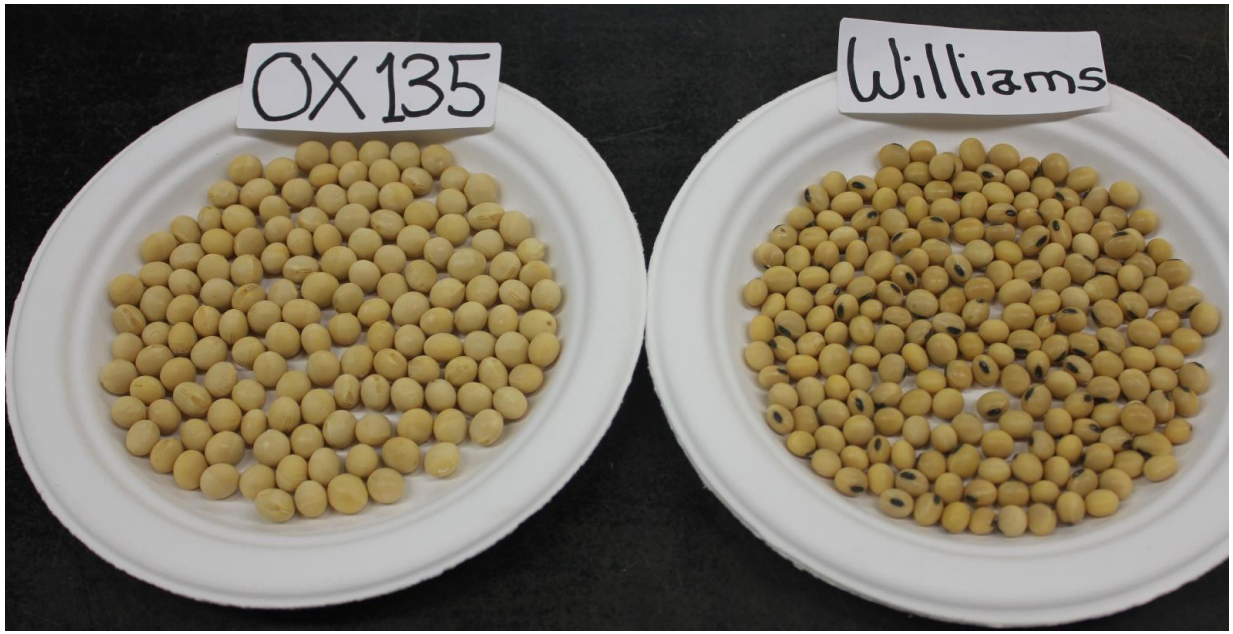
Canada's Commitment to Quality

Eric Fedosejevs, PhD

Harrow Research and Development Centre

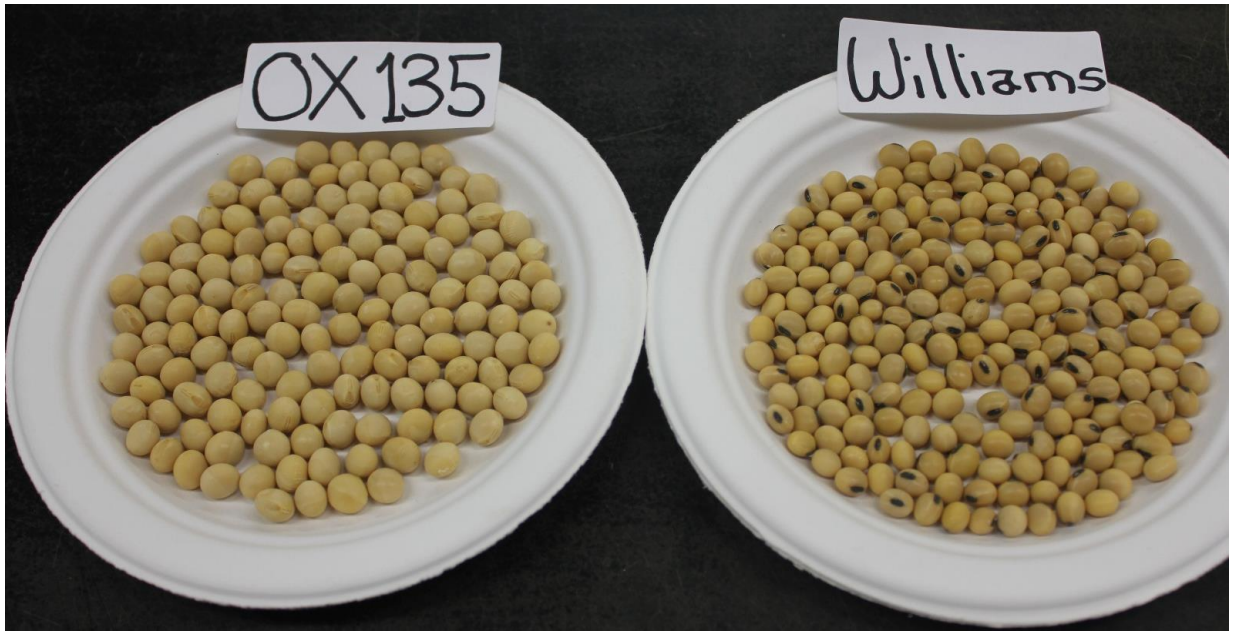
What are food-grade soybeans?



Food-grade
= Human food

Commodity
= Animal feed/crush

What are food-grade soybeans?

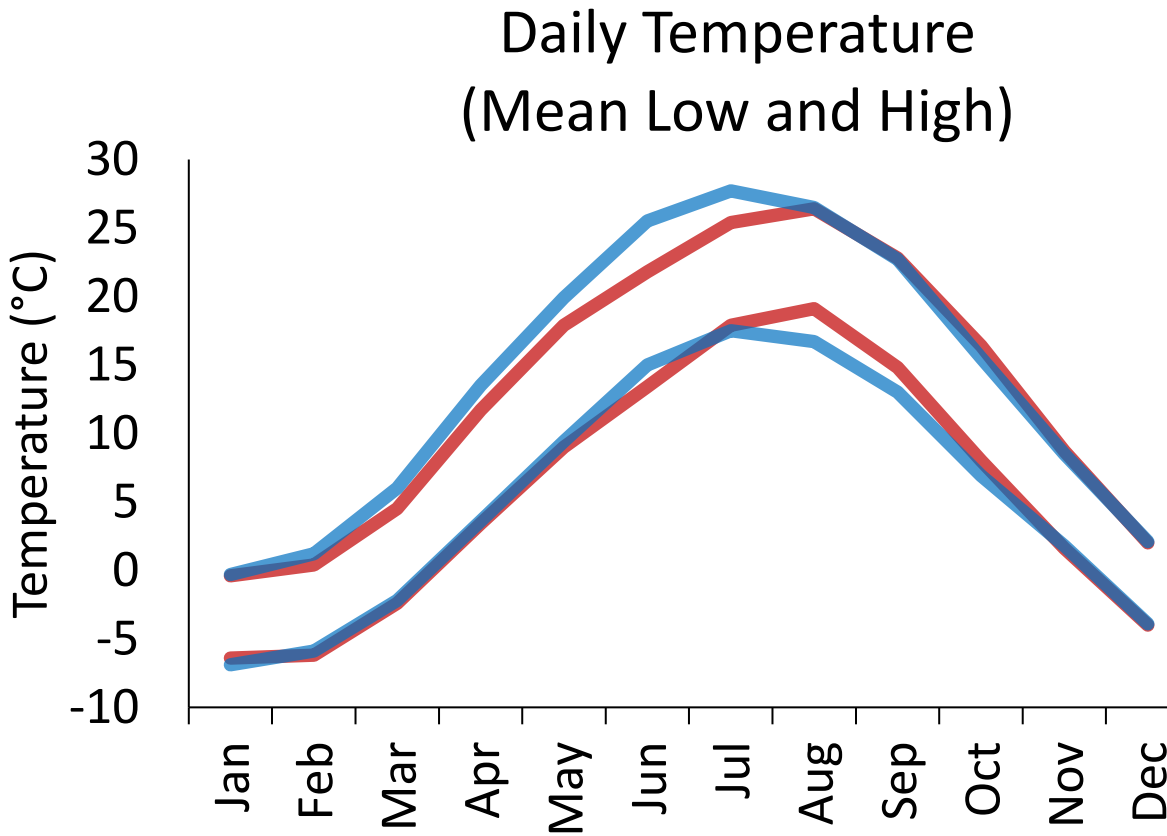


- Light hilum
- Large seeds (>200 mg)
- High protein (41-49%)
- High sugar
- Mostly non-GMO
- Mostly identity-preserved

- Dark hilum
- Small seeds (160-190 mg)
- Low protein (36-40%)
- Variable sugar
- Mostly GMO
- Mostly commodity

Canada's food-grade soybean reputation

- Ideal climate for high protein and quality



Sapporo, Hokkaido, Japan
Chatham, Ontario, Canada

Canada's food-grade soybean reputation

- Canadian Identity Preserved Recognition System (CIPRS)
- Decades of investment in research, particularly at Agriculture and Agri-Food Canada's (AAFC's) Harrow Research and Development Centre (Harrow RDC)

Canadian Identity Preserved Recognition System

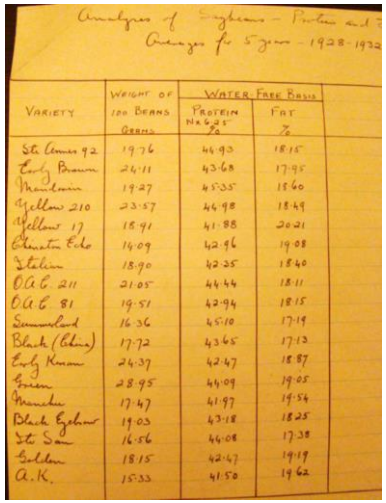
Système canadien de reconnaissance de ségrégation

Harrow RDC is at the heart of Canadian food-grade soybean production

Harrow Research and Development Centre (RDC)

Graphic: Soy Canada

History of food-grade soybean research at Harrow



Variety	Weight of 100 Beans Grams	Water Free Basis Protein N x 6.25 %	Fat %
Ste Anne 92	19.76	44.93	18.15
Early Brown	24.11	43.68	17.95
Mandarin	19.27	45.55	18.60
Yellow 210	23.57	44.98	18.49
Yellow 17	18.91	41.88	20.21
Scioto Eclo	14.09	42.96	19.08
Stelam	18.90	42.25	18.40
O.A.C. 211	21.05	44.44	18.11
O.A.C. 81	19.51	42.94	18.15
Summerland	16.36	45.10	17.19
Black (Ohio)	17.72	43.65	17.13
Early Kenan	24.37	42.47	18.87
Green	28.95	44.09	19.05
Manchu	17.47	41.97	19.54
Black Eyebrow	19.03	43.18	18.25
Ste Sam	16.56	44.08	17.38
Golden	18.15	42.47	19.19
A.K.	15.33	41.50	19.62

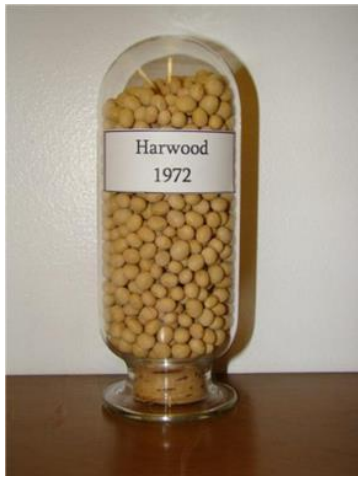
1923 – Dr. F. Dimmock launches soybean breeding program

1933 – A.K. (All Kinds) Harrow commodity bean released

1951 – Harosoy released with light hilum, yellow seed coat

1971 – First container of Special Quality White Hilum exported to Hong Kong and Japan

1972 – Harwood exported for tofu and miso use



1982 – first Export Mission to Japan

1984 – first Canadian Workshop on Export Markets, breeding for food use begins in earnest

1989 – Harovinton released as first intentional tofu variety with high protein and large seed size

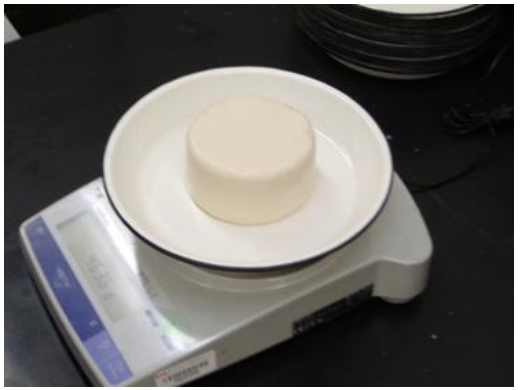
Soybean team (2018)

History of food-grade soybean research at Harrow

Harovinton Soybean
This soybean, developed by Dr. Richard Buzzell was named Seed of the Year in November 2006 at the Royal Agricultural Winter Fair in Toronto. This high protein cultivar makes high-quality tofu and is valued by Japanese tofu producers who call it "Asian Pearl" and have made it the nation's soybean industry standard.

AAFC Harrow seed quality program

- Monitoring food-grade soybean quality for over 25 years
- Dr. Eric Fedosejevs took over gradually from Dr. Lorna Woodrow in 2021



Seed quality program objectives

- Identification of soybean characteristics relevant to soy food quality
- Development of new technologies; characterization of commercial cultivars; monitoring seasonal variation
- Application of technologies in breeding programs and studies

Harrow RDC

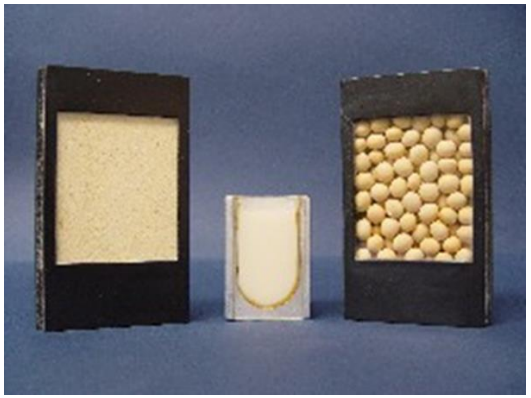
Quality monitoring pipeline

Evaluating soybean quality

1. **Seed composition** – rapid & accurate testing with NIRS
2. **Processing performance** – evaluation via manufacturing and testing of soy foods

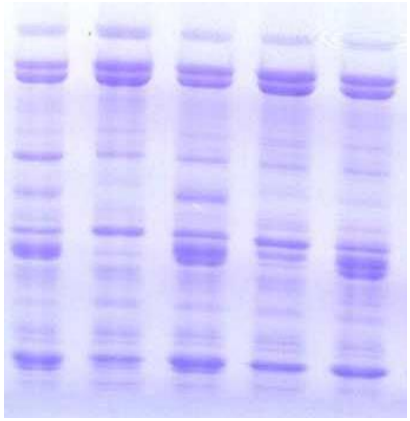
1. Measuring seed composition via NIRS

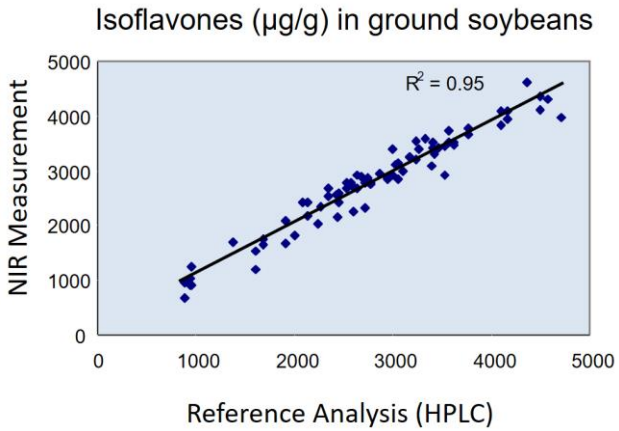
- Near Infrared Spectroscopy (**NIRS**)
- Small sample size
- Non-destructive
- Very rapid
- Many components analyzed simultaneously
- Models tailored over decades to Canadian food-grade soybean varieties and germplasm



1. Measuring seed composition via NIRS

- Models updated annually based on laboratory reference methods (HPLC, electrophoresis, and colorimetric assays)
- Separate models for whole beans, ground beans, and soymilk





NIRS models developed at Harrow

- Whole/ground seeds:
  - Protein, oil (refined from FOSS model)
  - Total free sugars, sucrose and oligosaccharides (stachyose and raffinose)
  - Total fermentable carbohydrates (miso)
  - Total isoflavones; daidzein; genistein
  - 11S:7S protein ratio
- Soymilk
  - Protein, oil, sugars, dry matter

Models under development:

- Phytate (affects tofu texture, nutrition)
- Saponins (bitter, soapy)
- Vitamin E (tocopherol)

2. Evaluating soy food processing performance

- Performance data is generated following standard operating procedures
- Benchmark varieties *e.g.* Harovinton and Kent are used for comparison
- Challenge is to replicate commercial processing methods as closely as possible in a laboratory setting

Lab-scale soymilk and tofu manufacturing

1. Soybeans are soaked for standard temperature and duration

2. Soaked soybeans are homogenized to produce a slurry

3. Slurry is separated into soymilk and okara

Lab-scale soymilk and tofu manufacturing

4. Soymilk is heated and cooled through a standard profile

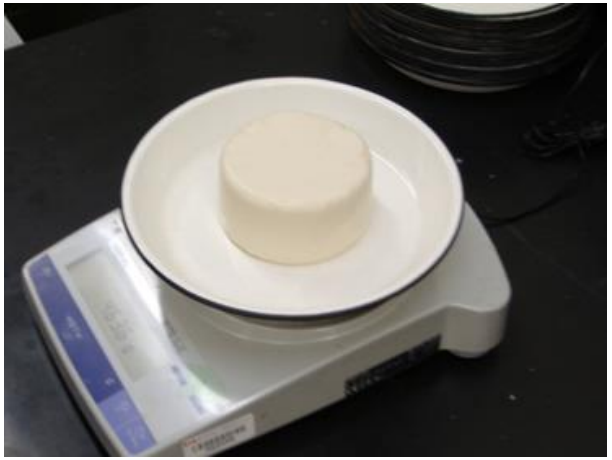
5. Coagulant is added to the soymilk to produce silken tofu

Coagulants

- $MgCl_2$ (Nigari)
- $CaSO_4$
- GDL (glucono-δ-lactone)

Lab-scale soymilk and tofu manufacturing

6. Tofu is cooled in a water bath until the internal temperature reaches 20˚C



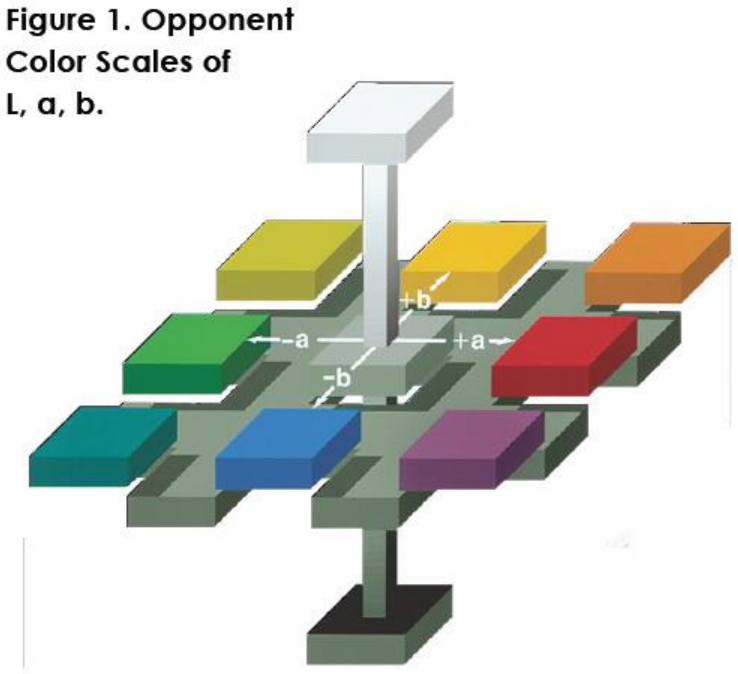
7. Tofu yield is determined prior to analysis of colour, pH, solids and texture

Assessing soymilk performance

- NIRS (protein, oil, sugars, dry matter)
- Colour (using the L, a, b system to mimic human colour perception)
- Viscosity
- pH
- Yield
- Protein and sugar recovery
- Specific gravity
- Total dissolved solids

Hunter L, a, b colour chart

Source: www.hunterlab.com



Assessing soymilk performance

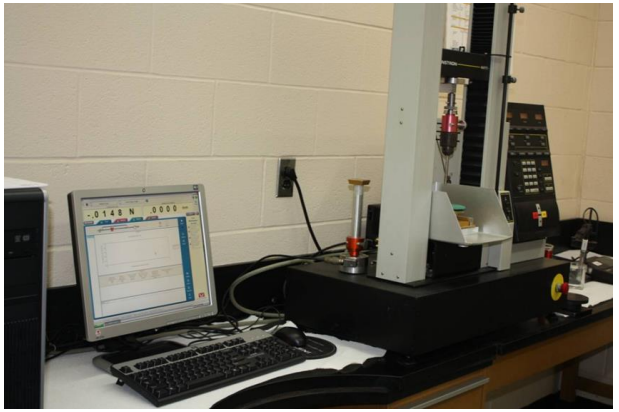
- NIRS (protein, oil, sugars, dry matter)
- Colour (using the L, a, b system to mimic human colour perception)
- Viscosity
- pH
- Yield
- Protein and sugar recovery
- Specific gravity
- Total dissolved solids

Did you know?

- The best measurement of food-grade soybean protein solubility for processors is **soymilk protein recovery**
- Reflects real processing conditions and is more reproducible than PDI or NSI

Assessing tofu performance

- Dry matter and protein yield
- Whey volume
- Tofu gel strength (hardness, firmness, and springiness)

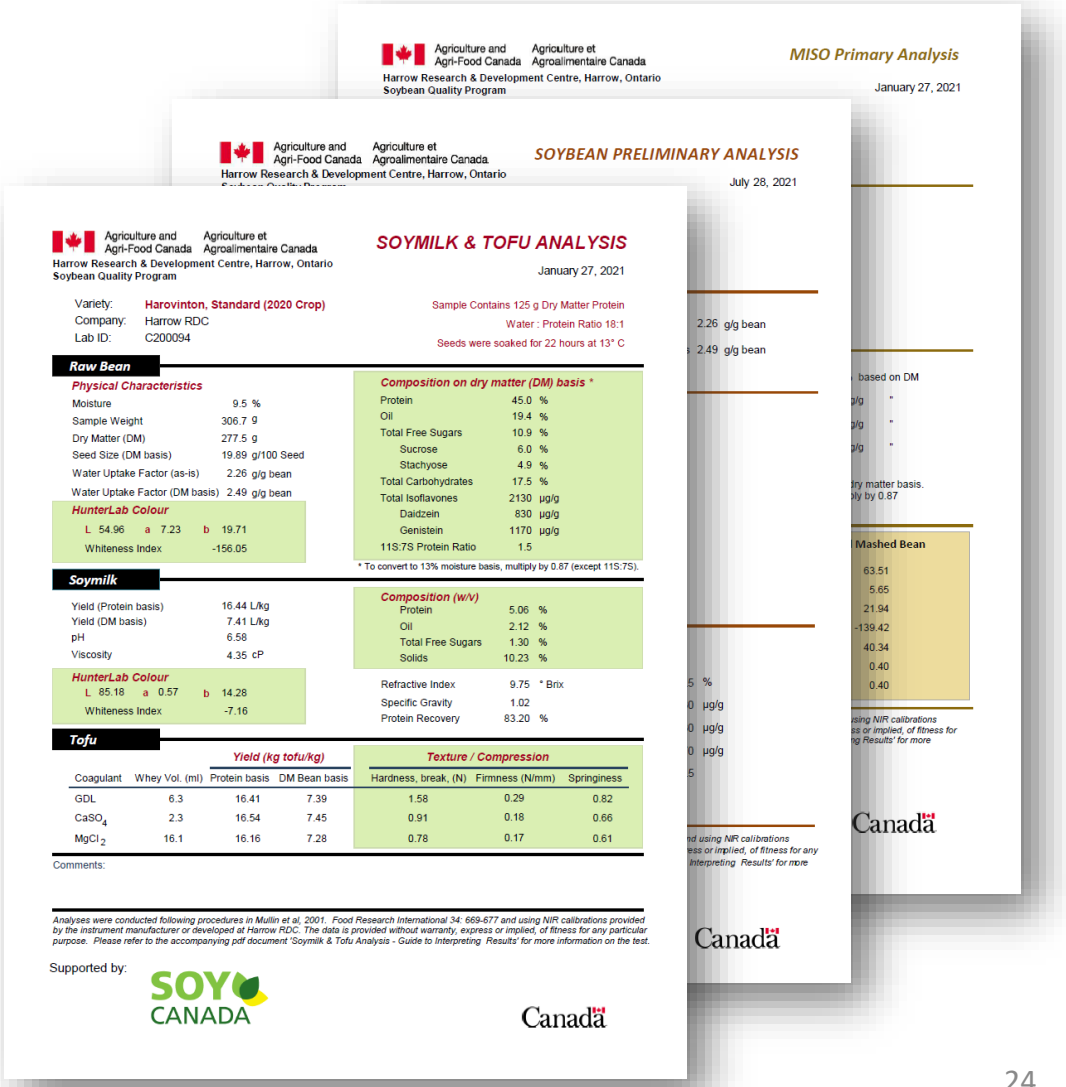


Assessing miso potential

- Raw and steamed bean water uptake factors
- Steamed mash colour

Quality testing data availability

- Testing reports provided to Soy Canada members



Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada
Harrow Research & Development Centre, Harrow, Ontario
Soybean Quality Program

MISO Primary Analysis
January 27, 2021

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada
Harrow Research & Development Centre, Harrow, Ontario

SOYBEAN PRELIMINARY ANALYSIS
July 28, 2021

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada
Harrow Research & Development Centre, Harrow, Ontario
Soybean Quality Program

SOYMILK & TOFU ANALYSIS
January 27, 2021

Variety: Harovinton, Standard (2020 Crop)
Company: Harrow RDC
Lab ID: C200094

Sample Contains 125 g Dry Matter Protein
Water : Protein Ratio 18:1
Seeds were soaked for 22 hours at 13° C

Raw Bean

Physical Characteristics

Moisture	9.5 %
Sample Weight	306.7 g
Dry Matter (DM)	277.5 g
Seed Size (DM basis)	19.89 g/100 Seed
Water Uptake Factor (as-is)	2.26 g/g bean
Water Uptake Factor (DM basis)	2.49 g/g bean

HunterLab Colour

L 54.96 a 7.23 b 19.71
Whiteness Index -156.05

Composition on dry matter (DM) basis *

Protein	45.0 %
Oil	19.4 %
Total Free Sugars	10.9 %
Sucrose	6.0 %
Stachyose	4.9 %
Total Carbohydrates	17.5 %
Total Isoflavones	2130 µg/g
Daidzein	830 µg/g
Genistein	1170 µg/g
11S:7S Protein Ratio	1.5

* To convert to 13% moisture basis, multiply by 0.87 (except 11S:7S).

Soymilk

Yield (Protein basis)	16.44 L/kg
Yield (DM basis)	7.41 L/kg
pH	6.58
Viscosity	4.35 cP

HunterLab Colour

L 85.18 a 0.57 b 14.28
Whiteness Index -7.16

Composition (w/v)

Protein	5.06 %
Oil	2.12 %
Total Free Sugars	1.30 %
Solids	10.23 %
Refractive Index	9.75 * Brix
Specific Gravity	1.02
Protein Recovery	83.20 %

Tofu

Coagulant	Whey Vol. (ml)	Yield (kg tofu/kg) Protein basis	Yield (kg tofu/kg) DM Bean basis	Texture / Compression Hardness, break, (N)	Firmness (N/mm)	Springiness
GDL	6.3	16.41	7.39	1.58	0.29	0.82
$CaSO_4$	2.3	16.54	7.45	0.91	0.18	0.66
$MgCl_2$	16.1	16.16	7.28	0.78	0.17	0.61

Comments:

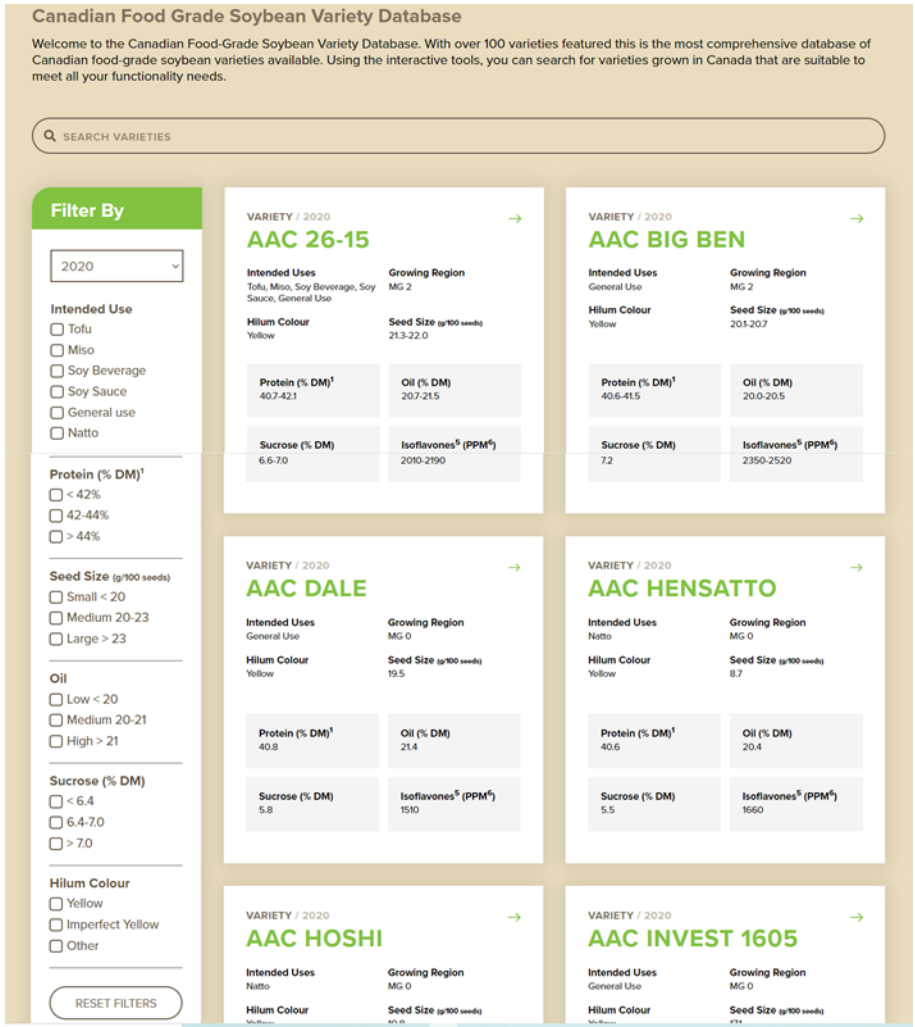
Analyses were conducted following procedures in Mullin et al, 2001. Food Research International 34: 669-677 and using NIR calibrations provided by the instrument manufacturer or developed at Harrow RDC. The data is provided without warranty, express or implied, of fitness for any particular purpose. Please refer to the accompanying pdf document 'Soymilk & Tofu Analysis - Guide to Interpreting Results' for more information on the test.

Supported by: SOY CANADA

Canada

Quality testing data availability

- Canadian Food-Grade Soybean Database: www.buycanadiansoybeans.ca
- Objective, comparative data on Canadian food-grade soybean varieties – now in 17th year
- Samples obtained from Ontario Soybean Variety Trials
- Analyses conducted at Harrow using NIR



Thank you for listening!

Please do not hesitate
to ask questions.