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Factors Needed to Maximize Corn Yield Potential in 2008

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Abstract
The start of the 2008 growing season was extremely difficult for planting and crop establishment, however, environmental conditions since have been fairly good. What type of yields should we expect from this turbulent season? What will it take to obtain high yields from this point in the growing season forward? And, the other side of that question – what don't we want to see happen?

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Factors Needed to Maximize Corn Yield Potential in 2008

By Roger Elmore and Lori Abendroth, Department of Agronomy

The start of the 2008 growing season was extremely difficult for planting and crop establishment, however, environmental conditions since have been fairly good. What type of yields should we expect from this turbulent season? What will it take to obtain high yields from this point in the growing season forward? And, the other side of that question – what don't we want to see happen?

Crop models can be helpful in addressing questions like this, because they can use weather data from 2008 as well as long-term data to synthesize what is probable, based on several different scenarios in the future. Hybrid-Maize - a corn model - was used here to predict yields for different regions of Iowa based on weather conditions through August 22, 2008.

In this analysis, six Iowa locations with automated weather stations were included. These stations are located at Iowa State University's Research and Demonstration farms and were chosen to represent different climates and regions of Iowa.

Modeling inherently causes the modeler to assume certain factors exist or will exist within a region. With in the context of this article, the focus is on attainable yields for the majority of the acres planted with in an area. Therefore, the planting date was set as when 50 percent of the corn was planted (based on USDA reports). If a producer planted much earlier or later than this date then they need to mentally shift the results to what they typically understand about planting date response in their area of the state. Planting dates for the western two locations (Sutherland and Lewis) were set as May 10; May 15 was used for the remainder of the state.

Hybrids planted across the state vary based on recommended relative maturities. Hybrid maturities used here are 105 day (Sutherland, Kanawha, and Nashua), 110 day (Ames), and 115 day (Lewis and Crawfordsville). The third assumption used for this yield simulation was that final plant populations were 32,000 plants per acre.

Estimating Yields Yield estimates are shown here as a percent of maximum potential yield (100 percent). However, maximum potential yield assumes that the main factors limiting corn yield after it has been planted are weather conditions. The model does not take into account other limiting factors that may exist, such as weed, insect, or disease pressure, hail damage, non-uniform emergence, etc. To some degree, limiting factors are in every Iowa corn field, so we can assume that the model estimates are higher than what many will obtain. The model only accounts for things like: temperature, sunlight, rainfall, etc.; anything other than weather variables is ignored. Yield estimates are provided in Table 1.

Table 1. Predicted corn yields (shown as percent of maximum potential yield) for different regions of Iowa. Estimated yield is based off of 2008 weather data through 22 August.

Region	NW	N	NE	C	SW	SE
Town	Sutherland	Kanawha	Nashua	Ames	Lewis	Crawfordsville
Best yield	90%	89%	98%	95%	90%	102%
Median yield	71%	73%	86%	86%	64%	81%
Worst yield	49%	61%	74%	68%	48%	70%

The yield ranges shown in Table 1 are simulations based on several different weather scenarios from here on out. If the weather from August 23 mimics that of the best year in the database, then yields similar to the 'best' yield are possible. If the weather mimics that of the median (middle of range) year, then we can expect 'median' yields. Finally, if the weather is similar to what existed for weather in the worst year, then yields may be similar to those in the 'worst' years. If the weather after August 22, 2008 is like that of the best possible year, yields could approach 102 percent of maximum potential at Crawfordsville (SE Iowa) to 90 percent at Sutherland and Lewis (NW and SW Iowa). The high value at Crawfordsville suggests that weather conditions there prior to August 23 were more conducive to high yields than the previous 'best' year in the weather database used by the model.

Apply Table 1 to individual farms by using the percent yield estimates and multiplying with normal yield expectations. If a grower planned to produce 200 bushels per acre in northern Iowa; yield expectations should now be in the range of 122 bushels per acre (61 percent of 200 bushels per acre) to 178 bushels per acre (89 percent of 200 bushels per acre) if there are no other limiting factors.

Future Weather Needs What will it take to obtain 'best' yields from this point in the growing season? On the other side of that question – what don't we want to see happen? Both of these scenarios are shown in Table 2.

Table 2. Weather factors that can happen between August 23 and physiological maturity that will directly impact Iowa attainable yields. Either scenario -best or worst- may occur based on the combination of weather variables that exist at each location. Numbers in parentheses are actual data experienced in the 'Best' and 'Worst' years.

Region	Factors for 'Best' Yields	Factors for 'Worst' Yields
NW	• High solar radiation (30% above normal) • Excellent rainfall (7 inches after silk) • Late frost (6 Nov)	• Low rainfall (0.9 inches after silk) • Early frost (27 Sept) • High average temperatures (7 ° F above normal after silk)
N	• †	• Low solar radiation (4% below normal after silking) • Low rainfall (1.1 inches after silk , normal = 3.4 inches)
NE	• High solar radiation (10% above normal after silk) • Excellent rainfall (5.2 inches after silk)	• Low solar radiation (9% below normal after silk) • Low rainfall 1.3 inches after silk)
C	• High solar radiation (38% greater than normal) • Excellent rainfall (9.2 inches after silking) • Late frost (22 Oct)	• Low rainfall (3.1 inches after silking) • Early frost (28 Sept.) • High average temperatures (5.8° F above normal after silk)
SW	• Excellent rainfall (8.4 inches after silk) • Low average temperatures (1.4 ° F below normal after silk)	• Low rainfall (2.6 inches after silk) • Early frost (18 Sept)
SE	• Excellent rainfall (11.4 inches after silk) • Low average temperatures (4.8 ° F below normal after silk)	• Low rainfall (2.1 inches after silk) • Early frost 23 Sept.)

† Solar radiation, rainfall, average temperatures, and frost dates were factors that resulted in yield differences for many – but not all - regions. If a weather factor is not included for a given region, that variable was not a distinguishing factor separating the best and worst of years in the simulation. Other weather factors are more important in those regions .

Summary To achieve maximum yields at this point forward, the corn crop needs plenty of light, excellent rainfall, cool temperatures and an average or later than average frost date. Corn yields will be significantly reduced, if the opposite set of conditions exist: low light levels, low rainfall amounts, warm temperatures, and an early frost will dramatically reduce yields across Iowa.

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