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Weekly Farm Economics: Perspectives on Non-decreasing National Yield Trends

Gary Schnitkey, Nick Paulson, and Jim Baltz

Department of Agricultural and Consumer Economics
University of Illinois

Carl Zulauf

Department of Agricultural, Environmental and Development Economics
Ohio State University

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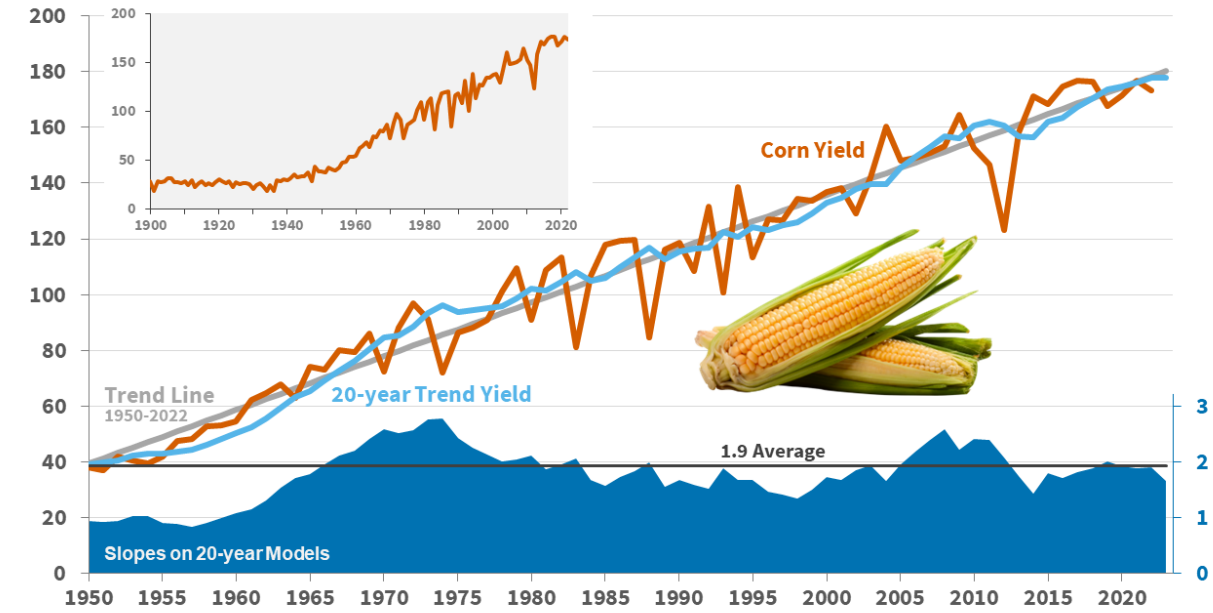
Since the 1940s, yields of many U.S. crops have exhibited significant upward yield trends due to continual technological advances. There may be concerns that trends are decreasing, either through potential impacts of climate change or because technological progress is slowing. Herein, we present an analysis of U.S. yields for the three largest crops in planted acres: corn, soybeans, and wheat. We conclude that an overall slowing of yield trends is not supported.

Corn Yields

Corn yields did not trend up or down during the first part of the 20th century, averaging 26 bushels per acre (see Figure 1). However, corn yields began increasing in the late 1930s and early 1940s. Technologies contributing to yield increases include hybridization and scientific breeding of corn, introduction and enhancements to fertilizers and pesticides, improvements due to mechanization, improvements in tillage and other farming practices, enhancements in irrigation and drainage, genetic modifications of seeds, use of precision farming, and use of new data technologies in agricultural decision-making.

Figure 1. U.S. National Corn Yields



From 1950 to 2022, corn yields have increased by an average of 1.9 bushels per year, according to a linear model fit through yields from 1950 to 2022 (see Figure 1). This line is the best linear fit line through the data from 1950 to 2022 and has a slope of 1.9 bushels per year, supporting a roughly average yield increase of 1.9 bushels per year.

While trending upward, corn yields have exhibited runs of above-trend and below-trend yields relative to the 1950-2022 trend line. Four of the more recent periods are:

- above trend from 2003 to 2009,
- below trend from 2010 to 2013,
- above trend from 2014 to 2018, and
- below or at the trend from 2019 to 2022.

Why those periods exist in the data is a good question. Several years of poorer weather or more conducive weather can influence yields. Moreover, the rate of technical innovations becoming available likely varies, exhibiting ebbs and flows over time. Also, disease and other pest problems could be cyclical. While those periods of above or below trend yields exist, developing predictive relationships for these periods has proven difficult.

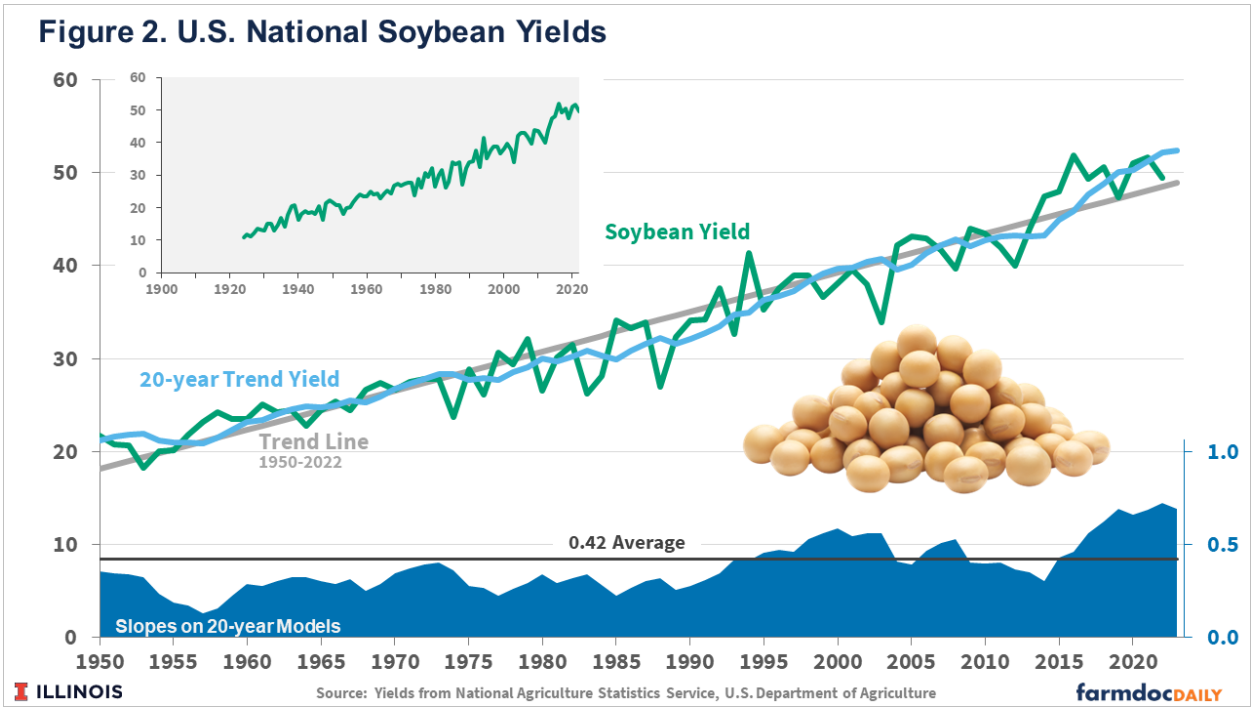
However, the existence of those periods does not suggest that the longer-term trend increases have changed much. To investigate, we fit models of shorter duration. For each year from 1950 to 2023, we used the previous twenty years to fit a linear model and forecast the subsequent trend yield. For example, the 2023 trend yield for these “20-year Models in Figure 1 is found by fitting data from 2003 to 2022 and then forecasting the yield for 2023. The slopes for each of the models also are reported in Table 1. For example, the 2023 model, based on data from 2003 to 2022, results in a 1.7 bushel per acre per year trend.

As expected, yield trends from the shorter duration, twenty-year models vary from the 1.9-bushel average using all years from 1950 to 2023 (see Figure 1). The shorter duration models suggest that yield trends escalated from the 1960s through 1974, reaching levels above the 1.9 average. Then trends declined from 1974 to 1998. Then, trends increased until roughly 2010 and then fell back to the 1.9 long-run average. In recent years, slopes have been around the 1.9 long-run average: 1.9 in 2020 through 2022 and 1.7 in 2023. The lower trend in 2023 results from recent below-trend yields in 2019 through 2022. For

the shorter-duration models, yield trends decreased in years following low yields, with the 1988 and 2012 droughts having a large impact on trend estimates.

Soybean Yields

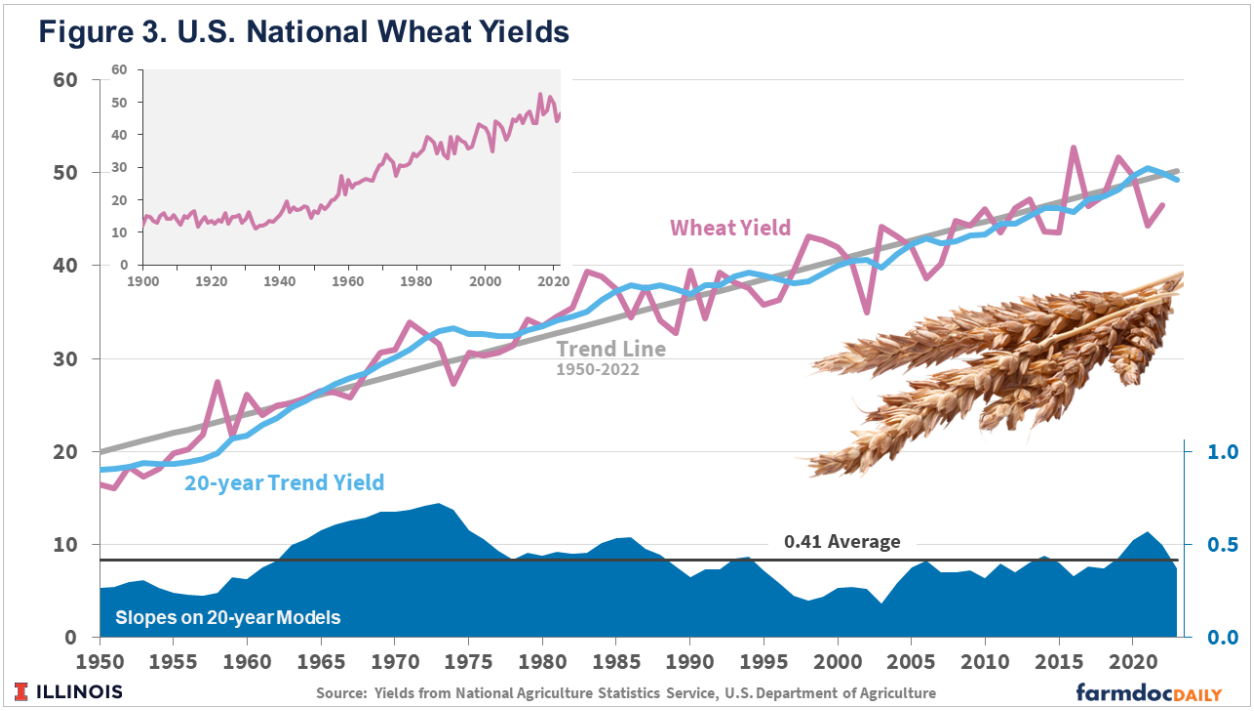
Soybeans were introduced into the U.S. after 1900 and have become a major crop. The National Agriculture Statistics Service (NASS) did not begin reporting soybean yields until 1924. Since 1924, soybean yields have been on a continuing increasing trend.



The average yield increase from 1950 to 2022 is .42 bushels per acre (see Figure 1). If anything, yield trends are higher in the later years. Trends from the 20-year model before 1994 were below the .42 average. Since 2014, soybean yields have been above the 1950-2022 trend. Recent advances in early planting of soybeans, seed inoculations, and soybean genetics likely contribute to higher yields. As a result, trend yields from the 20-year models have been above the 1950-2022 trend yields in recent years.

Wheat Yields

Like corn, wheat yields have been on an upward trend since the mid-1950s, with technological progress playing a large role in these trend increases (see Figure 3). Trend yield averaged .41 bushels per acre using the 1950-2023 trend. The models based on 20 years of data have trends near the long-run average.



Commentary

Yield trends are important in the growth of overall production in the United States, and trend estimates help to project future production levels. Since the 1940s, yields of major crops in the U.S. have trended higher, largely because new technologies have become available. Concerns can exist that those trends are slowing, either because technical innovation has slowed or because climate change is influencing yields. Government policies that slow technological development also could play a role in reducing trends. While increases in yields do exhibit variability over time, there is little support that longer-term yield increases are slowing.

Yield increases and productivity gains in agriculture have been remarkable since the 1940s and should not be taken for granted. Still, there are large incentives to keep innovating. For example, recent advents in use of data in analysis, as well as other technologies, suggest the potential for further productivity increases.

Negative impacts on aggregate yield increases for major crops in the U.S. from climate change may not have yet occurred but remain a risk and concern for the future. Furthermore, the full effect of technological progress could be masked by the effects of climate change, particularly in aggregate data.

Still, it seems reasonable to expect yields to increase in the future. Finding new uses for growing output likely will continue to be a concern and may put downward pressures on commodity prices.