2-12-2007

300 bushels of corn . . . when and how?

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Abstract
Corn yield potential is an important topic for discussion--driven by the imminent need to either grow corn on acres currently allocated to other crops or increase corn yields. Bob Wisner, Iowa State University economist, stated at the 2006 ICM Conference that there are a couple of avenues to obtain enough corn for the ever-increasing demand for corn in Iowa these next four to five years.

Keywords
Agronomy

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

Crop Production

300 bushels of corn . . . when and how?

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Corn yield potential is an important topic for discussion—driven by the imminent need to either grow corn on acres currently allocated to other crops or increase corn yields. Bob Wisner, Iowa State University economist, stated at the 2006 ICM Conference that there are a couple of avenues to obtain enough corn for the ever-increasing demand for corn in Iowa these next four to five years:

a) *Either* . . . with 15 bushels per acre above the 2005 Iowa average yield (173 bu/acre), we would need 20.2 million acres of corn in Iowa (a 63% increase).

b) *Or* . . . with 12½ million acres of corn (like we had in 2005 and 2006), we would need to produce more than 312 bushels of corn per acre (a 187% increase from current yield trends).

In reality, a combination of both tactics is necessary, but neither is likely practical. Is it even possible to produce 300 bushels of corn per acre?

The short answer is, "Yes!" Many growers are producing yields over 300 bu/acre every year. Some of these producers are represented in the National Corn Growers Yield Contest every year (**www.ncga.com**). Contest winners from across the country typically produce between 250 to 350 bushels per acre per year. In 2006, seven of the 27 national winners produced over 300 bu/acre with the highest yield of 347 bu/acre coming from Purdy, MO. National contest winners have rarely yielded more than 350 bu/acre, yet yields of 360–370 bu/acre have been documented. Yields of 300 bu/acre are possible with today's genetics, excellent management, and stress-free environments. The difficulty is in producing yields of this caliber on a large scale. Unfortunately, most producers do not have the right combination of these three factors to produce 300 bushels per acre.

Iowa's average corn yield was 166 bu/acre in 2006, which is just slightly above the 30-year trend line. Our highest average yield was 181 bu/acre in 2004. Iowa is increasing yield at approximately 2 bushels per acre per year; more than 60 years will be necessary to have a state average of 300 bu/acre.

So what is limiting yield on Iowa fields?

Two primary factors: environment and management. We can generally rule out genetics since most producers have access to the same genetics as the contest winners do. Management factors that can be controlled include nutrients, weeds, diseases, insects, and water (through irrigation).

Indeed, many Iowa producers average 230 to 270 bu/acre by paying close attention to management. So, one might ask, what is limiting the yields for this group? We'd suggest that it is a higher degree of management and water. Part of the management decision may be simply to produce corn economically—and not to go all out for contest-winning yields. So a different economic situation (where no inputs are limited) may allow some of Iowa's top producers to approach or surpass 300 bu/acre. If we use a 230-bushel average yield though, it would still require roughly 32 years for these producers to reach 300 bu/acre.

Where are yield increases coming from?

Yield increases are coming largely from improved stress tolerance. It is a combination of improved genetics and management. Some corn breeders suggest that the observed yield increases come as a result of improved genetics and management, whereas others put more weight on the improved genetics as the driving force. In either case, corn stress tolerance has increased over the past five decades, allowing us to plant more seed per acre and withstand more environmental stress. The point, though, is that this effort to increase corn stress tolerance has not increased yield potential—it has only increased the plant's tolerance toward stress. Transgenic hybrids are no different; whether they are herbicide resistant or insect resistant, transgenic hybrids are only protecting yield—not increasing yield potential.

A strong point of concern among some agronomists and scientists is the fact that irrigated (stress-free) National Corn Growers Contest winners have not increased yields in the past 20 years. Similar yields have been attained by this group of growers since 1985. This suggests that contest winners have arrived at a yield ceiling. As the average corn yield increases and approaches this yield ceiling, the rate of annual gain will decrease substantially.

Dramatic changes must occur for the pace of yield gains to continue at their current rate, and even more change is necessary if the yield gain is to increase. Some forecast that a doubling of yield gains will occur. Therefore, instead of corn yields increasing at 2 bu/acre/year they would increase at 4 bu/acre/year. Yet, the greatest increase we have ever experienced in U.S. agriculture was during the early 1980s; the 30-year trend line at that time was increasing at 2.3 bu/acre/year (see "Introduction: Corn following corn," Figure 1, page 2). If a 10-year trend line is used instead of a 30-year, the outlook is a bit more promising; for example, a 10-year trend line currently shows that U.S. corn yields are increasing at 2.7 bu/acre/year. This is assuming that weather conditions will continue to mimic those of the past 10 years though.

In addition to these ideas, we must recognize that certain forces are at work to actually reduce the annual gain in yield. Factors that will likely reduce national and state yield trends are yields of corn following corn are reduced 5 to 15 percent compared to corn following soybean; if Conservation Reserve Program (CRP) land is converted to corn production, these are less productive; and environmental concerns.

Yet, we do not rule out dramatic changes in this discussion. The promise of a "drought gene" in the future will simply be another tool to help protect yield potential, not increase it. However, the promise of a "yield gene" in the truest sense may increase actual corn yield potential. If such a gene exists and can improve yield by 25 percent (at least one company suggests this is the current expectation), it would increase Iowa county yield averages from 164 to 205 bu/acre, top producers' yields from 230 to 288 bu/acre, and yield contest winners' yields from 350 to nearly 440 bu/acre. A yield of 440 bu/acre is over the top of the current yield ceiling and approaching what some have called the theoretical yield potential for corn.

We are not confident that average yields will reach 300 bushels per acre in the near future. Without any major paradigm shifts, these yield levels may be achieved in three to six decades. The short-term answer for supplying corn in Iowa without imports must be a combination of increased acres planted to corn and the slow but consistent increases in corn yields we have experienced over the years. Research is crucial for increasing corn yield potential.

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