Enhancing milling quality through variety development

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Outline

• Variety development
• Challenges in oat breeding
• Oats for milling
• Breeding a good milling oat
• Summary
Variety development
Steps to producing a new variety

Early generation
- Selection pressure
- Un-replicated breeding nurseries

Late generation
- Variety production
- Replicated yield trials
- National trials

Variety production
- Seed multiplication
Traits of interest

• **YIELD**
  - Milling quality
    - Kernel content
    - Thousand grain weight
    - Specific weight
  - Grain composition
    - β-glucan
    - Low lignin husk
    - High oil content
    - Protein content
    - Avenanthramide content
  - Disease resistance
    - Mildew
    - Crown rust
    - Barley yellow dwarf virus
    - Oat mosaic virus
    - Fusarium
Crossing

• Choosing parents
  – Identify parents based on known characteristics and traits of interest
    • High yield varieties
    • High quality lines
    • New disease alleles
  – Worldwide program
    • Exchange of interesting lines from other breeding programs

• Formulate crossing list
  – Mix of commercial and experimental crosses
  – Match traits of interest to gain improvement in the progeny
The female parent
The cross

Male parent

The finished cross

Female parent
After ten days seeds begin to develop in the female plant. After 28 days the crosses can be harvested and seed collected to form the next generation.
Traits measured

• Agronomic traits
  – Disease
  – Flowering time
  – Height
  – Maturity
  – Yield

• Quality traits
  – Kernel content
  – Hullability
  – Thousand grain weight
  – Specific weight
  – Grain shape

• Grain composition
  – Beta glucan
  – Oil
  – Nitrogen
**Integrated selection matrix**

- Traffic light system for selecting which material progresses in the breeding program
National trials

• Once a selection has passed all our internal assessments it is entered into externally run National trials
• A new variety must be distinct, uniform and stable
• The first stage is National list trials run by BSPB
• The second stage is Recommended list trials run by AHDB
Challenges in oat breeding
Oats for milling
# Meeting the needs of the supply chain

<table>
<thead>
<tr>
<th>Farmer</th>
<th>Miller</th>
<th>Consumer</th>
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<tbody>
<tr>
<td>Yield</td>
<td>Kernel content</td>
<td>Beta glucan content</td>
</tr>
<tr>
<td>Maturity</td>
<td>Hullability</td>
<td>Oil</td>
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<td>Crown rust resistance</td>
<td>Specific weight</td>
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<tr>
<td>Mildew resistance</td>
<td>Thousand grain weight</td>
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<td>Oat mosaic virus resistance</td>
<td>Grain shape</td>
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<tr>
<td>Height</td>
<td>Screenings</td>
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</tbody>
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Grain quality for milling oats

• Specific weight
  – Measure of density/packing

• Kernel content
  – Percentage groat in relation to whole grain

• Hullability
  – The ease with which the husk is removed

• Thousand grain weight
Oat grain health benefits for consumers

- Beta glucan is a soluble fibre
- Soluble fibres are known to have a cholesterol lowering effect
- Beta glucan is concentrated in the bran layer of the oat grain
- Maintaining and increasing the beta glucan content of oat grain is a key factor in producing new milling oats
Breeding a milling oat
Early generation selection

• High throughput methods
  – Near Intra Red Spectroscopy (NIRS)
    • Kernel content
    • Groat nitrogen content
    • Groat oil content
    • Groat beta glucan content
  – Megazyme beta glucan assessment

• Marker assisted selection
Beta glucan analysis by NIRS

• Bi parental populations
  – 96 progeny grown in field as 1 m rows
Balancing multiple selection criteria
Early selection

- Only material of good quality progresses in the breeding program
- High throughput techniques are enabling this
  - NIRS to identify lines with high BG
  - Laboratory dehuller to identify lines with high kernel content
  - Marker analysis to identify lines with good disease resistance
- Late generation selection occurs during replicated yield trials
Summary

• Oat breeding is a complex process involving many stages of selection
• Breeding for one purpose involves balancing many traits, this can cause a trade off
• High throughput techniques are enabling selection to occur on smaller samples earlier in the breeding program
Thank you