

Corn Yield-Trends from 1987 through 2015 By Yield Environments

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INTRODUCTION

Average corn (*Zea mays* L.) grain yield per harvested area has significantly increased in the US for past few decades. However, it is not clear whether this average corn yield change is primarily due to: **uniform yield increase** across all yield environments (Fig. 1A), **partial yield increase** driven by changes in parts of corn yield environments (Fig. 1B), **a change in frequency** without actual yield increase (Fig. 1C), or **combination** of all the above (Fig. 1D).

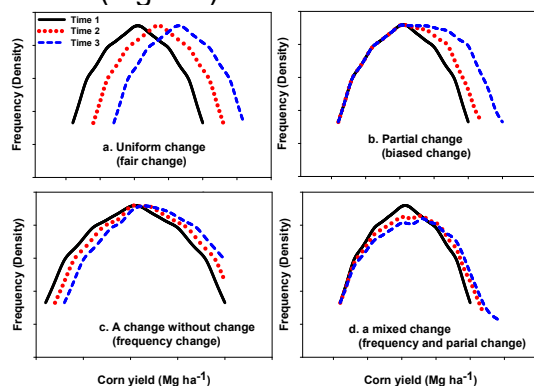


Figure 1. Theoretical framework for scenarios that result in an overall average yield improvement. An overall average yield increase (trend line in red) for a region can be a result of a similar yield increase across all yield environments (A), significant increase in a single or few best yield environments (B), an increase in only the proportion of best yield environments (and/or a decrease in the proportion of lower yielding environments, C), or an increase in both the yield and proportion of best yield environments (D). Note that the overall yield gain in panels A and B is average of yield gains in different environments. The overall yield gain in panels C and D is not average of yield gains in the different environments due to changes in proportion of data with year. These are examples, not an exhaustive list, of scenarios on how average yield across environment might have changed.

Objective

- To examine corn yield trends 1987-15
- identify cause for yield increased and
- suggest direction for future research.

MATERIALS & METHODS

Two sources of data used for this analysis were a field study (Dupont Pioneer®) and USDA survey data.

RESULTS and DISCUSSION

A. Yield trend by environments

B. Average trend

1. Field data

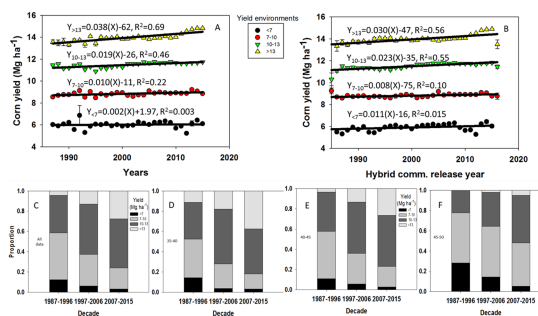


Figure 2. Yield trend in the low (<7), medium (7-10), high (10-13), and very high (>13 Mg ha⁻¹) yielding environments by field study years 1987-2015 (A) or by hybrid commercial release year (B) and proportion of the low, medium, high, and very high yield environment for, entire dataset (C), for 35-40° N (D), 40-45° N (E), and 45-50° N (F) degree latitudes for the field study decade years 1987-1996, 1997-2006, and 2007-2015. Trend lines for low yielding environment (<7 Mg ha⁻¹) in both panels (A, B) were not significantly different from 0. Vertical bars in each data point are standard error bars.

2. USDA survey data

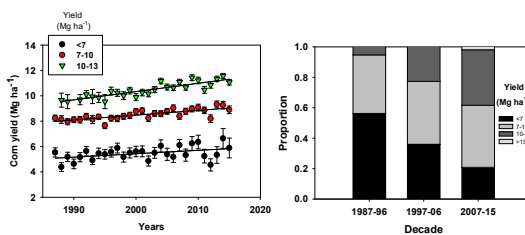


Figure 3. Corn yield trends for three yield environments (left panel) and proportion of yielding environment by decade (right panel), using historical yield record of USDA for the states of Arkansas, Colorado, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Michigan, Nebraska, New Jersey, New York, North Carolina, North Dakota, Oklahoma, South Dakota, Tennessee, Texas, Wisconsin, and Wyoming for years 1987-2015. Vertical bars in each data point are standard error bars.

- Yield improvement was recorded in the high- (HY) and very high-yielding (VHY) environments
- the proportion of HY and VHY environments increased
- yield for medium (MY) and low-yielding (LY) environments did not significantly change over time, and
- the proportion of LY and MY environments has decreased over time.

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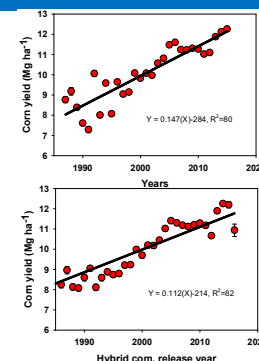


Figure 4. Average corn yield trends from 1987-2015 by field study years (top panel) and by hybrid commercial release year (bottom panel) for the entire North America using optimal density for each yield environment and dominant hybrid CRM for each latitude. Vertical bars in each data point are standard error bars.

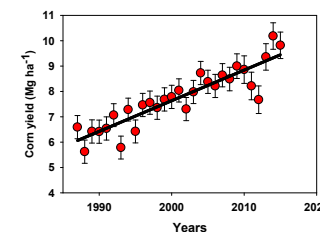


Figure 5. Corn average yield trend from 1987-2015 using historical yield record of USDA for years 1987-2015. Vertical bars in each data point are standard error bars.

CONCLUSION

An increase in the yield ceiling and proportion of high yielding environments (or a substantial decrease in the proportion of MY and LY environments) were the main reasons responsible for yield improvement.