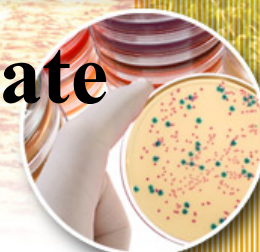




Agriculture and
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Condiment Mustard Breeding: Update

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Canada

Outline of the presentation

- **Results of brown and oriental mustard Co-op Mustard Test**
- **Performance of brown mustard test hybrids in the yield trial**
- **Oriental mustard yield trial**
- **Yellow mustard yield trial**



Summary of the yield of the brown mustard line B1630DH182 in the Co-op Mustard Test

	Centennial Brown (check) (kg/ha)	B1630DH182 (kg/ ha)	CV (%)	LSD (5%)
AAFC-Farm date1	2093	2568*	6.8	231
AAFC-Farm date 2	2212	3236*	12.7	467
Vanscoy	1020	1512*	15.3	293
Swift Current	1343	1541	15.2	326
Redver	1967	2273	9.5	313
Codale (Hytech)	1806	2386*	9.6	309
Medicine Hat	2606	2582	10.6	410
Taber	2556	2851	11.5	452
Melita, Manitoba	3120	3444	7.6	357

Agronomic performance of the brown mustard (*Brassica juncea*) line B1630DH182 in the Co-op Mustard Test

	Yield		Seed Weight	Seed Color	Height	Maturity
	kg/ha	% check	g 1000 ⁻¹ seed	WI E313	cm	days
Centennial Brown (check)	2085		3.00	-2.73	133	89
B1630DH182	2486†	119	3.72‡	-4.42‡	146‡	91‡
S.E.	69		0.04	0.48	2.2	0.6
L.S.D. (5%)	136		0.08	0.95	4.4	1.2
# station years	9		9	9	9	8

† Significant at $P=0.05$; ‡ Significant at $P=0.01$



Quality traits of the brown mustard (*Brassica juncea*) line B1630DH182 in the Co-op Mustard Test

	Fixed Oil	Protein	Glucosinolate		Chloro
			Allyl	Butyl	
	% whole seed		$\mu\text{mole / g seed}$		mg kg ⁻¹ seed
Centennial Brown (check)	34.3	30.4	105	0.59	
B1630DH182	35.0†‡	30.1	126‡	0.48	
S.E.	0.25	0.20	2.34	0.02	
L.S.D. (5%)	0.49	0.39	4.60	0.04	
# station years	9	9	6	6	

† Significant at $P=0.05$; ‡ Significant at $P=0.01$



Summary of disease reactions for the brown mustard (*Brassica juncea*) line B1630DH182

Entry	Year	Blackleg severity (0–5)	White rust severity (0–9)	
			Race 2a	Race 2v
Amigo (check)	2016	0.4	R	S
Centennial Brown	2016	0.7	S	S
B1630DH182	2016	0.6	R	R

R: resistant; S: susceptible



Summary of the yield of the oriental mustard line O123DH25 in the Co-op Mustard Test

	Cutlass (check) (kg/ha)	O123DH25 (kg/ha)	CV (%)	LSD (5%)
AAFC-Farm date1	2380	2683*	6.8	231
AAFC-Farm date 2	2047	2564*	12.7	467
Vanscoy	1345	1380	15.3	293
Swift Current	1397	1535	15.2	326
Redver	2306	2509	9.5	313
Codale (Hytech)	2370	2730*	9.6	309
Medicine Hat	2729	3042	10.6	410
Taber	3039	2869	11.5	452
Melita, Manitoba	3382	3178	7.6	357
Station years	9	9		

Agronomic performance of the oriental mustard (*Brassica juncea*) line O123DH25 in the Co-op Mustard Test

	Yield		Seed Weight	Seed Color	Height	Maturity
	kg/ha	% check	g 1000 ⁻¹ seed	WI E313	cm	days
Cutlass (check)	2330		2.81	-30.5	134	90
O123DH25	2490[†]	107	2.89[†]	-34.2[‡]	137	91
S.E.	69		0.04	0.5	2.2	0.6
L.S.D. (5%)	136		0.08	1.0	4.3	1.1
# station years	9		9	9	9	8

[†] Significant at $P=0.05$; [‡] Significant at $P=0.01$



Quality profile of the oriental mustard (*Brassica juncea*) line O123DH25 in the Co-op Mustard Test (2016)

	Fixed Oil	Protein	Glucosinolate		Chlorophyll
			Allyl	Butyl	
	% whole seed		μmole / g seed		mg kg ⁻¹ seed
Cutlass (check)	39.7	28.9	120	0.46	
O123DH25	39.2†	29.1	120	0.59	
S.E.	0.3	0.2	2.33	0.02	
L.S.D. (5%)	0.5	0.4	4.60	0.04	
# station years	9	9	6	6	

† Significant at $P=0.05$; ‡ Significant at $P=0.01$



Summary of disease reactions for the oriental mustard (*Brassica juncea*) line O123DH25

Entry	Year	Blackleg severity (0–5)	White rust severity (0–9)	
			Race 2a	Race 2v
Cutlass (check)	2016	0.55	R	8.1
O123DH25	2016	0.64	R	8.5

R: resistant; S: susceptible



- **Development of hybrid varieties in brown and oriental mustard (*B. juncea*) using the Ogura cytoplasmic male sterile (cms) hybrid system**



Ogura cytoplasmic male sterile (cms) hybrid system

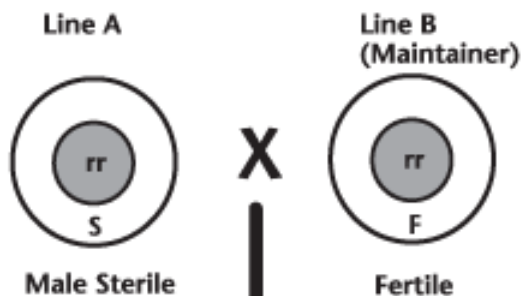
Three parental lines

1. A line: female line and male sterile (no pollens in the anther of the flower)
2. B line: Maintainer line and male fertile (with pollens in the anther of the flower)
3. R line: Restorer line and male fertile (with pollens in the anther of the flower)

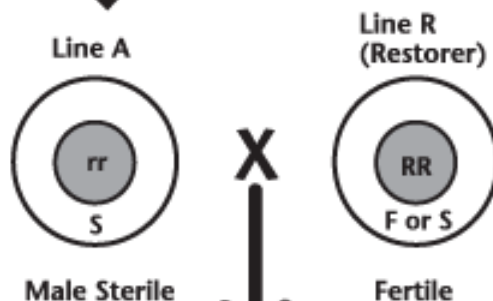


Ogura cms hybrid seed production in canola

Step 1: Foundation seed crossing block to produce more Line A seed



Step 2: Hybrid seed crossing block to produce actual hybrid seed for commercial crops



Step 3: Commercial canola production

S = sterile cytoplasm
F = fertile cytoplasm
rr = homozygous for maintainer gene
RR = homozygous for dominant restorer gene
Rr = heterozygous for restorer gene

(Self-pollinates to produce seed)



Advantages of hybrid varieties:

- 1. Strong growth vigor, higher yielding potential,**
- 2. Genetic uniformity**
- 3. Reduce GMO contamination**



➤ **Performance of brown mustard test hybrids
in the yield trial in 2016**



Summary of the yield of the three test hybrids B2952, B3164 and B3318 in the yield trials at 5 locations

	Saskatoon	Scott	Swift Current	Redver	Medicine Hat
Centennial Brown (check) (kg/ha)	2126	2007	1333	1958	1855
B2952(kg/ha)	2384*	2447*	1476	2795*	2089
B3164(kg/ha)	2334*	2835*	1501	2513*	1993
B3318(kg/ha)	2446*	2745*	1555*	2658*	1834
CV (%)	7.5	11.4	11.3	12.0	10.1
LSD	242	388	217	407	293



Agronomic performance of the brown mustard (*B. juncea*) test hybrids B2952, B3164 and B3318 in the yield trials

	Yield		Seed Weight	Seed Color	Height	Maturity
	kg/ha	% check	g 1000 ⁻¹ seed	WI E313	cm	days
Centennial Brown (check)	1841	100.0		-2.08	133	89
B2952	2201[‡]	119.5		-2.08	141[‡]	92[‡]
B3164	2198[‡]	119.4		-3.71[‡]	141[‡]	91[‡]
B3318	2226[‡]	120.9		-2.45	133	90
L.S.D. (5%)	167			0.73	4.7	1.09
# station years	5			5	5	

† Significant at $P=0.05$; ‡ Significant at $P=0.01$



Quality profile of the brown mustard (*B. juncea*) test hybrids B2952, B3164 and B3318 in the yield trials

	Fixed Oil	Protein	Glucosinolate		Chlorophyll
	% whole seed		Allyl	Butyl	mg kg ⁻¹ seed
Centennial Brown (check)	35.7	29.6	115	0.65	
B2952	36.9‡	28.6‡	113	0.51	
B3164	37.1‡	28.9	124†	0.62	
B3318	36.6†	29.1	123†	0.54	
L.S.D. (5%)	0.83	0.70	6.3	0.22	
# station years	5	5	1	1	

† Significant at $P=0.05$; ‡ Significant at $P=0.01$



- **The test hybrids B2952, B3164 and B3318 will be advanced into Co-op Mustard Test in 2017**



➤ **Oriental mustard yield trial in 2016**



Summary of the yield of the oriental mustard line O123DH132 from the yield trials at 3 locations

	Redver	Swift Current	Medicine
Cutlass (check) (kg/ha)	1960	1390	2220
O123DH132	2280*	1390	2480
LSD	285	206	494



Agronomic performance of the oriental mustard (*B. juncea*) line O123DH132 in the yield trials

	Yield	Seed Weight	Seed Color	Height	Maturity
	kg/ha	g 1000 ⁻¹ seed	WI E313	cm	days
Cutlass (check)	1809	2.59	-27.7	136	89
O123DH132	1982	2.74	-33.0‡	144†	91
S.E.	102	0.08	1.11	3.6	1.2
L.S.D. (5%)	214	0.17	2.20	7.0	2.4
# station years	3	1	3	3	2

† Significant at $P=0.05$; ‡ Significant at $P=0.01$



Quality profile of the oriental mustard (*B. juncea*) line O123DH132 in the yield trials

	Fixed oil	Protein	Glucosinolate		Chlorophyll
			Allyl	Butyl	
	% whole seed		$\mu\text{mole / g seed}$		$\text{mg kg}^{-1} \text{ seed}$
Cutlass (check)	42.0	26.7			
O123DH132	40.5†	27.9‡			
S.E.	0.56	0.47			
L.S.D. (5%)	1.11	0.92			
# station years	3	3			

† Significant at $P=0.05$; ‡ Significant at $P=0.01$



➤ **Yellow mustard yield trials in 2016**



Summary of the yield of the yellow mustard lines Y3443, Y3446 and Y3451 from the yield trials at 3 locations

	Saskatoon	Swift Current	Medicine
Andante(check) (kg/ha)	1910	1840	2140
Y3443	2150*	1750	2100
Y3446	2110*	1840	2110
Y3451	2110*	1800	2260
LSD	179	160	277



Agronomic performance of the yellow mustard lines Y3443, Y3446 and Y3451 from the yield trials

	Yield	Seed Weight	Seed Colour	Height	Maturity
	kg/ha	g 1000 ⁻¹ seed	WI E313	cm	days
Andante (check)	1947	5.85	-31.6	123	90
Y3443	1990	5.80	-33.5[†]	123	89
Y3446	2015	5.83	-34.6[‡]	126	89
Y3451	2037	6.13	-34.0[†]	124	89
S.E.	56	0.19	0.94	3.1	0.3
L.S.D. (5%)	110	0.38	1.86	6.1	0.6
# station years	3	1	3	3	2

[†] Significant at $P=0.05$; [‡] Significant at $P=0.01$



Quality traits of the yellow mustard lines Y3443, Y3446 and Y3451 from the yield trials

	Fixed Oil	Protein	Hydroxybenzel GSL	Mucilage	Chlorophyll
	% whole seed		$\mu\text{mole g}^{-1}\text{seed}$		$\text{mg kg}^{-1}\text{ seed}$
Andante (check)	29.3	31.8	147	79	2.09
Y3443	30.0	32.1	157	64	1.90
Y3446	29.4	32.0	151	75	2.64
Y3451	29.6	32.2	147	77	1.53
S.E.	0.36	0.49	5.9	8.3	0.82
L.S.D. (5%)	0.71	0.97	11.6	16.6	1.67
# <i>station years</i>	3	3	1	1	1

† Significant at $P=0.05$; ‡ Significant at $P=0.01$



Making yellow mustard synthetic lines in Chile winter nursery

1. SG2000:

- 26 isolation tents for making yellow mustard synthetics**



SG2000: yellow mustard synthetic production



SG2000: Tent 48



Making yellow mustard synthetic lines in Chile winter nursery

2. Hytech:

- 43 isolation tents for making yellow mustard synthetics: **lost due to poor germination**
- 2 tents for making brown mustard hybrids
- 2 tents for making oriental mustard hybrids



Hytech: yellow mustard synthetic production (discontinued)



Hytech: yellow mustard synthetic production discontinued



Hytech: Brown and oriental mustard hybrid production



Hytech: Brown and oriental mustard hybrid production



2017 Field trials

- 1. Brown mustard hybrids in Co-op Mustard Test**
- 2. Brown and oriental mustard test hybrids in yield trial**
- 3. Yellow mustard synthetics in yield trial**



Yellow mustard: Breeder Seed supply

Description	Year	Variety	Total Weight (kg)
Breeder Seed Cert # 04-7000040-501	2004	AC Base	70
Breeder Seed Cert # 06-7000040-502	2006	AC Pennant	11
Breeder Seed Cert # 14-7002859-502	2014	AC Pennant	307
Breeder Seed Cert # 09-7063704-501	2009	Andante	24
Breeder Seed Cert # 10-7000040-501	2010	Andante	45
Breeder seed Cert # 15-7000030-530	2015	Andante	82
not available yet	2016	Andante	400
Breeder Seed Cert # 13-7002359-501	2014	Adagio	48
Breeder Seed Cert # 14-8057603-505	2014	Adagio	16



Brown and oriental mustard: Breeder Seed supply

Description	Year	Variety	Total Weight (kg)
Breeder Seed Cert # 05-7000040-502	2005	Centennial Brown	15
Breeder Seed Cert # 07-7056181-135	2007	Centennial Brown	25
Breeder Seed Cert # 14-7002359-501	2014	Centennial Brown	200
Breeder Seed Cert # 07-7000040-502	2007	Amigo	55
Breeder seed Cert # 15-7000030-531	2015	AAC Brown 100	226



Brown and oriental mustard: Breeder Seed supply

Description	Year	Variety	Total Weight (kg)
Breeder Seed Cert # 95-7000040-51	1995	AC Vulcan	100
Breeder Seed Cert # 04-7000040-502	2004	Cutlass	25
Breeder Seed Cert # 15-7002359-501	2015	Cutlass	850
Breeder seed Cert # 15-7000030-532	2015	AAC Oriental 200	91



Future Breeder Seed production

- **AAFC-Saskatoon Research Center will be responsible for the Breeder Seed production of conventional varieties of yellow mustard, and brown and oriental mustard.**
- **Mustard 21 will contract private companies (Hytech) for brown and oriental mustard hybrid seed production and yellow mustard synthetic seed production.**



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