

## Indiana Distribution and Yield of Corn, Wheat, and Oats\*

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Indiana has been an important agricultural state because much of it has climatic, soil, and topographic conditions favorable for the growth of valuable crops, because there is a market close at hand, and because many competent, informed farmers live within its borders.

In this article the distribution and yield of three chief crops, corn, wheat, and oats, are discussed, the basis being the annual county totals and averages reported by the U. S. Census and the U. S. Department of Agriculture Coöperative Crop Reporting Service at the Experiment Station, Purdue University. The special purposes of this study are to disclose the relative importance of these crops in the various parts of the state, with recent changes therein and the relative yields received in the average, favorable, and poor years. These factual data are presented chiefly by maps. Some attempts are made in the text to interpret or explain the contrasts most conspicuous on the maps. The present paper is an elaboration of certain topics discussed in more general terms in earlier ones.<sup>1</sup>

### Corn Distribution

Corn is grown on almost every representative Indiana farm. On the average for the state, about 25 acres per farm is devoted to corn. The average farm of the southeastern and also of the northern counties has about 15 acres and of the hilly south-central counties about 10 to 12 acres; in the large region called central Indiana, on the other hand, the average farm has about 30 acres of corn even though it includes a total of only 80 acres.

A map of the counties showing the number of acres devoted to corn for the average of ten recent years, not published here because of lack of space, discloses that most counties of central Indiana have between 60,000 and 90,000 acres of corn, depending partly on the size of the county. The largest county totals are found in the northwestern part of central Indiana where two relatively large counties, Benton and Tippecanoe, devote, on the average, somewhat more than 100,000 acres to corn. Several other counties also approach that total. In the Wabash lowland of southwestern Indiana, the county acreage in corn is almost as great as in much of central Indiana, several counties having more than 50,000 acres. In most of the rest of southern Indiana, however, the county totals are less than 30,000 acres; in six counties they are less than 20,000 acres.

\* Read in the General Session of the Academy.

<sup>1</sup> Visher, S. S., 1927. *Geography of Indiana agriculture*. Proc. Indiana Acad. Sci. 37:101-116; Econ. Geog. Indiana pp. 108-149. New York, 1923.

Since the counties vary in size, it is illuminating to compare the average acreages devoted to corn with the total area of the county. Figure 1 shows the percentage of the total land area which has been planted to corn during a recent decade. This map discloses that on the average more than one-quarter of all the land (which includes roads, railroads, towns, and cities) is devoted to corn in much of central Indiana, where each average square mile has about 180 acres of corn. Three large areas devote more than 30% of all their land to corn. The largest of these is Benton and two adjacent counties; other high counties are Clinton and Tipton, north of Indianapolis, and Hancock, Rush, and Shelby, east and southeast of Indianapolis.

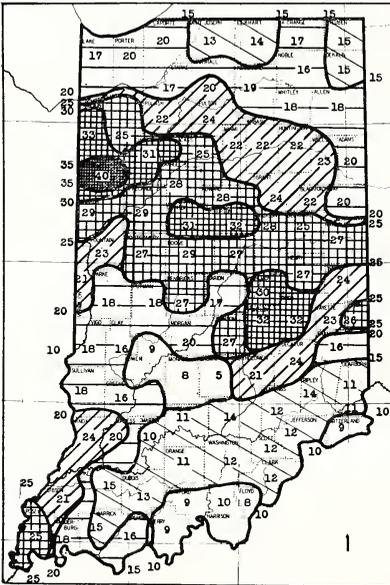


Fig. 1. Corn: Percentage of total land area which is planted to corn (15 year average, 1923-1937).

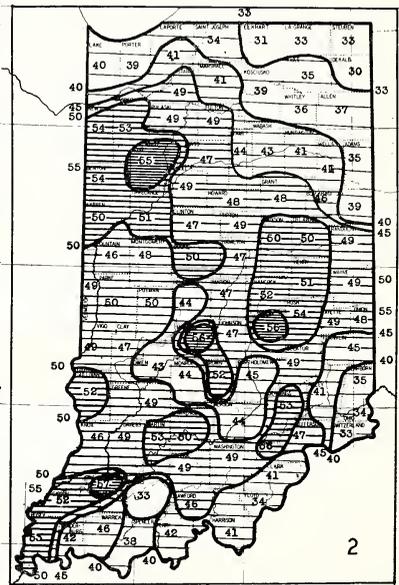


Fig. 2. Corn: Percentage of cropland planted to corn (10 year average).

A large part of southern Indiana, except the Wabash lowland, devotes less than 15% of its land area to corn, which is also true of 4 northern counties. In other words, they have less than 90 acres per average square mile. Eight southern counties devote less than one-tenth of their total area to corn; Brown County only one-twentieth.

The percentages of the cropland devoted to corn are dealt with in Figure 2, which affords a number of surprises. Even where, as in Brown County, only one-twentieth of the total land area is in corn, more than half of all the cropland may be so used. This means that considerable areas are planted to corn in successive years. This map makes conspicuous, in a way not so easily shown otherwise, that corn is a major crop in almost all parts of the state. Only in Dubois and 4 extreme northeastern counties is less than one-third of the cropland used in any

particular year for corn, and of these low counties the county with least, DeKalb, devotes 30% to corn. In only a dozen additional counties, bordering those just mentioned, plus 3 at the extreme southeast, does corn occupy less than 40% of the cropland. In most of the counties it occupies approximately one-half of the cropland; in seven counties corn occupies 54 to 57% of the cropland. The largest region where corn occupies less than 40% of the cropland, in the northeast one-eighth of the state, is often too cool at night in spring and autumn for good corn growth, because of the relatively high latitude and altitude. The other areas with less than 40% of their cropland in corn contain much hilly land where sheet erosion and gullying has been especially extensive and where the better farmers no longer plant corn on hillsides.



Fig. 3. Corn: Changes in acreages of 10% or more for average of last five years as compared with preceding decade. Inclined shading means gain; horizontal shading, loss; close, 13-15%; light, 10-11%.

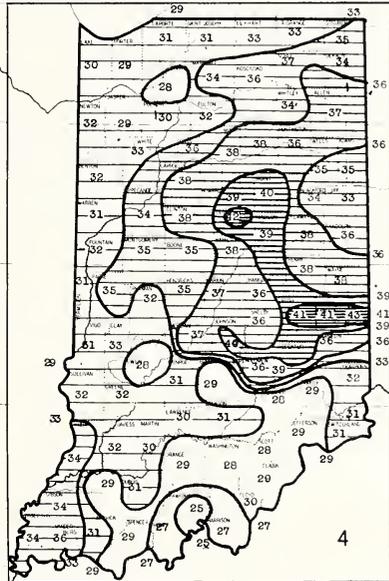


Fig. 4. Corn: Average yields, county averages (15 year averages). Bushels per acre.

Figure 3 discloses the changes in acreages devoted to corn, based on the average of the last five years as compared with the average of the ten preceding years. It shows that in only two counties, St. Joseph and Starke, has there been a gain as great as 10%; on the other hand, there has been a loss of 10 or 11% in many central and southern counties, and a loss of 13 to 15% in six counties, all in the southeastern third of the state. This decline has been encouraged by the soil conservation program of the federal government, but much of it merely continues a decline which has taken place for decades, following serious soil erosion on hillsides and resulting in reduced yields and the cessation of farming

of many tracts.<sup>2</sup> Moreover, most of the counties with considerable declines (Fig. 3) still devote more than half of their cropland to corn. This means that "corn follows corn." In other words, crop rotation is incompletely practiced, despite the ever louder expert urging that rotation pays. As more and more farmers come to practice complete rotation, the areas devoted to corn will decrease until nowhere will more than half of the cropland be devoted to corn.

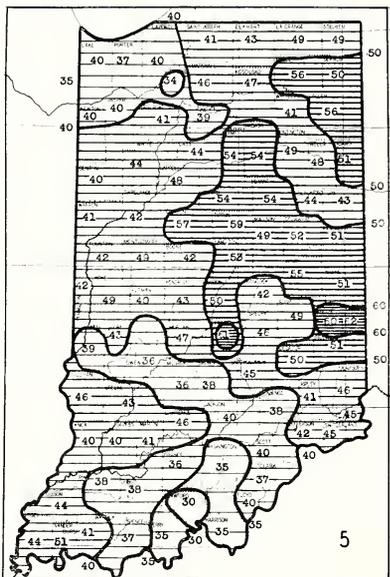


Fig. 5. Corn: Maximum county average yields (based on 15 years, 1920-1936, except 1921-1922). Bushels per acre.

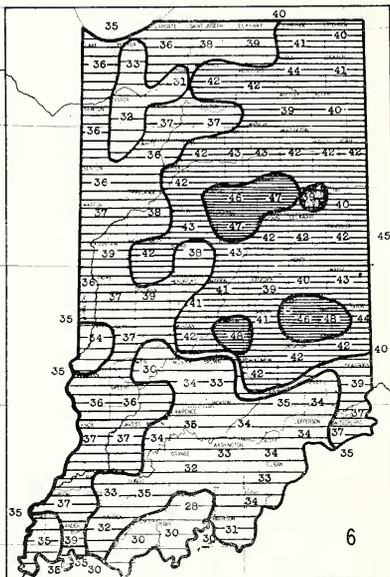


Fig. 6. Corn: Yields in a good year (county average). Only in the best two years of a decade are higher yields received. Bushels per acre.

#### Average Corn Yields

Despite the fact that Indiana has an exceptionally dependable climate and consequently far less fluctuation in crop yields than have most regions, nevertheless, there is considerable variation from year to year. Hence an average based on a considerable number of years is notably more accurate than the yield for a short period. Figure 4 shows the yields by counties from an average of 15 recent years. It discloses that two large areas have an average yield of 29 bushels per acre or less; an area which is even larger receives an average of over 38 bushels. By far the larger of the poorer areas is in southern Indiana and includes thirteen counties, three of which (Harrison, Perry, and Crawford) receive an average of 27 bushels per acre or less; indeed, the 15-year average for Crawford County is only 25 bushels per acre.

<sup>2</sup> Visher, S. S., 1937. Indiana regional contrasts in soil erosion and their chief causes. Proc. Indiana Acad. Sci. 46:143-159.

The highest average yields of corn are received in east-central Indiana, extending from Grant and Tipton counties to Rush, Johnson, and Union. In this area yields of 39 or more bushels are normal. In other words, farmers here have a right to expect nearly half again more corn per acre than the average farmer of the one-fourth of the state where corn yields are relatively low. The counties with highest corn yields for the average of these 15 years are Grant and Johnson, where the average is 40 bushels, Rush and Fayette with 41, Tipton 42, and Union 43.

The wide variation among the counties in average yields is related to variation in soil, temperature, rainfall, and in the percentage of the rain which soaks into the ground. Of course care and seed also count. The northwestern area with lower than average yields has much sandy or mucky soil, and it also has relatively frequent drouths. The southern low-yield area has much thin soil on the sloping land, and the bottom lands are being injured by the transfer thereto of infertile materials eroded from the hillsides. Moreover, some of the level upland has poor "white clay" soil. Likewise, more of the rain in southern Indiana falls as sharp showers, which fact means that more of it runs away and hence less of it soaks in. Only rain which soaks in is really helpful to crops. Abundant data on Indiana's contrasts in rainfall intensity reveal that southern Indiana receives a much larger percentage of its rainfall in hard downpours, much of which runs away if there is any appreciable slope, carrying with it soil.<sup>3</sup> The lower yields in southern than in central Indiana are also partly the result of more damage from insufficient rainfall in July and often excessively high temperatures.<sup>4</sup> Dr. Rose has found that when there are many days with temperatures above 90° the yield suffers.<sup>5</sup>

### Maximum Corn Yields

Not only are average yields interesting, but one wishes to know how large a yield may sometimes occur. Of course on choice land in exceptional years, yields of 150 bushels per acre are occasionally received. But what about the average of all the cornfields of a whole country?

Figure 5 shows the greatest county average yield received during 13 recent years for which county records are available. In the year of best corn yields (for most of the state this was 1925 or 1937) 22 counties, one-fourth of the state, had average yields of 50 bushels or more per acre, five counties had averages of 55 to 59 bushels (Allen, Noble, Clinton, Tipton, and Henry), and three counties received 60 bushels or more (Fayette 60, Johnson 61, and Union 62). On the other hand, even in their best year, in one-fourth of the state's counties, the average was 40 bushels or less; in five counties it was 35 or less, and in Crawford it was only 30.

<sup>3</sup> Visher, S. S., 1938. Rainfall intensity contrasts in Indiana, causes and consequences. *Geog. Rev.* 28:627-637. (Abstracted in *Proc. Indiana Acad. Sci.*, 47:147-148, 1938.)

<sup>4</sup> Visher, S. S., 1936. Indiana regional contrasts in temperature and precipitation, with special attention to the length of the growing season and to non-average temperatures and rainfalls. *Proc. Indiana Acad. Sci.* 45:183-204.

<sup>5</sup> Rose, John K., 1932. Climate and corn yield in Indiana 1887-1930. *Proc. Indiana Acad. Sci.* 41:317-321; corn yield and climate in the corn belt. *Geog. Rev.* 26:88-102, 1936.

### Minimum Corn Yields

A map, not published, shows the smallest county average yields and may advantageously be briefly described. Although Indiana is deservedly famous for the general dependability of its corn crop yields as compared to Illinois, Iowa, Missouri, and other more western parts of the Corn Belt, nevertheless, in the worst of recent years surprisingly low county average yields have occurred in certain parts of the state. For some sections the worst year was 1930; for others it was 1934 or 1936. For the state as a whole the smallest average yields were received in 1901 (19.8 bushels), in 1887 (20.0 bushels), in 1890 and 1893 (24.7 bushels), in 1934 (24.8 bushels), and in 1924 (25.6 bushels).

Along the Ohio River in south-central Indiana are five counties which received in their worst year recently less than a 10-bushel average, with Harrison and Floyd having averages of only 7.3 bushels. Ten additional nearby counties had 15 bushels or less. Northwestern counties having relatively low yields were Lake and Porter with 11 each, Jasper and Pulaski with 12, and Benton, Warren, and Starke with 14.

The highest average minimum yields in this period are 25 to 33 bushels per acre and are located in east-central Indiana. Tipton, one of the flattest counties in the state favored with good soil, has the highest minimum yield, 33 bushels per acre, more than four times the average minimum yields for two southern counties (Harrison and Floyd).

### Normal Range in Corn Yields

In addition to the map of average yield (Fig. 4), of maximum yield (Fig. 5), and of minimum yield (not published here), two maps of the yield in four years out of five have been prepared. One of these shows the yields which are exceeded in four years out of five; in other words, it shows the yield of the next to the poorest year in a decade. The other map shows the yields which are received in the best one-fifth of the years—eight years of each decade do not have yields as high as these. These maps show distinctly better than does Figure 4, of the average yield, which may reasonably be expected. Only rarely are the yields greater than those given in Figure 6 or less than those given in Figure 7.

Figure 6 discloses that in all but the poorest year of a decade, yields of 40 bushels or more have been received as county averages in more than one-third of the state (mostly in the east-central and northeast) and more than 47 bushels in four central and eastern counties. On the other hand, in nearly one-third of the state, mostly in the south, yields in excess of 35 bushels occur only once a decade. In the poorest counties, Crawford to Spencer, yields of over 30 bushels are as unusual as this.

Figure 7 discloses that in the poorest two years of a decade the yields averaged higher than 30 bushels in about one-third of the state and more than 41 bushels in three counties. On the other hand, in much of the state, especially at the south, west, and north, yields of less than

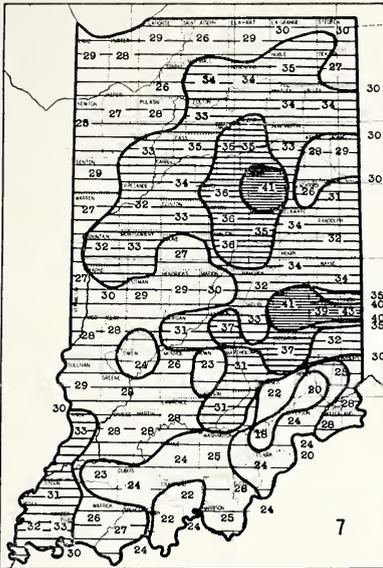


Fig. 7. Corn: Yields in even a poor year. Only the poorest two years of a decade have smaller county average yields. Bushels per acre.

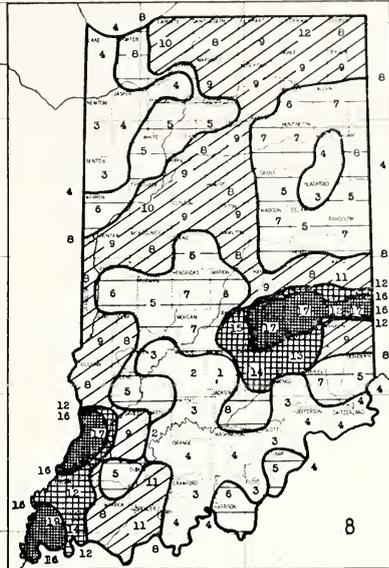


Fig. 8. Wheat: Percentage of total land area which is sown to wheat, by counties (15 year average, 1923-1937).

30 were received in the two poorest years of a decade. In many southern counties yields of less than 25 bushels are as frequent as this, and in five counties yields of less than 22 bushels.

### Wheat Distribution

The amount of land devoted to wheat in Indiana is much less than for corn, and there are much wider variations from year to year. This reflects the fact that Indiana's climate is generally not so well suited to wheat, that the yield varies more widely, and that the price fluctuations are more significant. Whereas most of the corn is fed to livestock on Indiana's farms, most wheat is sold in competition with the wheat of other areas, including foreign countries. The fact that Indiana's wheat is soft and not so suitable for bread flour as the harder western wheat is a major reason that much of Indiana's wheat is shipped out of the state to less discriminating bread eaters.

A map of the number of acres sown to wheat for the average of the past decade, not published here, shows that more than 40,000 acres is devoted to wheat on the average in only four counties, all in the southern half of the state. In about one-third of the state 20,000 or more acres per county are sown to wheat. The largest region of this type is in the northwestern part of the state, followed by the southwestern corner and by six counties (Shelby and neighboring counties). Four groups of counties which devote less than 10,000 acres each to wheat are seven situated in south-central Indiana, six at the extreme

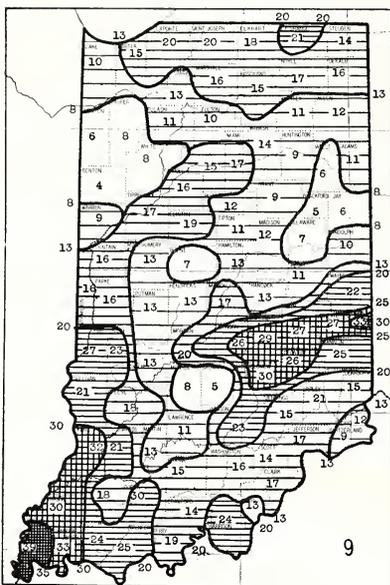


Fig. 9. Wheat: Percentage of the cropland in wheat (10 year average).

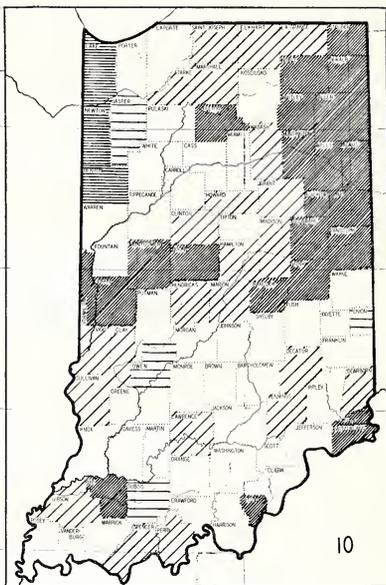


Fig. 10. Wheat: Changes in acreages of 10% or more for the average of last five years as compared with preceding decade. Horizontal lines mean loss; light 10-19%; close, 20% or more. Tilted lines mean gains; light, 10-29%; dark, 30% or more.

southeast, and seven in the north, partly in the northwest and partly in the northeast. Aside from three small counties (Ohio, Blackford and Floyd), the only county having less than 3,500 acres in wheat is Brown, which has only 1,000. The counties with largest average acreages are Knox, 55,800; Posey, 47,400; Shelby, 45,000; and Rush, 43,800.

Figure 8 shows the percentage of the total area of each county which was sown to wheat for the average of the 15 years, 1923-1937. It makes conspicuous the fact that two areas devote relatively large shares of their area to wheat, one at the southwest and the other at the southeast, some distance north of the corner. In these areas about one-sixth of all the land is used for wheat, in Posey County 19%. On the other hand, a large area in south-central Indiana and smaller ones in northwestern and northeastern Indiana devote less than 8% or even less than 4% of their land to wheat. The southern large area with little wheat contains much hilly land, ill-adapted to wheat; the northwestern area contains much sandy land also unfavorable to wheat. The counties which devote one-sixth or more of their land to wheat are situated in the southern half of the state, rather than in the northern half, partly because the higher average winter temperatures are more favorable.

Figure 9 discloses that in much of the region south of the National Road (No. 40) more than one-fifth of the cropland is devoted to wheat; north of that line an average of only about one-eighth is so used. Ex-

ceptions to the rule that about one-fifth of the cropland of southern Indiana is devoted to wheat are found in Brown (5%), Monroe (8%) and some adjacent or Ohio River counties where about one-eighth or less is so used. Likewise, along the northern border of the state, more of the cropland is devoted to wheat than is true for the average of northern Indiana.

The counties with the largest proportion of their cropland in wheat for the average of a recent decade are Posey 39%, Vanderburgh 33%, Knox 32%, Bartholomew 30%, Shelby 29%. Conversely, the counties with least wheat relatively are Benton, Blackford, Brown, Jay, Delaware and Boone, with from 4.4 to 7%.

Figure 10 shows the changes in the amount of land devoted to wheat for the average of the last five years as compared to the average of the preceding ten years. Whereas 19 counties had shown a 10% or greater decrease in land in corn and only two had shown a 10% or greater increase, the opposite condition prevailed as to wheat. Only seven counties showed more than a 10% decrease; one-third of the counties of the state showed an increase of more than 10%. The decreases are in the northwest and south, and the increases are most general in the northeast quarter; but more than a dozen counties of the southern third of the state also show increases. The increases are largest in the section where relatively little land is devoted to wheat without any obvious reason (see discussion of Fig. 8). Another factor is that in recent years a new variety of wheat has been developed which grows better than those previously available in the northeastern part of the state.

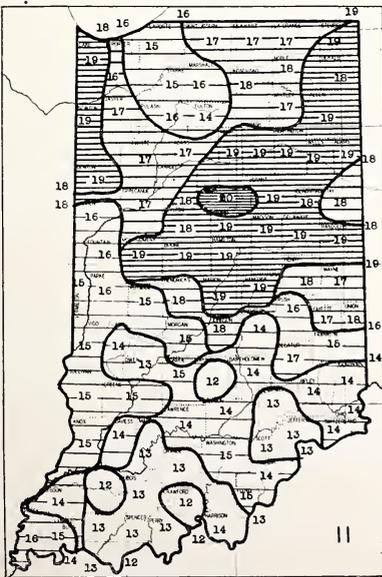


Fig. 11. Wheat: County average yields (18 year average, 1920-1937). Bushels per acre.

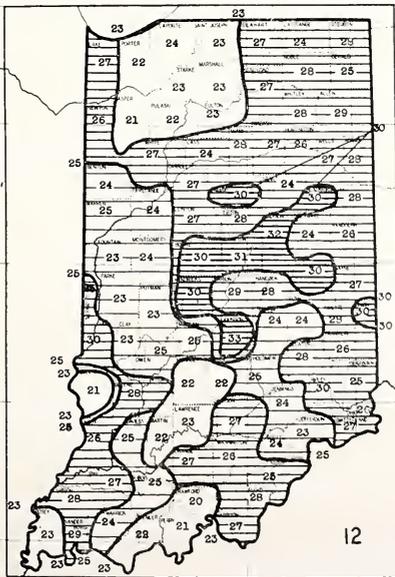


Fig. 12. Wheat: Maximum yields, county averages; highest in 16 years (1920-1937 except 1921, 1922). Bushels per acre.

## Average Wheat Yields

Figure 11 presents the county average yields of wheat for the average of 18 years, 1920-1937. The length of this period is significant because wheat yields vary widely in Indiana. This map shows that in a large northeastern and a small northwestern area yields average from 18 to 19.5 bushels, whereas in most southern counties the average is less than 14 and in three is less than 12. The large northeastern area with especially high yields is the one in which the acreage devoted to wheat has increased. In the counties where an exceptionally large proportion of the land is devoted to wheat, the yields are not large, however. This suggests that in those sections considerable land ill-adapted to wheat is sown to it or all of it is not as well cared for as is most of the wheat in the north.

## Maximum and Minimum Wheat Yields

Figure 12 shows the greatest county average wheat yield per acre harvested from 1920-1937 (except 1921, 1922, for which strictly comparable data are not available). It discloses that in the best year average yields of 30-33 bushels were obtained in seven central counties but that even in their best year eight northern and nine southern counties received less than 22 bushels, Crawford with 20 being the lowest. The eastern counties fared better than the western ones. For the state as a whole, the average yield was 25.9 bushels in 1931, 21 in 1918, 20.7 in 1906, and 20.0 in 1926.

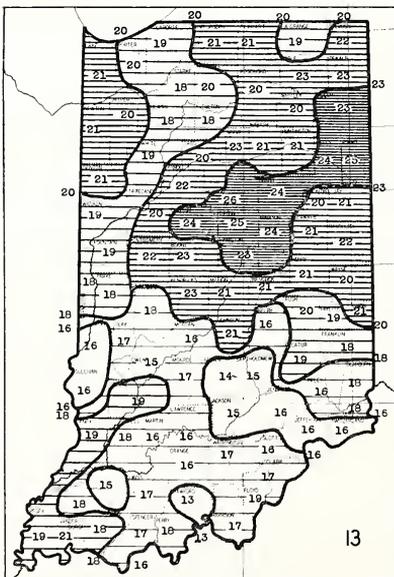


Fig. 13. Wheat: Yields in good years. In the best two years in a decade, even better county average yields are received. Bushels per acre.

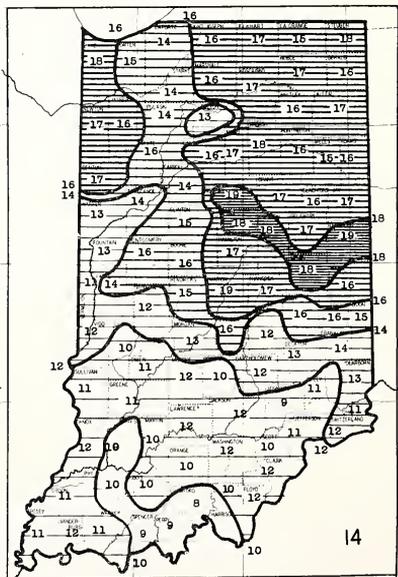


Fig. 14. Wheat: Yields in even a poor year. Only the poorest two years of a decade have lower county average yields. Bushels per acre.

A map, not published, of the smallest county average yields during the 16 years considered in Figure 12 discloses that in poor years central Indiana, except some western counties, had yields of about one-half greater than those received in many southwestern or northern counties and twice as great as Pike, Gibson, Posey, Parke, DeKalb, Cass, La-Grange, and Kosciusko counties, which had averages of only six bushels per acre. Several other southwestern counties had averages of only seven bushels, namely, Harrison, Crawford, Orange, Spencer, Clay, and Vigo, as did also five northern counties, Lake, Pulaski, Fulton, Marshall, and Noble. For the state as a whole, the average wheat yield was only 5.3 bushels in 1900, 8.0 in 1912, and 9.0 in 1896.

### Normal Range In Yields

The maximum and minimum yields of record suggest the limits, but from a practical point of view it is even more desirable to know the normal range in yield. Figure 13 shows the yield that can reasonably be expected in a good year. Only the best year in a decade has appreciably larger county averages. This map discloses that in good years wheat yields of 20 bushels per acre are received in the northeastern quarter of the state, the central part of which area receives averages of 23 bushels per acre. On the other hand, all of southern Indiana received less than 20 bushels, much of it less than 18 and ten counties less than 16 bushels.

Figure 14 discloses the yields which may be expected in even poor years but not the very poorest of a decade. In only the three worst years of 15 (1923-1937) was the yield smaller than is shown in this map. It discloses that 16-bushel yields can quite confidently be expected even in poor years in the northeastern quarter of the state and in four northwestern counties but that only one southern county receives yields greater than 12 bushels in such a year, although six receive averages of less than 10 bushels.

### Distribution of Oats

Three-fourths of Indiana's counties have devoted for the average of the past decade 10,000 acres or more to oats. The exceptions are in a wide belt parallel with the Ohio River, extending from Gibson to Union county with a short northward extension in central-southern Indiana. Many northern counties devote 30,000 or more acres to oats, and four northwestern counties (Benton, White, Jasper, and Newton) devote from 50,000 to 78,000 acres. The counties with smallest acreages, (aside from the small Fayette, Union, Ohio, Floyd, and Scott counties) are Brown 2,500, Martin 4,000, Clark 4,500, and Jennings 4,500.

Figure 15 discloses that in the southern half of the state less than one-tenth of the land is sown to oats on the average; in the northern half only the northeastern counties have less than one-tenth of their land thus used, and most counties have one-eighth or more of their land in oats. Two large areas, one at the east and the other at the west, have 15% or more of their land in oats; four western counties have more than 20% in oats and Benton County, 30%. At the other extreme, eleven

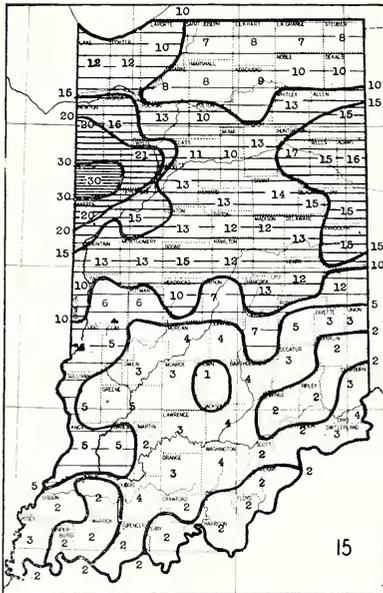


Fig. 15. Oats: Percentage of total land area which is sown to oats (10 year average).

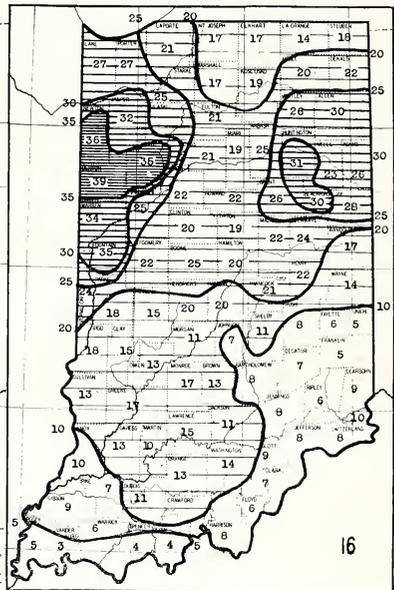


Fig. 16. Oats: Percentage of cropland sown to oats (10 year average).

southern counties have less than 2% of their land area in oats. Brown County with 1.2% has least.

Figure 16, of the percentage of the cropland which is sown to oats, discloses that oats occupy less than one-tenth of such land in the south-east, less than 5% in the extreme south, but more than a quarter of such land in large areas in the northwest and northeast. Benton County leads with 39% of its cropland in oats for the average of a recent decade.

#### Yield of Oats

The yield of oats varies widely in Indiana. For the entire state it has varied since 1887 from 13.5 bushels per acre in 1934, 17 in 1933, 17.5 in 1890, to 42 in 1917 and 1918, 41 in 1920, and 40 in 1912. The average yield for the state as a whole for 1887-1934 is 29.8 bushels per acre. Figure 17 shows the average yields by counties for the 15 years, 1920-1934. It discloses that in the northeastern quarter yields of 29 or more bushels were average; in most of southern Indiana yields were less than 23 and in seven counties 21 or less.

Figure 18 shows the maximum yield of oats during twelve recent years. During this period no one of the exceptionally favorable seasons for oats is included, and hence the maxima shown are not the highest yields ever received. Nevertheless, the period included two years with a high state average (37 bushels), and hence the maxima shown on this map presumably approach the all-time high. Figure 18 discloses that in

the best year county average yields of 45 bushels per acre or more were received in seven counties in the eastern half of the state with yields of 40 to 45 received in about 25 other counties, all in the northeast two-thirds of the state. In most of southern Indiana the largest county averages were less than 35 bushels per acre and in four counties, chiefly in the southeast, less than 30 bushels.

In the poorest year for oats, yields of 15 bushels per acre or less were received in most counties.<sup>6</sup>

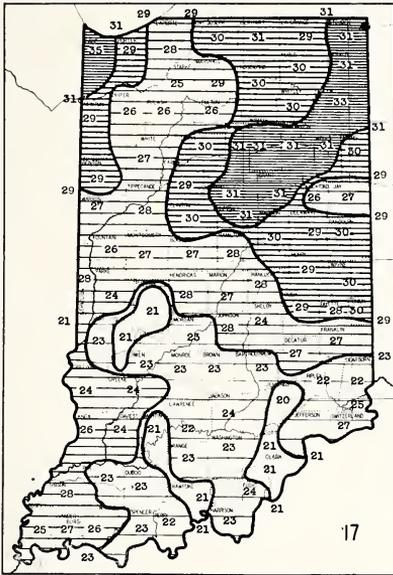


Fig. 17. Oats: Average yields, county averages for a recent 15 year period. Bushels per acre.

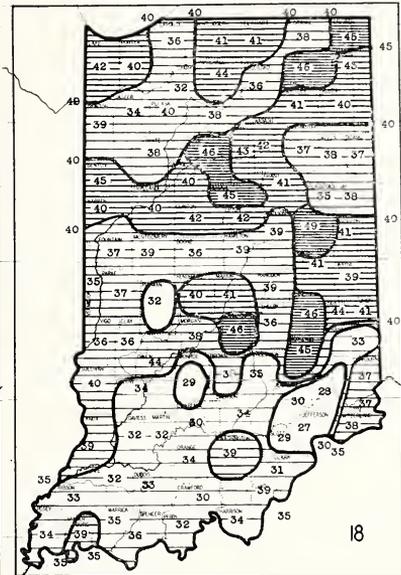


Fig. 18. Oats: Maximum yields, county average, 1923-1931. Bushels per acre.

### Conclusions

The distribution of corn, wheat, and oats over Indiana is far from uniform, despite the fact that all three are important in each of the 92 counties. Differences in the proportion of the total land area and of the cropland thus used vary somewhat systematically. Corn occupies nearly or fully one-half of the cropland in all but the most northern elevated and sometimes too cool counties. Wheat occupies a large share of the land of the section with mildest winters because the wheat is winter wheat. Oats are least extensive along the state's southern border where hot weather often comes too early to permit proper development in the spring (the oats are spring sown). Oats are most extensive, in rotation with corn, in the northwestern part of the state.

<sup>6</sup> Acknowledgments: Assistance in making the numerous calculations was received from three students working for the N. Y. A., especially James Hyndman and Alice Rosenthal. The maps were drafted with the aid of a grant from the Graduate School of Indiana University.

Relative abundance of land devoted to these crops does not correlate closely with average yields. Corn occupies more than half of the cropland in many counties which have a relatively low yield. Similarly, wheat is most extensively sown in one of the less productive areas; conversely, wheat is distinctly less extensive in several counties which have above average yields. Likewise, oats yield better in the eastern than in the western half of the state but are more widely grown in the western half.

The maps of non-average yields throw light upon the contrasts from year to year in the yields and are helpful in understanding certain aspects of the distribution. The distribution of these crops, however, reflects several influences aside from yields, particularly the facts that: (a) no better crop is readily available; (b) the requirements for labor of these crops do not conflict badly, and hence they are often grown so that the farmer is occupied at periods when otherwise there would be little to do; (c) the possibility of receiving a big yield. The maps of maximum yields indicate this inviting possibility.