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Corn Yield Potential Estimates Amidst a 'Perfect Storm'

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Abstract
As of Sunday, July 1, 16 percent of Iowa's corn crop had silked, two weeks ahead of normal (USDA July 1). A good share of the crop will silk in the next few days to two weeks. This is the most critical time for corn in terms of effects on yield potential (see Elmore ICM News), a time when water use maximizes (see Al-Kaisi et al., ICM News). Unfortunately, this timing coincides with dry soils across most of Iowa and a forecast for unseasonably high temperatures at least through the end of this week. Many wonder about the impact of this 'perfect storm' on corn yield potential. How will this rare combination of circumstances - corn at the most critical developmental stage, dry soils and hot dry weather persisting for several more days – impact yield potential? The corn simulation model, Hybrid-Maize, helps us address these questions.

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Corn Yield Potential Estimates Amidst a "Perfect Storm"

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As of Sunday, July 1, 16 percent of Iowa’s corn crop had silked, two weeks ahead of normal (USDA July 1). A good share of the crop will silk in the next few days to two weeks. This is the most critical time for corn in terms of effects on yield potential (see Elmore ICM News), a time when water use maximizes (see Al-Kaisi et al., ICM News). Unfortunately, this timing coincides with dry soils across most of Iowa and a forecast for unseasonably high temperatures at least through the end of this week. Many wonder about the impact of this ‘perfect storm’ on corn yield potential. How will this rare combination of circumstances - corn at the most critical developmental stage, dry soils and hot dry weather persisting for several more days – impact yield potential? The corn simulation model, Hybrid-Maize, helps us address these questions.

1. Has 2012 weather from planting through July 2 affected corn yield potential?

   No, at least not at the three sites modeled in the historical as well as the 2012 weather data recorded to date at those sites. Obviously, some Iowa fields have experienced afternoon leaf rolling for a week or more already. At least some of these are related to rootworm feeding (see Erin Hodgson’s July 2 ICM News article). Other fields like this perhaps experienced soil compaction, excessive tillage or other issues that affected root growth and soil moisture (see Elmore’s ICM News on emergence issues). Yields are already affected in those fields. However, fields that have not had significant leaf rolling as of July 2 still had high yield potential.

2. What effect will this week’s extremely hot and dry weather have on yield potential?

   That depends on the location and the kind of year we have for the rest of the season.

   Best-case: If the best year in the weather database occurred at each of the sites, estimated yields in Gilbert/Ames could be reduced by about 11 percent compared to yield estimates at the same site on July 2 (Figure 1). Crawfordsville would experience a 4 percent reduction, and Sutherland would actually see a 3 percent yield increase over that of July 2. In the best year at Sutherland, significant rain events occurred before mid-July. I need to say here that these are best year – best year comparisons. That is the estimated yields from July 8 are as if the best possible year started on July 9 and the same is true for the July 2 estimates. That also means that the best possible year could and does differ between July

http://www.extension.iastate.edu/CropNews/2012/0705elmore.htm
2 and July 8; at Gilbert/Ames for example, the best year following July 2 was 2009, and for July 8 was 2004 (see Table 2 for the specific years at each site).

Worst-case: The encouraging part of the analysis is that forecast conditions between July 2-8 are actually better than the worst year weather for all three sites. This corresponds with measurements of stress-days discussed by Elwynn Taylor in the ICM News and as shown on the July 5 daily feature on Mesonet.

![Figure 1. Yield advantage for July 2 conditions over those of July 8 within yield groups and locations.](image)

**The Modeling Approach Used to Address These Questions**

1. **Has 2012 weather from planting through July 2 affected corn yield potential?**

   The Hybrid-Maize uses historic weather data from automated weather stations. In this case, I used weather data from three of Iowa State University's Research and Demonstration Farms - NW Iowa near Sutherland, SE Iowa near Crawfordsville, and central Iowa using a combination of data from Ames and Gilbert.

   The model allows users to compare yield potentials given the weather actually recorded up through the simulation date. In this case it included 2012 weather data through last Monday, July 2. The model generates real-time yield predictions for the current season. What that means is that actual weather conditions up to the date of the simulation are in a sense considered the base from which to start. That is what we have to work with; unfortunately, we can’t change what has happened so far in 2012. Then the model ‘asks’ a series of ‘what if’ questions. For example: What is yield potential if, from this day forward, we have weather conditions like those we had in the best possible year in the weather database for that location? What if the worst historical weather occurred? The weather record begins in either 1986 or 1988 for the three research and demonstration farms we’re working with here (Table 1).

   Common inputs for all three sites modeled are provided in Table 1. Factors that varied across locations such as soil textures are shown in Table 2. Residue levels at planting, corn suitability ratings and other field-specific information are not factored into the analysis. However, some of the variability, especially in the early-season
2. What effect will this week’s extremely hot and dry weather have on yield potential?

The five to seven day NOAA forecast on July 3 was for continued hot-dry weather. Using those forecast high and low temperatures, I generated a new – some might say fictitious - weather file for each location for the crop model (see high/low temperatures used in Table 2). The model then provided real-time yield predictions using actual weather data through July 2, 2012, and the forecast average temperatures through July 8. All other weather variables – i.e. solar radiation, precipitation (which was nil at all three sites) and relative humidity - in these model runs were the same as those of July 2; only high/low temperatures were changed. Because crop canopies were already completely developed or nearly so on July 2, I assume in this analysis that light interception, crop water use, etc., are stable during this time frame.

As mentioned earlier, the real-time yield predictions are based on weather data from previous years at that location and are summarized into five yield-level groups ranging from best yield to worst yield years. For example, what if the best previous weather occurred and what if the worst previous weather occurred from July 9 through the end of the season. Data from these model runs are summarized in Figure 1. Bars for the three locations are grouped together according to the five yield-level categories from best to worst.

| Table 1. Hybrid-Maize model input factors that were the same across locations |
|------------------------------------|--------------------------|
| Factor                             | Factor Input Value/ Date |
| Emergence date                     | 1 May 2012               |
| Plant population                   | 32,000 plants per acre   |
| Soil moisture at planting           |                          |
| Top soil                           | 75% Field capacity (FC)  |
| Sub soil                           | 100% Field capacity (FC) |
| Rooting depth                      | 40 inches                |
### Summary

As of July 2, corn may not have yet experienced yield reductions. Although yield estimates vary with locations based on July 8 model runs, if 2012 turns out as 'median' year, we may see yield reductions of 7 to 9 percent due to the weather forecast for the week of July 2-8. The best news is that yields at this time can still better the worst year experienced at each of the sites.

We must remember that not all of Iowa’s corn emerged on May 1 and will enter critical phases of crop development during better conditions. That, of course, remains to be seen.

We all know that many things can happen between now and harvest. If soil moisture conditions do not improve, yields will be reduced much more than these estimates. Meanwhile, let’s hope for cooler temperatures and rain!

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