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## Do Big Soybean Crops Always Get Bigger?

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The USDA’s August [Crop Production](#) report forecast the 2014 U.S. average soybean yield at 45.4 bushels per acre. That exceeds the previous record yield of 44.0 bushels in 2009 and is 1.7 bushels above our calculation of the 2014 (unconditional) trend yield based on actual yields from 1960 through 2013. Comments by traders and market analysts indicate there is a widespread expectation that the forecast will increase in subsequent *Crop Production* reports. This would explain the weakness in soybean prices since the release of the August report.

There is an old market saying that “big crops get bigger” and this appears to be the basis for the expectation that USDA soybean yield forecasts will increase in subsequent *Crop Production* reports. That is, in years when the final yield estimate is well above trend, the USDA forecast of the average yield tends to increase from August forward. Recent research by [Isengildina, Irwin, and Good](#) documents this tendency in USDA corn and soybean forecasts. However, these same authors argue that the shortcoming of this type of analysis is that it is backward-looking. Specifically, the analysis starts by identifying years when the final yield estimate (typically January) is well above an in-sample calculation of trend and then traces the pattern of yield forecasts from August through the final estimate in January after harvest. That analysis can be more aptly identified as answering the question “*did* big crops get bigger.” Isengildina, Irwin, and Good go on to analyze whether crops that are expected to be big actually get bigger, or “*do* big crops get bigger.” Specifically, they identify years when the August USDA forecast is large relative to an out-of-sample trend yield estimate and then test whether forecast changes in following USDA *Crop Production* reports (September, October, November, and January) can be predicted based on the trend-deviation of the August forecast. Very little evidence for either corn or soybeans is found that “big crops get bigger” (or “small crops get smaller”) based on this forward-looking analysis and the authors conclude that, “...this bias may appear obvious to market analysts in hindsight but it is difficult to anticipate.”

We updated and extended the analysis of Isengildina, Irwin, and Good for the U.S. corn yield in big crop years in a recent *farmdoc daily* article ([August 20, 2014](#)). The analysis revealed that: 1) historically, not all big corn crops get bigger, 2) weather conditions through July this year were not completely consistent with an average corn yield that has one of the highest positive deviations from trend, and 3) average August temperatures in 2014 year may not be consistent with a large increase in the USDA corn yield

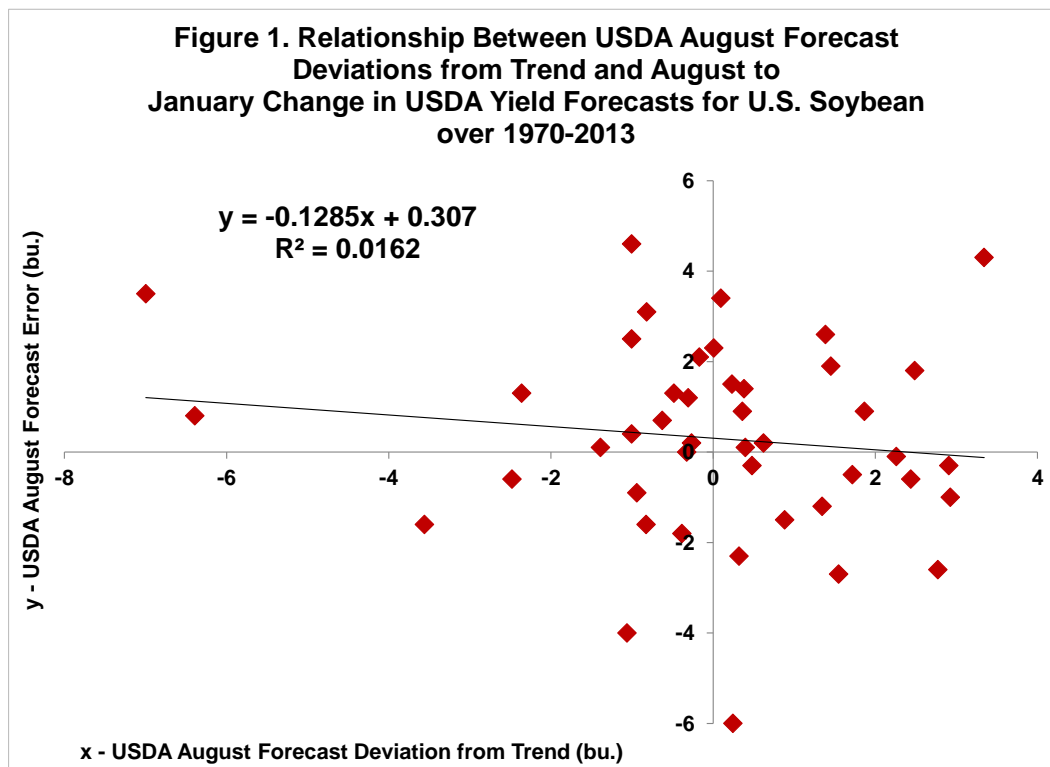
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forecast from August to January. We concluded that the results did not necessarily imply that the U.S. average corn yield will not increase, only that such an outcome would be highly unique given the nature of the 2014 growing season.

In this article, we extend the analysis of big crop patterns to the U.S. average soybean yield. We again update the sample used by Isengildina, Irwin, and Good through 2013 and then determine whether the additional data change their results for soybeans. Next, we extend the analysis by limiting our focus only to years with large expected positive deviations from trend in August. In addition, we compare summer weather in 2014 to previous years identified as having a similarly large expected trend deviation and look for other statistical clues that might be helpful in projecting future changes to USDA soybean yield forecasts. The analysis might provide an objective basis for forming expectations about changes in yield forecasts this year based on what is known in early September.

We begin by calculating the deviation from August USDA soybean yield forecasts from the out-of sample trend yield for each year over 1970-2013 using the same procedure as Isengildina, Irwin, and Good. Out-of sample trend yield is calculated based on actual U.S. average yield (January estimate) from 1960 through the year prior to the current year. For example, the 1970 trend yield is estimated based on 1960-1969, the 1971 trend yield is based on 1960-1970, and so on. The magnitude of deviations can be calculated as bushels or as percentages. We then compute for each year the change in the USDA soybean yield forecast from August through the January estimate (this "final" estimate was actually released in December in the early part of the period). Paralleling the results for corn, the R2 near zero indicates there is a total lack of relationship between the two variables in bushel terms (Figure 1). A similar lack of correlation is found if the analysis is repeated in percentages.



Clearly, adding recent years to the sample does not alter the findings of Isengildina, Irwin, and Good that the deviation of the August USDA soybean yield forecast from trend does not predict subsequent changes in USDA soybean yield forecasts. However, there are some notable outliers (1988, 2012) that could influence the results and a significant relationship in years with large positive trend deviations could be masked by the large overall variability in the sample. So, we next identify the 10 years over 1970-

2013 when the August USDA yield forecast had the largest positive deviations from the calculation of out-of-sample trend yield for that year. A slightly different set of years emerge as having the largest deviation depending on whether deviation is calculated in terms of bushels or as a percentage. As a result, we include the 12 years that include the top 10 by both measures.

The relevant yield data for the identified 12 years of large August forecast trend deviations are presented in Table 1. That data consist of the magnitude of the deviation of the USDA August soybean yield forecast from out-of-sample trend yield, the monthly USDA soybean yield forecasts, the January USDA soybean yield estimate, and a calculation of the monthly and total change in the USDA yield forecasts through the forecast cycle for each year. The deviations of the August yield forecast from trend yield ranged from 1.3 bushels to 3.3 bushels and averaged 2.2 bushels, above the 2014 deviation of 1.7 bushels. But, contrary to the expectation that big crops get bigger, the January yield estimate in those 12 years was above the August forecast in only four years. The positive differences (rising forecasts) ranged from 0.4 to 3.8 bushels and averaged 2.2 bushels. The differences in the eight years when the January estimate was below the August forecast ranged from -0.4 to -2.6 bushels and averaged -1.1 bushels. So, there are years with large expected positive deviations from trend associated with large subsequent upward revisions in USDA soybean yield forecasts (e.g., 1985, 1986, 1992, 1994), but there are also years with large expected positive trend deviations and subsequent downward revisions in yield forecasts, some of which were large (e.g., 1999, 2000). This has important implications for interpreting the USDA's August 2014 forecast of 45.4 bushels. As noted above, the out-of-sample trend deviation for this forecast is 1.7 bushels. Historical yield forecast patterns, suggests there is a greater chance that subsequent revisions to this forecast will be lower rather than higher. The widely-held view that USDA soybean yield forecasts will rise in the future is equivalent to arguing that 2014 is the same type of year as a 1985, 1986, 1992, or 1994. This may turn out to be true, but the historical record indicates such statements are not justified based simply on the size of the August 2014 forecast relative to trend.

**Table 1. Years with 12 Largest Positive Deviations from Trend Yield in August and USDA Yield Estimates for U.S. Soybean over 1970-2013**

	1971	1982	1985	1986	1987	1992	1994	1997	1998	1999	2000	2010
	---bushels per acre---											
Trend Deviation	1.3	2.1	1.4	1.8	3.0	2.5	3.3	2.9	2.4	1.5	2.7	1.6
USDA Yield Forecasts												
August	28.8	32.3	31.5	32.9	34.7	35.8	37.6	39.3	39.5	39.2	40.7	44.0
September	27.7	32.6	33.2	33.1	34.0	35.9	38.2	39.3	40.0	37.9	39.5	44.7
October	27.4	32.4	33.9	33.3	34.2	36.3	40.5	39.0	38.7	37.0	38.7	44.4
November	28.0	32.4	34.2	33.8	34.1	37.3	41.5	39.2	38.6	36.7	38.0	43.9
January Estimate	27.6	31.5	34.1	33.3	33.9	37.6	41.4	38.9	38.9	37.6	38.1	43.5
Change in USDA Yield Forecast												
August to September	-1.1	0.3	1.7	0.2	-0.7	0.1	0.6	0.0	0.5	-1.3	-1.2	0.7
September to October	-0.3	-0.2	0.7	0.2	0.2	0.4	2.3	-0.3	-1.3	-0.9	-0.8	-0.3
October to November	0.6	0.0	0.3	0.5	-0.1	1.0	1.0	0.2	-0.1	-0.3	-0.7	-0.5
November to January	-0.4	-0.9	-0.1	-0.5	-0.2	0.3	-0.1	-0.3	0.3	0.9	0.1	-0.4
August to January	-1.2	-0.8	2.6	0.4	-0.8	1.8	3.8	-0.4	-0.6	-1.6	-2.6	-0.5

Note: Positive changes in USDA forecast highlighted in green, negative changes in USDA forecast highlighted in red.

While the August forecast deviation from trend is not helpful in predicting USDA yield forecast changes, this does not eliminate the possibility that conditioning on other information might allow one to better characterize which type of year 2014 represents. One obvious source of conditioning information is summer weather. Table 2 summarizes summer weather in Illinois, Indiana, and Iowa this year and for the four previous years with large expected positive deviations from trend and subsequent upward revisions in USDA soybean yield forecasts (from Table 1). June this year was wetter and warmer, July was drier and cooler, and August was wetter and warmer than those previous four years. Overall, the picture that emerges from this examination of key weather variables is that 2014 does not uniformly match weather patterns in previous high-yielding years when USDA yield forecasts increased. The fairly unique weather in the summer of 2014 does not appear to point towards either upward or downward changes in the USDA soybean yield forecast.

**Table 2. Summer 2014 Weather Conditions in Illinois, Indiana, and Iowa Compared to Previous Years of Large Positive Deviations from Trend Yield in August and Positive Changes in USDA Yield Forecasts for U.S. Soybeans over 1970-2013**

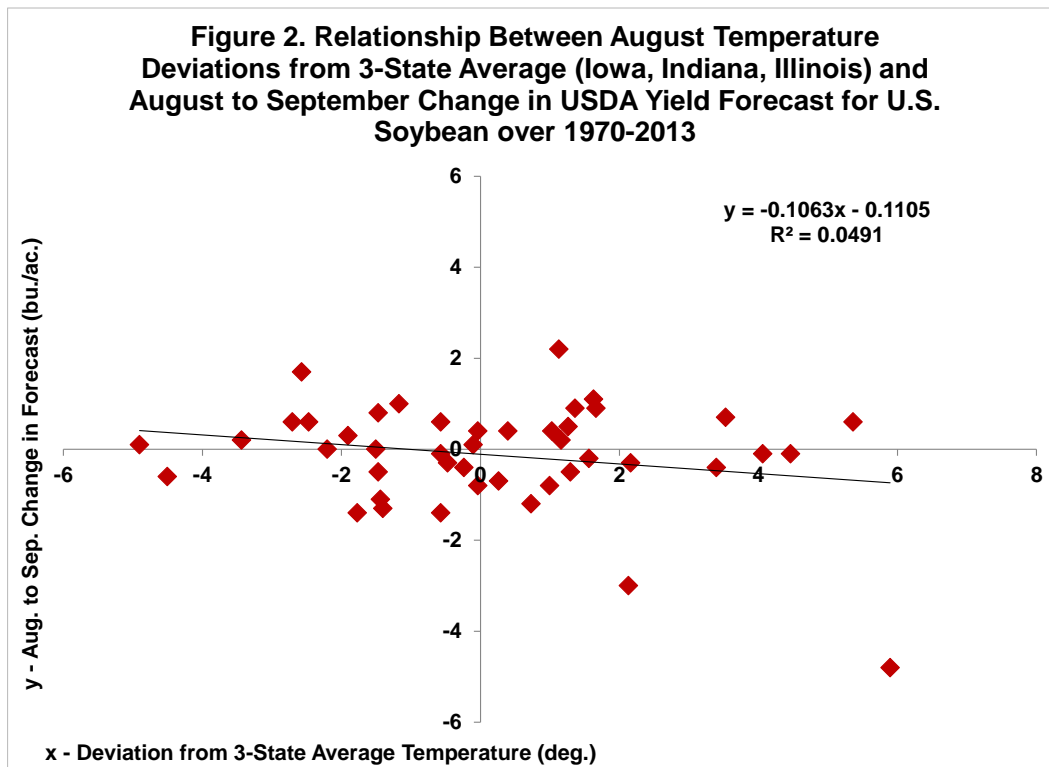
Year	State	June		July		August	
		Precipitation	Temperature	Precipitation	Temperature	Precipitation	Temperature
		---inches---	---degrees---	---inches---	---degrees---	---inches---	---degrees---
2014	Illinois	6.6	72.9	3.2	70.4	6.1	71.5
	Indiana	5.8	72.8	3.4	69.2	4.9	72.8
	Iowa	9.3	70.2	3.2	68.9	5.1	73.9
	Three-State Avg.	7.2	72.0	3.2	69.5	5.4	72.7
Four-Year Avg. (1985, 1986, 1992, 1994)	Illinois	3.6	71.1	4.7	74.7	3.2	69.8
	Indiana	3.8	69.8	5.2	74.0	3.6	69.3
	Iowa	4.0	69.3	5.1	71.9	3.5	67.5
	Three-State Avg.	3.8	70.1	5.0	73.6	3.4	68.9
1960-2013 Avg.		4.4	70.6	4.1	74.5	3.7	72.3

The analysis so far is similar to our earlier analysis of big corn crop years ([August 20, 2014](#)). That is, anticipating future changes in USDA soybean yield forecasts based on the trend deviation of the August forecast is quite difficult and 2014 weather does not provide much in the way of useful clues either. We did find that the direction of the change from the August forecast to the September forecast in corn provided useful insight into the direction of the August to January change. For the 12 years included in the soybean analysis here (Table 1), all four years with a September forecast less than the August forecast, also had a January estimate lower than the August forecast. However, in the seven years when the September forecast was larger than the August forecast, the January estimate exceeded the August forecast in four years and was less than the August forecast in three years. The September forecast was unchanged from the August forecast in one year, with the January estimate less than the August forecast. While the direction of change in the yield forecast from August to January was sometimes signaled in September, the magnitude of the change was not. Overall, this evidence suggests that the USDA's upcoming September 2014 soybean yield forecast will, at best, provide limited information regarding whether the January yield estimate will be above or below the August forecast this year.

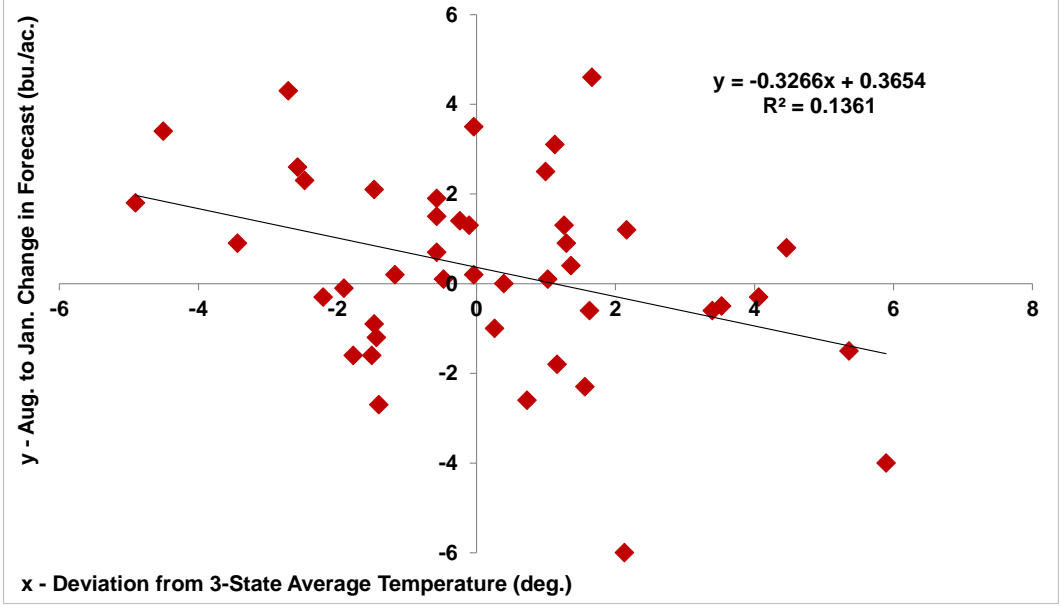
It would certainly be useful to have a better early indication of the direction of change in either (or both) the September soybean yield forecast or the January yield estimate. To a large extent, the USDA's August yield forecast (at least the objective yield forecast portion of the overall forecast) incorporates the assumption of normal weather conditions for the remainder of the growing season. Like corn, crop weather models clearly reveal that August weather conditions have an important influence on the soybean yield outcome. That relationship leads to the expectation that deviations in August weather conditions from average conditions might explain the change in the yield forecast from August to September and/or January. Our analysis in corn suggests that cool weather in August (at least 2.5 degrees below average) is a key contributor in high-yielding years to larger corn yield estimates in January compared to the August forecasts. For this reason, we examine the correlation between August weather conditions in Illinois, Indiana, and Iowa and the change in the U.S. soybean yield forecasts by the USDA. The relationship between the deviation in actual August precipitation from average August precipitation and the change in the soybean yield forecast from August to September for all years from 1970 through 2013 was examined. The same relationship for just the 12 years identified here with large August yield forecasts was also examined. The analysis was repeated for both all years and the 12 years with large August yield forecasts based on the change in the yield forecast from August to January. The results revealed little relationship between precipitation deviations from average and changes in U.S. soybean yield forecasts.

The previous analysis described for August precipitation deviations from average was repeated for temperature. For all years from 1970 through 2013, a very small negative relationship was found

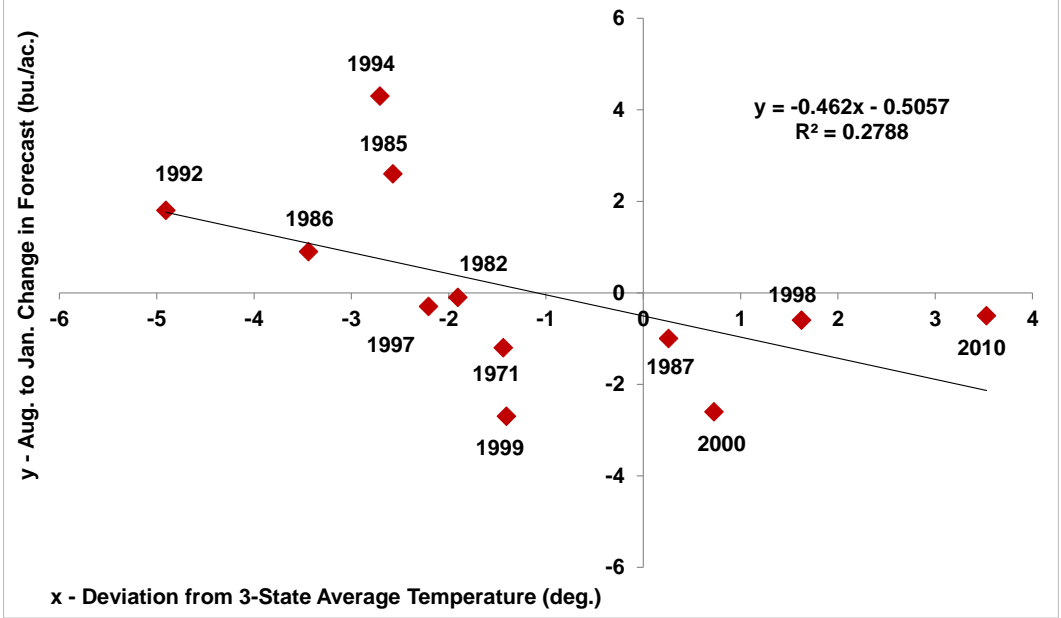
between August temperature deviations from average and the change in the yield forecast from August to September (Figure 2). A slightly stronger relationship was found between August temperature deviations and the change in the yield forecast from August to January (Figure 3). The analysis was extended by regressing both August temperature and precipitation deviations from average on both the August to September and the August to January changes in yield forecasts for the period 1970 through 2013. While both temperature and precipitation deviations were statistically significant, the model still only explained about one-quarter of the change in yield forecasts. Finally, a stronger relationship was found between August temperature deviations from average and the change in the yield forecast from August to January in the 12 years with large August yield forecasts relative to trend (Figure 4). Even for those 12 years, however, large outliers were observed and the temperature deviations explained only 28 percent of the August to January change in yield forecasts.



**Figure 3. Relationship Between August Temperature Deviations from 3-State Average (Iowa, Indiana, Illinois) and August to January Change in USDA Yield Forecast for U.S. Soybean over 1970-2013**



**Figure 4. Relationship Between August Temperature Deviations from 3-State Average (Iowa, Indiana, Illinois) and August to January Change in USDA Yield Forecast for U.S. Soybean in Years with 12 Largest Deviations Positive Deviations from Trend Yield over**



## Implications

The final USDA estimate of the 2014 U.S. soybean yield will have obvious implications for soybean prices for an extended period. History suggests that the September forecast will give some limited indication of the direction of change in yield forecasts from August to January, particularly if the September forecast is less than the August forecast. Many analysts are on record anticipating that the final soybean yield estimate will be well above the August forecast of 45.4 bushels and it appears that the market is trading a much higher yield. Much of the expected yield increase is based on the concept that “big crops get bigger,” with support also coming from very high crop condition ratings late in the season and early harvest reports of high yields. The analysis in this article, however, reveals that 1) historically, a minority of big soybean crops get bigger, 2) summer weather conditions this year did not uniformly match weather patterns in previous high-yielding years when USDA soybean yield forecasts increased, and 3) average August temperatures contain limited information about the likely change in the USDA soybean yield forecast from August to January. These results do not imply that the U.S. average soybean yield this year will not be large and will not increase, only that such outcomes cannot be predicted based on the size of the August yield forecast relative to trend or weather conditions to date. The conservatism of USDA early season soybean yield forecasts documented in this recent *farmdoc daily* article ([September 4, 2014](#)) provides a sounder basis for arguing that USDA soybean forecasts will rise starting in September.

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