Development of a Two-Row Barley Variety For California Craft Malting and Brewing

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Isabel A. del Blanco, Lynn Gallagher, Jorge Dubcovsky
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Acknowledgements

• UC Davis Barley Breeding Program
  – Lynn Gallagher, Breeder
  – Isabel A. del Blanco, Breeder
  – Jorge Dubcovsky, Faculty Leader

• UC Davis Plant Pathology Department
  – Bryce Falk
  – Evan Pellerin

Support
• AMBA
• CCIA
• USDA Triticeae CAP
• AgTech Seed Fund
Outline

• Barley Breeding at UC Davis

• Breeding for Malting Quality

• Genetic Mapping for Virus Tolerance

• Yield and Quality Evaluations

• Ongoing work
UC Davis Barley Breeding Program

• Fall Sown Spring

• Breeding objectives
  – Primarily 6-row animal feed
  – Hulless ‘naked’ human food
  – Recently two-row malting

• Variety Releases
  – Ishi, 2005, 6-row feed
  – Tamalpais, 2007, 6-row, hulless, high beta-glucan
Challenges for barley in California
Breeding Pipeline

- Iterative Process
- Cross between parents with different qualities
- Select among progeny
- Produce superior pure line

Parent 1 \( \times \) Parent 2

- Year 1: F1 hybrid, self pollinate
- Year 2: 1000's of plants
- Year 3-5: 100's of small plots
- Year 6: 10's of small plots
  - Preliminary Quality
- Year 7-9: Select fewReplicated Yield Trials
- Year 10-12: Variety Release
Breeding for Malting Quality

• Historically one of the largest regions for malting

• Resurgence of brewing in the state
  – Over 500 breweries
  – Using more than 150,000 tons of malt

• All grown and processed out of state
  – Demand for malting quality barley for craft malting

• Breeding efforts began in early 2000’s
Butta12

- First elite malting line
  - Multiple disease resistant
  - Good malting Quality

- More work to be done
  - Virus Susceptible
  - Lodging problems

- Virus problems are stochastic
  - Difficult to breed for resistance

- Crossed to Madre Selva
  - Virus tolerant two-row barley
Genetic mapping of CYDV resistance

• Goal – to identify loci for tolerance to CYDV
  – Most harmful of the viruses

• Identify genetic markers linked to the tolerance
  – Accelerate breeding and ensure tolerance is present

• Find the lines that contain all of the resistance and have the best agronomics and malting quality

• Must do in greenhouse conditions
  – Inoculate seedlings with virus infected aphids
  – Evaluate repeatedly
Virus Infection of Barley
Map of CYDV Tolerance Loci
Effect of Tolerance Loci on CYDV Tolerance

- Explains 37-42% of the variation in infection

![Graph showing disease scores](image)
Preliminary Field Evaluation of Resistant lines

• Evaluate in 1 m rows

• Lines UC1409, UC1410
  – All four tolerance loci
  – Good agronomic properties
  – Acceptable malting quality
Large Scale Yield and Quality Evaluation

• With support of the AgTech Seed Fund

• Plot scale trials in 6 locations in California

• Large grain increase in Davis for further malting evaluations

• Production of pure seed for variety release
Site Locations

SNB, Chico
Site Specific Challenges
## Select Yield Results, 2015

### Yield Davis

<table>
<thead>
<tr>
<th>Variety</th>
<th>Yield (lb/acre)</th>
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<tbody>
<tr>
<td>Ishi</td>
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<tr>
<td>UC1409</td>
<td>5500</td>
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<tr>
<td>Butta12</td>
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<tr>
<td>UC1410</td>
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<td>Full Pint</td>
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### Yield SNB

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Select Malt Quality Results, SNB, 2015

Barley Protein (%)

Malt Extract (%)

Beta-glucan (ppm)

Overall Quality
Variety Release

• Decided to release UC1409
  – Highest and most stable yield
  – Best agronomics – Disease and lodging resistant
  – Best malting profile

• Planted breeder seed, Nov 2015

• Foundation seed available, Aug 2016
Additional Field Scale Trials

• Craft Malting start-up

• Collaboration for larger scale production

• Develop variety specific malting recipes

• 3 locations, 100 acres
  – Irrigated and Rain-fed
Grain Increase, Summer 2015
Planting November 2015
Growing 2015-2016
Fertilizer Management

• Optimize inputs

• Maintain yield and Quality

• Mark Lundy
  – Small grains extension specialist
Summary

• Cultivar release of UC1409
  – First California adapted malting barley

• Ongoing work
  – Optimize inputs for yield and quality
  – Develop malt products with craft malt houses

• Continued breeding
  – Further improve quality and yield
Thank you
Questions??

Joshua Hegarty – JM Hegarty@ucdavis.edu
## Quality SNB

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<th>UC#</th>
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<th>Rep</th>
<th>Weight (mg)</th>
<th>6/64&quot; (%)</th>
<th>Color (Agtron)</th>
<th>Extract (%)</th>
<th>Wort Clarity (%)</th>
<th>Protein (%)</th>
<th>Wort Protein (%)</th>
<th>S/T (%)</th>
<th>DP (°ASBC)</th>
<th>Alpha-glucan (ppm)</th>
<th>Beta-glucan (ppm)</th>
<th>FAN (ppm)</th>
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