Alternative oilseed crops and Brassica genetics
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Camelina near Lacrosse
Origin of Brassica Oilseeds: Triangle of U

- Brassica nigra
  - Black mustard (weed)
  - Indian (brown) mustard
  - Ethiopian mustard
  - Some high oil types

- Brassica carinata
  - BB
  - Ethiopian mustard
  - Some high oil types

- Brassica juncea
  - BBCC
  - Indian (brown) mustard
  - Condiments, high oil types

- Brassica oleracea
  - CC
  - Cole crops: cabbage etc.
  - Chinese cabbage, etc.
  - Some high oil types

- Brassica napus
  - AACC
  - Most Rapeseed & Canola

- Brassica rapa
  - AA
  - Chinese cabbage, etc.
  - Some high oil types

- Less related: Yellow mustard, Camelina
Rapeseed vs Canola

- Oils: Rapeseed has relatively high levels of erucic acid, which is not Generally Regarded As Safe (GRAS) by the FDA.
- Meal: Some rapeseed has high levels of glucosinolates (mustardiness) which can be a problem in feed.
- A true canola has to have low levels of each; markets like PCC want it for both reasons.
- Specific canola oils (high-oleic) may provide a premium (PCC, e.g. Nexera varieties)
Oilseeds 101: Herbicides in crop rotations

- *Brassica* oilseed crops are extremely sensitive to Group 2 herbicides, IMIs and SUs, many of which have long residuals.

- Some IMIs (*Beyond*) are increasing in popularity with Clearfield wheat varieties.

- Do you have to quit using Group 2 herbicides to grow *Brassicas*?
Group 2 herbicides inhibit a gene needed to make proteins:

Unfortunately, certain simple mutations in the gene make it so the herbicide can’t work

**Sequence of Acetolactate Synthase gene in Camelina**

TACCAAGCCCTAATCCTGTTCTCTCTCGATCCGTAACGTTCCTCCACGTCAGCAGAACAGGAGGCCTGTTG
CAGCTGAAGGCCTACGCTGGATCCACAGTAACAGGTATCTGTATAGCTACCTAGCTGGTAGGTACAGCTAC
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GGGAAAGCCATTATAAGCACTGGTGTCGCTCAACATCAATATGGGCTGCTCCGAGACATGCTGTTG
AACCGAGCAGTGCTATCATCAGCAGAGCCTGCTGGAGCTAGGTTTGTGACTGGGCTCCTGCTG
Sequence of Acetolactate Synthase gene in Camelina

**Best mutation causing resistance in Camelina**
Selection of IMI-SU resistant camelina mutant in the field.

- 10 M seeds/acre rate
- Seed mutagenized (EMS)
The SM4 mutant had the highest levels of resistance and broadest spectrum.

Biomass of Camelina treated with Herbicide

- Control Flucarbazone Sulfonylurea Imazethapyr

Herbicide Treatment

- Calena
- SM4
- IM1
- IM6
- IM10
- IM18

% of Control Biomass
Group 2 resistance genes vary in how they can be used

- The Clearfield designation (BASF) indicates it is highly resistant to Beyond® which can be applied to the crop or used to follow applications
- A similar gene has been developed for SUs (Cibus)
- Other versions of the gene provide less resistance and can be used to follow group 2 herbicide applications in rotation (e.g. SURT, IMI RT)
- Be careful that your variety is tolerant to the herbicide you are using in your rotation.
- All these traits are OK for non-GMO premiums
Other herbicide resistant traits are GMOs

Roundup-Ready varieties (glyphosate)

Liberty Link varieties

• Liberty (Glufosinate), post emergence herbicide
• LL varieties of soybean, corn, cotton, canola
• Isn’t used widely in the west
• Label doesn’t list many of our weeds
• Has a pretty broad spectrum of control
• Sometimes tank mixed with grass herbicides (e.g. Assure II)
• Good for rotating from glyphosate use!!!
Development of Camelina as a Northwest Oilseed Crop

**Camelina sativa**
- A small-seeded *Brassica* relative.
- More tolerant to heat & drought than most *Brassicas*.
- Oil has good properties for biodiesel and advanced biofuels.
- Meal is comparable to canola but higher in Omega 3 fatty acids.
- Meal recently approved for beef, chicken, eggs.
- Is currently a non-food crop (FDA) but some oil is being sold for cooking.
Current markets for Camelina are limited

- Biodiesel (e.g. Steve Camp)
- Seed (e.g. Linnaeus)
- Specialty food oil (Ole World Oils)
- Odessa Plant- Clean Energy Holdings?
Research efforts for market expansion: local and national

Non-food crop, very easily genetically engineered

- Low emission, high-octane Jet-A
- Replacements for higher value oils
- Feed stocks for resins, plastics, etc.
- Added value to meal

Potentially high value, high acreage rotation crop for intermediate/low rainfall.

Specialty food use: e.g. Ole World Oils

Low erucic acid for FDA approval

Farmer’s market to Costco shelf
Pros and Cons:
Cold hardy, small seed

Small winter canola one day after first (20°C) frost

Small camelina after same frost

Camelina, canola, wheat

Seed size variation
Later stages of growth
Camelina agronomic practices

- Planting – **early spring** or late fall/winter dormant
- 4-8 lb/acre of seed
- Shallow drilling or broadcast seeding + packing works
- Seed into weed free fields, use Poast® for grass weeds
- Avoid fields with carryover herbicides – IMI’s, SU’s,
- 25-100 lb/a N fertilizer, 75-150 lb N total
- Direct cut as soon a color is brown
- Few insect pests – flea beetles, aphid, weevil
Camelina yields from 2008 to 2011 at PNW research sites

<table>
<thead>
<tr>
<th>Location</th>
<th>Annual precipitation (in)</th>
<th>Number of trials or years</th>
<th>Yield Range (lbs/acre)</th>
<th>Average yield (lbs/acre)</th>
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<tbody>
<tr>
<td>Lind, WA</td>
<td>9.5</td>
<td>5</td>
<td>115-1030</td>
<td>600</td>
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<tr>
<td>Ralston, WA</td>
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<td>760-1580</td>
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<td>Lacrosse, WA</td>
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<td>1540-2000</td>
<td>1800</td>
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<tr>
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<td>1549-1756</td>
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<td>2300</td>
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<td>4</td>
<td>700-2200</td>
<td>1700</td>
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Camelina trial at Ralston
Breeding efforts at WSU

- Herbicide residual tolerance: WSUHT 554
- Food grade oil (low erucic)
- Larger seed size, faster early growth
- High yield and oil content
Questions or Comments?