

Bulletin 261

# The Crop System in Iowa County

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BY J. A. HOPKINS, JR.

This bulletin, the first of a series of four, summarizes a study of the organization and management of farms in Iowa County, which was made in an effort to discover systems which will yield larger farm incomes\*. The central questions in such a study have to do with the use of the farmer's resources, of which land and labor are the most important.

The farm operator will want to select the crop enterprises which will give him the greatest returns from his land over a period of years. In selecting the crops to utilize the land it will be necessary to consider the type of the soil, the topography, the climatic conditions, the location of the area with regard to markets and transportation facilities, the requirements of livestock enterprises for feeds and the demands of other crops for labor at different seasons of the year.

## SOURCE OF DATA

The data which serve as a basis for this publication were obtained by detailed records kept on 28 Iowa County farms during the three years, 1925 to 1927. The study was carried on by the Agricultural Economics Section of the Iowa Agricultural Experiment Station and the Bureau of Agricultural Economics of the United States Department of Agriculture. Twenty-two records were obtained in 1925 and 26, and 18 in 1927. Additional data on the acreages and yields of crops for 1928 were obtained by visiting the farms in that year.

Complete records were kept on the farms of the financial transactions of the business, the disposition of each crop produced, and the quantities of each feed consumed by each class of livestock. Account was kept of all transfers of materials, such as straw or stover, from one enterprise to another and of the use of man and horse labor by each enterprise. These records were checked up by a field man who spent his entire time at this work. They were then sent in to the office at Iowa State College, where they were posted and summarized.

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\*Because of the volume of data obtained it was decided to divide its publication into four separate publications. This is the first of the series, and deals with the crop system. A second takes up the requirements and the performance of the livestock enterprises as found in Iowa County and suggests the livestock systems which seem adapted to that section. The third examines the place and functions of horses and tractors as sources of power on the farms, and the types of farm equipment thru which this power may be applied most effectively. A fourth bulletin proposed will deal with the problem of combining livestock and crop systems into well rounded and profitable farm organizations.

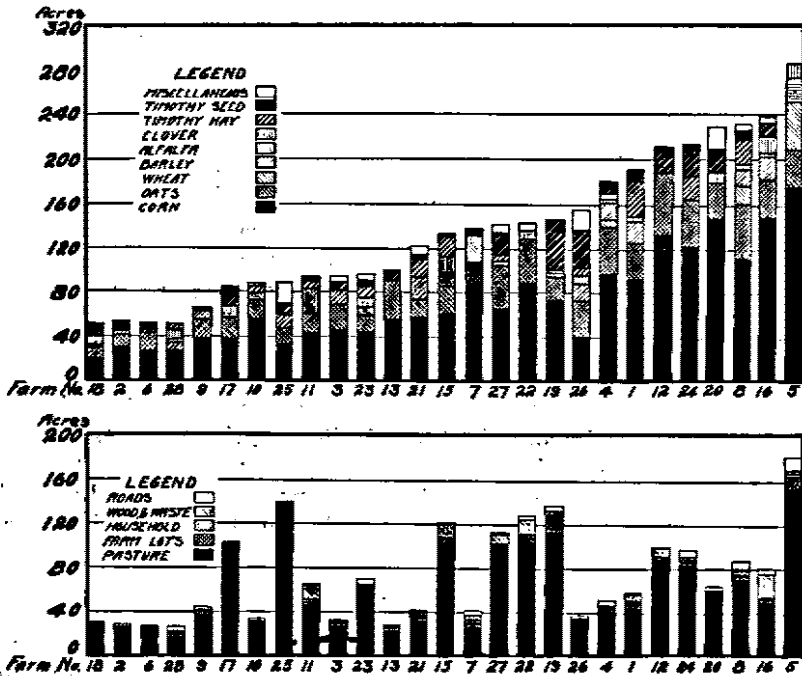


Fig. 1. Distribution of land on cost route farms.

### The Iowa County Crop System

The farmer's problem in planning his crop system is to get from his land the largest net returns either of salable crops or of feed crops needed by the livestock. At the same time, the system should conserve the soil fertility and obtain the greatest production over a series of years.

Various crops, such as oats and barley, compete for labor or equipment at the same time. From these the farmer must select that crop which promises to be most profitable. In Iowa corn is generally the most profitable, as shown in table I. But it is not desirable to plant the entire acreage to corn. It is necessary to plant a certain acreage of oats or barley in order to use the labor when it is not needed by the corn, to provide needed feeds for complementary livestock enterprises, or to conserve soil fertility by permitting the seeding down of forage and soil-building crops.

According to the United States agricultural census of 1925, the farms of Iowa County averaged 160.5 acres, of which approximately 60 percent was in crops. The farms studied were somewhat larger, averaging 198 acres for the three years; of this, 129 acres, or about 65 percent, were in crops. Taking the county as a whole, corn accounted for 48 percent of the crop land in

TABLE I. YIELD AND VALUE OF PRINCIPAL IOWA COUNTY CROPS,  
1923-1927

	1923	1924	1925	1926	1927	Ave. 1923-27
<b>Corn</b>						
Yield, bu. ....	41	28.5	50.6	45.1	37	40.4
Price, Dec. 1 .....	.57	1.03	.55	.53	.74	.68
Value per acre	23.37	29.36	27.83	23.90	27.38	27.47
<b>Oats</b>						
Yield, bu. ....	34	40	41	34	36	37.0
Price, Sept. 1 .....	.32	.40	.33	.30	.40	.35
Value per acre	10.88	16.00	13.53	10.20	14.40	12.95
<b>Barley</b>						
Yield, bu. ....	26	27	28	31	35	29.6
Price, Sept. 1 .....	.50	.66	.64	.54	.66	.60
Value per acre	13.00	17.82	17.92	16.74	23.10	17.76
<b>Wheat</b>						
Yield, bu. ....	22	16	25	23	19	21.0
Price, Sept. 1 .....	.87	1.10	1.39	1.10	1.21	1.14
Value per acre	19.14	17.60	34.75	25.30	22.99	23.94
<b>Timothy seed, lb.</b>						
Yield, lbs. ....	211	189	158	180	180	184
Price, Sept. 1 .....	6.25	6.00	6.40	4.86	3.10	5.32
Value per acre	13.19	11.34	10.11	8.75	5.89	9.79

1925. On the cost route farms 67 acres, or 51 percent, of the crop land were in corn. Figure 1 and table II show that while the proportion of the land in corn differed considerably from farm to farm, the proportion did not vary greatly between different sizes of farms.

The next most important crop after corn is oats, followed by wheat and barley. Oats averaged 32 acres per farm on the cost route in 1925, but decreased to 22 acres in 1927. Wheat and barley largely took the place of oats on this land, increasing from 1 acre of wheat and 3.3 acres of barley in 1925 to 6.1 acres of wheat and 6.4 acres of barley per farm in 1927.

#### TYPES OF LAND AND RELATIONSHIP TO CROPPING SYSTEMS

The use to which the land on a particular farm is put depends largely on the type of its soil and topography. Iowa County is typical of the Mississippi Loess section of east-central Iowa,

TABLE II. USE OF LAND ON IOWA COUNTY COST ROUTE FARMS—BY  
SIZE GROUPS

Crop acres	40-79	80-119	120-159	160-199	200-239	240-279
Number of farms	5	9	5	2	5	1
Acres operated	86.7	165.3	237.3	239.5	312.2	323.2
All crops, acres	55.4	94.1	145.0	135.7	224.6	242.3
Corn	29.0	47.9	70.6	93.7	127.9	148.9
Oats	12.9	31.6	30.6	37.7	45.8	35.2
Wheat	.....	1.5	6.8	5.9	4.0	.....
Barley	2.9	2.7	3.1	16.8	4.2	20.7
Alfalfa	1.0	.1	.....	.....	.....	3.7
Clover & timothy	4.8	10.0	5.5	21.8	14.9	15.4
Timothy seed	4.7	5.7	32.1	11.8	21.4	13.2
Misc. crops	.1	4.6	6.3	.1	6.5	5.3
Pasture	25.0	61.6	75.0	40.4	73.8	49.4
Waste, lot & misc.	6.3	9.7	17.3	15.3	13.8	31.5
% farm land in corn	33.4	29.0	29.8	29.1	41.0	46.1
% farm land in small grains	18.2	15.6	17.3	24.4	17.3	17.3

TABLE III. USE OF LAND—AVERAGE FOR THREE YEARS

	1925-27	1925	1926	1927
Acres operated .....	197.8	201.8	197.1	193.6
All crops, acres: .....	129.4	133.1	130.1	123.9
Corn .....	67.4	73.1	68.5	59.0
Oats .....	27.7	31.6	28.5	21.8
Wheat .....	3.5	.9	4.0	6.1
Barley .....	5.1	3.3	5.8	6.4
Alfalfa .....	.3	.2	.4	.3
Clover & timothy .....	10.1	12.2	6.8	12.1
Timothy seed .....	11.3	10.3	9.0	15.6
Misc. crops .....	4.0	1.4	7.7	2.7
Pasture .....	55.5	55.5	54.0	57.3
Waste, lots & misc. ....	12.8	13.3	12.8	12.4
Percentage farm land in:				
Corn .....	34.1	36.2	34.8	30.5
Oats .....	14.0	15.7	14.5	11.3
Wheat .....	1.8	.4	2.0	3.2
Barley .....	2.6	1.6	2.9	3.3
Clover and timothy .....	5.1	6.0	3.2	6.2

which extends from Marshall and Jasper counties eastward to Clinton and Louisa counties along the Mississippi River. The topography varies from gently to strongly rolling. Many of the farms contain some rough land which cannot well be kept in tilled crops. The rough land is left in pasture and used, generally, by the cattle enterprise. Figure 2 shows a typical permanent pasture, and fig. 3 gives a good idea of some of the rotation pasture.

The several more or less distinct land types found on the cost route farms will be divided in this study into five types: the bottomland, the level upland, gently rolling upland, rolling and rough.

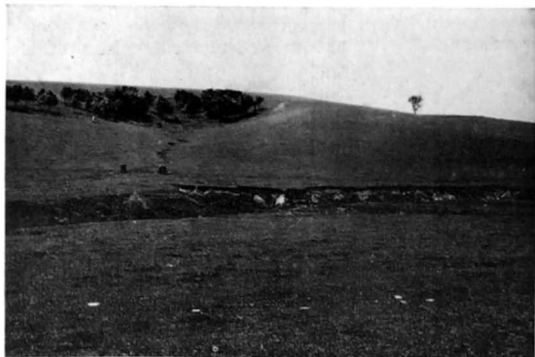


Fig. 2. A permanent pasture in Iowa County.



Fig. 8. Summer feeding New Mexico steers on an Iowa County rotation pasture.

About one-tenth of the land was bottomland of the Wabash silt loam type along the larger streams. Many of the fields are badly cut up by the streams, or are subject to floods. Consequently nearly half are kept in permanent pasture. About one-third of the land was in corn, 12 percent in small grains and 6 or 7 percent in rotation pasture.

It is believed that this bottomland can stand continuous cropping better than most other types. Table IV shows that about 60 percent of the land cropped is in corn, 20 percent in small grains and about 20 percent in hay or rotation pasture. This corresponds to a five-year rotation with three years of corn. But some of the land was kept in corn for four years and some for only two.

On the Wabash loam the corn yield runs high in years of normal rainfall, but is seriously reduced in wet years as shown in table VI. Small grains also yield well, but are more likely to lodge than on most of the upland soils. If the dry and wet years are taken together, as in table V, the average yield over several

TABLE IV. DISTRIBUTION OF LAND BY TYPES OF SOIL AND TOPOGRAPHY

Percentage of total land acreage						
	Corn	Small grain	Hay	Timothy seed	Pasture	Alfalfa
Bottomland	34	12	2	....	52	....
Level upland	46	27	7	11	7	2
Slightly rolling	38	22	9	4	24	4
Rolling	40	22	12	3	23	....
Rough	22	9	5	3	60	....

Percentage of land in crops						
	Corn	Small grain	Hay	Timothy seed	Rotation pasture	Alfalfa
Bottomland	60	22	5	....	13	....
Level upland	46	28	7	11	6	2
Slightly rolling	41	22	10	4	19	4
Rolling	43	23	12	3	19	....
Rough	37	15	9	5	32	....

TABLE V. CROP YIELDS FROM VARIOUS TYPES OF SOIL AND TOPOGRAPHY—FOUR YEAR AVERAGE, 1925-1928.

	Corn	Oats	Wheat	Barley	Hay	Timothy seed
	bu.	bu.	bu.	bu.	tons	lbs.
Bottomland	53.0	48.7	27.0	24.0	1.1	.....
Level upland	53.2	45.0	18.7	34.3	1.5	230
Slightly rolling	59.5	46.8	25.4	29.1	1.4	228
Rolling	60.3	49.1	20.9	37.8	1.0	219
Rough	53.7	37.4	.....	28.1	.9	237

years on this type, especially on fields not well drained, is likely to run lower than on the upland soils.

About one-tenth of the land was level upland of the Muscatine silt loam type. This soil is highly retentive of moisture. For the entire period from 1925-1928 the yields of the various crops on the Muscatine silt loam averaged about the same as on the bottoms, except from wheat and barley, which occurred in acreages too small to give a representative yield.

On the level upland there was a much smaller percentage of land in pasture than on the bottomland, and a larger proportion was in some sort of a cropping system. Forty-six percent was in corn, 28 percent in small grains, 7 percent in hay and 11 percent in timothy for seed. This corresponds to a four-year rotation with two years of corn on some of the farms and to a five-year rotation with two years of corn on the others.

About seven-tenths of the total land is of the Tama silt loam. In studying the influence of topography on cropping systems and yields this land was divided into two types, the gently rolling and the rolling upland. The gently rolling comprised four-tenths, and the more strongly rolling about three-tenths of all the land.

Tables V and VI show that these two classes contain the most highly productive land of the area if we average together wet years and dry. As an average of the four years the better drained Tama silt loam soils yielded about 6 bushels more than the two level types of bottomland and upland. With small grains and hay there was little noticeable difference in yields.

The crop acreages on the Tama silt loam correspond essentially to a five-year rotation with two years of corn, one of small grain, one of hay and one of pasture. Slightly over 40 percent of the land was in corn, 22 or 23 percent in small grains, 10 or 12 percent in hay and about 19 percent in rotation pasture, besides 4 or 5 percent in permanent pasture.

About one-tenth of the land was classified as rough or sharply rolling. This was mostly of the Clinton silt loam type. Forty percent of this land was kept in permanent pasture. Of the land included in the crop system 37 percent was in corn, 15 per-



cent in small grains, 9 percent in hay, 5 percent in timothy for seed and 32 percent in rotation pasture.

The variation in the cropping systems found in 21 rough fields on nine farms reflected the difficulty of working them and in getting them back into a good stand of grass after they were plowed up. Twelve of the fields were in corn for two years out of five. Eight were in corn for only one year. Most were in small grains for one year and a crop of hay was cut from about half the fields before they were turned back into pasture. On about a quarter of the fields the grass failed to give a good stand and the field was put back in crops after one year.

#### IOWA COUNTY CROP ROTATIONS

Many rotations or sequences of crops were found. Some farms had more or less regular rotations. Several farms had more than one rotation. One had seven distinct sequences of crops in different fields. However, most of the cropping systems may be fitted into four fairly distinct rotations. These are determined partly by the type of soil and topography, partly by the relative value of the different crops, but with the exercise of considerable choice by the farmer.

The most intensive common system of cropping was found on the bottomland. A large part of this land was kept in corn for three successive years, followed by one year of small grain and then one year of hay or pasture. This system was also followed on about a quarter of the upland.

Most of the level upland was kept in corn for two years, followed by one year of small grain, one year of hay and one of pasture. This was the most common of all the rotations and was found on all the types of land. It keeps 40 percent of the land in corn, in contrast with 60 percent in the intensive bottomland rotation.

Another rotation, found less often but on all the types of soil, consisted of two years in corn, one in small grain and one in hay or pasture. This system keeps 50 percent in corn and, consequently, is more highly profitable than the second rotation discussed.

The fourth rotation was found chiefly on the rough land, which it was desired to keep in pasture a large part of the time. It consists of two years of corn, one of small grain and three of hay and pasture.

Of the crops mentioned, corn fills the central place in the systems. It is the crop of highest value per acre and provides the main source of feed. Oats and barley are used, for the most part, to supplement corn as a feed. The wheat, however, provides a crop primarily for sale and, thereby, differs in its

chief function from the other crops, which lead to a cash income only indirectly thru the livestock. Even on the farms which produce only livestock for sale, the small grains form a necessary part of the rotation since they serve as a nurse crop for the hay and pasture.

### The Corn Crop

Corn is the main crop of Iowa County, because of the large production per acre, both in quantity of feed and value. The average yields for the county for the years 1925 to 1927 were 51, 45 and 37 bushels. The yields on the east route farms were 63.3, 55.8 and 50.7 bushels in the same years.

Table I shows that corn is a crop of high value as well as of high productivity in physical terms. With a yield of 40.4 bushels and an average price for the five years (1923 to 1927) of 68 cents, the corn crop was worth on an average \$27.47 per acre. Oats, yielding 37 bushels, were worth \$12.95 per acre and barley, with an average yield of 29.6 bushels, was worth \$17.76.

It was found that the different soil and topographic types varied in their yields from year to year. The yield on the bottomland was reduced by flooding in 1927 and 1928. Table VI shows that there was much more uniformity in yield on the rolling upland than the bottomland or level upland.

Altho corn is the crop which ordinarily yields the greatest value per acre, the number of years a field can profitably be kept in this crop is limited. It is commonly believed that continuous cropping results in reduced yields. An attempt was made to study this influence from the records, with the results shown in table VII. In the first column of this table are shown the average yields per acre on fields in corn one, two, three or four years. It will be seen that the second year corn yielded about 2 bushels per acre less than the first year. The fields in corn for a third year yielded about 5 bushels less than in the second. In the fourth year the yield was reduced by another 10 bushels.

However, the comparison of the yields on fields in corn one, two or more years does not give an altogether accurate comparison because different fields were included in different groups. Consequently it was decided to compare the yields thruout the

TABLE VI. VARIATIONS IN CORN YIELDS ON DIFFERENT TOPOGRAPHY TYPES

Year	Bottom-land	Level upland	Slightly rolling	Rolling	Rough
	bu.	bu.	bu.	bu.	bu.
1925	66.8	62.4	61.4	63.7	58.5
1926	57.3	54.4	58.7	56.3	49.5
1927	46.7	43.4	55.4	55.2	55.1
1928	40.5	52.6	64.3	64.7	49.8

TABLE VII. DECLINE IN CORN YIELD FROM CONTINUOUS CROPPING

	Av. yield by years	Fields in corn three years		Fields in corn four years	
		Acres	Variation from av. yield of year	Acres	Variation from av. yield of year
First year in corn	56.6 bu.	865	+5.3 bu.	90	+7.2 bu.
Second year	55.0	865	+1.5	90	+ .1
Third year	50.2	846	-4.3	81	-1.3
Fourth year	40.1	.....	....	81	-10.0

period on just those fields which were in corn three or four years. The third and fifth columns in table VII show how the yield in these fields compared with the average yield for the years in question.

On the fields in corn for three years, the yield in the first year was 5.3 bushels above the average on all farms for the year. In the second year it was 1.5 bushels above the average, and in the third year it was 4.3 bushels below the average. This makes a decline of 9.6 bushels in the three years. In the fields in corn for four years, the yield declined 8.5 bushels in the first three years, and another 8.7 bushels in the fourth, making a decline of 17 bushels in four years.

Of course these data do not warrant sweeping conclusions because of the small number of fields included. However, the results are remarkably consistent for all the different topographic types. The same trend is clearly evident in nearly every case. Since this is true, it seems a very doubtful policy to count on putting corn in the rotation for more than two consecutive years. According to these figures, a five-year rotation with three years of corn would produce only about 10 percent more grain than a four-year rotation with two years of corn. Besides this, there would be a smaller forage and pasture production.

#### REQUIREMENTS IN PRODUCTION

The average amounts of man labor, horse work and the other cost factors used per acre in producing corn on the cost route farms are shown in table VIII. Since the yields on these farms are somewhat above the average, it is thought these figures may serve as reasonably good guides of performance for other farmers under equally favorable conditions.

Including the fall plowing, an average of 10.9 hours of labor per acre was used in growing the corn up to the time it was picked. On the bulk of the farms this was between 8 and 12 hours per acre. In picking the corn an average of 7.8 hours was used and the bulk of the farms fell between 5 and 8.5 hours per acre.

The elements of the costs of producing the corn other than the labor, horse labor and materials can be expressed in terms of value only. For the three years of the study the man labor averaged \$5.46, which includes \$3.15 in growing, if we include the fall plowing, and \$2.31 in picking the crop. The horse labor was valued at \$3.46 in growing the crop and 2.00 in picking. The depreciation, interest and upkeep of the equipment amounted to \$2.53. An hour of tractor use cost 98 cents, and miscellaneous expenses amounted to \$1.72. These expenses together amounted to \$19.54, which may be called the total operating cost per acre.

The operating expense is one of the most significant indexes of efficiency that the records yield, since it represents the combination of all the expense factors together. Since these expense factors are largely controlled by the farmer, the total operating expense shows how successful he has been in operating economically. The operating expense ranged from \$7.66 to \$34.51 per acre, but over two-thirds were between \$17.00 and \$25.00. The operating expense is closely associated with the cost per bushel

TABLE VIII. CORN—PHYSICAL AND FINANCIAL COSTS PER ACRE

	Average	1925	1926	1927	Range—1927	
	1925-27				Low	High
Cost per bu. ....	\$ .464	.409	.490	.525	.427	.607
<b>Physical costs</b>						
growing						
Labor hours .....	10.9	11.2	11.1	10.1	7.5	12.1
Horse hours .....	25.3	26.9	24.6	24.1	17.0	33.0
Tractor hours .....	1.0	1.1	1.0	.9	.....	1.7
Manure tons .....	.6	.4	.7	.6	.1	1.4
Picking						
Man hours .....	7.8	8.8	7.4	6.7	4.9	9.5
Horse hours .....	14.6	16.1	14.8	13.2	9.5	17.1
<b>Financial costs</b>						
Growing						
Seed cost .....	\$ .49	.47	.54	.46	.32	.51
Labor cost .....	\$ 3.15	3.25	3.07	2.82	2.05	3.77
Horse cost .....	\$ 3.46	3.77	3.47	3.25	1.75	5.13
Equipment charge .....	\$ 1.53	1.74	1.67	1.39	.90	2.35
Tractor cost .....	\$ .93	.90	1.00	1.06	.....	1.79
Manure cost .....	\$ 2.56	.92	3.29	3.84	.29	6.12
Misc. costs .....	\$ 1.37	1.18	1.35	1.45	.57	2.59
Total cost growing	\$13.55	12.23	14.47	14.18	9.71	17.37
Total acres raised	71.1	76.1	70.3	65.9	32.9	99.4
Picking						
Labor cost .....	\$ 2.31	2.77	2.08	1.96	1.43	2.85
Horse cost .....	\$ 2.00	2.20	2.07	1.83	1.07	2.90
Equipment charge .....	\$ .94	.98	1.00	.80	.48	1.52
Misc. costs .....	\$ .73	.70	.65	.68	.21	1.68
Total cost picking	\$ 5.99	6.63	5.81	5.07	3.75	8.80
Total operating cost	\$19.54	18.86	20.28	19.25	14.40	26.60
Building charge .....	\$ .74	.83	.68	.67	.27	1.16
Land charge .....	\$ 7.17	6.92	7.14	7.55	5.40	10.15
Gross cost .....	\$27.45	26.61	28.10	27.47	20.16	36.43
Stalk credit .....	\$ .86	.92	.74	.91	.60	1.25
Net cost .....	\$26.59	25.69	27.36	26.56	19.17	35.11
Acres picked .....	52.3	56.9	50.8	48.7	15.0	86.0
Yield bu. per acre	57.3	62.8	55.8	50.7	46.3	64.3

of corn. Before finding the cost per bushel it is necessary to add the fixed charges, which consisted of the charge for the use of the land, averaging \$7.17, and the charge for the use of buildings, which amounted to 74 cents. This gives the total expense from which the credits for stover or stalk pasture are deducted to find the net cost of the grain.

The cost per bushel is to be considered, not as the exact and absolute cost, but merely as an index for comparison of different farms. Cost per bushel combines the operating expense with the fixed charges, as for land and building use, and is also influenced by the yield.

During the three years of the study the cost per bushel varied from 27.6 to 93.4 cents. The averages were 40.6 cents for 1925, 49.6 cents for 1926 and 52.5 cents for 1927. The greater part of this variation may be attributed to differences in the yields, which averaged 63.3 bu. in 1925, 55.8 in 1926 and 50.7 in 1927. These yields were 10 to 13 bushels higher than for the county as a whole, and are some indication of the superiority of the cost route farms. On about two-thirds of the farms the cost per bushel was within 5 cents of the average for the year. But even among this group of efficient farmers, some were producing their main crop at a fourth less cost per bushel than others. Each year the corn on a few farms cost twice as much per bushel as on others.

#### HOW EFFICIENT FARMERS REDUCED THE COST

The costs were kept down in many ways on the more efficient farms. Choosing high yielding varieties and testing of the seed in order to make a good stand undoubtedly had a notable influence, but the amount of their influence can hardly be measured. In raising the crop the right choice of equipment and sizes of teams reduced the labor and expense. This usually meant the use of large teams and large capacity machines, as will be discussed more at length in another bulletin on the use of power on the crops. The two-row cultivator was found to save about three-quarters of an hour of man labor per acre each time the corn was cultivated. With three cultivations the saving in man and horse labor amounted to about 70 cents per acre. The corn pickers, on the two farms using them, did not save appreciable amounts of labor or expense. Improved types of machines may change this in the future, however.

Occasionally it was possible to save expense by avoiding unnecessary operations. In a few cases where it was free from weeds, the corn was cultivated only twice. This was sometimes made possible by attempting to kill the weeds by extra work before the crop was planted. Commonly three cultivations were

used and often even four. This involves a question of judgment in deciding on the needs of the crop and how far it will pay to go in meeting them. The same applies to the fitting of the seed-bed. However, the farms with the lowest corn cost did not always have the least labor per acre. Frequently the low cost was obtained by getting higher yields. These often seemed to come partly from doing the needed work at just the right time and in the most effective manner. In a good many cases the soil treatment, or the strain and virility of seed corn, which helped in getting the good stand, seemed the outstanding causes of the low costs. Effectiveness in the use of labor was only one of the contributing causes. Among the six consistently low cost farms during the three years, the differences in yield were responsible for slightly over half the difference in the cost of corn per bushel while the difference in the amount of labor and horse work accounted for only about one-eighth.

#### SEASONAL LABOR REQUIREMENTS ON CORN

In planning for the crop it is necessary to consider the season when its demands for labor and horse work are heaviest. Figure 4 shows the labor required to grow a 40-acre field of corn on the typical farms of the cost route. It will be observed that at two periods of the year the labor requirements are high. The first of these is from the early part of May to the middle of July. This covers the planting of the crop and its cultivation. For most of the period it runs up to almost 36 hours of man labor and between 100 and 120 hours of horse work per week. At this time a heavy use was made of the tractor for plowing and discing in addition to the horses.

The second peak period of labor requirement on corn is from the first of November to the middle of December. From 20 to 60 hours per week were spent in picking the corn. Along with this about 100 hours of horse work were used per week.

One man with a five-horse team should be able, by spending all his time on the corn crop, to plant and take care of between 50 and 60 acres of corn. The demands of the other enterprises on a well balanced farm will prevent handling much more than this, as will be seen later on when the labor requirements of a crop system will be shown. It should not be forgotten that there was a wide range in the amounts of labor used on the different farms.

Table IX shows what may be considered normal requirements for labor in the production of a 40-acre field of corn. These have been computed by taking the most common number of times that each operation was performed, and then computing

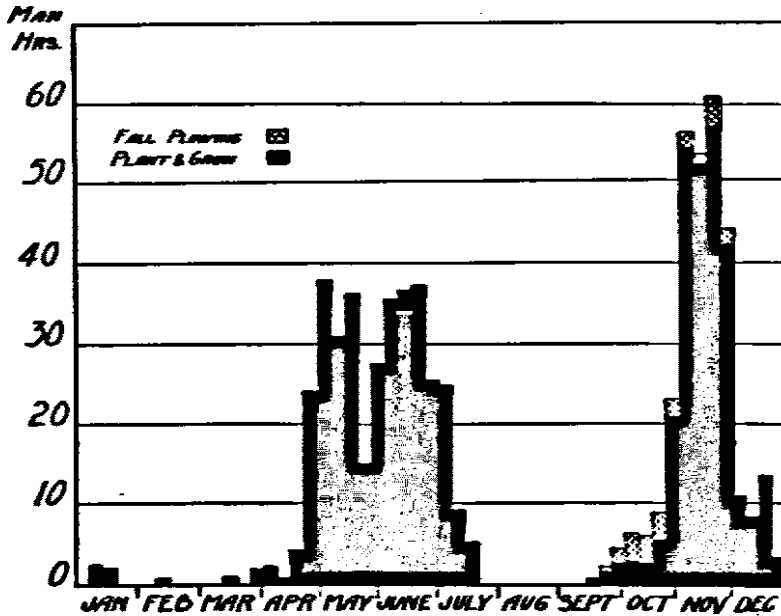


Fig. 4. Weekly labor requirements on 40 acres of corn in 1927.

for this the labor and horse work requirements with the most efficient size of team commonly used.

A five-horse team on a 28-inch plow used less labor and horse work than the other horse drawn plows. The requirements for plowing are, therefore, based on this outfit. Similarly the 9-foot disc and the 20-foot harrow, both with four-horse teams, were selected.

TABLE IX. NORMAL LABOR REQUIREMENTS ON 40 ACRES CORN

Operation	Size of machine	Teams	Times over	Total hours		Hours per acre once over	
				Man	Horse	Man	Horse
Growing							
Plow	28"	5 horses	1	80	404	2.0	10.1
Disc	9'	4 "	2	40	160	.5	2.0
Harrow	20'	4 "	2	20	80	.2	1.0
Plant	7'0"	2 "	1	32	64	.8	1.6
Harrow	20'	4 "	1	10	40	.2	1.0
Cultivate*	3'6"	2 "	3	120	360	1.5	3.0
Planting		2 "	1	296	540	7.2	13.5
Total				652	1648		

\*If a 3-row cultivator is used the requirements are 94 man hours and 288 horse hours per acre for 3 cultivations, making total labor requirements of 568 man hours and 1,276 horse hours instead of 652 and 1,648.

The most common number of times each operation was performed was twice over with the disc, twice over with the harrow before and once after planting, and three cultivations.

Counting on an eight-hour day in the field, 10 days time for one man would be required to plow the 40 acres. Five days would be needed to disc, two and a half to harrow, and three days to plant the corn. This makes 20½ days, or about three and a half weeks, to fit and plant the seedbed.

After planting, slightly over a day would be needed to harrow the 40 acres before the corn comes up. If a one-row cultivator is used, 21 days would be needed to cultivate three times. If a two-row cultivator is used, 12 days would be sufficient.

In the fall a man and team would be kept busy about 35 days, or a month and a half, picking the corn. In all, the 40 acres of corn may be considered as taking about 82 days of labor if cultivated with a one-row cultivator, or 72 days with a two-row. A tractor and three-bottom plow used instead of the four-horse 28-inch plow would reduce the requirements by about five days. A 10-foot disc pulled by a tractor may be expected to reduce the labor for discing by two days.

On a farm with a tractor and six horses it would be possible for two men, one using the tractor and the other the horses, to raise 80 acres of corn with 68 days of labor for the two men, counting the day as eight hours in the field.

Manure is applied to a part of the corn acreage only. On the cost route farms, the manure applications averaged between 2½ and 3 tons per acre for the whole corn acreage, or about 6 to 8 tons per acre on those acres covered. About two-thirds of this was applied to the crop preceding the corn, usually hay or pasture.

Manure should be applied to a greater acreage of the corn land, and it is thought that by more care in the conservation and the handling of the manure some increase in application might be possible. Since there are usually two successive years of corn in the rotation, this same amount of manure applied at the rate of about 4 tons per acre to the sod preceding the first year of corn, or else in the first year of the corn crop, would give the largest results. An application of 6 or 7 tons over the entire field, however, would be much preferable.

#### COSTS OF SILAGE

On about half the farms in each of the three years, part of the corn crop was put into the silo. For the three years this averaged 16.9 acres per farm on the farms where silage was made. The yield averaged 8.2 tons per acre for the three years, but was 9.1 tons in 1925, 7.5 tons in 1926 and 8.1 tons in 1927. The



TABLE X. COST OF SILAGE—1925 TO 1927

	Average	1925	1926	1927	Range—1927	
	1925-27				Low	High
Av. cost per ton .....	\$ 3.95	3.63	4.32	3.55	2.80	4.30
No. farms .....	29	9	11	9		
Acres .....	16.9	14.6	14.1	17.1	5.9	82.0
Tons per acre .....	8.2	9.1	7.5	8.1	6.4	9.8
Bu. corn per ton .....	6.8	6.4	6.8	5.7	5.0	6.9
Cost growing per acre.....	\$21.66	14.80	20.48	22.03	16.48	25.35
<b>Physical costs</b>						
Labor hrs. ....	15.2	17.0	16.0	12.4	10.4	16.6
Horse hrs. ....	23.8	27.4	23.0	20.4	16.4	21.8
Twine lbs. ....	3.4	3.7	2.7	3.8	2.1	4.7
<b>Financial costs</b>						
Labor cost .....	\$ 4.44	\$ 5.17	\$ 4.55	\$ 3.50	\$ 2.21	\$ 4.99
Horse cost .....	3.18	3.65	2.97	2.66	1.64	3.50
Equip. cost .....	1.34	1.58	1.26	1.00	.60	1.45
Machine charge .....	2.94	3.46	2.86	2.72	1.97	4.67
Twine cost .....	.47	.51	.39	.49	.29	.59
Misc. exp. ....	1.64	1.64	.92	1.24	.70	1.66
Use of silo .....	1.43	2.05	1.37	1.17	.64	2.42
Gross cost .....	\$37.31	37.55	35.33	34.81	26.36	39.78
Credit—corn picked up .....	4.81	4.67	3.41	5.90	3.46	7.55
Net cost of silage per acre .....	32.50	32.88	32.42	28.91	22.90	32.22
Cost of ensiling per ton.....	1.70	1.77	1.86	1.43	1.21	1.89
Cost of ensiling per acre .....	14.01	16.01	12.95	11.61		

total cost of the silage varied inversely with the yield. Table X shows that in 1925 the cost-per-ton index was \$3.63. In 1926 it was \$4.32 and in 1927 it was \$3.55, with an average for the three years of \$3.95. On about three-fifths of the farms the yield varied from 7 to 10 tons per acre and the cost per ton from \$3.25 to \$5.00.

The average cost of growing corn was about \$22.00 per acre. Where the yield was large and this \$22.00 was divided among a large number of tons per acre, the cost per ton was less than with a smaller yield. The ensiling cost averaged about \$14.00 per acre, or \$1.70 per ton, varying from \$1.14 to \$2.44 per ton. It required about 15 hours of man labor and 24 hours of horse work, costing an average of \$4.44 and \$3.18, respectively. In addition to these expenses it is necessary to count on using about 3.4 pounds of twine, costing about 50 cents. The machine cost an average of \$2.94 per acre of corn or 48 cents per ton. In addition to this there was an expense of \$1.34 for regular farm equipment used in silo filling, \$1.43 for interest and depreciation on the silo, and about \$1.64 for miscellaneous expense.

#### METHODS OF HARVESTING

Out of the 4,409 acres of corn grown on the cost route in the three years of the records, 3,245 acres were picked for grain, 440 acres were cut for silage, 331 were cut for fodder and most of the rest was hogged-down.

It is interesting to compare the labor used in these different methods of harvesting. Where the corn was picked an average

TABLE XI. FODDER SHREDDED—COSTS AND YIELDS PER ACRE

	Average	1925	1926	1927	Range—1927	
	1925-27				Low	High
No. farms .....	11	11	8	10	-----	-----
Acres .....	11.4	14.6	12.2	7.3	2.9	12.0
Cost growing per acre .....	\$19.07	17.50	19.06	22.57	16.06	24.83
Physical costs						
Twine lbs. ....	3.1	2.9	3.1	3.4	-----	4.8
Labor hrs. ....	18.2	17.1	19.4	18.8	13.8	24.4
Horse hrs. ....	18.3	17.9	18.9	18.5	13.0	27.7
Expenses of cutting and shredding						
Machine chg. ....	\$ 1.96	1.39	2.67	2.28	0	3.06
Fuel .....	.37	.20	.71	.31	0	.86
Twine cost .....	.41	.40	.41	.43	0	.58
Labor cost .....	5.16	5.06	5.11	5.48	3.83	7.21
Horse cost .....	2.66	2.69	2.54	2.74	1.85	3.99
Equipment .....	1.16	1.15	1.27	1.14	.95	1.39
Misc. exp. ....	1.84	1.70	1.49	2.60	1.07	4.63
Total cost of shredding .....	\$13.59	12.58	14.21	14.98	11.22	19.42
Yield corn, bu. ....	51.3	49.0	49.8	52.1	44.0	66.7
Fodder, tons .....	1.6	1.5	1.6	1.6	1.5	2.0

of 7.8 hours of labor and 14.6 hours of horse labor was used per acre. The total cost of picking averaged \$6.00 per acre, or 10½ cents per bushel.

Most of the labor of hogging-down corn went for the construction and moving of temporary fences. On 13 farms on which records were obtained on the hogging-down of corn in 1927, an average of one hour of labor and one-half hour of horse labor was used per acre. The expense per acre, computed in the same manner as for corn picked, averaged 36 cents and in the extreme case was about 90 cents.

When the corn was cut and shredded for fodder an average of 18.2 hours of labor and 18.3 hours of horse labor was required during the three years for the whole operation, as is given in table XI.

The labor was valued at \$5.16 and the horse labor at \$2.66. The use of the machine and engine cost an average of \$1.96 per acre. Other items brought the total expense of cutting and shredding up to \$13.59 per acre. More than twice as much labor was required as to pick the corn from the stalks. The added labor and expense, valued at \$7.50, yielded 1.6 tons of shredded fodder.

The costs and the results of the different methods of harvesting the corn crop, taking the data of the three years together, are shown in table XII.

A large saving occurred both in time and expense where the corn was harvested in the simpler ways of hogging-down or picking. But, of course, the preferable method in any particular case will depend on the purpose for which the corn is used. If the roughage is needed and the fodder seems to be worth as

TABLE XII. CORN—COMPARISON OF METHODS OF HARVESTING PER ACRE

Method	Product per acre	Hours labor	Horse hours	Total expense per acre of harvesting
Picking from stalks	57 bu. corn	7.8	14.6	\$ 6.00
Hogging-down	800 lbs. pork	1.0	.5	.36
Shredding	51 bu. and 1.6 T. fodder	18.8	18.5	14.98
Ensiling	8.2 T. silage	15.2	23.8	14.01

much as \$7.00 per ton more than the standing stalks, it becomes economical to cut the fodder and shred it. If succulent roughage in the form of silage is needed, it will probably be worth while to go to the expense of \$1.70 per ton to ensile a part of the crop.

The corn comprised nearly four-fifths of the grain raised on these farms, both in weight of grain and value. Its disposition, therefore, involves the most important questions of economy in the use of crops. As has been pointed out already, about a sixth of the crop was cut for silage or was hogged-down. From the remaining acreage an average of 3,381 bushels of corn was picked per farm, taking the three years as a whole. Of this grain the hogs consumed 1,846 bushels, or 55 percent. An average of 322 bushels, or 10 percent, was fed to the general purpose farm herd of cattle. The feeding steers got 444 bushels, or 13 percent of the crop, the horses 161 bushels, or 5 percent, and the poultry 110 bushels or 3 percent. The average amount of corn sold was 257 bushels, or 7 percent of the corn raised. At the same time an average of 518 bushels was bought, or just about twice as much as was sold.

### Oats

On the typical Iowa County farm oats is the crop next in importance to corn. The oat crop is generally planted after the second year of corn in the rotation and is used as a nurse crop for the clover and timothy which are to provide hay and possibly pasture for the following one or two years. An average of 32.8 acres of oats was raised per farm in 1925, 28.5 acres in 1926 and 21.8 acres in 1927. Compare this with the average of 76 acres of corn per farm. The yields averaged 46.1 bushels per acre in 1925, 42.7 in 1926 and 44 bushels in 1927. The average yields for the county for the same years were 41, 34 and 36 bushels. At the prices prevailing in these years, the crop was worth \$13.53 in 1925, \$10.20 in 1926 and \$14.40 in 1927. Corn in the same years averaged \$27.83, \$23.90 and \$27.38. For the five years, 1923 to 1927, the average value of the crop per acre at

prices on farms was \$12.95 for oats, \$17.76 for barley, \$23.94 for wheat and \$27.47 for corn.

#### REQUIREMENTS IN THE PRODUCTION OF OATS

Table XIII shows that the largest element of expense in producing oats was labor, of which an average of 9 hours per acre was used. The next largest item was the horse labor, of which 13.1 hours were used. The seasonal distribution of this labor is given in fig. 5. In planting a field of 20 acres of oats, for instance, it required on the cost route farms about 50 hours of labor and 150 hours of horse labor between April 10 and May 10, or roughly one-fifth of the time of one man and a team of four horses. In harvesting and threshing the crop, between the middle of July and the first part of September, about 125 hours of labor and 150 hours of horse work were used, or approximately half a month's labor for one man and five days work for a four-horse team.

After the man and horse labor, the largest item of expense was for seed of which an average of 3.7 bushels per acre was used at an expense of \$1.66. Threshing cost \$1.39 at 3 cents per bushel. The twine used amounted to about 2.6 pounds per acre and cost 35 cents. For the use of the regular farm equipment a charge of 86 cents was made.

When these various expenses are added together we have an operating expense, as explained for the corn crop, of \$10.34. The operating cost, however, varied widely as in the case of corn. On the bulk of the farms it was between \$9.00 and \$13.00. When we add to the operating expense an average of 47 cents for the buildings used by the oats and \$6.90 for the use of the

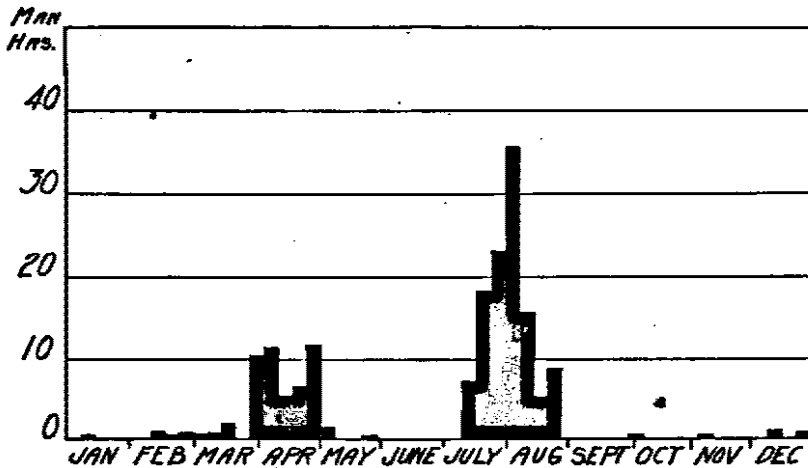


Fig. 5. Weekly distribution of labor on 20 acres of oats, 1927 averages.

TABLE XIII. OATS—PHYSICAL AND FINANCIAL COSTS PER ACRE

	Average				Range—1927	
	1925-27	1925	1926	1927	Low	High
Cost per bu. ....	\$ .349	.342	.341	.383	.256	.618
Acres .....	28.2	32.6	30.2	19.8	4.7	42.4
Yield, bu. ....	44.1	46.1	42.7	44.0	29.4	70.5
<b>Physical costs</b>						
Seed bu. ....	3.7	3.7	3.6	3.7	2.9	5.3
Twine (lbs.) .....	2.6	2.5	2.5	3.1	2.5	3.8
Man hrs. ....	9.0	9.5	9.2	8.2	6.1	12.0
Horse hrs. ....	13.1	13.4	13.1	12.8	10.4	19.3
Tractor hrs. ....	.5	.7	.4	.3	0	1.7
<b>Financial costs</b>						
Seed cost .....	\$ 1.66	1.98	1.44	1.47	1.07	2.01
Labor cost .....	2.57	2.75	2.62	2.31	1.74	3.84
Horse cost .....	1.79	1.89	1.75	1.71	1.02	3.13
Equip. chg. ....	.86	.93	.86	.72	.36	1.70
Tractor cost .....	.40	.46	.39	.29	0	2.19
Threshing .....	1.39	1.46	1.30	1.45	.88	2.10
Misc. exp. ....	1.67	1.25	1.56	2.63	.71	8.47
<b>Gross opr. cost</b> .....	<b>\$10.34</b>	<b>10.69</b>	<b>9.83</b>	<b>10.79</b>	<b>7.49</b>	<b>16.23</b>
Bldg. chg. ....	.47	.53	.39	.52	0	1.73
Land chg. ....	6.90	6.80	6.79	7.89	5.33	10.15
<b>Gross exp.</b> .....	<b>\$17.72</b>	<b>17.87</b>	<b>17.01</b>	<b>19.20</b>	<b>14.88</b>	<b>25.64</b>
Straw credit .....	\$ 2.04	1.70	2.33	2.48	1.64	3.66
Pasture credit .....	.39	.61	.11	.09	0	.42
<b>Net expense</b> .....	<b>15.39</b>	<b>15.78</b>	<b>14.57</b>	<b>16.63</b>	<b>13.04</b>	<b>22.67</b>

land, we have a gross expense per acre of \$17.72, which may be said to indicate the approximate portion of the expenses on the farms in question which may be attributed to the oats. After deducting credit for the straw, the gross expense is about 35 cents per bushel of oats.

These figures of expense should be considered primarily as indexes comparable with the corresponding figures on other farms. They may fairly be compared to the corresponding expenses on other alternative small grain crops, especially spring crops. But they do not represent an absolute cost, nor can they be compared to the costs per acre or per bushel on corn or other crops.

Figures 6 and 7 show the distribution of labor on the barley and wheat during the three years of the cost study.

Table XIV shows the labor and horse use requirements which we might expect on a reasonably efficient farm in raising a 20-acre field of oats, barley or wheat. The records show that the majority of the fields were disced twice for small grain crops and harrowed once. The 9-foot disc, 11-foot grain drill, 20-foot

TABLE XIV. NORMAL REQUIREMENTS IN RAISING 20 ACRES OATS, WHEAT OR BARLEY

Operation	Size of machine	Team	Times over	Man hours	Horse hours
Disc .....	9'	4 horses	2	20	80
Harrow .....	20'	4 "	1	5	20
Plant .....	11'	4 "	1	12	50
Cutting .....	8'	4 "	1	16	64
Shocking .....				30	
Threshing .....				62	84
<b>Total</b> .....				<b>165</b>	<b>298</b>

harrow and 8-foot binder were the most efficient of the commonly used implements, and the four-horse team seemed in general, the most efficient and easily managed. Where an endgate seeder was used in planting, however, the labor requirement was only about half as much as with the grain drill.

It may be considered that with the teams and machines named it would ordinarily take five eight-hour days to disc the land, one day to harrow it and three days to sow. Three men would be required for four days to cut and shock. Threshing may be expected to take just half the labor of producing the crop, requiring a crew of about nine men and five teams for between a day and a half and a day and three-quarters. Figures 6 and 7 show the weekly distribution of labor in 1927 on the fields of oats and barley.

### Barley

Barley is a crop competing directly with oats in its labor requirements and in the time of year during which it uses the land. In each of the three years of the cost study, some barley was grown on from a third to a half of the farms on the route. In 1925 the average size of the fields of barley on the route farms was 9.9 acres. In 1926 it was 17.3 acres. In 1927 the fields averaged 12 acres. In 1928 it appeared from observation that the typical field had been increased considerably and it was quite clear that barley was being grown on many more farms than in the earlier years.

Generally the barley crop in Iowa County has yielded more pounds of feed per acre than has the oat crop. Thus the average yield of oats for the county for the five years, 1923 to 1927,

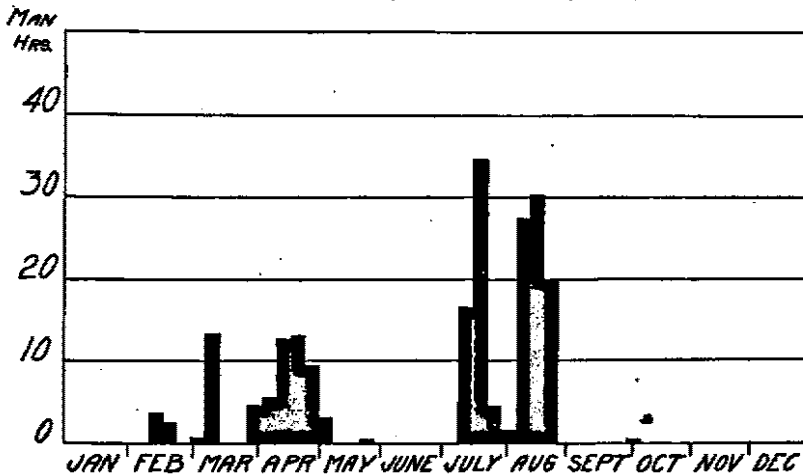


Fig. 6. Average weekly distribution of labor on 20 acres barley in 1927.

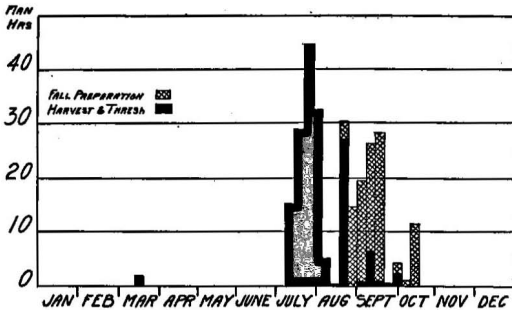


Fig. 7. Average weekly distribution of labor on 20 acres wheat in 1927.

was 37 bushels, while the average barley yield was 29.6 bushels. At this rate the oat crop weighed an average of 1,184 pounds and barley, 1,420 pounds. On the east route farms the average yield of oats for the three years, 1925 to 1927, was 44.3 bushels, or 1,418 pounds of grain; of barley, 33 bushels, or 1,584 pounds of grain.

Because of its higher yield it is worth suggesting seriously the possibility of replacing a part of the oat acreage with barley for feed. In some years, however, particularly 1928, many feed-



Fig. 8. Sweet clover in barley stubble.

TABLE XV. BARLEY—PHYSICAL AND FINANCIAL COSTS PER ACRE

	Average	1925	1926	1927	Range—1927	
	1925-27				Low	High
Cost per bu. ....	\$ .51	.59	.50	.49	.43	.63
Acres .....	13.0	9.9	17.3	12.0	2.0	20.0
Yield, bu. ....	33.4	31.9	35.6	31.6	27.1	37.9
<b>Physical costs</b>						
Seed, bu. ....	2.4	2.5	2.3	2.5	2.0	3.0
Twine, lbs. ....	2.7	2.7	2.3	2.6	2.4	3.3
Man, hrs. ....	9.0	11.1	9.0	7.6	6.0	12.4
Horse, hrs. ....	14.1	16.0	13.7	13.1	12.6	16.4
Tractor, hrs. ....	.4	.2	.6	.3	0	1.1
<b>Financial costs</b>						
Seed cost .....	\$ 1.90	2.33	1.69	1.49	1.32	2.28
Labor cost .....	2.55	3.46	2.51	1.96	1.44	3.11
Horse cost .....	2.05	2.90	1.76	1.81	1.39	2.32
Equip. cost .....	.81	1.01	.77	.71	.54	.84
Threshing .....	1.42	1.53	1.42	1.34	1.21	1.50
Misc. exp. ....	2.50	2.25	2.73	3.01	.71	7.17
Total opr. cost.....	11.23	13.14	10.37	10.32	9.88	10.75
Bldg. chg. ....	.14	.20	.22			
Land chg. ....	7.94	7.56	8.32	7.75	5.74	8.33
Gross expense .....	\$19.31	20.89	19.41	18.07	15.40	19.11
Pasture credit .....	.36	.29	.24	.57	0	1.07
Straw credit .....	1.90	1.73	1.89	2.03	1.30	2.74
Net expense .....	17.05	18.87	17.28	15.47	13.43	16.98

ers had trouble in feeding barley because of a fungus with which it was affected.

Some small grain was sold to provide a source of cash on most of the farms. Because of the low price of oats in the past few years, either barley or wheat would have brought in more money per acre than oats, as table I discloses.

The cost of producing barley was nearly the same as for oats except for two or three items which were slightly higher, as shown in table XV. An average of 2.4 bushels of seed was used at a cost of \$1.90, as compared to \$1.66 for oats. The total operating cost of the barley averaged \$11.23 an acre as against \$10.34 for oats. This was probably due largely to the fact that many of the fields of barley were decidedly smaller than the fields of oats. The land on which the barley was grown was somewhat better than the oats land and the charge for rent averaged \$7.94 as compared to \$6.90 for oats. This brought the gross expense on the barley up to \$19.31 per acre, or \$1.60 more than for oats. The average index of cost per bushel for barley averaged 51 cents, compared to 35 cents for oats.

### Winter Wheat

In each of the three years of the study five or six of the farms raised some wheat. On these farms the wheat fields averaged 14.3 acres in 1925, 15.5 acres in 1926 and 26.9 acres in 1927. Like barley, there was a tendency for the wheat to displace a part of the acreage of oats. This was furthered by the low price of oats and the reasonably satisfactory price of wheat during



these years. It may be seen from table I that the average yield of wheat in the county for the five years, 1923 to 1927, was 21 bushels, which at an average price of \$1.14 made the wheat crop worth nearly \$24.00 per acre—next in value to corn.

The expenses in the production of wheat, as shown in table XVI, were usually somewhat higher than for oats. An average of 1.8 bushels of wheat was planted at an expense of \$2.35, or about 70 cents more per acre than for the seed oats. In preparing the seedbed and planting an average of 3.3 hours of man labor and 9.7 hours of horse work were used. In harvesting, 8.4 hours of man labor and 8.5 hours of horse labor were used. This makes a total of 11.7 hours of man labor and 18.2 hours of horse labor as compared to a total of 9.0 and 13.1 hours on the oats. The difference is chiefly in the fact that the land was plowed for the wheat on about a third of the farms. Where the crop was seeded after discing and without plowing, the labor requirements were but little higher than for oats or barley.

The total operating expense on the wheat averaged \$15.38 per acre as compared to \$10.34 for the oats. The gross expense

TABLE XVI. WHEAT—PHYSICAL AND FINANCIAL COSTS PER ACRE

	Average	Range—1927				
	1925-27	1925	1926	1927	Low	High
Cost per bu. ....	\$ .86	.68	.90	.91	.80	1.70
Acres .....	16.1	14.3	15.5	26.9	5.9	42.2
Yield bu. ....	22.6	25.8	32.4	21.8	11.9	20.0
Fall seeding						
Physical costs						
Labor hrs. ....	8.3		8.4	8.2	1.9	8.2
Horse hrs. ....	9.7		8.9	10.1	4.0	10.2
Tractor hrs. ....	.6		.7	.6	0	.9
Seed bus. ....	1.5		1.8	1.7	1.5	1.9
Financial costs						
Labor cost .....	.92		1.00	.88	.56	1.73
Horse cost .....	1.14		1.18	1.12	.47	1.41
Equip. chg. ....	.47		.46	.50	.14	.99
Seed cost .....	2.35		2.74	2.15	2.03	2.53
Misc. exp. ....	.70		.99	.54	.06	1.38
Total seeding cost	5.69	5.62*	6.38	5.20	4.11	7.61
Harvesting						
Physical costs						
Twine lbs. ....	8.1	2.6	3.5	3.0	1.9	8.1
Labor hrs. ....	8.4	9.0	8.8	7.9	5.3	7.8
Horse hrs. ....	8.5	6.9	8.1	8.6	7.9	9.1
Tractor hrs. ....	.1	.2	.1	.01		
Financial costs						
Labor cost .....	\$ 2.43	2.80	2.57	2.21	1.47	2.54
Horse cost .....	1.11	1.31	1.15	1.06	.72	1.31
Equip. chg. ....	.56	.87	.63	.41	.25	.55
Threshing .....	1.26	1.30	1.53	1.07	.83	.98
Misc. exp. ....	4.43	1.96	1.68	5.59	.56	6.01
Total opr. cost	15.38	13.43	15.89	15.53	11.24	14.31
Bldg. chg. ....	.05	.06	.06	.03		
Land chg. ....	6.99	6.59	7.10	7.07	5.38	7.99
Gross expense	\$22.42	20.05	23.05	22.63	16.02	23.18
Straw credit .....	2.90	1.94	2.75	3.30	1.70	3.99
Net expense	19.52	18.61	20.30	19.33	14.67	20.85
Return on land & bldgs. ....	15.40	28.71	13.42	12.87	2.72	14.32

\*Records do not cover period prior to Jan. 1, 1925, consequently seeding costs were estimated for this year.

on the wheat averaged \$22.42 as compared to \$17.72 for oats. The wheat provided a crop worth nearly \$32 per acre on the cost route farms as compared to \$19 for the oats. The purpose served by the two crops in the farming system differs somewhat. The oat crop at sowing time tends to compete with the preparation of the soil for corn. One of the main difficulties in the way of a larger acreage of wheat is that it is difficult to clear the ground of corn in the fall in time to prepare the seedbed and plant the crop, which is generally done in September or early October. Where corn is cut for silage or fodder, this problem is solved as far as that acreage is concerned.

The purpose of corn and oats is primarily to produce feed. The purpose of wheat is primarily the production of a crop that can be sold for cash. An average of 242 bushels of oats was sold per farm out of an average crop of 1,120 bushels and an average of 137 bushels was bought. Between 80 and 90 percent of the wheat crop was either sold or held at the end of the year, awaiting sale. The higher price of wheat indicates that if some small grain is to be sold, wheat has a decided advantage over oats for this purpose. On the other hand, oat straw has more feeding value than that of barley or wheat when the straw is wanted for roughage.

### Mixed Clover and Timothy Hay

Mixed clover and timothy hay provides the chief roughage on the typical Iowa County farm. The census of 1925 showed 50,000 acres in Iowa County in hay crops, of which 46,000 were in clover or timothy. This is about 19 percent of the total of 215,000 crop acres. The cost route farms averaged 16.1 acres in clover and timothy in a total of 38 fields in the three years. A somewhat larger acreage was cut for timothy seed so that about 22 percent of the crop was in clover or timothy for hay or seed. The percentage of the crop used for hay varied from year to year. If the hay crop promised to be heavy so that the farm's needs for roughage could be satisfied from a small number of acres, a larger part than usual would generally be cut for seed. It should be borne in mind in examining the data given here that the type and quality of these hay crops were quite variable. Both timothy and clover were seeded in the small grain crops. In the first year there was usually considerable clover in the hay. In the second year the clover had often largely or wholly disappeared and the hay was mostly timothy. On the fields summarized in table XVII the average yield was 1.2 tons per acre in 1925, 1.1 tons in 1926 and 1.4 in 1927.

In seeding the timothy and clover in the small grain the seed and extra labor cost an average of \$1.90 in the two years for

TABLE XVII. MIXED HAY—YIELDS AND COSTS PER ACRE

	Average 1926-27	1925	1926	1927	Range—1927	
					Low	High
Costs per ton .....	\$11.84	9.72	13.76	12.08	9.28	18.27
Acres .....	16.1	14.9	17.3	16.1	5.8	31.6
Yield per acre, tons	1.2	1.2	1.1	1.4	.9	1.9
<b>Physical costs</b>						
Labor hrs. ....	5.7	5.8	5.5	5.8	3.9	10.2
Horse hrs. ....	8.4	9.0	8.5	7.7	5.2	15.2
<b>Financial costs</b>						
Labor cost .....	\$ 1.61	1.68	1.48	1.71	.95	2.74
Horse cost .....	1.18	1.25	1.18	1.10	.52	1.76
Equip. chg. ....	.54	.59	.56	.46	.27	.71
Manure cost .....	2.40	1.47	2.01	3.79	.32	7.64
Other exp. ....	2.62	.83	2.81	2.28	.48	3.23
Total opr. exp. ....	8.34	5.79	8.04	9.32	4.84	14.90
Land & bldg. chg. ....	7.78	7.64	7.83	7.97	6.81	10.24
Gross cost .....	16.12	13.33	15.87	17.30	13.51	23.08
Pasture credits .....	\$ 1.01	1.21	1.28	.49		1.33
Net cost .....	15.11	12.12	14.59	16.81	13.51	22.64

which complete records are available. In harvesting an average of 5.7 hours of labor and 8.4 hours of horse labor was required per acre. The seasonal distribution of this labor is shown in fig. 9. These cost \$1.61 and \$1.18, respectively, for man and horse labor. A charge of \$2.40 was made for manure and 54 cents for the use of equipment. The total expense of seeding and cutting the crop averaged \$8.34, and the charges for the use of land and buildings brought the total expense up to \$16.12 per acre. After deducting credits for the use of pasture, this amounted to \$11.84 per ton for the hay.

Liming the land in order to get larger yields of clover should reduce the costs materially, and either increase the capacity of

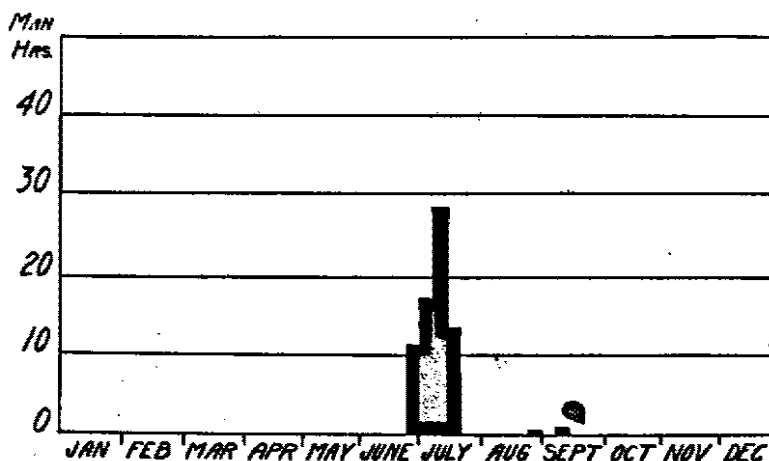


Fig. 9. Weekly distribution of labor on 30 acres clover and timothy hay in 1927.

TABLE XVIII. TIMOTHY SEED

	Average				Range—1927	
	1925-27	1925	1926	1927	Low	High
Cost per cwt. ....	\$ 5.19	5.47	5.07	5.19	8.28	13.53
No. of acres .....	20.3	21.7	17.1	22.1	6.1	33.6
Yield, lbs. ....	225	176	248	244	125	390
Seeding pre. year .....	.77		.76	.78		2.88
<b>Physical costs</b>						
Labor hrs. ....	6.1	5.5	5.9	6.7	3.1	9.0
Horse hrs. ....	5.6	5.3	5.5	5.5	2.6	9.6
Twine lbs. ....	2.0	1.9	1.8	2.3	1.6	3.7
<b>Financial costs</b>						
Labor cost .....	\$ 1.84	1.56	1.62	1.73	.86	3.25
Horse cost .....	.82	.80	.78	.86	.37	1.70
Equip. chg. ....	.41	.38	.42	.42	.18	.80
Tractor cost .....	.22	.20	.34	.18		.36
Manure .....	1.89	1.51	1.89	2.16		4.60
Threshing .....	1.43	1.45	1.33	1.49	.98	2.64
Misc. exp. ....	1.18	.78	1.49	1.14	.51	2.08
Total opr. cost .....	7.95	6.68	8.62	8.74	5.11	13.69
Land chg. ....	7.62	7.12	7.76	7.90	6.75	10.15
Gross expense .....	15.57	13.79	16.38	16.64	13.26	21.96
Straw credit .....	2.58	2.07	2.79	2.80	2.25	3.73
Pasture credit .....	.77	1.10	.44	.70		3.41
Clover seed credit .....	.54	.74	.54	.47		2.85
Total credit .....	\$ 3.89	3.91	3.78	3.97	2.25	7.86
Net expense .....	11.68	9.89	12.59	12.67	10.11	16.89

the farm for livestock, or else reduce the number of acres necessary to provide forage and so release more land for corn or wheat.

### Timothy Seed

Reference has already been made to the timothy seed crop as being closely related to the timothy hay. On some farms an acreage of timothy is grown primarily for the seed, but on a larger number the seed is partly an element of elasticity in the forage system. That is, the amount of timothy to be cut for seed is decided after it is seen how much of the timothy acreage is needed for hay.

Timothy seed was raised on 9 farms in 1925, on 11 in 1926 and 12 in 1927. The average yields were 176 pounds of seed per acre in 1925, 248 in 1926 and 244 in 1927. The yields, however, varied widely in each of the three years. For the whole period a variation of from 150 to 300 pounds per acre would be typical of the bulk of the farms. The expenses of seeding and raising the timothy up to the time it is harvested would not, of course, differ from the expenses on the crop cut for hay.

Figure 10 shows that the labor requirements on timothy seed occur almost entirely in late July and August when other farm work is not pressing.

In harvesting and threshing the main expenses were for labor. An average of 6.1 hours of labor and 5.6 hours of horse work was used per acre. These were valued at \$1.64 and 82 cents, respectively. The charge for manure averaged \$1.89 and that for threshing \$1.43. The total operating expense aver-

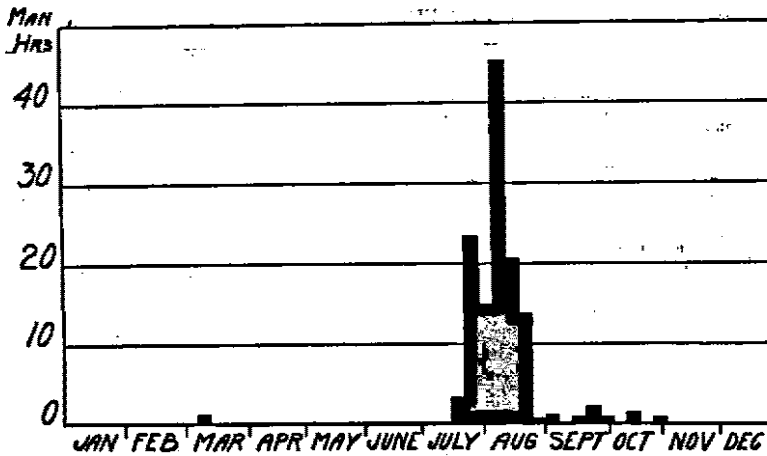


Fig. 10. Weekly distribution of labor on 20 acres timothy seed.

aged \$7.95. After the land charge of \$7.62 was added this gave a gross expense of \$15.57. Credits for pasture of the stubble, for clover seed separated from the timothy and for the straw after the seed had been threshed out of it totalled \$3.89 per acre.

The price of timothy seed has not been sufficient in the last few years to give a very high return on the use of the land and buildings after deduction of the expenses.

The farmers raising timothy seed would, with few exceptions, have done much better to raise corn or wheat instead. The replacement of this low yielding crop by a more profitable one seems pretty clearly to be one of the most promising opportunities to increase the returns from the crop system in this farming area.

### Alfalfa and Sweet Clover

In the effort to obtain heavier yields of hay of greater feeding value, both alfalfa and sweet clover have been tried on several of the Iowa County cost route farms. Several unsatisfactory stands were obtained mostly because of acidity of the soil. Where the soil has been limed thoroly and the crop did not winter kill, good yields were obtained. Table XIX shows that the yields of alfalfa were about twice as high as on the timothy and clover.

Three of the fields of alfalfa were patches of under four acres. This would cause the labor requirements to run somewhat higher per acre than on the larger fields of timothy and clover. But the chief reason that the labor requirements were twice as high on alfalfa as on the mixed hay was that it was necessary to cut the

TABLE XIX. EXPENSES AND YIELDS ON FOUR FIELDS OF ALFALFA

Field	A	B	C	D
Cost per ton .....	\$ 7.26	\$10.72	\$14.23	\$22.55
Acres .....	3.7	1.6	3.8	31.2
Yield, tons per acre .....	2.7	3.4	2.2	1.9
Previous cost of seeding .....			6.0	8.12
Labor hours .....	12.6	15.3	21.4	8.1
Labor cost .....	3.40	4.61	5.41	2.34
Horse hours .....	21.1	21.2	25.7	13.6
Horse cost .....	3.74	3.22	3.96	1.95
Equip. charge .....	1.62	2.52	2.08	.68
Manure .....		10.00	1.60	19.60
Tractor expense .....		7.21		
Misc. expense .....	5.03	1.65	4.06	2.17
Total operating cost .....	13.79	29.21	23.11	34.86
Land charge .....	5.84	7.63	8.30	7.99
Total expense .....	19.63	36.84	31.41	42.85

alfalfa three times per year. The greater care in preparing the seedbed and the heavier applications of manure also contributed to heavier expense.

Altho sweet clover has proven itself useful for pasturage and, in some cases, for hay, one of its most valuable uses is as a soil building crop. Like alfalfa, sweet clover will not do well on acid soil, and the need of most of the Iowa County soil for lime has been the chief factor limiting its production. The yields of sweet clover hay on the three fields covered by the records were higher than was typical of the mixed hay, as is shown by table XX. Consequently, the cost per ton on two of the three fields was lower than the average of the timothy and clover.

The most successful use of the sweet clover was in fields A and B, where it was seeded in the spring in the oats or barley. A crop of hay was then cut after the oats had been removed. In one of these cases the sweet clover was kept for pasture in the



Fig. 11. Alfalfa grows well on land that has been limed.

TABLE XX. EXPENSES AND YIELDS OF HAY ON THREE FIELDS OF SWEET CLOVER

Field	A	B	C
Cost per ton .....	\$ 6.72	\$ 7.12	\$14.41
Acres .....	9.6	60.4	8.3
Yield, tons .....	2.6	1.2	1.6
Cost of seeding .....		.50	.98
Labor hours .....	15.9	5.2	8.9
Labor cost .....	5.01	1.51	2.26
Horse hours .....	24.1	8.1	17.0
Horse cost .....	2.96	1.22	2.62
Equip. chg. ....	1.23	.68	1.37
Manure .....			6.33
Misc. expense .....	1.42	2.72	1.69
Total operating cost .....	10.62	6.68	15.20
Land charge .....	6.89	3.79	8.38
Gross expense .....	17.51	10.37	23.58
Pasture credit .....		.83	
Net cost per acre .....	\$17.51	\$ 9.54	\$23.58

second year. In the other it was plowed under the following spring and the field was planted in corn. By producing a crop of small grain and also a crop of hay in the same year, the returns from the land were greatly increased and became more nearly equal to the usual returns from a crop of corn. As liming becomes more common the planting of alfalfa and sweet clover is continually increasing. The advantages of these crops are clear. If they permit growing the same amount of forage on half the acreage of land previously needed, the remaining acreage is left for the production of corn or wheat for sale, or for the feeding of more livestock.

#### Modification of the Crop System

We are now in a position to view the crop system as a whole and to raise the question whether it may not be possible on some of the farms studied, and on the typical farm in the area, to modify some of the acreages in various crops to advantage.

About seven-tenths of the land on the farms studied consisted of slightly rolling or rolling Tama silt loam. On this land the most common rotation or crop system approximates a five-year rotation with two years of corn, one of oats, one of hay and one of rotation pasture. From the field in hay about half the acreage was generally cut for timothy seed. The same rotation was the most common on the level upland. It occurred also on the rough lands and on the bottoms.

Four considerations, already mentioned, suggest the advisability of modifying the cropping system. The first is that with the low price for oats in the past several years, oats have not been profitable as a cash crop. If it is desired to sell some small grain for cash, wheat promises a decidedly larger income. The limiting factor here is the problem of getting the soil prepared in the fall. But this may generally be solved without much diffi-

TABLE XXI. APPROXIMATE EXPENSES IN SHIPPING AND HAULING LIME<sup>1</sup>

Freight rates per ton		Trucking charge per ton mile	
Miles	Rate	Miles from station	Cost of trucking <sup>2</sup>
25	\$ .65	1	\$ .42
50	.63	2	.84
75	.73	3	1.26
100	.88	4	1.68
125	1.05	5	2.10
150	1.15	6	2.52
175	1.25	7	2.94
200	1.35	8	3.36
		9	3.78
		10	4.20

<sup>1</sup>Courtesy of F. N. Masters of the Agr. Econ. Section, Iowa Agr. Exp. Sta.

<sup>2</sup>An additional charge of about 20 cents per ton should be added for loading and unloading.

culty for the acreage where silage is cut or where some corn is cut green for feeding in the early fall.

The second consideration is that the timothy seed crop has seldom proved profitable, and its displacement by some other crop on most farms is to be desired. The third is likewise related to the hay crops. It would be desirable to obtain larger yields of hay and to raise hay of higher feeding value than the present mixture, which is partly clover but largely timothy on most farms.

This leads to the fourth problem; in order to produce more clover hay, or sweet clover for pasture or hay; or alfalfa, it will be necessary to apply lime on practically every farm in the Iowa County farming area. The cost of liming, as determined largely by the length of the haul, is the biggest drawback to liming. The variations in the cost of liming that may be expected are shown in table XXI.

If the cropping system is to be modified so as to include more corn and wheat on the upland, the soil fertility problem will probably become more acute because of the heavier demands of these two crops. It will be necessary to give more care to the manure produced on the farms, or to use more green manure crops, or both.

Table XXII shows the crop system as found on seven of the cost route farms. It also shows some possible modifications in the acreages, which, if carried out, should give a greater crop return from the same land. An average of about 250 bushels of oats sold from the cost route farms brought an income of about \$90 and required about six acres of land. About seven acres of timothy per farm cut for seed yielded about 1,600 pounds and gave an income of about \$85.



### SOME MODIFICATION WOULD IMPROVE THE FIVE-YEAR ROTATION

If the timothy seed crop were left out of the crop system and that part of the oat crop sold as grain replaced with wheat, the rotation would become essentially the five-year rotation suggested in table XXII. Assuming five 25-acre fields, or their equivalent, we would then have two fields, or 50 acres, in corn which would yield about 300 bushels more than the 45 acres at present. Of the third field half would be in oats and the other half in wheat. The wheat might be expected to yield about 275 bushels, of which about 250 could be sold after reserving the seed for the next year. Under the prices obtaining during the past three years, the wheat would yield nearly twice the income obtained from the oats and timothy seed.

The fourth field would be in clover and timothy and would furnish, with the average yields found, about 30 tons of hay. On the ordinary Iowa County farm, much less hay than this is needed if full use is made of the corn stalks. Also, more pasture is needed with the typical sized cattle enterprise than this rotation would provide. If the clover and timothy can be pastured by turning in a small number of stock, or by fencing off part of the field, it could be used for pasture instead of hay. The fifth field would be used for pasture.

### FOUR-YEAR ROTATIONS POSSIBLE ON MANY FARMS

Many of the farms in Iowa County have little or no land so rough that it cannot be tilled. On these farms a smaller area of pasture is needed than where there is much rough land and a large cattle enterprise. Here a four-year rotation, such as shown in table XXII, has evident advantages over the five-year rotation just discussed.

Assuming four 35-acre fields on the quarter section farm, the first field and half of the second would be in corn. These 52½ acres of corn might be expected to yield between 400 and 500 bushels more than the five-year rotation now used on the seven farms shown. The remainder of the second field would be in oats and would be seeded down to clover and timothy.

The third field would contain 17½ acres of clover and timothy. The remainder would be in wheat and should yield a salable crop of about 360 bushels after deducting the seed. This acreage would also be seeded down. In the fourth field the clover and timothy, which had been seeded partly in the second and partly in the third year of the rotation, would be used for pasture. This rotation might be expected to yield crops with \$600 to \$700 greater value than the ordinary five-year rotation. It may be rather puzzling at first to see just how this rotation could be fitted into four fields without additional fences. Figure

TABLE XXII. ALTERNATIVE CROP SYSTEMS FOR A 160 ACRE FARM ON GENTLY ROLLING OR ROLLING UPLAND

	Yield, cost route av.	Av. of 7 Iowa Co. farms		Suggested 5-year rotation		Suggested 4-year Rotation		4-year rotation with alfalfa	
		Acres	Yields	Acres	Yields.	Acres	Yields	Acres	Yield
Total acres .....		158.9		160.0		160.0		160.0	
Lots and waste .....		7.9		8.0		8.0		8.0	
Pasture .....		59.7		25 Permanent		10 Permanent		10 Permanent	
Total crops .....		89.1		38 Rotation		85 Rotation		82 Rotation	
Corn .....	57.8 bu.	44.9	2578	50.0	2865	52.5	3008	64.0	3667
Oats .....	44.1 bu.	21.6	958	12.5	551	17.5	772	18.0	708
Wheat .....	22.6 bu.	1.9	48	12.5	282	17.5	396	18.0	363
Barley .....	83.4 bu.	.2	7		20				
Clover & timothy hay .....	1.2 tons	8.7	10.4	17.0	20	17.5	21		
Timothy seed .....	226 lbs.	6.9	1559	2.0					
Miscellaneous .....		4.8				2.0		2.0	
Alfalfa hay .....								8.0	20.0
Alfalfa hog pasture .....								4.0	
Value:									
Corn at .70 .....			\$1,801		\$2,005		\$2,106		\$2,567
Oats at .40 .....			881		220		809		282
Wheat at \$1.10 .....			47		310		436		398
Barley at .60 .....			4						
Hay at \$12.00 .....			125		240		252		240
Timothy seed at \$5.30 .....			83						
Total value crops .....			\$2,441		\$2,575		\$3,108		\$3,487

<p><i>FIELD 1</i></p> <p>1927 — CORN —</p> <p>1928 CORN — OATS</p> <p>1929 WHEAT — HAY</p> <p>1930 — PASTURE —</p>	<p><i>FIELD 2</i></p> <p>1927 CORN — OATS</p> <p>1928 WHEAT — HAY</p> <p>1929 — PASTURE —</p> <p>1930 — CORN —</p>
<p><i>FIELD 3</i></p> <p>1927 WHEAT — HAY</p> <p>1928 — PASTURE —</p> <p>1929 — CORN —</p> <p>1930 CORN — OATS</p>	<p><i>FIELD 4</i></p> <p>1927 — PASTURE —</p> <p>1928 — CORN —</p> <p>1929 CORN — OATS</p> <p>1930 WHEAT — HAY</p>

Fig. 12. How fields would be used in suggested four-year rotation.

12 is designed to show that additional or temporary fences would not be needed.

The labor that would be needed by this suggested rotation is shown in fig. 13 in comparison with that of the seven 160-acre farms on which records were obtained.

An advantage of the suggested four-year rotation with one and a half years of corn is that it would largely avoid the drain on fertility and reduction in corn yield where corn is raised repeatedly two or more years. Each part of a field would be in corn only three years in eight.

However, many farms have only a small cattle enterprise, or have rough permanent pasture which largely suffices for that requirement. On these farms it may be desired to keep a larger acreage of land in corn. The rich bottomlands come in this classification. If one field of the four is sufficient for both hay and pasture, this will permit modifying the four-year rotation so that 50 percent is in corn, one field in small grains and the

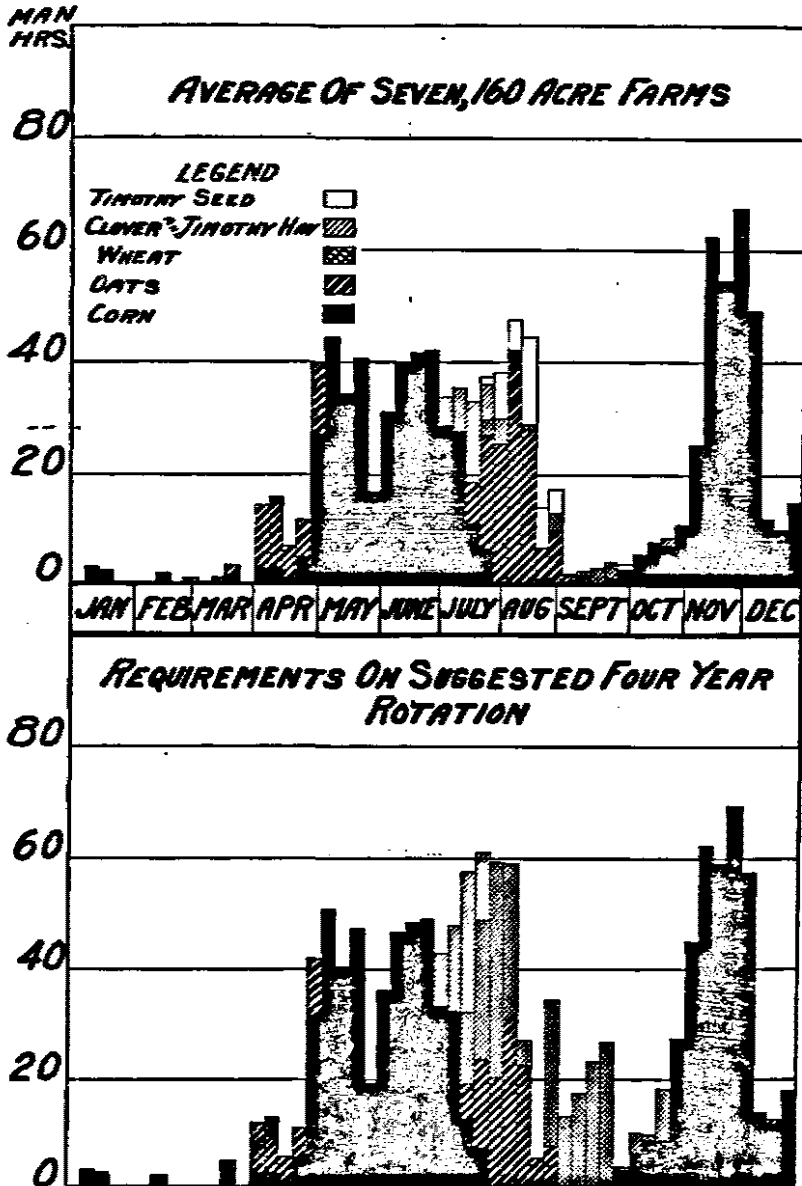


Fig. 13. Average crop labor requirements per week on seven cost route farms compared to suggested four-year rotation.

fourth field in hay and pasture. On many farms the land is already divided up so that no additional or temporary fences are needed to separate the hay from the rotation pasture.

The bottomland seems capable of supporting a four-year rotation with two years of corn. Bottomland fields are frequently cut up by streams or drainage ditches, making it impossible to divide them equally. Here the odd sized bottom fields can be rotated in conjunction with a similar rotation on other fields.

An opportunity for using a regular rotation on bottom fields may be illustrated by Farm No. 22. Here there are three fields of which field A contains 15.8 acres, field B 16.1 acres and field C, 21.3 acres. The size of these fields cannot be changed because a drainage ditch runs between fields A and B, and field C is divided from B by a corner of a neighbor's farm. The crops planted during the past five years and the yields obtained were as follows:

CROPS RAISED AND YIELDS ON FARM 22

Field acres	A 15.8		B 16.1		C 21.3	
	Crop	Yield	Crop	Yield	Crop	Yield
1925	Corn	63 bu.	Corn	68 bu.	Corn	71 bu.
1926	Corn	55 bu.	Oats	48 bu.	Corn	48 bu.
1927	Corn	37 bu.	Past.		Corn	86 bu.
1928	Corn		Past.		Oats	
1929	Corn		Past.		Past.	

SUGGESTED CROP PLAN FOR NEXT FOUR YEARS

Field	Bottomland			Gently rolling upland
	A	B	C	D
1930	Wheat	Corn	Corn	Pasture
1931	Pasture	Corn	Wheat	Corn
1932	Corn	Wheat	Pasture	Corn
1933	Corn	Pasture	Corn	Wheat

This land should be put into a regular four-year rotation to obtain satisfactory yields. On this farm there are six other fields that can be cropped. It would seem feasible to put the most productive field into a four-year rotation with the bottom land. The other five fields could then be kept in a five-year rotation, which would involve a smaller drain on their fertility. The program for the next four years would give field A a two-year rest before it is again put into corn.

#### ROUGH LAND REQUIRES LONGER ROTATIONS OR SPECIAL TREATMENT

It was pointed out earlier in the bulletin that the most common rotation on the rough land consists of two years of corn, one of small grains and three of hay or pasture. This land is the hardest to put into a regular cropping system, especially on farms with areas both of rough land and of other smoother types.

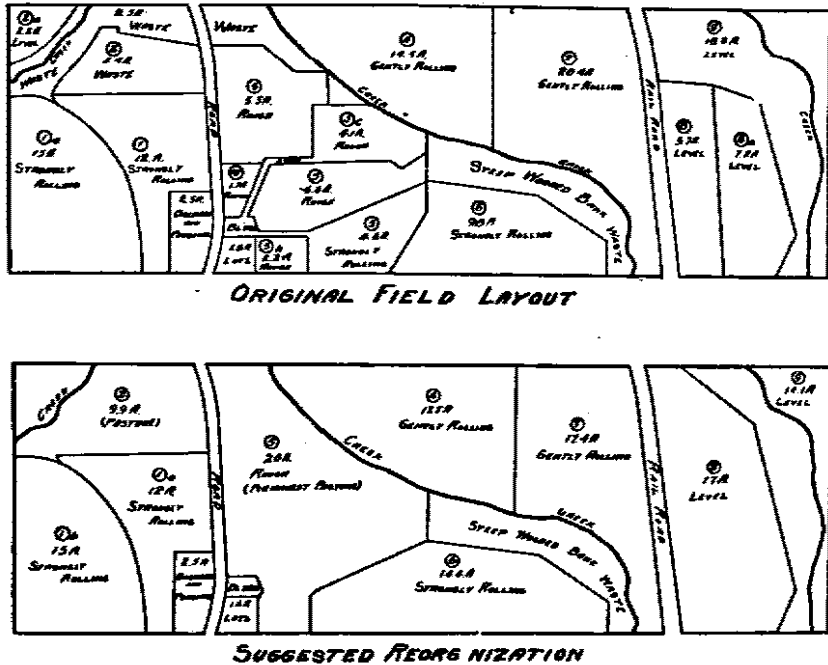


Fig. 14. Tentative reorganization plan for farm with rough land.

Farm No. 11 is probably cut up by roads, streams and other natural features more than any other farm studied. It consists of 156 acres, which have been divided up into small fields to conform to several small hills. In all there are 18 fields, of which 12 are smaller than 10 acres. On the smooth fields, there were two or three years of corn in a five-year rotation. On the rough fields there were sometimes one and sometimes two years of corn, followed by oats, then hay, and one or two years of pasture. Fields 9, 5a and 5c were in pasture thruout the period.

In fig. 14 is shown a rearrangement of the fields for greater production, and to eliminate the small patches. First, part of the bottomland in field 9 might well be included with fields 8 and 8a to make one field of about 17 acres. Fields 4 and 7 together amount to 35 acres. When it becomes necessary to replace the fence separating the fields, it should be moved to the east far enough to make them of equal size. The three smooth fields can be put in a four-year rotation of two years of corn, one of small grains and one of hay or pasture.

Now, on the rough land, fields 1, 1a, 5a and 6 are strongly rolling, but not too rough to crop. If 5a and 6 were combined we would have three fields of about equal size. These could be put

into a rotation of two years of corn, one of small grains and three of hay and pasture.

On the northeast corner of the farm is a small level patch of 2.2 acres which might well be thrown in with field 2 to make a pasture of 9.9 acres. North and east of the buildings are fields 10, 3, 5, 5b and 5c, which are too rough to crop to advantage; these may be combined into a pasture field of 20 acres.

These two fields, together with field 9, will make a total of 44 acres of permanent pasture besides 12 to 16 acres of rotation pasture each year. The three smooth fields in the four-year rotation amount to 52 acres. The three rough fields will contain about 42 acres. Under this plan there would be 10 fields instead of 18 and none smaller than 10 acres.

Since only three fields are in the four-year rotation, two will be in corn one year and only one the next. This is awkward, but the land could not be divided into four fields because of the stream and railroad, and a four-year rotation seems as intensive a cropping system as the land will stand at present. It is inconvenient to have two rotations on the same farm, when the area of crop land is small, but here this could hardly be avoided. The area of crop land on this farm is too small and the farmer could make fuller use of his labor, horses and equipment if he rented or bought an additional 80 acres.

The rotations suggested here assume that the soil has not been limed to permit the production of alfalfa or sweet clover. Where it is possible to raise alfalfa, a much smaller acreage is needed for hay, and more is available for corn or small grains. If 10 or 12 acres could be set aside from the main rotation and planted in alfalfa, this would provide not only the needed hay, but also three or four acres of alfalfa pasture for the hogs, which would help materially in reducing the costs of hog production.

A four-year rotation could then be used with two years of corn, one of small grains and one of pasture. About 64 acres of corn could then be raised on a 160-acre farm instead of the 45 on the seven farms described. Liming would also permit the use of sweet clover to increase the carrying capacity of the pasture and to help maintain soil fertility.

The suggested rotations are, of course, not intended as unqualified recommendations for Iowa County. The purpose of the discussion is to illustrate modifications of the cropping system which would be worth consideration by the farmers of the area. It should be decidedly profitable for a farmer to become acquainted with the possibilities of alfalfa and sweet clover, at least on a small scale. After trying them out, he could take them into his general crop system in so far as they are usable, and revise the rotation to increase the production of feeds and salable crops.

## Summary

The data on which this discussion rests were obtained by careful records kept on 28 farms in Iowa County from 1925 to 1930.

On these farms it was found that corn was the crop yielding the largest amount of feed and the largest value per acre. Wheat followed second, and oats were decidedly under either corn or wheat in value.

About one-third of the farm land was in pasture; about one-third, or less, in corn, and about one-eighth in oats.

The acreage in timothy for seed yielded a product of the least value per acre of any crop.

It would be desirable to replace a part of the oats acreage with wheat in order to get a crop which would bring in a larger cash income.

Where possible, the elimination of most, or all, of the timothy seed acreage should be considered, and more profitable crops should be used instead.

On the level or moderately rolling upland, which comprises about three-fourths of the land in the farms studied, a four-year rotation with more corn and wheat than are now raised and less of oats and timothy for seed might be expected to increase the cash income and also the amount of available feed.

If some land can be limed and planted in alfalfa, more hay of greater feeding value than that which is now raised may be secured. A small acreage of alfalfa for hog pasture would also be valuable. The remainder of the crop land could then be put into a four-year rotation to increase the production of corn and wheat.

Data are presented showing the usual requirements of the principal crops for labor and horse work as well as for the principal materials used, such as twine and seed.

It is shown that the use of the two-row cultivator and other large-capacity machinery accomplishes a noteworthy saving of labor, and that a larger saving in time and expense is made when the corn is picked or hogged-down than when shredded or ensiled.

The use of sweet clover as a pasture and soil building crop, with an occasional cutting for hay, was successful on the three fields where it was planted on limed ground.