



FEFO 10-01
January 27, 2010

YIELD INCREASES ON ILLINOIS CROPS: QUESTIONS FOR THE FUTURE

Over time, yields on crops grown in Illinois have increased due to technological advances. In this article, growth rates are examined for the four crops with the largest number of acres in Illinois: corn, soybeans, wheat, and alfalfa. Of the four crops, corn has the highest growth rate from 1960 through 2009. In the most recent decade, corn growth rates have exceeded the 1960-2009 average while soybeans, wheat, and alfalfa growth rates have been below 1960-2009 averages.

Yields and Growth Rates

Growth rates were calculated using states yields as reported by the National Agricultural Statistical Service (NASS), an agency of the U.S. Department of Agriculture. Illinois yields released by NASS for 2009 are 175 bushels for corn, 46 bushels for soybeans, 56 bushels for wheat, and 3.9 tons for alfalfa.

Yearly percentage growth rates were calculated for the years from 1960 through 2009. To illustrate calculations, take the corn yield of 179 bushels for 2008 and 175 bushels for 2007. These yields result in a 2008 growth rate of 2 percent ($179 \text{ bushels in } 2008 / 175 \text{ bushels in } 2007 - 1$). Growth rates vary tremendously from year to year, ranging from a high of 68 percent in 1989 down to -44 percent in 1988. This variability makes it difficult to find statistical differences in growth rates across crops and across time.

Growth rates are used rather than yearly bushel (or ton) increases so that comparisons can be made more easily across crops. There are relationships between the two measures. Over time, a constant percent growth rate implies that trend bushel increase is rising. For example, corn has a 1.9 percent growth rate over the 1960 through 2009 period. During the 1960s, corn yields average 87 bushels. A 1.9 percent growth rate implies a 1.7 bushel increase. Average corn yield during the 2000s is 162 bushels and a 1.9 percent increase yields a 3.1 bushel yearly increase, 1.4 bushels higher than the 1960s trend bushel increase.

Growth Rates across Crops

Geometric averages of growth rates from 1960 through 2009 are:

- 1.9 percent for corn
- 1.1 percent for soybeans,
- 1.5 percent for wheat, and
- 0.8 percent for alfalfa.

Over the entire 1960 through 2009 time period, corn has the highest growth rate, followed by wheat, followed by soybeans, followed by alfalfa. The above growth rates lead to higher relative yields for corn than the other three crops during the 2000s.

To illustrate, all of a crops yields were divided by the average crop yield during the 1960s. Corn had an average yield of 87 bushels during the 1960s. All corn yields from 1960 through 2009 were divided by the 87 bushel average during the 1960s. The resulting "normalized" yields were then used to calculate average by decade. Due to the division, all crops have an average of 1.00 during the 1960s (see Table 1). Normalized corn yields average 1.20 during the 1970s (see Table 1), indicating that yields during the 1970s are on average 20 percent higher than during the 1960s. Normalized corn yields increase to 1.31 during the 1980s and 1.52 during the 1990s. During the 2000s, normalized corn yields are 1.86, indicating that corn yields are 86 percent higher during the 2000s as compared to the 1960s.

Table 1. Illinois Crop Yields Normalized by Averages for the 1960s, 1960 - 2009.¹

Decade	Corn	Soybeans	Wheat	Alfalfa
1960s	1.00	1.00	1.00	1.00
1970s	1.20	1.15	1.07	1.20
1980s	1.31	1.23	1.37	1.29
1990s	1.52	1.43	1.35 *	1.36 *
2000s	1.86	1.55 *	1.63 *	1.37 *

¹ Each crops' yields are divided by the average during the 1960s. The 1.20 yield for corn during the 1970s means that the 1970s corn yield was 1.2 times higher than during the 1960s. In other words, the 1970s yields were 20 percent higher than the average for the 1960s.

* Indicates that the respective crop has a statistically lower mean yield than corn during the respective decade. For example, soybean yields during the 2000s were statistically lower than corn yields. The statistical tests of mean were conducted using a 5 percent test level.

Source: Yields taken from National Agricultural Statistical Service. Calculations are original.

Normalized soybean yields during the 2000s are 1.55, indicating that 2000s soybean yields are 55 percent higher than during the 1960s. While there has been growth in soybean yields, soybean growth has lagged corn growth. During the 2000s, normalized corn yields are 20 percent higher than normalized soybean yields ($.20 = 1.86 / 1.55 - 1$). Normalized corn yields during the 2000s are statistically higher than normalized soybean yields during the 2000s. Much of the difference between corn and soybean yields occurred in recent decades. Between the 2000s and 1990s, corn yields increased by 22 percent ($1.86 / 1.52 - 1$) compared to 8 percent for soybeans ($1.55 / 1.43 - 1$). During the 2000s, normalized wheat yields are 1.63 and normalized alfalfa yields were 1.37. Normalized yields for both wheat and alfalfa yields are statistically lower than normalized corn yields.

Growth Rates across Time

Average growth rates were calculated for each decade. Corn, for example, has average growth rates of 4.3% during the 1960s, 2.2% during the 1970s, -0.3% during the 1980s, 1.3% during the 1990s, and 2.3% during the 2000s (see Table 2). As can be seen, there is wide variability in growth rates across decades. None of the growth rates by decade are statistically different than the 1960 through 2009 average.

Table 2. Geometric Growth Rates for Illinois Crops by Decade.

Period	Crop			
	Corn	Soybeans	Wheat	Alfalfa
1960 - 2009	1.9%	1.1%	1.5%	0.8%
1960s	4.3%	2.7%	3.9%	2.5%
1970s	2.2%	1.4%	1.2%	2.0%
1980s	-0.3%	0.3%	3.2%	-0.5%
1990s	1.3%	0.5%	0.2%	0.8%
2000s	2.3%	0.7%	-0.7%	-0.5%

Source: Yields from National Agricultural Statistical Service, U.S. Department of Agriculture. Calculations are original.

While not statistically different, several features of growth rates by decade stand out. The first is that the highest decade growth rates for all crops occur during the 1960s. During the 1960s, average growth rates are 4.3 percent for corn, 2.7 percent for soybeans, 3.9 percent for wheat, and 2.5 percent for alfalfa (see Table 2). The 1960s results contrast with those for the 2000s. Except for corn, all crops have average 2000s growth rates that were below the

1960 through the 2000s average. Soybeans average growth rates are .7% for the 2000s as compared to 1.1% for the 1960-2009 average. Wheat averaged -.7 percent for the 2000s compared to 1.5 percent for 1960-2009. Alfalfa averaged -.5 percent for the 2000s compared to .8 percent for the 1960-2009.

Questions for the Future

Experience during the 2000s suggests that growth rates may be declining from early periods, particularly for soybeans, wheat, and alfalfa. If growth rates are declining, it may be due to a change in public emphasis away from increasing productivity to placing more emphasis on environmental and other societal concerns. As a result, gaining governmental approval of new technologies that increase yields has become longer and more protracted. For example, it is much more difficult today to gain approval of new herbicides and insecticides than in the past. There are “fears” of adopting biotechnology on a number of levels, leading to protracted approval processes and controversy surrounding biotechnologies. Moreover, agricultural production practices have come under scrutiny: Emphases have been placed on switching to more soil conserving tillage practices and on lowering fertilization rates. All of these efforts may have societal benefits, but they do not necessarily lead to increased agricultural productivity. Recent relatively higher growth rates for corn yields stands in contrast to lower growth rates for soybeans, wheat, and alfalfa. A number of potential causes could explain corn higher growth rates. In recent decades, seed and genetic companies have placed a great deal of investment in developing new corn hybrids through traditional plant breeding and use of biotechnology. Farmers have adopted these new hybrids, as evidenced by the high adoption of biotechnology hybrids. In 2009, 84 percent of all acres in Illinois were planted to some biotech hybrid, an increase from no acres before biotechnology altered hybrid introductions were introduced in the 1990s (data from National Agricultural Statistical Service).

More observations on yields in the future will provide further evidence of whether yield productivity is changing over time. Historically, agricultural productivity increases have been substantial and have provided positive benefits, with many of the benefits accruing to consumers in the form of lower food prices. Continued high growth rates would continue this benefit stream.

Submitted by: Gary Schnitkey, Department of Agricultural and Consumer Economics, University of Illinois