Planting Date by Management Interactions in Corn and Soybean

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Topics: Planting date x Management Interactions

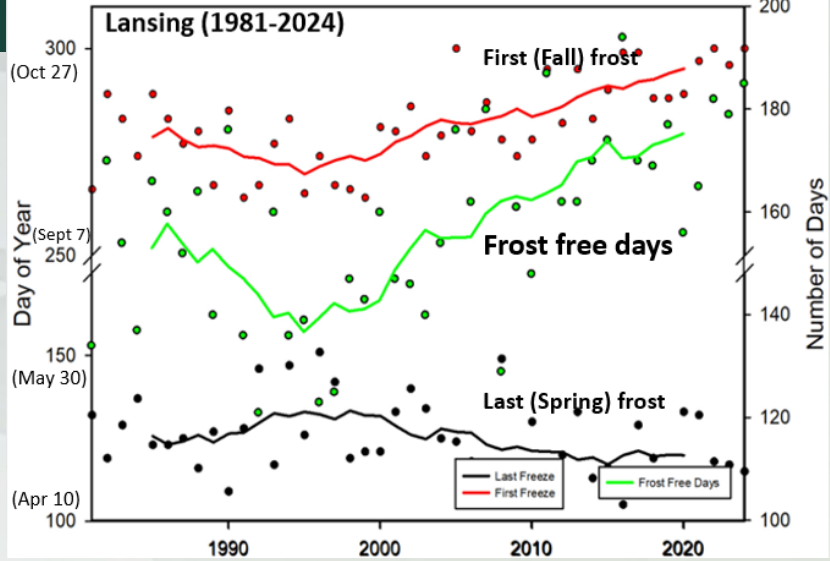
1. **Planting date** impacts on Corn vs Soybean (northern US)

2. Planting date **Interactions** with other management factors
   - Variety selection (**Relative Maturity**)
     - Impact on Yield, Phenology, and Dry down
   - Other factors (Systems approach)

3. Take home messages and Resources

Weather Trends

- (Relatively) short growing season
  - is <u>expanding over time</u>, later fall frost and earlier spring frost
- More rainfall during planting/ harvesting window
  - Wet spring, leading to planting challenges
  - Wet fall, leading to harvest issues (and winter crop plantings)



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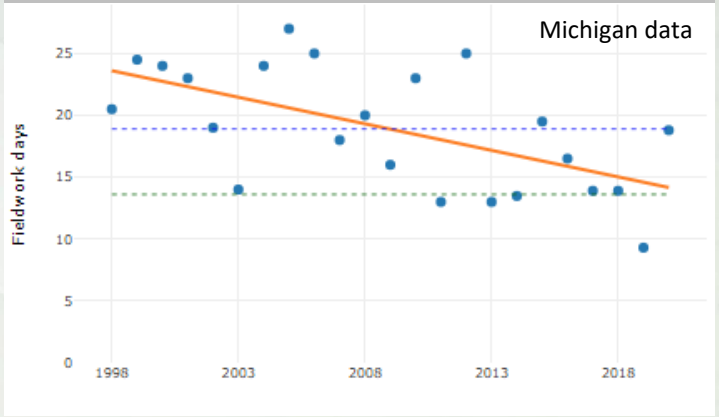
Decline in #days for Field work (mid-April to mid-May)



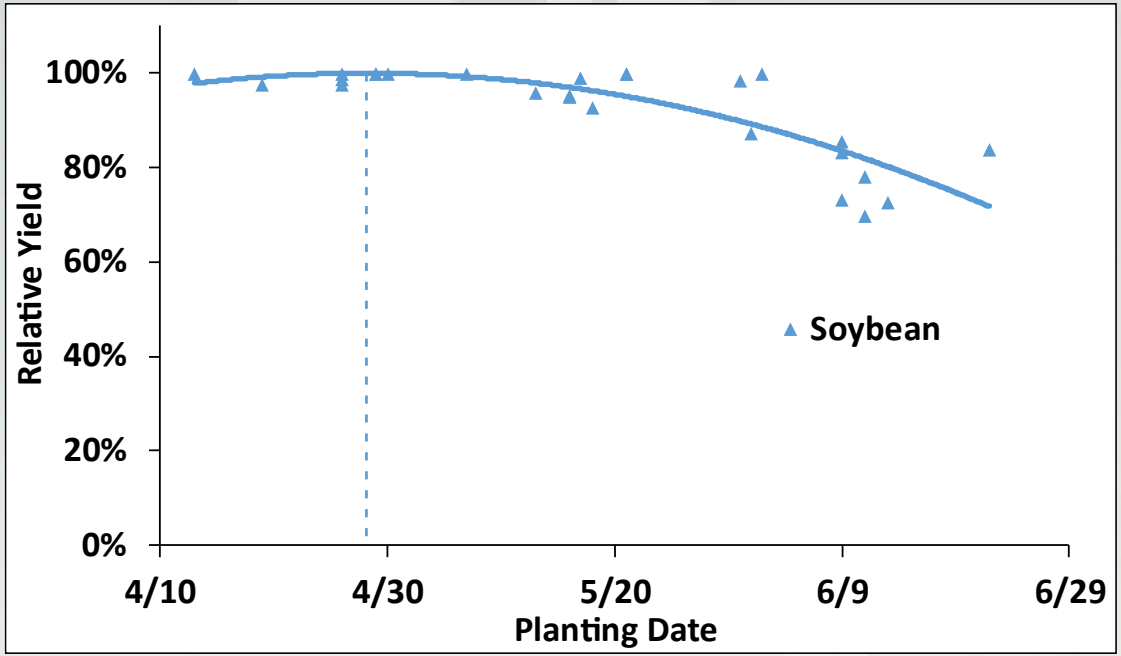
Source: USDA, KSU

Planting Time Impacts Crop Growth in Michigan/northern US

Pictures taken mid-July

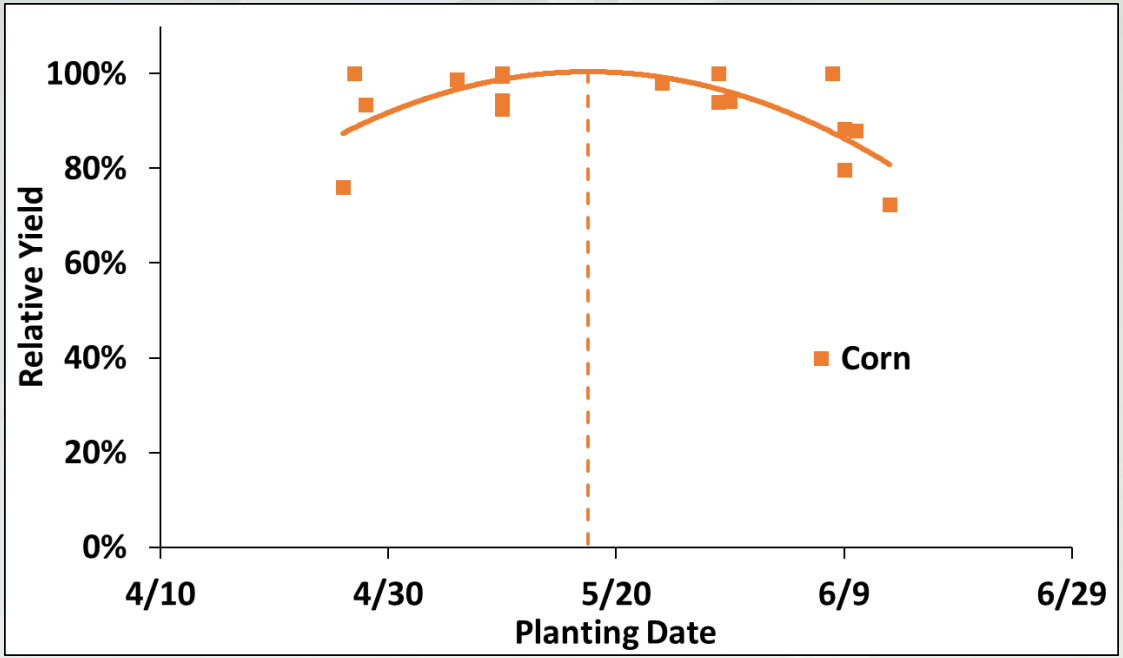
Planting date:	Late April	Mid-May	Late May - early June	Early/Mid June

Planting Time Impacts Crop Yield in Michigan/northern US



Data from Lansing & Richville, MI (2018-2024)
Each data point is average of ≥16 plots

Planting Time Impacts Crop Yield in Michigan/northern US



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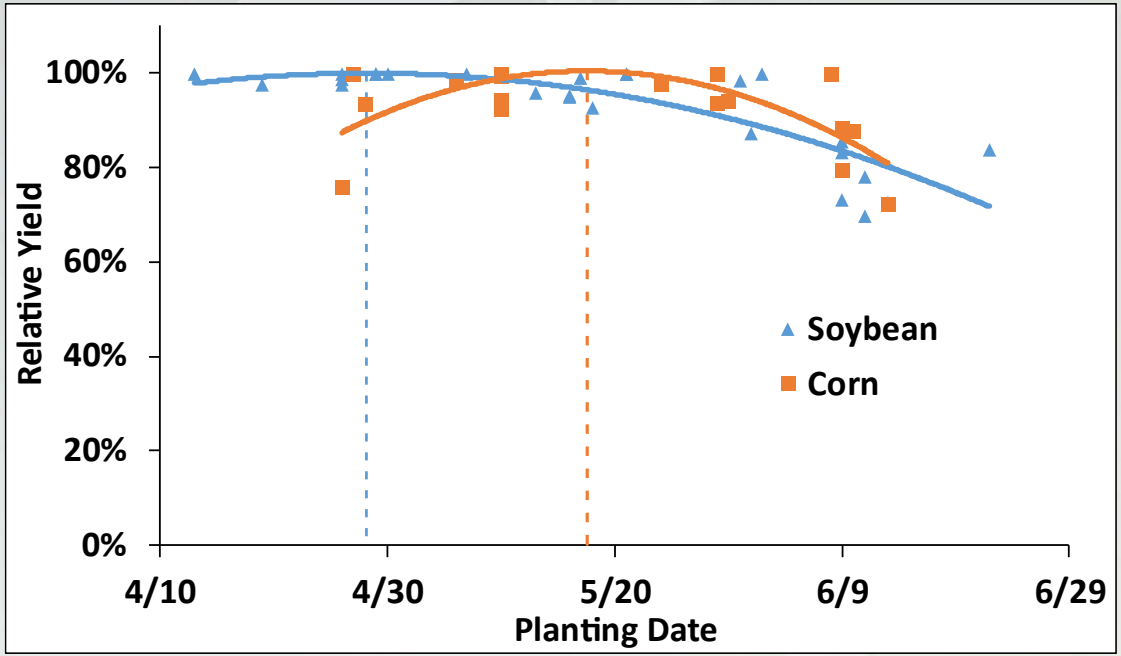

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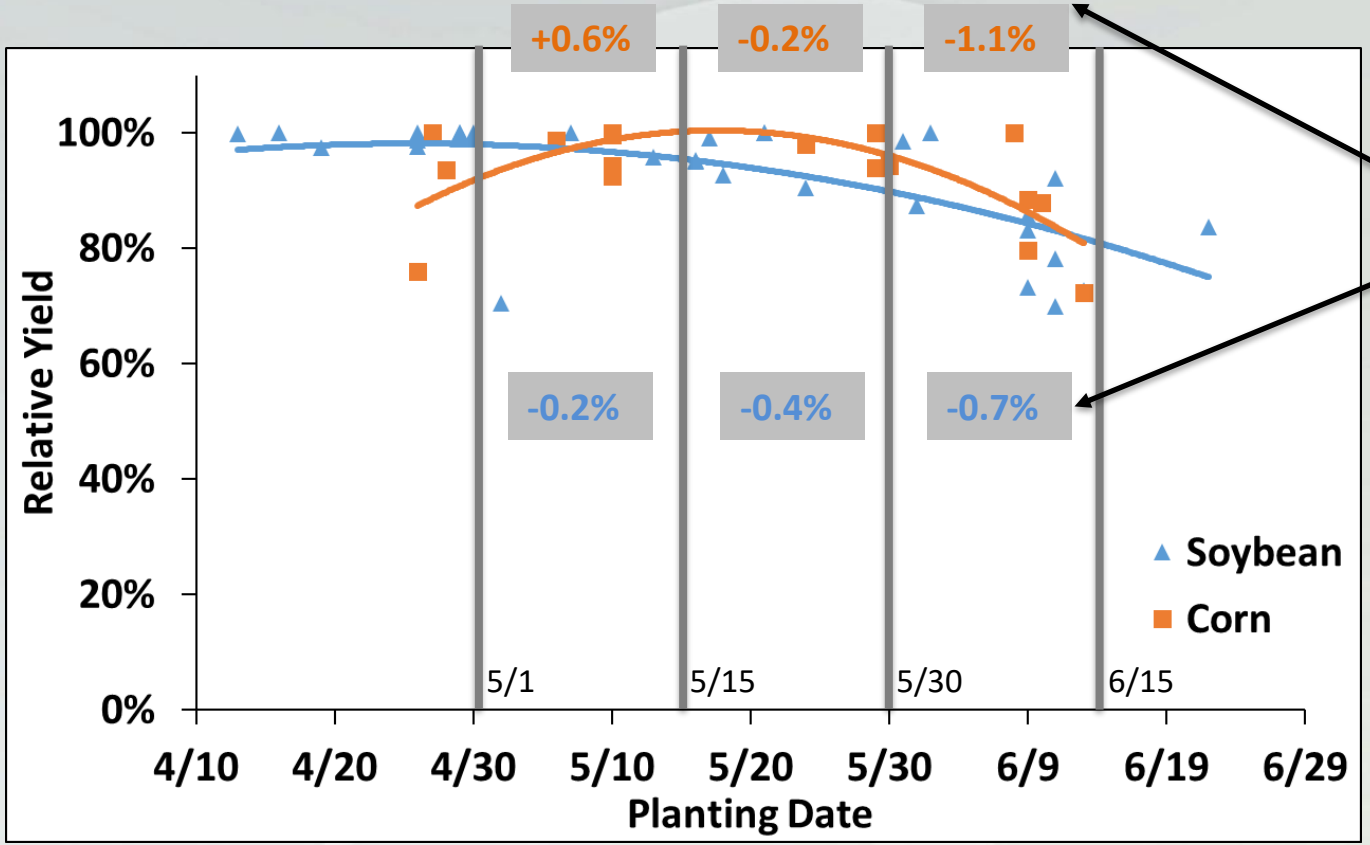
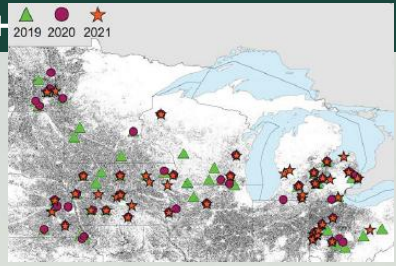
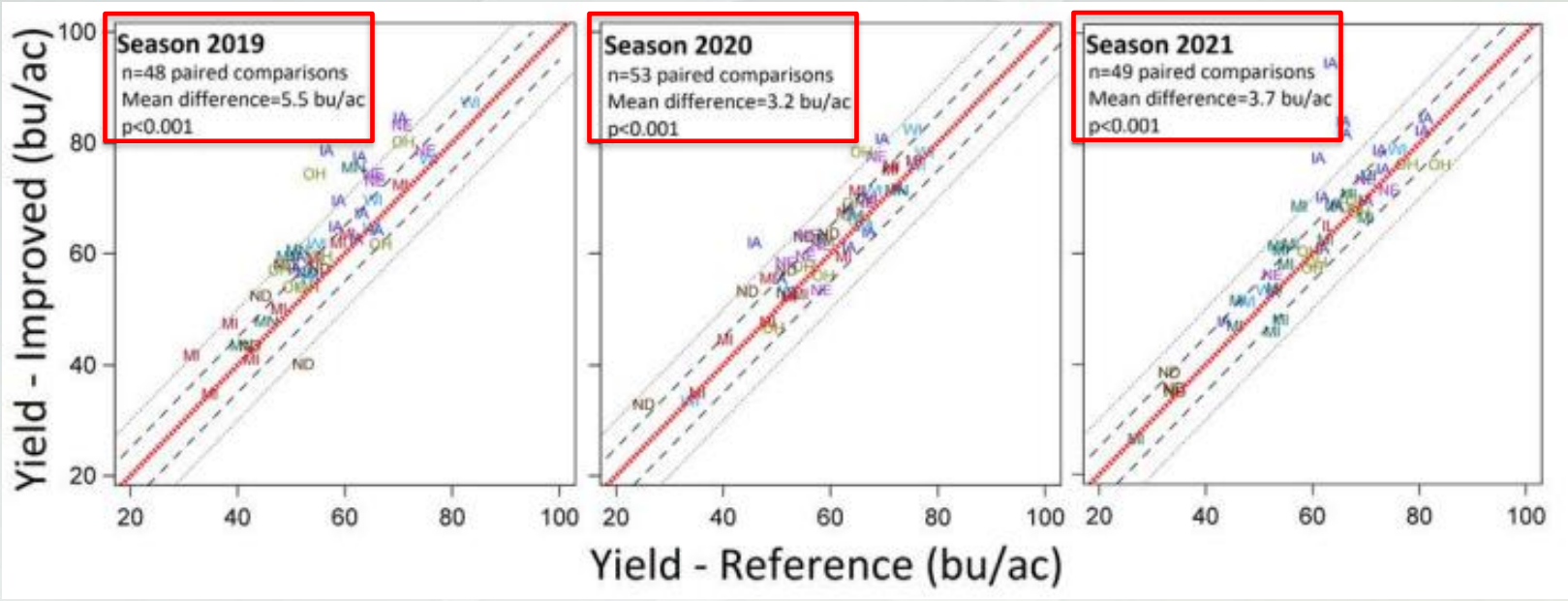


Data from Lansing & Richville, MI (2018-2024)
Each data point is average of ≥16 plots

Soybean: On-farm trials





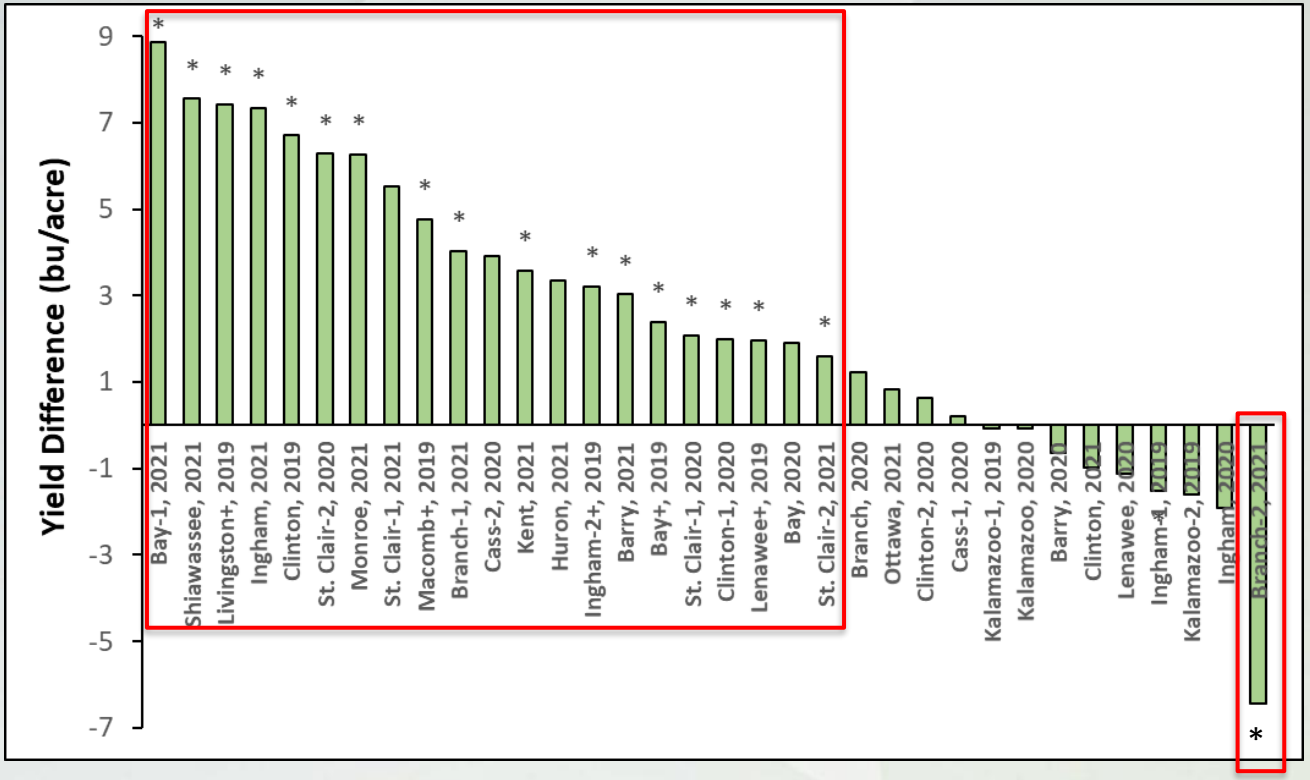
Reference is Typical planting

Improved is Early Planting + other management
(e.g., fung./insect. spray, late-MG, lower seed rate)

Profit increase in Improved trt:
$51 (2019), $31 (202), $53 (2021)

Soybean Planting date: On-farm trials (Michigan)

Yield diff. =
Early planting -
Typical planting



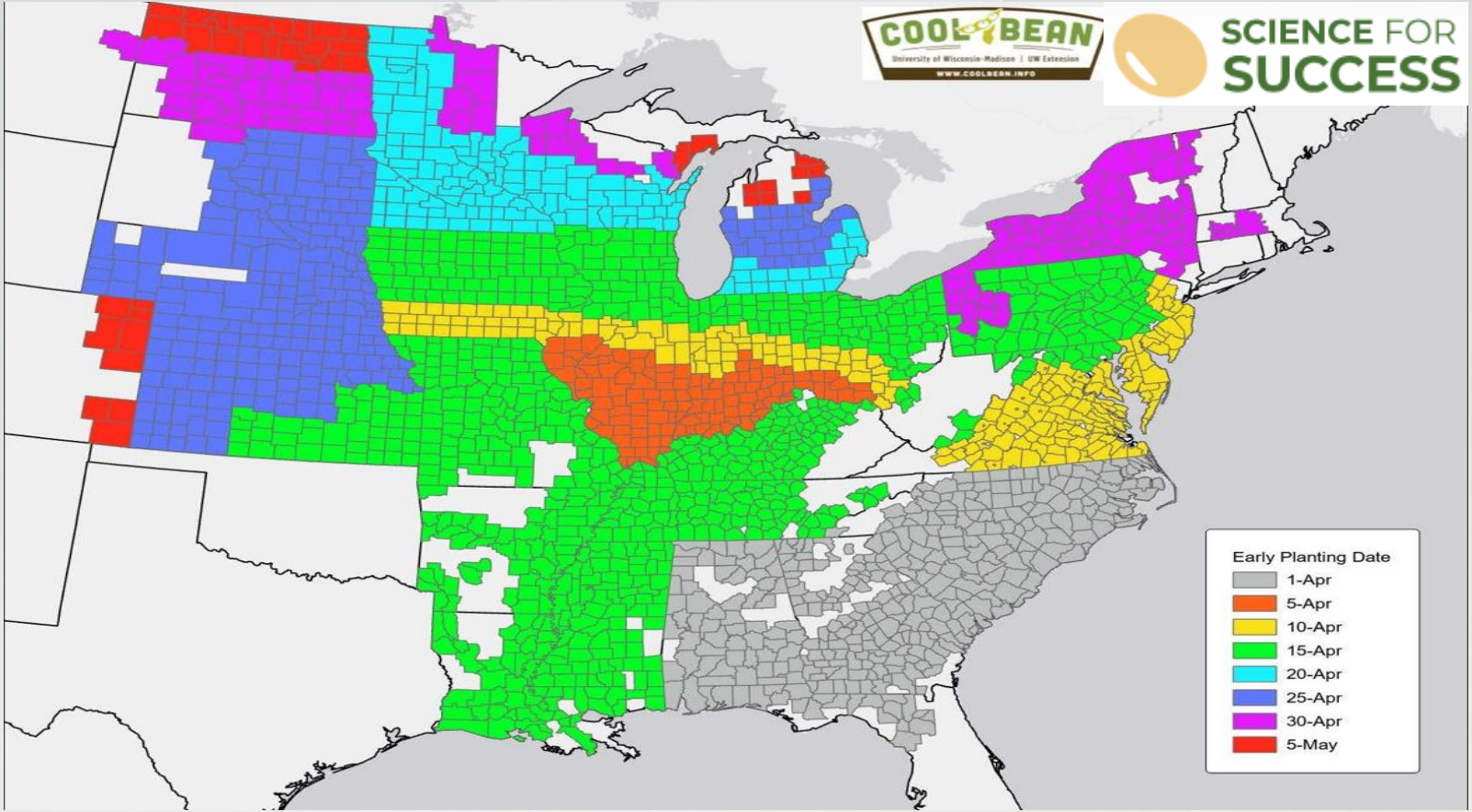
* Denotes significant differences at P <0.10
\+ denotes fung./insect. spray at R3 in early planting in 2019

Risk vs Reward of Early Soybean Planting

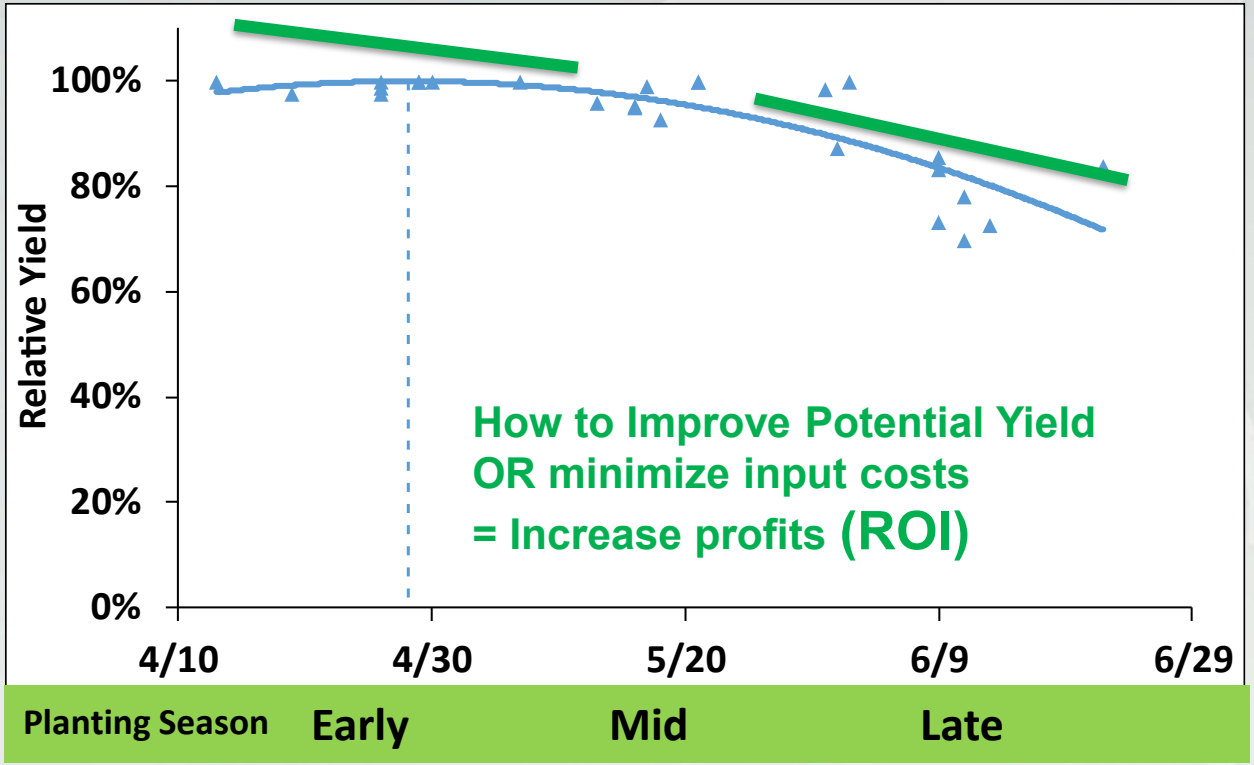
- Rewards:
  - Increase in yield
  - Extended planting window
  - Minimize yield penalty from late planting
- Risks:
  - Poor germination/emergence, plant stand
  - Freeze damage to emerged plants
  - Crop insurance coverage dates (updated)
- Optimal time:
  - Based on field conditions and crop responses (corn vs soy)
  - Target fields suitable for early planting, high yields
  - Do NOT plant if forecast of cold rain in 24 hrs


Mike Staton

Crop insurance replant dates for Soybean: moved earlier



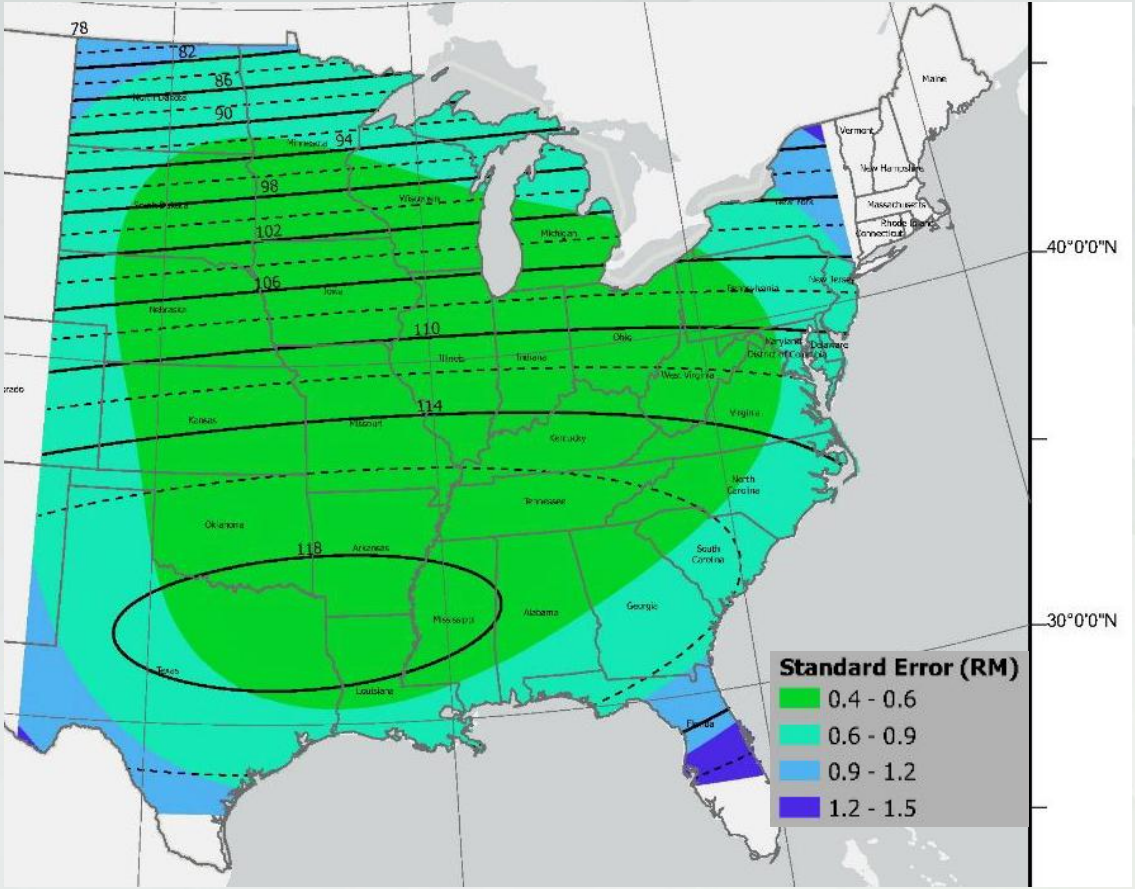
Planting Time: change other management?



Factors to consider:

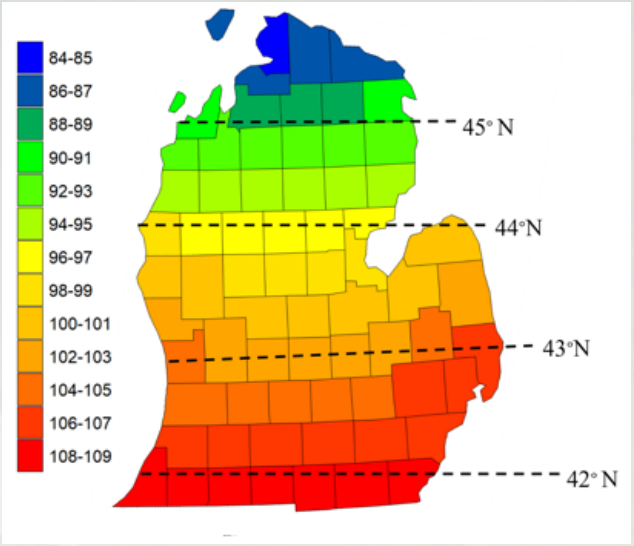
- Variety Selection:
  - **Relative Maturity**
  - Traits
- Seedbed preparation
- Planting method/Seed placement/Row Spacing
- Planting depth
- Seed rate
- Seed quality
- Seed treatment
- Pest control
- Fertility
- Harvest Decisions

Corn: Relative Maturity (RM) for max yield



Mourtzinis et al (2025), Agron J. OVT Data from 30 states (2014-2023)

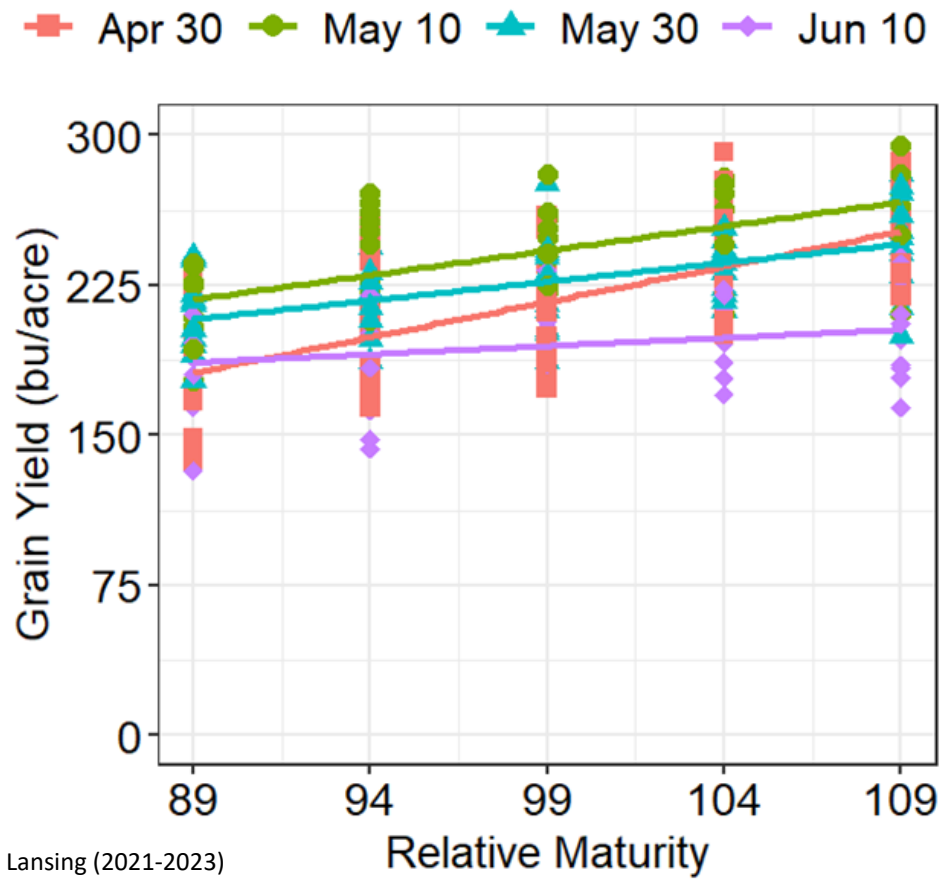
RM map for Michigan



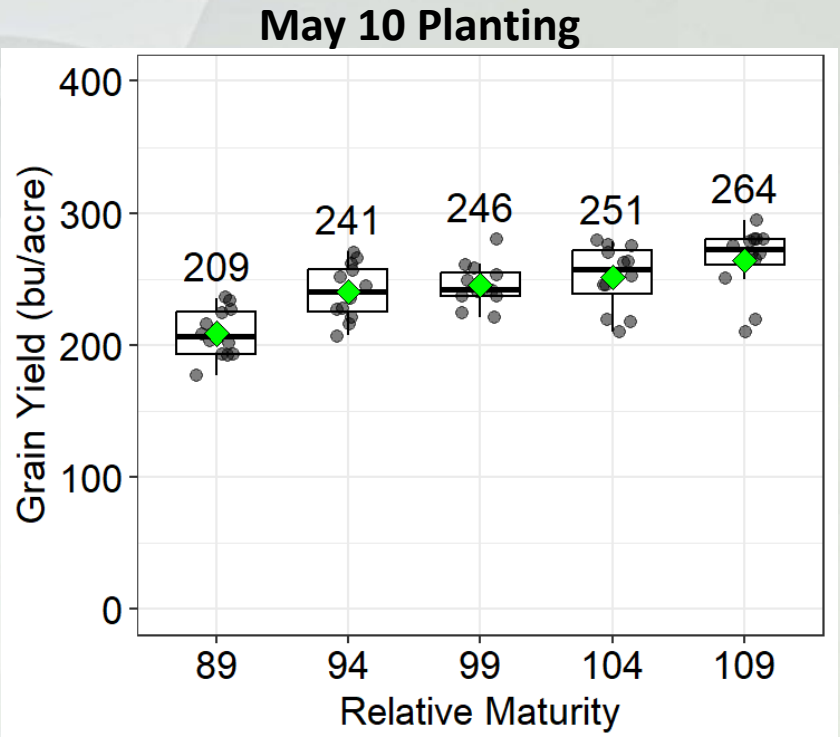
Agyei et al (2024, Data from ~12 MI location (2006-2022)

Based on Typical planting date ONLY

Corn Yield: Relative Maturity vs Planting date

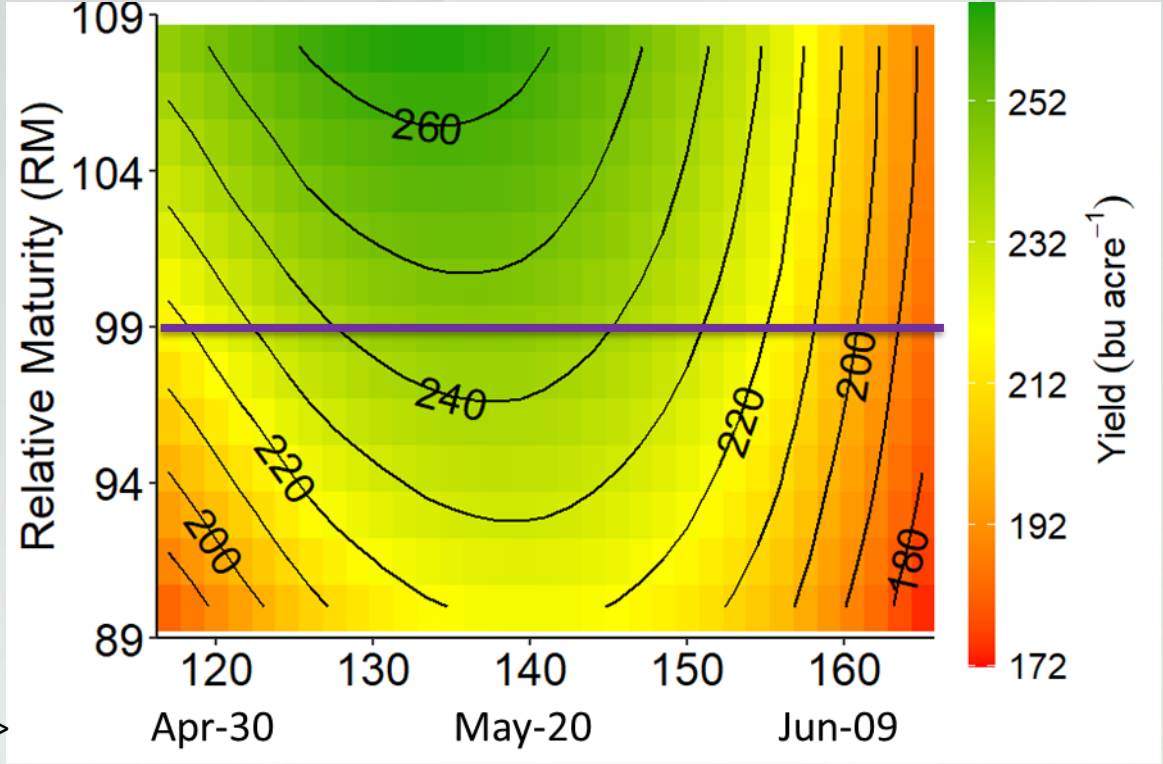


Lansing (2021-2023)



- Use **Late-maturity** hybrids for early planting

Corn Yield: Relative Maturity vs Planting date

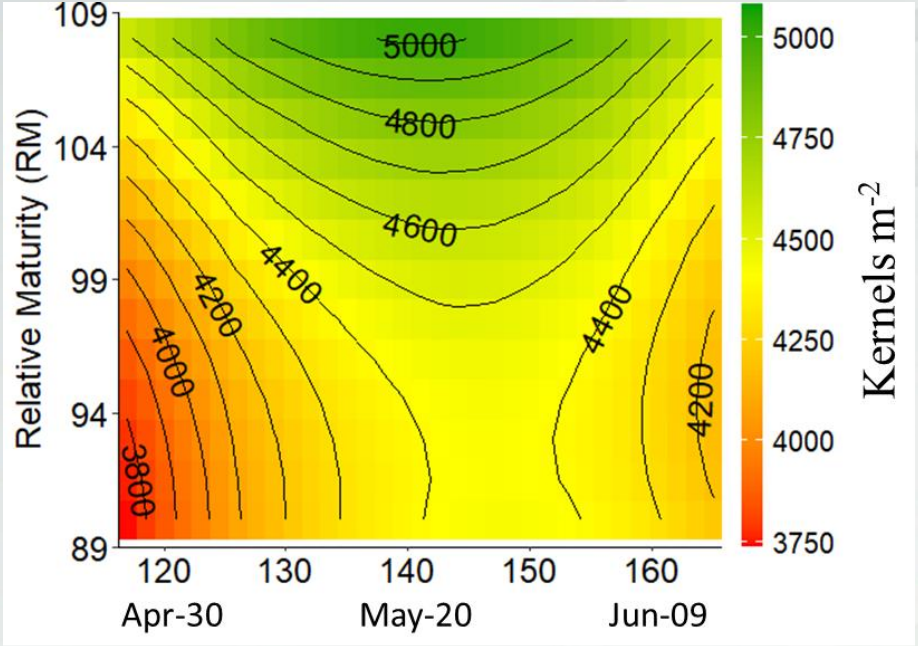


Data from Lansing, MI
Pooled across 2021, 2022, 2023
Crop Science (2025)

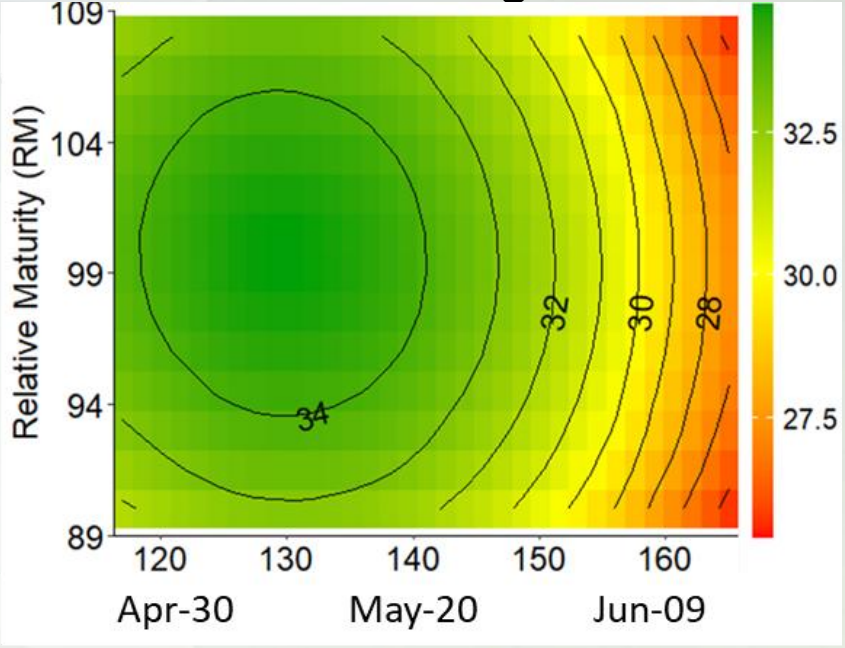
- Use **Late-maturity** hybrids for early season planting

Corn Kernel Number vs Weight

Kernel number



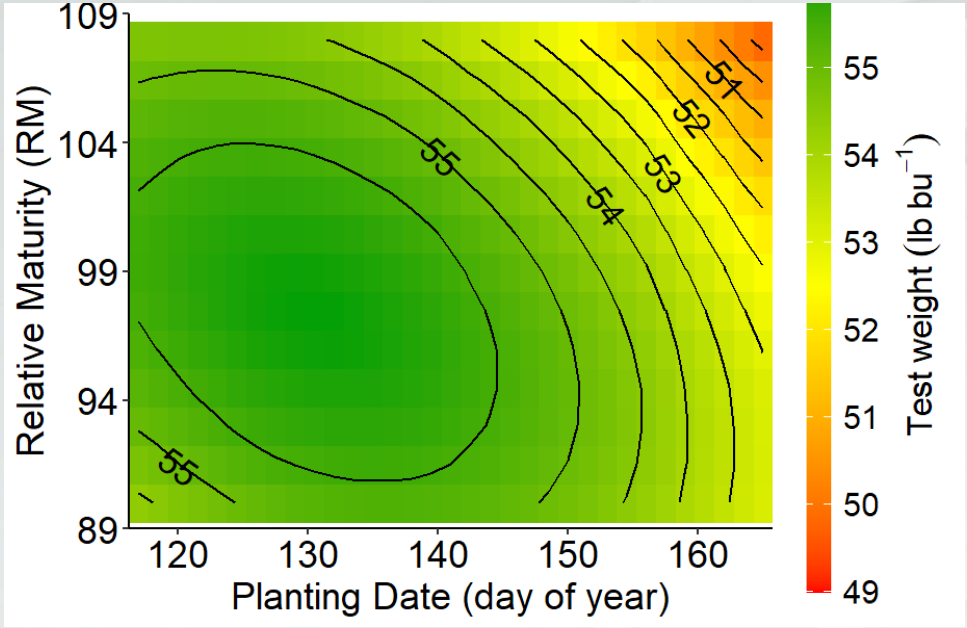
Kernel weight



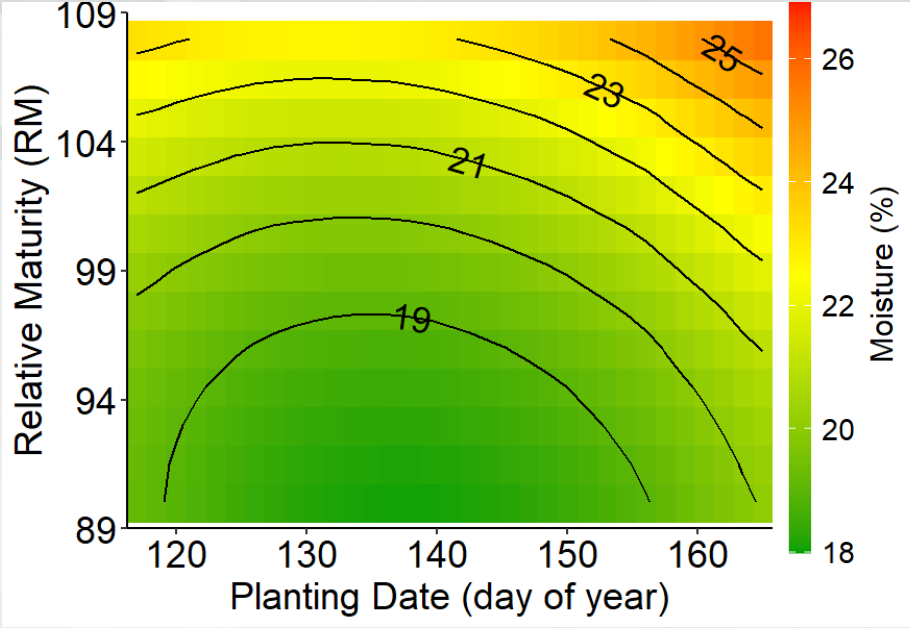
- Under timely planting, greater kernel number while maintaining high kernel weight

Corn Kernel Test Weight & Moisture

Test Weight

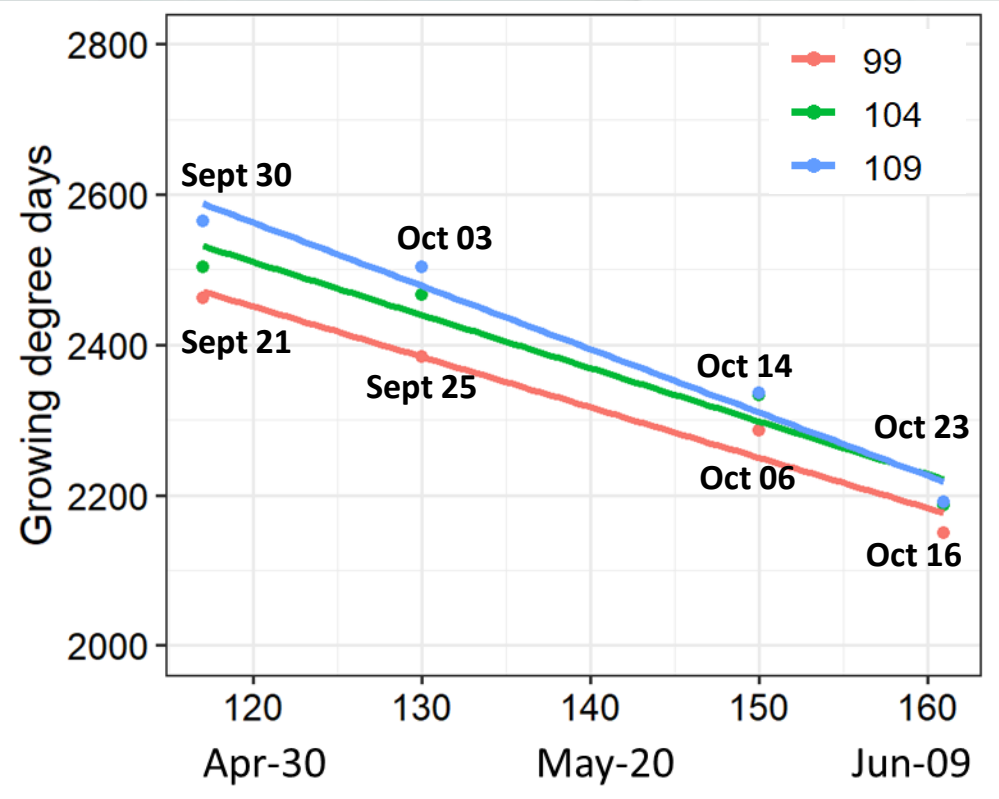


Moisture



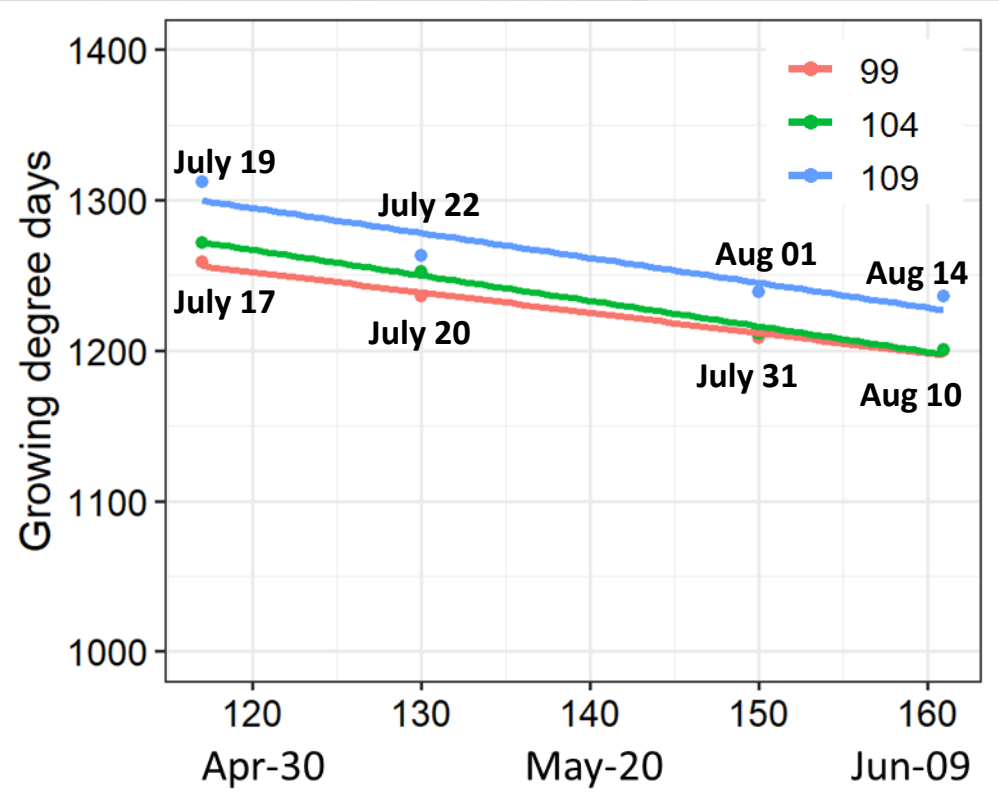
- High test weight and low moisture when using late-maturity hybrid under early plantings

Corn: Time to Black Layer vs GDD Compression



- **GDD Compression**: Decrease in hybrid GDD requirements with delayed planting
- Compression of **6.4 GDD (4.1 - 8.6) per day delay in planting** for Black Layer

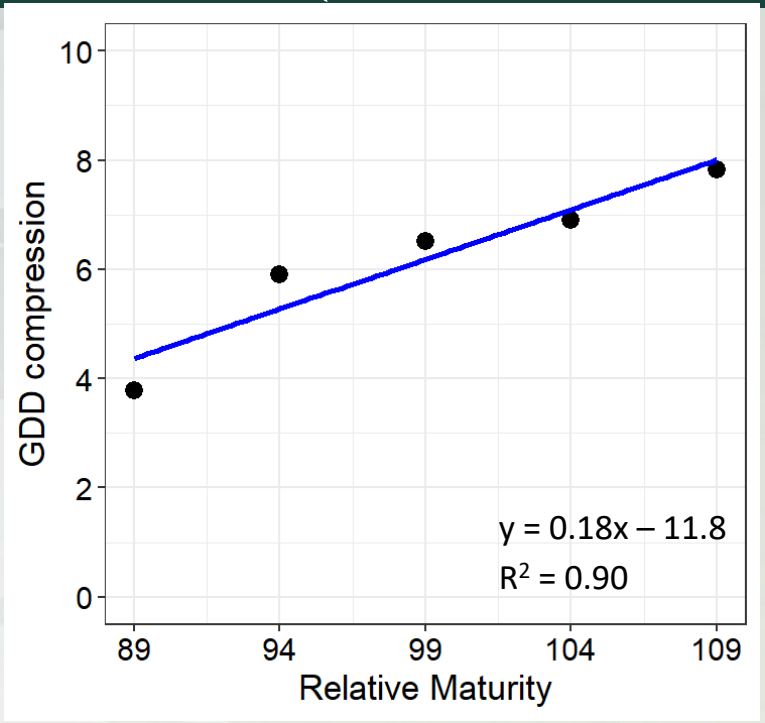
Corn: Time to Silking vs GDD Compression



- **GDD Compression**: Decrease in hybrid GDD requirements with delayed planting
- Compression of **1.4 GDD (1.0 – 1.9) per day delay in planting** for Silking

Corn: GDD Compression

Year	To Silking	To Black Layer
2021	1.5 (1.1 - 2.0)	5.5 (4.0 - 7.1)
2022	1.9 (1.3 - 2.6)	7.4 (3.9 - 11)
2023	0.8 (0.5 - 1.1)	6.4 (4.3 - 7.8)
Average	**1.4 (1.0 – 1.9)**	**6.4 (4.1 - 8.6)**

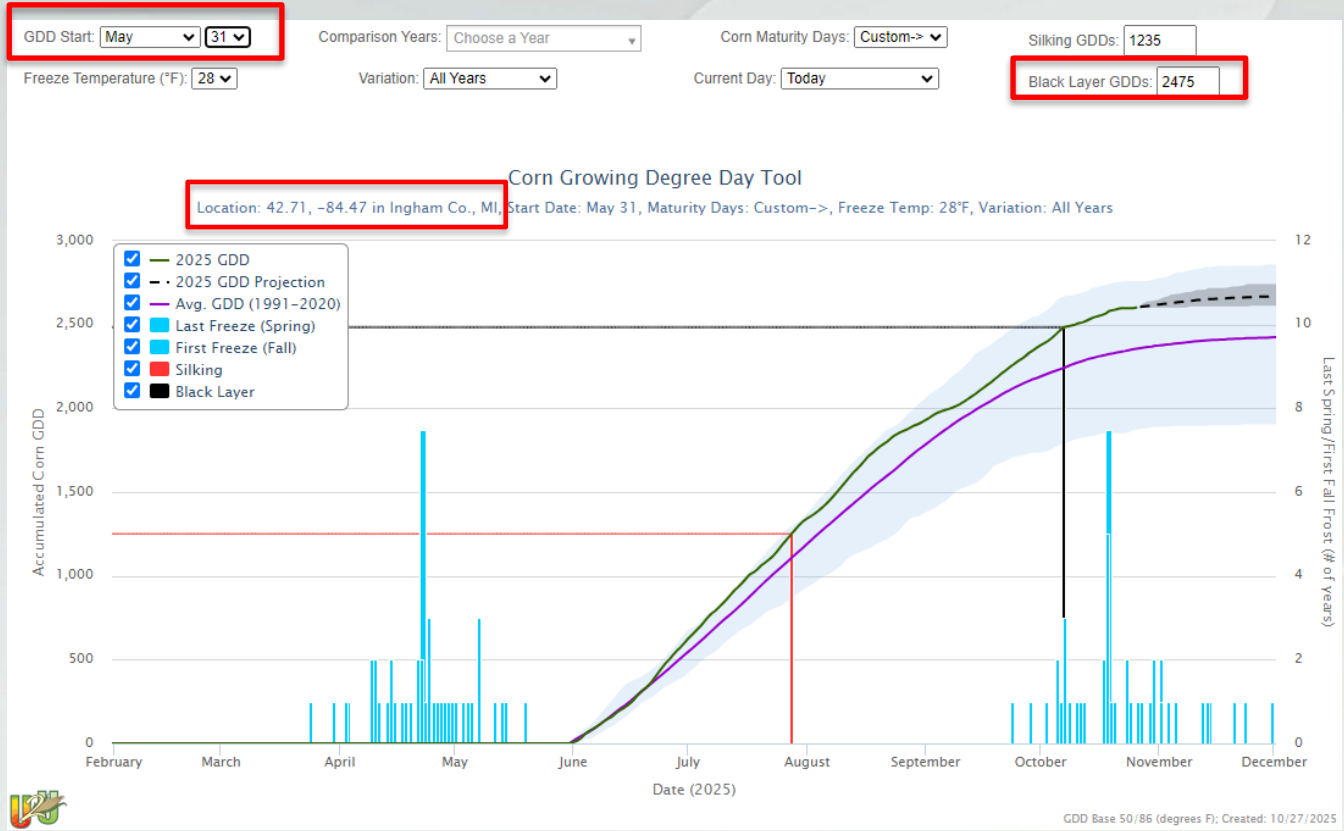


Data from 5 hybrids (89, 94, 99, 104, 109 RM) over 3 yrs, Lansing, MI

- Compression to silking was only ~25% of total GDD compression
- Rate of GDD compression increased with late-maturity hybrids

Corn: Useful 2 Usable Tool (U2U)

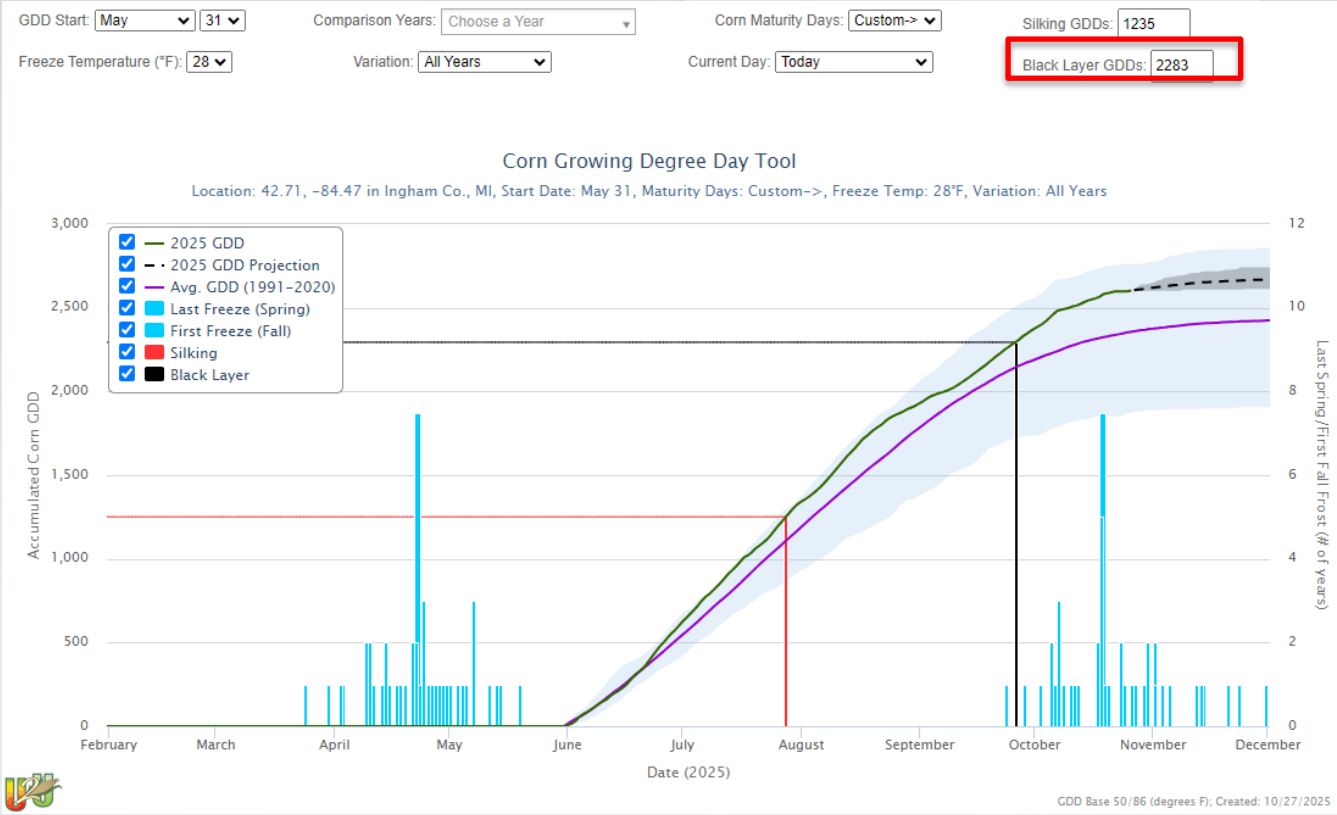
https://mygeohub.org/groups/u2u/purdue_gdd



Does NOT account for GDD compression, so **manually change black layer GDDs**

Corn: Useful 2 Usable Tool (U2U)

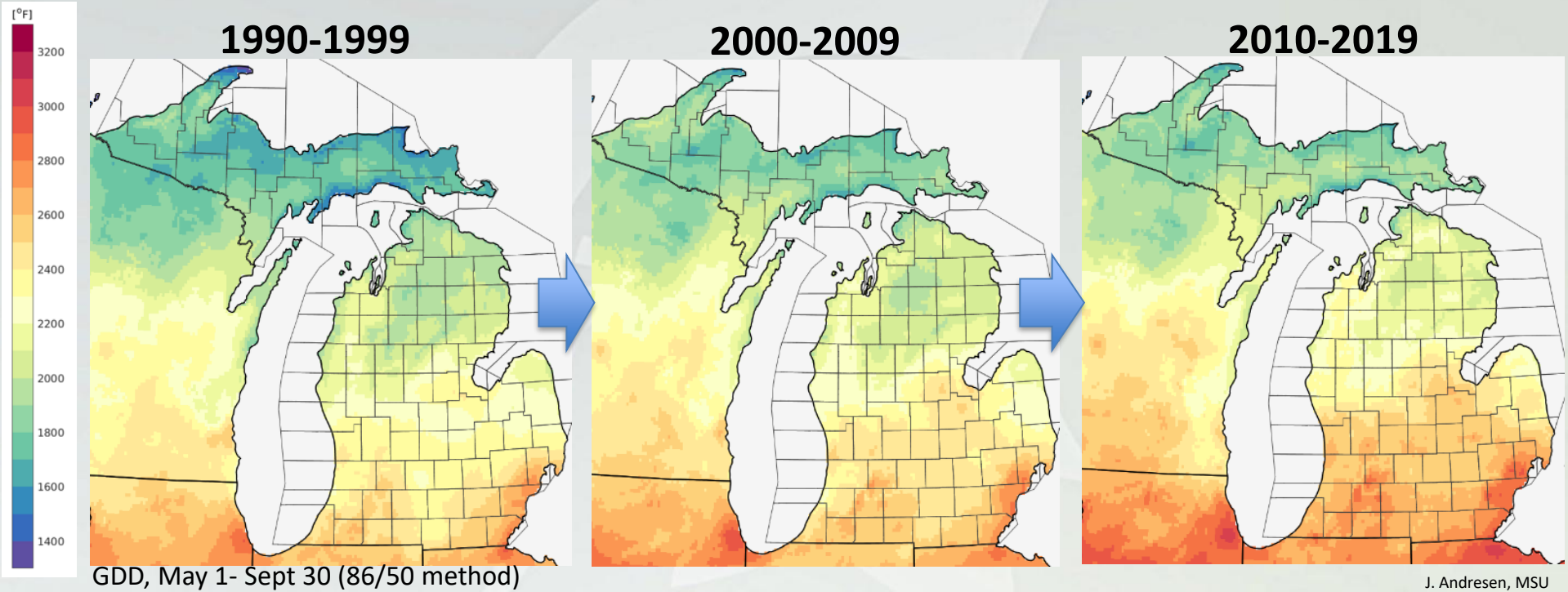
https://mygeohub.org/groups/u2u/purdue_gdd



New Black layer GDD for delayed planting:

2475 – (30*6.4) = 2283

Corn: GDD changes over time



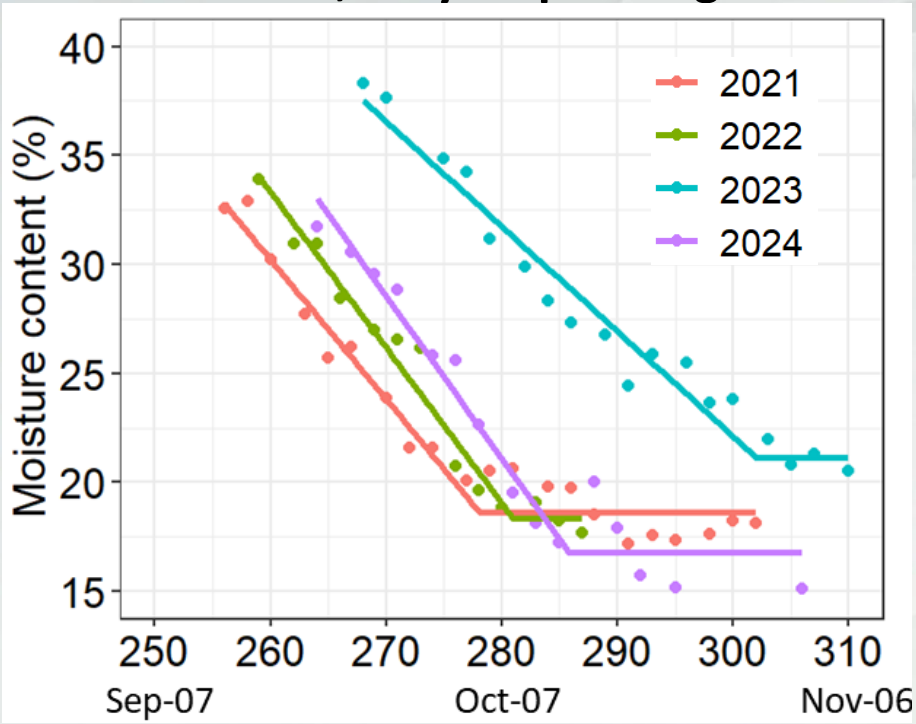
GDD, May 1- Sept 30 (86/50 method)

J. Andresen, MSU

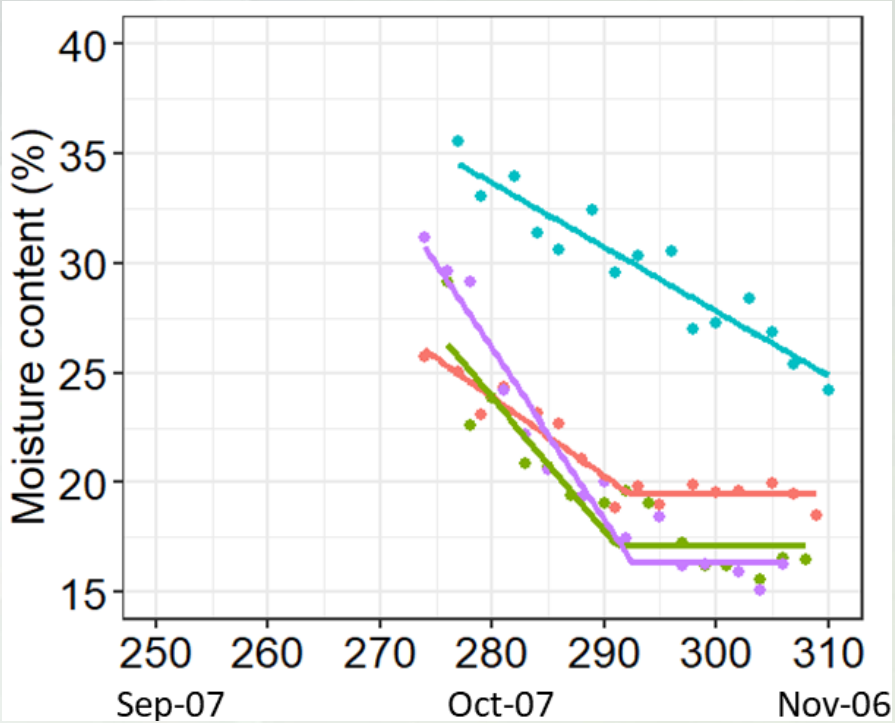
- Seasonal GDD totals are increasing over time in Michigan and other northern states
- Use hybrid GDD information in addition to RM ratings

Corn: Drydown (for maximum **Profits**)

99 RM, May 10 planting



109 RM, May 10 planting

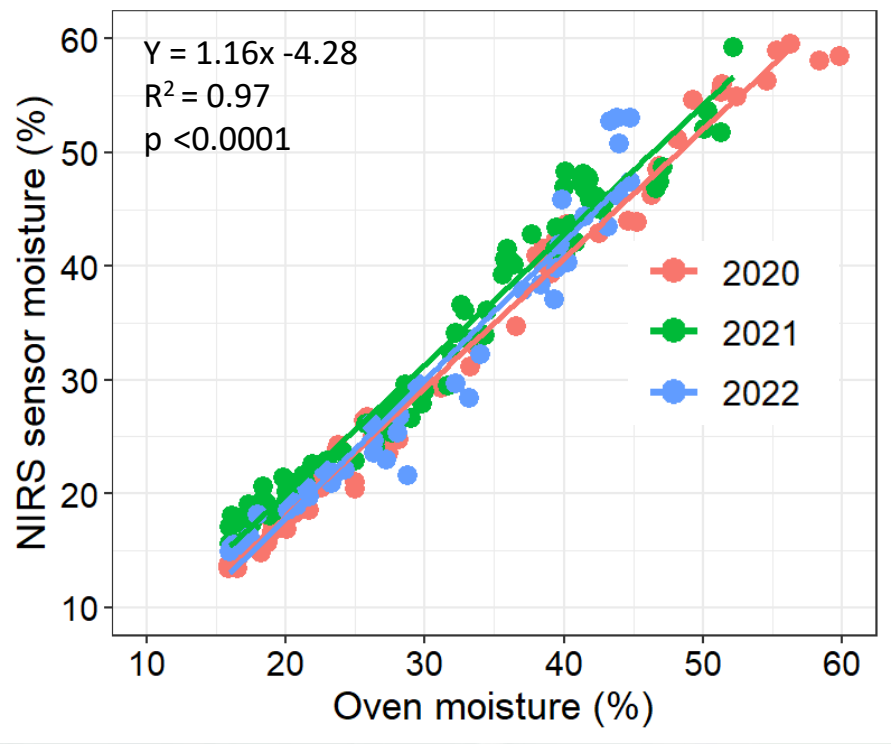


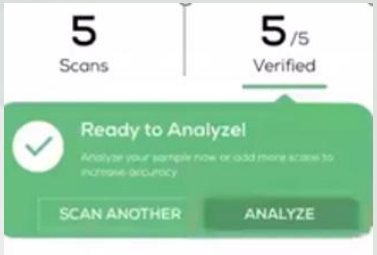
Corn: Drydown (for maximum **Profits**)

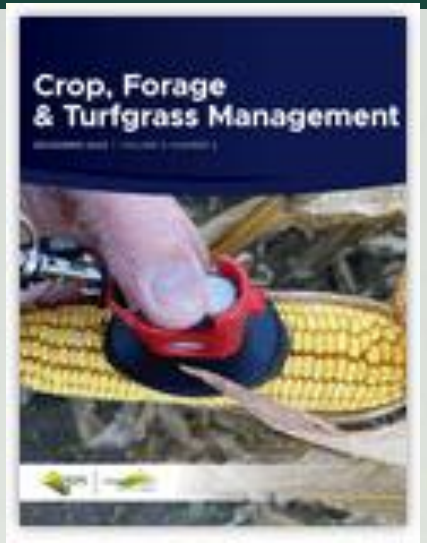
Variable	2021/22/24	2023
Moisture- Black Layer	**26 - 35%**	**32 - 39%**
Moisture- Plateau	**14 - 23%**	**20 - none**
Drydown Rate (per day) ***99 RM, May 10 Planting***	**0.70%**	**0.47%**
Drydown Rate (per day) *99 RM, May 30 Planting*	**0.64%**	**0.45%**
Drydown Rate (per day) ***109 RM, May 10 Planting***	**0.56%**	**0.39%**

Wet Fall

Corn: Measure moisture In-field?







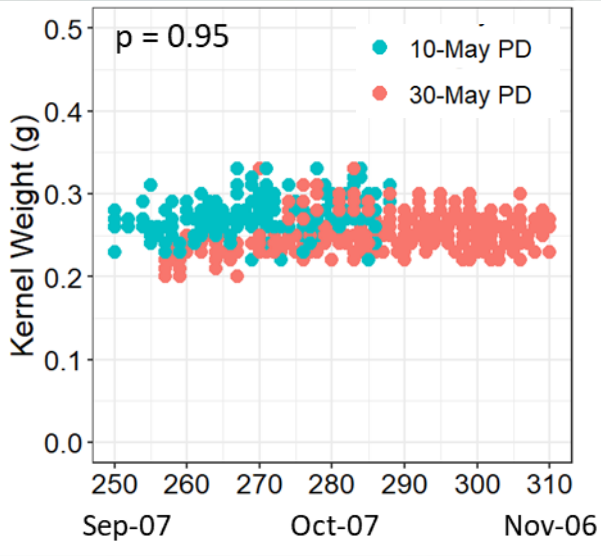
-NIR sensor (e.g., SCiO, annual cost)
-Other options?

Agyei et al. (2023; Crop, Forage & Turfgrass Mgmt.)

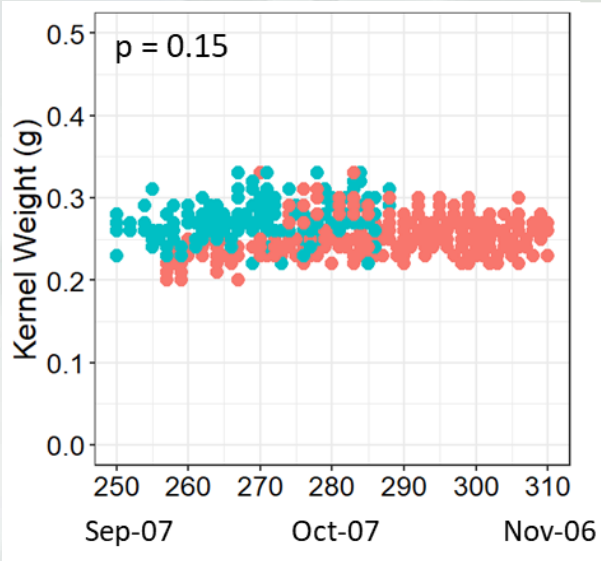
- Fast and non-destructive estimation of kernel moisture is important for harvest planning

Corn: Kernel weight after Black Layer

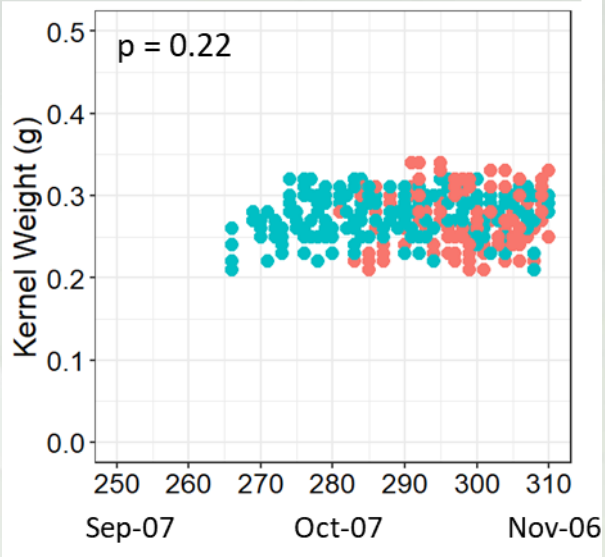
89 RM



99 RM

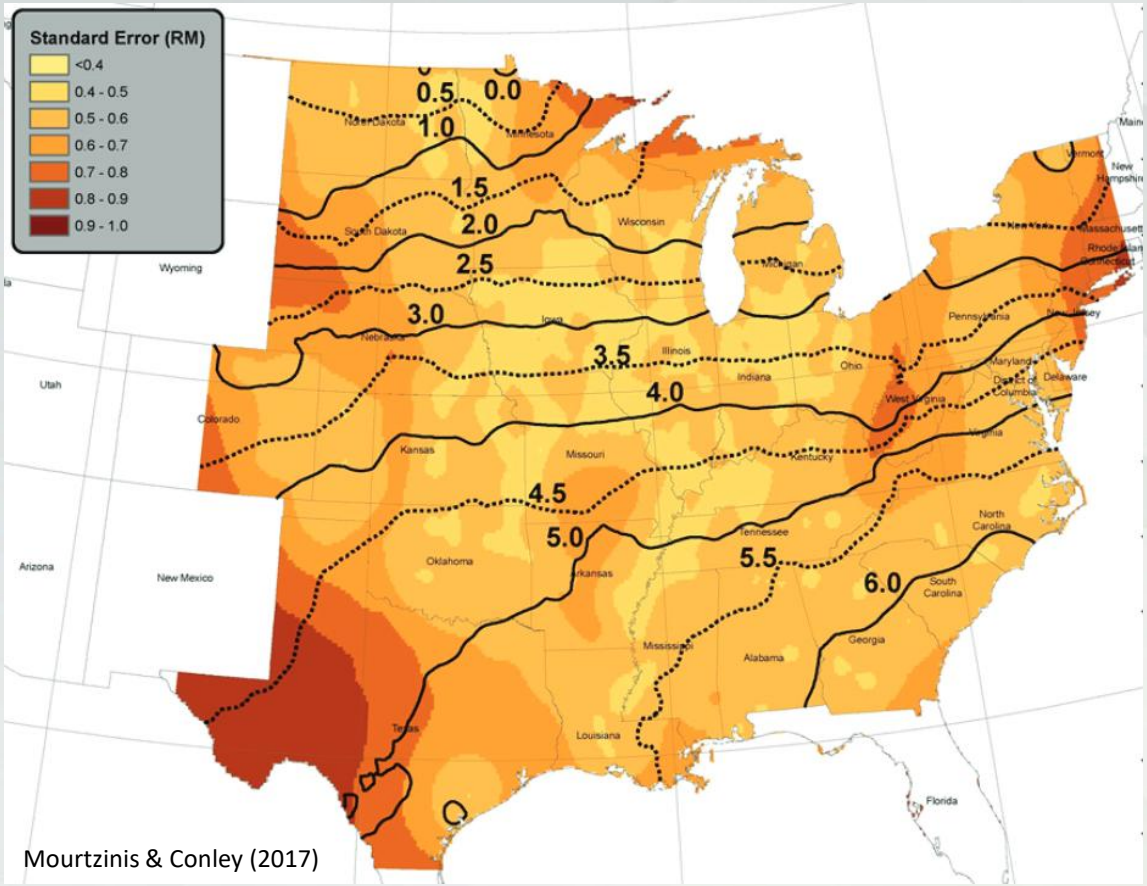


109 RM

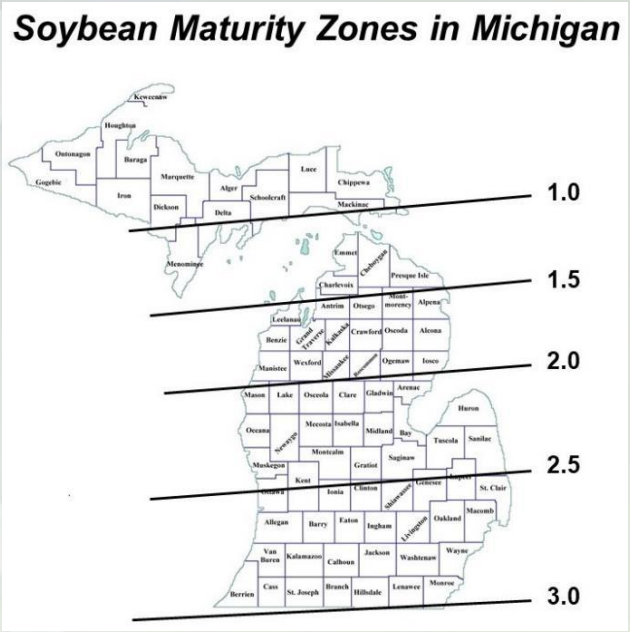


- No change in kernel weight after black layer (i.e. No Phantom yield loss) across hybrid RMs and planting dates

Soybean: Maturity Group (MG)

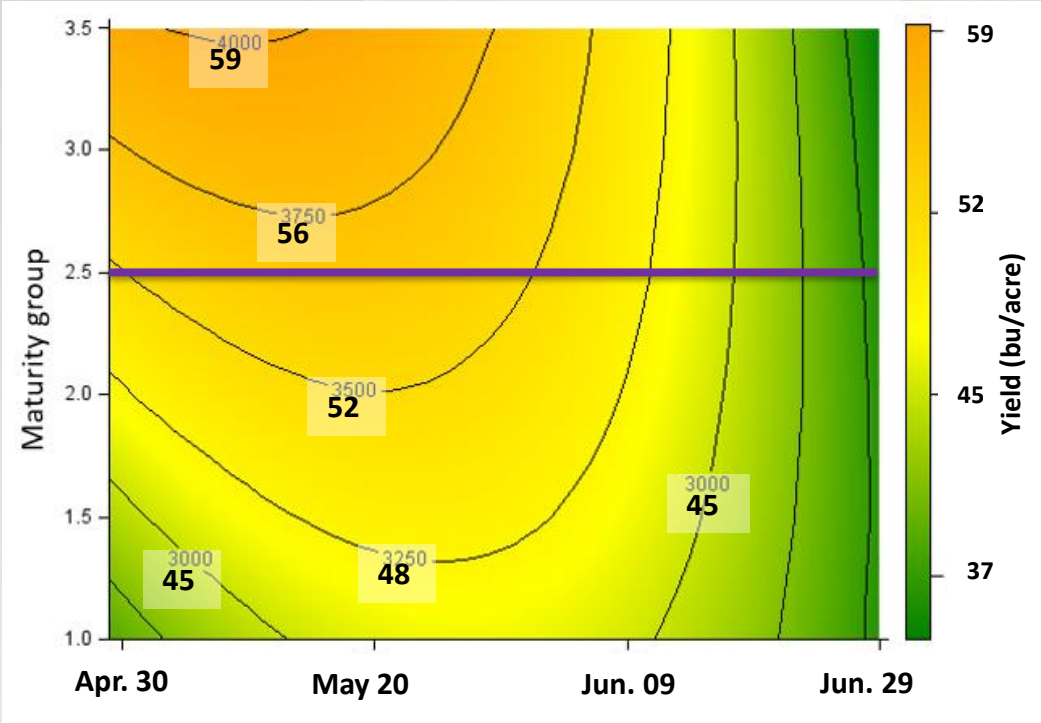


Mourtzinis & Conley (2017)



Based on Typical planting date ONLY

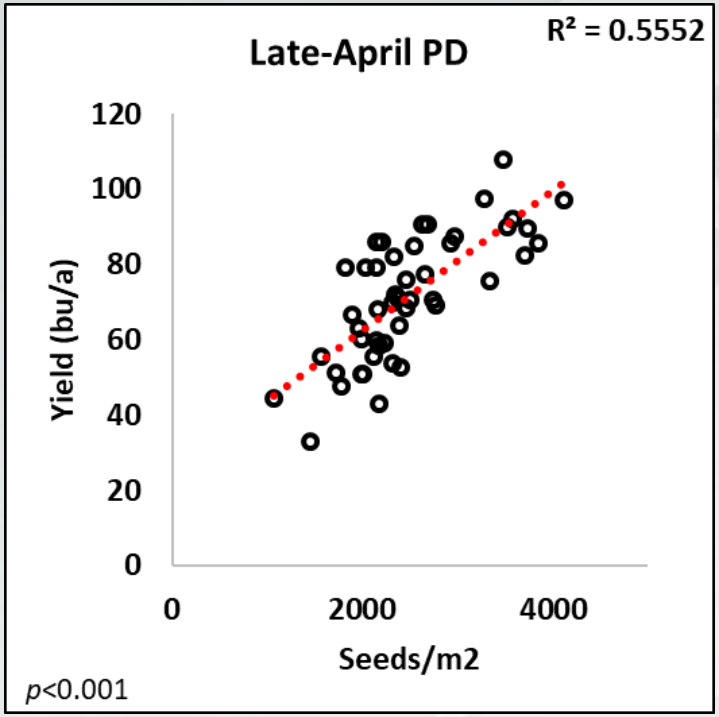
Soybean: Maturity Group vs Planting date

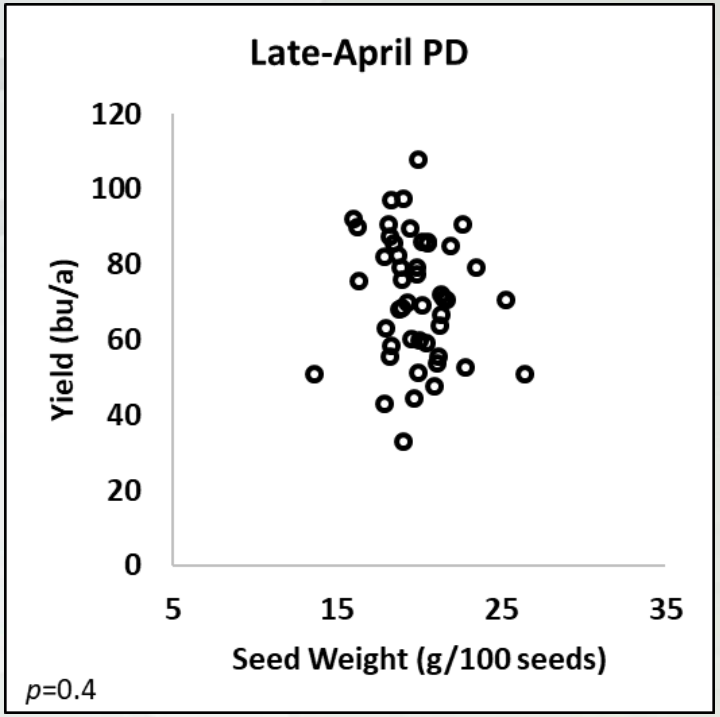


2 Years data (Lansing, MI)
Siler & Singh (2022, Crop Sci.)

- Late maturity variety for early-season planting (till 1st week of May)
- Switch to early maturity with delay in planting (starting early June) OR Double crop soy

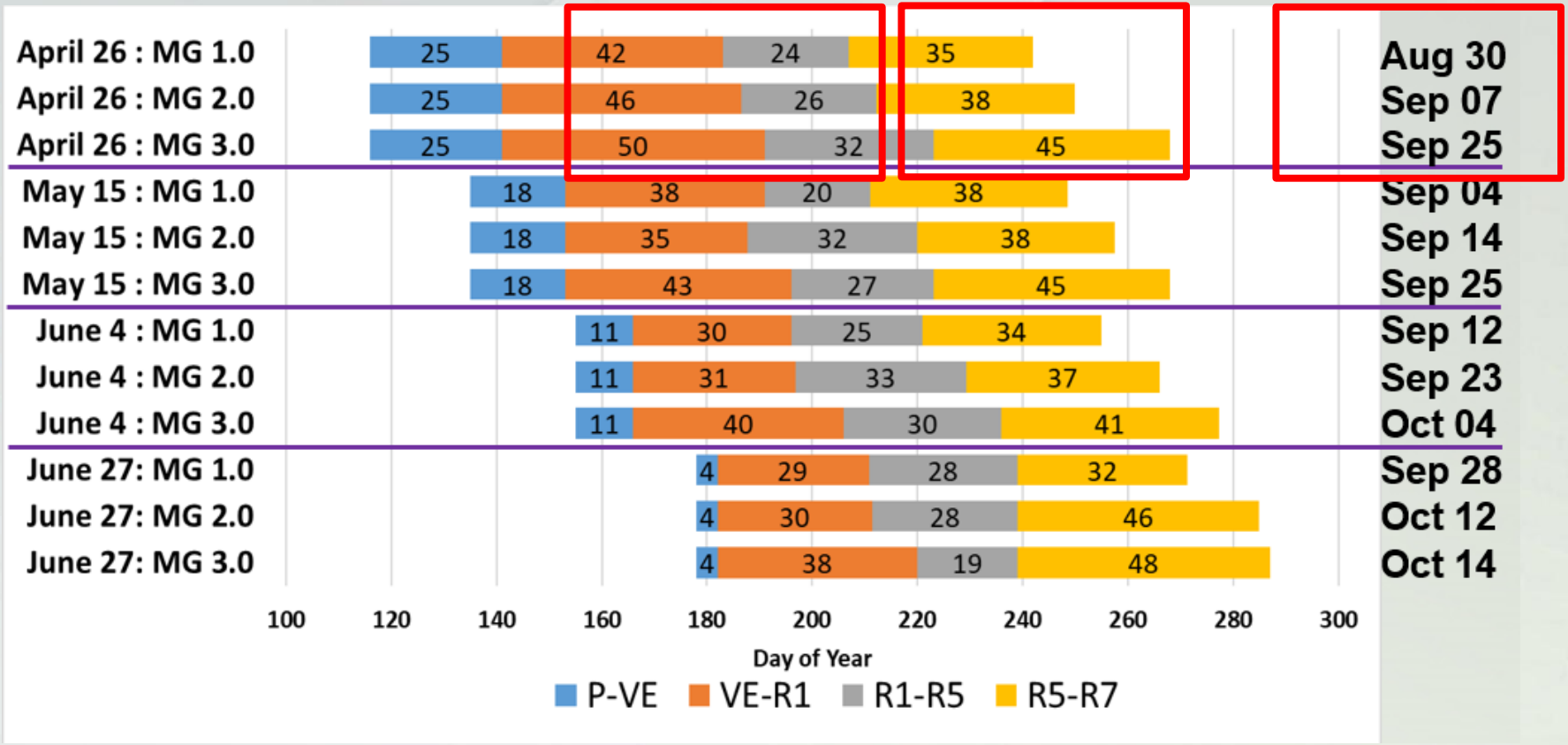
Driver of soybean yield increase: Seed Number vs Weight





- Combination of early planting and longer maturity: more time spent in V stages (increased # nodes/pods/seeds), as well as R stages (more time to fill increased number of seeds)

Soybean Phenology



Physiology of Yield Increase

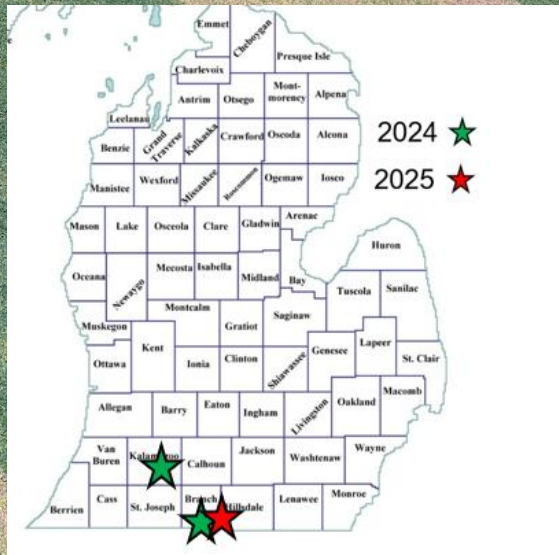
- Adjust planting date and soybean maturity to:
  - Harvest more light prior to the onset of reproductive development
  - Maximize number of nodes/pods/seed per acre, longer reproductive phase
  - Minimize the impact of periods of extreme heat and/or moisture stress during flowering and pod set

Soybean PD x MG trials: On-farm

E1.5 E2.5 L1.5 L2.5 L1.5 E2.5 E1.5 L2.5 E2.5 L1.5 E1.5 L2.5

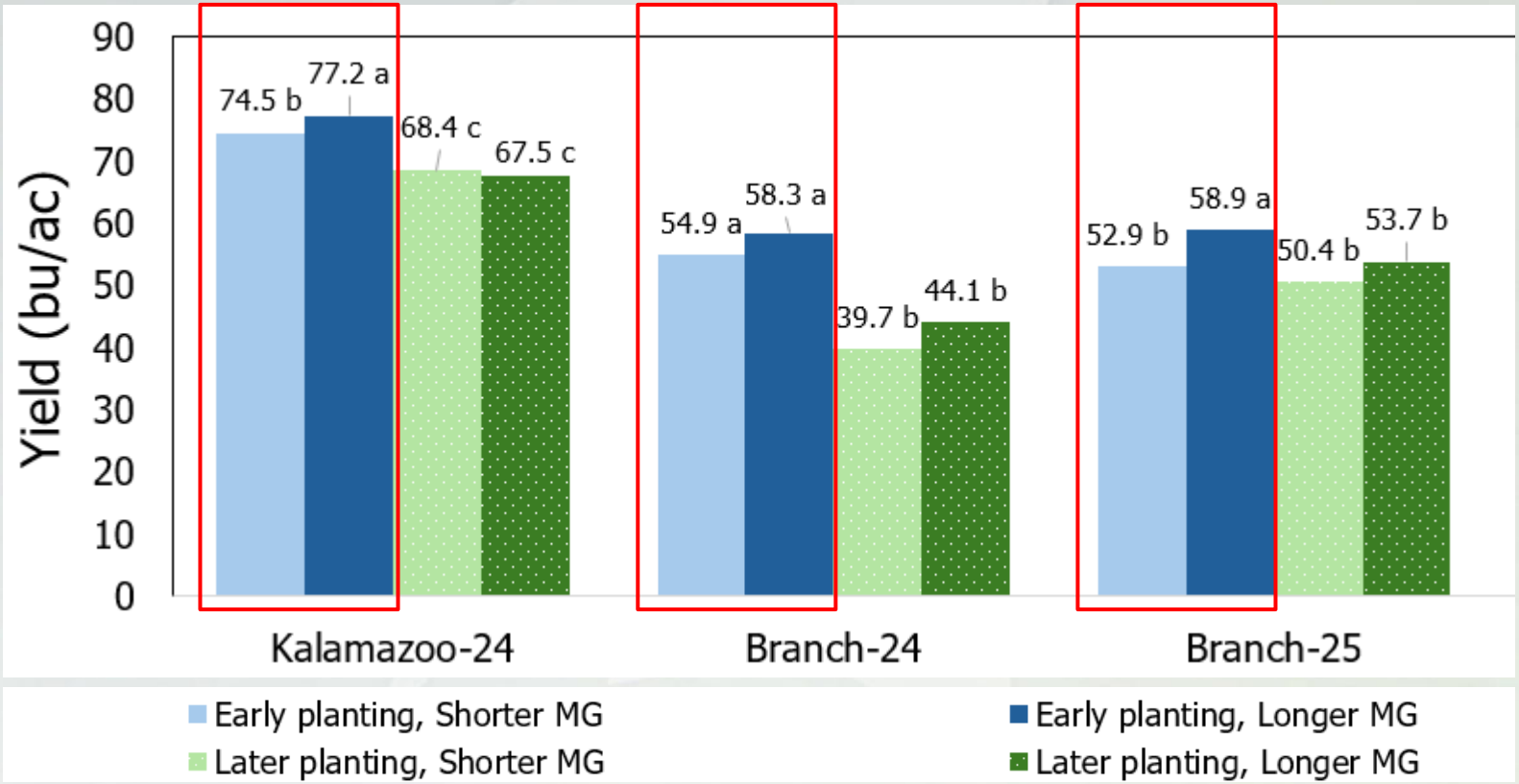
Planting date:
- Early (E): ~late-April
- Later (L): ~mid-May

Maturity Group:
- Shorter (e.g., 1.5)
- Longer (e.g., 2.5)



Source: E. Anderson, MSU

Soybean PDxMG trials: On-farm

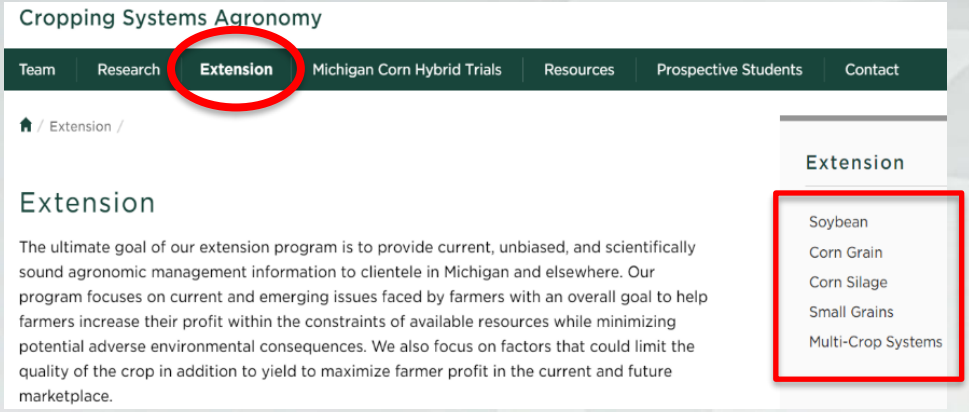


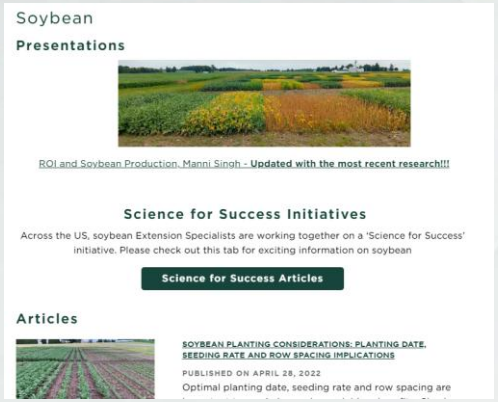
E. Anderson, MSU

Take Home Messages

- Optimal planting time is critical, however planting in marginal soil conditions can reduce yield (more so in corn)
- Other management practices (e.g., maturity) can be adjusted based planting time (Systems approach) to improve yields and profits
- Benefits of early-season planting can be expanded upon with the use of late-maturity varieties (conduct on-farm trials for your location)
- **Portfolio approach** in maturity selection (also provide genetic diversity)
  - Plant late-maturity varieties first (30-40% acres)
  - Plant mid- and early-maturity varieties in sequence to “stack” soy flowering/pod set or corn pollination
  - Plant 20-30% acres to each of mid- and early-maturity varieties

Resources: agronomy.msu.edu





- **Technicians**:
  - Patrick Copeland
  - Lorato Wood
- **Graduate Students**
  - Benjamin Agyei
  - Wallas da Silva
  - Aadil Rahman
  - Previous students
- **Undergrad/Intern students**
- **Past students**
- Mike Particka
- Tom Wenzel
- **Farmer cooperators**
  - Dr. Christy Sprague
  - Dr. Chris Difonzo
  - Dr. Jeff Andresen
  - Dr. Laura Lindsey (OSU)
  - Dr. Ignacio Ciampitti (KSU)
  - Dr. Shawn Conley (UW)
  - Dr. Erin Burns
  - Dr. Dechun Wang
  - Dr. Kurt Steinke
  - Dr. Sarah Lebeis
  - Dr. Lisa Tiemann
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Thanks!

Cropping Systems Agronomy
MICHIGAN STATE UNIVERSITY

MICHIGAN SOYBEAN COMMITTEE

NCSRP NORTH CENTRAL SOYBEAN RESEARCH PROGRAM

SCIENCE FOR SUCCESS

CORN MARKETING PROGRAM CMPM OF MICHIGAN

NORTH CENTRAL SARE Sustainable Agriculture Research & Education

CORN Outreach & Research Network

Project GREEEN

M-AAA Michigan Alliance for Animal Agriculture

MICHIGAN STATE UNIVERSITY Extension

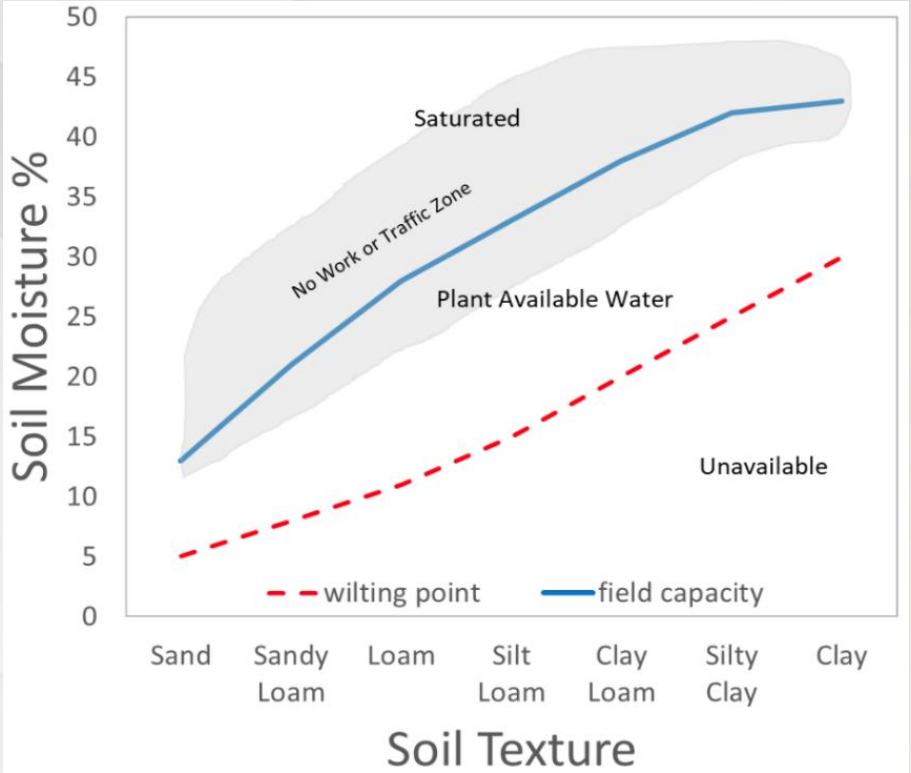
USDA NIFA

Seed companies

Field Conditions at Planting- Optimal **Soil Moisture**

- Avoid tilling/planting when soil is wet "**mudding it in**"
  - Side-wall compaction
  - Non-ideal seed placement
  - Poor seed-to-soil contact
  - **Soil Compaction**

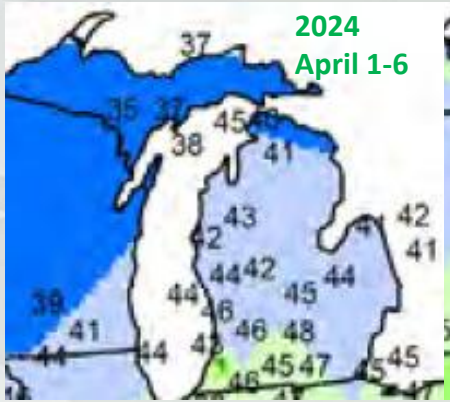
- Soil too wet to plant?
  - When soil at desired planting depth just deforms, ok if crumbles
  - Use soil moisture sensor

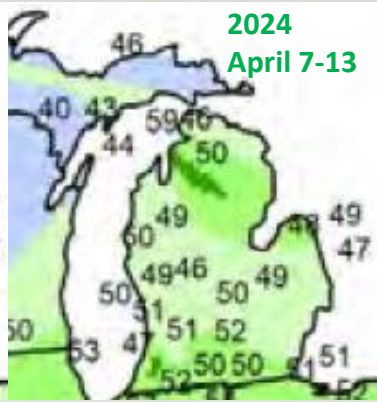


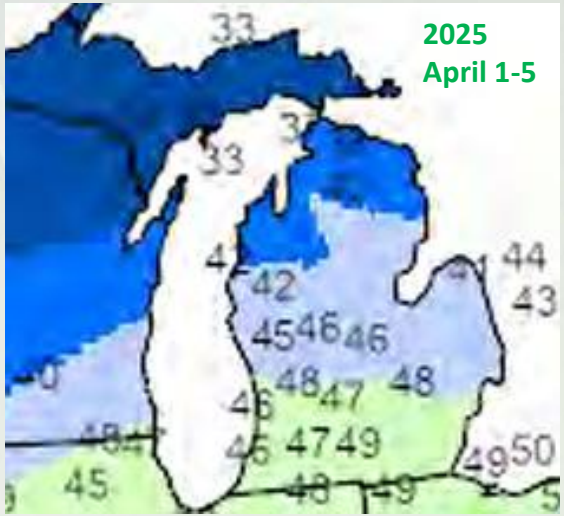
https://extension.sdstate.edu/planting-wet-soils

Field Conditions at Planting- Optimal **Soil Temperature**

- Wait for <u>soil temp</u> 45-50° F and **rising**
- **Imbibitional chilling injury** at <50° F for first 24 hrs (soybean), 48 hrs (corn)
- Slow emergence and uneven stand (of greater concern in corn)







Source: USDA (top 4'')

Seed Quality

- Germ. % on seed tag
- Early plantings: use high quality seed
- Test seed vigor (use same lab)
  - Cold test
  - Saturated cold test

Source: OSU


Source: Tom Siler (MCIA)

Length of Growing Season (1999-2023)