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Hot July Weather and Corn Yields

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The onset of high temperatures in much of the Corn Belt this week has raised the issue of the impact of high summer temperatures on corn yields. See this recent article for an overview of the effects of high temperature on corn plant physiology and yield potential.

In order to provide further insight on temperature impacts, we examine state-average corn yields for Illinois over 1975 through 2010 in years when the average July temperature exceeded 77 degrees or about 2 degrees above the average temperature for the state over the entire time period. We chose this temperature cutoff because preliminary data indicates July 2011 will be at least this warm. Summer weather and trend-adjusted yield data for those 10 years are presented in Table 1. Note that the observations are ordered by average July temperatures (largest to smallest). A linear regression trend estimate over 1975-2010 is used to re-state all yields in terms of 2011 technology. For example, the actual Illinois yield in 2002, 135 bushels per acre, is increased to 152 bushels to reflect the improvement in corn production technology since 2002.

Table 1. Summer Weather and Trend-Adjusted Corn Yield for Illinois in Years with Hot July Temperatures

Year	July Temperature	July Precipitation	August Temperature	August Precipitation	Trend-Adjusted Yield
1983	79.0	1.93	78.8	2.4	132.2
1980	78.8	2.97	77.2	5.3	151.9
1999	78.4	2.77	71.6	2.7	162.8
2002	78.1	2.61	74.9	4.4	152.1
1986	77.7	5.62	69.6	2.1	182.5
2010	77.7	5.35	76.9	3.2	158.9
1977	77.6	3.57	71.8	6.9	169.6
1988	77.5	2.6	77.9	2.5	116.7
1987	77.3	4.29	74.1	5.5	177.6
2006	77.1	4.09	74.6	4.1	172.5
1975-2010 Avg.	75.2	4.0	73.3	3.6	168.7

Note: Average monthly temperature is in degrees Farenheit and total monthly precipitation is in inches. Trend-adjusted yield is based on a linear trend estimate over 1975-2010.

The state average trend-adjusted corn yield in the selected 10 years varied from 116.7 to 182.5 bushels and averaged 157.8 bushels, compared to the 36-year average of 168.7 bushels. Consistent with previous research, a substantial part of the variation is associated with the large range in July precipitation and varying temperature and precipitation conditions in August. In addition, extremely dry conditions were experienced prior to July in 1988. The available data indicates average July temperature in 2011 will be above 77 degrees and that the average precipitation will be below the 1975-2010 average of 4 inches.

The other years since 1975 that most resemble 2011 July weather conditions (hot and dry) are 1977, 1980, 1983, 1999, and 2002. What happened in those years? As indicated in Figure 1, crop condition ratings (percent rated good or excellent) declined sharply in each year, except 1977, as the growing season progressed from late June through early September. The seasonal pattern of the crop condition ratings was influenced by August weather conditions in each of those years. Average August temperature and precipitation varied considerably in those years, with various combinations of above and below average temperature and precipitation. At one extreme were the cool, wet conditions of 1977 and at the other extreme were the hot, dry conditions of 1983. The average crop condition ratings from late June through early September for those 5 years, along with the condition ratings through the third week of July 2011, are presented in Figure 2. To date, 2011 crop condition ratings are generally tracking the average of the five analog years.

Figure 1. Crop Condition Ratings for Illinois Corn in Years with Hot July Temperatures

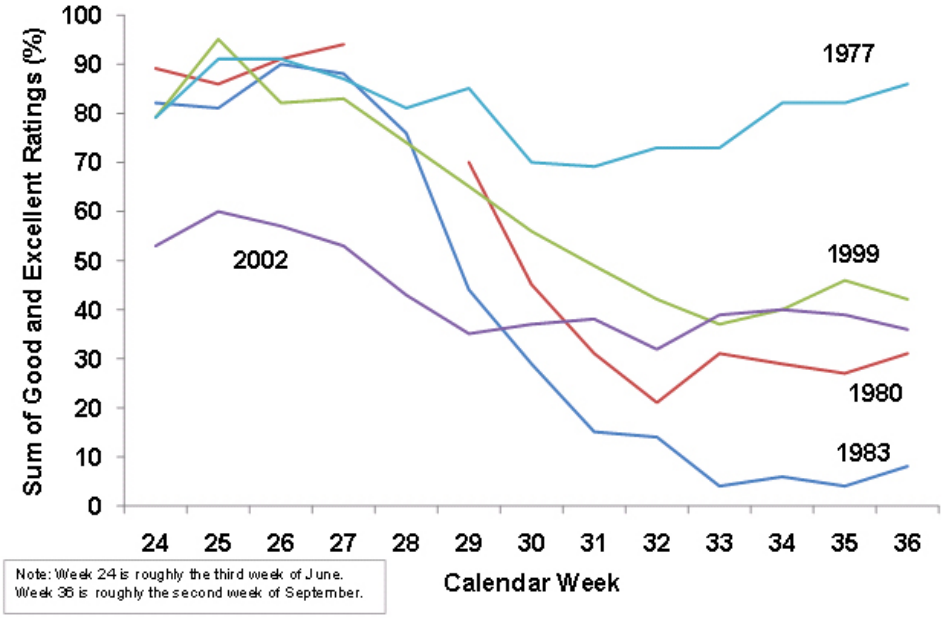
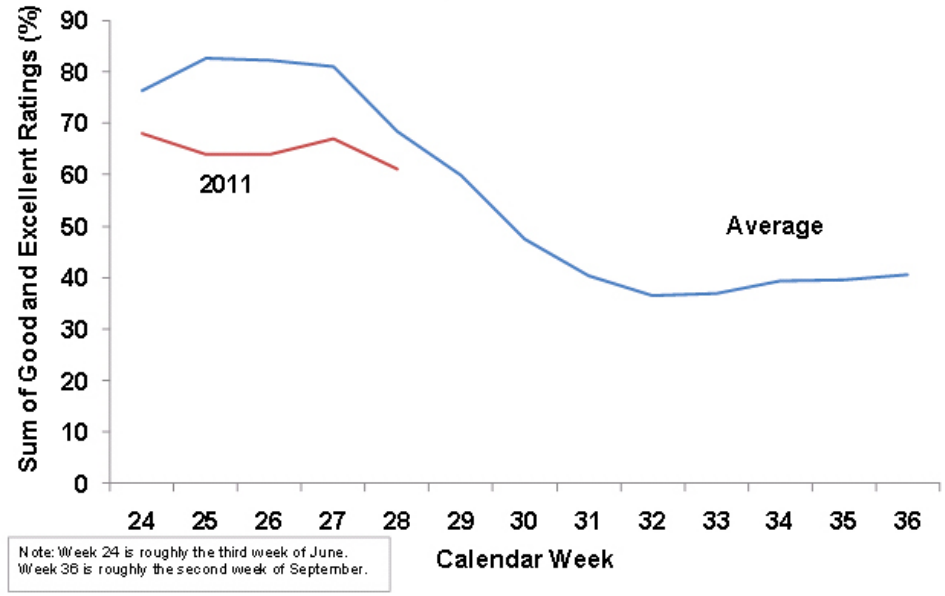
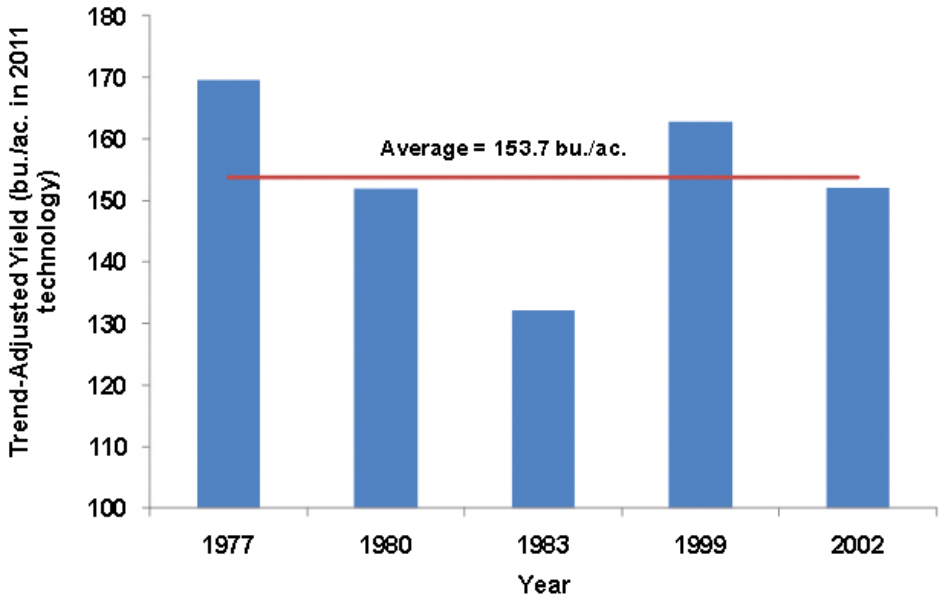


Figure 2. Comparison of 2011 Crop Conditions for Illinois Corn to Date and Average Condition in Years with Hot July Temperatures



As shown in Figure 3, the state average trend-adjusted corn yield varied from 132.2 to 169.6 bushels in the five years since 1975 that had similar July weather conditions to those expected for 2011 (Figure 3). Not surprisingly, the lowest yield was in 1983 when August was also hot and dry and the highest yield was in 1977 when August was cool and very wet. The average yield for the five years was 153.7 bushels, 15 bushels below the 36 year average (trend-adjusted). The Olympic average (excluding the highest and lowest) for the period was 155.6 bushels, 13.1 bushels below the 36 year average.

Figure 3. Trend-Adjusted Illinois Corn Yield in Selected Years with Hot July Temperatures



Conclusion

Corn yield prospects in Illinois this year are still very uncertain. However, the history of corn yields in years with hot, dry conditions in July clearly points to the potential for a below average yield. Much will depend on actual weather conditions in the last week of July and in August. Weekly crop condition ratings will provide some indication of potential yield. Without favorable conditions during that period, a state average corn yield in the mid- to low-150's might be expected. That compares to a trend yield for 2011 of 168.7 bushels.

Some other Corn Belt states have experienced hot, dry conditions in July. We have not done a similar analysis for these states, but comparable results would be expected. The implications for the U.S. average corn yield are less certain because parts of the Corn Belt have fared better than Illinois this summer.