Corn Tillers:
The Good, the Bad, the UGLY

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CORTEVA agriscience

KANSAS CORN

Thanks for joining!

Hometown: Hartville, Missouri

Background: Family cow-calf operation

B.S., Missouri State University

Ph.D., Kansas State University

Dissertation: Drivers, development, and impact of **tillering** plasticity mechanisms for **corn yield stability** in Kansas environments

Crop plasticity

Definition: crop ability to express different traits in different environments

- Natural characteristic *(adapt or die!)*
- Suppressed or removed through domestication
- Extent/expression differs by crop species

Plasticity types

Different characteristics in different environments

Source: energy accumulation

- Leaf number, size, shape
- Canopy architecture, branching

Sink: energy use

- Yield components
- Root structure

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Kansas Corn

Corn tillers – both!

Historically called **"suckers"**
(Lyon, 1905; Williams, 1912)

Masked through genetic selection
(still observed in modern hybrids)

Generally **unstudied** with mixed yield reports and conclusions

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Oddities pique interest

Greg Lyon
Adams, TN

Robert Brunel
Sainte Rose, MB

Benji Ellis
Statesboro, GA

Oddities pique interest

Dusty Rich
Earlham, IA

John Lopez
Italy, TX

Nathan Vander Schaaf
Okaton, SD

Today's question

Are corn tillers good, bad, or just flat ugly?

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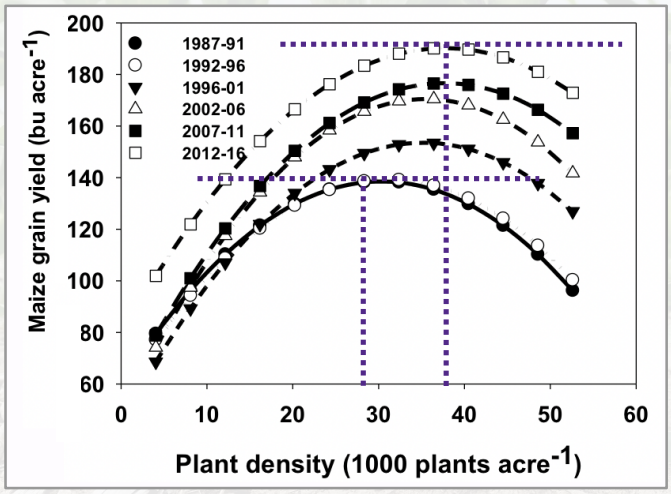
Plant density dependence



Assefa, Y., Carter, P., Hinds, M. et al. Analysis of Long Term Study Indicates Both Agronomic Optimal Plant Density and Increase Maize Yield per Plant Contributed to Yield Gain. Sci Rep 8, 4937 (2018).

Kansas corn production

Area	Environment	Final Plant Population (plants per acre)
Dryland		
Northeast	100- to 150-bushel potential	22,000-25,000
	150+ bushel potential	24,000-28,000
Southeast	Short-season, upland, shallow soils	20,000-22,000
	Full-season, bottomground	24,000-26,000
Northcentral	All dryland environments	20,000-22,500
Southcentral	All dryland environments	18,000-22,000
Northwest	All dryland environments	16,000-20,000
Southwest	All dryland environments	14,000-20,000
Irrigated		
Environment	**Hybrid maturity**	**Final Plant Population**
Full irrigation	Full-season hybrids	28,000-34,000
	Shorter-season hybrids	30,000-36,000
Limited irrigation	All hybrids	24,000-28,000

Roozeboom, K., Devlin, D., Duncan, S., Janssen, K., Olson, B., & Thompson, C. (2007). Optimum planting practices. In Corn Production Handbook (p. 13). Kansas Agricultural Experiment Station, Kansas State University.

Optimum plant densities vary **seasonally**

Reduced plant density dependence could be useful

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Plot Structure

Treatments:

- Plant density
- Hybrid
- Tiller presence

10,000 pl ac^{-1}
17,000 pl ac^{-1}
24,000 pl ac^{-1}

×

P0657AM
P0805AM

×

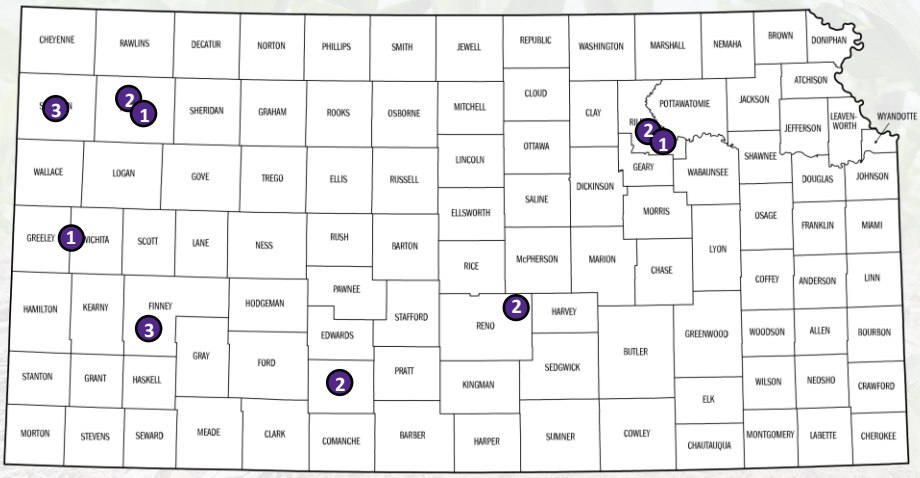
Tillers intact
Tillers removed

Tiller removal

Target stage: **V10** (tenth-leaf), by hand

- Avoid V12+ ear development
- Avoid regrowth

Trials (2019-2021)



Total sites: **17**

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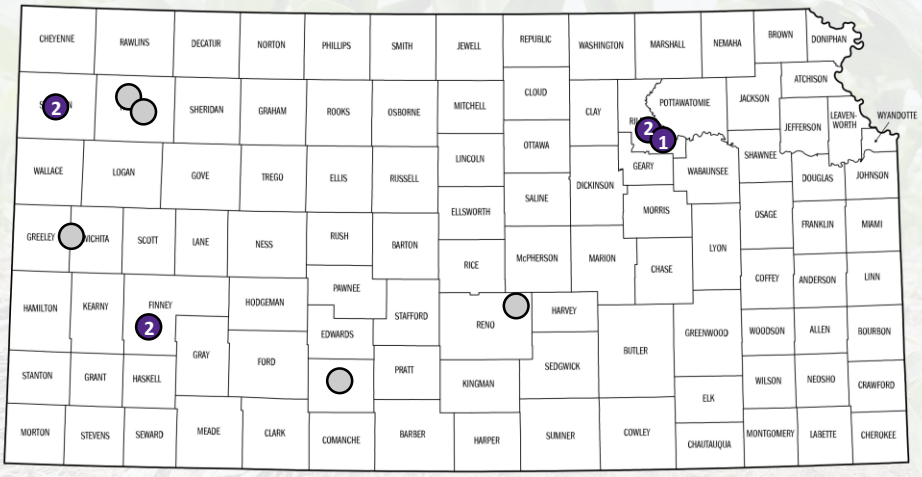
Trials (2019-2021)



Intensive sampling total: **7**

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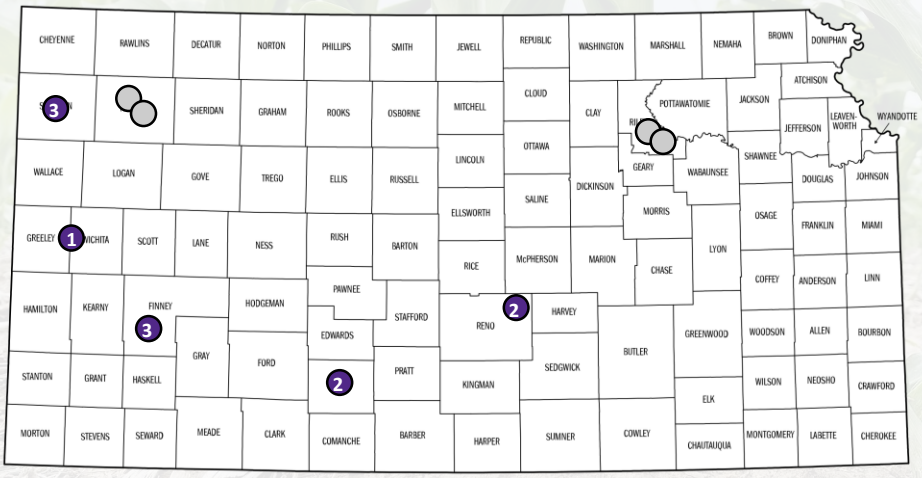
Trials (2019-2021)



Limited subsurface irrigation: **11**

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The Good.

Can tillers contribute anything positive?

What good could they possibly provide?

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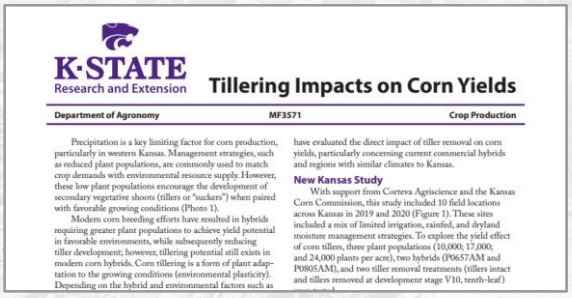
Crop Science

ORIGINAL RESEARCH ARTICLE

Crop Ecology, Management & Quality

Effect of tillers on corn yield: Exploring trait plasticity potential in unpredictable environments

Rachel L. Veenstra[1] | Carlos D. Messina[2] | Dan Berning[2] | Lucas A. Haag[3] | Paul Carter[4] | Trevor J. Hefley[5] | P.V. Vara Prasad[1] | Ignacio A. Ciampitti[1]



K-STATE Research and Extension

Tillering Impacts on Corn Yields

Department of Agronomy | MF3571 | Crop Production

Precipitation is a key limiting factor for corn production, particularly in western Kansas. Management strategies, such as reduced plant populations, are commonly used to match crop demands with environmental resource supply. However, these low plant populations encourage the development of secondary vegetative shoots (tillers or "suckers") when paired with favorable growing conditions (Photo 1).

Modern corn breeding efforts have resulted in hybrids requiring greater plant populations to achieve yield potential in favorable environments, while subsequently reducing tiller development; however, tillering potential still exists in modern corn hybrids. Corn tillering is a form of plant adaptation to the growing conditions (environmental plasticity). Depending on the hybrid and environmental factors such as

have evaluated the direct impact of tiller removal on corn yields, particularly concerning current commercial hybrids and regions with similar climates to Kansas.

New Kansas Study

With support from Corteva Agriscience and the Kansas Corn Commission, this study included 10 field locations across Kansas in 2019 and 2020 (Figure 1). These sites included a mix of limited irrigation, rainfed, and dryland moisture management strategies. To explore the yield effect of corn tillers, three plant populations (10,000; 17,000; and 24,000 plants per acre), two hybrids (P0657AM and P0805AM), and two tiller removal treatments (tillers intact and tillers removed at development stage V10, tenth-leaf)

2019, 2020 sites:
10 total

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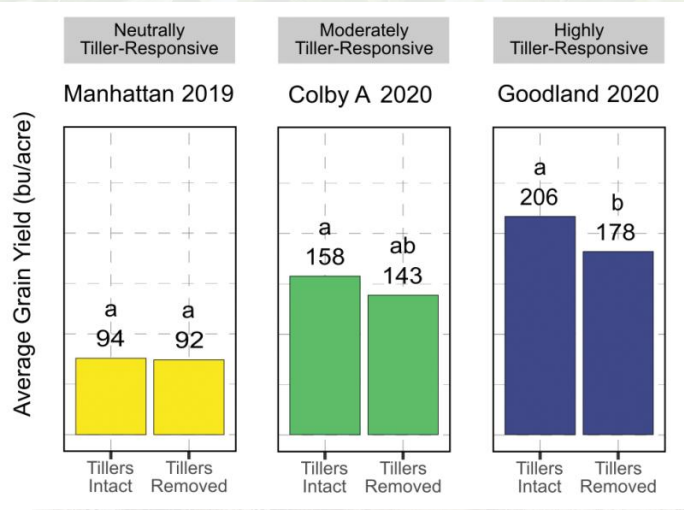
Will tillers reduce yields?
Not in our case!



Will tillers reduce yields?
Not in our case!

Does the **number** of tillers that develop matter?

Tiller effectiveness varies by **environment**.

Tillers could **compensate** for lost plants to a limited degree in our plots.

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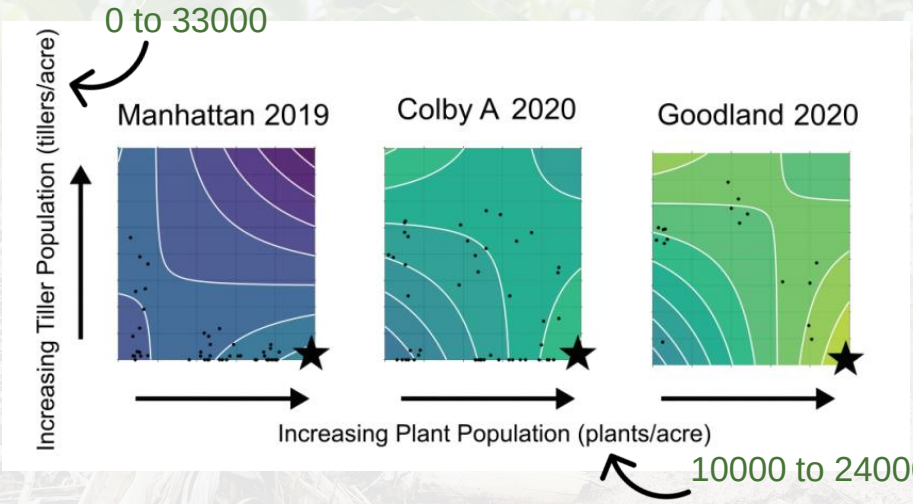
Does the **number** of tillers that develop matter?



Tiller presence **did not** reduce yield in evaluated environments or plant densities.

Tillers could produce **ears** and harvestable grain.

In favorable scenarios, corn tillers had plant density **compensation potential**.

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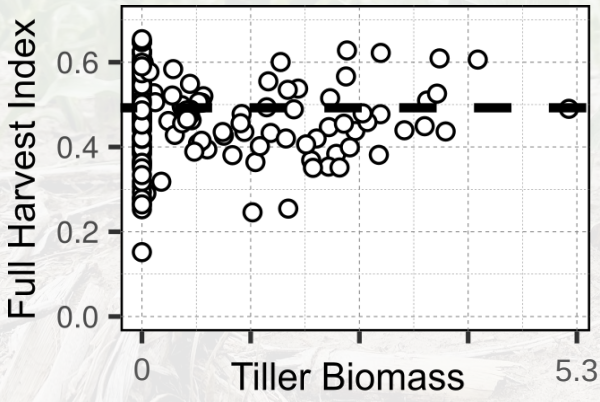
Do corn tillers reduce whole plant reproductive efficiency?

No, tiller development had no impact on full HI.



Tons of dry shoot biomass per acre

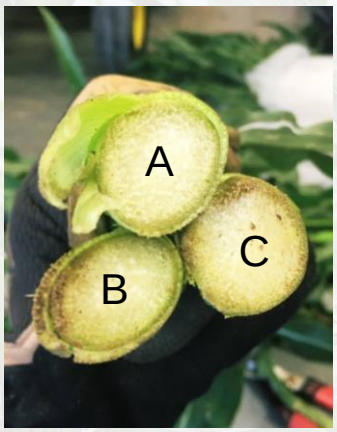
Carbohydrates

Corn stem is **storage organ**

Sugars stored in stems, **moved to ears** during grain fill

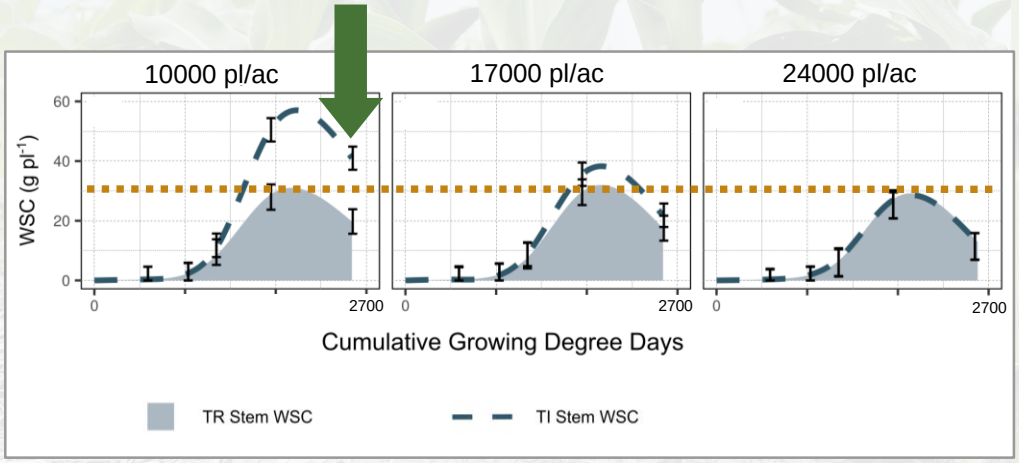
Stem carbohydrates

Indicates energy needs and internal plant balance



WSC = water-soluble carbohydrates

Carbohydrate reserves



Do tillers **increase** C reserves and can plants **use** that stored energy?

Yes, tillers **increase** WSC reserves with added stems.

WSC buffering is **agronomically** significant:
1) increased standability
2) stabilized kernel weights.

Yes, we found evidence that WSCs were moving from tillers to main ears. *(70s study too, and P in the 80s)*

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The Bad.

What about all the extra leaf area?

Can you predict how my tillers will yield?

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Happy plants? A disaster?

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Common Concerns

Yield

Water

Nutrient use

Harvest index

Water

Tassel ears

Predictability

Water

Common Concerns

Yield

Our studies showed no reductions in yield **JUST** because tillers were present.

This does **NOT** mean yield reductions could never happen.

Our 17 sites give a strong case that we should not **ASSUME** yield reductions if tillers are present.

Tillers? Don't panic.

Common Concerns

Harvest Index and Nutrient Use

Our studies showed no significant impact on harvest index **JUST** because tillers were present.

Again, this may not **ALWAYS** be the case.

Agrees with previous research that demonstrated carbohydrate and nutrient **movement** from tillers to main stalk.

Tillers? Don't panic.

Common Concerns

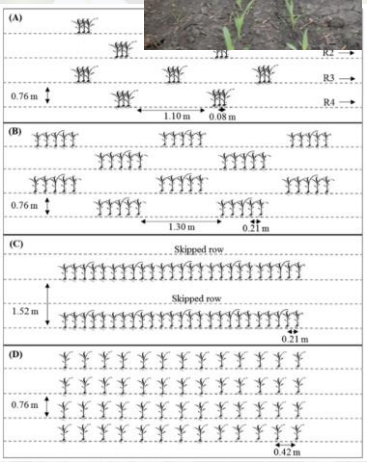
Water, water, water

Site context:

- 13 to 22 in
- <100 to 200+ bu/acre

2022 plots might have performed differently…

Common Concerns



Water, water, water

More tillers = more leaf area = more transpiration?

Alternative planting geometry

- More humidity in canopy
- Extending soil water
- Clumped plants = fewer tillers

At which point do tillers hurt more than help?
Or is the plant just "dead" at that point?

Common Concerns

Tassel Ears and Predictability

How to predict tassel ears?

How to prevent tassel ears?

How to predict tiller yields?

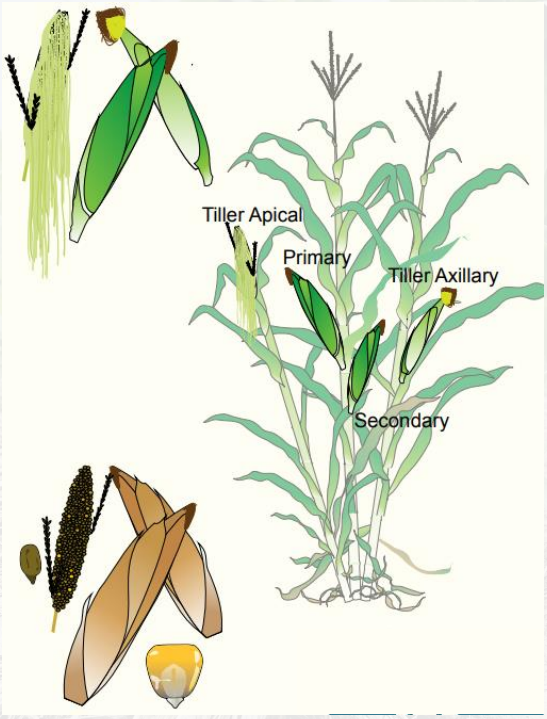
Good questions – not much information available.

Where were the observed yield increases coming from?

High **kernel numbers** were the most closely associated component.

More ears = more kernels

Ear **type** was also important.



Ear Type

Primary Ears

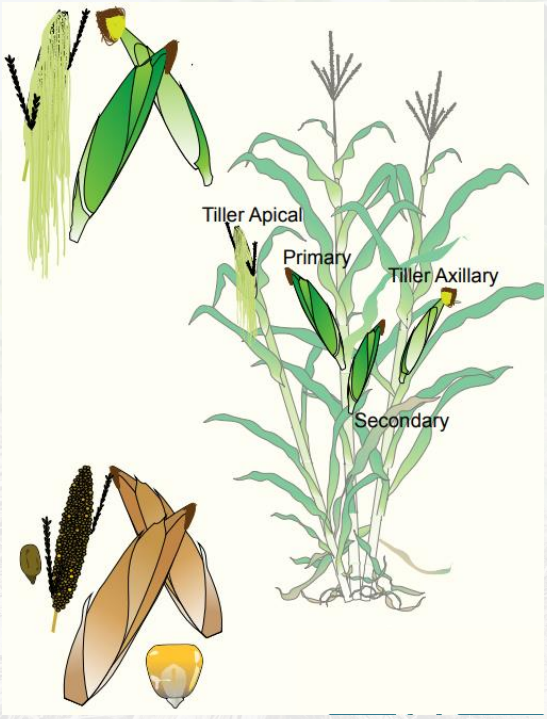
- Yield drivers *(why density is key)*

Secondary Ears

- Form of plasticity *(in a good year)*

Tiller Axillary Ears

- Typical-looking ears on tiller stems *(harvestable)*



Ear Type

Tiller Tassel Ears

- Atypical, ugly, and confused mixes of ear and tassel *(NOT harvestable)*

Male/female flower abortion process is disrupted during development.

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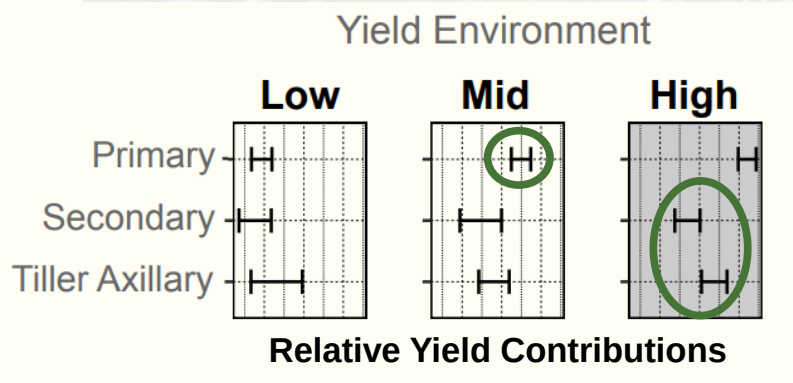
Ear Type

Tiller Tassel Ears

- Atypical, ugly, and confused mixes of ear and tassel *(NOT harvestable)*

Our analysis showed no detectable yield penalty with tassel ears – very surprising!

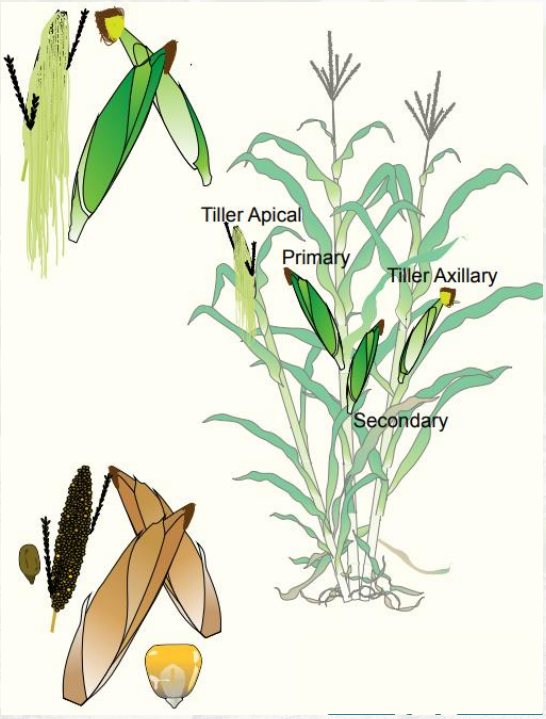
Ear Type



Ear Type

Tiller ears have less **direct competition** than secondary ears would.

Adding more shoots – mimic of adding to plant **population**.



To-Go Box

Three key points to remember.

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Key points

1) Tillers did **not** reduce corn yields in any of our trials. *(doesn't mean it can't happen)*

2) Environment impacted the **number** of tillers and the **performance** of those tillers.

3) Tillers **increased** energy reserves and these reserves could move throughout the plant.

Thanks for having me!

Rachel Veenstra
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#TillerQueen