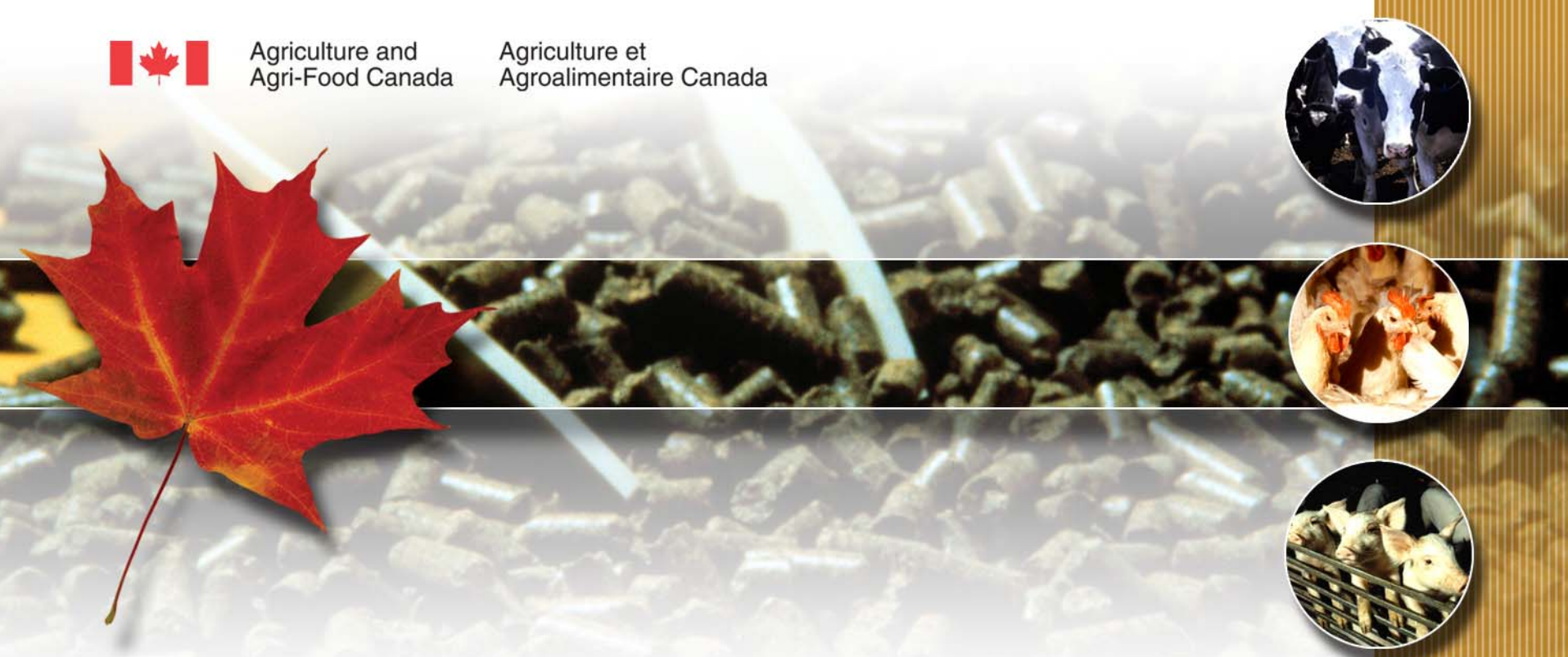


Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Breeding Triple Low Canola

J. Relf-Eckstein and G. Rakow
Agriculture and Agri-Food Canada,
Research Centre, Saskatoon, SK

Canada

“Triple Low” Canadian Canola

1. Low erucic acid oil

“less than 2% erucic acid”

2. **Low glucosinolate meal**

“the solid component of the seed must contain less than 30 micromoles of any one or any mixture of 3-butenyl glucosinolate, 4-pentenyl glucosinolate, 2-hydroxy-3 butenyl glucosinolate, and 2-hydroxy-4-pentenyl glucosinolate per gram of air-dry, oil-free solid”

3. **Ultra low fibre meal**

“the solid component of the seed must contain less than 2% acid detergent lignin content”

Brassica napus, *Brassica juncea* and *Brassica rapa* species

Rapeseed to canola

- **Late 1940's to early 1970's "single low"**
  - oil portion of seed (40 to 44%)
    - industrial use to edible oil – low erucic acid oil varieties
  - meal portion of seed (60%, 36 to 37% protein)
    - problems – palatability and anti-nutritional factors
    - low glucosinolate 'Brownowski' identified

- **Mid 1970's to 1980's "double low"**
  - low erucic acid oil, low glucosinolate meal
  - varieties *B. rapa*: 'Tower' 1974 & *B. napus* 'Candle' 1977, 'Westar', 1982
    - "canola < 2 % erucic acid oil, < 30 µmoles/g meal", GRAS status,1985

- **Mid 1980's to late 1990's**
  - herbicide tolerant (HT) canola
  - hybrid systems in *Brassica napus* canola

- **Trend in western Canadian canola production acreage**
  - 1994: 50% *B. napus* 50% *B. rapa*
  - 2000: 95% *B. napus* 5% *B. rapa*
  - 2006: 98% *B. napus* HT canola (>50% hybrids)

Canola quality mustard: diversification and expansion of *Brassica* production

Beginning 1950's

- potential of *Brassica juncea* investigated by plant breeders, AAFC Saskatoon and animal scientists, University of Saskatchewan
  - yield advantage + resistance to shattering, disease resistance
  - genetic diversity and expansion of production to brown soil zones, hot, dry

Early 1980's to 1995

- development of low erucic acid *B*. *juncea* – Australia, 1981
- development of low glucosinolate *B*. *juncea* – Saskatoon, 1985
- improvement of canola quality fatty acid profile *B*. *juncea* AAFC-SRC & Saskatchewan Wheat Pool (SWP),1995

2000 to 2005

- regulatory approvals Canada, U.S.A. GRAS status – SWP, 2001/2003
- development and commercialization under contract registration by SWP of *B*. *juncea* canola
  - (Arid and Amulet, 2002; Estlin, 2005)

Brassica juncea canola commercial cultivars

Cultivars	Yield[1]		Oil (%)	Protein (%)	T-SAT[2] (%)	T-GSL[3] (µmol/g)
	kg/ha	%				
Estlin	2650	**105.5**	**45.1**	48.6	6.7	**12.4**
Arid	2510	100.1	44.2	49.6	7.0	13.4
Q2[4]	2580	102.7	44.5	47.5	6.9	11.4
Sites	18	18	18	18	18	18

B. *juncea* canola cultivar 'Estlin' rated R for resistance to black leg disease; 0.1 µmoles per gram seed allyl isothiocyanate glucosinolate, 64% C18:1.

1 – 2003-2004 Combined Data
2 – Total saturated fats (%)
3 – Total glucosinolate content of seed (µmoles per gram seed)
4 – Black seeded *B*. *napus* check

Data courtesy: Dr. Derek Potts, Viterra

Low fibre, yellow-seeded *Brassica napus* canola

Early 1970's

- yellow-seeded forms of *Brassica* investigated by plant breeders, AAFC Saskatoon and animal scientists, University of Saskatchewan

1970's to 2001

- non pigmented seed coat sources in naturally occurring *Brassica* sp.
  - *B*. *abloglabra*, *B*. *juncea*, *B*. *carinata*, *B*. *rapa*
- introgressed into pigmented form of *B*. *napus* (1970's to 1998)
- conventional breeding methods; field production; seed quality, disease resistance and agronomic selection strategies (1980's to 2001)

2003 to current

- selection of *B*. *napus* line YN01-429 (2003)
  - true breeding, yellow-seeded (low fibre), low glucosinolate, low total saturated fat, high oil content, competitive in seed yield with open-pollinated check cultivars, moderate resistance to black leg disease
- establishing genetically diverse yellow-seeded canola gene pools for commercialization into hybrid varieties

Low fibre, yellow-seeded *Brassica napus* canola

Lines	Yield[1]		Oil (%)	Protein (%)	SW[2] (g/1000)	T-GSL[3] (µmol/g)	Fibre[4] (% meal)		
	kg/ha	%					ADL	ADF	NDF
YN01-429	2030	**109**	**49.1**	46.9	**3.30**	12.9	**1.3**	**8.2**	**14.9**
46A65/Q2[5]	1890	100	45.8	49.0	2.77	17.7	5.4	13.6	19.1
Station yrs	6	6	6	5	4	4	4	4	4

1 – Yield at AAFC Saskatoon, Scott and Melfort, 2002-2004; 6 station years

2 – 1000 seed weight (grams per 1000 seeds)

3 – Total glucosinolate content of seed (µmoles per gram seed) by g.c.

4 – Insoluble fibre by Ankom 200 Fibre Analyzer: ADL is acid detergent lignin; ADF is acid detergent fibre (cellulose + lignin); NDF is neutral detergent fibre (hemicellulose + cellulose + lignin + pectin)

5 – Black seeded checks

Brassica juncea canola meal

Meal	Crude Protein (%)	ADF[1] (%)	NDF[1] (%)	Crude Fibre (%)	Crude Fat (%)
B. juncea	42.4	**11.4**	**18.8**	7.7	1.4
B. napus (black)	39.0	17.0	27.8	11.4	2.5

1 – ADF is acid detergent fibre; NDF is neutral detergent fibre

Data courtesy: Dr. Derek Potts, Viterra & Dave Hickling, CCC
R.T. Zijlstra, D. R. Hickling and J. F. Patience, 2003

Value of yellow-seeded *Brassica*

1974 (G.D. Stringam, D.I. McGregor & S.H. Pawlowski)

- yellow-seeded *B. rapa* had thinner hulls, lower fibre higher oil, than brown-seeded forms *B. rapa*

1982 (J.M. Bell & A.Shires)

- hulls from yellow-seeded *B*. *rapa* 'R500' less NDF and lignin than brown-seeded *B*. *napus* 'Tower'
- energy components of hulls more digestible in yellow-seeded 'R500'

1999 (B.A. Slominski, J. Simbaya, L.D. Campbell, G. Rakow & W. Guenter)

- 2-week growth trial, 4-day old broiler chickens
- significantly lower Feed to Gain ratio with yellow-seeded *B*. *napus* canola meal than black-seeded *B*. *napus*
- **~ 6 % (significant) increase True Metabolizable Energy with yellow-seeded *B*. *napus* canola meal** (as previously reported, Slominski, 1977)

2003 (R.T. Zijlstra, D.R. Hickling & J.F. Patience)

- 28-day growth trial, pigs, fed *B*. *juncea* & *B*. *napus* canola meal (15%)
- **2.5% increase Feed Efficiency (+5.8% days 22-28) *B*. *juncea***
- **42 g/d (4.7%) increase Av. Daily Gain (+16.8% days 22-28) *B*. *juncea***

The future of low fibre, yellow-seeded *Brassica*

Increasing the value chain of Canadian canola

- **Superior value canola meal with increased energy content** (6% +)
  - ultra low fibre (< 2% ADL, < 10% ADF)
  - ultra low glucosinolate meal (< 2 μ moles/g)
  - reduction in anti-nutritional factors (phytate, sinapine)

- **Increased total oil content** (50 - 52 %)
  - superior technological and nutritional quality
    - high stability oils (high oleic and low linolenic)
    - low total saturated fat (< 5%)
  - opportunities for biofuel

- **Multiple species of *Brassica* canola**
  - genetic diversity for sustainable gene pool development & production
  - expanded production area & choice of species to minimize risk

- **Increased value at farm gate, feed industry, crushers, end users**
  - high yielding, disease resistant canola
  - increased seed size and seedling vigour
  - preferred crop production systems of HT hybrids

Global perspective of yellow-seeded *Brassica*

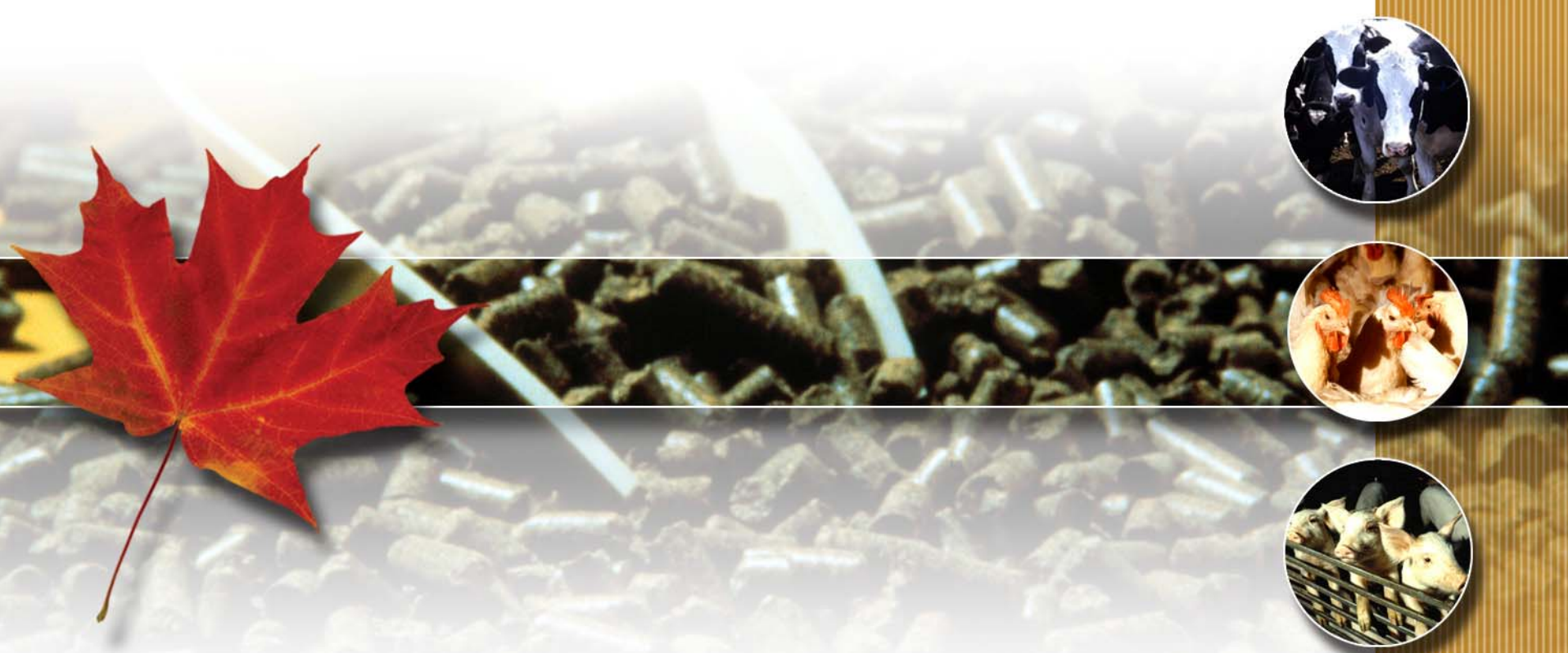
- China
- European Union
- Siberia
- Australia

We have a choice to mobilize our Canadian canola industry (as defined by animal and human nutrition researchers, Canadian Grain Commission, chemists, Council, crushers, end-use customers, federal regulators, plant breeders, producers, provincial gov't, private companies, universities, etc.)

"Made in Canada"

- **it is time to recognize and acknowledge our achievements**
- **it is time to be aggressive and position Canada in a competitive, global oilseeds market with the superior quality and potential of "triple low" rapeseed/canola**
- **what do we have to lose?**

Acknowdgements for the vision of low fibre, yellow-seeded *Brassica* for Canada



Canada