Corn Hybrid/Maturity Selection

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Hybrid Selection

- **Adaptation** (maturity, GDD requirement)
- **Yield potential and stability**
- **Agronomic characteristics**
  - Standability (stalk quality, lodging)
  - Disease resistance
  - Herbicide resistance (e.g. glyphosate)
  - Insect protection (stacks)
- **Others**: field history, management, G x E x M responses, farm drying capacity, end use, hybrid characters (e.g. drought tol., emergence/vigor, drydown, grain quality...)
Difference Between Highest/Lowest Yielding Hybrid

Hybrid in each zone is average of 12 plots (3 locations, 4 reps)

40-60 bu/A difference

<table>
<thead>
<tr>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
<th>Zone 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>237</td>
<td>225</td>
<td>211</td>
<td>207</td>
</tr>
<tr>
<td>236</td>
<td>225</td>
<td>212</td>
<td>210</td>
</tr>
<tr>
<td>29</td>
<td>40</td>
<td>37</td>
<td>32</td>
</tr>
<tr>
<td>52</td>
<td>42</td>
<td>39</td>
<td>52</td>
</tr>
</tbody>
</table>

Grain yield (bu/ac)
Yield Stability

- Yield potential and stability (consistency)
- Concept of G x E (Genotype x Environment interaction)
- Multi-location/sources hybrid performance data

Source: Bob Nielsen, Purdue
Performance of Conventional Hybrids

Relative performance of conventional corn hybrids

Grain yield difference (bu/A) = hybrid average – trial average

- All hybrids
- Top 20%

Source: Joe Lauer, UW
Performance of Conventional Hybrids

Relative performance of conventional corn hybrids

Grain yield difference (bu/A) = hybrid average – trial average

Source: Joe Lauer, UW
Performance of Conventional Hybrids

<table>
<thead>
<tr>
<th></th>
<th>IngCon97</th>
<th>IngBt97</th>
<th>DIFF</th>
<th>IngCon101</th>
<th>IngBt101</th>
<th>DIFF</th>
<th>IngCon102</th>
<th>IngBt102</th>
<th>DIFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVG</td>
<td>156.4</td>
<td>157.2</td>
<td>0.8 bu, BT</td>
<td>156.9</td>
<td>156.7</td>
<td>0.2 bu, Con</td>
<td>128.5</td>
<td>149</td>
<td>20.5 bu Bt</td>
</tr>
<tr>
<td>LOW</td>
<td>130.8</td>
<td>144.8</td>
<td></td>
<td>146.6</td>
<td>135.5</td>
<td></td>
<td>101.8</td>
<td>131.8</td>
<td></td>
</tr>
<tr>
<td>HIGH</td>
<td>182.8</td>
<td>184.9</td>
<td></td>
<td>167.1</td>
<td>176.2</td>
<td></td>
<td>154.6</td>
<td>181.3</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>MoCon97</th>
<th>MoBt97</th>
<th>DIFF</th>
<th>MoCon101</th>
<th>MoBt101</th>
<th>DIFF</th>
<th>MoCon102</th>
<th>MoBt102</th>
<th>DIFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVG</td>
<td>181.3</td>
<td>184.3</td>
<td>3 bu BT</td>
<td>174.2</td>
<td>183.5</td>
<td>9.3 bu BT</td>
<td>189.3</td>
<td>193.8</td>
<td>4.5 bu BT</td>
</tr>
<tr>
<td>LOW</td>
<td>162.2</td>
<td>157.5</td>
<td></td>
<td>164.7</td>
<td>156.9</td>
<td></td>
<td>162.1</td>
<td>183.5</td>
<td></td>
</tr>
<tr>
<td>HIGH</td>
<td>205.0</td>
<td>218.4</td>
<td></td>
<td>190.3</td>
<td>209.3</td>
<td></td>
<td>207.0</td>
<td>202.7</td>
<td></td>
</tr>
</tbody>
</table>

Source: Chris Difonzo, 2019 MCPT data

*Pest pressure is mostly absent in these trials
Performance of Conventional Hybrids

<table>
<thead>
<tr>
<th></th>
<th>All entries</th>
<th>Herbicide resistance only</th>
<th>Above ground insect resistance</th>
<th>Above and below ground insect resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Av. Yield (bu/ac)</strong></td>
<td>226</td>
<td>220</td>
<td>224</td>
<td>229</td>
</tr>
<tr>
<td><strong>Range (bu/ac)</strong></td>
<td>181-262</td>
<td>196-249</td>
<td>181-260</td>
<td>192-262</td>
</tr>
<tr>
<td><strong>No. of hybrids</strong></td>
<td>334</td>
<td>13 (4%)</td>
<td>209 (63%)</td>
<td>113 (34%)</td>
</tr>
</tbody>
</table>

*Pest pressure is mostly absent in these trials
Optimal Hybrid Maturity Selection

- Relative maturity (days)
- Heat units (GDDs)
- Grain moisture at harvest
- Days to mid silk
- Test weight/moisture at harvest

Role of Planting date?

Source: Jeff Coulter, UMN
Seasonal GDD totals are increasing with time. Use GDD ratings for hybrid selection vs relative maturity “days”? 
End Point? Frost (28 °F) Dates

Early First Frost | Median First Frost | Late First Frost

Source: [https://mrcc.illinois.edu/VIP/frz_maps/freeze_maps.html](https://mrcc.illinois.edu/VIP/frz_maps/freeze_maps.html)
Zone 1
- 2622 GDD
  - Cass
  - Branch

Zone 2
- 2478 GDD
  - Ottawa
  - Saginaw
  - Ingham
  - Lenawee

Zone 3
- 2342 GDD
  - Montcalm
  - Mason
  - Iosco
  - Huron

Zone 4
- 2086 GDD
  - Presque Isle
  - Iosco

Grain
Grain & Silage
Not planted due to covid restrictions

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2020 Corn Hybrid Testing Locations

https://varietytrials.msu.edu/corn
Relative Maturity Vs Yield & Moisture

One Planting date (mid-season)

Data from MCPT Trials at one planting time (Zone 2, 2013 onwards)
## Relative Maturity Vs Economic Returns

### Difference b/w: Late- Early

<table>
<thead>
<tr>
<th>Zone</th>
<th>Drying Cost ($bu^{-1} point^{-1}$)</th>
<th>Corn Grain Price ($bu^{-1}$)</th>
<th>2.5</th>
<th>3.5</th>
<th>4.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.03</td>
<td></td>
<td>-11*</td>
<td>-8*</td>
<td>-5</td>
</tr>
<tr>
<td></td>
<td>0.04</td>
<td></td>
<td>-17*</td>
<td>-14*</td>
<td>-11*</td>
</tr>
<tr>
<td></td>
<td>0.05</td>
<td></td>
<td>-23*</td>
<td>-20*</td>
<td>-17*</td>
</tr>
<tr>
<td>2</td>
<td>0.03</td>
<td></td>
<td>-1</td>
<td>4</td>
<td>10*</td>
</tr>
<tr>
<td></td>
<td>0.04</td>
<td></td>
<td>-6*</td>
<td>-1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>0.05</td>
<td></td>
<td>-11*</td>
<td>-6</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.03</td>
<td></td>
<td>-19*</td>
<td>-21*</td>
<td>-22*</td>
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<td></td>
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<td></td>
<td>-25*</td>
<td>-26*</td>
<td>-27*</td>
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<tr>
<td></td>
<td>0.05</td>
<td></td>
<td>-30*</td>
<td>-31*</td>
<td>32*</td>
</tr>
</tbody>
</table>

*Mid-season planting*

*7 year data*
Recent planting seasons...

- Variability in planting window
- Extreme weather events lead to poor field planting conditions
- Need to adjust agronomic practices based on planting time?
- Optimal hybrid maturity selection to best utilize the relatively-short growing season
Weather Trends: Wetter and Warmer

Spring

Fall

First, Last Freezes and Frost-Free Season Length
Lansing, MI, 1981-2018

16 Days
1951-2017
<table>
<thead>
<tr>
<th>Planting Time</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Early Season</strong></td>
<td>• Extended Growing Season</td>
</tr>
<tr>
<td>(before early-May)</td>
<td>• Use of Late-maturity hybrid?</td>
</tr>
<tr>
<td></td>
<td><strong>Mid Season</strong></td>
</tr>
<tr>
<td></td>
<td>• Timely drydown, harvest, fall operations</td>
</tr>
<tr>
<td><strong>Late Season</strong></td>
<td>• Restricted Growing Season</td>
</tr>
<tr>
<td>(June)</td>
<td>• Use of Early-maturity hybrid? Field drydown</td>
</tr>
</tbody>
</table>
Corn Phenology vs Yield Formation

Development Stage

Yield Components

Plant Population

Ears/Plant

Kernel Rows/Ear

Kernels/Row

Potential

Harvestable

Kernel Weight

Illustration by Justin McMechan
GDD Compression with **Late planting or Replant?**

- **GDD Compression**: Decrease in hybrid GDD requirements with delayed planting

- **6.8 fewer GDDs** for every day of delay beyond May 1 (Nielsen et al., 2002)
  - Example: May 31 vs May 1 planting (30 days delay x 6.8 = 204 less GDDs needed)

- Need Michigan data on new hybrids to verify compression and yield impacts
2020 Field Research

- Planting times: 3
  - Early (May 7)
  - Mid (May 25)
  - Late (June 9)

- Hybrid maturities: 4
  - 2100-2600 GDD (1100-1300 silk GDD)
  - 85 - 103 CRM (Comparative Relative Maturity)
Silking and Black Layer

- No GDD compression observed for silking time
- Late-maturity hybrids showed GDD compression
Trend towards Increase in Yield by using late-maturity hybrid in early planting

Greater Moisture by using late-maturity hybrid in late planting
Kernel Moisture Drydown

**In-Field Estimation**

- **Grain moisture (%)** vs **Days after black layer (R6)**
  - First 20 days: 0.69% per day
  - Next 20 days: 0.44% per day
  
  
  \[ r^2 = 0.83 \]

- **Oven method (% moisture)** vs **Scio data (% moisture)**
  - \[ y = 0.8447x + 5.1855 \]
  - \[ R^2 = 0.988 \]

Source: ISU
Kernel Moisture Drydown

Grain Drydown Forecast Tool Example

Daily drydown rate vs. normal

Daily Moisture Forecast

Source: Jeff Andresen, MSU
Useful 2 Usable Tool (U2U) 

https://mrcc.illinois.edu/U2U/gdd/ 

Does NOT account for GDD compression. 

Goal: Update tool with new data. Develop NEW tool for estimating maturity dates, and dry down rates
Summary

- Use **multi-environment data** in making hybrid selection decisions
- For **mid-season planting**, mid- and early- maturity hybrids have competitive yield, and low moisture
- Benefits of early-season planting can be expanded upon with the use of late-maturity hybrid
- Select early-maturity hybrid to minimize yield loss/ moisture issues in delayed/replant situations
- **Portfolio approach** in maturity selection, accounting for planting time (early vs late), GDD compression, and drying capacity
  - Plant late-maturity hybrids first (~50% of acres)
  - Plant mid- and early-maturity hybrids in sequence to “stack” pollination
  - Plant ~20-30% acres to each of mid- and early-maturity hybrids
Thanks!

- Bill Widdicombe
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- Kalvin Canfield
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- Maddi Yaek
- Garrett Zuver
- Mike Particka
- Paul Horny
- Charles Scovill (Syngenta)
- Undergrad students
- Farmer cooperators
- Dr. Laura Lindsey (OSU)
- Dr. Chris Difonzo
- Dr. Dechun Wang
- Dr. Marty Chilvers
- Dr. Erin Burns
- Dr. Christy Sprague
- Dr. I. Ciampitti (KSU)
- Dr. Shawn Conley (UW)
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