WHAT DOES IT TAKE TO GROW CORN AT ITS YIELD POTENTIAL?

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Yield potential (Ymax) can be defined as the maximum yield that can be achieved in a given environment for a certain crop or plant species. Yield potential is therefore a situation where plant growth is unlimited by water or nutrient supply and where growth potential is limited solely by uncontrollable growth-defining factors such as genetic characteristics of the plant, solar radiation, temperature and CO2 concentration. The management of yield potential is possible through plant breeding, selection of the proper cultivar or hybrid, sowing date, and plant density in relation to the variation in yield potential that is experienced from the seasonal patters of solar radiation and temperature.

How does one determine the yield potential of corn? There are several approaches to quantify Ymax, which include (i) theoretical calculations form components of yield and radiation use efficiency, (ii) measurement of Y max in well-controlled, small scale experiments in which one attempts to eliminate all biotic and abiotic stress factors, and (iii) the use of well calibrated crop simulation models. There is a lot of debate about what the yield potential of corn is. Waggoner (1994) and Evans (1993) consider corn yield potential to be virtually unlimited based on the trends observed in the trend in yields observed in yield contests. Tollenaar and Lee (2002), on the other hand, argue that there has been little improvement in yield potential and most of the trends in yield gain observed over the years has come from increased stress resistance.

Figure 1 shows the trend in both average and yield contest winning corn yields for Iowa (rainfed) and Nebraska (irrigated) over the past 38 years. Although there is a steady increase in yield gain over time, it is evident that average yields are only 50% of the yields that are achieved by contest

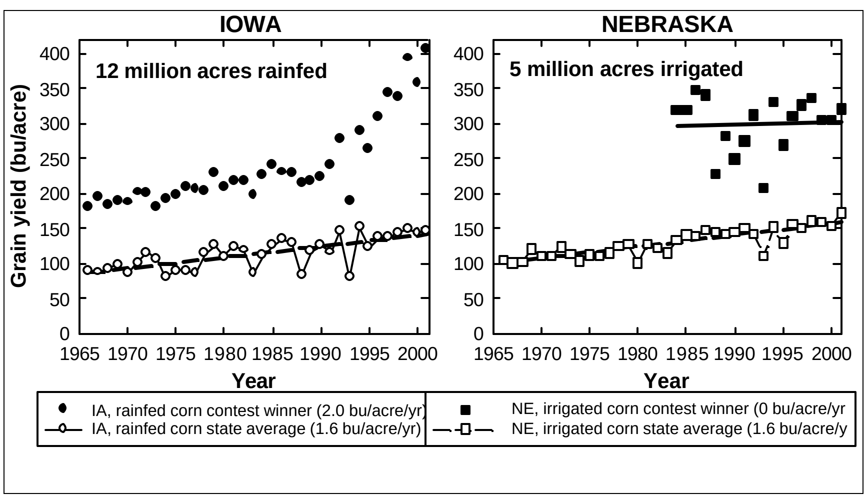

Figure 1. Yield trends for Iowa rainfed (left) and Nebraska irri gated (right) cron yields. Lower line indicates the state average and upper line the average of yield contest winners.

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winners. It is interesting to note as well that there has been no trend in yield gain for contest-winning irrigated corn in Nebraska. This suggests that the yield potential for current maize hybrids in the corn belt is around the 300 bu/acre range. However, there is a significant *and exploitable* yield gap under current production practices. The yield gap depicted in Figure 1 will not be closed by genetic technology but by improvements in management that improve pest management, nutrient supply, fertilizer efficiency and soil quality.

At the University of Nebraska, we have been conducting a long-term field experiment designed to collect detailed plant data to obtain a better understanding of the nutrient needs and management needed to obtain yields at or near the yield potential ceiling. The central hypothesis to our study is that intensive corn-based systems can be designed to achieve the optimal balance of productivity, profitability and environmental quality. This experiment has been conducted with crop rotations as the main plot (continuous corn and corn-soybean), with a range in plant density (P) of 30,000 to 44,000 plants/acre with two levels of nutrient management intensity (M1 – conventional soil-test-based rates and M2 – intensive application rates designed to achieve yields close to yield potential. Maximum yields have been obtained under intensive fertilizer management with plant populations between 37 – 44 thousand plants/acre. Hybrid characteristics, planting date and an understanding of climatic trends are very important in optimizing yie ld. In this presentation, I will present the trends in yield and yield components that we have observed over the past five years. Our finding suggest that fertilizer management strategies that are based upon a yield goal that is far below the yield potential do not allow expression of attainable yield that is possible under higher plant densities or more intensive nutrient management strategies. I will end with a discussion of the types of management tools that are needed to achieve yield potential and the benefits of high yields to improving soil quality and sustaining high productivity.

References

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