

An Index for Acres Converted: Corn to Soybeans

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It is easy to see from the acreage plots that something other than climate is driving the number of soybean and corn acres planted in Iowa. In the past 20 years, the amount of corn acres has steadily decreased while the number of soybean acres has grown as a weak exponential. Here are some explanations for the growth of soybeans over corn:

1. The value of soybeans has dramatically increased over the past decades with the products like soy-diesel and soy-ink driving an ever-increasing demand. Prices for soybeans are approximately three times as much per bushel than corn. And, while corn will produce many more bushels per acre than soybeans, it likely will not produce three times more bushels per acre than soybeans.

2. The growth of conservation tillage has made planting soybeans very attractive. For many years, the majority of soybeans were planted by conservation tillage or no-till methods. Conservation tillage means that more than 30% of the seed bed is covered by residue before planting {1}. The method of choice for soybean planting has been conservation tillage. So as the practice has grown, so has the willingness for farmers to plant soybeans.

3. In the past, soybeans were known only to be planted by the "big" farmers with many acres. The reason is that back in the old days, farmers only grew crops to feed their animals and would not market much of their crop. The trend in farming today is for farmers to operate more acres and to own fewer animals. These farmers are more likely to use conservation tillage and more likely to plant a marketable crop like soybeans.

4. The timing of soybean planting in Iowa makes the crop a very attractive option. Many times, wet or cold springs prohibit farmers from getting corn planted early enough. Since soybeans have a shorter growing season requirement (in most cases), soybeans can be planted later in the spring. An old farmers saying is that corn should be planted by May 5. Many times, farmers are unable to get all of their corn planted by May 5 (due to cold or moisture) and so they convert potential corn acres into soybeans. Another advantage of soybeans is that early freezes often will not hurt soybeans, but rather help to kill the stalk and dry out the beans. An extremely early freeze will stunt the plant, but soybeans are often much safer than corn in very cold weather.

5. Since soybeans are planted later in the growing season, they are often easier to spray herbicides on. Often corn acres will require two passes, since the weeds often germinate after the first pass of spray wears out. On the other hand, soybeans are planted and first sprayed after many weeds have already begun to grow. The spray is thus very effective. Also, the popularity of the effective "Round-Up Ready Soybeans" has made planting soybeans very attractive. Soybeans have also dramatically improved genetics in recent years and tolerance to extreme and marginal climates.

Although these factors have played a role in the growth of soybeans, there is still a factor of corn acres being converted to bean acres because of the spring weather. Daryl can remember the spring of 1994 when his neighbor planted over 200 more soybean acres than normal, because of a wet and cold spring. The farmer was unable to plant until the middle of May, which was too late to plant most corn varieties.

A planting index?

One of the issues that needs to be addressed before any index can be created, is how it will be interpreted by the public. If our index would produce a number like "6 out 10 chance" that this spring will be a conversion year, how useful a number like that would be?

Currently, farmers are given climatological guidance valid for a 3 month span or so. For example, reports like "above average temperature" and "above average precipitation" are expected for a region are often giving out to the public. How does a farmer use such a forecast? Many farmers have an inherent distrust for meteorologists and just ignore the forecast anyway. This is where an index could potentially be useful. If the index had a proven track record, it could build credibility and sway farmers' decisions.

In our project, we are looking to provide farmers with guidance on the chances that they will be able to get all of their corn acres planted. This guidance is important to the marketing of either potential crop. Many times, cold and wet springs will drive corn prices higher in the cash and futures markets, since buyers will worry about shorting supplies.

Since temperatures are what we decided to correlate with ability to plant corn, we used temperatures at a certain date to give farmers a chance of being able to plant a percentage of their corn.

Effect of weather on planting

Cold and wet springs can have dramatic impacts on the amount of acres planted. In large, flat areas, common throughout the corn belt, wet spots can develop, preventing equipment from being able to navigate the field to plant. If the field was originally intended for corn, this area is often skipped and planted around. If the area is of appreciable size, a farmer will come back later and often plant beans over the wet spot. This is feasible, since corn and beans are harvested at different times. This is also more practical than planting corn in the wet spot, because of enhanced pest concerns, mixing varieties and maturities, and the hassle of planting short rows.

Temperatures versus Precipitation

While cool springs and wet springs are more than likely correlated, their individual effects on spring planting vary. Corn needs soil temperatures of 52 degrees F before

the plant will germinate. Even at these temperatures, the plant will not aggressive grow. Once soil temps get near 55 degrees F, growth is much more vigorous. While dry springs are conducive for field work to complete on time, if the weather is cool, farmers will hesitate to plant, since the seed may often root in the soil before emerging. {2}

Acres Converted

To test our hypothesis, we identified years which we saw as “conversion years”; that is, in which acres that would have been planted with corn were actually planted as soybeans. We picked these years by noting where corn acres decreased significantly in comparison to the surrounding years (the three-year running average). Obviously, there can be some error in this. Not every non-corn acre in the state of Iowa automatically becomes a soybean acre- for example, an acre could be used for alfalfa or taken out of production entirely.

The Index

$a = \text{May 12} - (\text{Day of last forecast average daily temperature below } 285K)$

$(.04a) * 100 = \text{percent of corn that can likely be planted.}$ (Obviously, if $a < 0$, use $a = 0$.)

This will give farmers a chance to invest in enough bean seed early if they need to, and will give futures markets an idea of how much corn will be harvested.

Additional websites

Joint Agricultural Weather Facility: <http://www.usda.gov/agency/oce/waob/jawf/>

The JAWF puts out weekly crop bulletins discussing forecasts, flooding, soil temperatures, and other key information for farmers across the nation. As part of the USDA (United States Department of Agriculture), they have extensive information available to them through their own observations and through NOAA (National Oceanic and Atmospheric Administration).

National Agricultural Statistics Service: <http://www.usda.gov/nass/pubs/staterpt.htm>

The NASS is a service for anyone interested in the numbers of agriculture. They monitor crop and soil conditions and archive massive amounts of statistical information (including corn and soybean acres planted by county and by year in Iowa). They fall under the same category as JAWF as an agency providing useful agricultural weather information under the USDA.

Midwest Regional Climate Center: <http://mcc.sws.uiuc.edu/>

The Midwestern Regional Climate Center provides information to users from Minnesota to Kentucky (for a fee). Their information is “near real-time”. They provide climatic data as well as weather and forecast data, but it’s hard to tell exactly what they have to offer without buying a \$75 subscription.

Correlations and Conclusions

A problem with the correlations arose when it was discovered that the model output for an average month was 5 Kelvins warmer than observations. This tended to skew the correlations later on in the lab. Future work could include correcting for this model output.

We correlated corn, beans, and corn conversion versus observations and model in the nine districts. We only got one “statistically significant” result- for corn conversion vs. model in northeast Iowa. It had an F value of 5.14 (3.5 is significant) and an R-sq value of 0.52.

From these numbers, it's obvious that more than temperature is at work here in the conversion of corn acres to soybean acres. The correlations were in every case positive but still not very good. We didn't account for precipitation, and it's possible that wet fields have more effect than cold on conversion of acres.

References

{1} <http://www.ecotill.com/en/ch1.htm>

{2} <http://www.ag.ohio-state.edu/~ohioline/b472/corn.html>

