RECENT DEVELOPMENTS IN CANARYSEED RESEARCH

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Introduction

Annual canarygrass (Phalaris canariensis L.), commonly known as "canary seed" has become a major alternate crop in western Canada. The area seeded to canarygrass in Saskatchewan increased from 2,000 acres in 1972 to 490,000 acres in 1996. Saskatchewan accounts for approximately 90% of the Canadian canaryseed production. The value of annual Canadian exports has averaged approximately $65 million during the last five years (Saskatchewan Agriculture and Food, 1996). Canaryseed is currently used as a feed for small pet songbirds. Dehulled canaryseed grain is high in protein. Canaryseed has potential for human consumption, a market which is much larger than the current birdfood market, the sole outlet for the crop. Current canaryseed varieties are not suited for the food market.

The hull surrounding the seed is covered by small silicified hairs. During threshing these hairs are knocked off the hull causing major irritation to combine operators and grain handlers. Studies have linked the silicified hull hairs of canarygrass to oesophageal cancer in humans and skin cancer in laboratory mice and livestock (O'Neill et al., 1986).

The coat of canarygass seed is dark and unappealing in appearance to the consumer. Yellow seed coat mutants, for instance, have been identified in reed canarygrass (Knowles, 1987). Consequently, canarygrass requires genetic modification to eliminate the hull hairs and dark seed coat colour.

CDC Maria glabrous cultivar

During the course of this project we evaluated a number of glabrous canaryseed lines. One of these (Canglb2) was registered as CDC Maria on June 12th, 1997.

Advantages of a glabrous cultivar are as follows:

1. Reduction in itchiness to the barley-wheat level during harvest and downstream crop handling.
2. Elimination of the grain polishing processing step.
3. Reduced shipping costs due to 11% greater seed packing.

CDC Maria is a glabrous (hairless) annual canarygrass ("canaryseed") line in which the richomes are completely absent from the glumes, paleae and lemmae.

The field testing data have been summarized in Tables 1 and 2. CDC Maria is adapted to the traditional canaryseed growing region of Saskatchewan in the Dark Brown and brown soil zones. The elimination of silicified hull trichomes (hairs) has led to a reduction in skin irritation (itching), increased test weight (+ 11 %) and kernel weight (+4%). CDC Maria is lowering yielding than the cultivar Keet in the brown soils (- 8%) and black soil (-13 %) of Saskatchewan. With respect to maturity and height this line is very similar to the cultivar 'Keet' (Table 1). CDC Maria was evaluated during the years 1992-1997 in the University of Saskatchewan spring cereal testing system and Regional Variety Testing (RVT) system. Data from two trials were made available courtesy of Dr. Perry Miller (AAFC Swift Current).

Table 1. Summary of agronomic performance of Keet and CDC Maria annual canarygrass, 1992-1997.

	Grain yield (kg/ha)			
Soil Zone	Brown	Dark Brown	Black	Average
Keet	1490	2143	1403	1853
CDC Maria	1403	1962	1255	1695
# of trials	6	23	10	39

Note: Yield trials consisted of 3 replicate RCBD's with Coefficients of Variation for yield under 15%.

Table 2. Days to heading, days to maturity and plant height of Keet and CDC Maria annual canarygrass, 1992-1997.

	Heading (days)	Maturity (days)	Plant height (cm)	Test weight (kg/hl)	Kernel weight (mg)
Keet	61.0	109	111.8	63.6	7.2
CDC Maria	61.6	109	112.0	70.5	7.5
# of trials	8	7	8	22	22

Although CDC Maria appears to yield approximately 10% less than Keet, the latter represents a 20% yield improvement over the canaryseed cultivars originally grown in North America during the 1950's (Putnam, et al, 1996).

The glabrous trait is simply inherited (Table 3) based on field and greenhouse results.

We obtained a 3: 1 ratio of pubescent:glabrous plants.

Table 3. F2 Segregation for hull pubescence in canaryseed, pooled over populations.

	Number of plants:			
	Hairy	Glabrous	X^2	Prob.
Five populations (Greenhouse)	1798	554	2,625	0.25-o. 10
Six populations (Field)	6009	2069	1,617	0.25-o. 10

Seedcoat colour modification

As a first step, the USDA canaryseed collection (n=140) was screened (M. Matus, 1996 M.Sc. dissertation) for yellow seed coat colour. Seven species were evaluated. None of the accessions had a light seed coat colour. Early in 1994 we initiated a seed coat colour mutant screening project with short-term financial assistance from the SADF Extension Research Unit. Over 3 million seeds were de-hulled and colour-sorted. Lighter coloured seeds were identified and 12 light-yellow lines have been identified. These lines are pubescent types. The yellow-seeded lines were evaluated at two sites in 1997 (Table 4).

Table 4. 1997 agronomic performance of yellow-seeded canaryseed lines relative to 'Keet'.

		N	Mean	Range		SE
Keet	Grain yield		2029			
CY lines	(kg\ha)	16	2184	1886	2340	33
Keet	Heading		53.3			
CY lines	(days)	16	55.2	52.7	57.3	0.5
Keet	Maturity		91.8			
CY lines	(days)	16	92.6	89.0	97.5	0.6
Keet	Height		91.2			
CY lines	(cm)	16	91.9	87.8	95.3	0.6

CY = yellow-seeded lines

Mean of 3-replicate trials at Kernen Research Farm and Seed Farm.

The yield of the yellow-seeded lines was comparable to that of 'Keet'. On average the lines were 8% higher yielding than Keet and slightly later maturing.

Table 5. F2 Segregation for seed colour in canaryseed, pooled over populations.

	Number of plants:			
	Brown	Yellow	X^2	Prob.
One population (Greenhouse	287	116	3.077	0.10-0.05
Two populations	815	270	0.013	0.95-0.90

The light-yellow seed coat colour is controlled by a single gene and is recessive to brown seed coat colour (Table 5). The yellow-seeded trait is currently being combined with the glabrous trait in order to develop an identity-preserved product that would be suitable for human consumption.

LEAF MOTTLE RESEARCH

The effect of leaf mottle on canaryseed grain yield has been investigated for two years (Table 6). With moderate disease pressure yield of 'Keet' was reduced by 13-18% The 1996 data are based on the use of a single fungicide while the 1997 data are based on the average of two products. The field trials consisted of a 4-replicate RCBD. The fungicides were applied 3-4 times during the growing season.

Table 6. Increase in yield and kernel weight due to fungicide protection, Saskatoon (1996) and Elrose (1997).

Cultivar	Grain yield (%)		Kernel weight (%)	
	1996	1997	1996	1997
Cantate	11		1	
PI203913	7		0	
CDC Maria	14"		4"	
Keet	18"	13*	5*	5*

* significant at P=0.05

Based on the 1996 data, the cultivar Cantate and the accession PI203913 are more tolerant of leaf mottle than either Keet or CDC Maria. A number of canaryseed accessions have reduced foliar damage scores than the controls (Table 7). Although PI203913 is characterized by low seedling infection levels (data not presented) and less yield reduction, foliar ratings in the field are no different than those of Keet. Accessions such as PI203913. 369984 and Cantate are currently being used in a breeding effort to increase the tolerance of canaryseed to leaf mottle.

Table 7. Leaf mottle severity of nine canaryseed cultivars at Saskatoon, 1996.

	Disease Rating (l-10)		
	7/8/96	**19/8/96**	**26/8/96**
1 PI170627	**3.8**	**7.2**	9.3
2 PI203913	**4.0**	**7.3**	10.0
3 PI266186	**3.7**	**7.0**	9.5
4 PI322734	**4.2**	**7.7**	9.8
5 PI368984	**3.0**	**5.8**	**8.7**
6 PI415822	**3.8**	**6.0**	**9.2**
7 Cantate	**3.5**	**5.3**	**8.2**
8 Keet	**4.5**	**7.3**	**9.7**
9 Elias	**4.3**	**7.7**	10.0

Average of four replications

Grain chemistry

Our initial results on the evaluation of canaryseed grain were presented at a previous Soil and Crops Update (Abdel-Aal et al., 1997) and are in the process of being published, in part (Abdel-Aal et al., 1997 and 1998). Since that time we have started comparing CDC Maria to Keet or Katepwa CWRS wheat (Table 8).

Table 8. Compositional properties of CDC Maria versus Keet canaryseed.

	CDC Maria	Keet	Katepwa	
		(% dry basis, 2 reps)		
Starch	61.2	59.1	59.8	
Crude Protein	21.6	22.3	17.3	
Total diet. Fibre	5.9	8.3	12.8	
Crude fat	7.7	2.1	1.6	
Total ash		2.1	2.1	
Minerals:		(mg/100g, 1 rep)		
Phosphorus	640	590	430	
Potassium	385	340	355	
Magnesium	200	195	155	
Calcium	40	40	20	
Sodium	10	10	10	
Iron	6.5	5.9	4.2	
Manganese	6.3	7.1	5.9	
Zinc	3.9	3.5	2.5	
Copper	0.2	0.2	0.3	
Vitamins:				
Thiamine	0.85	0.79	0.44	
Riboflavin	0.16	0.16	0.15	
Niacin	0.68	0.89	7.29	
Antinutrients:				
				Soybean
Phytate (mg/g)	18.1	17.5	9.4	
Trypsin (TIU/mg) Inhibitor	0.56	0.51	0.47	30.3

The above data is based on year of testing and is thus preliminary in nature. However, there do not appear to be large differences between CDC Maria and Keet in grain composition. The canaryseed cultivars were higher in protein and oil than CWRS wheat, but lower in total dietary fibre. Canaryseed was higher in phosphorus and calcium content. With regards to vitamins, canaryseed was higher in Thiamine but lower in Niacin content. Canaryseed had a higher phytate content than CWRS wheat. Both canaryseed and wheat trypsin inhibitor levels were much lower than those of soybean. We are currently evaluating grain samples for alkaloid levels.

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