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## One Perspective on High Yield for 2014 U.S. Corn and Soybeans

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### Overview

With U.S. corn and soybean conditions near record good-to-excellent levels and the June acreage report behind us, market discussion is turning to the possibility of a high yield (see *farmdoc daily* [June 16, 2014](#)). This article will try to add perspective to this discussion. While most will focus on the numbers, the author's focus is to illustrate methods that use historical yield data to assess what are high yields. It is important to understand that these methods will give different estimates of high yields over different periods of data. In short, the methods are data sensitive. In addition, other methods exist.

### Data

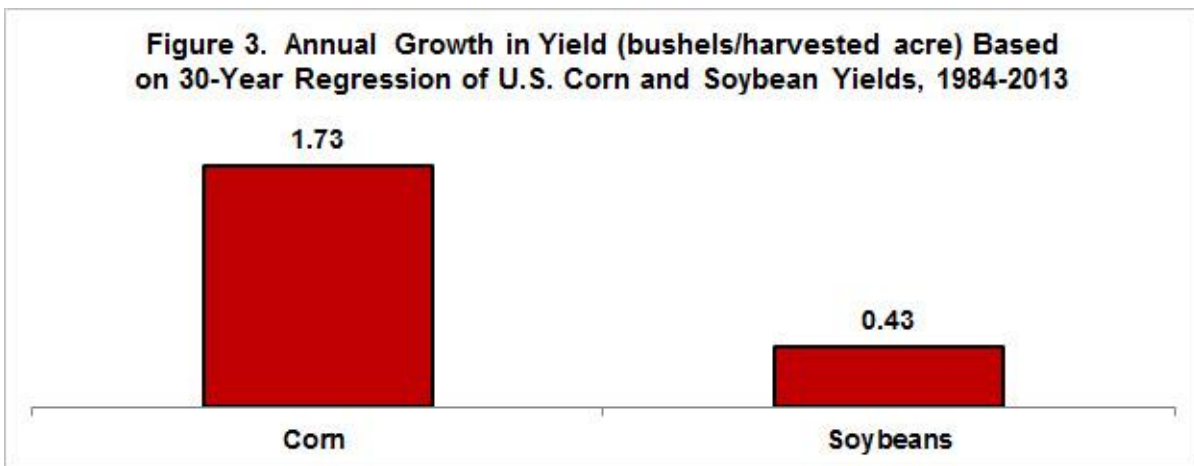
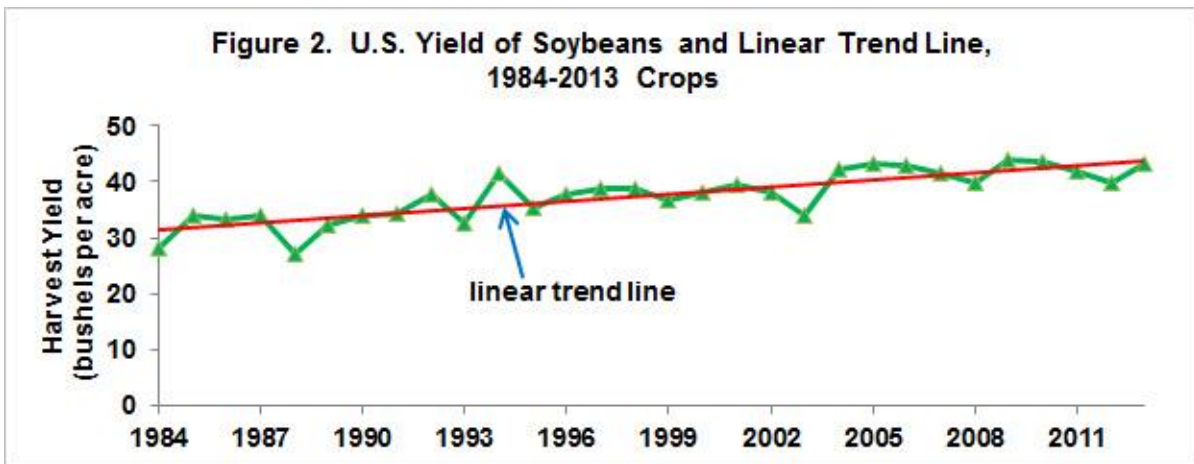
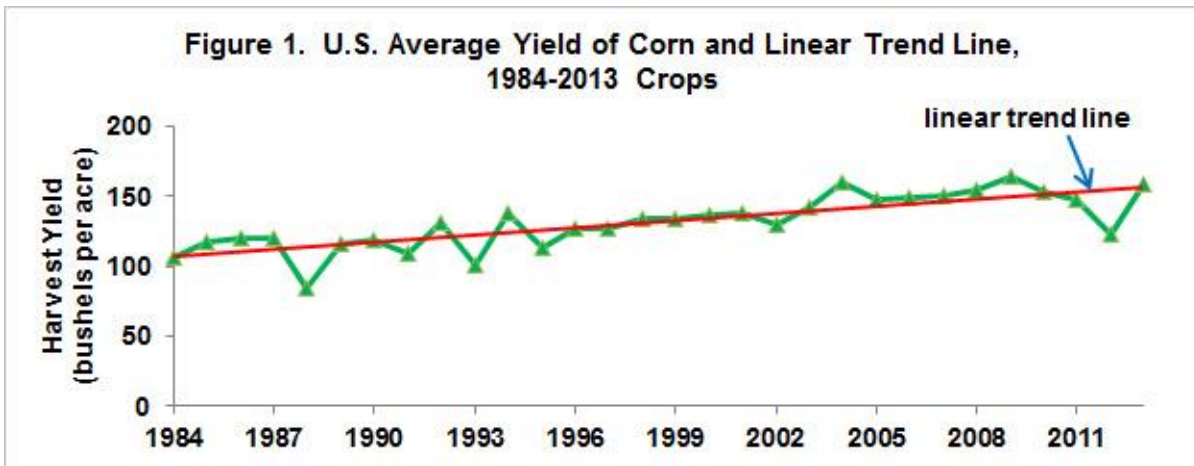
This study uses harvest yield per acre for states and the U.S. over the 30 crop years from 1984 through 2013. Selection of the study period is a critical factor. A longer period means more observations and thus, usually, better statistical properties for the analysis. But, it also tempers the importance of more recent yields, which may contain more information about current yield technologies and weather patterns. Trade-offs exist and reasonable analysts can select different periods. The author likes 30 years as a balance between statistical properties and the potential information value of more recent yields. Source for the yields is the U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS) Quick Stats website, available [here](#).

### Methods

The base method starts with estimating a linear trend line yield using linear regression techniques. Figures 1 and 2 presents the annual U.S. harvested yield per acre for corn and soybeans, respectively, from 1984 through 2013. The figure also contains the linear trend line estimated by regression. A key attribute of a trend line is the slope of the line. For this particular analysis, the slope is interpreted as the annual rate of increase in yield from 1984 through 2013 given a linear time line and the use of regression techniques. Given these assumptions, the U.S. yield of corn increased 1.73 bushels per acre per year while the U.S. yield of soybeans increased 0.43 bushels per acre per year (Figure 3). The yield of corn increased 4 times faster than the yield of soybeans over this period.

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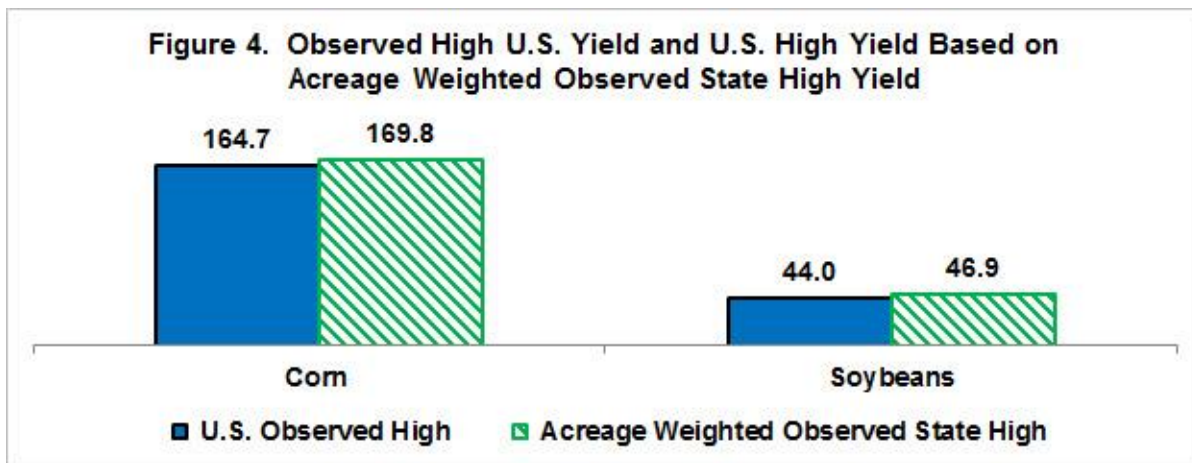
**High Yield Estimate 1**

The first set of estimates is based on asking what the existing record U.S. yield is. They are 164.7 bushels per harvested acre for corn and 44.0 bushels per harvested acre for soybeans. Both occurred in 2009.

**High Yield Estimate 2**

A related question is what would U.S. yield be if every state attained its record yield at the same time? This question builds upon an observation made by Gary Schnitkey in his March 25, 2014 *farmdoc daily* article, "Causes of High U.S. Corn Yields: Evaluation of County Yields," available [here](#)). Gary observed, "corn yields have to be above average across the vast majority of the corn-belt counties for the U.S. to have a

corn yield significantly above trend." Thus, the historical record high yield in each state was identified and this yield was then multiplied by the state's harvested acres projected for 2014 by USDA, NASS in the June 30 *Acreage* report. The estimated production was then summed across all states and divided by the number of U.S. harvested acres projected for 2014. Yields of 169.8 and 46.9 resulted (Figure 4). These yields are almost 5 and 3 bushels per acre higher than the record U.S. yield for corn and soybeans, respectively. This difference illustrates that it is very unusual for all of the U.S. to have the same weather, in the case record yield weather. Given this observation, it is worth noting that the highest share of corn rated very poor and poor is only 10% in Minnesota and 9% in Kansas in the June 30 *Crop Progress* report. For soybeans, the comparable shares are 11% for Louisiana, 10% for Minnesota, and 9% for Arkansas. Thus, while some areas in the U.S. are not favorable due to dryness or excessive moisture, the current crop conditions report suggests the U.S. record yield estimate based on record state yields is a relevant consideration.



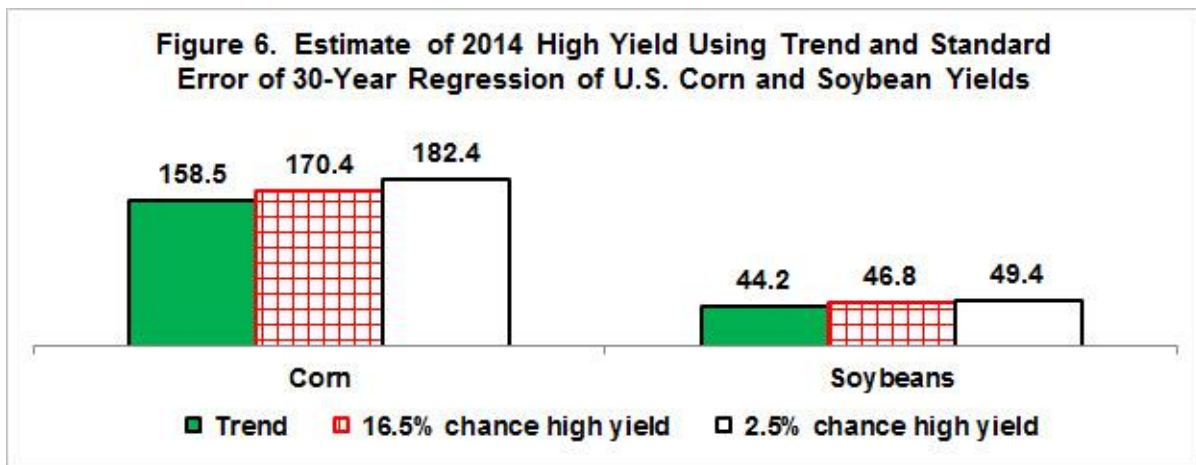
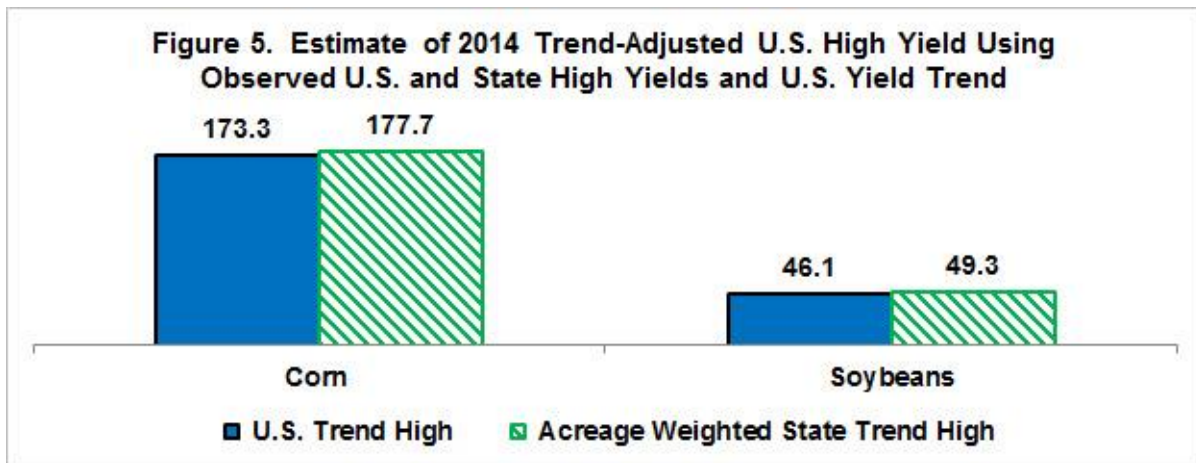
### High Yield Estimate 3

As noted above, the record U.S. yields for corn and soybeans occurred in 2009. But, it seems reasonable to assume that the entire yield distribution is trending upward, not just the average yield. One assumption is that record high yields are trending up at the same rate as average yield. To illustrate for U.S. soybeans, the high yield is 44.0 bushels per harvested acre in 2009 (Figure 4). Since U.S. soybean yield is increasing 0.43 bushels per year, the trend adjusted record U.S. soybean yield for 2014 is 46.1 bushels ( $44.0 + 5 \text{ years} \times 0.43$ ) (Figure 5). For U.S. corn, the comparable yield is 173.3 bushels per harvested acre. The same type of adjustment can be made to each state yield using its record yield adjusted for its trend and brought forward to 2014. For example, for Illinois corn, record yield is 180.0 bushels in 2004 and its trend yield increase is 1.75 bushels per year. The resulting 2014 trend adjusted high yield estimate is 197.5 bushels ( $180 + 10 \text{ years} \times 1.75$ ). The U.S. high yield estimate that results from applying the trend adjustment to state record yields is 177.7 for corn and 49.3 for soybeans (Figure 5). It is important to underscore the assumption that record yield is increasing at the same rate as average yield. Disagreement exists about this assumption, but disagreement exists on both sides --- that record high yields are increasing faster and are increasing slower than average yields. Whatever your view on this issue, it is important to understand the role of this assumption in deriving the third set of high yield estimates.

### High Yield Estimate 4

The fourth high yield estimate utilizes only information from the trend line regression. It is common to forecast a trend line into the future. For example, for 1984-2013 yields and using a linear regression, the 1984-2013 trend line projects a trend average yield of 158.5 for U.S. corn and 44.2 for U.S. soybeans. Since the trend yield is the middle of the yield distribution, trend yields have a 50% chance of occurring. Higher yields have a smaller chance of occurring. We can utilize the estimated variation around the trend yield, called its standard error, to obtain estimates of the probability of yields higher than trend yield. I have calculated the yields that have a 2.5% and 16.5% chance of occurring. For corn, the variation of historical corn yields around its trend line suggests there is a 16.5% chance of a yield equal to or greater than 170.4 and a 2.5% chance of a yield equal to or greater than 182.4. For soybeans, the variation of historical yields

around its trend line suggests there is a 16.5% chance of a yield equal to or greater than 46.8 and a 2.5% chance of a yield equal to or greater than 49.4.



### Summary Observations

The current crop conditions report suggests that yields are likely to be above trend line. History and statistical methods can give us some idea of what high yields might be. It is important to use a variety of methods and data. When the different methods and data used in this report are combined, the 30 years of U.S. and state yields from 1984 through 2013 suggest that, with good weather throughout the growing season over most of the U.S., a U.S. corn yield in the low-to-mid 170s and U.S. soybean yield in the 47-48 range is attainable. Higher yields could occur but the odds of such yields based on historical yields is very small.

### References

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Schnitkey, G. "Causes of High U.S. Corn Yields: Evaluation of County Yields." *farmdoc daily* (4):55, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, March 25, 2014.

This publication is also available at <http://aede.osu.edu/publications>.