Indiana Regional Contrasts in Large Corn Yields

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In the *Proceedings* for 1938, the regional contrasts in average corn yields were mapped and discussed, as were the county average yields in the best one-fifth of the years and in the best year of the fifteen studied. The maps were made from estimates compiled by the Crop Reporting Service of the U. S. Department of Agriculture (1). The present study is of yields of 100, 125, 140, 150 and more bushels per acre authenticated by the Indiana Corn Growers Association. This study has three chief objectives: 1) To make more widely known Indiana's unexcelled record in the production of large yields and to present some of the reasons for this high rank. 2) To throw light upon the comparative significance of various factors which affect yields. This is aided by revealing the significant regional contrast in the frequency of big yields. 3) To illuminate the problem of weather and crop yields (2). This is aided by disclosing the fluctuations from year to year in the number and size of yields.

The first of the accompanying maps shows the distribution by counties of the 3,605 five-acre tracts which have produced some time in the fifteen years 1923-1939 an authenticated yield of one hundred or more bushels of corn per acre. The figure entered in each county is the total number of such yields in that county. The counties which are most darkly shaded have had the most such yields, each of them at least sixty-five during the fifteen years. The counties which are unshaded have had fewer than fifteen such yields, several of them none.

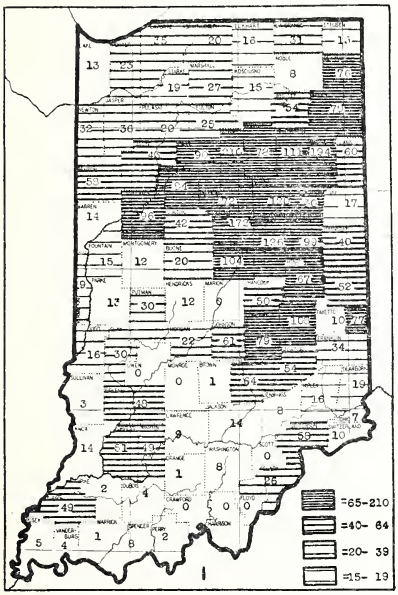
An authenticated yield of one hundred bushels per acre or more for the average of a five-acre plot entitles the member producing it to a gold medal awarded by the Indiana Corn Growers Association, which Association includes the outstanding corn growers of Indiana. The data for Figures 1 and 2 were obtained from the Annual Reports of the Association (3).

The first map makes conspicuous the fact that the farmers of a triangular region extending from Union County at the southeast and DeKalb County at the northeast to Lafayette at the west have grown an exceptional number of hundred bushels per acre yields. To almost all of the counties in that region have gone at least sixty gold medals during the fifteen years.

Few of the farmers of southern Indiana have succeeded in obtaining hundred bushel corn yields. In six counties none have been authenticated during these fifteen years; three others have had only one such yield and several others have had only a few.

The northern-most counties of Indiana have had many more big yields than have most of those of southern Indiana, but Figure 1 shows clearly that the counties along the northern border of Indiana have fewer than those not quite so far north.

A more surprising revelation of this map is that the western counties of Indiana have had far fewer high yields than have the eastern counties. This is despite the fact that corn is of especial importance in most western counties and also that Purdue University is located in the western part of the State. Purdue University, through its experiment station, agronomy department, and extension division, has played an important role in helping the more progressive farmers to obtain high yields.



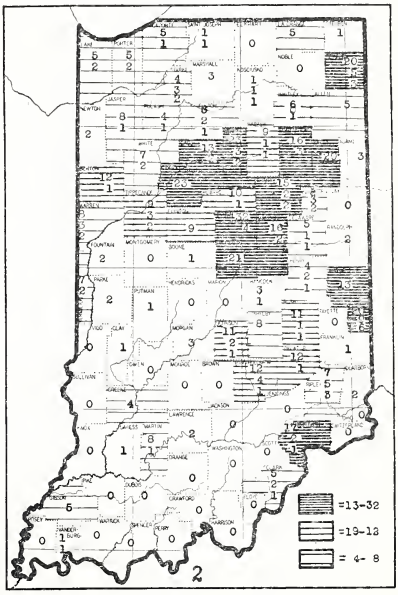


Fig. 1. Number of hundred-bushel corn yields, 1925-1939. Data from Annual Reports, Indiana Corn Growers Association.

Fig. 2. Number of corn yields of more than 125 bushels, 1925-1939. First figure is total, second is 140-bushel yields, third is 150-bushel yields. Data from Annual Reports, Indiana Corn Growers Association.

No county bordering Illinois is in the highest classification on this map and only two are in the second classification. On the other hand, three of the eastern-most counties are in the highest category and three others are in the second.

The fact that the most southern and the most northern counties have had relatively few hundred-bushel yields is by no means entirely due to the inferiority of the soil. The five-acre tracts which have had hundred-bushel yields are practically all carefully fertilized, and although the average soil is not so good in some counties as in others, at least small areas of soil adapted to successful fertilization occur in each county. The highest yield ever obtained in Indiana was produced on well-fertilized muck land in northern Indiana and the second highest yield was produced on river-bottom land in southern Indiana.

Hundred-bushel corn yields, nearly three times the normal or average Indiana yield, are obtained only when several conditions are favorable. Superior seed is required, of course, as well as highly fertile soil, excellent care and proper spacing of the plants. These conditions practically always are achieved as a result of exceptional knowledge and effective work on the part of the farmer. But even though the farmer does his work with the best of skill, a big yield is not possible unless the weather is favorable. The importance of the weather is shown by the variation from year to year in the number of hundred-bushel yields obtained by the same farmers. For example, in 1925 there were 191 such yields in Indiana, but the next year there were only about a fifth as many (forty-one). In 1929 there were 105 such yields but in 1930, when most of the state was affected by a severe drouth and exceptionally high temperatures during July, there were only twenty-three yields of a hundred bushels per acre or more. These were mostly in localities which happened to have thunder storms which broke the drouth. Likewise, during 1934, when a mid-summer drouth was widespread, there were only thirty-four farmers who had hundred-bushel yields. In 1935, there were more than three times as many (113). In 1936, likewise, there was a severe drouth with record-breaking high temperatures, with the result that only seventy farmers succeeded in getting hundred-bushel yields. In 1937, weather conditions were exceptionally favorable and 596 hundred-bushel yields were authenticated. The weather was good in 1938 and 686 hundred-bushel yields were authenticated; in 1939 weather conditions were remarkably favorable during the weeks which are most important for corn, with a partial result that 1,499 Indiana farmers harvested yields which averaged for five acres an authenticated one hundred bushels per acre or more. The number of authenticated hundred-bushel yields in the other years of this fifteen-year period is as follows: 1927 (65), 1928 (40), 1931 (37), 1932 (93). For convenience of comparison with these high yields, the Indiana average corn yields for 1925 to 1939 were as follows: 1925 (43.5), 1926 (38), 1927 (31.3), 1928 (35.2), 1929 (32), 1930 (26.5), 1931 (39), 1932 (37.5), 1933 (29.5) 1934 (24.8), 1935 (38), 1936 (25.5), 1937 (45), 1938 (41), 1939 (51.5).

The larger number of big yields during the last few years compared with most of the early ones is partly due to the widespread recent use of hybrid corn, which was almost unknown a few years ago. Nevertheless, many of the big yields of recent years and even of 1939 were not of hybrid corn. Factors of great importance, however, in explaining the increase in high yields are the increased knowledge of the agricultural methods by which such yields can be obtained when the weather is favorable, and the desire to compensate for the reduction in acreage called for by the Soil Conservation Act. This Act, by encouraging the growing of legumes, has also been significant in improving the soil.

The influence of outstanding leadership is shown on this map at numerous points. Counties which have had, at least for a time, agricultural agents possessed of special ability and enthusiasm stand conspicuously ahead of their neighbors. Examples are Martin, Daviess, Gibson, and Jefferson counties. The exceptionally high standing of

Tippecanoe County, because of the accessibility of Purdue University, is another example of the clear influence of leadership. On the other hand, certain counties have done much less well than the records of their neighbors suggest is possible. The farmers of such counties presumably have not had as successful leadership in this respect, or else some other conditions have been unfavorable.

When the number of high yields is totalled by groups of counties, most of the irregularity which is due to the presence of a few exceptional farmers disappears. For example, despite the good record of a small group of farmers in Martin County, the south-central fifteen counties of Indiana have had an average of less than a single hundred-bushel yield per county per year. By contrast, an equal number of counties of the same average size in the eastern part of north-central Indiana, Grant County and its neighbors, have had a county average of about ten such yields each year. Likewise the sixteen most northerly counties have each produced an average of only one or at the most two such yields per average year while each of the sixteen counties just to the south of these northern ones produced an average of about two and one-half times as many. Just south of the best part of the state in this respect the average number of high yields is even smaller than it is in the most northernly sixteen counties, and the average decline continues and increases fairly rapidly toward the south. The eight counties bordering on the Ohio River west of Louisville have produced a total of only twenty such yields in the fifteen years despite the famous fertility of the river-bottoms. The ten counties bordering Illinois produced 223 such yields, or an average of 1.4 per year each, while the ten counties bordering the state of Ohio produced more than twice that many (459).

Another way of stating the regional contrasts in big yields is: Of the counties which have few or no hundred-bushel yields, only two are in the northern third of the state, seven are in the central third and twenty-one are in the southern third, including all but one of those which have not had such a yield in this fifteen-year period.

Thus it is apparent that with two chief exceptions there is an average increase both toward the north and toward the east in the number of high yields. The first of these exceptions is that the most northernly counties do less well than do those not quite so far north. The second exception is that southwestern Indiana stands almost as high as southeastern so far as number of yields per county is concerned, although not in the size of the yields. (Several of the highest yields produced in Indiana came from the southeast, none of them from the southwest.) Part of any advantage which the southwest has over the southeast in the number of high yields per county is, however, due to the fact that the counties of southeastern Indiana are relatively small in area.

Some comparisons between Figure 1 and some maps published in the Indiana Academy of Science Proceedings for 1938 (1) are of interest. The area of most hundred-bushel yields is not the one in which corn occupies an exceptionally large percentage of the crop land. That area is mostly in the south-central part of the state, where, for example, in Pike and Brown counties fifty-seven and fifty-six per cent of the crop

land, on the average, is in corn. This means that much corn is planted year after year on the same land.

Many of the counties with numerous hundred-bushel yields are in the area which had, during the fifteen years studied, relatively high average yields; thirty-eight to forty-three bushels per acre for the entire county. The part of the state which has low average yields (less than twenty-nine bushels per acre), include only two of the counties shaded in the present maps, namely, Jefferson and Clark.

The part of the state which has county average yields of from forty to forty-eight bushels in the best one-fifth of the years includes all the counties with the most hundred-bushel yields with the exception of Tippecanoe County. None of the counties which have county average yields of less than thirty bushels per acre in the best one-fifth of the years are shaded on the present map. However, only three of them (Crawford, Perry and Owen) have not received at least one authenticated hundred-bushel yield. Only the far northern counties and Fayette County have relatively high county average yields in their best one-fifth of the years and yet have relatively few hundred-bushel yields. (Fayette County is relatively small in area.)

One hundred-twenty-five-bushel Yields

Figure 2 shows the distribution of the 517 yields of 125 bushels per acre or more which have been authenticated by the Indiana Corn Growers Association during 1925-1939. Even in Indiana, yields of 125 bushels per acre are less than one-sixth as numerous as yields of 100 to 124 bushels. Indeed they were quite rare until 1939 when 274 farmers were fortunate enough to obtain so large a yield. The other years of these fifteen had the following number of 125-bushel yields: 1937 (92), 1938 (84), 1925 (12), 1927 and 1932 (each 9), 1933 (7), 1931 (6), 1929 and 1934 (each 5), 1935 and 1936 (each 4), 1928 (3), 1926 (2), 1930 (1).

On Figure 2 some of the counties have more than one typed figure. The second, if it is present, indicates the number of authenticated yields of 140 or more bushels per acre which have been received in these fifteen years. The third figure, for the few counties possessing it, records the number of yields of 150 bushels or more per acre.

This second map is shaded with respect to the number of 125-bushel-per-acre yields. The counties which have had most such outstanding yields are shaded most. The medium shading indicates from nine to fourteen such yields, and the lightest shading indicates three or less. Twenty-eight of Indiana's ninety-two counties have not had during the fifteen years an authenticated 125-bushel yield.

The counties which have grown the largest number of 125-bushel yields of corn are nearly all situated in north-central Indiana, but several southeastern counties also stand high. No county on the northern border of the state has had more than five such yields in these fifteen years and of those which border on the Ohio River only one has had more than five, namely Jefferson County. Of those bordering on Illinois, three counties about mid-way between north and south have had seven to twelve such yields. Three of the counties on the eastern margin of the

state have had from thirteen to twenty such big yields. Of the counties which have not recorded a 125-bushel yield, three are in the northern third of Indiana, seven in the central third and nineteen in the southern third.

The two western tiers of counties have had seventy-nine yields of 125 bushels or more, the two central tiers have had 158, the two eastern ones, 161.

It appears, therefore, that until the northern and the eastern borders of the state are approached, there is a general northward and eastward increase in the 125-bushel yields comparable to that noted in the hundred-bushel yields.

One-hundred-forty-bushel Yields

Yields of 140 bushels per acre are decidedly more rare than those of 125 bushels. During 1925-1939, inclusive, there have been only eighty-seven such big yields, of which fifty-two occurred in 1939. The number in the other years were: 1937 (15), 1938 (10), 1931 and 1932 (each 2), and one each in 1925, 1927, 1933, 1934, 1935 and 1936. There were none in 1930.

The number of the 140-bushel yields which have been authenticated in each of the counties is indicated, it will be recalled, by the second figure in the county on Figure 2. Thirty-three of Indiana's counties have recently had this large yield. The counties with the largest number of such yields are: Union, nine; DeKalb and Ripley, each five; Tipton, four; Blackford, Huntington, Miami, Starke, Tippecanoe, and Warren, each three; Cass, Clark, Fulton, Grant, Henry, Jefferson, Johnson, Lake, Madison, Porter and White, each two; and the following, one each: Delaware, Hancock, Howard, Jasper, Kosciusko, LaPorte, Pulaski, Rush, St. Joseph, Vanderburgh, and Whitley.

The distribution of the yields of 140 bushels or more per acre is not so sharply concentrated as is that of the yields of 100 to 139 bushels per acre. Such exceptional yields reflect the skill of the grower even more than they do favorable natural conditions. Most of them have been produced by men who repeatedly have had yields large enough to win gold medals from the Indiana Corn Growers Association. Just the right amount of the proper fertilizer, just the right spacing of the corn, neither too little nor too much cultivation, and, of course, highly productive seed are required as well as favorable weather. To add to the difficulties is the fact that the spacing which is best in a wet season is not the same as that in a dry one. Similar variation occurs in cultivation and fertilization.

These high yields (140 bushels), however, have not been obtained in two-thirds of the state's counties, including those in the western half of the state south of the Wabash River, with the one exception of Vanderburgh County. Moreover, that exception had a yield only slightly over 140. This strongly suggests that the prolonged hot weather of southwestern Indiana interferes seriously with high yields. The considerable number of high yields in northern counties suggests that, whenever the season of warm weather is sufficiently long and moist, high yields can

be obtained with proper fertilization and other care. The nine high yields in Union County are of interest, not only because of the active friendly rivalry between several outstanding corn growers, but because Union County is relatively elevated (the county averages 960 ft.), and hence has lower average temperatures than its latitude implies. (The average elevation of southwestern and south-central Indiana is less than 500 ft.) Union County is appreciably cooler than most of the other southern counties (4).

Corn Yields of One Hundred-fifty Bushels or More Per Acre

During 1925-1939 there have been in Indiana thirty-four authenticated yields of 150 bushels or more of corn per acre. Of these, twenty-one were received in 1939, seven in 1937, two in 1932 and one each in 1927, 1931, 1934, and 1938.

There have been during the fifteen years studied eleven authenticated yields of 160 bushels or more per acre of corn in Indiana, seven of them in 1939, two in 1937, and one each in 1932 and 1934. Of these eleven, five have been of more than 170 bushels per acre, two each in 1937 and 1939 and one in 1934. Two yields of more than 180 bushels per acre have been received, one in 1934 and the other in 1939.

The state record for Indiana is 182.6 bushels per acre, produced in 1934 by Harold Pankop, of Corunna, DeKalb County. The second highest yield is of 180.1 bushels per acre, produced in 1939 by Clark Dellinger, of Jeffersonville, Clark County, on the Ohio River. Neither of these record yields was of hybrid corn; the larger was of Reid Yellow and the second was of Johnson County White. The third largest yield, of 179.1 bushels per acre, was produced in 1937 by R. L. Heilman, of Hope, Bartholomew County. This production and the next and many following were with hybrid corn. The fourth highest yield was of 178 bushels per acre grown in 1939 by Paul McCray, of Liberty, Union County. The fifth was of 173.6 bushels grown in 1937 by Alvin C. Brown, of Holton, Ripley County (Johnson County White Corn). Louis Whipple, of College Corner, Union County, holds sixth place with 169.8 bushels of hybrid corn produced in 1939. Other high records in decreasing order are as follows: 7) 167.8 bushels in 1939, Nelson Jones, Whiteland, Johnson County; 8) 165.6 bushels by Herman Pankop, of Corunna, DeKalb County, in 1932; 9) 162.5 bushels by Ewart Farrar, Walkerton, Starke County, in 1939; 10) 162.3 bushels by A. Clamme, Hartford City, Blackford County, in 1939; 11) 162.0 bushels by Alvin C. Brown, of Holton, Ripley County, in 1939.

Most of the foregoing holders of 160-bushel records have in other years produced from 140 to 160 bushels per acre, because, as already remarked, these high yields require exceptional agricultural skill as well as favorable weather. Acquiring this exceptional skill usually takes years. Many of the most successful corn growers began by producing 75 to 85 bushel yields (for which they received a bronze medal from the Indiana Corn Growers Association), then they won a silver medal by obtaining a 85 to 99 bushel yield. Subsequently they produced more than a hundred-bushel-per-acre yield. Some of them won several gold medals

with progressively higher yields whenever weather conditions were favorable. The first authenticated Indiana yield of over 130 bushels per acre was obtained in 1925 (144 bushels), the first yield of over 150 bushels was obtained in 1927 (152.6); the next one of over 140 bushels was obtained in 1931 (156). The next year, the latter farmer set a new record of 165.6 busels, and three years later his younger brother set the present record of 182.6.

Indiana Compared With Other States

Extended correspondence has disclosed that several states have corn growers' associations modelled after Indiana's. They have, however, operated for fewer years, and use somewhat different standards. For example, the unit of area considered is ten acres in Ohio, Illinois, and Iowa, instead of five, as in Indiana and Minnesota. It is believed, however, by men qualified to judge the matter, that more than ninety per cent of Indiana's hundred-bushel yields have come from fields of ten acres or more. Only in the muck lands of northern Indiana and in some of the river bottoms of southern Indiana are five-acre fields important in the contests. In parts of these latter areas it is impossible to have compact ten-acre fields of high fertility.

A significant variation in standards used is with respect to moisture content. New corn varies widely in moisture content from season to season and field to field, occasionally having as much as thirty-five per cent of its weight moisture; rarely as little as ten per cent. The standard used in Indiana is 17.5 per cent; in Ohio it is 20 per cent; in Illinois 16.5; in Iowa 15.5; and in Minnesota 14. The authenticated yields reported from each state are based on the adopted moisture content. Consequently, interstate comparisons require recalculation of the yields to put them on a comparable basis.

Ohio produced in twelve years (1917-1928) 181 hundred-bushel yields, while Indiana produced 571 in the same period. The highest authenticated yield was 176.2 bushels per acre, which on the basis of the moisture content used in Indiana would be slightly less than 172 bushels. Indiana has had five authenticated yields in excess of 172 bushels.

Illinois in ten years (1930-1939) had 187 hundred-bushel yields, of which 102 were in 1939. (The comparable totals for Indiana were 3,220 and 1,499). During 1939 three Illinois farmers obtained 150-bushel yields, in contrast with twenty-three in Indiana. The highest Illinois yield ever authenticated was 155.4 bushels in 1939. This is equivalent to 157 bushels with 17.5 per cent moisture. A map of Illinois' hundred-bushel yields reveals that only two were produced in the southern thirty-five counties; by contrast, the thirty-five counties of northern Illinois had 117 such yields or nearly two-thirds of the state's total as well as the largest yield. The northern-most tier of counties had, however, only one such yield, and only two counties of the eastern tier had a 100-bushel yield. The largest number of high yields have been obtained from the central and north-central part of the state.

Iowa, during 1938 and 1939, had 328 100-bushel yields; 265 in 1939, in contrast with 2,185 for Indiana. The highest yield authenticated for

Iowa is 163 bushels of 15.5 per cent moisture content corn, which is equivalent to 166.5 bushels on Indiana's basis. Indiana had in 1938 and 1939 five larger yields.

Minnesota had in 1939 thirteen hundred-bushel yields on the basis of 17.5 moisture content, the highest being 131. Nine of these yields came from the southern tier of counties, two from the next tier and the remaining two from elsewhere in the southern third of the state.

Scattered reports of larger yields from other states are worthy of mention. Apparently all of them ignored moisture content, and some of them were by measure rather than by weight. (Two bushel baskets of new ear corn often yield less than a bushel of shelled corn of standard moisture content). The highest reported yield, 225 bushels from a single acre in the elevated cooler part of western North Carolina, experts believe, was equivalent to considerably less than 200 bushels of 17.5 per cent moisture corn, a total which has been excelled by the best acre of several Indiana fields. Indeed, one four-acre DeKalb County tract was estimated by competent judges to have yielded an average of more than 200 bushels per acre.

Summary and Conclusions

During the fifteen years 1925-1939, inclusive, authenticated yields of at least one hundred bushels per acre as the average of a compact five-acre tract have been produced on 3,605 Indiana farms, with the result that the farmers have been awarded a gold medal by the Indiana Corn Growers Association. During these years there were 517 such five-acre tracts which produced at least 125 bushels per acre, and eighty-seven which produced at least 140 bushels. Eleven have produced 160 bushels or more, five have produced more than 170 bushels, and two 182.6 and 180.1 bushels per acre.

Although the human factor is of supreme importance in obtaining such phenomenally large yields, favorable weather is essential, as is proved by the wide variation from year to year in the number of big yields. For example, in 1925 there were 191 hundred-bushel yields but in 1926 only forty-one; in 1929 there were 105, but in 1930 only twenty-three. The distribution of these big yields over the state strongly suggests that there is an average improvement in climate for corn from the south northward, until the northern-most counties are almost reached, and from the west eastward, except for the most elevated northeastern counties which have produced fewer large yields than their neighbors. Corresponding northward and eastward average increases were found as to county average yields discussed in the Proceedings for 1938. Northern Indiana normally is distinctly less hot and less subject to July drouth than is southern Indiana and is also less subject to damaging rainstorms (4). The eastern part, because of its greater elevation, also has fewer hours of high temperature than does the western part in corresponding latitudes. Much evidence indicates that for large yields not only must there be abundant rainfall and warmth, but that temperatures above 90° are harmful. (5).

In brief, Indiana farmers have achieved national prominence with respect to both corn yield and corn quality (as shown by many prizes for the finest corn exhibited at the International Livestock and Grain Exposition) not only because many of the farmers are exceptionally well informed and otherwise competent but because Indiana is a superior state for corn growing.

References

1. Visher, S. S., 1939. Indiana distribution and yield of corn, wheat, and oats. Proc. Indiana Acad. Sci., **48**:143-156.

2. Visher, S. S., 1940. Weather influences on crop yields. Corn, wheat, oats, and their yields in Indiana correlated with the weather by climographs. Econ. Geog., **16**:437-443; Abstract published in the Proc. Indiana Acad. Sci. for 1939, P. 118.

3. Beeson, K. S., (editor) Indiana Corn Grower's Association Annual Reports. Indianapolis.

4. Visher, S. S., 1935. Indiana regional contrasts in temperatures and precipitation, Proc. Indiana Acad. Sci., **45**:188-204.

Visher, S. S., 1938. Rainfall intensity contrasts in Indiana, causes and consequences, Geog. Rev., **28**:627-637.

5. Visher, S. S. (See footnote 2.)

Rose, John Kerr, 1936. Corn yield and climate in the corn belt, Geog. Rev., **26**:88-102. See also Proc. Indiana Acad. Sci., **41**:317-321.