Maximizing Wheat Yield with Precision Planting and Agronomic Management



Project GREEEN

Cropping Systems Agronomy
MICHIGAN STATE UNIVERSITY

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MICHIGAN WHEAT PROGRAM

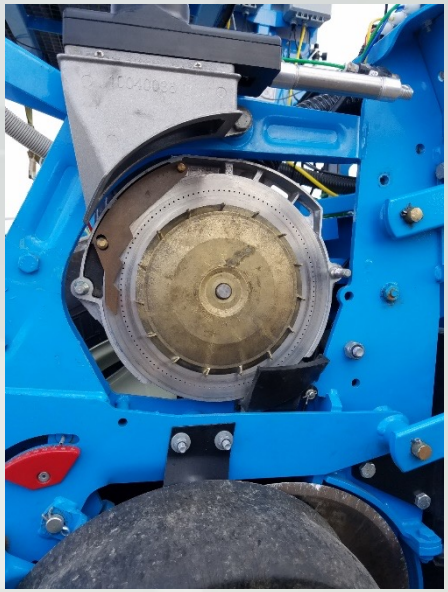
Michigan Crop improvement association

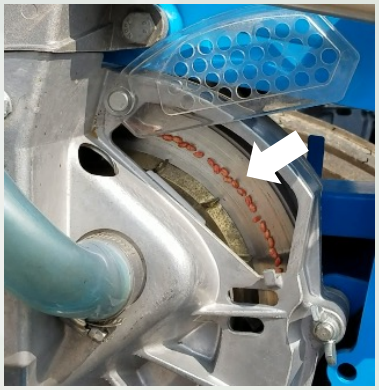
Wheat Yield Potential

- **Goal**: Design a canopy structure that maximizes:
  - Light Interception
  - Resource Use Efficiency
- **Components**:
  - Planting method: seed placement, stand establishment
    - Seeding depth
    - Seed-to-seed spacing
    - Row spacing
  - Seeding rates
  - Variety selection (leaf angle, tillering)
  - Planting time

Wheat Seed Placement

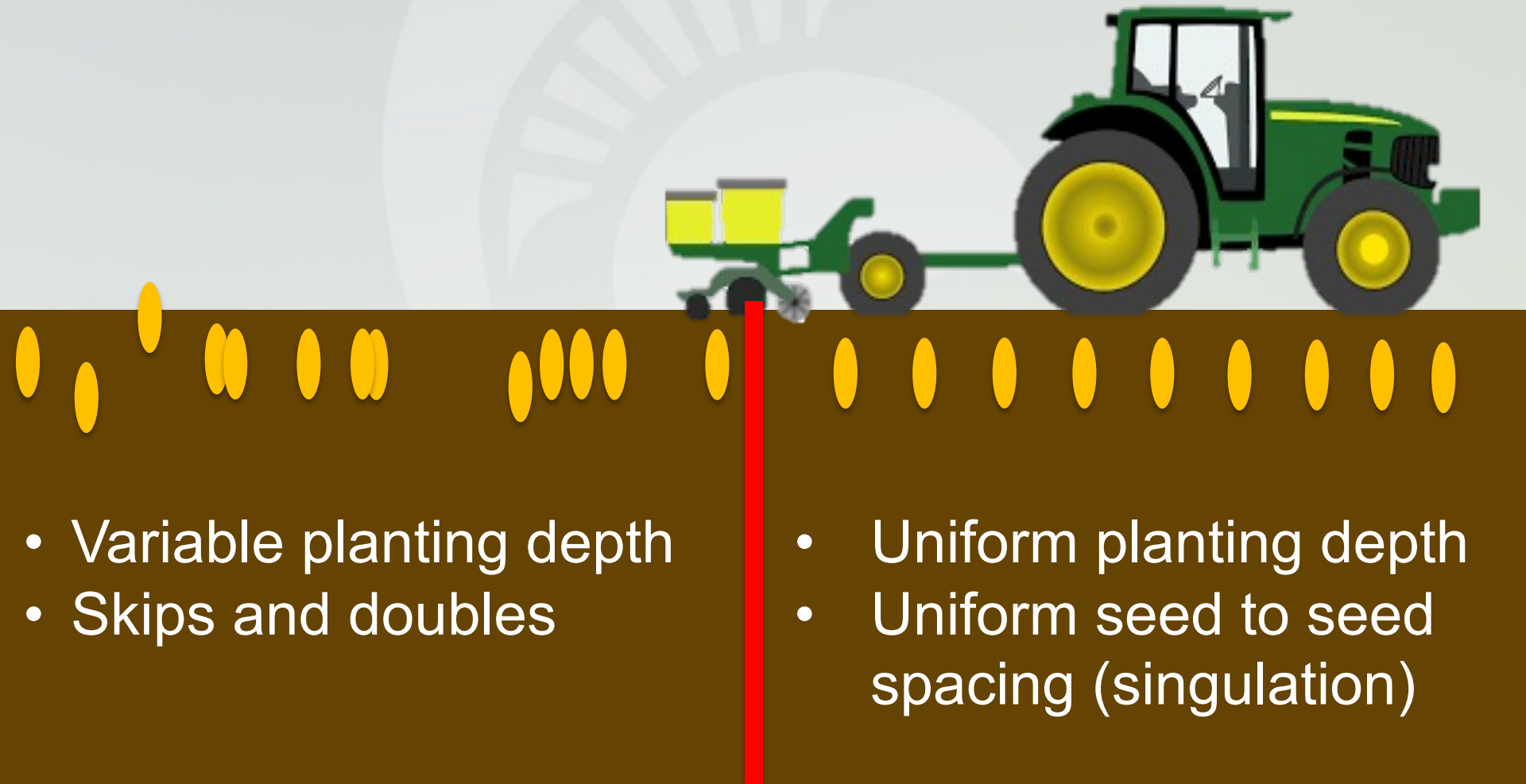
Conventional drill with rotating gear that “spills” seed into the drop tube.





Precision planter with vacuum that picks up individual seeds and drops one seed at a time down the drop tube.

Uniform Seed Placement



- Variable planting depth
- Skips and doubles

- Uniform planting depth
- Uniform seed to seed spacing (singulation)

Target: Uniform Depth and Singulation

- More uniform placing of plants within row (less gaps)
- More uniform number of tillers/plant (4-5)
- More uniform planting = more uniform head emergence (better head scab control?)
- Are we there yet??

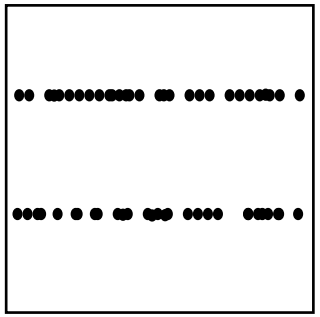
Project Objectives

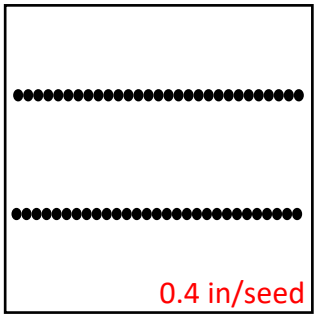
Seed drill
7.5'' Row Spacing

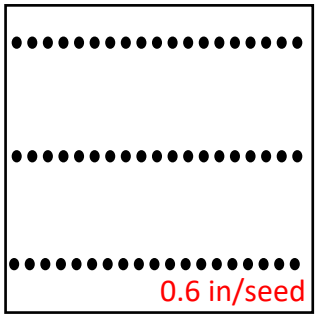
Precision Planter
7.5'' Row Spacing

Precision Planter
5'' Row Spacing

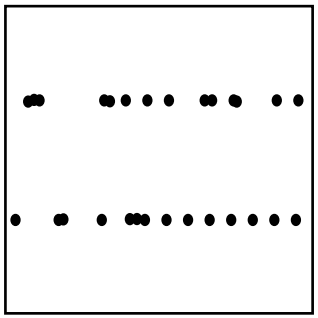
2 million seeds/acre

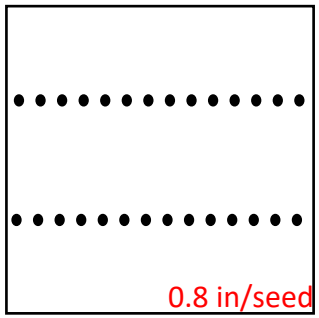


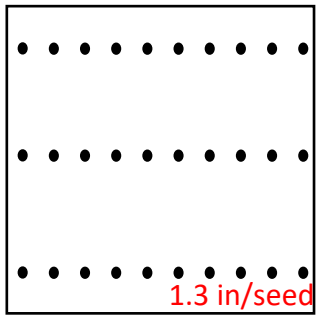




1 million seeds/acre







Objective #1

Objective #2

Objectives and hypothesis

- Compare seed placement accuracy of conventional drill to available PP technology. *Hypothesis: Precision planter will result in more accurate seed placement (depth and spacing) than the seed drill.*

- Determine the optimum row spacing and population in wheat planted with PP. *Hypothesis: Narrow rows at lower population will produce higher yield compared to wider rows at higher populations.*

- Quantify the response to seeding density in wheat varieties with differing growth habits. *Hypothesis: Wheat variety with narrow leaf angle and erect growth will perform better under higher seeding rate*.

Project Details

- Trial locations:
  - MSU Mason farm, Lansing, MI
  - SVREC, Frankenmuth, MI
- Years
  - 2018-19 (2017-18 as prelim. research)
  - 2019-20
- Split plot design
  - Main plots:
    - Seed drill (7.5’’)
    - Precision planter, 4 spacings (5’’, 7.5’’, 10’’, 15’’)
  - Sub plots:
    - Seeding rate- 0.5, 1.0, 1.5, and 2.0 million seeds/acre

Variables Measured

- Stand count
- Seed placement
  - Seeding depth
  - Seed-to-seed spacing
- Canopy light interception
  - Canopy closure
  - Leaf area index (LAI)
- Tillering and plant uniformity (~10 plants)
- Yield components: 1-2 m row per plot
  - Spikes per unit area
  - Kernels per spike
  - Thousand kernel weight (TKW)
  - Total biomass and harvest index
- Harvest: grain yield, moisture, TW
- Quality

5” spacing

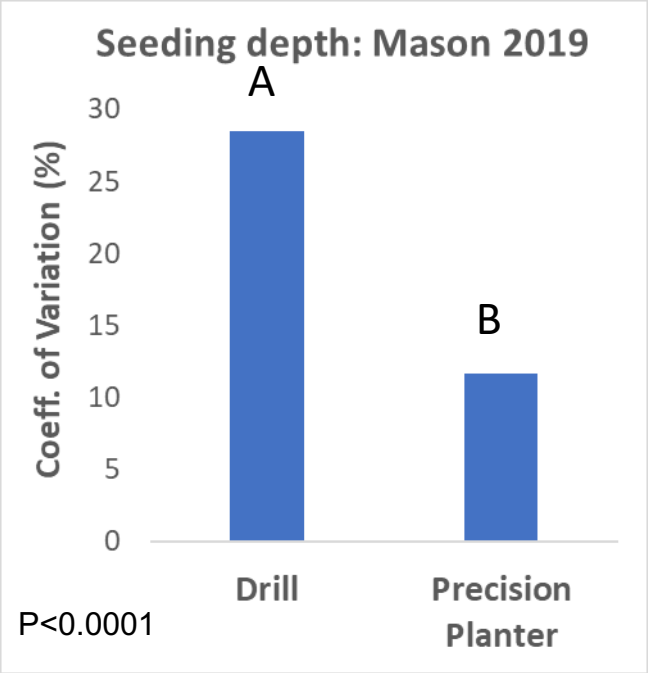
15” spacing

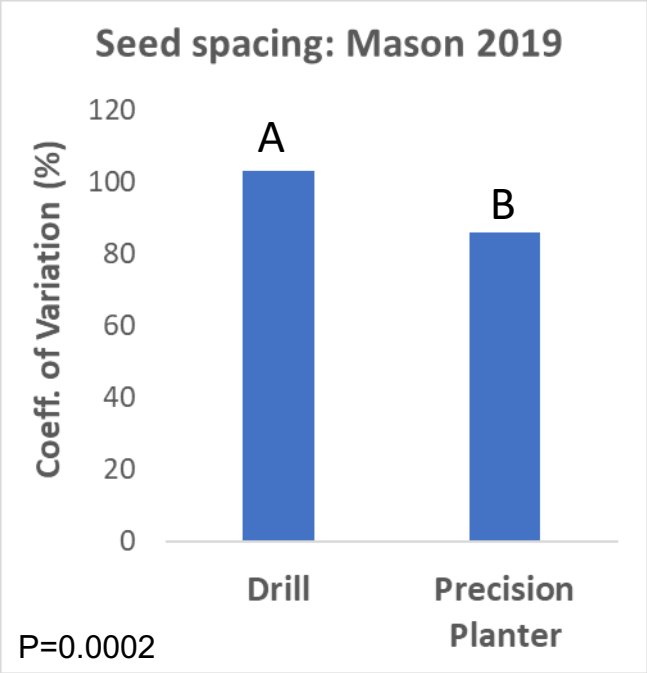
Variability in Seed Placement

DRILL

PLANTER

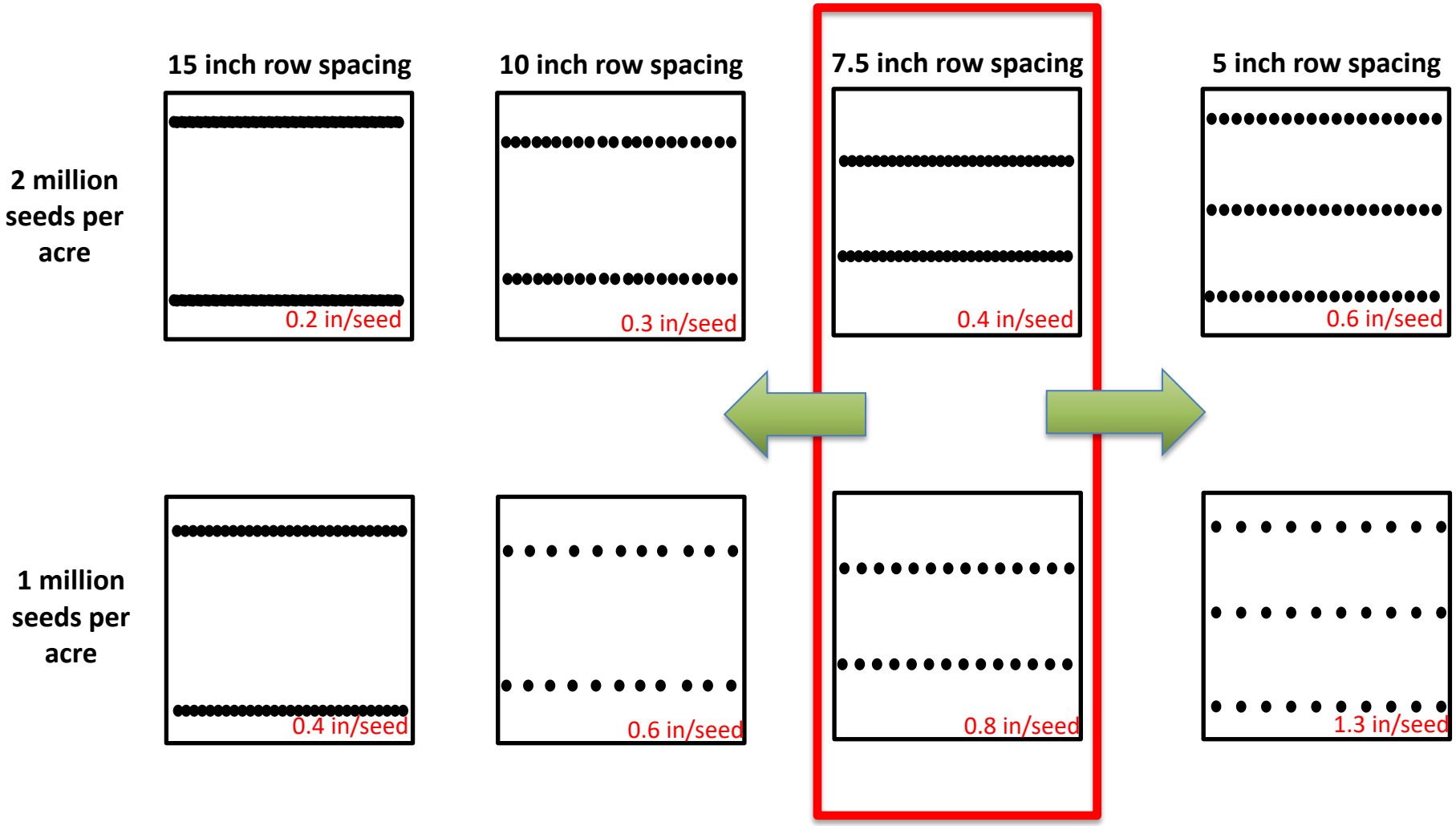
Variability in Seed Placement



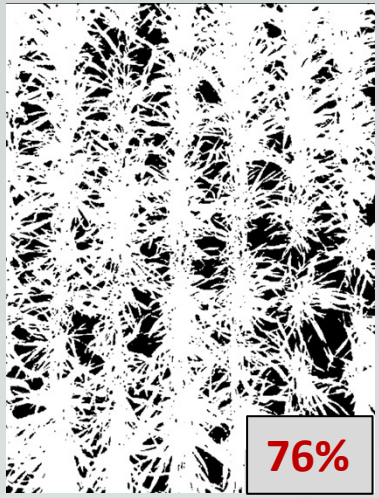


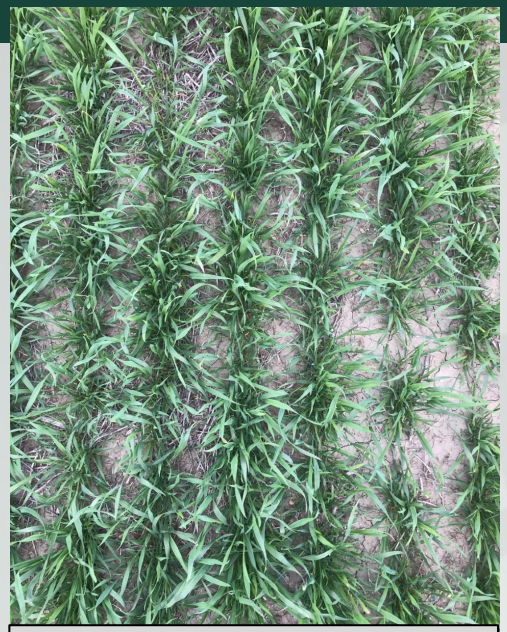
- Planter reduced variability in seeding depth by **59%**
- Variability in seed-seed spacing was reduced by **17%**

Planter Configuration



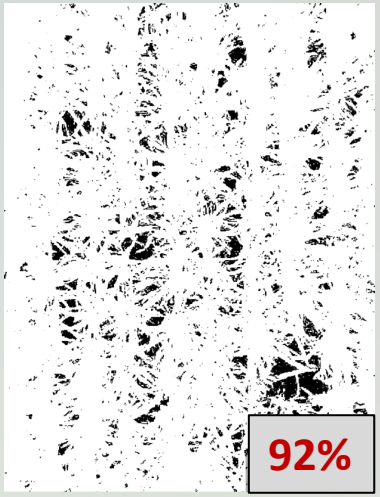
May 8, 2020

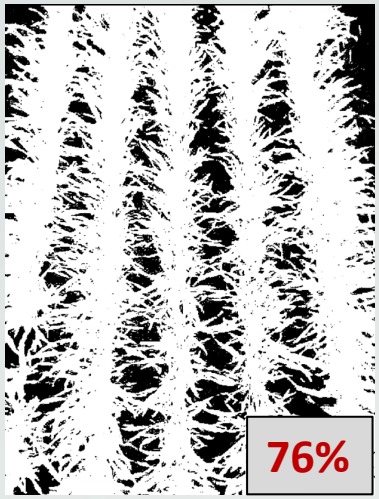




7.5'' spacing

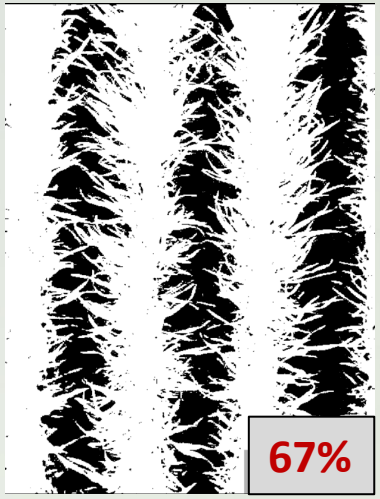
5'' spacing





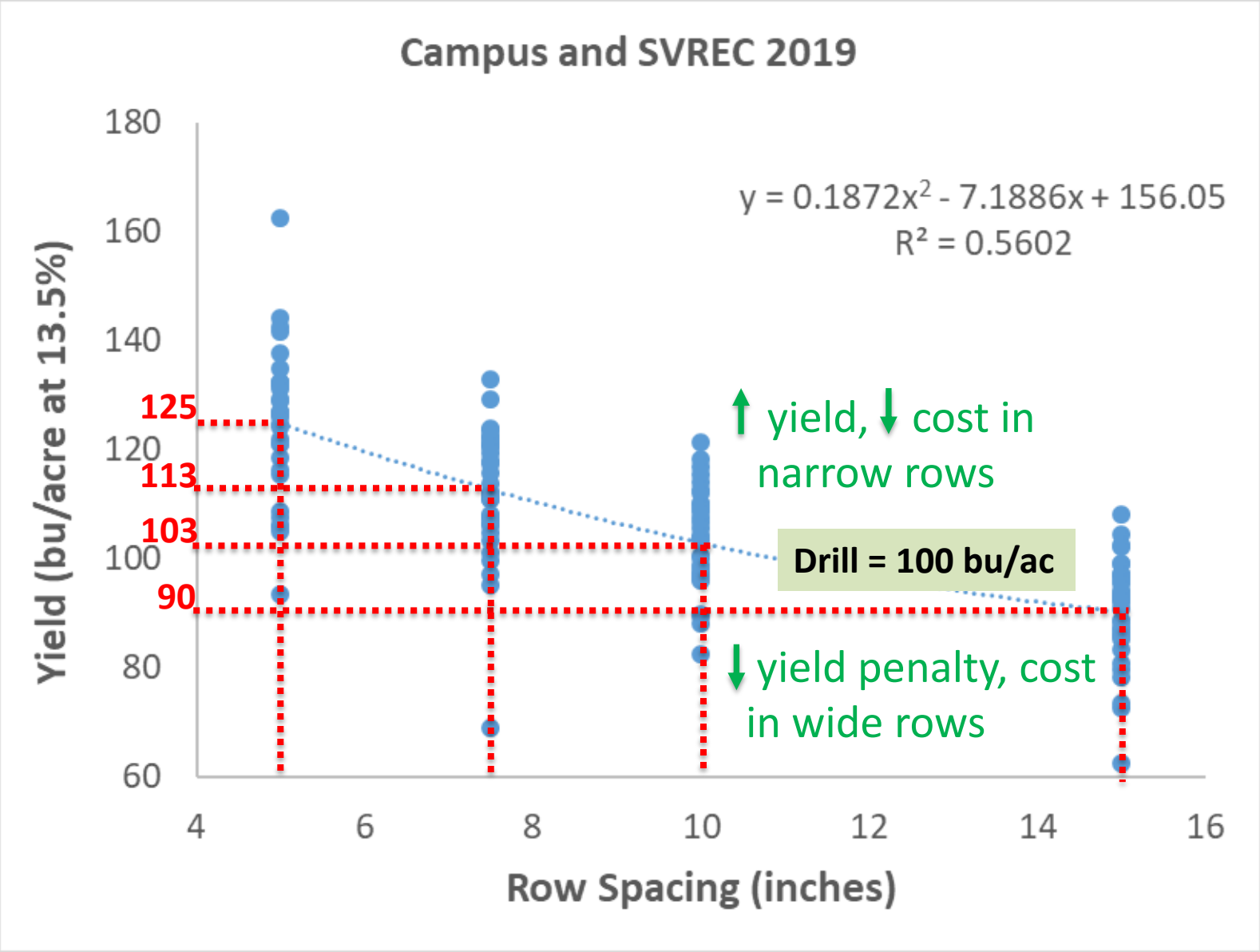
10'' spacing

15'' spacing

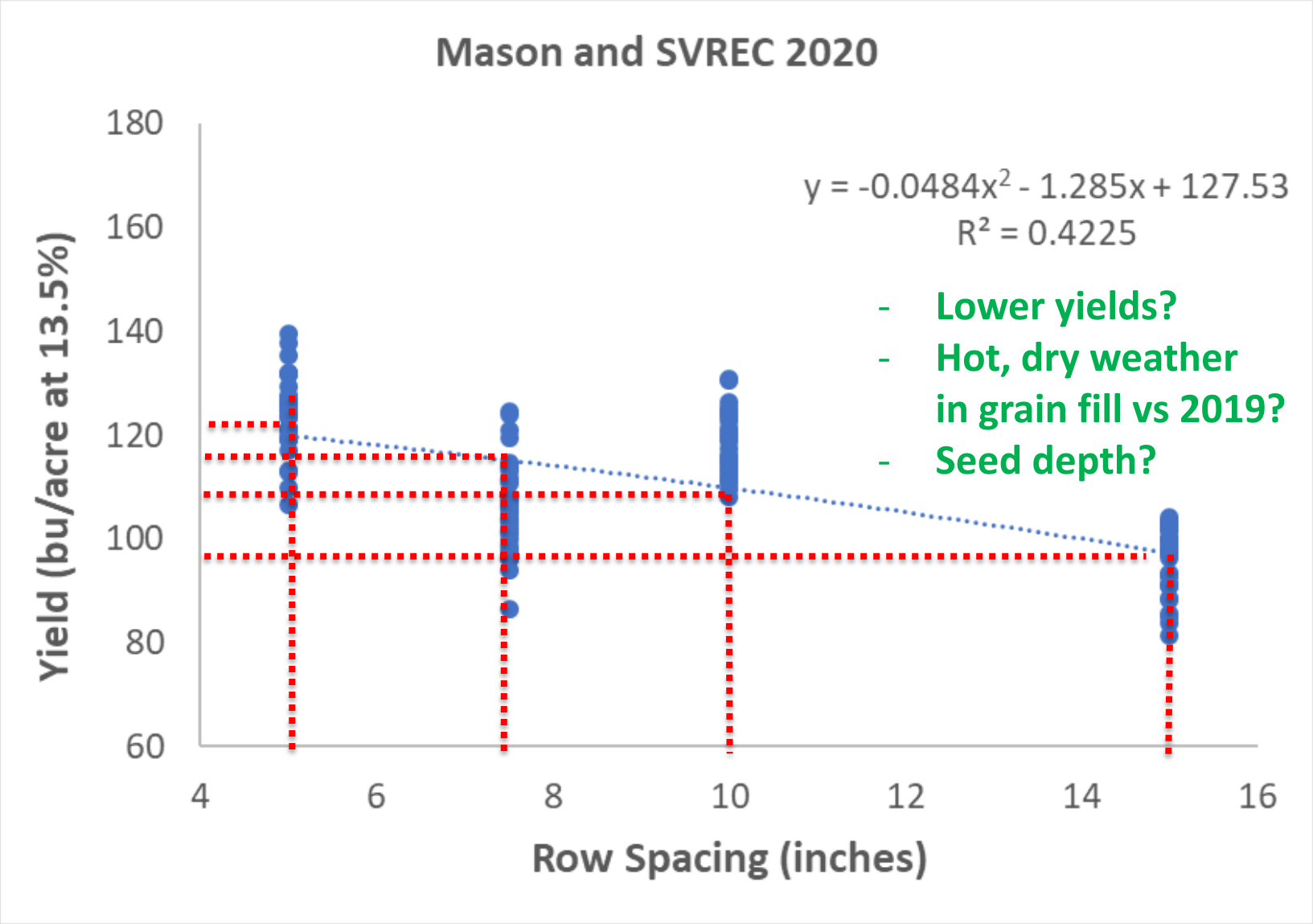


June 10- 77%
Others >95%

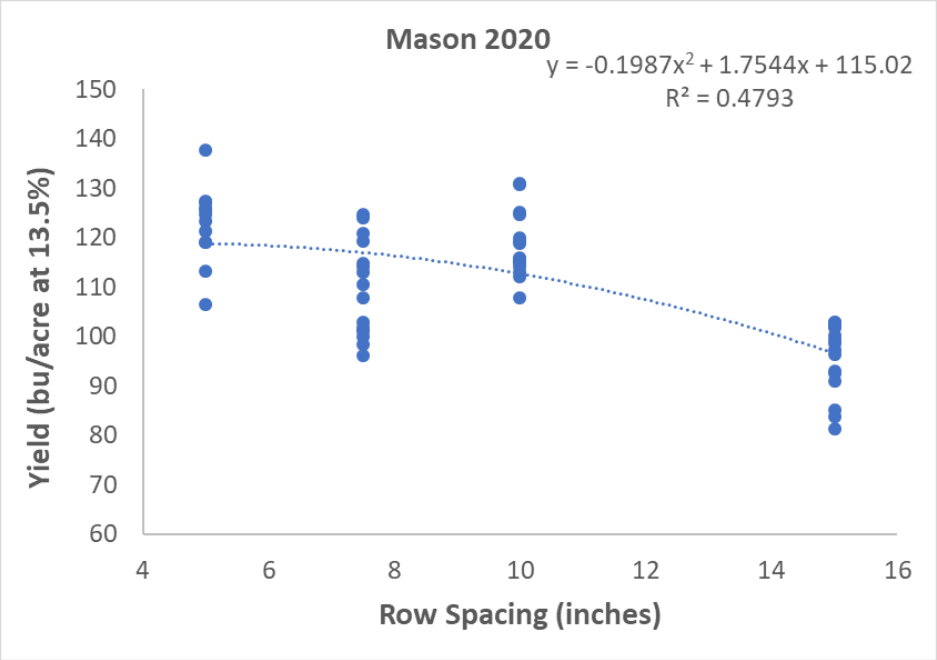
Row Spacing vs Yield- 2019

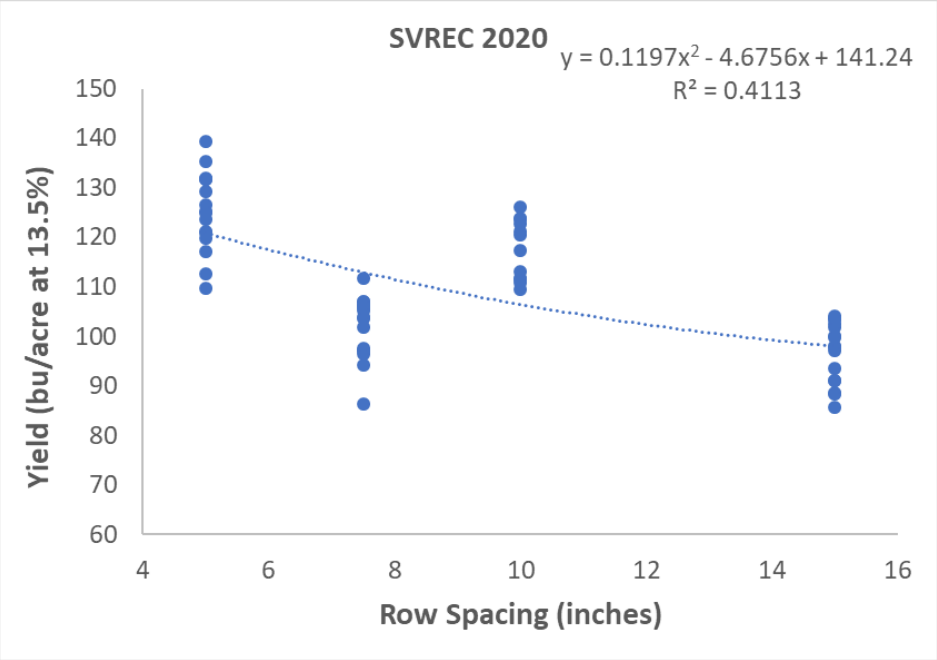


Row Spacing vs Yield- 2020

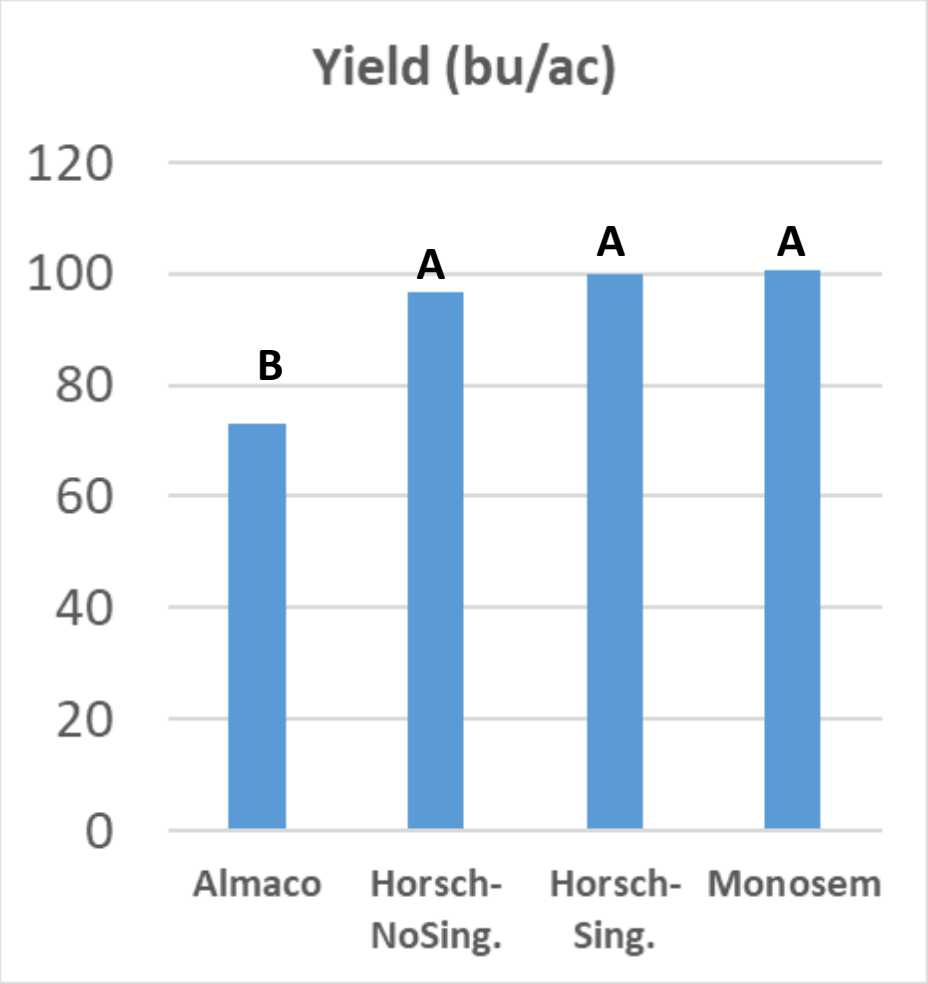


Row Spacing vs Yield- 2020





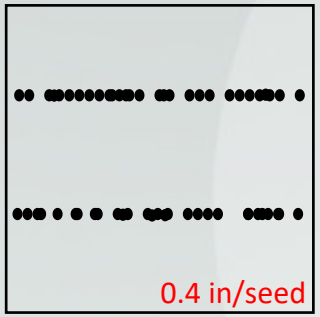
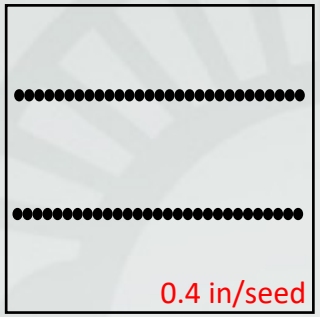
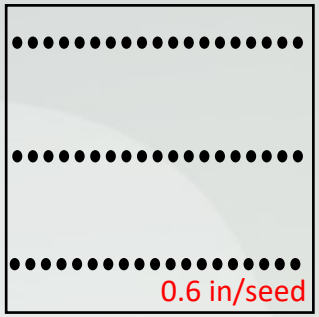
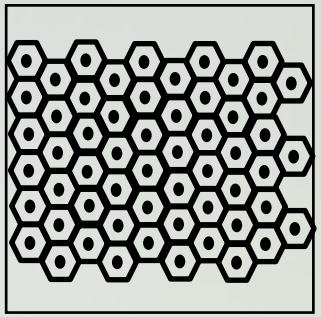
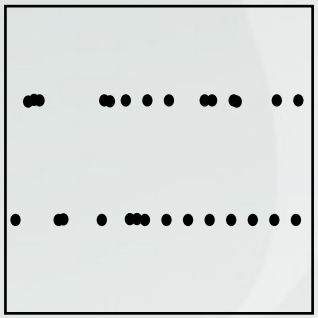
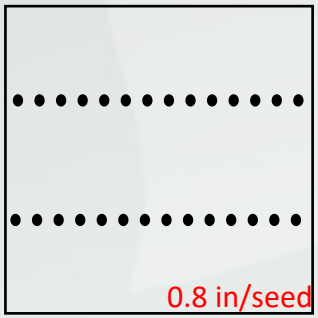
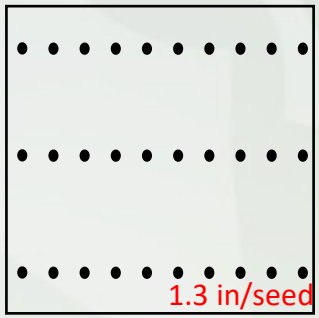
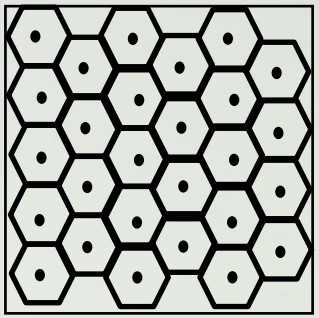
2020 Equipment comparison



Take Home Messages

- Narrow row spacing in wheat production can lead to increased yield potential (more uniform plant spacings)
- Potential for reduction in seeding rate (<1.5 m seeds/ac) without limiting yield (≤ 1.0 m in 15'' rows)
- Improved seed placement (seeding depth, spacing) at planting can lead to increase in crop uniformity and overall yield potential
- Optimize current planter configuration vs invest in new planting technology to be used for multiple crops

Precision Planting- Current and Future?

	Seed drill 7.5'' Row Spacing	Precision Planter 7.5'' Row Spacing	Precision Planter 5'' Row Spacing	Future? Robotics
2 million seeds/acre	 0.4 in/seed	 0.4 in/seed	 0.6 in/seed	
1 million seeds/acre		 0.8 in/seed	 1.3 in/seed	

2D vs 3D distribution