Oil Content and Quality Analysis in Washington Field Oilseed Samples

Cross-Cutting Project 4

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Objective: The purpose of this project is to provide oilseed quality analysis as a service in support of the field research component of this project. We are providing data on parameters such as oil yield from a seed crusher, total oil content, and fatty acid composition. Fatty acid composition is the key determinant of oil quality for biodiesel. This work will allow our research team to assess the suitability, locations and crop varieties, across growing seasons for oil content and quality.

Summary: In 2008 and 2009, 400 and 700 field samples, respectively, were processed. Canola and camelina varieties had a wide range of crop yields and oil yields on a per-acre basis. In both canola and camelina, years with higher crop yields were correlated with higher NMR oil content and seed crusher oil yield. Oil content and fatty acid composition varied less among varieties. Canola has much higher content than camelina of fatty acids that are ideal for biodiesel.

Background: In addition to traditional field measures of oilseed yield, it is important to consider both the oil content and oil quality. Oil content in combination with seed yield determines the oil yield per acre. Oil quality determines the value as biodiesel. The most valuable fatty acids are oleic and linoleic acids, 18:1 and 18:2. Fully saturated fatty acids like stearic 18:0 are undesirable because they reduce the cold flow; highly unsaturated fatty acids such as linolenic acid 18:3 are undesirable because they increase nitrous oxide emissions and are also unstable.

Below: Oil and Seedmeal, products of oilseed crusher:

Spring Camelina Variety Trials 2008-2009

'Calena' and 'Celine' had highest crop and oil yields each year. Oil contents and seed crusher oil yields were generally similar among varieties. Both crop yields and NMR oil content were higher in 2009 than 2008. (Varieties listed in order of oil yield.)

Camelina Variety Trial, Dusty, Spring, 2008 (Hulbert)

Camelina Variety	NMR oil content (%)	crusher oil yield (%)	crop yield (lbs/A)	oil yield (lbs/A)
Calena	32.1	27.6	2016	646
Celine	31.4	27.2	1764	553
Ligena	31.1	26.7	1741	542
Blain Creek	31.2	26.5	1695	529
Columbia	31.1	26.7	1550	482

Camelina Variety Trial, Pullman, Spring 2009 (Guy)

Camelina Variety	NMR oil content (%)	crusher oil yield (%)	crop yield (lbs/A)	oil yield (lbs/A)
Celine	34.3	31.2	3379	1160
Calena	34.2	31.0	3089	1057
Columbia	34.3	31.5	3056	1049
Ligena	34.2	31.3	3023	1033
Blaine Creek	33.6	29.8	2805	943

Irrigated Canola Variety Trial 2008-2009

'Camus' and '13-86' had highest oil crop and oil yields in 2008, and the lowest in 2009. Both crop yields and NMR oil content were higher in 2008 than 2009. NMR oil content was well correlated with seed crusher oil yields among varieties. (Varieties listed in order of oil yield. Research by Stevens, Davenport, Peters, and Okwany.)

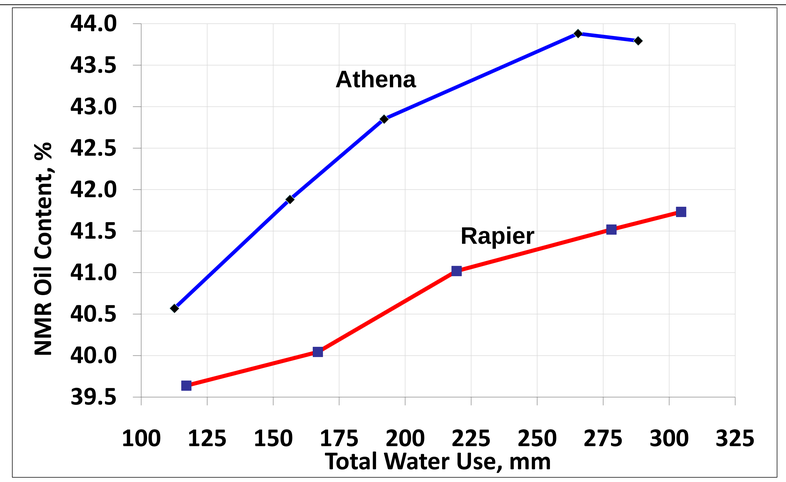
Canola Irrigated Variety Trial, Prosser, 2008

Canola Cultivar	NMR oil content (%)	crusher oil yield (%)	crop yield (lbs/A)	oil yield (lbs/A)
Camus	42.2	39.5	2483	1047
13-86	40.9	38.0	2455	1004
Baldur	40.9	38.1	2319	949
Athena	41.0	38.2	2175	892
Rapier	40.1	37.3	2025	812
Salute	36.7	32.7	1078	395

Canola Irrigated Variety Trial, Prosser, 2009

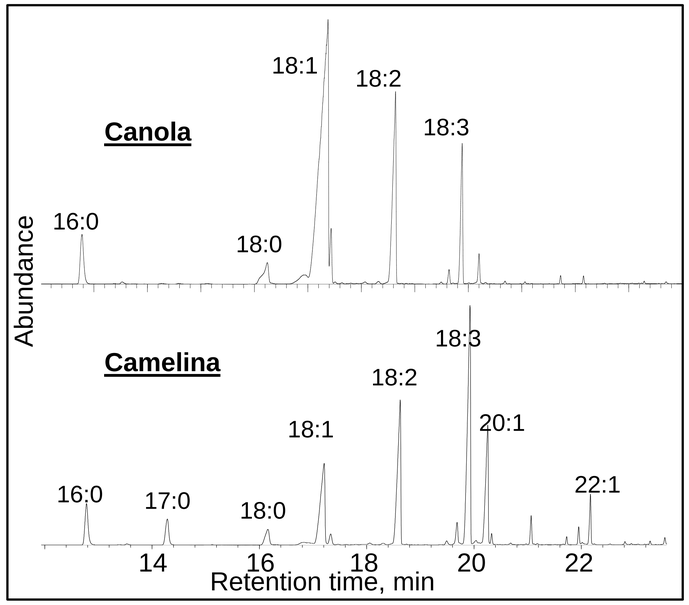
Canola Cultivar	NMR oil content (%)	crusher oil yield (%)	crop yield (lbs/A)	oil yield (lbs/A)
Athena	39.0	35.4	1408	549
Baldur	37.9	34.0	1445	548
Navajo	38.1	34.4	1179	449
Rapier	37.4	33.0	1094	409
Camus	39.1	35.5	812	317
13-86	38.0	35.2	634	241

Effect of Irrigation on Seed Oil Content (Prosser, 2008): Oil content of two canola varieties steadily increased as irrigation level increased. The variety 'Athena' had consistently higher oil content than 'Rapier'.



Fatty Acid GC Profiles for Canola and Camelina

Oleic acid 18:1 is the most abundant fatty acid in canola, whereas the less desirable linolenic acid 18:3 is the most abundant in camelina. Other fatty acids shown are 16:0=palmitic, 17:0=internal standard, 18:0=stearic, 18:2=linoleic, 20:1=eicosenoic, and 22:1=erucic acid.



Key Fatty Acids in Canola and Camelina Varieties

The sum of oleic and linoleic acid contents is key to biodiesel quality. The tables below indicate that canola varieties uniformly contain about 80% of these two fatty acids, while camelina contains far less, 34 to 38%. Thirteen other camelina varieties showed similar results (data not shown). The camelina varieties all contained a great diversity of fatty acids as seen in the GC profile, above. The differences between canola and camelina suggest that biodiesel quality would be much higher with canola, with camelina likely to have higher nitrous oxide emissions due to high linolenic acid 18:3 levels. The differences between canola and camelina are almost certainly the result of more intensive breeding in canola, with strong selection for varieties high in 18:1 oleic acid which has superior cooking and storage quality.

Key Fatty Acids in Canola Varieties
(Varieties in order of highest sum 18:1+18:2)

Canola Variety	Oleic 18:1	Linoleic 18:2	Sum 18:1 +18:2
Camus	61%	19%	81%
13-86	63%	18%	81%
Baldur	63%	17%	81%
Athena	61%	19%	80%
Rapier	61%	19%	80%
Salute	57%	21%	78%

Key Fatty Acids in Camelina Varieties
(Varieties in order of highest sum 18:1+18:2)

Camelina Variety	Oleic 18:1	Linoleic 18:2	Sum 18:1 +18:2
Ligena	18%	21%	38%
Columbia	19%	18%	36%
Blain Creek	19%	17%	36%
Celine	17%	17%	34%
Calena	17%	17%	34%