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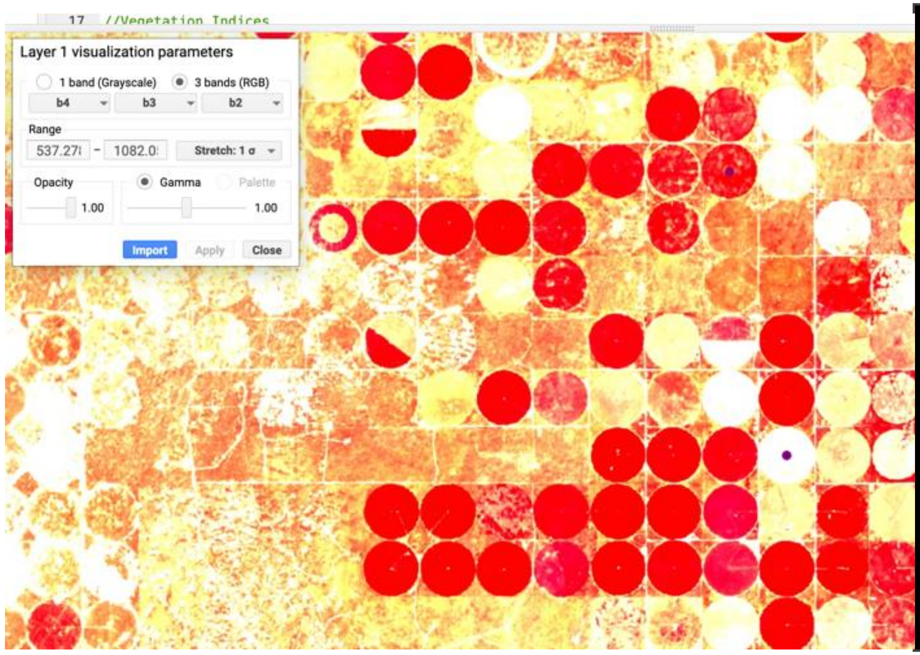

Corn Management, Plant Density and N Rates: Learning from the Past and Looking into the Future

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Outline

Historical changes for corn

Planting date changes, and changes in grain yield components

Changes in leaf angle and canopy architecture

Plant density changes over time

Late season N applications

Future with using satellite sources

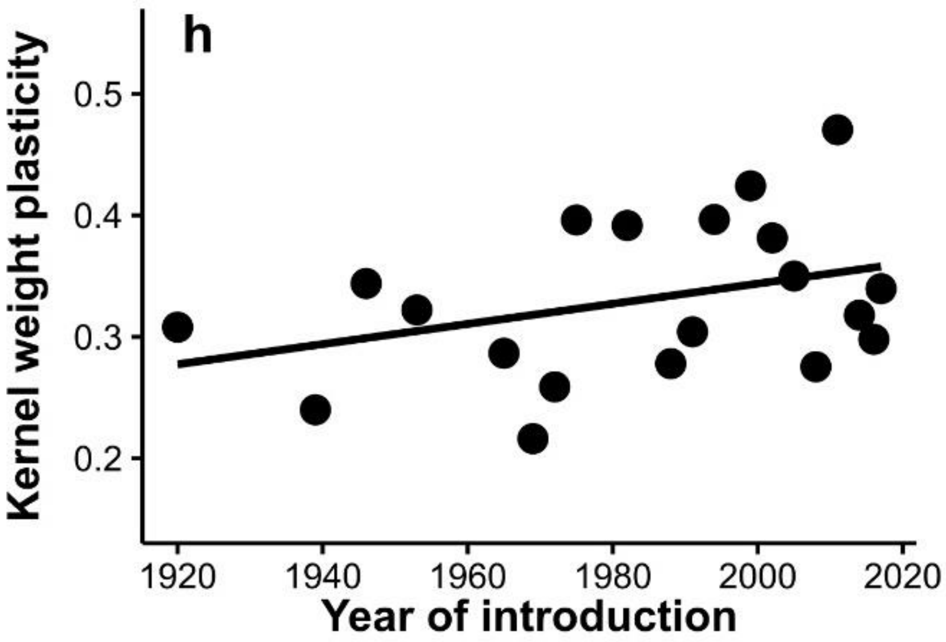
Perspectives and Conclusions

CORN - GRAIN WEIGHT RESPONSE TO STRESSES

Control

Reduced grain set
~ stress during flowering

Reduced leaf source
~ stress during grain-filling

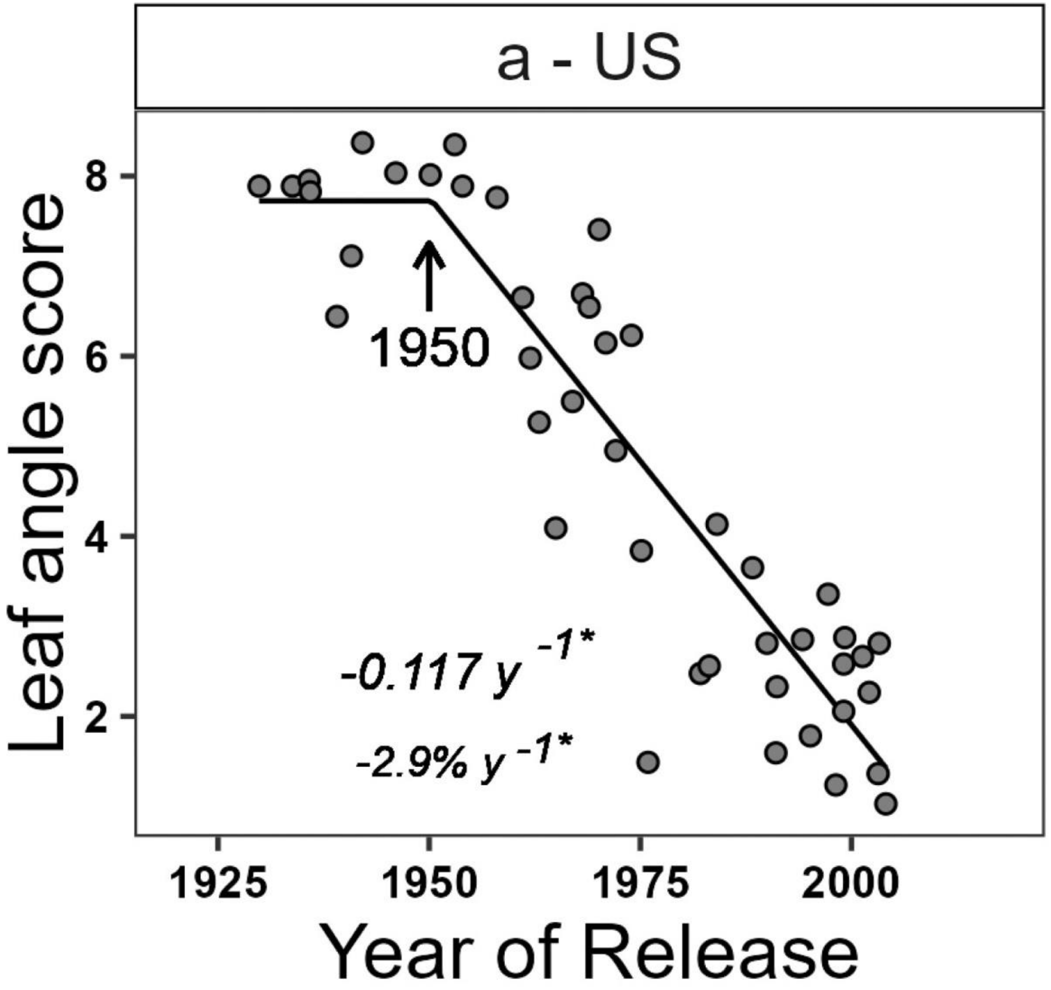


NEW hybrids showed a **more plastic grain weight** due to:

- Higher reductions in grain weight with a **source limitation during grain-filling**
- Higher grain weight when **favorable grain-filling**, partially compensating for reductions in grain set

Changes in leaf angle and canopy architecture (k coefficient)

State of knowledge about the changes in plant (leaf angle score) and canopy architecture (k coefficient).

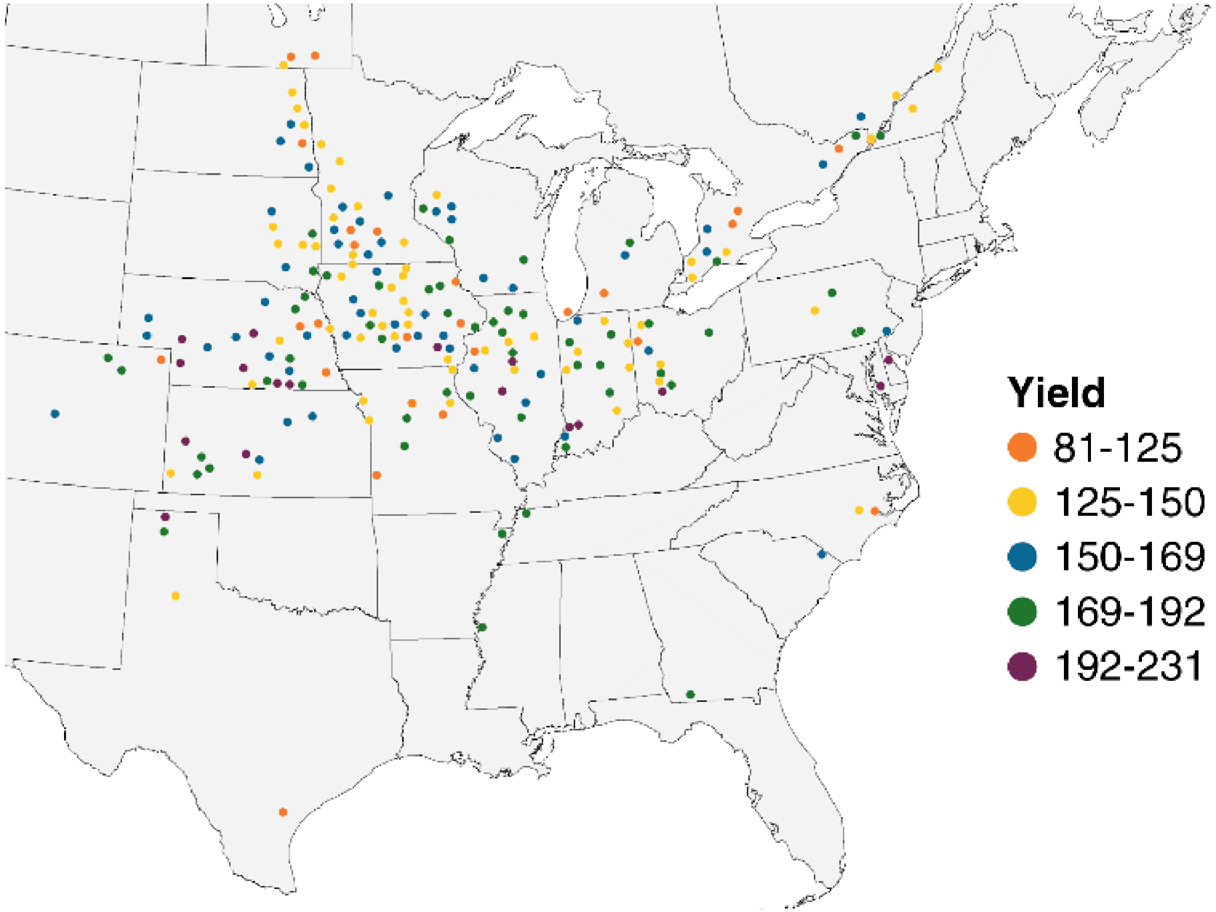


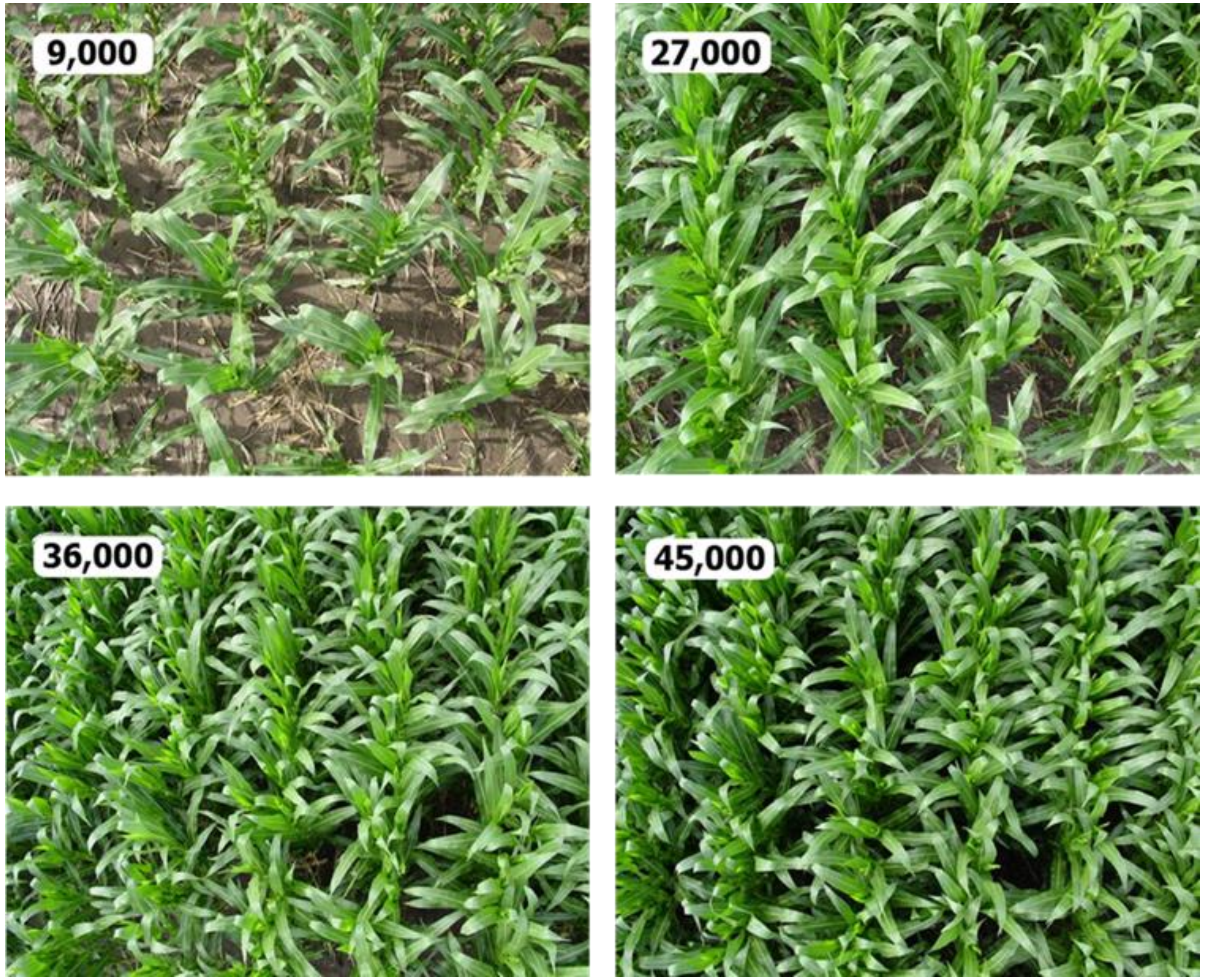
A larger leaf angle score at flowering (USA) denotes more planophile leaves (reprinted from Messina *et al.*, 2009).

Plant density and corn yield gain in North America

Ciampitti Lab

Geographical location for average corn yield, number of observations and yield data distribution by latitude group





Assefa, Ciampitti, et al. 2018 (Nature Sci. Reports)

Plant density and corn yield gain in North America

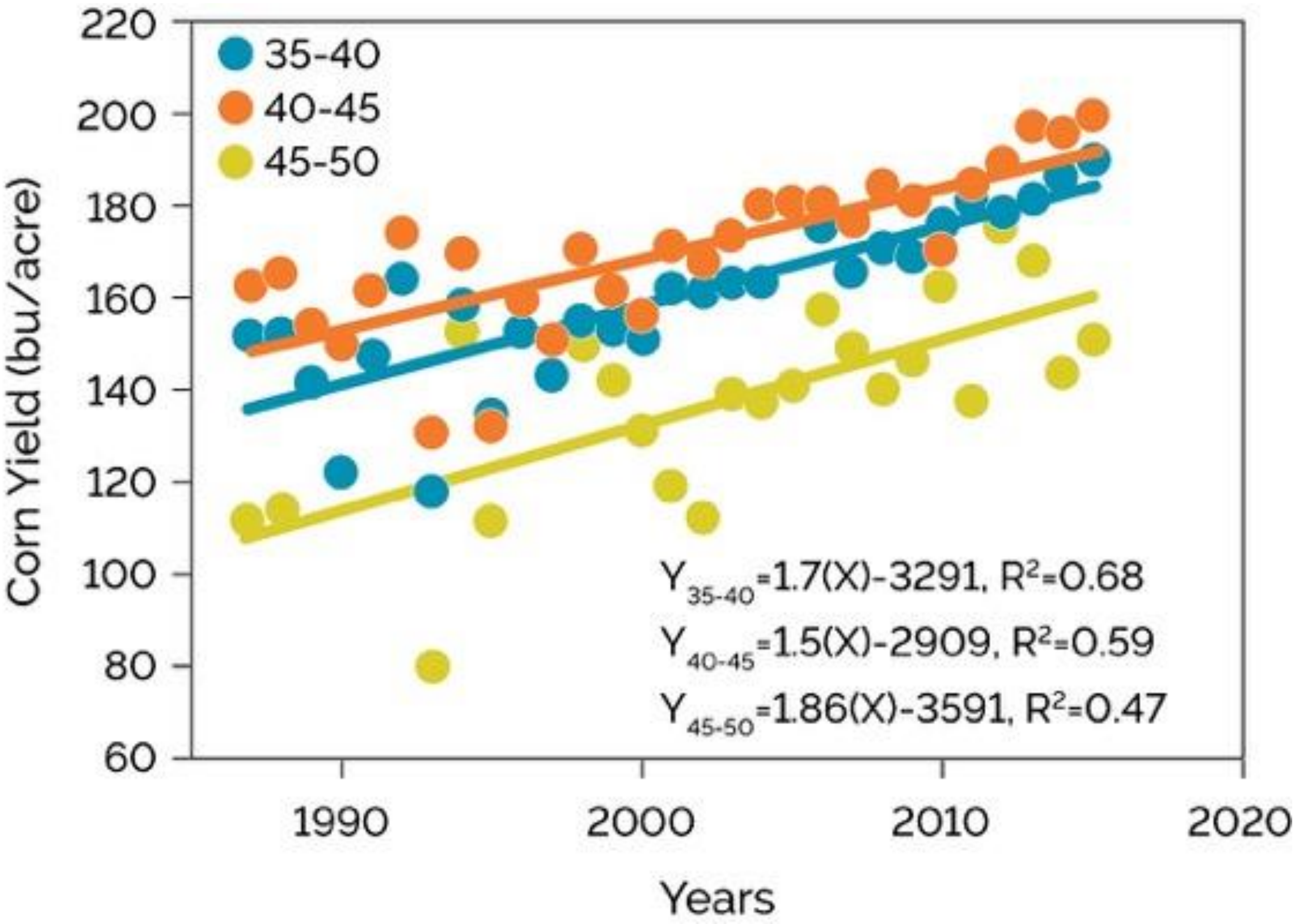
Ciampitti Lab

Average corn yield increased from **135 bu/acre in 1987** to **188 bu/acre in 2015**, representing an overall yield gain of **53 bu/acre**.

Corn yield gain for the 35-40 latitude group was 1.7 bu/acre per year.

for the 40-45 latitude group was 1.5 bu/acre per year.

for the 45-50 latitude group was 1.86 bu/acre per year.



Assefa, Ciampitti, et al. 2017 (Crop Sci.)

Plant density and corn yield gain in North America

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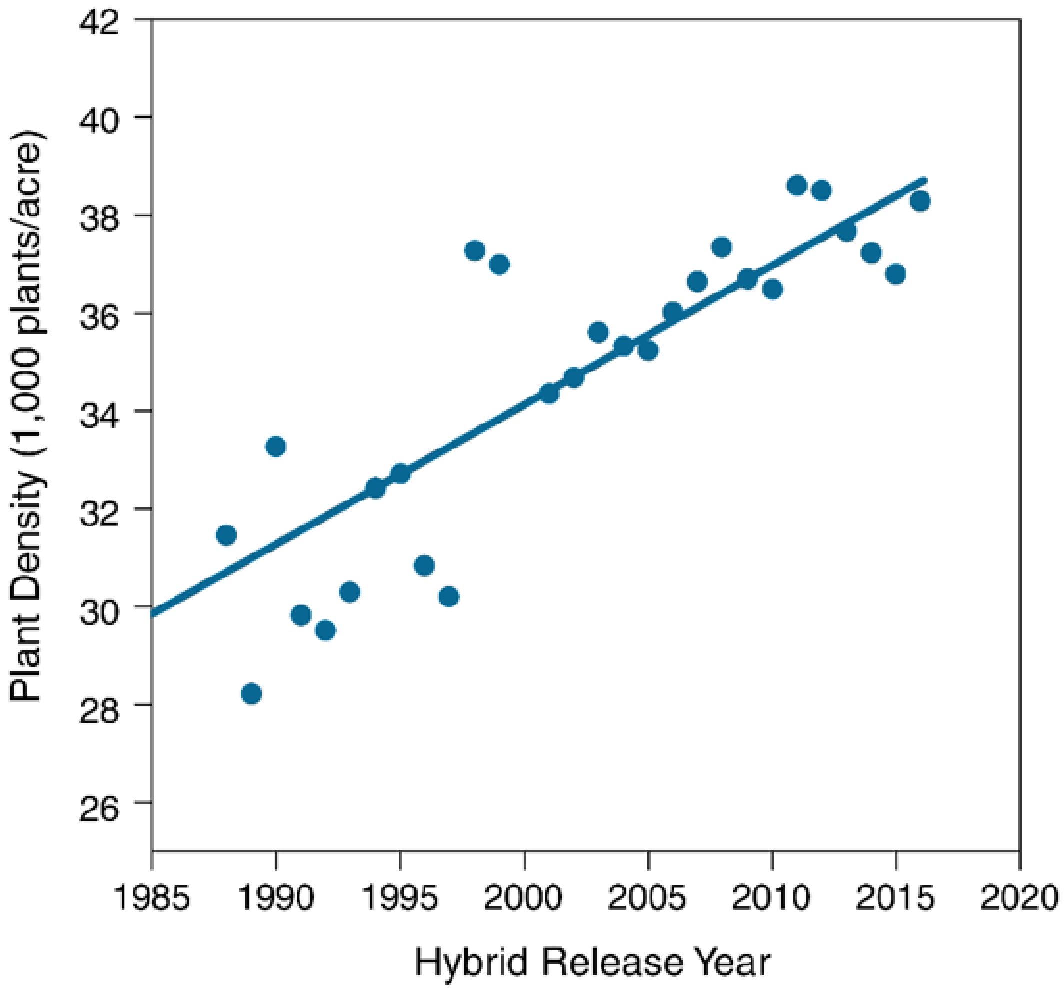
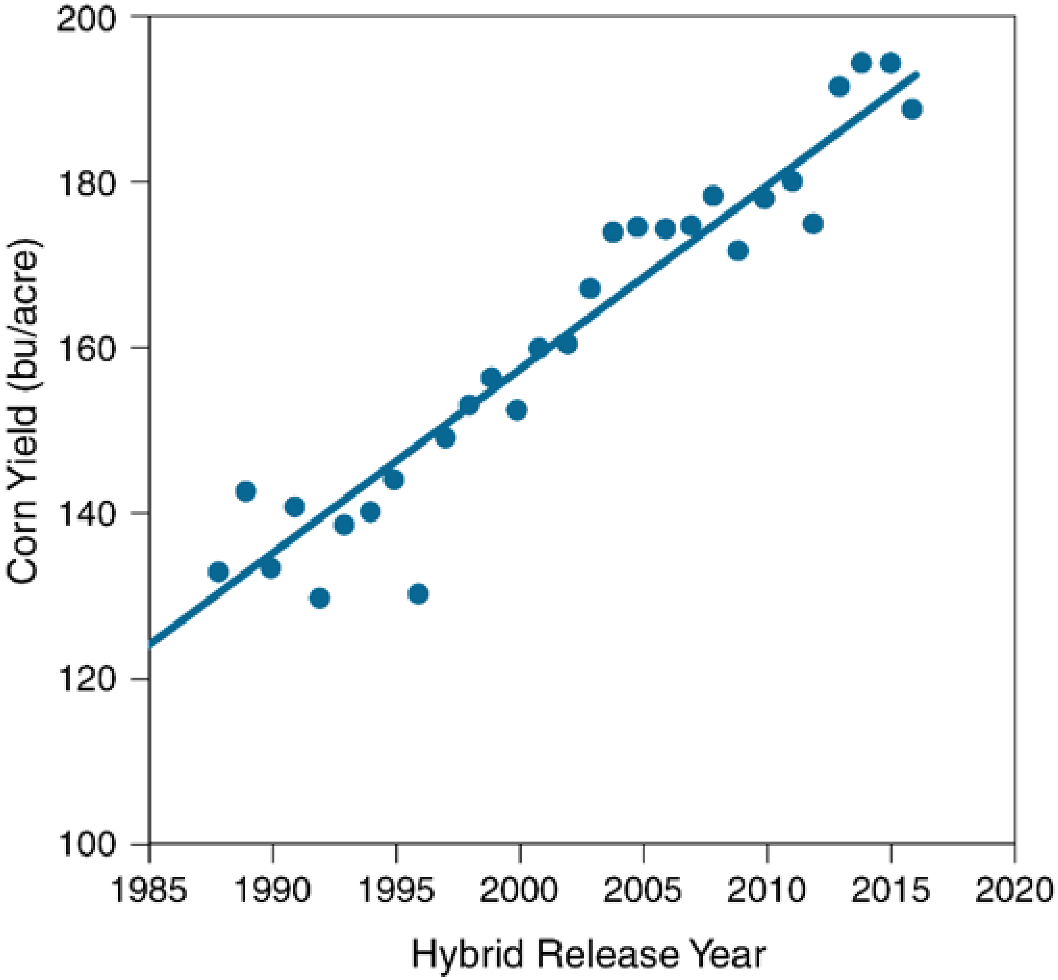


Optimum plant density (AOPD) increase in **285 pl/acre/yr**



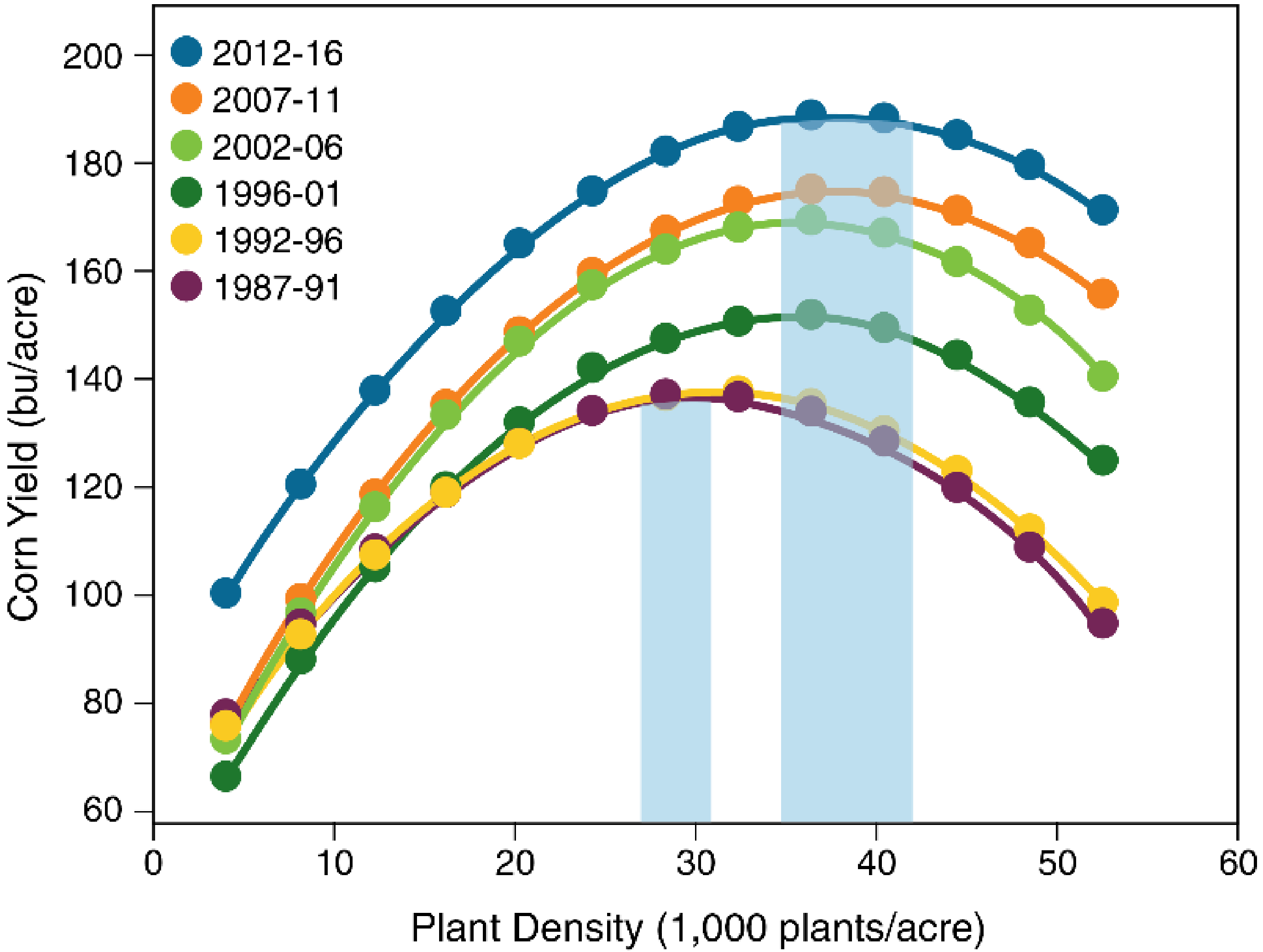
Maximum yield at AOPD **2.23 bu/acre/yr**

Assefa, Ciampitti, et al. 2018 (Nature Sci. Reports)

Plant density and corn yield gain in North America

Ciampitti Lab

The agronomic optimal plant density (AOPD) ranged from **30,500 pl/acre** for 1987-1991 to **37,900 pl/acre** for 2012-2016, with yields moving from **135 to 195 bu/acre**



The confidence interval for the AOPD point widened over time

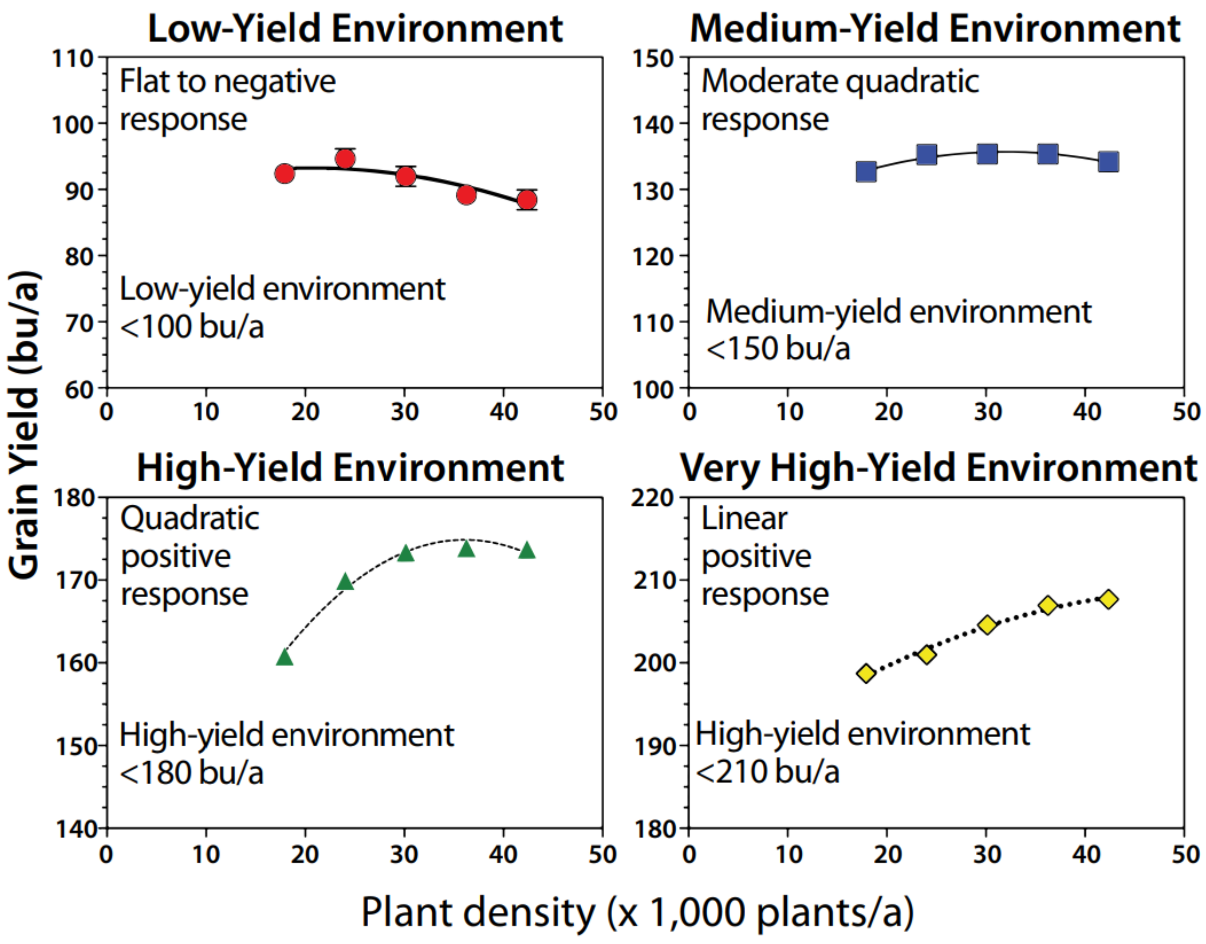
Assefa, Ciampitti, et al. 2018 (Nature Sci. Reports)

Corn yield response to nitrogen

Grain Yield Data Distribution: Yield

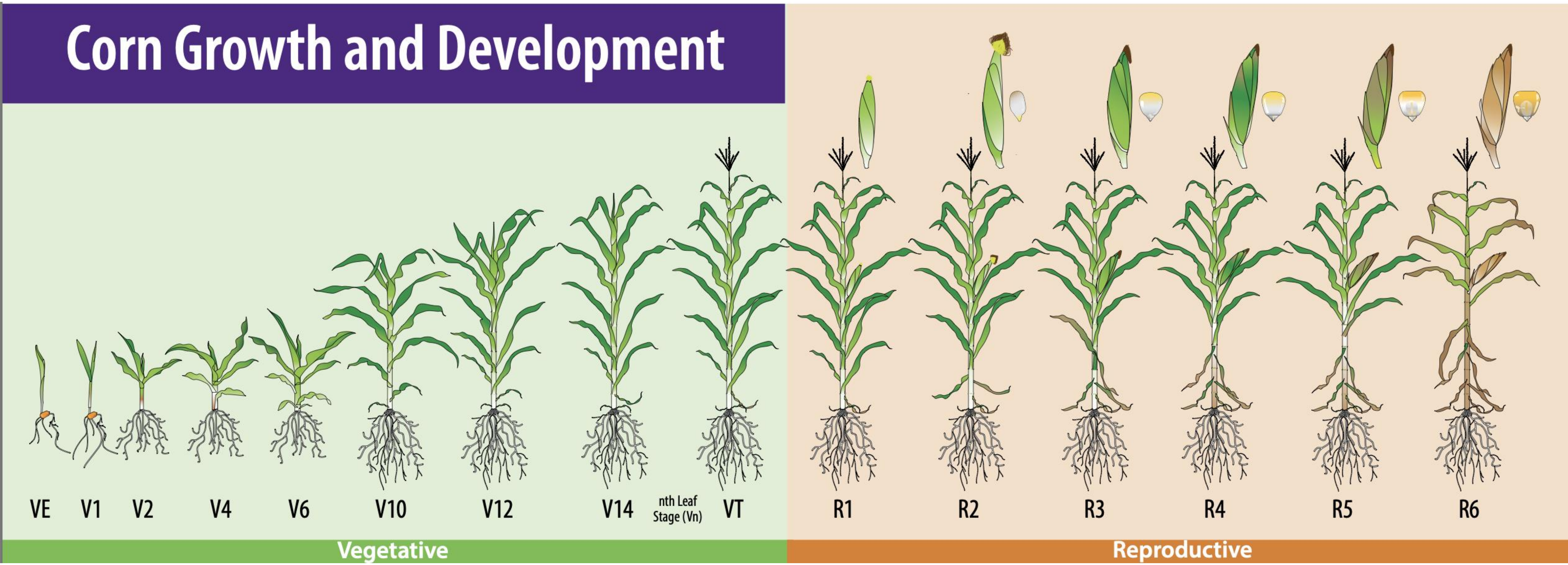
Database divided by Environment

- LOW YIELDING ENVIRONMENT <100 bu/acre
  - Optimal plant density <20K plants/acre
- MEDIUM YIELDING ENVIRONMENT <150 bu/acre
  - Optimal plant density 22-26K plants/acre
- HIGH YIELDING ENVIRONMENT <180 bu/acre
  - Optimal plant density 28-32K plants/acre
- VERY HIGH YIELDING ENVIRONMENT 200 bu/acre
  - Optimal plant density 32-36K plants/acre



Extension publication on this plant density project:
https://bookstore.ksre.ksu.edu/pubs/MF3389.pdf

With **LOW- and MEDIUM-YIELD** environments, response to plant density was flat to slightly negative.



Extension publication on Corn Growth and Development poster:
https://bookstore.ksre.ksu.edu/pubs/MF3305.pdf

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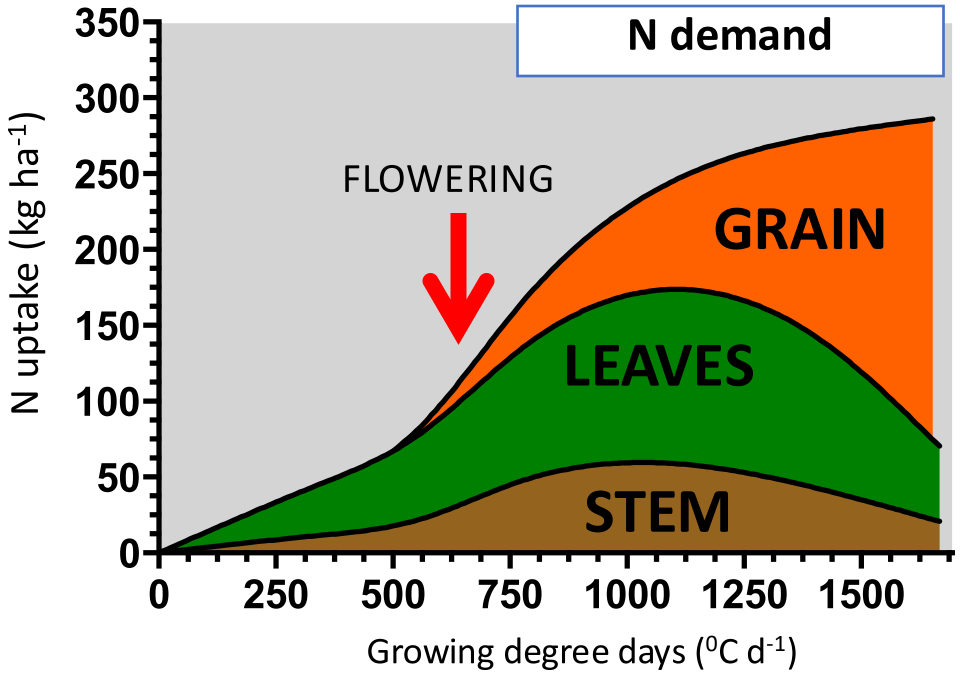
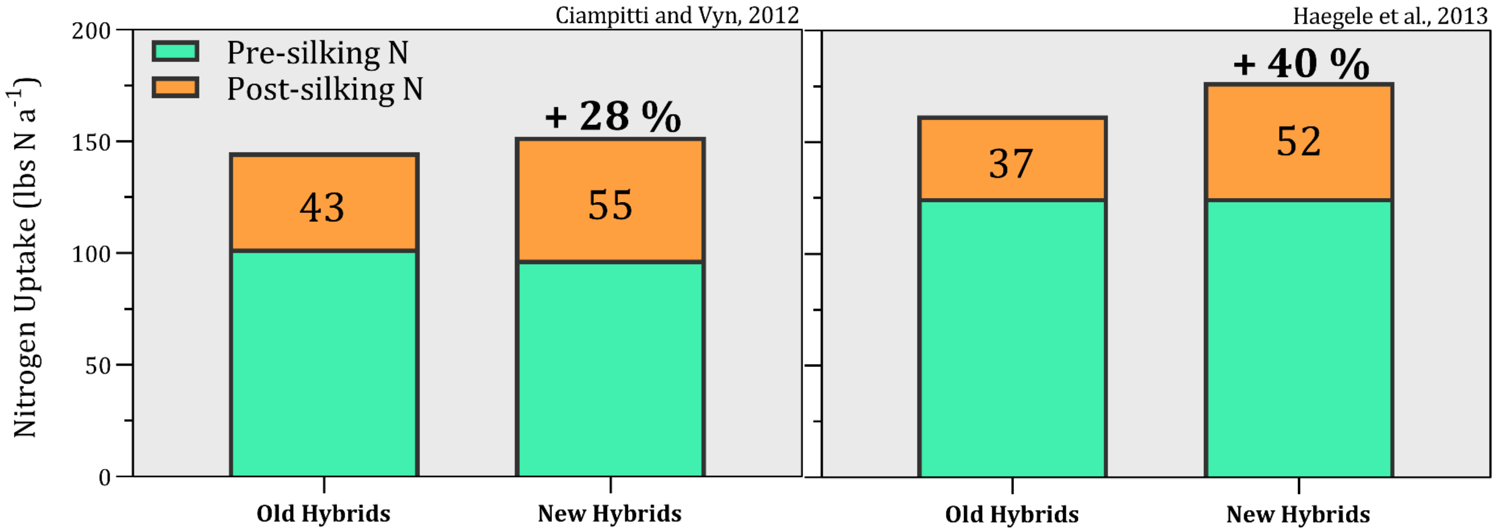
NITROGEN DEMAND CHANGES OVER TIME – CORN HYBRIDS

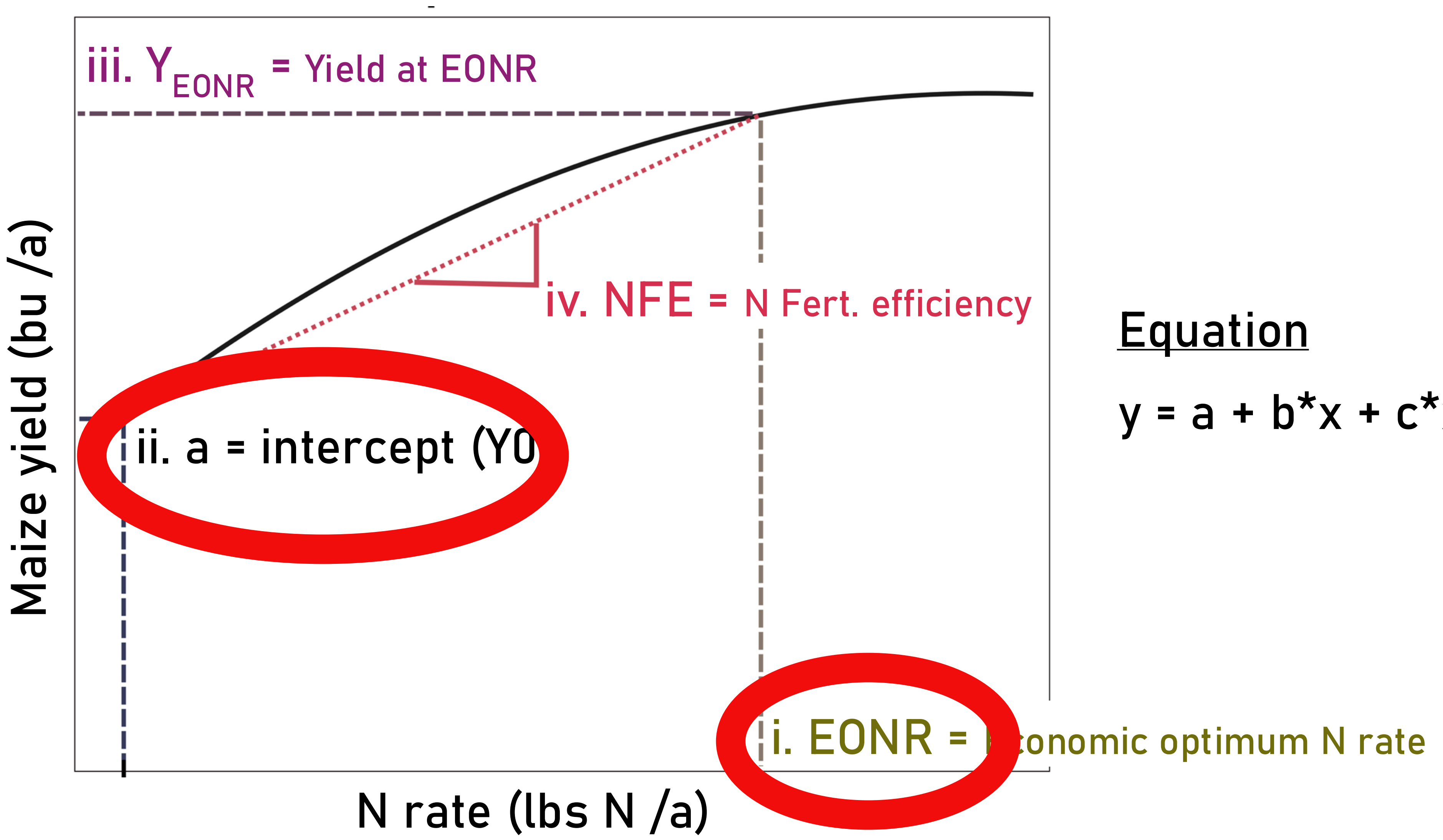




Greater post-flowering N uptake was observed for NEW corn HYBRIDS.

In overall, an increase of **30% of post-flowering N UPTAKE**.

RESPONSE MODEL



Equation

$y = a + b*x + c*x^2$

Solving the puzzle of nitrogen management

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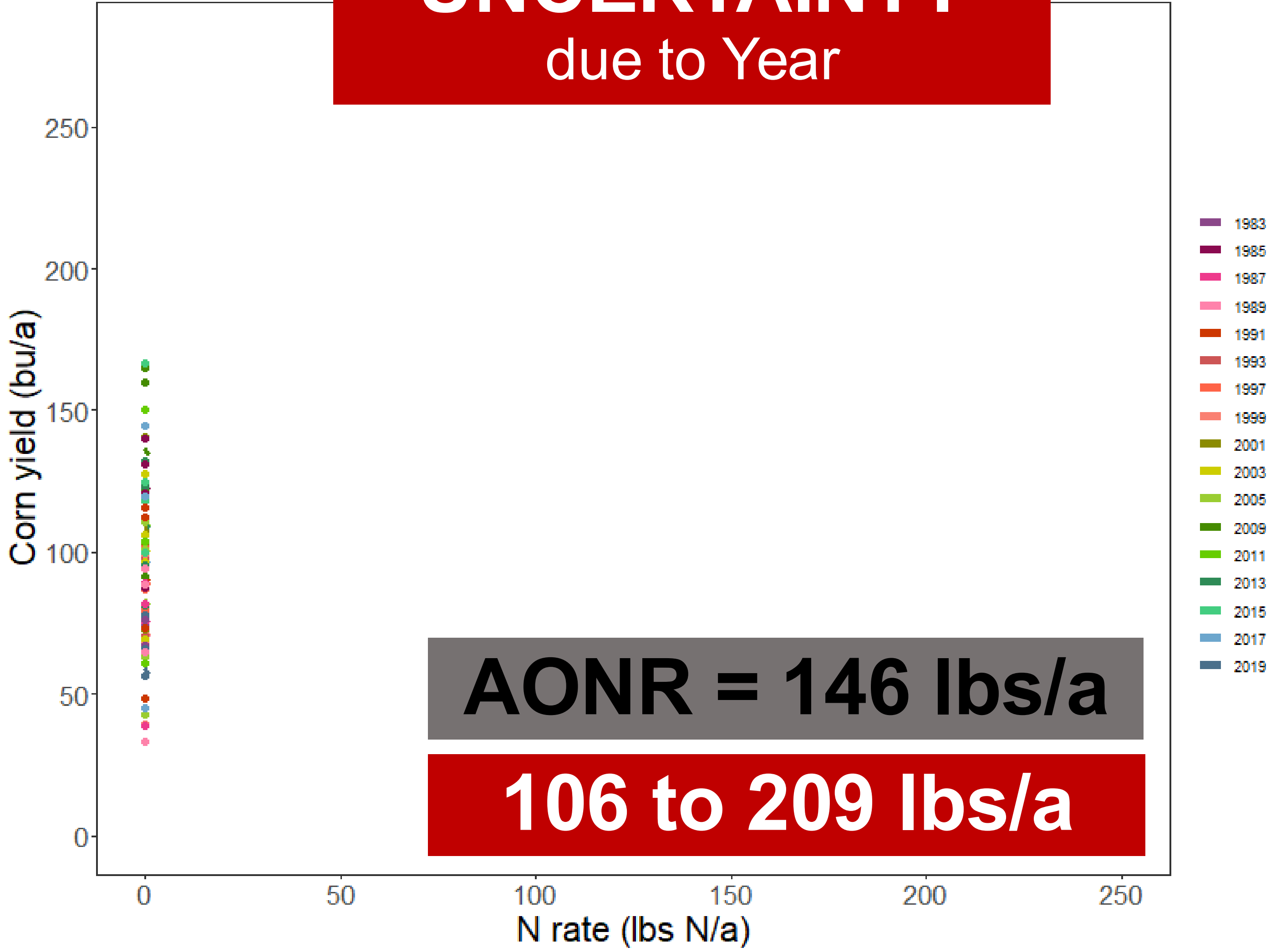
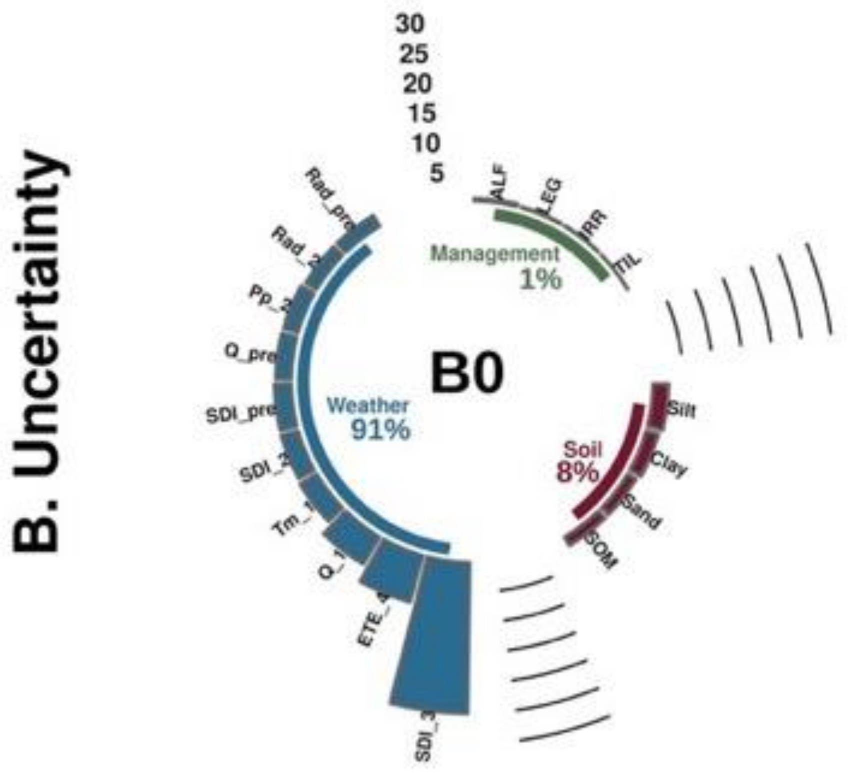
Irrigated Corn

UNCERTAINTY
due to Year



AONR = 146 lbs/a

106 to 209 lbs/a



Correndo, Ciampitti et al., 2021, 2022

Late season N applications and changes over time

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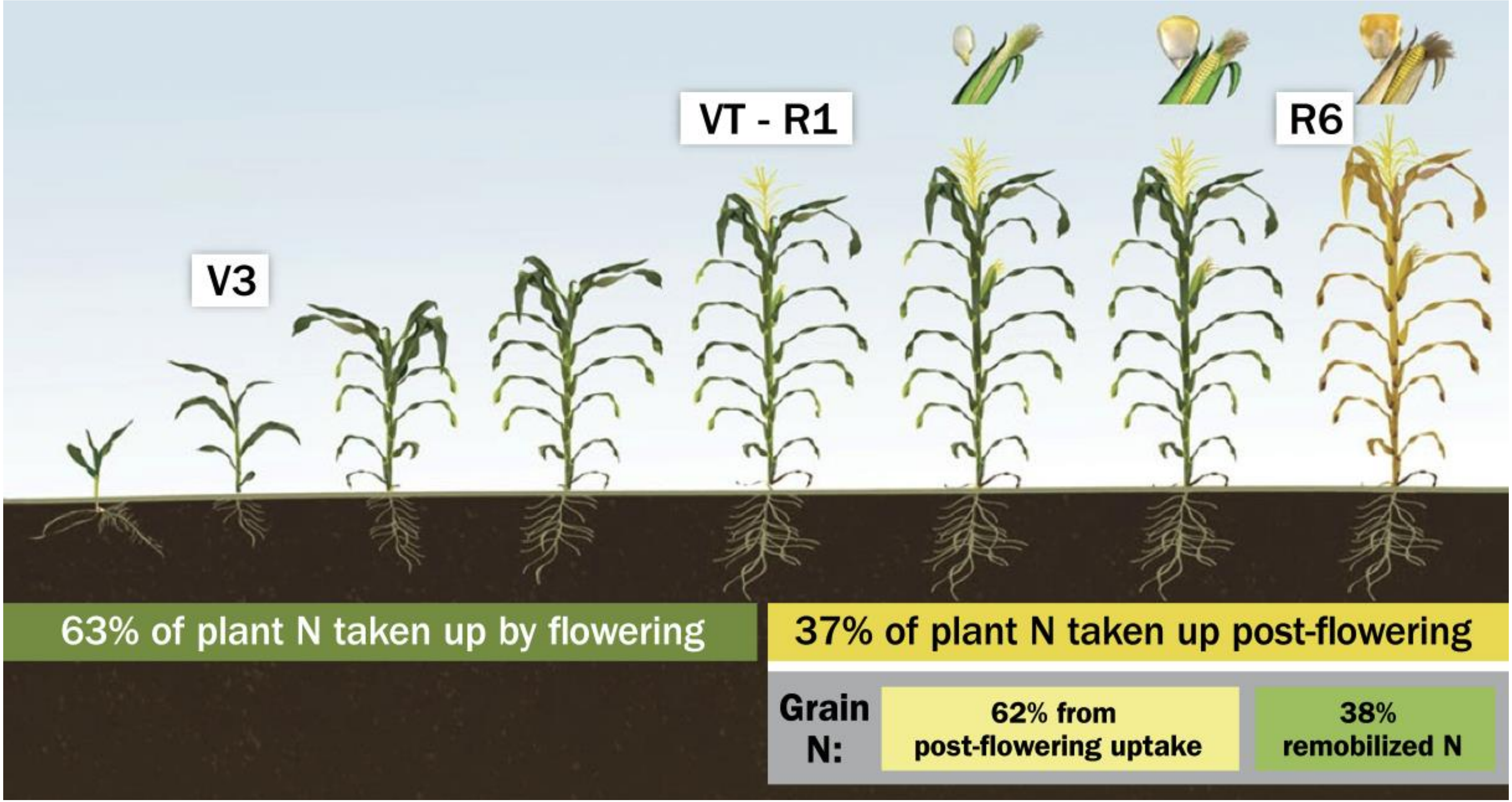


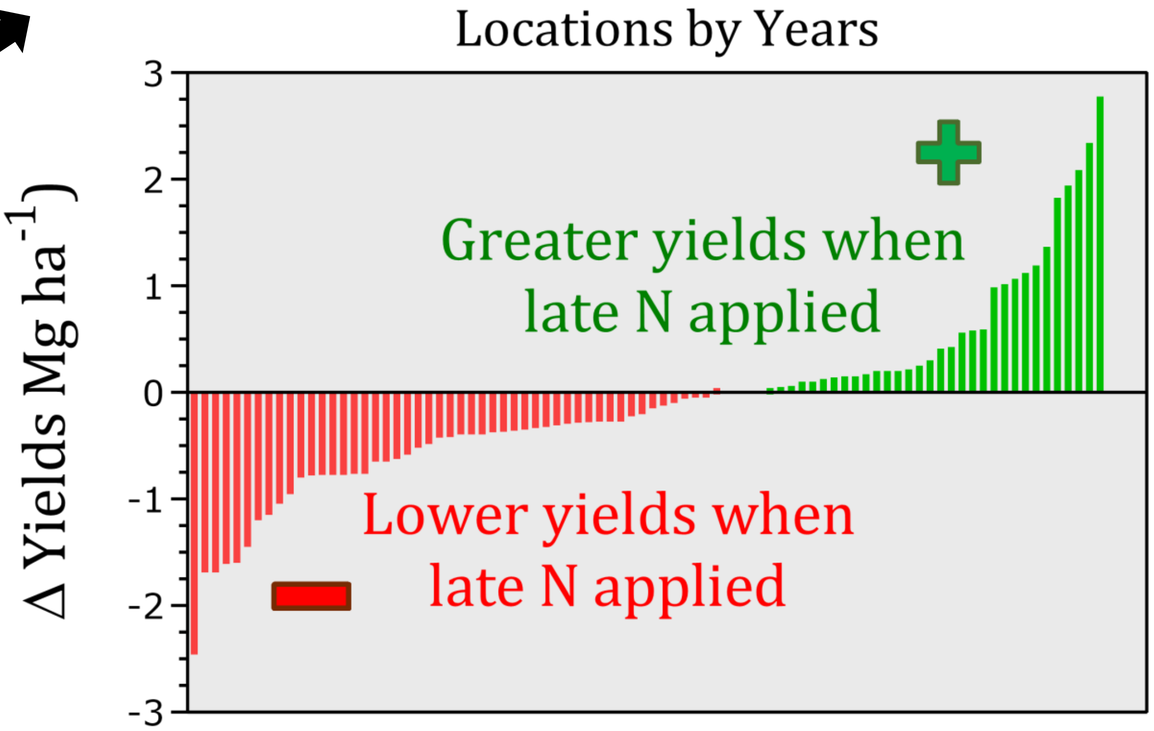
Late season N applications and changes over time

Grain yield increases in corn accompanied by N demand
(Ciampitti and Vyn, 2012)

Linked with an increased post-silking N uptake for modern hybrids
(Mueller and Vyn, 2016; Ciampitti and Vyn, 2012)

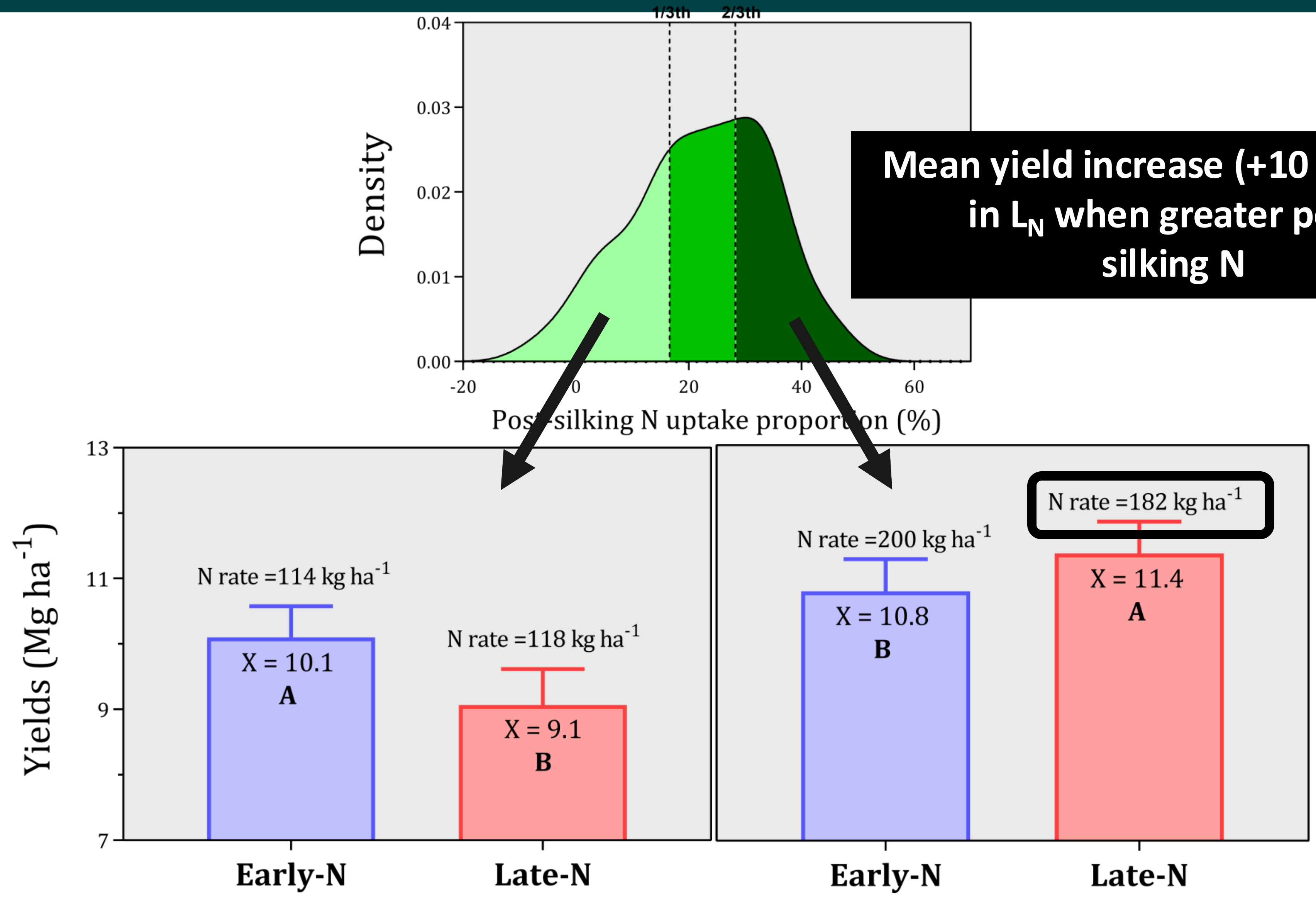
What about late N applications?

Greater synchrony between plant N demand and fertilizer N supply



Fernandez, Ciampitti, et al. 2019 (Field Crops Res.)

Late season N applications and changes over time



Mean yield increase (+10 bu/acre) in L_N when greater post-silking N

Low post-silking N uptake (< 16.4%) High post-silking N uptake (> 28.6%)

Fernandez, Ciampitti, et al. 2019 (Field Crops

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What about with the new corn hybrids, short vs tall corn?

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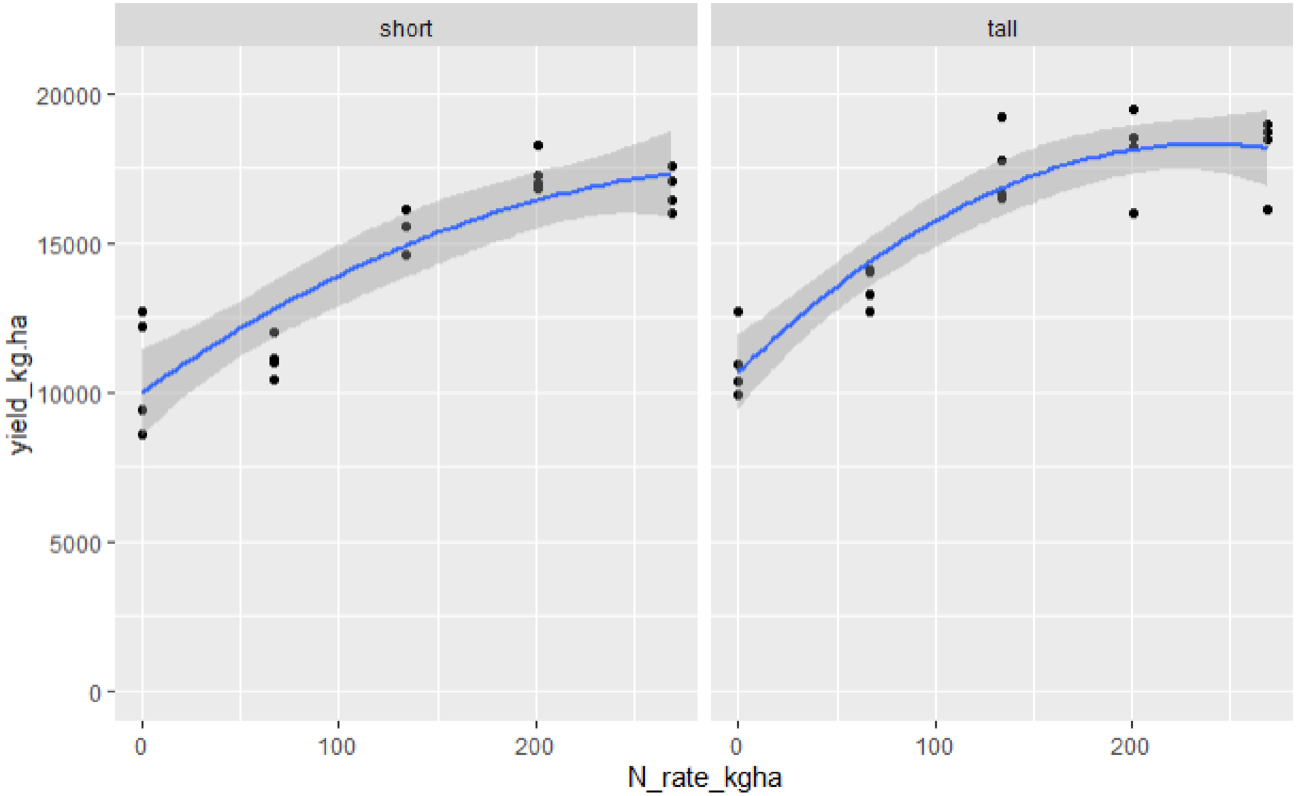
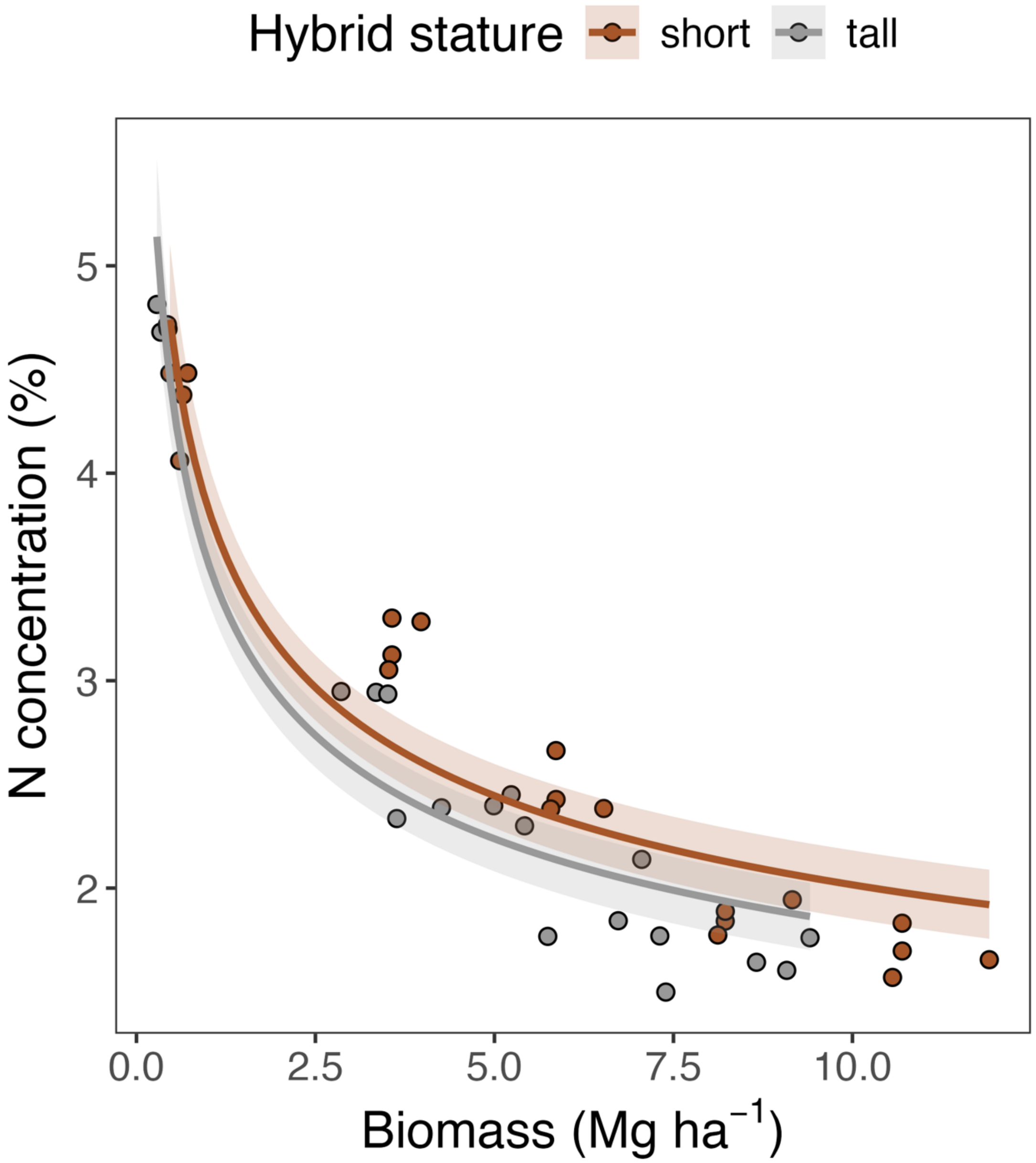
Changes in canopy stature, with +leaf to stem ratio can promote less dilution of N, but changes in N dilution curves per unit of biomass did not differ



With similar optimum N rates



Bosche, Ciampitti t al., 2025

Future Perspectives

From a canopy perspective, corn hybrids present more planophile leaves.

From a plant density perspective, changes in optimal density increases over time, with wider range for the optimal value.

From an optimal N perspective, high late season N demand was more evident for hybrids with better growing conditions after flowering (with more N uptake). With N rate increasing with yields over time.

Lastly, preliminary data from new stature hybrids, did not show significant changes in this dilution curve.

This phenomenon has a dual implication, i) no direct N improvements were observed per unit of biomass, and ii) from the management, optimal N rates might not differ relative to traditional hybrids.

Thanks for your time

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