding much promise for protecting soil from water and wind erosion, for reducing drowning in areas needing drainage, and for lowering labor and power requirements

A SYSTEM of land management which provides year around protection of the soil from the ravages of water and wind erosion is constantly being sought by agricultural scientists.

Strip cropping, terracing, contour planting, mulch tillage and contour listing are systems of land management which have been tested in Iowa. Some of these systems were found to be practical in certain areas of the state. Research by Browning and Norton (9)* (at the Iowa Agricultural Experiment Station) demonstrated the soil-and-water-conserving value of contour listing. They found that, except in the deep loess soils common to western Iowa, the plant count and yield were generally below that for conventionally farmed corn, that is, plowing, double disking, harrowing, and surface planting.

Table 1 shows the average annual soil and water loss data for a western Iowa loess soil (10). This table shows that two-thirds less soil and one-half less water was lost from the contour-listed corn than from the contour-surface-planted corn. This saving of soil and water was accomplished in spite of the fact that the ridge formed by the lister was not maintained throughout the year but was obliterated by the second cultivation when the soil was thrown to the corn plant for weed control.

The detrimental effect of erosion is even greater than soil loss data would seem to indicate because (5, pp. 8.16 and 12) the eroded particles contain a higher percentage of plant nutrients than the original soil and these nutrients are often much more available.

TABLE 1. AVERAGE ANNUAL SOIL AND WATER LOSSES FROM CORN LAND AS AFFECTED BY CROPPING SYSTEMS.
Ida silt loam, 1948-52

Rotation and method of planting	Soil loss tons per acre	Runoff, inches
Corn-oats (sweet clover catch)		
Surface planted up-and-down-hill	30.44	4.02
Surface planted on the contour	10.84	2.78
Contour listed	3.37	1.65
Corn-oats-meadow-meadow		
Contour listed	1.79	0.95

Total average annual rainfall on the Western Iowa Experimental Farm, 29.15 in; slope, 14 percent; length of slope, 72.6 ft (Reference 10).

A study of bed-farming practices used for the production of cotton and tobacco and other high-value crops indicated several advantages of the elevated ridge, such as drainage of the ridge, high-capacity equipment and low total power requirement per acre for seedbed preparation.

A review of the literature concerning corn production in the corn belt showed that Jones and Beasley (7) at the Missouri Agricultural Experiment Station conducted ridge-farming experiments for three years starting in 1938. They found decreases in yields which were offset in part by reductions in labor requirements. The experiment was abandoned due to inadequacy of equipment to construct and cultivate ridges.

Shortly after World War II, many new herbicides were put on the market. The phenomenal sales and use of the materials, particularly 2,4-D, are indicative of their effective-

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The authors—W. F. Buchele, E. V. Collins and W. G. Lovely—are, respectively, agricultural engineer (agent), agricultural engineering research branch (ARS), U.S. Department of Agriculture; professor of agricultural engineering, Iowa State College, and agricultural engineer, AERB (ARS), USDA.

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*Numbers in parentheses refer to the appended bibliography.

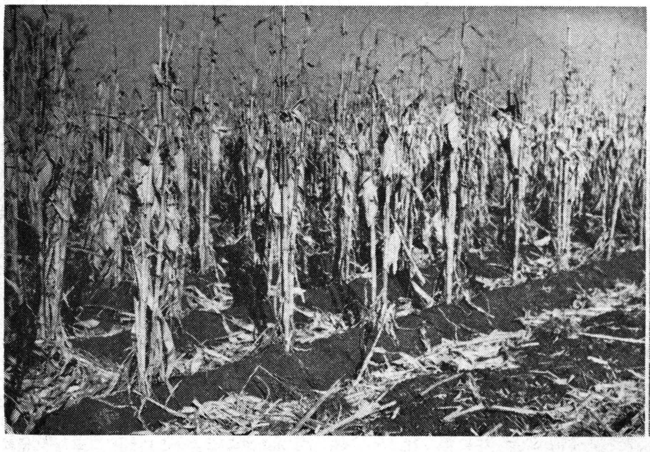
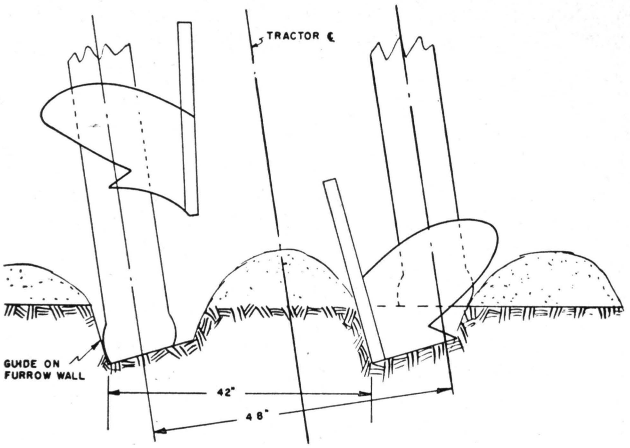


Fig. 1 *(Left)* Mature ridge-farmed corn grown in 1953 • Fig.2 *(Right)* Plowing ridges with International Harvester C tractor and modified two-way moldboard plow



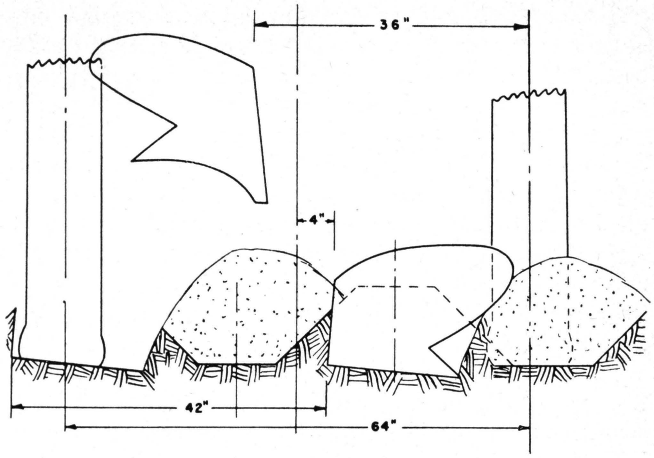


Fig. 3 *(Left)* Wheel spacing of the International Harvester tractor shown plowing ridges in flat land • Fig. 4 *(Right)* Wheel spacing of Ford tractor shown reversing ridges formed the previous season

ness. In 1946 agricultural engineers of the Iowa Agricultural Experiment Station and U.S. Department of Agriculture started research experiments on equipment and methods of applying herbicides to control weeds.

Lovely *et al.* (8) reported on the use of flame cultivation, pre-emergence and postemergence applications of 2,4-D to control weeds. Results indicated that a pre-emergence application of 2,4-D gave excellent early control of annual grasses and most broadleaved weeds. This spray, applied at time of planting, retarded the growth of annual grasses and prevented the growth of susceptible broad-leaved weeds for a period of four to five weeks.

The normal, early mechanical cultivations were eliminated and efficient weed control was obtained with two cultivations, the first being done when the corn was 12 to 15 in high.

DEVELOPMENT OF MACHINERY AND CULTURAL METHODS

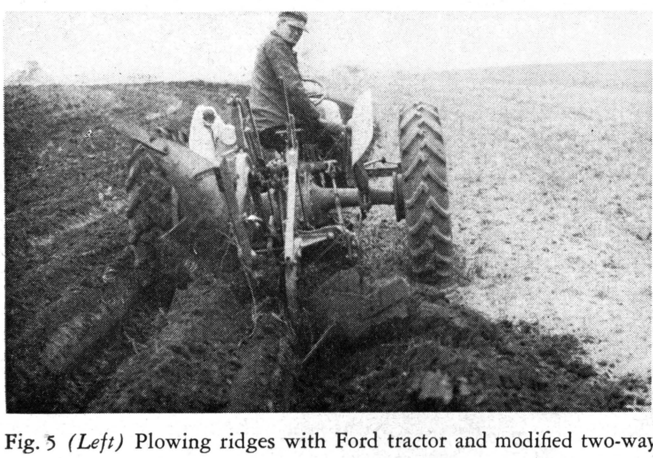
Based on the following factors a modified system of ridge farming was evolved: pre-emergence weed control, effectiveness of the contoured furrow in soil and water control, and the tillage capacity of the lister (which actually tills one-third of the land). This system, proposed by E. V. Collins (8 and 1), consisted of planting on contoured ridges, pre-emergence spraying to control early weed growth and mechanically cultivating to control late weed growth. By adopting this system the ridges were maintained throughout the year. Fig. 1 shows a field of mature ridge-farmed corn.

For the past four years agricultural engineers of the U.S. Department of Agriculture and the Iowa Agricultural Experiment Station have conducted ridge-farming investigations at several locations in Iowa. Methods and equipment for growing corn, soybeans, oats, grasses and legumes on ridges were studied.

A machinery program was initiated in 1951 to develop farm machinery which would economically transform the above principles into actual farming practices. The following paragraphs contain a report on the machines currently being used to grow corn on ridges and their operating characteristics.

During the first season, a two-bottom lister was used to construct contoured ridges. It was found unsatisfactory because it formed pairs of furrows, whereas pairs of ridges were required to facilitate accurate planting and cultivating. Another fault of the lister was that it placed the crop residue in a vertical plane extending up through the middle of the ridge where the planter runner was to operate. The crop residue interfered with the operation of the planter and cultivator. Poor stands resulted when seeds were planted in this crop residue.

The moldboard plow operating at a depth of about 8 in was found to construct satisfactory pairs of ridges approximately 15 in high. When a 42-in row spacing was used, a 14-in plow bottom placed the furrow slice on 28 in of untilled soil. In this manner the power requirement was reduced to approximately one-third that of conventional



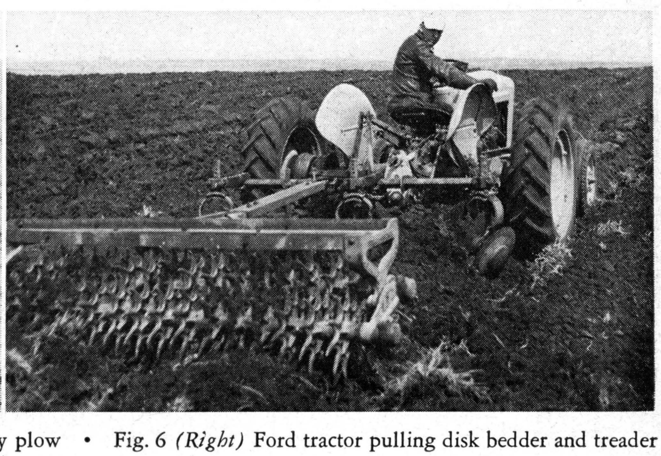


Fig. 5 *(Left)* Plowing ridges with Ford tractor and modified two-way plow • Fig. 6 *(Right)* Ford tractor pulling disk bedder and treader

plowing. By using a two-way plow the operator could turn around at the end of the row and return by guiding on the landside of the previous furrow. Time spent at row ends was thus held to a minimum and accurate parallel paired ridges were constructed by this procedure.

The two-way plow shown in Fig. 2 was modified to increase plow-bottom suction and beam clearance. As supplied by the manufacturer, the front end of the plow beam scraped off the top of the previously formed ridge and did not have sufficient suction for deep plowing. Fig. 3 shows the wheel spacing for the International Harvester tractor plowing flat land.

The Ford two-way plow shown in Fig. 5 made satisfactory ridges after it was modified by adding trailing-hitch adapters (3) to provide a higher lift so the up-bottom could clear the previously formed ridge. Fig. 4 shows the wheel spacing on the Ford tractor that was used to plow ridges in flat land and to reverse ridges made the previous season. Reversed ridges as shown in Fig. 4 were made by inverting the old ridge with a plow. The soil was placed in the adjacent furrow.

Nitrogen fertilizer was applied during the ridge-plowing operation. The fertilizer was dropped just ahead and slightly to the landside of the down-plow bottom. Conventional starter-fertilizer equipment supplied with the planter was used. A shutoff was required on each hopper to distribute fertilizer only under the ridge being formed. Fertilizer dropped during the reversing of ridges was placed at a depth of 10 to 14 in. This system provided an economical method for deep placement of fertilizer on top of the crop residue. Consequently, both fertilizer and the completely covered crop residue were located approximately in a horizontal plane below the turned furrow slice.

After plowing, the ridges were left in the rough state until planting time; however, if weed control were a problem, or if the ridges were constructed just prior to planting, the ridges were tilled with a tool-bar disk bedder or a disk cultivator. On loose or cloddy soils, the treader (rotary hoe pulled backwards) was pulled behind the disk bedder to firm the ridge. Fig. 6 shows the disk bedder and treader.

The ridges were planted with a mounted two-row planter equipped with single-disk furrow openers. The disk cut through the surface trash and did not clog as had a previously tested stubrunner furrow opener. (The stalks clogged on the runner, scraped off the top of the ridge, and materially reduced the height of the ridge). The conventional open-centered presswheel was found to satisfactorily firm the soil over the seed on the ridges.

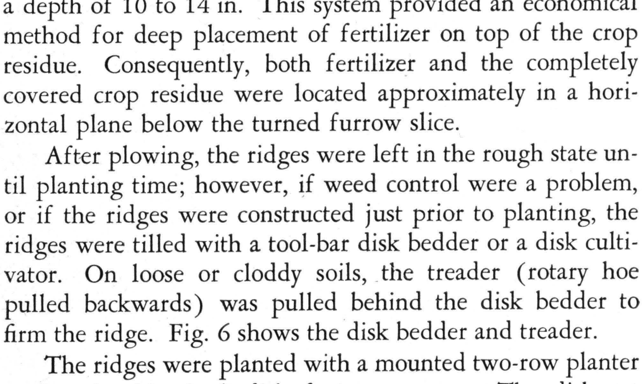


Fig. 7 Side view of cultivator equipped with disk hillers

After planting, the entire land surface was sprayed with 1½ lb of 2,4-D ester per acre mixed in 10 gal of water. Self-propelled and tractor-mounted sprayers were used to apply the spray after planting; however, a sprayer mounted on the planting tractor could have been used to spray during the planting operation. An application of 2,4-D at the above rate, after the corn has emerged, may cause serious damage to the corn plant and reduce yields; therefore, pre-emergence sprays should be applied before the corn has emerged. When the corn plants were about 14 in in natural height, the 2,4-D had begun to lose its effectiveness and the stunted grass was starting to recover. Because of the height of the corn, the cultivator could be and was operated at speeds much higher than normal for the first cultivation. The cultivator (Fig. 7) was equipped with four disk hillers per row using 12-in disks in front and 16-in disks in rear. The front disks were staggered (11) with respect to each other and were set at an approximate 15-deg angle with the row and about 4 in above the rear disks. This slight angular set of the front disk-hillers caused the disks to push the soil rather than lifting and throwing it into the row.

PHYSICAL-CHEMICAL ENVIRONMENT OF THE ROOT BED

Extensive field and laboratory measurements of soil temperature, soil moisture, bulk density, and available nutrients were made on ridged and listed plots. These measurements were used *(a)* to determine the environmental conditions of the root bed, *(b)* to indicate changes which would improve the conditions and *(c)* to correlate with yield and plant count data so that an early conclusion could be reached concerning the value of the various practices.

Moisture Content

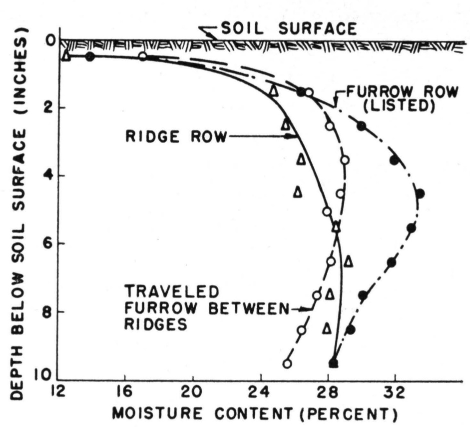
It was a common observation that, after each rain, the surface of the ridge dried ahead of that of the furrow because of its greater elevation. The height of the ridge established a moisture tension of approximately 30 cm which is equivalent to one-half of that required for the drainage of the soil macropore space. This tension was sufficient to cause rapid drainage of the ridge after a rain and reduced the period of saturation of the root zone. Thus the time the seed or its seedling must spend in a wet soil is deceased.

Fig. 8 shows an average soil-moisture profile for the ridge, furrow and traveled furrow between ridges during the latter part of June. A statistical analysis of the data showed that there was no real difference in the total moisture contents between ridge and lister farming; however, an analysis would probably show real differences in the moisture contents at some specific depth, such as 5 in below the soil surface.

It was noted in Fig. 8 that the maximum moisture content of the ridge was at the 7-in depth while that of the lister furrow was at the 4-in depth. Considering the ridge to be approximately 12 in high at time of sampling, the point of maximum moisture content of the ridge was found to be 9 in above the similar point in the furrow. It was thus apparent that the isomoisture lines of the soil (lines joining points of equal moisture content) approximated, with a smaller amplitude, the soil surface profile.

Temperature

The better draining of the ridge contributed to the reduction of the specific heat of the soil. The reduction in specific heat was one of the reasons the root bed of the ridge heated to a higher temperature than the root bed of the furrow. A given quantity of radiation increased the temperature of the surface soil of the ridge more than the furrow. It should be noted that (except during early morning and late evening on north-south rows) the ridge and furrow received the same quantity of radiation. The soil temperature of the ridge at the 3-in depth was found to be 1 to 8 F warmer than the equivalent depth in the furrow and slightly warmer than the 3-in depth in the flat-planted row. Fig. 9 shows an average soil-temperature profile of the ridge and furrow for the growing season. The temperature differential was greatest at the surface and decreased with depth. Continuous 24-hr studies of the temperature cycle showed that the temperature at any depth in the ridge was always higher than the equivalent depth in the furrow. At the 3-in depth, the maximum temperature was reached at 4:30 p.m. in both the ridge and furrow.



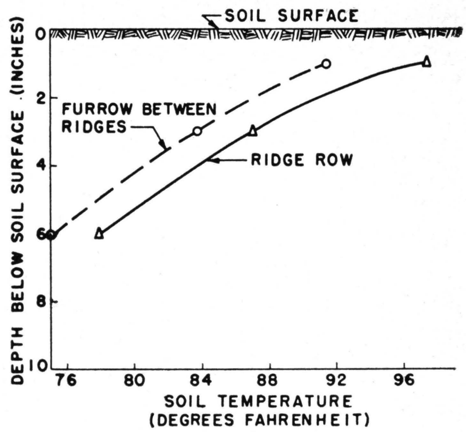
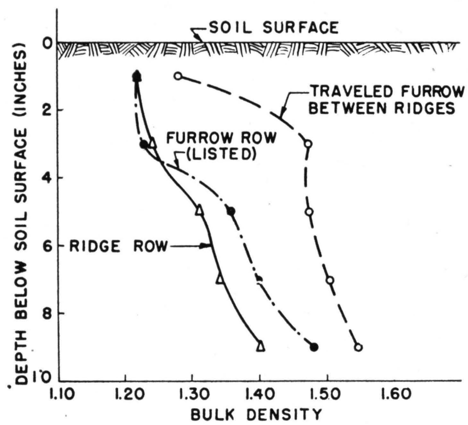


Fig. 8 *(Left)* Soil-moisture profile • Fig. 9 *(Right)* Soil-temperature profile



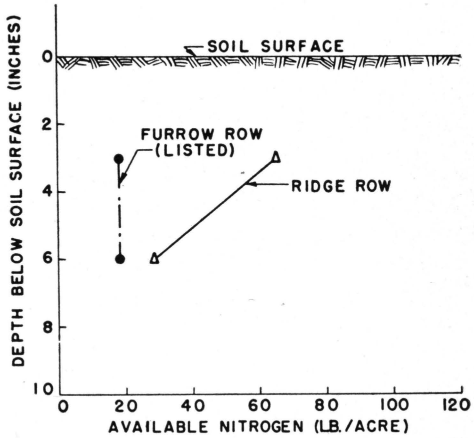


Fig. 10 *(Left)* Bulk-density profile • Fig. 11 *(Right)* Available-nitrogen profile

As the temperature of the soil water increases, the viscosity and surface tension decrease and the vapor tension and rate of evaporation increases. The above factors explain the inverse relationships in the soil between temperature and the moisture content at field capacity (1) and temperature and the capillary conductivity.

The rapid draining and drying of the ridge noted previously prevented an extreme loss of moisture by evaporation. The capillary conductivity of the warmed crust was so reduced that the water lost by evaporation could not be replaced fast enough by capillary flow to maintain film contact between the soil particles. Thus the higher temperature of the ridge contributed to the further drainage of the ridge as well as evaporation of water from the surface of the ridge.

This higher soil temperature combined with the good drainage characteristics of the ridge increased the rate of emergence and the total germination of the planted seed. Stands were found to be consistently more uniform on ridge-farmed plots (1).

Structure

The physical condition of the soil was evaluated by determining the bulk density of each 1-in layer of the upper 10 in of the soil.

Fig. 10 shows the bulk-density profiles of the ridged row, listed furrow and the traveled furrow. Wheel travel was found to compact the soil in the furrows. The slow drying of the furrow contributed to this problem as the ridge could be and often was planted and cultivated when the furrow was actually too moist to till. Comparing the bulk-density profiles of traveled furrows and listed furrows with the soil-moisture profile shown in Fig. 8 indicated that compaction due to wheel travel materially reduced the amount of water entering the furrows.

The apparent packing action of the lister bottom during the forming of the furrow increased the bulk density at the lower depths. This compaction reduced the downward movement of water and resulted in, as shown in Fig. 8, a decrease in moisture content with depth below the maximum moisture zone.

Available Nutrients

Fig. 11 shows the available-nitrogen supply as determined by soil tests in the ridge and listed-furrow rows during the latter part of June. The addition of a starter fertilizer increased the available nitrogen supply in the ridge row and lister furrow (1). The increase in available nitrogen over and above that of the unfertilized plots at the 3 and 6-in depth for the ridge row and lister furrow was 18.2, 8.4 and 6.2 5.0 lb per acre, respectively. One or more of the following reasons could account for the higher nitrogen supply in the ridge: *(a)* The higher temperature increased the rate of nitrification due to the increased activity of the bacteria; *(b)* soluble nutrients were dissolved in the water accumulating in the lister furrows and were carried from the field in the runoff water, and *(c)* the available nutrients were leached from the soil by the water infiltrating through the lister furrows into the subsoil. The application of 2,4-D pre-emergence spray did not in any way affect the amount of available nitrogen in the soil.

The application of starter fertilizer increased the quantity of available potassium in the ridge and furrow(1). The act of ridging did not improve the supply in plots where starter fertilizer was not applied.

Other Physical Factors

The elevation of the ridge as described by Hilgard (6) provides a chimmey effect for the ready escape of air from the soil when water enters the soil through the furrow. This avenue of escape decreases the compression of the soil air and reduces the part it plays in lowering the infiltration capacity of the soil.

Compaction of the furrows by wheel travel plus the reduction of the wetted perimeter between the accumulated water and the surface of the furrow tended to decrease the infiltration capacity of a ridged field. Fig. 12 shows a ridged plot of the contour-tillage experiment. This picture shows water, after a 1½-in rain, standing in furrows compacted by wheel travel. The wheels of the wide front-end tractor operated in alternate furrows during the farming operations. The horizontal flow of water through the ridge from the traveled furrow to the untraveled furrow permitted water not infiltrated in one furrow to move laterally to the adjacent furrow; however, the fact remains the only water lost from the field was lost from the traveled furrows. No water was found standing in the flat planted plots, but three areas were found where erosion had occurred. The erosion washed out numerous hills of corn and carried soil from the field.

The effect of compaction upon infiltration capacity is shown when Figs. 8 and 10 are compared with Fig. 12. Reduced travel, fewer operations with multiple equipment and plowing out of the tractor tracks should improve the infiltration capacity of the furrows.

OBSERVED BENEFITS OF RIDGE FARMING

During the development of the cultural practices, a number of problems associated with other systems of farming such as drowning and sidehill slippage were eliminated by the intrinsic characteristics of ridge farming.

The height of the ridge ranges from approximately 15 in at the time of plowing to 10 in at harvest time. A ridged field laid out on the true contour will have as a minimum 5 in of aboveground water storage capacity; however, when the grade is slightly irregular, the aboveground capacity may be reduced to about 2 in of water. This storage capacity (2 in) plus the infiltration of water into the soil will store a high percentage of the rains.

Calculations of the cross-slope carrying capacity have been made on furrows 1000 ft long. Water moving at a depth of 2 in in the above furrows graded to a 0.5 percent slope can carry 2.2 in of water per hour from the field.

The ridge-furrow combination provided an accurate steering guide for planting, cultivating and picking. The front wheels of the tractor tended to follow the furrows of previously formed ridges. The ridges prevented sidehill slippage of tractors and implements. This minimizes the careful attention normally required for the first cultivation of contoured rows and permits higher operating speeds for later cultivations.

During the picking of corn, the furrows helped the equipment to follow the contour. While picking the curved portions of contoured ridged rows, the rear guide wheel of self-propelled equipment often rode on the sloping portion of the ridge. The differential brakes were used at times to prevent the rear guide wheel from crossing the ridge. The tapered ends of the stalk-gathering points of the corn picker were located in the furrows below the base of the plant. This permitted the points to gather and lift lodged stalks.

Observations indicated that there was a certain amount of weed control derived from the effect of splash erosion of raindrops. The soil was undermined from the base of the grass seedlings and carried down slope to the furrow. The root-killing effect of the 2,4-D pre-emergence spray combined with the undermining of the root system had a tendency to stunt the grasses and contributed to the ease with which the first mechanical cultivation controlled the grasses.

As stated previously, during the ridge-plowing operation one section of top soil is placed upon another section of untilled top soil. This procedure permitted the accumulation of top soil and provided a deeper seedbed. This is especially beneficial in thin land.

On level poorly drained land the elevated seedbed of the ridge provided a certain amount of protection against drowning of the crop during flooded conditions. It has been observed in several low spots that the ridged seedbed was inundated for a shorter period of time than the flat planted

Fig. 12 *(Left)* Water standing in the furrows after a rain where the tractor had traveled approximately twelve times • Fig. 13 *(Right)* An air view of a 120-acre field of ridged land (foreground), showing the correction strips (generally horizontal lines) and waterways (generally vertical lines)

seedbed. The reduction of the inundation period prevented the drowning of ridge planted crops during the 1951 and 1954 crop years.

FIELD LAYOUT FOR CONTOUR RIDGE FARMING

The field layout of contoured ridges was similar to that used for contoured listed furrows and contoured surface planted rows. Basic information pertaining to design and layout of contoured listed furrows and parallel terraces was utilized in the contour ridge farming field layout. In addition to the normal layout, it was necessary to locate level areas (either grassed or surface planted) at all row ends to facilitate turning. Waterways were established to carry water in natural draws, to aid turning where sharp bends occurred in contour lines and to break long rows into lengths of 1000 ft or less.

Both terraced and unterraced fields have been contour ridge farmed. Ridges were constructed down the slope parallel to the upper terrace so that all of the point rows drained into the lower terrace channel. A grassed or surface-planted turn alley was located in the lower terrace channel. The through rows drained into the grassed waterways. By plowing ridges down the slope from the upper terrace the furrows will almost always drain to the waterways.

In an unterraced field parallel ridges were constructed above and below a guide line with a 0.5 percent grade. The furrows above the guide line decreased in grade until grade reversals occurred. These grade reversals forced the water to accumulate in the ridge furrow and caused overtopping and failure of the ridges.

True contour guide lines without grade were established in another unterraced field. An air view of this field is shown in Fig. 13. The generally horizontal lines are correction strips and the generally vertical lines are waterways. The top guide line was located about 5 ft in vertical interval below the highest point in the field. The criterion for establishing the succeeding contour guide lines laid out down the slope was based on limiting the grade in any furrow to 4 percent for a distance of no more than 100 ft. Steeper grades in furrow channels were used for shorter rows. A grassed correction strip or turn alley was seeded above each contour guide line. Ridges were constructed down the slope parallel to the guide line so that all point rows drained onto a lower grassed correction strip. In the area above the top guide line as shown in Fig. 13, the ridges were constructed parallel to the north-south road without regard to contour. Many of the straight rows drained to the correction strip above the top guide line. Due to the large amount of runoff from these straight rows, the contour ridges below the correction strip were overtopped during a heavy storm. A number of downslope ridges successively failed until sufficient capacity was developed to store the water dumped by the straight rows or until several furrows with sufficient grade to a waterway were encountered.

In addition to the above failure, other field observations have been made on overtopped ridges below correction strips. In every case, the ridge-furrow combination prevented the erosion of the entire slope. A portion of the soil from the eroded ridges was found deposited in the furrows below the failed ridges.

Experience has shown that the ends of the rows should be turned down slope to provide drainage for the furrows. The grassed waterways and correction strips were 30 ft wide to facilitate turning and were interconnected to simplify hay harvest.

YIELDS

Experiments were designed to provide yield data on ridge, lister and conventional farmed plots. These data are summarized in Table 2.

TABLE 2. YIELD OF CORN PRODUCED BY DIFFERENT SYSTEMS OF FARMING

Year	No.	Soil type	Topography	Farming system, bushels per acre: Listed	Ridge	Conventional
1952	1	Clarion-Webster*	Level	44.3	66.8	79.7
	2	Clarion-Webster	Level		101.0	111.0
	3	Clarion-Webster*	Level	77.9	82.1	98.3
	4	Loess	Sloping	122.0	126.0	
1953	5	Clarion-Webster*	Level	52.0	63.0	63.8
	6	Clarion-Webster	Level		70.8	71.8
	7	Clarion-Webster	Level		73.0	65.0
	8	Loess*	Sloping	94.7	82.6	
1954	9	Clarion-Webster	Level	71.3	65.3	72.6
	10	Clarion-Webster	Sloping		33.7	38.8
	11	Clarion-Webster	Level		46.0	41.4
	12	Carrington Clyde	Level		50.4	61.3

*Yield differences were significant at the 5 percent level. All plots were harvested with a single-row picker.

Inspection of Table 2 shows that yields were fair to high in 1952 and 1953 but were low in 1954. The low yields in 1954 were due to the unusual weather conditions. By statistical analysis, significance between farming methods was found at the 5 percent level on the Clarion-Webster soil in 1952 and 1953 and on the loess soil in 1953. With the exceptions of 4, 8, and 10 all of these experiments were on level land.

The data indicates that highest yields were produced on the conventional farmed plots. It should be pointed out that conventional farming on sloping land permitted soil erosion and that yields would decrease as the top soil becomes depleted over a period of years.

In all cases, except experiment 1, yields from ridge-farmed plots were similar to yields from conventional-farmed plots. The differences were not great enough for significance at the 5 percent level.

On Clarion-Webster soil in 1952 and 1953 yields produced by listing were significantly lower than those produced by conventional farming. In experiments 1 and 5 yields from listed plots were significantly lower than yields from the ridge farmed plots.

The yield difference shown in the 1953 experiment on loess soil are not indicative of results obtained under normal crop management.

SUMMARY AND CONCLUSIONS

This study was initiated in 1951 to develop the machinery, tillage and cultural practices used in the ridge-farming system. The primary objectives were to develop a system of farming that would effectively control soil and water losses and continuously maintain high yields. The results were compared with lister and conventional farming.

The moldboard plow constructed a better ridge than the lister. It placed the crop residue below the plowed furrow slice and provided an economical method for deep placement of commercial fertilizer.

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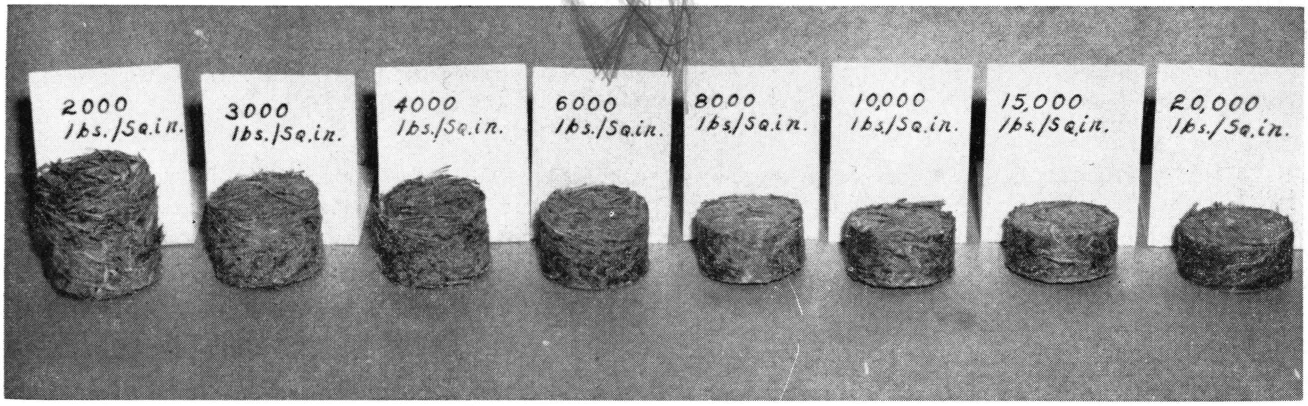

Fig. 3 The relative density of pellets with respect to the pressure applied in pelleting is indicated in this picture. These 2¼-in-diam pellets are all of equal weight. A pelleting pressure of 4,000 to 6,000 lb per sq in appears to be a practical range

storage space. Higher pressures produce more dense and more durable pellets. The cattle seem to experience difficulty in eating pellets made at 8,000 to 10,000 lb per sq in pressure (50 to 60 lb per cu ft, actual density) but in spite of this difficulty they ate the pellets which were made of high-quality forage quite readily. Such high-pressure pellets would, however, probably not be desirable for feeding purposes.

A pellet ejected from the press immediately after pressure is applied seems to expand more after ejection and does not stand handling as well as a pellet held in the press for a short period of time. The exact relationship of this and many other factors have only been studied in a very limited way, and a satisfactory portable pelleting machine which could be sold at a price that the average farmer can afford is undoubtedly, a long way off. However, the over-all procedure appears to have tremendous possibilities in reducing labor, maintaining high-quality feed, and reducing the cost of storage structures, feed-handling equipment, and long-distance transportation.

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Ridge Farming

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When necessary, additional seedbed preparation was accomplished with conventional tool-bar bedding tools or disk cultivators. Treaders were used to firm the seedbed if planting were done immediately after ridges were constructed.

The use of pre-emergence applications of 2,4-D made ridge farming practical by retarding weed growth until the corn was 12 to 15 in high. Conventional sprayers were used. At this stage of growth the delayed first mechanical cultivation continued to control weeds by covering them with soil. The cultivation also increased the height of the ridge. The most successful cultivating tool was a tractor-mounted cultivator equipped with disk hillers.

Physical and chemical measurements of the environmental conditions of the root bed of the ridge, lister furrow and traveled furrow between the ridge were made in the field and in the laboratory. The results of these studies are as follows:

- The elevation of the ridge contributed to its rapid drainage; less moisture was found in the upper portion of the ridge.
- The specific heat of the ridge soil was reduced by drainage. As a result of this, the ridge warmed to a higher temperature than the furrow.
- A larger quantity of available nitrogen was found in the ridged seedbed.
- Wheel travel compacted alternate furrows and apparently reduced their infiltration capacity.

Field layouts for contour ridge farming were successfully accomplished on both terraced and unterraced fields.

Growing corn on ridges (ridge farming) provided aboveground water-storage capacity, reduced water runoff and soil erosion, and produced yields equal to those obtained by conventional practices.

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