Illinois field crops and soils
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The assistance of many members of the Department of Agronomy is gratefully acknowledged.
Illinois is near the center of the largest area in the world that has both deep, dark prairie soils and well-distributed rainfall during the growing season. Most of Illinois has been farmed only 75 to 150 years. Thus, agriculturally speaking, the soils are relatively young.

Illinois soils are valued at about $10 billion. The annual value of agricultural products sold is about $2 billion which ranks Illinois from second to fourth among states in value of agricultural products.

This circular describes Illinois field crops and soils.
Field Crops in Illinois

The topography, soils, and climate of Illinois combine to form unusually favorable conditions for the production of its important crops. In states farther north, the growing season is shorter and cooler, while in those farther west, drought is more common. In states south of Illinois, the soils are relatively older and more highly weathered; consequently, they are lower in native fertility. In large areas in these states to the south, the ground is also rolling to steep, making farming difficult. East and south of Illinois, most soils developed under forest cover and therefore have a more shallow layer of organic matter than the predominantly prairie soils farmed in Illinois.

Because of its favorable conditions, Illinois, compared with adjacent states, usually produces the highest yields per acre of corn, soybeans, and wheat, and the second highest yields per acre of oats and hay.

Illinois soils are cropped intensively. About 65 percent of the cropland is in row crops, 14 percent in small grains, and only 17 percent in hay and pasture. This intensive cropping has been possible because the surface soils are predominantly silt loams and many are nearly level to only gently rolling.

Census data indicate that about 58 percent of the cash income of Illinois farmers is from the sale of livestock and livestock products and only 42 percent from the sale of crops. These data grossly underestimate the relative importance of crops, because about one-half the corn crop and nearly all the hay and oats produced are fed on the farms. Thus these crops are shown as cash receipts from livestock rather than field crops. The value of harvested field crops ($1.5 billion in 1963) is more than 50 percent greater than livestock sales.

Agriculture is often referred to as a declining industry. Such references give an impression that is misleading generally and totally false in particular concerning field crops in Illinois. Since 1946, the acreage of harvested field crops has increased only slightly, but the total tons of grain crops and hay produced has more than doubled because of large increases in acre yields.
Rainfall, Growing Season, and Native Vegetation

Rainfall is quite dependable during the growing season. Short periods usually occur every year when moisture is deficient for crops, but drouth has reduced corn yields 50 percent only once in 80 years. The subsoil is nearly always fully recharged with moisture before the new growing season begins. Irrigation systems are rare except for specialty crops grown on sandy soils.

A short growing season is seldom a hazard to field crops in Illinois. In the northern counties of the state, a shift to slightly earlier corn hybrids and soybean varieties avoids the danger of premature frost more than one year in ten. In central and southern Illinois, corn planted from early May to late June is usually mature before a killing frost in the fall.

Average annual rainfall ranges from 46 inches in extreme southern Illinois to 32 in extreme northeastern.

The frost-free period (time between the last killing frost in the spring to the first in the fall) is 50 days longer in southern than in northern Illinois.

About 62 percent of Illinois was tall grass prairie and about 38 percent was forest.
Over the past 600,000 years, four great glaciers (ice sheets) spread across parts of Illinois in the order shown by the four maps above. They are known as the Nebraskan, Kansan, Illinoian, and Wisconsinan glaciers. Between each invasion and after the last one, a mantle of wind-blown soil particles (loess) spread over the state (upper right). Loess came mainly from the floodplains of the major rivers, hence the deep (25 feet) and relatively coarse deposits near the Mississippi, Illinois, and Ohio Rivers. On the Illinois-Indiana line near Danville, the loess thins to about 2 feet and is very thin or indistinguishable in north-eastern Illinois.

At the time of pioneer settlement, about 62 percent of the land was covered by tall prairie grass. The 38 percent under forest cover (vegetation map, page 5) was mainly on steep, rough land probably because slow-growing tree seedlings, competing with tall, vigorous annual grasses, could become established only on less favorable sites. Under trees, organic matter is returned to the surface few inches mainly in leaf litter. Because of the seasonally recurring death and replacement of the root systems, prairie soils have a much deeper layer of organic matter than forest soils.

Today Illinois agriculture is concentrated on prairie soils. About 80 percent of the harvested crops in Illinois are grown on soils that developed under native grass cover.
General Soil Regions and Characteristics of Some of Their Key Soils

Illinois has seven general soil regions. Each region contains several different soil types. Some general features of all soils are described below, and important soils in each region are discussed on the following pages.

The state has many kinds of soil because it is long, because the glaciers left various materials, and because there are differences in loess cover. Nevertheless, important generalizations can be made about its soils.

1. Silt loam is the dominant soil texture.
2. Most of the cropped soils developed under tall prairie grass cover. Consequently, the proportion of organic matter in the surface soil is high — 3 to 6 percent — and the surface soil is deep — often 12 to 20 inches.

3. Much of the cropland is nearly level to gently rolling; only a small acreage is steep. Steep slopes are usually left in timber or used for grazing.
4. Waterholding capacity is generally high — 10 to 14 inches in the surface 5 feet.

Typical soils in each of the seven regions shown on the above maps are described in a general way and characteristics of nine key soil types are described in some detail later. Each of these nine soils is important in one of the regions, but in no sense represents all soils in the region.
Region 1

This is a large region of deep, dark, highly productive prairie soils. The representative soils, *Muscatine* and *Flanagan*, are the best soils in Illinois. They are silt loams with 14 to 20 inches of topsoil that contains 4 to 6 percent organic matter, are inherently moderately acid, and can supply relatively large amounts of nitrogen for crops.

*Sable and Drummer*, which occur in level and depressional areas, contain 6 to 8 percent organic matter and are darker, deeper, higher in clay, and nearly neutral in reaction, and require artificial drainage. When drained, Sable and Drummer are 90 to 95 percent as productive as Muscatine.

*Clinton and Hosmer* are representative of bands of soil that developed under forest cover. These bands are scattered through the region, mainly along streams and on steep slopes. They are much less important for farming than prairie soils. They are light-colored silt loam soils that developed in moderately thick loess with a surface layer high in organic matter but only about 4 inches deep. The subsoils are moderately permeable to water, are low in phosphorus, low to medium in potassium, and medium to strongly acid.

Region 2

This region in the northeastern part of the state differs from Region 1 in that the loess cover varies from little to none. The underlying till or outwash therefore strongly influences the characteristics of the soil. Soils are often higher in clay and more compact than in Region 1. Crops root less deeply and feed on smaller supplies of available water and plant nutrients.

Large areas of very productive soils with moderately permeable outwash deposits as underlying material are also scattered through Region 2. In the northern tip of the region, the soils are extremely variable. Near Lake Michigan, they are high in clay and slowly permeable. Farther west, much of the underlying material is coarse till or outwash. Forest and prairie soils are mixed throughout.
In years when the distribution of rainfall is nearly ideal, crop growth on the better soils in Regions 1 and 2 is similar. In wet years, more areas drown out in Region 2. On the other hand, the effects of drought are also more evident than in Region 1 because root growth is more shallow.

*Elliott* is an imperfectly drained soil in this region with a dark-colored silt loam topsoil 10 to 14 inches thick. Internal drainage is only fair, but tile drains are effective. The surface is gently sloping and the soil is susceptible to erosion. The topsoil is medium to slightly acid, low in available phosphorus, and medium in available potassium.

**Region 3**

This is the claypan area in southern Illinois that covers about a fourth of the state. The surface is very high in silt content, but it is underlain at 12 to 20 inches with subsoil that is high in clay, hence the term claypan. Because of the claypan, drainage on the nearly level soils is poor, and tile drains do not function properly. To provide surface drainage, farmers have developed a system of bedding with deadfurrows between narrow lands. Before they are treated, the soils are generally strongly acid.

*Cisne*, the typical soil, developed under prairie, is relatively low in organic matter, 1.5 to 2 percent in the surface. The loess through the rooting zone is strongly weathered and leached of calcium and potassium. Originally Cisne had a pH of 4.0 to 4.2, was low in available potassium and nitrogen, and was medium in phosphorus. It is wet in spring because the subsoil is compact, but is drouthy in summer because crop roots are shallow unless fertility has been built to a high level. Yields vary more widely from year to year than in regions where the subsoil is higher in fertility and is better drained. In seasons with nearly ideal rainfall they are nearly equal to yields on the dark-colored soils in central and northern Illinois.

Throughout Region 3, there are scattered unproductive "slick spots" where the subsoils are so high in sodium that structure is destroyed, and the internal drainage is very poor.
Region 4

This region consists of the floodplains of the major rivers — the Mississippi, Illinois, Ohio, Wabash, Sangamon, Kaskaskia, and Embarrass rivers. When drained and protected from flooding by levees, the bottomlands and terraces are cropped intensively and are highly productive.

The floodplains that receive their deposits from erosion from nonacid areas in northern Illinois are mainly nearly neutral silt loams. Lawson is a typical bottomland soil in this area. It is dark-colored, imperfectly drained, and silt loam in texture, and the topsoil is neutral to only slightly acid. It is well supplied with phosphorus and potassium. Organic matter is high. Lawson soils are subject to flooding and crops are often damaged by high water.

The floodplains in the southern one-fourth of the state are usually acid, because the deposits came from erosion on strongly weathered acid soils. Belknap, an important bottomland soil in southern Illinois, is strongly weathered and low in phosphorus and potassium. It responds well to drainage, protection from flooding, and adequate use of fertilizer.

Region 5

Sandy soils are concentrated in a few areas. They are often nearly level, dark-colored sandy loams that have a high organic matter content for sands. These soils work easily, but are drouthy. Without irrigation, it is only in years when rainfall is unusually favorable that they produce crop yields comparable with those on adjacent upland prairie soils. Irrigation of vegetables and speciality crops is increasing.

Hagener, a representative type, is a well-drained sandy soil with a dark-colored topsoil 8 to 14 inches thick. The topsoil is medium acid and moderately high in organic matter, 3 to 5 percent. Phosphorus and potassium are low. Hagener is subject to erosion by wind.
Region 6

These are mainly forest soils. They are concentrated along streams and on steep slopes throughout the state. They contain less organic matter than adjoining prairie soils and the organic matter zone is only 4 to 6 inches deep. Forest soils are more strongly leached than prairie soils and tend to be more acid, and lower in nitrogen, phosphorus, and potassium. Because they are steep or occur along streams, they are used more for grazing than for cropland.

Clinton, previously described in Region 1, and Fayette are representative soils in the northern two-thirds of Illinois in Region 6.

Grantsburg in the Ozark uplift region in southern Illinois developed in moderately thick loess on bedrock. It is weathered, strongly acid, and low in available phosphorus.

Region 7

The deep loess deposits adjacent to the floodplains of the major rivers are on a dissected hilly landscape. They are light in color because they formed under forest cover. They respond well to good management, but erosion is a general problem on them. Fayette is a representative soil next to the floodplains of the Illinois River and north of Nauvoo along the Mississippi River. Alford is a typical soil along these rivers south of the Fayette area and along the Wabash River.

Average yields on various soils

Under good management, these soils have produced the following average yields over a long period. In the most favorable seasons, yields have been as much as 50 percent higher.

<table>
<thead>
<tr>
<th>SOIL</th>
<th>CORN BU.</th>
<th>SOYBEANS BU.</th>
<th>WHEAT BU.</th>
<th>OATS BU.</th>
<th>ALFALFA-MIXED HAY, TONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscatine</td>
<td>110</td>
<td>40</td>
<td>48</td>
<td>75</td>
<td>5.0</td>
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<tr>
<td>Flanagan</td>
<td>108</td>
<td>39</td>
<td>48</td>
<td>73</td>
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<tr>
<td>Sable</td>
<td>100</td>
<td>39</td>
<td>44</td>
<td>66</td>
<td>4.7</td>
</tr>
<tr>
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<td>44</td>
<td>66</td>
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<td>80</td>
<td>29</td>
<td>37</td>
<td>55</td>
<td>3.9</td>
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<td>Hosmer</td>
<td>70</td>
<td>28</td>
<td>36</td>
<td>45</td>
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<td>88</td>
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<td>25</td>
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<tr>
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<td>69</td>
<td>26</td>
<td>34</td>
<td></td>
<td>3.3</td>
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<tr>
<td>Lawson</td>
<td>96</td>
<td>38</td>
<td>41</td>
<td>63</td>
<td>4.6</td>
</tr>
<tr>
<td>Belknap</td>
<td>73</td>
<td>29</td>
<td>33</td>
<td></td>
<td>3.7</td>
</tr>
<tr>
<td>Alford</td>
<td>87</td>
<td>30</td>
<td>41</td>
<td>54</td>
<td>4.0</td>
</tr>
<tr>
<td>Fayette</td>
<td>91</td>
<td>31</td>
<td>40</td>
<td>66</td>
<td>4.2</td>
</tr>
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</table>
Major Field Crops

Corn

- Planting corn, fertilizing, adding insect and weed killer.
- Cultivating corn to control weeds and break soil crust.

<table>
<thead>
<tr>
<th>Year</th>
<th>Corn %</th>
<th>Other crops %</th>
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<td></td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td></td>
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</tr>
<tr>
<td>1930</td>
<td></td>
<td></td>
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<tr>
<td>1890</td>
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<td></td>
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<tr>
<td>1870</td>
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</tbody>
</table>

Soybeans

- Planting soybeans and adding herbicide with 4-row planter.
- Cultivating soybeans to kill weeds.

<table>
<thead>
<tr>
<th>Year</th>
<th>Soybeans %</th>
<th>Other crops %</th>
</tr>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>1950</td>
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<tr>
<td>1930</td>
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<td>1910</td>
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<td>1870</td>
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</tbody>
</table>
Corn is the leading crop in Illinois, accounting for about one-half the value of all harvested crops. Only Iowa has a larger corn acreage than Illinois. About one-half the grain corn is sold off the farm where it is produced. Less than 5 percent of the acreage is harvested for silage.

From 1886 until 1936, corn yields remained fairly constant except for yearly changes due to weather. Since 1936, the trend has been dramatically upward as farmers increasingly applied the knowledge from agricultural research. From 1940 to 1950, hybrid corn caused most of the increased yield. Since then, more fertilizer, especially nitrogen, and in southern Illinois potassium, better weed and insect control, thicker planting, and more timely operations (made possible by more and better machinery) have accelerated the rate of increase.

The great increase in efficiency is shown by the fact that the number of bushels produced per man-hour of labor rose from 3.4 in 1921 to 21 in 1963.

Before 1930, soybeans were little grown in Illinois and then mainly for hay. The increase in acreage in soybeans since then has about offset the reduction in acres of wheat, oats, and hay. Illinois leads all states in the production and processing of soybeans. They are the second-ranking crop in the state. Acreage has expanded rapidly and yields per acre have moved sharply upward. Production per man-hour of labor rose from 1.3 bushels in 1921 to 8 bushels in 1963.
Both hard and soft red wheats are grown, the soft mainly in southern Illinois and the hard in northern. Wheat production, mostly winter, has stabilized at slightly less than 2 million acres. The increase since 1942-1943 has been due largely to an attractive price support combined with higher yields. Yields per acre have fluctuated more widely than those for most other crops except oats. Wheat is a cash-grain crop and little is fed on the farms where it is produced. The amount grown per man-hour of labor increased from 1.9 bushels in 1921-22 to 15.0 bushels in 1959-60.

About 95 percent of the oats grown are spring varieties, mainly yellow-kernel types. Winter oats are grown only in southern counties. Acre yields have moved upward since 1940, but at a slower rate than for competing crops. The acreage has declined rapidly since 1950 because corn and soybeans are more profitable. The decrease in forage crops has reduced the need for oats as a companion crop. About five times as many oats are being produced per man-hour as were produced 40 years ago.

After 40 years of little change, hay yields in Illinois increased greatly since 1940. The increase is due mainly to use of lime and fertilizer and an increase in the proportion of the acreage that is in alfalfa, which yields more than other hay crops. Yields have gone up so much since 1940 that the hay needed for livestock can be grown on fewer acres. (The shift from horses to tractors from 1920 to 1940 reduced the amount needed in Illinois.) Hay produced per man-hour of labor increased from 0.13 ton in 1921 to 0.30 ton in 1963.

In earlier periods, Illinois grew a wide variety of crops that are no longer important except in small areas. Some of these crops, with maximum acreages and years in which they were grown, are shown in the table at left.

The production of certain vegetables, especially for canning, is important in Illinois. Acreages, however, are small compared with field crops. Typical acreages are as follows: sweet corn, 70,000; green peas, 27,000; tomatoes, 11,000; asparagus, 10,000; and popcorn, about 30,000.

Peaches are an important crop in southern Illinois, 40,000 acres, and apples are grown in a few southwestern counties. Several thousand acres of strawberries, cantaloupes, and watermelons are also grown.
Supply of Lime, Nitrogen, Phosphorus, and Potassium

Nitrogen

The nitrogen content of the surface layer and the depth to which the nitrogen-rich layer extends differ widely among soils. The total nitrogen in the surface 4 feet of uneroded soils is typically about 15,000 pounds per acre in the deep prairie Muscatine soil (Region 1, page 8) and 9,000 pounds in Cisne, a highly weathered prairie soil in southern Illinois (Region 3, page 9).

Area 1. The well-drained prairie soils varied from pH 5.5 to 6.0. In small depressional areas, marine shells raised the pH to 7.4. Most prairie soils are neutral at 30 to 48 inches below the surface. Forest soils were about pH 5.0 on the surface and at a depth of 30 inches.

Area 2. Upland soils were near pH 4.0 on the surface and in the subsoil. Bottomland and terrace soils reflect the lime status of the uplands from which the sediments came. Except for the floodplains of the Mississippi and Wabash rivers and the northern parts of the Kaskaskia and Embarrass rivers, they are acid in Area 2 and nearly neutral in Area 1.

Lime

Before they were limed, the surface of Illinois soils ranged from about pH 4.0, strongly acid, to 7.4, slightly alkaline (map, lower left).

Phosphorus

Before fertilizers were applied, Illinois soils in the top 6% inches contained 800 to 1,800 pounds of phosphorus per acre. Soils that have a deep, well-drained profile supply more phosphorus to crops than those in which rooting depth is restricted. The amount of organic matter is also a factor, because much of the soil phosphorus is in humus. High pH in the upper subsoil may also result in greater response to phosphorus. The soils in Region 2 with shallow loess cover and compact subsoils are most responsive to phosphorus fertilizer, while those on deep loess and well-drained subsoils in Region 1 are least responsive.

Potassium

Illinois soils vary greatly in their capacity to supply potassium, as shown on the generalized map below. Within each of the regions on the map, there are small areas that also differ widely from the description given for the general region.

The total potassium per acre varies from 18,000 pounds per acre in the top 6% inches of soil in silt loams in southern Illinois to 50,000 pounds in clays high in organic matter in the northern part of the state. The potassium content of the subsoil is usually as high as or even higher than in the plow layer.
Fertilizers

Illinois leads all states in the combined total amounts of the three major plant nutrients—nitrogen, phosphorus, and potassium—that are applied. Illinois farmers, however, apply less nutrients per acre than farmers in the states to the east and southeast. In these states, the soils are inherently lower in fertility, especially nitrogen, because they were formed under forest cover. There farmers have farmed their soils longer and began using fertilizers earlier. In Illinois, the outlook is for a large increase in the use of nitrogen, and lesser increases in phosphorus and potassium.

Limestone

Illinois farmers have spread more agricultural limestone than those in any other state, about 100 million tons between 1920 and 1964. Applications reached a peak between 1946 and 1949, when prices were high and Agricultural Conservation Program allotments were large. Tonnage then fell sharply until 1953 and has since risen about a third above the low point. One reason for the reduced limestone tonnage compared with the 1946-1949 period is that nitrogen is being partly substituted for legume nitrogen. The decrease in acres of legumes has reduced the need for limestone.

Micronutrients and secondary nutrients

A few micronutrient deficiencies have been found in small areas on field crops in Illinois. Manganese deficiencies are common on soybeans and oats on alkaline sands, especially in cool, wet springs. The
supply of boron for long-term stands of alfalfa appears to be marginal in some areas and shows as deficiency symptoms in drouth periods. Neighboring states report yield increases in corn from applications of zinc and boron, but results in Illinois through 1963 have not identified deficient areas.

Since crop yields are increasing rapidly at the same time that reserves are being reduced by additional years of cropping, it is likely that the need for applications of micronutrients will increase.

The secondary nutrients—sulfur, calcium, and magnesium—have not yet been found deficient in Illinois soils.

Herbicides

The development of chemicals for weed control, beginning with 2,4-D in the early 1940's, greatly changed techniques for weed control. Timely and effective cultivation is still an important method of control, but is rapidly being supplemented by specific chemicals for specific purposes. The increase has been greatest in pre-emergence treatment because:

1. When broad-leaved weeds were controlled by post-emergence treatment with 2,4-D, grasses became a greater problem than before.
2. The area infected with giant foxtail, a serious annual grass, has spread.
3. The acreage of corn that is check-rowed has declined and consequently cross-cultivation for weed control is impossible.
4. Selective pre-emergence herbicides that can effectively kill weeds without damaging the crop are being developed.

Agronomy Research Fields

No other state had a system of experiment fields as comprehensive as that of Illinois. Between 1902 and 1920, the Experiment Station established experiment fields to represent many important soils. Their unique characteristic was one rotation and a standard set of fertility treatments on all fields, many of which were continued for 50 years. Though inadequate in experimental design by modern standards, when first established they were part of an outstanding program for learning how to fertilize and manage Illinois soils.

The original plots were large enough so that they could be subdivided to include new treatments as additional knowledge became available on rotation and fertility. The plots have served as the basis for important studies on the effects of 30 to 50 years of certain cropping and fertility practices on subsoil fertility and physical conditions. These fields were the main source of information for calibrating the Illinois soil tests for phosphorus and potassium.

The Department of Agronomy conducts field experiments at six research centers in addition to those at the older agronomy experiment fields. A wide variety of modern experiments on crop varieties, weed control, cropping systems, and lime and fertilizer treatments is being conducted on them.

Certain types of applied research must be conducted on the soils and under the climatic conditions that occur throughout the state. Crop varieties, for example, perform differently in northern, central, and southern Illinois. The research centers were chosen not only to represent areas with different growing seasons but also to represent key reference soils from which interpretations can be made for many additional important soils.
The Morrow Plots

The Morrow Plots, the oldest soil experiment field in America and a historic landmark on the University of Illinois campus, were laid out in 1876. Three of the original plots (continuous corn, corn-oats, and corn-oats-clover) remain though each has been subdivided. The continuous corn plot in 1964 was producing its 89th consecutive corn crop. From 1876 to 1904, no soil treatment was applied and the only difference among plots was in cropping sequence. In 1904 each of the three plots was divided in half lengthwise (as shown by the horizontal dotted lines) and the south half of each (that nearer the bottom of the picture) was treated with manure, limestone, and phosphorus. No important change was made in plot layout for the next 50 years. By 1955, the treated half of the plots was yielding nearly twice as much as the untreated half.

Influence of treatments on nitrogen

The amount of nitrogen per acre when the experiment was started in 1876 is not known. When tests were made in 1904, differences among plots were small. But by 1953, the soil on the plots in continuous corn without manure, lime, and phosphorus had lost nearly half the nitrogen from the plow layer. The rate of loss was reduced by 50 percent on the plots that received regular treatments of manure, limestone, and phosphorus.

The loss was reduced to only 4 percent on plots with a rotation of corn-oats-clover and treatments of manure, limestone, and phosphorus.

New treatment started in 1955

To learn whether permanent injury had resulted from intensive cropping without fertilization on some plots and whether the better treatments that had been used could be still further improved, liberal amounts of nitrogen, phosphorus, potassium, and limestone were applied in 1955 on one-fourth of all plots (outlined in white left of center in photograph).

On the plots that had received manure, limestone, and phosphorus from 1904 to 1954, corn in rotation has responded little to the new treatments applied each year since 1955.

On the plots that had not previously been treated, the response to the treatments that began in 1955 has been large, an increase of 59 to 62 bushels an acre.

On the plot in continuous corn, the untreated half yielded 16 bushels an acre less in 1964 than the half treated with manure, limestone, and phosphorus even though both halves have received liberal amounts of nitrogen, phosphorus, and potassium since 1955. These results show that 10 years of liberal fertilization have not offset the effects of 50 years of cropping without treatment.
General Soil Conservation Requirements

Illinois soils are a vital national resource for food production. In order to preserve this natural resource, two general conservation measures are needed on all soils that are cropped in Illinois: high fertility to maintain organic matter; and less tillage to maintain soil tilth and reduce erosion.

A few specific measures are needed for the three general slope classifications.

On nearly level soils, these measures help maintain productivity:
1. Sod waterways in surface drainageways to prevent erosion.
2. Tile drains where they are needed to insure good drainage.
3. Residue management to maintain humus.
4. Cover crops on soils subject to erosion.

On gently rolling soils, these measures help to prevent or reduce erosion.
1. Proper balance between row and sod crops.
2. Contour farming (farming across slopes rather than up and down them) and terraces as needed.
3. Sod waterways to provide surface drainage.

On rolling to steep soils, these measures are essential to reduce erosion.
1. Less acres in row crops.
2. Contour strips with diversion terraces.
3. Pasture or trees on the steepest land.