



Changes in Yields, Acres, and Prices of Cereal Grains over Time in the United States

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Since the early 1950s, U.S. acres in corn have increased while decreases have occurred in other cereal crops (barley, oats, rice, rye, sorghum, and wheat). These acreage changes likely are related to the greater growth rate in corn yields as compared to the yields for other crops. As has happened in the past, crop production likely will become more concentrated if differential yield responses continue to exist across crops.

Approach

USDA typically designates nineteen "principal crops" grown in the United States (see page 5 of [NASS Acreage report](#)). Of these nineteen, seven are cereal crops: barley, corn, oats, rice, rye, sorghum, and wheat. Cereals are high in energy, often providing calories in the diets of humans and animals. As such, these grains can substitute for one another, particularly in livestock diets. In the following sections, changes in yields, harvested acres, and prices are compared across crops.

All data were obtained from the National Agricultural Statistical Service (NASS) and represented values for the United States. Averages were calculated for the five years at the beginning of each decade starting with the 1950s and ending with the 2010s. Then each decade average was divided by the average from 1950-54. As a result, the 1950-54 values for yields (panel A of Table 1), acres harvested (panel B), and prices (panel C) for all crops equal 1.00. This normalization process allows easy comparison of changes across crops over time.

Change in Yields

For corn, the 1960-64 yield value is 1.59, meaning that corn yields were 59% higher in 1960-64 than in 1950-54. Corn yields increased in each decade: 2.14 in 1970-74, 2.54 in 1980-84, 3.04 in 1990-94, 3.59 in 2000-04, and 3.82 in 2010-14. Since the 1950s, corn yields in the United States increased by 282% (i.e., 3.82 value – 1).

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Of the cereal grains, corn had the highest yield increase. Based on 2010-14 values, the rank order of crops was 1) corn (3.82), 2) sorghum (3.11), 3) rice (3.03), 4) wheat (2.63), 5) barley (2.53), 6) rye (2.10), and 7) oats (1.86). Overall, only three crops had yield increases above 200% from the 1950-54 period to the 2010-14 period: corn (3.82), sorghum (3.11), and rice (3.03).

Similar rankings existed for earlier periods, except that corn and sorghum switched places. Sorghum yields exceeded corn yields in 1960-64, 1970-74, 1980-84, and 1990-94. Corn yields then exceeded sorghum yields in 2000-04 and 2010-14.

Table 1. Change in Yields, Harvested Acres, and Prices, Cereal Crops In the U.S.

Period	Barley	Corn	Oats	Rice	Rye	Sorghum	Wheat
Panel A. Changes in Yields (Base Period = 1950-54) ¹							
1950-54	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1960-64	1.22	1.59	1.29	1.54	1.49	2.19	1.46
1970-74	1.51	2.14	1.49	1.89	2.01	2.77	1.81
1980-84	1.91	2.54	1.63	1.95	2.24	2.82	2.11
1990-94	2.08	3.04	1.70	2.36	2.13	3.37	2.19
2000-04	2.18	3.59	1.84	2.74	2.11	3.02	2.37
2010-14	2.54	3.82	1.86	3.03	2.10	3.11	2.63
Panel B. Change in Harvested Acres (Base Period = 1950-54) ²							
1950-54	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1960-64	1.19	0.84	0.60	0.82	1.05	1.50	0.77
1970-74	0.94	0.87	0.39	0.80	0.74	1.72	0.81
1980-84	0.91	0.97	0.24	0.90	0.48	1.56	1.13
1990-94	0.72	0.97	0.12	0.80	0.24	1.16	0.99
2000-04	0.44	1.00	0.05	0.70	0.18	0.89	0.79
2010-14	0.27	1.19	0.03	0.73	0.16	0.63	0.74
Panel C. Change in Market Year Average Prices (Base Period = 1950-54) ³							
1950-54	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1960-64	0.75	0.72	0.81	0.96	0.70	0.75	0.85
1970-74	1.34	1.25	1.21	1.65	1.03	1.30	1.20
1980-84	2.01	1.84	2.17	1.82	1.73	1.94	1.73
1990-94	1.69	1.51	1.62	1.37	1.69	1.64	1.50
2000-04	2.03	1.40	1.94	1.17	2.12	1.58	1.52
2010-14	4.44	3.48	4.38	2.82	5.16	3.92	3.24

Source: Data for National Agricultural Statistical Service, QuickStats

¹ Yields were averaged for five-year periods at the beginning of the decade. Each period average is then divided by the 1950-54 average. The 2.54 for the 2010-14 period for barley means that yields were 154% (2.54 - 1) above the 1950-54 average

² See footnote (1) for explanation of calculation. Panel B applies to harvested acres.

³ See footnote (1) for explanation on calculation. Panel C applies to market year average prices.

Changes in Harvested Acres

Panel B shows values for harvested acre changes. Corn has a value of 1.19, indicating that acreage increased 19% in 2010-14 as compared to 1950-54. Corn is the only crop with an increase. Acres in all other cereals declined. Overall, total acres of these cereal crops have decreased. There were 384 million of cereal crops in the 1950-54 period. Total acres declined by 27% to 281 million acres in the 2010-14 period.

There is strong, positive correlation between yield increases and acreage changes. Following is a rank order of yield and harvested acre changes in 2010-14.

Order	Yield Change	Acre Change
1	Corn (3.82)	Corn (1.19)
2	Sorghum (3.11)	Wheat (.74)
3	Rice (3.03)	Rice (.73)
4	Wheat (2.63)	Sorghum (.64)
5	Barley (2.54)	Barley (.27)
6	Rye (2.10)	Rye (.27)
7	Oats (1.86)	Oats (.03)

These rank orders are remarkably consistent, with only sorghum and wheat switching second and fourth places.

Of special interest is the relationship between corn and sorghum over time. Corn and sorghum are very close substitutes to one another. From 1960-64 to 1990-94, sorghum had a higher yield increase than corn: 2.19 sorghum value compared to 1.59 corn value in 1960-64, 2.77 sorghum value compared to 2.14 corn value in 1970-74, 2.82 sorghum value compared to 2.54 corn value in 1980-84, and 3.37 sorghum value compared to 3.04 corn value in 1990-94. In these periods, acreage changes for sorghum exceeded corn: 1.50 sorghum value compared to .84 corn value in 1960-64, 1.72 sorghum value compared to .87 corn value in 1970-74, 1.56 sorghum value to .97 corn value in 1980-84, and 1.16 sorghum value compared to .97 corn value. The situation reversed in the later periods. Corn yield exceeded sorghum yield increase in 2000-04 and 2010-14: 3.59 corn value compared to 3.02 sorghum value in 2000-04 and 3.82 corn value compared to 3.11 sorghum value. In these later periods, corn acre changes exceed sorghum changes: corn value is 1.00 compared to sorghum value of .89 in 2000-04, and 1.19 corn value and .63 sorghum value in 2010-14.

Changes in Prices

Market year average prices tend to be negatively correlated with yield and acre changes. The following rank orders yield, acre, and price changes in 2010-14. Price changes are listed in reverse order. Wheat has the lowest price increase and is placed first. Rye has the highest price increase and is placed seventh.

Order	Yield Change	Acre Change	Price Change (reverse order)
1	Corn (3.82)	Corn (1.19)	Rice (2.82)
2	Sorghum (3.11)	Wheat (.74)	Wheat(3.24)
3	Rice (3.03)	Rice (.73)	Corn (3.48)
4	Wheat (2.63)	Sorghum (.64)	Sorghum (3.92)
5	Barley (2.54)	Barley (.27)	Oats (4.38)
6	Rye (2.10)	Rye (.27)	Barley (4.44)
7	Oats (1.86)	Oats (.03)	Rye (5.16)

The four crops with the largest increases had the lowest price increase: corn, sorghum, rice, and wheat. The three crops with the smallest yield increases had the highest price increases: barley, rye, and oats. Overall, there is a negative relationship between yield increases and price changes.

Commentary

Many of these cereal crops have specific uses none of the other grains can provide. For example, wheat is used to make flour and the other cereal grains are imperfect substitutes for making the flours that predominate in the United States. Wheat likely will always be produced for this flour demand. However, all of these crops also substitute for one another. The other crops could substitute for wheat in livestock diets. In livestock diets, costs are important in determining use.

The above analysis illustrates a positive correlation between yield and acreage changes, and a negative correlation between yields changes and price changes. Correlations do not imply causality, but these relationships do have an economic rationale. Crops with higher yield increases likely have lower costs than crops with lower yield increases because fixed costs are spread over more production. Lower costs then make the crop more competitive, leading to more use of the crop's production in end use, leading to acreage increases. However, the price for the higher yielding crop does not have to increase as much to induce more production due to the lower costs.

If yield changes differ across crops, there likely will be forces that cause the crop with the highest yield increase to grow in acres. Budgets likely will show the crop with the highest yield increase to be more profitable than crops with lower increases. Diversity of crops may be desirable. For example, pest problems may become more prevalent if one crop is increasingly relied upon. To obtain crop diversity, however, attention likely needs to be paid to yield changes across crops.

Reference

USDA, National Agricultural Statistics Service. *Acreage* (June 2015). Released June 30, 2015. <http://usda.mannlib.cornell.edu/usda/nass/Acre//2010s/2015/Acre-06-30-2015.pdf>