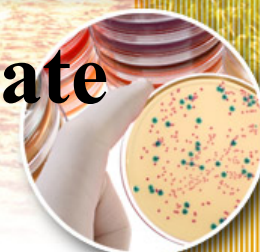




Agriculture and
Agri-Food Canada

Agriculture et
Agroalimentaire Canada



Condiment Mustard Breeding: Update

Bifang Cheng, Mustard Breeder

Agriculture and Agri-Food Canada, Saskatoon Research Centre

Canada

➤ **Brown Mustard**

- **Co-op Test**
- **AAC Brown 120 (B1630DH182)**
- **Candidate variety B3318**
- **Yield trial**



Brown mustard Co-op entries

1	Centennial Brown (check)
2	AAC Brown 120 (B1630DH182)
3	B2952
4	B3164
5	B3318



Brown and oriental Co-op Mustard Test

Trial sites	CV (%)
AAFC-Saskatoon date 1	10.9
AAFC-Saskatoon date 2	4.8
AAFC-Scott	6.5
AAFC-Swift Current	10.4
Redvers	9.7
Brooks	13.2
AAFC-Lethbridge	13.6
Medicine Hat	10.9
Melita, Manitoba	5.4

Agronomic performance of the new brown mustard variety AAC Brown 120 (B1630DH182)

	Yield		Seed Weight	Fixed Oil	Protein	Glucosinolate		Seed Color	Distinct Green	Chloro	Height	Maturity
	kg/ha	% check	g 1000 ⁻¹ seed	% whole seed		Allyl	Butyl	WI E313	%	mg kg ⁻¹ seed	cm	days
Centennial Brown (check)	1860	100	2.90	35.8	29.1	102	0.54	-3.28	0.11	5.69	130	87
AAC Brown 120	2117†‡	114	3.58†‡	36.3†‡	29.3	120†‡	0.46†‡	-5.03†‡	0.31†‡	7.48†	140†‡	90†‡
S.E.	42		0.04	0.17	0.15	1.49	0.03	0.14	0.06	0.75	1.47	0.39
L.S.D. (5%)	84		0.07	0.34	0.29	2.94	0.05	0.28	0.11	1.53	2.92	0.77
# station years	21		21	21	21	21	21	21	21	12	18	17

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

Data from the yield trial (2015) and Co-op Mustard Test (2016-2017) (21 station years)



Yield of brown mustard hybrid B3318 in the Co-op Mustard Test

	Centennial Brown (check) (kg/ha)	B3318		LSD (5%)
		(kg/ha)	% of check	
AAFC-Saskatoon date 1	1715	2349*	137	337
AAFC-Saskatoon date 2	1358	1832*	135	110
Scott	2464	2807*	114	252
Swift Current	1606	1972	123	274
Redvers	2053	2422	118	322
Brooks	1306	1837*	141	323
AAFC-Lethbridge	1242	1560*	126	269
Medicine Hat	1297	1354	104	213
Melita, Manitoba	2186	2398*	110	193

Yield of brown mustard hybrid B3318 in the yield trial

	Centennial Brown (check) (kg/ha)	B3318		CV (%)	LSD (5%)
		(kg/ha)	% of check		
AAFC- Saskatoon	1822	2408*	132	9.6	330
Redvers	2016	2776*	138	14.7	556
AAFC-Swift- Current	1083	1351	125	10.1	195



Agronomic performance of the brown mustard (*Brassica juncea*) hybrid B3318 in the Co-op Mustard Test (9 locations) and yield trial (8 locations)

	Yield		Seed Weight	Seed Color	Height	Maturity
	kg/ha	% check	g 1000 ⁻¹ seed	WI E313	cm	days
Centennial Brown (check)	1754		3.03	-3.05	134	88
B3318	2176[‡]	124	2.93[‡]	-3.97[‡]	138[†]	89[†]
F value	90		22	49	4.52	5.91
L.S.D. (5%)	89		0.05	0.26	3.15	0.76
L.S.D. (1%)	118		0.06	0.35	4.19	1.01
# station years	17		17	17	15	13

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



Quality traits of the brown mustard (*Brassica juncea*) hybrid B3318 in the Co-op Mustard Test and yield trial

	Fixed Oil	Protein	Glucosinolate		Chloro
			Allyl	Butyl	
	% whole seed		$\mu\text{mole / g seed}$		$\text{mg kg}^{-1} \text{ seed}$
Centennial Brown (check)	35.6	29.2	109	0.59	4.58
B3318	37.6[‡]	27.9[‡]	106	0.44	4.97
F value	168	84	3.85 ^{ns}		0.23 ^{ns}
L.S.D. (5%)	0.30	0.28			
L.S.D. (1%)	0.39	0.38			
# station years	17	17	15	15	15

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



Summary of disease reactions for the brown mustard (*Brassica juncea*) hybrid B3318

Entry	Year	Blackleg severity (0–5)	White rust severity (0–9)	
			Race 2a	Race 2v
Amigo (check)	2017		R	S
Centennial Brown	2017		S	S
B3318	2017		R	S

R: resistant; S: susceptible



Request for support for registration of brown mustard (*Brassica juncea*) hybrid B3318



Minimum Standards for Condiment Mustard Cultivar Registration

To receive support for registration, a candidate must show merit. A candidate that shows merit is “equal to”, “better than” or “superior to” current check cultivars.

1. Agronomic traits considered for merit evaluation include: Yield.

➤ B3318 is superior to Centennial Brown in yield.

2. Seed quality traits considered for merit evaluation include: oil content (fixed oil for *B. juncea* only), protein content, glucosinolate content (for *B. juncea* only) chlorophyll content and/or green seed (*B. juncea* only).

➤ B3318 is equal to Centennial Brown in allyl glucosinolate content, but has a higher oil and lower protein content than Centennial Brown.

➤ B3318 is equal to Centennial Brown in green seed.



Minimum Standards for Condiment Mustard Cultivar Registration

3. Resistance to blackleg and white rust diseases is considered in the evaluation for merit.

Brown mustard (*Brassica juncea*):

1) Blackleg -- highly resistant; equivalent to but not more susceptible than the designated check Amigo

➤ B3318 has a similar level of blackleg resistance as the check variety Amigo and Centennial Brown.

2) White rust races –resistant to race 2a; equivalent to but not more susceptible than the designated check Amigo

➤ B3318 is resistant to white rust race 2a as Amigo. Centennial Brown is susceptible to white rust race 2a.



Brown mustard replicated yield trial



Brown mustard replicated yield trial

- **Entries: 30 (29 test hybrids and the check Centennial Brown)**
- **4 Replicates**
- **Randomized complete block design**
- **Locations:**
 - 1. Saskatoon (AAFC): CV: 9.6%**
 - 2. Swift Current (AAFC): CV: 10.1%**
 - 3. Redvers: CV: 14.7%**



Agronomic performance of the hybrids B3657, B3664, B3665 and B3667 in the yield trials

	Yield		Seed	Oil	Protein	GLS	Color	Chlorophyll	Height	Lodging	Maturity
	Kg/Ha	%CentBr	g/1000s	%	%	Umole/g	WI		cm	1-5	Days to
Centennial Brown	1830	100.0	3.01	36.6	28.1	107	-3.66		140	2.00	91
B3657	2299[‡]	125.6	2.38[‡]	38.6[‡]	26.4[‡]	92[‡]	-2.74[‡]		133	2.25	90
B3664	2395[‡]	130.9	2.87[‡]	38.5[‡]	27.3[‡]	115[‡]	-3.02		140	1.88	91
B3665	2540[‡]	138.8	2.92[‡]	38.8[‡]	27.3[‡]	116[‡]	-4.33		142	2.13	90
B3667	2467[‡]	134.8	2.75[‡]	39.3[‡]	26.6[‡]	112[‡]	-3.85		144	1.50	92
F-Value	6.08		59	17.4	12.0	59	6.2	ns	2.64	1.54 ^{ns}	2.48 ^{ns}
LSD (5%)	296		0.08	0.65	0.55	3.47	0.82		7.21		
LSD (1%)	396		0.10	0.86	0.73	4.81	1.10		9.62		
Station-years	3		3	3	3	1	3		3	2	2



- **Oriental mustard**
 - **Co-op Test**
 - **Yield trial**



Oriental mustard Co-op entries

1	Cutlass (check)
2	O123DH25
3	O123DH132
4	O2459DH31
5	O2521



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

	Yield		Seed Weight	Fixed Oil	Protein	GLS Allyl	Seed Colour	Distinct Green	Chlorophyll	Height	Maturity
	kg/ha	% Check	g/1000seed	% whole seed		μmole/g seed	WI E313	%	mg/kg seed	cm	days
Cutlass	1892	100.0	2.57	41.1	27.6		-38.0	0.21		128	86
O123DH25	2031†	107.3	2.73‡	40.5‡	27.5		-38.9	0.26		132	88†
O123DH132	1786	94.4	2.58	40.1‡	28.2‡		-44.1‡	0.26		135‡	86
O2459DH31	1914	101.2	2.86‡	41.3	27.9†		-44.5‡	0.19		150‡	86
O2521	2010†	106.2	2.73‡	39.4‡	28.7‡		-34.3‡	0.08†		146‡	87
S.E.	55		0.03	0.19	0.17		0.58	0.06		2.00	0.56
F-Value	9.14		261	253	29.9		2120	5.93		21.7	8.76
L.S.D. (5%)	108		0.05	0.37	0.33		1.14	0.11		3.9	1.10
# station yrs	9		9	9	9		9	9		7	7

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



Oriental mustard replicated yield trial

- **Entries: 30 entries (29 test hybrids and Cutlass (check))**
- **4 Replicates**
- **Randomized complete block design**
- **Locations:**
 - 1. AAFC-Saskatoon (AAFC): CV:12.7%**
 - 2. AAFC-Swift Current: CV: 8.4%**



Yield of the oriental mustard hybrids O3640 and O3649 from the yield trials at two locations

	AAFC- Saskatoon	AAFC-Swift Current
Cutlass (check) (kg/ha)	1965	1067
O3640	2352*	1219*
O3649	2558*	1181
CV (%)	12.7	8.4
LSD (p=0.05)	285	134



Agronomic performance of the oriental mustard (*B. juncea*) hybrids O3640 and O3649 in the yield trials

	Yield		Seed	Oil	Protein	allyl	but	Color	Chlorophyll	Height	Maturity
	Kg/Ha	%Cutlass	g/1000s	%	%	Umole/g	Umole/g	WI		cm	Days to
Cutlass	1780	100.0	2.72	40.5	28.3	123	0.48	-40.5		135	87
O3640	2087†	117.2	3.39‡	40.3	28.3	111‡	0.39‡	-34.7‡		155‡	88
O3649	2162‡	121.5	3.09‡	39.6‡	28.4	105‡	0.28‡	-34.7‡		150‡	89
F-Value	6.64		36	6.17	0.06 ^{ns}	55	239	26.6		11	1.85 ^{ns}
LSD (5%)	238		0.18	0.61		3.85	0.02	1.99		9.19	
LSD (1%)	331		0.26	0.85		5.53	0.03	2.76		12.8	
Station-years	2		1	2	2	1	1	2		2	1

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



- **Yellow mustard**
 - **Co-op Test**
 - **Yield trial**



Yellow mustard Co-op entries

1	Andante (check)
2	Y1992
3	Y3428
4	Y3463
5	Y3464
6	Y3517
7	Y3551



Yellow mustard Co-op Test

Locations	CV (%)
AAFC-Saskatoon date 1	11.6
AAFC-Saskatoon date 2	9.5
AAFC-Swift Current	6.6
AAFC Scott	12.5
Redvers	9.9
Brooks	6.4
Malita, Manitoba	14.4



Agronomic performance of the yellow mustard lines in the Co-op test

	Yield		Seed	Color	Green Seed	Height	Mucilage	Maturity
	Kg/Ha	%Check	g/1000s	WI	%	cm		Days to
Andante	1674	100.0	5.7	-35.8		114	74.2	91
Y1992	1785	106.6	5.5‡	-37.7‡		115	90.7‡	92
Y3428	1743	104.1	5.4‡	-37.0		120‡	101.0‡	93
Y3463	1676	100.1	5.7	-37.2+		125‡	91.0‡	92
Y3464	1749	104.5	5.4‡	-36.6		121‡	81.4+	92
Y3517	1702	101.7	5.6	-37.6‡		123‡	68.0+	92
Y3551	1707	102.0	5.4‡	-42.7‡		125‡	75.9	92
F-Value	1.18^{ns}		12.1	36.6		9.34	31.6	3.81
LSD (5%)			0.12	1.04		3.97	5.67	0.82
LSD (1%)			0.16	1.37		5.25	7.48	1.09
#station years	7		7	7		7	7	5



Quality traits of the yellow mustard lines in the Co-op test

Entries	Oil	Protein	GLS	Mucilage	Chlorophyll
	%	%	μmol/g seed	cS*ml/g seed	mg kg ⁻¹ seed
Andante	29.5	33.1	148	74.2	
Y1992	30.7‡	32.1‡	150	90.7‡	
Y3428	30.1‡	32.7	153	101.0‡	
Y3463	29.5	33.4	158‡	91.0‡	
Y3464	30.4‡	31.9‡	145	81.4†	
Y3517	29.7	33.1	159‡	68.0†	
Y3551	29.8	33.6	151	75.9	
F-Value	9.03	9.89	4.03	31.6	
LSD (5%)	0.41	0.55	6.7	5.67	
LSD (1%)	0.55	0.73	8.9	7.48	
#station years	7	7	6	7	



Yellow mustard replicated yield trial

- **Entries: 30 entries**
- **Check: Andante**
- **4 Replicates**
- **Randomized complete block design**
- **Locations:**
 - 1. AAFC-Saskatoon: CV: 10.8%**
 - 2. AAFC-Swift Current: CV: 7.6%**
 - 3. Redvers: CV: 10.0%**



Agronomic performance of Y3425, Y3486, Y3496, Y3527 and Y3531 in the yield trials

	Yield		Seed	Oil	Protein	GLS	Color	Chlorophyll	Height	Mucilage	Maturity
	Kg/Ha	%Andante	g/1000s	%	%	Umole/g	WI		cm		Days to
Andante	1799		5.97	29.8	32.4	146	-36.0		111		90
Y3425	2082	115	5.91	30.5⁺	32.4	153	-38.5[‡]		127[‡]		92[‡]
Y3486	1914	106	5.70⁺	30.4⁺	32.9	150	-38.9[‡]		124[‡]		92[‡]
Y3496	1872	104	5.94	30.3	32.6	150	-40.3[‡]		118[†]		91[‡]
Y3527	1874	104	6.00	30.0	33.3⁺	149	-40.2[‡]		120[‡]		92[‡]
Y3531	1988	110	5.93	29.6	34.0[‡]	156	-37.7		124[‡]		92
F-Value	1.89 ^{ns}		3.33	2.87	5.78	1.42 ^{ns}	6.33		5.41		4.46
LSD (5%)			0.21	0.55	0.73		1.63		5.56		1.05
LSD (1%)			0.28	0.73	0.96		2.16		7.37		1.40
Station-years	3		2	3	3	2	3		3		2



Chile winter nursery

Contract with SG2000:

- **28 tents for making yellow mustard synthetics**
- **18 tents for making brown mustard hybrids**
- **24 tents for making oriental mustard hybrids**



SG2000: Brown mustard hybrid production



SG2000: yellow mustard synthetic production



Chile winter nursery

Contract with Hytech: Production of commercial hybrid seed of B3318

B3318: F1 hybrid of Ogura cms male sterile line (B12-A line) x Ogura cms restorer line (B2543DH63)

- **Ogura cms male sterile line: B12-A line**
- **Ogura cms maintainer: B12**
- **Ogura cms restorer line: B2543DH63 (RfoRfo)**



HyTech Production Chile S.A.

Avenida El Bosque Central 092, 9^o, comuna Los Andes
Km 679,3 Ruta 5 Sur - Comuna P. L. Canel
Fono: 65-3681900

LINEA:.....**B12-A line (male sterile)**.....

LOTE:.....**17BM4TR35**.....

SUPERFICIE (HA).....**0,08ha**.....

FECHA DE SIEMBRA:.....**26-10-2017**.....

NOMBRE DE POTRERO:.....**CUEVAS 17/18**.....

NUMERO REGISTRO SAG:.....**S/N°**.....

RESPONSABLE:.....**OSCAR JARAMILLO**.....

FONO RESPONSABLE:.....**991833203**.....





HyTech Production Chile S.A.

LINEA:.....**B2952**.....
LOTE:.....**17EM1TR38**.....
SUPERFICIE (HA).....0,08ha.....
FECHA DE SIEMBRA:.....26-10-2017.....
NOMBRE DE POTRERO:.....VELIZ 17/18.....
NUMERO REGISTRO SAG:.....S/N.....
RESPONSABLE:.....OSCAR JARAMILLO.....
FONO RESPONSABLE:.....991833203.....





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
Breeder seed cert# 16-7002359501	2016	Andante	400
Breeder Seed Cert # 13-7002359-501	2014	Adagio	48
Breeder Seed Cert # 14-8057603-505	2014	Adagio	16
Breeder Seed Cert# 17-002359-501	2017	Adagio	200



Brown 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
Breeder Seed Cert # 17-7002359-502	2017	AAC Brown 120	270



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



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White rust test: Dr. Hossein Borhan, Mr. Colin Kindrachuk and Mr. Mehran Yazdan



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Thank you!

