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Soil Survey

Decatur County Iowa

By
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and
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UNITED STATES DEPARTMENT OF AGRICULTURE
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COUNTY SURVEYED

Decatur County is in the south-central part of Iowa (fig. 1). Leon, the county seat, situated near the center of the county, is about 60 miles south of Des Moines. The shape of the county is rectangular, and its area is 533 square miles, or 341,120 acres.

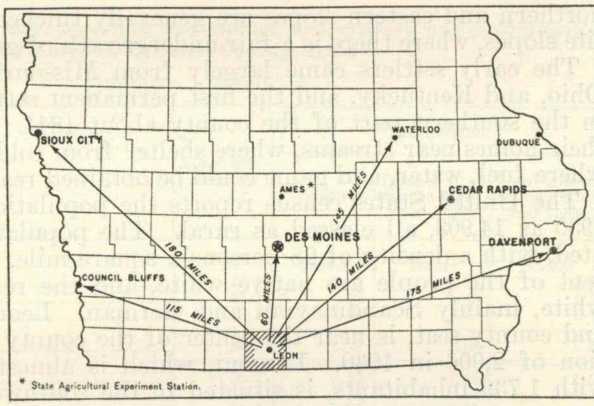

FIGURE 1.—Sketch map showing location of Decatur County, Iowa.

The county occupies a part of a broad nearly level plain which is extensively dissected by streams, among which Thompson, Weldon, and Little Rivers are the most important. These streams have cut deep valleys through the level plain. They cross the county in a north-south direction. Thompson River is the largest stream. It flows in a tortuous course over the flood plain. The stream bed lies from 75 to 125 feet below the general level of the uplands. The first-bottom land along the river is only one-fourth mile wide in some places but is as much as 1 mile wide in others. In places along the valleys of Thompson and Weldon Rivers, remnants of narrow terraces lie from 6 to 15 feet above the first bottoms and adjacent to the uplands.

Geologic erosion has carved drainageways in nearly every section of the county. It is most severe in the southeastern part and along the uplands adjacent to the valleys. Here, the relief comprises deep gorges cut by drainageways and steep rugged slopes separated by sharp ridges. Long gentle slopes occur near the heads of the principal streams and tributaries.

The more nearly level parts of the county are on the divides between the principal drainage systems. The most extensive areas of this kind are in the northeastern part between Leon and Weldon, south of Van Wert, and between Garden Grove and Le Roy. An important level area is in the southwestern part at Lamoni. These areas are coextensive with the soils differentiated as Grundy silt loam and Edina silt loam on the soil map.

The level upland has only a slight range in elevation. The altitude at the railway station at Lamoni, which is situated on a level plain in the southwestern part of the county, is 1,126 feet above sea level, whereas elevations on this same plain at other places are as follows: Van Wert, 1,155 feet; Weldon, 1,146 feet; Le Roy, 1,112 feet; and Garden Grove, 1,115 feet.[1] The altitude at the railway station at Davis City in the Thompson River Valley is 914 feet, and at the railway station at Leon, situated in a narrow valley, is 1,019 feet.

Before the county was settled by white men, grasses formed the principal type of native vegetation, except on bottom lands and steep slopes, which supported a growth of oak, hickory, hazel, elm, and other trees and shrubs. The more valuable stands of trees commonly grew on the bottom lands. The stands of trees and shrubs on the northern and eastern slopes are generally thicker than on the opposite slopes, where there is a fair undergrowth of grasses.

The early settlers came largely from Missouri, Illinois, Indiana, Ohio, and Kentucky, and the first permanent settlements were made in the southern part of the county about 1844. The pioneers built their homes near streams, where shelter from cold was provided, and where fuel, water, and game could be obtained readily.

The United States census reports the population of the county in 1930 as 14,903, all classed as rural. The population is well distributed, with a density of 28 persons a square mile. More than 98 percent of the people are native white, and the rest are foreign-born white, mainly Scandinavian and German. Leon, the largest town and county seat, is near the center of the county and had a population of 2,006 in 1930. Lamoni, which is almost as large as Leon, with 1,739 inhabitants, is situated in the southwestern part. Other important towns are Garden Grove, Grand River, Davis City, Le Roy, Weldon, Van Wert, and Pleasanton. These towns serve the surrounding rural communities. There is no important manufacturing industry in the county.

CLIMATE

The climate is well suited for the raising of livestock and general farming. Occasional extremes in climate are slightly injurious to crops or livestock.

Short periods of intense cold weather accompanied by high winds frequently occur during the winter, but this sudden change in temperature very seldom has a harmful effect on the livestock or on the general routine of farm work.

The mean annual precipitation of 34.15 inches is well distributed throughout the year, and the amount is sufficient, with suitable tillage, for profitable crop yields. The heaviest precipitation occurs during the summer.

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[1] GANNETT, HENRY. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U. S. Geol. Survey Bull. 274, ed. 4, 1072 pp. 1906.

No drought in the history of the county has been so severe as the one in 1934. During the summer of that year, the rainfall was so scant and the soil became so extremely dry, that for the first time in the history of the county the corn crop was a complete failure, except on some of the bottom lands where the most favorable moisture conditions existed because of subirrigation. The supply of well water on many of the farms became insufficient to furnish drinking water for livestock. Even the native trees, which had never been known to suffer from adverse climatic conditions, showed the effects of the drought, and many died.

The average date of the last killing frost is April 29 and that of the first, October 9, which gives an average frost-free season of 163 days. Killing frost, however, has been recorded as late as May 25 and as early as September 15. Farm work frequently begins about the middle of March. In most years, plowing, late gathering of crops, and pasturing can be carried well into December.

Table 1, compiled from the records of the United States Weather Bureau station at Lamoni, gives the more important climatic data for the county as a whole.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Lamoni, Decatur County, Iowa*

[Elevation, 1,138 feet]

Month	Mean temperature	Precipitation		
		Mean	Total amount for the driest year (1933)	Total amount for the wettest year (1909)
	°F.	Inches	Inches	Inches
December	26.5	1.07	0.53	2.60
January	21.1	.95	.48	1.96
February	25.2	1.25	.07	1.01
Winter	24.3	3.27	1.08	5.57
March	36.7	1.82	1.36	1.59
April	50.4	3.06	.83	4.36
May	61.1	4.14	2.05	4.72
Spring	49.4	9.02	4.24	10.67
June	69.9	4.69	1.35	8.11
July	74.3	4.16	3.40	11.78
August	72.8	3.96	5.23	.37
Summer	72.3	12.81	9.98	20.26
September	65.3	4.38	6.17	5.75
October	53.5	2.97	.85	3.63
November	38.3	1.70	.52	3.66
Fall	52.4	9.05	7.54	13.04
Year	49.6	34.15	22.84	49.54

AGRICULTURE

The first settlers in Decatur County made their living largely by hunting and trapping. As the population increased, the growing of crops and the feeding of livestock became the principal farming enterprises, and the proceeds from the sale of livestock became the chief source of farm income.

Corn, hay, oats, and wheat are the most important crops, and all these crops, except wheat, are consumed by livestock within the county. Hay is cut mainly from fields of mixed timothy and clover. Rye and grain sorghums are grown on a few farms as forage crops. Alfalfa is highly prized among the farmers for hay and for building up the fertility of the land, and the acreage of this crop is steadily increasing as farmers acquire the knowledge of proper methods of seeding and handling. Practically every farm in the county has a small plot of ground, one-fourth acre or more, devoted to the production of potatoes and vegetables. Most of the home orchards contain a few apple, peach, plum, and cherry trees. Strawberries are the most popular small fruit, and blackberries and raspberries are grown to some extent. The average yields of corn and oats are lower and the average yields of winter and spring wheat are higher in Decatur County than in the State as a whole. The Iowa Year Book of Agriculture for 1932 reports average yields in Decatur County as follows: Corn, 28 bushels; oats, 27 bushels; winter wheat, 17 bushels; and spring wheat, 20 bushels. Comparable average yields for the entire State are 42.7, 35.3, 16, and 11.9 bushels, respectively. The county produces practically the same average yields of other crops as does the State as a whole. Timothy hay yields an average of 0.8 ton; clover, 1.8 tons; alfalfa, 2.1 tons; soybeans, 13 bushels; and potatoes, 101 bushels.

The acreages devoted to the principal crops in 1879, 1889, 1899, 1909, 1919, 1929, and 1934 are given in table 2.

TABLE 2.—*Acreages of the principal crops in Decatur County, Iowa, in stated years*

Crop	1879	1889	1899	1909	1919	1929	1934 [1]
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Corn	65,757	56,035	73,111	67,147	63,866	61,638	9,928
Oats	16,284	21,237	17,485	20,801	25,625	28,167	458
Wheat	7,785	1,358	1,073	4,205	29,704	6,193	841
Rye	1,682	633	772	257	976	279	215
Barley	7	33	112	54	52	667	
Potatoes			859	549	315	279	251
Hay	27,644	62,308	58,344	49,513	30,797	44,724	[2] 50,316
Timothy and timothy and clover mixed			(3)	47,325	27,456	35,771	[4] 33,836
Clover alone			501	384	1,024	3,823	
Alfalfa				8	141	2,545	1,473
Sweetclover						827	506
Annual legumes for hay					24	975	12,286
Other tame hay			56,447	1,565	1,920	546	[5] 2,215
Wild hay			1,396	231	232	237	
Soybeans						2,531	15,625
Clover seed						1,942	
Timothy seed						9,597	
	Trees	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*
Apples		98,562	101,858	78,269	27,023	13,324	11,318
Peaches		1,515	14,009	39,015	4,431	5,178	4,978
Cherries		4,787	10,033	10,919	5,704	3,775	2,964

[1] Year of severe drought.
[2] Includes sorghums for silage and fodder.
[3] Not reported separately.
[4] Includes clover alone.
[5] Includes wild hay.

The total value of field and orchard crops, vegetables, and farm gardens in 1929 was $2,310,956, of which the principal items were cereals, $1,609,921, and hay and forage, $433,737. Dairy products were sold for $393,812, and poultry raised and eggs produced were valued at $742,835.

A few livestock are raised on every farm and fattened for the market. Commercial dairies are operated only near the towns. Many farmers milk a few cows and sell cream to local creameries. Cattle feeding was an important side line on many farms until recent low market prices made it unprofitable. This partly accounts for the decrease in the number of cattle on the farms. The decrease was intensified by the drought of 1934, which forced the sale of livestock on account of insufficient feed.

Hereford and Shorthorn are the most popular breeds of beef cattle, and Jersey is the dominant breed used for dairy purposes. Only a few herds, however, consist exclusively of purebred cattle. Swine are raised on most farms. All the most popular breeds, including Poland China, Duroc-Jersey, Berkshire, Chester White, and Tamworth, are raised. Sheep raising is of minor importance as compared with cattle or hog raising.

The number and value of livestock on farms in stated years are given in table 3.

TABLE 3.—*Number and value of livestock on farms in Decatur County, Iowa, in stated years*

Livestock	1880 [1]	1890 [1]	1900		1910		1920		1930		1935 [1]
	Number	*Number*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*
Cattle	28,129	51,339	48,801	$2,340,970 (Cattle, Horses, Mules, Sheep, Swine)	32,469	$906,318	30,404	$1,803,901	34,177	$1,840,179	31,593
Horses	7,718	13,579	13,852		14,231	1,646,801	11,789	928,283	7,890	509,964	6,507
Mules	590	360	596		894	113,310	1,350	135,915	1,198	95,262	728
Sheep	11,081	9,740	15,710		14,878	74,704	14,731	178,720	23,928	168,510	14,995
Swine	57,245	57,946	59,026		38,348	339,074	42,793	777,777	50,587	610,763	24,530
Poultry	67,751	[2] 234,706	178,769	70,476	209,135	119,822	273,103	278,945	[2] 246,240	[2] 206,842	[2] 167,921

[1] Value not reported.
[2] Chickens only.

A few farmhouses are equipped with modern conveniences including electric lights, running water, and central heating systems. Shelter for livestock is sufficient on most farms, and the same is true for the grain grown. The machinery owned by most farmers includes a plow, disk, cultivator, grain binder, grain drill, corn planter, mowing machine, hay rake, hay stacker, wagon, manure spreader, and harrow. The field work on most farms is performed with three- or four-horse teams. A few tractors are used, especially in the operation of harvesting machinery.

Fertilizers are used to a very small extent. The fertilizers, chiefly superphosphate or rock phosphate, are used principally in the growing of crops in an experimental way. Lime is being used much more extensively each year, in order to sweeten the acid soils, especially land to be seeded to alfalfa. In 1929, only 76 farmers reported the purchase of fertilizer at a total expenditure of $5,265, or $69.28 a farm reporting. The purchase of feed was reported by 1,269 farms in the same year, at a cost of $392,634, or $309.40 a farm reporting.

Farm labor is sufficient. Most of the farms are operated by the farmer and members of his family. Extra labor generally is employed during the grain-threshing and corn-picking seasons. Laborers were hired on 744 farms in 1929 at wages totaling $161,230, or $216.71 a farm reporting.

Since the first settlement of the county a gradual decrease has taken place in the proportion of farms operated by their owners. Owners operated 74.7 percent of all farms in 1880; whereas in 1935 they operated only 46.8 percent, tenants operated 52.3 percent, and managers 0.9 percent. Most of the tenants lease the farms for a share of the crops, but a few pay a cash rental, ranging from $5 to $8 an acre, depending on the value of the land and its location.

The average size of the 2,088 farms in the county in 1935 was 161.9 acres. Most of the farms include about 160 acres each. The few large farms are mainly in the rough broken sections. The land included in farms in 1935 totaled 332,549 acres, which is 97.5 percent of the area of the county. Of this, 141,132 acres, or 42.4 percent, were devoted to crops; 109,191 acres were in plowable pastures; 41,192 acres, in woodland pasture; 19,882 acres, in other pasture; 2,630 acres, in woodland not pastured; and 18,792 acres represented other land in farms.

The average farm investment, as compiled from the census of 1930, is divided as follows: 59.8 percent land, 21.3 percent buildings, 4.9 percent implements, and 14 percent domestic animals. Land values have fluctuated during the last few years. The average assessed value of land and buildings, which was $62.21 an acre in 1930, decreased to $32.27 in 1935.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called, collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil [2] and its content of lime and salts are determined by simple tests.[3] Drainage, both internal and external, and other external features, such as relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics, soils are grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase.

The most important group is the series, which includes soils having the same genetic horizons, similar in their important characteristics

[2] The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

[3] The total content of readily soluble salts is determined by the use of the electrolytic bridge. Phenolphthalein solution is used to detect a strong alkaline reaction.

and arrangement in the soil profile, and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics or the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus, Wabash and Grundy are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Wabash silt loam and Wabash silty clay loam are soil types within the Wabash series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, which differs from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. For example, within the normal range of relief for a soil type, there may be areas that are adapted to the use of machinery and the growth of cultivated crops and others that are not. Even though there may be no important difference in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such an instance the more sloping parts of the soil type may be segregated on the map as a sloping or hilly phase. Similarly, soils having differences in stoniness may be mapped as phases, even though these differences are not reflected in the character of the soil or in the growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

SOILS AND CROPS

The soils of Decatur County differ widely in color, texture, structure, content of organic matter, and other important characteristics. On the basis of these characteristics, the soils are separated into types. Each type, besides its internal characteristics, has its particular physiographic position, degree of slope, and kind of vegetation. As a result of these internal and external features, each soil is used in a particular way. All of the soils may be placed, on the basis of use, into two broad groups, namely, soils used mainly for the production of cultivated crops and soils used mainly for pasture.

The soils of the first group are typical of the prairie region, where the normal well-developed soils are smooth and rich in organic matter. They are suited to the production of cultivated crops, and more than

75 percent of their total area is used for this purpose. The surface soils are nearly black, owing to their high content of organic matter, and their texture ranges from silt loam to silty clay loam, but they are everywhere mellow and easily tilled. The subsoils vary in texture but, in general, are heavier than the surface soils. This group includes soils of the nearly flat upland and the better drained first bottoms. These smooth desirable soils at one time almost covered the county, but, as a result of partial destruction of the smooth upland plain by erosion, they now occupy less than one-half of its area. Erosion has gone on during past geologic ages, but its progress has greatly accelerated within recent years, through unwise management of the land. The former surface along the streams has been dissected to form valleys with slopes of varying degrees of steepness.

As a general rule, the gentle slopes occupied by soils of the first group mark the first break from the flat divides. The lower slopes are steeper and for the most part are covered with trees. These slopes are occupied by the second general group of soils and are used mainly for pasture. The soils vary in character according to the degree of slope. The dark-colored surface layer characteristic of Prairie soils becomes thinner as the slope becomes steeper, and, under the forest growth of the lower slopes, it disappears and is replaced by grayish-brown soil. Various parent materials are exposed as the streams cut down through successive layers of loess, gumbotil, leached and unleached glacial drift, and, in many places, bedrock formations, and their weathered products enter into the composition of the soils. With this group of soils used mainly for pasture is also placed Wabash loam, a poorly drained soil of the first bottoms. This soil differs widely from the other soils of the group, but, like the others, it is used mainly for pasture. It occupies a comparatively small total area.

The various topographic features with coextensive types of soil have largely determined the present land use in different parts of the county, subject, of course, to the limitations imposed by the general climatic and economic conditions. If a large part of the county had been composed of smooth land with the rich dark-colored soils of the first class, the agriculture would have centered around the production of corn, which would have been sold for cash or fed to hogs as in other parts of Iowa. As a large part of this county, however, is not well adapted to the production of corn, it is necessary for the farmers to engage in a type of farming that will utilize the land to best advantage. More than 25 percent of the land is entirely unsuited to the production of any cultivated crop. An area of almost equal size, which can be farmed only with difficulty and with the risk of washing and gullying, may be regarded as marginal for farm crops, and the greater part of such land is used for pasture. The rough land, as a whole, does not have a high carrying capacity for livestock. In some places, it is wooded, and the growth of grasses is so sparse that it has little value for grazing. In other places, the moisture held by the soil is not sufficient to support grass of good quality throughout the grazing season, and, as a result, pastures "burn out' during the latter part of the summer.

A general appraisal of the soil resources shows that certain soils in this county are well suited to the production of corn, forage, hay crops, and oats, and that other soils provide pasture ranging in quality from good to poor. The soils of these two general groups do not occur in large continuous bodies but in irregular strips, and areas of the two classes of soils are intricately intermixed. A large proportion of the farms contain both farming and grazing soils. The type of farming adopted must be designed to utilize the pasture land in connection with the cropland. The farmers have turned to the raising of beef cattle as the enterprise best suited to this purpose. The limited amount of corn grown is barely sufficient to finish the beef cattle for market and does not allow the buying of feeders for fattening.

Dairying is not developed to a great extent in this part of Iowa for two reasons, both of which are closely related to the character of the soil. The better land is needed for corn, and owing to the comparatively small production of oats, the concentrated protein feeds needed in dairying are lacking. The second difficulty in dairying is the dearth of good pasture.[4]

In the following pages the various soils in the two groups are described in detail, and their suitability to the different crops is discussed. The accompanying soil map shows the distribution of the soils, and table 4 gives their acreage and proportionate extent.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Decatur County, Iowa*

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Grundy silt loam	40,768	12.0	Shelby loam, steep phase	84,992	24.9
Grundy silt loam, slope phase	6,848	2.0	Weller silt loam	31,168	9.1
Edina silt loam	15,488	4.5	Lindley loam	68,224	20.0
Shelby loam	29,056	8.5	Wabash loam	12,288	3.6
Chariton silt loam	35,968	10.5	Rough stony land	192	.1
Bremer silt loam	320	.2			
Wabash silt loam	3,520	1.0	Total	341,120	
Wabash silty clay loam	12,288	3.6			

SOILS USED MAINLY FOR THE PRODUCTION OF CULTIVATED CROPS

The soils of this group are capable of producing, over a large part of their area, the cultivated crops common to this section. More than one-half the area of each soil is smooth and flat or gently sloping land which can be tilled without danger of serious erosion. The soils are characterized by an abundance of organic matter, as is indicated by their dark color. The surface soils are friable and easily tilled. They absorb the rainfall and are retentive of moisture. The group includes Grundy silt loam, Grundy silt loam, slope phase, and Edina silt loam of the broad flat-topped divides; Shelby loam of the gentle slopes; Chariton silt loam and Bremer silt loam of the terraces; and Wabash silt loam and Wabash silty clay loam of the stream bottoms.

Grundy silt loam.—The 6- or 7-inch surface layer of Grundy silt loam is black friable silt loam high in organic matter. Below this, the material is distinctly granular and friable to a depth of about 18 inches. Between depths of 18 and 30 inches is brown heavy silty

[4] HOLMES, C. L. TYPES OF FARMING IN IOWA. Iowa Agr. Expt. Sta. Bull. 256, pp. [116]–166, illus. 1929.

clay which is rather hard when dry and very plastic when wet. This layer is darkened by organic matter and is mottled with rusty brown, yellow, and gray. Soft iron concretions cause rusty-brown and black spots. At a depth of about 30 inches, the material is lighter in color but similar in texture and compactness to that in the layer above. The lighter color is due to an increased mottling of rusty brown, yellow, and gray. At a depth of about 40 inches, the soil becomes lighter textured, approaching heavy silt loam which is less plastic and not nearly so tough as the material in the layer above. The texture becomes less heavy with depth, until, at a depth of about 5 feet, the soil loses its compactness and plasticity. In many places at this depth, the change in color from the yellowish brown of the overlying material to the grayish brown of the underlying material is noticeable. Rusty-brown and black iron stains occur throughout the soil material below a depth of 40 inches, but, in most places, they are less pronounced in the grayish-brown layer. Grundy silt loam is free from stones or pebbles down to the deeper drift substratum.

This soil is acid in reaction to a depth of 5 feet or deeper. The degree of acidity ranges from slight to strong, and, in general, the acidity decreases with depth. Below a depth of 5 feet the soil is neutral or slightly alkaline.

Grundy silt loam occupies the broad divides of the uplands. The largest areas are in the northern part of the county, north of Leon and in the vicinity of Van Wert, Weldon, and Garden Grove, and in the southwestern part around Lamoni. Smaller narrow areas occur throughout various parts.

Surface drainage is slow, but, owing to the friable consistence of the subsoil, there is very little danger that the soil will become excessively wet except during abnormally wet seasons. Water has been observed standing in the fields after a heavy rainfall, but it disappears after a few days of dry weather.

Practically the entire area of Grundy silt loam in this county is devoted to cultivated crops, chiefly corn, small grain, and hay. In seasons of well-distributed rainfall, yields are higher on this than on any other soil in the upland sections. Corn yields from 30 to 35 bushels to the acre; oats, 25 to 30 bushels; wheat, about 20 bushels; red clover and timothy alone, about 1½ tons; and alfalfa, provided the soil has been limed and a good stand is obtained, 2 to 3 tons.[5]

Soil conditions of Grundy silt loam are very favorable for the growing of all the common crops, especially corn. The mellowness of the surface soil provides an excellent seedbed, and, with modern methods of seedbed preparation, enough firmness can be developed in the surface soil that the seed can obtain sufficient moisture and plant nutrients for germination and to produce a thrifty growth. Both surface soil and subsoil are rich in organic matter and nitrogen. The granular subsoil provides good soil aeration so that micro-organisms can survive and convert plant nutrients in the soil to an available form for growing crops. The productivity of this soil can be maintained easily if erosion is checked and if both nitrogen and organic matter used by crops are returned to the soil. All that is necessary to prevent erosion

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[5] Crop yields are based on reports from local farmers, the Iowa Yearbook of Agriculture, 1932, and agricultural data from the U. S. Department of Agriculture.

is careful plowing of the land adjacent to the more sloping areas, so that more water is taken up by the soil and run-off water does not form gullies. Nitrogen is supplied readily by the growing of legumes which are successful if lime is applied to the land. The lime requirement of the surface soil, according to tests, ranges from 2 to 4 tons to the acre. Organic matter may be added to the soil by applying barnyard manure or by turning under green-manure crops.[6]

Grundy silt loam, slope phase.—The slope phase of Grundy silt loam is similar to the typical soil in most respects, but, owing to its occurrence on slopes, it has a shallower surface soil. The upper layer of the typical soil, which is darkened by black organic matter, is about 18 inches thick, whereas the corresponding layer of the slope phase is about 8 inches thick. This layer is thinner on the steeper slopes, where, in some places, the heavy yellow or brown subsoil is exposed. The material is somewhat variable below the surface layer; over the greater part of the areas, it does not differ in appearance from that in the corresponding layers of the typical soil. In the more sloping areas, the gray and brown mottling and other evidence of poor drainage are fewer. On some of the lower slopes, however, where the soil is moistened by seepage water, gray and mottled colors are more strongly developed.

The slope phase of Grundy silt loam occurs on narrow stream divides where the relief ranges from moderately to steeply sloping, and the dark-colored soil cannot be so easily protected from erosion as on the broad divides. It is only slightly less productive than the typical soil, but it is not so durable. Decreased productivity naturally appears sooner in the more sloping areas than in the typical soil, owing to their thinner surface soil and greater susceptibility to erosion. Erosion can gain headway easily on the narrow stream divides unless care is taken in cultivation to protect the soil. The bordering lower steeper slopes should be kept in grass or either terraced or plowed on the contour when cultivated, in order that the gullies may not encroach on areas of Grundy silt loam, slope phase.

In places where this soil is farmed judiciously, yields very nearly equal those obtained on the typical soil. Almost all of it is cultivated. About 30 percent of the cultivated land is seeded to timothy and clover, and the rest is in corn and oats.

Subsoil drainage in most places is better than in typical Grundy silt loam. Because of this feature, it was observed that in the abnormally wet season of 1935 the corn crop on this soil was much more successful than that on typical soil. Yields of corn on the slope phase of Grundy silt loam in normal years are between 25 and 30 bushels an acre and those of oats between 20 and 25 bushels. Timothy and clover yield about 1 ton of hay.

Edina silt loam.—Edina silt loam occupies the slightly depressed or extremely flat areas on level divides, within the large areas of Grundy and other soils. This soil generally is regarded as inferior to Grundy silt loam in productivity.

The surface soil is very dark grayish-brown silt loam when dry and is almost black when wet. It ranges from 5 to more than 12 inches in thickness. Beneath the surface layer is a layer of fine

[6] BROWN, P. E. SOILS OF IOWA. Iowa Agr. Expt. Sta. Spec. Rept. 3, 261 pp., illus. 1936.

floury silt loam, laminated in structure. It ranges from gray to almost white and from 3 to 10 inches in thickness. This gray layer is the distinguishing characteristic of the Edina soils, and in many places it is close enough to the surface to be brought up when the fields are plowed deeply. It has a tendency to retard the movement of moisture, and the land, therefore, is poorly drained. Beneath the gray silty layer is very tough plastic silty clay or clay, which bakes hard on drying. The colors of this material are variegated, being mainly drab and gray, stained with yellow, brown, and black. At a depth of 50 or more inches, this material gives way to lighter textured material, in which gray predominates. The reaction is decidedly acid throughout, but the degree of acidity is greatest in the surface soil and gray layer.

The most extensive areas of Edina silt loam are in the northeastern part of the county and southeast of Leon. This soil occurs almost entirely in the eastern half.

About the same proportion of Edina silt loam as of Grundy silt loam is under cultivation and devoted to the same crops. Yields, however, are decidedly lower than on the Grundy soil. During abnormally wet seasons, as in 1935, corn makes a poorer stand than on the Grundy soil, the yield is correspondingly smaller, and, in some fields, the crop is almost a failure. Average yields of corn are about 25 bushels an acre; of oats, between 20 and 25 bushels; of wheat, about 20 bushels; and of red clover and timothy, about 1½ tons.

Certain differences in soil characteristics account for the lower yields obtained on Edina silt loam, as compared with those on Grundy silt loam. In the first place, the Edina soil has neither the granular subsoil—a most favorable condition for plant growth—nor so dark or rich a subsoil as has the Grundy soil. The gray layer characteristic of the Edina soil is almost invariably associated with a soil leached of its plant nutrients. The material in this layer generally is slightly more acid than that in either the overlying or the underlying material.

Drainage of this soil is naturally poor, owing to its position in exceedingly flat or slightly depressed areas, the gray compact silty layer, and the tough impervious clay subsoil, which hinder the movement of water. Tiling does not alleviate this condition unless the lines are laid very close together, because the drawing power of the tile is weak in the heavy subsoil. If the tile are laid above the heavy clay subsoil, the danger from frost injury is increased. If they are laid in the clay layer below the frost line, broken stones, broken tile, gravel, and the black surface soil should be placed on top of the tile, with the heavier soil above that, to prevent clogging of the lines by the fine clay particles.

Heavy applications of lime would benefit this soil greatly. A well-limed soil will produce sweetclover and alfalfa, which are deep-rooted plants that send their long roots well into the tough subsoil. When the plants die, the roots decay, leaving channels through which moisture and air can reach the lower levels, thereby allowing better aeration and oxidation in the subsoil.

Shelby loam.—The 8- or 10-inch surface soil of Shelby loam consists of dark grayish-brown mellow loam. It is underlain by yellowish-brown moderately gritty silty clay loam. The partly weathered parent drift lies at a depth ranging from 24 to 30 inches. This is a variegated heavy silty clay containing glacial gravel and boulders. In many places, yellowish-brown, reddish-brown, and gray colors are intermingled throughout the soil profile. The mottled appearance is not due to soil development but to the colors of the various materials composing the drift. In places, the proportion of coarse sand is large. In many places, streaks and seams of white limy material are present at a depth of several feet, and here and there they are near the surface.

In the higher positions, comparatively narrow strips of heavy brown or reddish-brown clay extend around the hillsides at a certain level. Their presence reduces the value of the land, as this included soil is difficult to handle and is unproductive. These areas, locally known as push soil, are composed of the little-altered heavy upper layer of the glacial drift, known as gumbotil. Their position can be traced by the poor growth of crops and native grasses. In cultivated fields, injurious effects of drought are noted first on this included soil, and in pastures the sparse growth of wire grass and other drought-resistant grasses is noticeable.

Shelby loam is developed in all parts of the county, on slopes bordering streams and drainageways. The most extensive areas are in the northern part, surrounded by areas of Grundy silt loam and Edina silt loam. The Shelby soil occupies a position intermediate between Grundy silt loam of the flat interstream divides and the soils of the stream bottoms. The relief ranges from gently to moderately rolling. The slopes everywhere are eroded to some extent and, in places, are badly gullied.

About 75 percent of the land is in cultivation, and the crops generally grown are the same as those grown on Grundy silt loam. Yields are slightly less than those obtained on the Grundy soil during seasons of normal rainfall. During seasons of abnormally high rainfall, however, as in 1935, larger yields of corn were returned by Shelby loam than by Grundy and Edina silt loams of the flat uplands where poor drainage conditions prevail. The productivity of Shelby loam, when first cultivated, cannot always be maintained, as the surface soil is subject to severe washing. Unless great care is taken in cultivation, the land should be reseeded to grasses and legumes after each 2 or 3 years of cultivation, in order that some organic matter may be restored to the soil. Shelby loam supports a good stand of bluegrass, and each 2 acres will support a cow during most of the grazing season.

During normal seasons, corn yields from 25 to 30 bushels an acre; oats, 20 to 25 bushels; and timothy, 1 to 1½ tons.

Chariton silt loam.—Chariton silt loam, to a depth of 10 inches, is very dark grayish-brown mellow silt loam which is slightly more gray when dry. Below this and continuing to a depth of 20 inches is distinctly gray floury silt loam which is laminated in structure and contains black organic and rusty-brown iron stains. The substratum is dark-brown silty clay or clay, which is very sticky and waxy when moist and very hard when dry. On a smoothly shaven surface of the material in this layer, spots of yellow or rusty brown appear, which are perhaps the interior parts of the soil particles. Pellets or soft concretions of iron also are present in this material.

At a depth of 24 inches, the yellow mottlings become more dominant and, at a depth of 30 inches, the material is colored with equal proportions of yellow and bluish gray. This material rests on soft plastic silty clay loam or silt loam. The surface soil and the underlying layers range from medium acid to strongly acid in reaction.

Chariton silt loam is developed on terraces of water-laid materials at two general levels above the present beds of the streams. One series of terraces has a low position—very little above the level of the Wabash soils of the flood plains. Overflows, however, are less frequent than on the Wabash soils. Despite occasional overflows, the profile is very similar to that of the higher lying Chariton soil. In this topographic position, the soil is extensively developed in Thompson, Weldon, and Little River Valleys. In places, the value of the land on the low terraces is reduced by the meandering of the streams. Over most of the area, surface drainage from the nearly level land is slow and underdrainage is retarded by the heavy clay subsoil, so that surplus water left by floods or heavy rains moves slowly. Very little damage, however, results from the infrequent periods of poor drainage.

About 95 percent of the lower lying land is farmed, and the rest is in permanent pasture. In normal years corn and hay crops return yields nearly as high as those obtained on the best upland soils. Yields of corn through a period of years in different places range from 25 to 30 bushels an acre; oats yield about 25 bushels; and red clover and timothy mixed, about 1½ tons.

The higher terraces are mainly along the Thompson River Valley. These terraces are nearly level, except in a few places where the surface is cut by streams. They range in elevation from 10 to 15 feet above the level of the first bottoms. The impervious layer beneath the subsoil causes slow subsoil drainage and, in places where the land is very level, water remains on the surface for several days after heavy rains. Even after most of the land in the field dries, an excessive amount of seepage comes to the surface in the lower positions on the higher terraces. These conditions, together with the high acidity of the surface soil and subsoil, are unfavorable to the growth of plants wtih deep root systems. The death rate among the trees set out on this soil during the summer of 1935 was exceptionally high because of these conditions, as compared with that of trees planted on more friable soils.

All Chariton silt loam on the higher terraces is under cultivation to the common farm crops, such as corn, hay, oats, and wheat. Yields from these crops on the higher lying areas are less than those obtained on the Wabash soils, and generally are slightly greater than those obtained on Weller silt loam. The average acre yield of corn is 25 bushels; oats, 15 bushels; and hay, 1 ton.

Bremer silt loam.—Bremer silt loam has a surface layer of very dark grayish-brown or nearly black silt loam which, when wet, appears black and becomes somewhat sticky. Below a depth of 12 inches, the color begins to fade and the material shows more gray, with streaks of rusty brown and black throughout. At a depth of about 20 inches the basic color is gray. It is mottled or stained with yellowish brown, rusty brown, and black, indicating poor subsoil drainage. The texture of the material in the lower layers ranges from silty clay loam to almost a clay, and it is heavy, compact, and very impervious. Lime carbonate is absent from the entire soil mass, and analyses indicate strong acidity. The maximum acidity is in the surface layer.

This soil occupies an area of only 320 acres on a terrace in the northwestern part of the county. The relief is level or undulating, and surface drainage is fairly good.

All the soil is in cultivation. This is a soil suited chiefly to corn which is grown almost continuously and yields about 45 bushels an acre in normal years. The high natural fertility of the soil enables it to withstand heavy cropping better than any other soil. In wet seasons the yield is reduced somewhat because of poor drainage, and in dry seasons yields are above normal. The average acre yield of oats is about 30 bushels; wheat, 20 bushels; and clover and timothy hay mixed, 1½ tons.

Wabash silt loam.—The surface soil of Wabash silt loam is dark-brown mellow silt loam to a depth of about 20 inches. Below this and continuing to a depth of 40 inches, the material consists of dark-brown silty clay loam which contains sufficient silt and very fine sand to maintain a friable consistence. In many places, heavy silty clay is reached at a depth of 36 inches. Both surface soil and subsoil are lacking in lime.

This soil occurs principally in the bottom lands along the streams that extend into the more level parts of the county. It is developed from alluvium washed from dark-colored soils of the higher slopes and uplands. Its occurrence in narrow valleys subjects it to considerable overflow after each rain, and the receding floodwaters leave accumulations of debris behind the various obstructions throughout the bottom lands.

In most places, the bottom lands occupied by this soil are too narrow to warrant its use for the growing of crops. Therefore about 50 percent of the land is used for pasture. This soil, in most places, forms only a small proportion of an individual farm. It supports a luxuriant growth of bluegrass which provides sufficient feed from each 2 acres for one cow throughout the grazing season. Corn is the principal crop grown, yields of which, during normal seasons, range from 35 to 40 bushels an acre.

Wabash silty clay loam.—Wabash silty clay loam differs from Wabash silt loam principally in the texture of the surface soil. The 6-inch surface soil of the silty clay loam is dark grayish-brown or almost black heavy silty clay loam which becomes very sticky when wet and very hard when dry. Under moderately moist conditions, however, the soil plows easily and the clods break down to a good tilth after being exposed to the weather. The surface soil grades into a dark-gray silty clay subsoil mottled with rusty brown. When wet the subsoil is very sticky, and when dry it breaks into large irregular-shaped pieces. A shiny surface is formed by the moldboard of the plow on large pieces brought to the surface. At a depth of about 20 inches, the subsoil gives way to dark-gray plastic clay which continues to a depth of 36 inches or more. Lime is lacking in both surface soil and subsoil.

This soil occurs in the bottom lands along Thompson and Weldon Rivers throughout the southern half of the county.

About 95 percent of the land is cultivated. The success of crops depends on the prevention of overflow and the improvement of drainage. Overflow is prevented either by building dikes along the edges of fields or by straightening the river channel so that water can be transported more rapidly downstream. Drainage is improved by artificial ditches.

The principal crop grown is corn, yields of which range from 35 to 40 bushels an acre in normal years. During wet seasons crops on most of this land are destroyed, either by overflow or by very poor drainage. On the well-drained bottom land where the valley is wide, however, as south of Davis City, excellent crops of corn are obtained even in very wet seasons. In the dry season of 1934, the highest yields of corn produced in the county were on this soil.

A few farms are composed entirely of Wabash silty clay loam, with the exception of a few acres of uplands which generally are used for building sites and pasture. Such farms have nearly as high a rating as those composed of Grundy silt loam. The undesirable features of farms composed largely of Wabash silty clay loam are poor drainage, which is injurious to crops during wet seasons, and flood during periods of high water, which sometimes is devastating and destroys most of the crop.

SOILS USED MAINLY FOR PASTURE

The soils of this group are used to a large extent for permanent pasture. They do not, however, include all the pasture areas of the county, as considerable parts of some soils in the first group are kept in pasture. The soils of this group are used to some extent for the production of farm crops. Almost half of Weller silt loam is devoted to cultivated crops, although some of the land so used should be kept in grass. About 25 percent of Wabash loam and 20 percent of the steep phase of Shelby loam are in cultivation. Lindley loam is used almost entirely as pasture.

Shelby loam, steep phase.—The steep phase of Shelby loam is the most extensive soil in the county and determines very largely the types of farming practiced. It has a dark-brown friable loam surface soil which grades, at a depth of about 4 inches, into a reddish-brown plastic gritty clay subsoil. Below a depth of 15 inches, the material in the subsoil changes more or less to bluish-gray clay mottled with rusty brown and black soft manganese concretions. Some rounded coarse gravel, sand, and iron concretions are present. Larger glacial boulders or cobblestones of quartzite, granite, gneiss, and similar rocks are strewn on the surface and are numerous throughout the soil. They are especially noticeable along the roads that traverse areas of this steep soil.

This soil is most extensive along the slopes of Thompson River Valley, and it occurs also in other important valleys. It is not uncommon for the steep slopes on the eastern and northern sides of the valley to be occupied by Shelby loam, steep phase, and the opposite sides to be occupied by Lindley loam.

About 80 percent of the total area of this soil is used for pasture and the rest for crops. It supports a good bluegrass pasture. All that is necessary to maintain a good pasture is the prevention of too close grazing and encroachment of native trees and undergrowth.

The productivity of this soil declines after a few years of cultivation, and very unprofitable yields are then obtained—from 10 to 15 bushels of corn an acre, 10 bushels of oats, and one-half ton of timothy hay. In many places, erosion strips the cultivated land of its surface soil and exposes the reddish-brown clay subsoil. Most of the gullied slopes are occupied either by this soil or by Lindley loam. The land should remain in native sod, and the concensus of opinion among the farmers is that more profitable returns would be obtained from this land after it had been judiciously used for pasture for a time. Most of the cultivated area is being reseeded gradually to grasses, and methods to check gullying are being established. Where a good stand of bluegrass is maintained, the land can be pastured at the rate of 3 acres a cow without injury to the stand. During wet seasons, an abundance of feed is produced by bluegrass.

Weller silt loam.—Weller silt loam has a grayish-brown or dark-gray floury heavy silt loam surface soil of varying thickness. Some slopes are completely devoid of the silty layer; over the greater part of the area this layer is 4 or 5 inches thick; and in few places does it exceed a thickness of 6 inches. It is underlain by grayish-brown or yellowish-brown silty clay loam or silty clay, which has a granular or fine-nut structure. Many of the soil particles are thinly coated with gray. Beginning at a depth of 18 inches and continuing to a depth of 30 inches, the material is brown or yellowish-brown heavy silty clay. The underlying material is mottled gray and yellowish brown.

Both the surface soil and subsoil are acid, and no lime is present in the material below the subsoil to a depth of 5 feet.

Weller silt loam is developed on narrow ridges that were covered with forest when the county was first settled, and also in the most deeply and thoroughly dissected parts.

About 50 percent of this land is devoted to cultivated crops, and the rest is used for pasture. Corn, oats, and hay are the principal crops, and yields are usually less than those obtained on Shelby loam or on the slope phase of Grundy silt loam. As it is a lighter colored soil than either of these two soils, Weller silt loam does not contain so much organic matter, nitrogen, or other necessary plant nutrients to produce such large crops as do the Shelby and Grundy soils. The structure of the subsoil of Weller silt loam, however, is equally as good as that of Grundy silt loam, and the Weller soil perhaps would be capable of producing as good yields as the slope phase of Grundy silt loam were enough organic matter, plant nutrients, and lime added.

Corn on this soil produces from 20 to 25 bushels an acre; oats, 15 to 20 bushels; wheat, 10 to 12 bushels; and hay, about 1 ton from two cuttings.

Lindley loam.—The upper 2 inches of Lindley loam in forested areas consists of dark-gray friable loam mixed with decaying leaves and roots. Below this and continuing to a depth of 6 or 8 inches is pale grayish-yellow or grayish-brown friable loam or silt loam. The next lower layer consists of a heterogeneous mixture of gravel, sand, and clay, and the color is brown or slightly reddish brown. The clay, which occurs in strata, lenses, and pockets, is sticky when wet and hard when dry. In the latter condition it breaks to sharp-angled fragments. At a depth of 24 inches, it rests on the less altered glacial drift, largely bluish-gray or yellow clay.

In many places the lower part of the surface soil is gray or almost white. It contains only a small quantity of organic matter and is highly acid. After a few years of cultivation, most of the organic matter in the upper part of the surface soil disappears, and the gray or nearly white material in the lower part is brought to the surface by the plow. The cultivated areas, therefore, appear much lighter in color than the virgin areas. In wooded areas, a great number of roots of trees and shrubs extend horizontally through the surface soil. This habit of growth is due to the impenetrable character of the subsoil.

With the exception of a few small cleared patches, Lindley loam is covered with trees and bushes. The most common trees are oaks, elms, and hickories. Over the greater part of the areas, hazel, buckbrush, and sumac form a dense undergrowth. This type of vegetation is characteristic of Lindley loam. On Shelby loam, steep phase, the trees are larger, the woods are more open, and a fair growth of grass can survive; but the thick underbrush on Lindley loam almost eliminates the grasses and greatly reduces the value of the land for pasture.

Lindley loam, like Weller silt loam, has a shallow surface soil, but it does not have the granular subsoil of the Weller soil. It resembles Shelby loam, steep phase, except that it has a much lighter colored surface soil than does the Shelby soil. Lindley loam occurs on steep slopes bordering the ridges, most of which are occupied by Weller silt loam. The most extensive areas of Lindley loam are in the southeastern part of the county.

Lindley loam is used almost exclusively for pasture, and the livestock feed on the few annual plants that grow among the undergrowth. Bluegrass grows only in the open patches among the trees. The dominant plant in some of the open spaces is known locally as poverty grass. As its growth is very short, it produces very little feed, and it becomes unpalatable during the middle of the growing season. Removal of the undergrowth and most of the trees often results in an improvement in the pasturage, as it allows the grasses to grow. Vigilance must be maintained, however, in order to prevent shrubs from sprouting and covering the entire surface. If underbrush is kept down and the land is terraced and fertilized, a fair pasture of bluegrass can be developed.

Wabash loam.—Wabash loam has a dark grayish-brown or black mellow loam surface layer to a depth ranging from 15 to 20 inches. The material below the surface layer is friable loam or silty clay loam, the color of which is fully as dark as that above. This layer continues to a depth of 36 inches, where it is underlain by black plastic silty clay loam mottled with rusty brown. No lime is noticeable at any depth.

This soil differs from the other soils of the Wabash series chiefly in the texture of the surface soil, which, however, is variable. In small areas the soil may contain sufficient sand to form a fine sandy loam or enough silt to form a silt loam. The subsoil likewise varies, and, in places, it may contain a large proportion of sandy material.

These variations, however, were not sufficiently large to indicate legibly on the soil map.

Wabash loam occurs in narrow valleys which are overflowed very frequently and receive sediments of silt, sand, and gravel washed down from the adjacent slopes. Consequently, the character of the surface layer may change after each overflow. Most of the adjacent slopes are occupied either by Shelby loam, steep phase, or by Lindley loam, and the materials of these soils contribute a large proportion of the additions to the Wabash soil.

This soil can be utilized to the best advantage for pasture, to which purpose about 75 percent of it is devoted. Because of frequent overflows of the bottom land more crops are destroyed than are harvested successfully. Corn is practically the only crop grown, and the yields obtained range from 25 to 30 bushels an acre.

Rough stony land.—Rough stony land comprises a few areas along Thompson River where limestone strata outcrop, mainly in the form of steep bluffs. The principal agricultural importance of the limestone is that it is a source of the lime which is needed for application to the acid soils. During the last few years considerable limestone has been quarried in these areas. On gentle slopes or shelves, where the surface of the limestone has been undisturbed for a long time, a thin dark-colored soil has developed or has been deposited, and a sparse growth of trees, mainly oaks and hickories, has taken hold. Over the greater part of this land, however, the bare limestone is exposed.

LAND USES AND AGRICULTURAL METHODS

It has already been pointed out that less than one-half of the land in Decatur County is used for the production of crops. Only about one-half of the total acreage so used is well suited for the production of corn and oats, which are necessary as feed crops in the prevailing system of livestock raising. The burden of producing grain for feed is placed on a comparatively small acreage, and the farmer is in the unfortunate position of being compelled to crop continuously much of his land that might better be kept in permanent pasture. This practice has resulted in rapid erosion of the sloping land and in the lowering of productivity in the more level areas. It is generally recognized that some improvement in the methods of soil management is necessary, in order that smaller acreages can be made to produce the necessary grain for feeding, and that land extremely susceptible to erosion can be released from cultivation.

The Soil Subsection of the Iowa Agricultural Experiment Station maintains 95 soil-experiment fields, located throughout all parts of the State. These fields are in counties where the soil survey has been completed, and the principal soil types have been determined. They are supervised by field men from the experiment station, who apply the fertilizers and harvest the crops. The cooperator gives the experiment plots the same care as is given the rest of the field. Crop yields are recorded, and soil-survey reports for the different areas are issued in special bulletins.

There are no field experiment plots, under the supervision of the experiment station, located in this county, but plots in neighboring counties, on soils similar to those predominating in Decatur County, indicate what may be expected from various soil treatments. Experimental plots are one-tenth of an acre in size. A definite rotation is used by the farm cooperator, who plants and cultivates the crops on the plots along with his regular crops. The plots are established on typical soils.

These experiments include tests of the different fertilizers, under both grain and livestock systems of farming. The older fields are laid out under both systems, but on the newer fields only a livestock system is used. The new fields have 9 plots each, including 3 check plots, and the older fields have 13 plots, with 3 check plots. Under the livestock system, barnyard manure is applied at the rate of 8 tons an acre, once in a 4-year rotation, together with crop residue plowed under. Limestone is applied in sufficient quantities to neutralize the acidity of the soil. Tests are made of the lime requirements once in the rotation, and additional lime is applied every fourth year, if needed. Under the grain system of farming, organic matter is supplied by plowing under crop residues and, in some instances, the second crop of clover. Ordinarily, the first crop of clover is used for hay, and the second crop is left for seed or plowed under. Rock phosphate and superphosphate are applied in both the grain and the livestock systems. Rock phosphate was applied at the rate of 1 ton an acre prior to 1925, once in a 4-year rotation. During the years 1925–32, 1,000 pounds of rock phosphate were used in the 4-year rotation, and since then only 500 pounds have been used. Superphosphate (16-percent) was applied at the annual rate of 200 pounds an acre at first. In 1923, the application was reduced to 150 pounds and was made 3 years out of 4, being omitted in the year in which a legume crop was produced; and since 1929, an equivalent amount (120 pounds) of 20-percent superphosphate an acre has been used.

Complete commercial fertilizer (2–8–2) [7] was used at the rate of 300 pounds an acre annually and disked in, but was changed in 1923 to 2–12–2, the equivalent of 150 pounds of 16-percent superphosphate which was applied at the rate of 200 pounds an acre. Since 1929, a 2–16–6 mixture has been used at the rate of 200 pounds an acre. Potash, in the form of muriate of potash, was applied at the rate of 50 pounds, 3 years out of 4, in a 4-year rotation.

In this county, records of these experiments apply only to Grundy silt loam. The figures are of interest to the farmers, as this soil covers an area of 40,768 acres in this county and is fairly representative of the other soils occurring on the nearly level upland. Table 5 gives the results of limestone and fertilizer treatments on corn, oats, wheat, and timothy and clover (alone or mixed) on Grundy silt loam, the average being taken from 12 individual experiment fields in Jefferson, Henry, Mahaska, Lee, Louisa, Ringgold, Van Buren, Wapello, and Wayne Counties. Both grain and livestock systems of farming are represented.

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[7] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

TABLE 5.—*Average acre yields*[1] *of crops and increases due to fertilizer treatment on Iowa experiment fields*[2] *on Grundy silt loam*

Treatment	Corn		Oats		Timothy and clover hay, alone or mixed		Winter wheat	
	Average yield	Increase from treatment	Average yield	Increase from treatment	Average yield	Increase from treatment	Average yield	Increase from treatment
13-plot series:	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Bushels*	*Bushels*
Check[3]	55.9	--------	44.7	--------	1.23	--------	22.2	--------
Manure	60.0	4.1	48.3	3.6	1.32	0.09	24.6	2.4
Manure+limestone	67.5	11.6	51.4	6.7	1.66	.43	28.0	5.8
Manure+limestone+rock phosphate	71.5	15.6	58.1	13.4	1.89	.66	32.7	10.5
Manure+limestone+superphosphate	72.2	16.3	64.5	19.8	2.21	.98	34.8	12.6
Manure+limestone+complete commercial fertilizer	71.0	15.1	61.0	16.3	2.26	1.03	34.5	12.3
Limestone	62.2	6.3	52.4	7.7	1.82	.59	28.6	6.4
Limestone+rock phosphate	64.1	8.2	55.8	11.1	2.01	.78	29.4	7.2
Limestone+superphosphate	64.0	8.1	56.6	11.9	2.04	.81	30.3	8.1
Limestone+complete commercial fertilizer	64.5	8.6	57.2	12.5	2.04	.81	33.3	11.1
9-plot series:								
Check[3]	51.3	--------	42.6	--------	1.25	--------	21.5	--------
Manure	55.1	3.8	47.6	5.0	1.60	.35	26.2	4.7
Manure+limestone	59.6	8.3	50.8	8.2	1.68	.43	27.0	5.5
Manure+limestone+rock phosphate	59.7	8.4	50.1	7.5	1.92	.67	31.7	10.2
Manure+limestone+superphosphate	61.4	10.1	51.0	8.4	1.98	.73	32.3	10.8
Manure+limestone+superphosphate+muriate of potash	63.5	12.2	49.8	7.2	2.19	.94	33.7	12.2
Manure+limestone+complete commercial fertilizer	62.6	11.3	54.1	11.5	2.03	.78	31.1	9.6

[1] 13-plot series: Corn yields averaged from 41 crops on 6 fields, oat yields from 21 crops on 6 fields, hay yields from 16 crops on 5 fields, and winter wheat yields from 6 crops on 3 fields. 9-plot series: Corn yields averaged from 24 crops on 6 fields, oat yields from 9 crops on 6 fields, hay yields from 8 crops on 5 fields, and winter wheat yields from 6 crops on 3 fields. Table includes 1935 data.

[2] 13-plot series includes Farson fields, series 2 and 4; Agency field, series 2 and 4; Agency field, series 1; West Point field, No. 1, series 1; and Mount Pleasant fields, series 100 and 200. 9-plot series includes Wapello field, series 1; Cedar field, series 1; Croydon field, series 1; Libertyville field, series 1; Milton field, series 1; and Denmark field, series 3.

[3] The yields given for the checks are the average of the yields on all check plots on all fields.

The value and effectiveness of lime, manure, and either rock phosphate or superphosphate are clearly indicated in the results in table 5. Lime showed the greatest economic return under both livestock and grain systems of farming. Marked increases are shown in the yields of corn, oats, and winter wheat, with manure alone and with manure and lime. The increases due to phosphate, both rock phosphate and superphosphate, are pronounced in the 13-plot series, but only slight in the 9-plot series. Yields of corn, oats, winter wheat, and timothy and clover (alone or mixed) were greatly increased where rock phosphate and superphosphate were used with manure and lime, the superphosphate showing the greatest return. Where used with manure and lime, superphosphate seemed to be more effective than raw rock phosphate on all crops. Potash, used in addition to lime and superphosphate, gave no significant increases in yield, and complete commercial fertilizer, when used with manure and lime, was not consistently superior to superphosphate. Superphosphate and rock phosphate seem to be more effective in the livestock system than in the grain system of farming. Where phosphate or commercial fertilizer is to be used on the farm, tests should be made in the field to determine the effectiveness of the treatment.

The results of experiments on Grundy silt loam on the Agency field in Wapello County are given in table 6. The experiments cover a period of 18 years and show the effects of manure, lime, and fertilizer under both livestock and grain systems of farming. The results are comparable to the average results on 12 individual fields located on Grundy silt loam shown in table 5.

The results of these experiments, as well as many others conducted on various soils throughout Iowa, emphasize the importance of soil treatments in obtaining larger crop yields and in maintaining permanently the fertility of the soil.

The use of all available barnyard manure and the plowing under of green-manure crops, are important practices in maintaining the organic matter and in supplying additional plant nutrients in the soils of Decatur County. Liming also is important, especially where legume crops are grown.

Rock phosphate or superphosphate may be used to advantage on most crops. Tests should be made in individual fields to determine which might be most effective and profitable. Muriate of potash may be used economically on some soils, but extensive applications should not be made before field tests are tried and the value of such applications determined.

Complete commercial fertilizers may be applied profitably to some soils, but experiments indicate that under average conditions a straight phosphate fertilizer gives as good results and greater profits. Comparison tests with phosphate are desirable. Approximately 47 percent [8] of all land in farms in this county is in pasture.

On many of the hillside pastures are scattered trees, brush, weeds, and thin stands of bluegrass. Areas of this kind should be improved. Brush should be cleared out and the slopes reseeded with suitable pasture mixtures. Where the soils are low in organic matter, or badly eroded and run-down, lespedeza has been successfully used by some farmers. Owing to its drought-resistant ability and tolerance of acidity, it will thrive in places where red clover and other legumes are unsuccessful. It seems to grow better than any other legume or grass on areas where the raw unproductive subsoil is exposed. An early maturing variety is recommended, as later varieties may not reseed themselves.

Where some of the surface soil remains, even though it is thin, a mixture of timothy, alsike clover, lespedeza, and Canada bluegrass has been used successfully. In places where the soil is sweet, sweetclover can be used in the mixture. Inoculated legumes are very valuable in a pasture, as they have the ability to supply nitrogen to the grasses. Lime and phosphate must be used, however, on many soils to insure successful growing of legumes. Practices recommended for control of erosion in this county include improved systems of rotation, contour tillage, contour strip cropping, retirement of eroded areas, unfit for cultivation, to grass or trees, improvement of pastures, contour furrowing, liming, and the use of legumes as green manure.[9]

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[8] Iowa Yearbook of Agriculture, 1935.

[9] Additional information on soil management, soil erosion, and the results of field experiments with fertilizers is given in Iowa Agricultural Experiment Station Bulletins 269 and 280, and Special Reports 2 and 3. Recommendations for pasture mixtures are given in Bulletin 331.

TABLE 6.—*Acre yields in field experiments* [1] *on Grundy silt loam in Wapello County, Iowa*

Plot No.	Treatment	Corn, 1918	Oats, 1919	Winter wheat, 1920	Timothy and clover, 1921	Timothy, 1922	Corn		Oats, 1925	Winter wheat, 1926 [2]	Timothy and clover, 1927	Corn		Oats, 1930	Winter wheat, 1931	Red-clover, 1932	Corn		Oats, 1935
							1923	1924				1928	1929				1933	1934 [3]	
		Bushels	*Bushels*	*Bushels*	*Tons*	*Tons*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Bushels*	*Bushels*	*Bushels*
1	Check	63.5	44.9	22.7	1.92	2.00	72.7	46.4	66.2	21.7	1.28	83.3	66.8	52.3	20.4	2.24	54.5	--------	48.8
2	Manure	64.5	62.2	31.5	2.09	2.20	71.8	51.9	70.8	19.0	1.96	89.4	72.7	63.7	28.3	2.05	62.1	--------	45.4
3	Manure+limestone	66.8	58.3	36.7	2.20	2.25	79.2	52.2	73.8	21.8	2.28	100.5	72.6	64.8	26.4	2.31	71.8	--------	54.5
4	Manure+limestone+rock phosphate	68.8	63.6	38.7	2.52	2.30	86.8	54.0	80.6	35.3	2.14	105.4	83.4	80.8	39.3	2.35	75.8	--------	54.5
5	Manure+limestone+superphosphate	70.0	66.6	40.0	2.39	2.80	85.4	60.2	77.9	38.9	2.05	97.8	78.2	83.3	38.2	2.38	72.9	--------	63.5
6	Manure+limestone+complete commercial fertilizer	66.0	65.6	34.7	2.52	2.50	83.0	55.4	77.3	30.7	2.47	101.0	85.1	68.6	43.6	2.50	77.6	--------	51.0
7 and 8	Check	58.9	51.8	31.4	1.82	2.25	68.0	43.5	67.1	16.7	1.29	75.9	65.6	53.6	21.1	1.87	58.3	--------	42.2
9	Limestone	61.3	59.5	43.8	2.02	2.40	71.3	50.7	72.1	18.6	1.69	83.5	73.2	59.5	28.3	2.14	65.1	--------	48.8
10	Limestone+rock phosphate	61.8	61.2	36.4	2.33	2.65	73.1	54.9	75.9	26.0	2.14	96.6	77.5	70.8	30.9	2.32	67.5	--------	57.9
11	Limestone+superphosphate	63.5	61.2	36.3	2.19	2.75	80.7	55.5	74.6	--------	2.26	93.4	69.0	72.4	36.0	2.29	68.6	--------	54.5
12	Limestone+complete commercial fertilizer	62.5	63.6	35.6	2.17	2.65	70.4	54.4	78.4	--------	2.14	93.6	77.3	85.5	38.5	2.35	70.7	--------	60.1
13	Check	52.5	52.0	22.8	1.56	2.40	63.9	42.7	58.5	--------	.91	67.0	56.5	55.5	28.7	1.36	60.1	--------	49.9

[1] Agency field, series 1, in NE¼NW¼SE¼ sec. 30, R. 12 W., T. 72 N.
[2] Wet weather prevented seeding of plots 11, 12, and 13.
[3] Corn poor due to drought; cut for fodder.

Weller silt loam and Lindley loam have a rolling to hilly relief, moderately heavy to extremely heavy subsoils, and are highly erosible. The more rolling areas of these soils should be left in permanent pasture or timber, and only the gently sloping areas should be cultivated. Careful cultivation and cropping, and the application of the best methods for controlling erosion, are necessary for the maintenance and improvement of these soils. Contour plowing and cultivating, and seeding the small surface ditches, are recommended in rolling areas. A 3-year rotation should be used where crop yields have decreased and the soil needs building up. A clean-cultivated crop should be grown only once in every 4 years on the more erosible rolling lands. Corn, small grains, and clover, or clover and timothy, make a satisfactory 3-year rotation. When used as a 4-year rotation, the field is left in hay the fourth year.

On farms where the land is flat to gently rolling and the soil fertility has been maintained, especially those farms which include the darker Prairie soils, a 4-year rotation of corn, corn, small grain, and clover will maintain productivity.

The heavy darker colored soils of the bottom lands and terraces—the soils of the Wabash, Chariton, and Bremer series—which have poor natural drainage because of their heavy subsoils and flat surfaces, would be greatly benefited by sweetclover grown in a rotation. Internal drainage and tilth would be greatly improved by the deep penetration of the roots and the plowing under of a coarse vegetal growth.

Many of the upland soils on slopes with a gradient in excess of 8 percent, now in cultivation, should be retired to permanent pasture. Unfortunately, much of this land must be farmed because of the lack of more level land on the individual farm.

MORPHOLOGY AND GENESIS OF SOILS

Decatur County is in the Prairie soil region of the United States. The normal profile for this region, however, is developed in only a very small proportion of the soils. Variations from this profile result, on the one hand, from excessive moisture and on the other, from the combination of two factors—a recently acquired forest vegetation and a sloping surface that favors rapid run-off and erosion. The compostion of the parent materials also have influenced greatly the character of the soils.

Three kinds of unconsolidated deposits—loess, glacial drift, and alluvium—constitute the parent materials from which the soils are derived. The parent materials differ in composition and method of accumulation.

Loess of Peorian age is the parent material of the soils on the flat or slightly undulating upland. The areas covered by loess are comparatively narrow and winding, and they represent remnants of a once extensive plain, which have escaped in the general denudation of the uplands. Loess in its unweathered condition has a comparatively uniform texture, in general consisting of more than 60 percent of silt, in places more than 70 percent. The clay content ranges from 20 to 25 percent. The remainder of the material consists mainly of very fine sand and fine sand, with small quantities of medium sand and coarse sand. Presumably, the loess was calcareous when deposited, but in southern Iowa it has been leached of carbonates at all depths, to the underlying drift. The loess capping on the broad divides is coextensive on the soil map with the areas of Grundy and Edina soils and on the narrow ridges with the Weller soils.

Under the Peorian loess is a material called by geologists, Loveland loess. It has a thickness of 2 to 3 feet, and its presence is marked in roadside cuts by a nearly white eroded terrace. This material is silty and is slightly heavier in texture than the younger loess above, but, owing to its narrow outcrop on hillsides, it has not produced soils of sufficient area to indicate on the soil map.

The glacial drift deposits which underlie the silty deposits may be referred to as the Kansan stage of glaciation. Kansan drift consists of boulder clay or till, with pockets and lenses of sand or gravel. When deposited, the mass of drift contained a large proportion of limestone and finely divided calcareous material. It is thought that the recession of the ice sheet left the greater part of the Kansan drift deposit spread out as a smooth plain. The agencies of weathering immediately began to oxidize and leach the material so that now three zones developed in the drift are exposed in Decatur County. The upper part is the thoroughly leached and oxidized heavy clay, to which the name gumbotil has been given. Its maximum thickness is 11 feet, but, in many places, it was partly or entirely removed by erosion before deposition of the loess. This material, which is little changed by soil-forming processes, outcrops in comparatively narrow bands on the hillsides as a tough plastic clay, locally known as "push soil". Fortunately for the farmer, silty material from the higher lying loess soils slumps down and covers the heavy clay over most of these outcrops. The next lower zone is grayish yellow, grayish brown, or buff. The upper part is reddish brown or brown, and this coloration is more pronounced in places where the gumbotil is absent. This zone is oxidized and leached of its carbonates. The third zone is oxidized but unleached and consists of grayish-yellow or gray till which generally is lighter in color than the material in the zone above. It is calcareous throughout and contains seams and concretions of lime.

A typical exposure of the loess and the three zones of the Kansan drift is described by Kay and Apfel as observed on the southern part of the line between secs. 4 and 5, Center Township (T. 69 N., R. 25 W.).[10]

In this section the Loveland loess and a part of the gumbotil are missing.

	Thickness (feet)
Loess, leached, buff	3
Gumbotil, Kansan	2
Till, Kansan, oxidized and leached; upper part grading distinctly into gumbotil	5½
Till, Kansan, oxidized and unleached; many concretions exposed	4

These three zones of Kansan drift, differing widely in composition, are exposed on the slopes, and on them are developed soils of different characteristics. As the bands of soil derived from them are narrow, especially in places where the slopes are steep, it was not prac-

[10] KAY, GEORGE F., and APFEL, EARL T. THE PRE-ILLINOIAN PLEISTOCENE GEOLOGY OF IOWA. Iowa Geol. Survey (1928) 34: 1–304, illus. 1929.

tical to show them separately on a soil map of the scale used in this survey. They, therefore, have been included with areas of Shelby loam and Lindley loam.

Recently deposited alluvium is distributed along nearly all the streams. It consists mainly of material that has been washed from the dark-colored upland soils farther upstream and deposited during periods of overflow. The soils developed over this material are classed with the Wabash series.

The soils of this county have developed from the various parent materials under the influence of a midcontinental climate characterized by high summer and moderate to low winter temperatures. The mean annual precipitation for the county is about 34 inches, most of which falls during the warmer months. The climatic and topographic features have combined to favor a heavy growth of tall prairie grasses on the smooth upland areas. The soil profiles developed in the nearly level areas depend largely on the conditions of soil moisture. In such areas, drainage is restricted on the surface, internally, or, in many places, both; therefore, the soil cannot be considered normally developed. The soils of the level prairies have dark-colored surface layers, owing to the high content of organic matter accumulated through the decay of the grass roots. Drainage conditions greatly influenced the accumulation of organic material. Level areas with slow drainage have the thick dark A horizons of the Grundy soils. Still more deficient drainage may result in the development of a gray subsurface layer, as in the Edina soils.

Grundy silt loam, as examined in the SE¼ sec. 15, T. 67 N., R. 27 W., has a very dark grayish-brown or black silt loam surface horizon to a depth of 18 inches. The material in the first 6 inches of this horizon is tightly bound with a network of grass roots and is rich in partly decayed grass roots and organic matter. The material is of very fine silty texture and is structureless or very finely granular. Beginning at a depth of 6 inches and continuing downward through the remainder of the dark-colored surface horizon, the material is of distinctly granular structure and falls apart very readily in small granular particles of fairly uniform size. The soil particles are soft and easily crushed, and when crushed the material has a slightly browner color. There is a sprinkling of very fine almost white material, but the quantity is not sufficient to affect greatly the color of the crushed material. A brown silty clay horizon lies beneath the dark-colored surface horizon. The material is compact in position and breaks apart into firm particles of irregular sizes with sharp edges and corners. When wet, it is very plastic and sticky. The pulverized material is rusty brown, owing to the yellow and rusty-brown centers of the soil particles. Below a depth of 24 inches, the material becomes heavier in texture and of less definite structure. It is underlain, at a depth of 60 inches, by grayish-yellow or blue soft structureless silty clay loam which is similar to the parent loess.

Areas of Grundy silt loam mapped on smooth narrow ridges or gentle slopes are differentiated from the typical soil on the map as a slope phase.

In level or slightly depressed areas on the prairies, conditions of excessive moisture have resulted in the development of a soil profile differing from that of the Grundy soils. The dark layer is similar in appearance but is thicker in most places and is slightly heavier textured in some places. Beneath the dark surface horizon is a podzolized layer of gray or nearly white laminated floury silt loam. The other horizons are almost identical with those of the Grundy soils. A soil similar in its profile development occurs on flat terraces. These dark-colored soils underlain by gray layers are classified as Edina silt loam on the loess-covered uplands and as Chariton silt loam on the terraces.

On the more gentle slopes, the Shelby soils have developed over glacial drift. Although these soils are modified to some extent by erosion, their profile development more nearly approaches that of the normal soil of the region. They are characterized by dark grayish-brown surface horizons underlain by brown well-oxidized horizons. The solum in most places is underlain at rather slight depths by the oxidized and leached zone of the Kansan till.

Lindley loam and Weller silt loam are light-colored soils developed under the influence of a tree vegetation. The Weller soil occurs on narrow nearly level ridges, but the Lindley soil occurs on steep slopes. Weller silt loam is developed from loess. It differs from Grundy silt loam, among other respects, in having a light-colored surface soil. Although a tough heavy B horizon is developed, this differs from that of the Grundy soil in color and structure. The Lindley soil is developed on the steeper slopes, from Kansan till similar to the parent material of the Shelby soils. Development, however, has taken place under the influence of a forest growth, consisting of oaks, elm, ash, maple, and other hardwood trees, together with a thick undergrowth of hazel, buckbrush, and other shrubs. Owing to the relief, Lindley loam has not attained normal thickness over the glacial drift. The surface soil is grayish-brown or gray loam, ranging from 3 to 8 inches in thickness, and it is underlain by grayish-brown or yellowish-brown clay loam or clay. This, in turn, is underlain by glacial drift. In most places, the solum and the parent drift are thoroughly leached, but, in small areas, the unleached zone of the Kansan drift may lie immediately below the soil layers.

Table 7 gives the results of mechanical analyses of Weller silt loam.

TABLE 7.—*Mechanical analyses of Weller silt loam in Decatur County, Iowa*

Sample No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
339205	Surface soil, 0 to 4 inches	0	0.1	0.1	0.3	0.6	69.0	29.8
339206	Subsurface soil, 4 to 15 inches	.1	.4	.5	1.3	1.6	51.7	44.3
339207	Subsoil, 15 to 30 inches	0	.1	.1	.4	.4	47.2	51.8
339208	Subsoil, 30 to 48 inches	0	.1	0	.4	.7	53.6	45.2

SUMMARY

Decatur County, situated in the south-central part of Iowa, has an area of 533 square miles, or 341,120 acres. Leon, the county seat, is about 60 miles south of Des Moines.

The climate is characterized by short hot summers and rather cold winters. The mean annual temperature is 49.6° F. The average frost-free season covers a period of 163 days. The mean annual precipitation of 34.15 inches is well distributed throughout the growing season.

Decatur County is one of a group of counties in southern Iowa which are confronted with conditions of agriculture different from those prevailing in other parts of the State. A comparatively small area of smooth productive soils, well suited to the production of corn and small grains, is interspersed with large areas of hilly land which can be used only as pasture. The problem of the farmers has been to utilize the land as a whole to the best advantage. Dairying has not been practiced generally, as the smooth land was not of sufficient area to produce the necessary protein feeds for this enterprise, and the pasture land could not be depended on during late summer. The type of farming now practiced seems to meet the situation as well as possible. The production of beef cattle on the farm is the most common pursuit, and it is one that makes the best use of all kinds of land.

On the basis of land use, the soils may be placed in two general groups: (1) Soils used mainly for the production of cultivated crops and (2) soils used mainly for pasture. With the first group are included the soils of the smooth interstream divides and of the better drained terraces and stream bottoms. These soils have dark-colored surface layers indicating the presence of large quantities of black organic matter. Their subsoils vary in character, according to drainage conditions and the composition of the underlying parent materials. None of these soils is permanently poorly drained, and all are mellow and easily tilled.

Grundy silt loam has slow drainage, but it is the better drained soil of the flat uplands. The surface soil is thick, dark colored, and silty, and the subsoil is dark distinctly granular heavy silt loam. It is a productive soil and produces well under a wide range of moisture conditions.

Edina silt loam differs from Grundy silt loam in having a gray or nearly white laminated subsurface layer underlain by a heavy compact layer of silty clay or clay. It is less well drained, more acid, and slightly less productive than the Grundy soil. Chariton silt loam is similar to Edina silt loam, but it occurs on terraces.

Shelby loam is characterized by a rather wide range in degree of slope. Good crops of corn and oats are produced on the smoother areas. A steep phase of this soil, occurring on the more dissected stream valley slopes, is used only for grazing. The Wabash and the Bremer soils are developed on first bottoms and terraces, respectively. Their surface soils are nearly black, and their subsoils are gray or mottled gray and yellow. They are highly productive in normal seasons if well drained. Weller silt loam, formed from loess, and Lindley loam, formed from glacial drift, are light-colored soils which were covered with forest when the county was first settled. Weller silt loam occurs only on narrow ridges and is used for cultivated crops to some extent. Lindley loam, on the slopes, is used only for pasture.

Limestone outcrops, covered in a few places with thin dark-colored soil, are mapped as rough stony land and have no agricultural value except as a source of lime.

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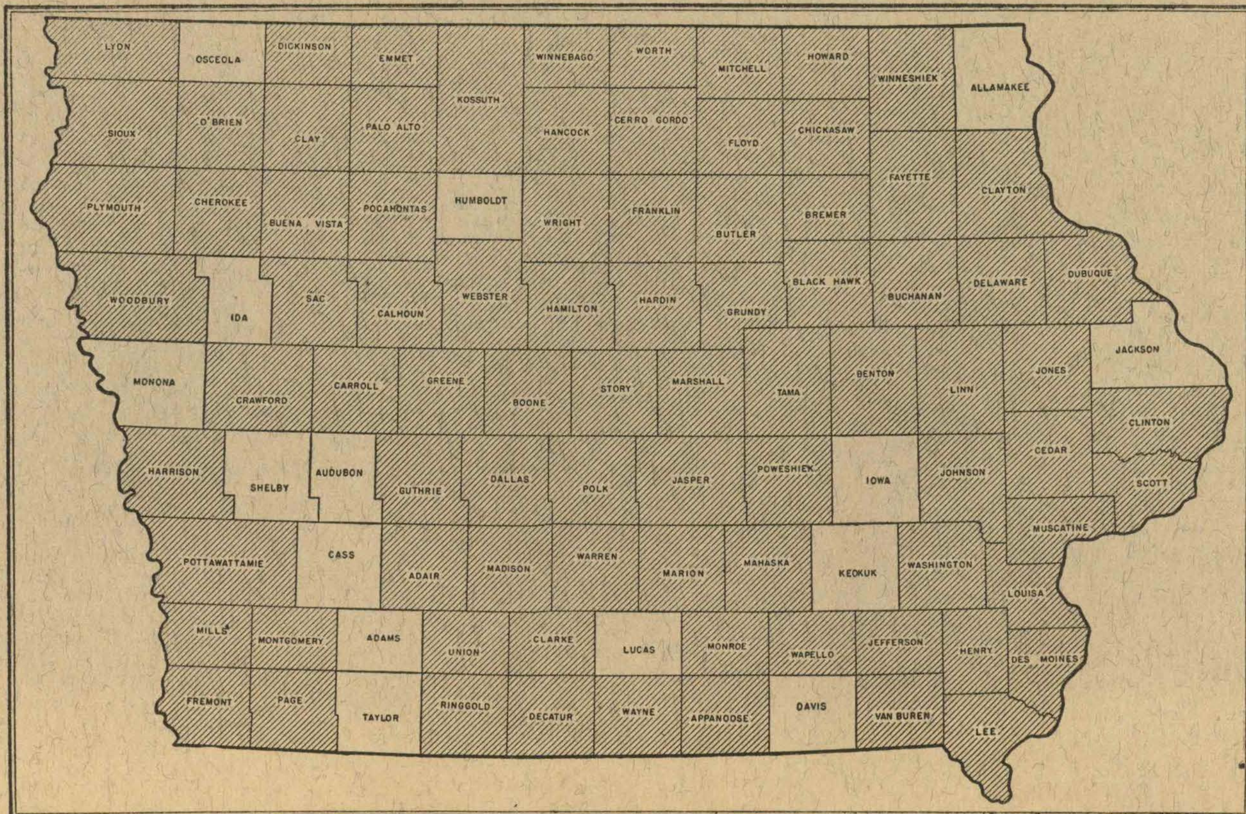

Areas surveyed in Iowa shown by shading.