Update on Fall Dormant Seeded Canola Research

E.N. Johnson[1], S. Shirtliffe[2], R. Gulden[2], C. Willenborg[2], L.V. Gusta[2], K. Topinka,[3]
K.N. Harker[4], G.W. Clayton[4], R.E. Blackshaw[5], and Y.Gan[6]

[1]Agriculture and Agri-Food Canada (AAFC), Box 10 Scott, SK, S0K 4A0
[2] Dept. of Plant Sciences, University of Saskatchewan, Saskatoon, SK S7N 5A8
[3]Alberta Agriculture, Food and Rural Development, Edmonton, AB, T6H 5Z2
[4]AAFC, 6000 C & E Trail, Lacombe, AB, T4L 1W1
[5]AAFC, Box 3000, Lethbridge, AB, T1J 4B1
[6]AAFC, Box 1030, Swift Current, SK, S9H 3X2

Key Words: seeding date, dormant seeding, seed coating, canola

Introduction

Alternative seed dates for canola (fall dormant and early spring seeding) have been evaluated across the prairies in the past decade (Kirkland and Johnson 2000; Johnston et al. 2002; Karamanas et al. 2002). Kirkland and Johnson (2000) reported a number of benefits for fall and early spring seeded canola including:

- higher yields;
- advanced maturity;
- increased seed size;
- increased oil content;
- reduced lodging;
- reduced production risk from:
  - late season insect attack;
  - fall frost.

The purpose of this paper is to provide an update of more recent research conducted on fall seeding, particularly in the areas of yield stability, oil quality, seed vigour, and polymer seed coats to reduce the risk of fall germination. Challenges facing producers who are attempting to adopt fall seeding technology are also discussed in the paper.

Effect of Seed Date on Canola Yield and Yield Stability

Kirkland and Johnson (2000) reported that seeding canola in fall or late April increased yield by 38% over mid-May seeding. The studies were conducted on fallow and stubble from 1993 to 1998. At Melfort, Johnston et al. (2002) reported much smaller yield differences between fall and mid-May seeded canola. Fall seeded canola yielded higher than mid-May seeded canola in one year of a two year study, but there was only a 7% yield advantage for the fall-seeded canola when combined over years. Canola seeded between April 26 and May 3 yielded 16% higher than dormant fall seeded canola in studies conducted under higher moisture regimes in Alberta (Karamanas et al. 2002).

Studies evaluating the relative yield of fall, April, and mid-May seeded canola have been continued at Scott, SK. In 1999 and 2000, the month of July was cool and wet resulting in favorable conditions for mid-May seeded canola. Average yields from 13 site-years of experiments from 1993 to 2001 are summarized in Table 1. Highest yields have been reported for April seeded canola, with slightly lower yields reported for fall dormant seeded canola. In addition, April seeded canola has resulted in less variable yields than either fall or mid-May seeded canola (Table 1). Many producers in the Brown Soil Zones of Saskatchewan have adopted April seeding of canola to reduce production risk.

Table 1: Effect of Seed Date on Yield of Canola at Scott, SK. Mean of 13 site-years of experiments seeded on fallow and stubble from 1993-2001.

Seed Date	Yield (kg/ha)	Yield (% of mid-May)	Index of Variability
Fall	1649	112	0.74
April	1728	117	0.66
mid-May (May 15 to 20)	1471	100	1.00

Seed Oil Quality

Kirkland and Johnson (2000) reported that the seed oil concentration of fall or April seeded canola was 1.5% higher than mid-May seeded canola. This is likely due to the early flowering period of fall and April seeded which occurs in mid to late June when air temperatures are cooler. In addition, seeding canola in the fall or April resulted in seed oil with lower levels of saturated fatty acids in 3 of 5 years (Table 2).

Table 2: Effect of Canola Seed Date on % Saturated Fatty Acid Concentration in Canola Seed. Scott, SK. 1996-2000.

	Saturated Fatty Acid Concentration (%) Seed Date			
Year	Fall	April	mid-May	$LSD_{0.05}$
1996	6.6	6.7	7.2	0.3
1997	7.7	7.7	7.5	0.3
1998	6.9	7.4	8.4	0.2
1999	6.7	6.9	7.0	0.2
2000	7.1	7.1	7.1	0.1
Mean	**7.0**	**7.2**	**7.4**	**0.5**

Seed Vigour

Seed produced from fall and April seeded canola generally has a higher thousand kernel weight than seed produced from later plantings (Johnson and Kirkland, 2000). Gusta et al. (2000)

reported that seed produced from fall and April canola plantings were larger, more mature and produced more vigorous seedlings in controlled environment studies. This higher level of seed vigour has been validated in field studies conducted at Scott, SK (Table 3).

Table 3: Effect of seed produced from fall, April, and mid-May seeded canola on plant density, plant biomass at bolting, and canola yield. Experiment was seeded in spring of 2000.

Seed Source (Seed Date and Year Grown)	Plants m^{-2}	Dry weight at bolting $g\ m^{-2}$	Yield ($kg\ ha^{-1}$)
Fall 98	40 a	25.8 a	2325 ab
April 98	35 a	24.2 a	2386 ab
May 98	30 a	6.0 b	1378 c
Fall 99	50 a	26.8 a	2772 a
April 99	45 a	26.4 a	2782 a
May 99	52 a	25.1 a	2193 b

Means followed by the same letter do not differ significantly

In addition, fifteen different seedlots of seed grown in different locations and different years were dormant seeded at Scott in the fall of 2000. Highest seed yields were obtained with canola seed obtained from fall plantings (Figure 1).

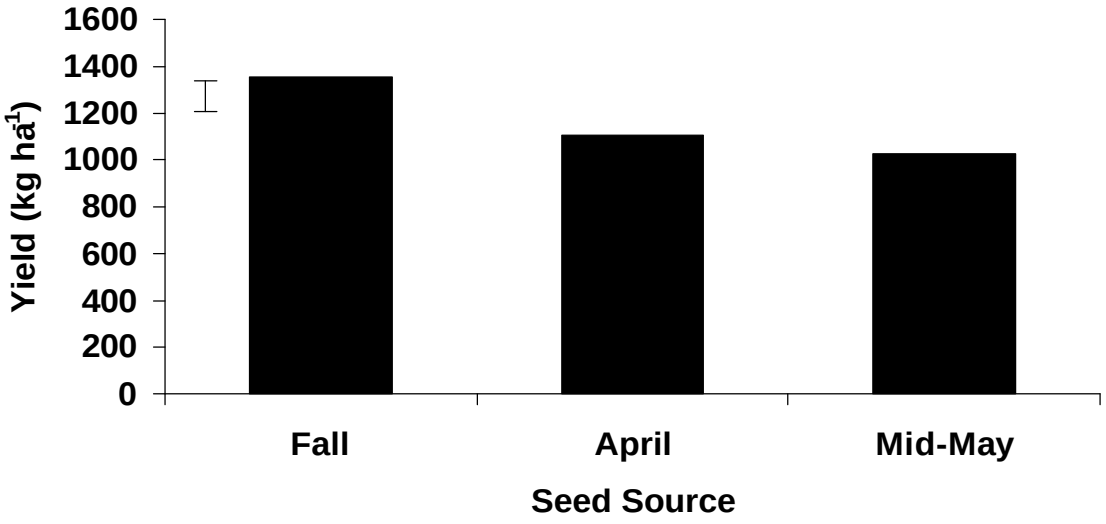

Figure 1: Effect of seed produced from fall, April, and mid-May plantings on yield of dormant fall seeded canola. Means are from five different seedlots obtained from different locations for each planting date. Error bar is the $LSD_{0.05}$. Scott, SK. 2000-2001.

Polymer Seed Coatings

Picking an optimum date for dormant fall seeding of canola is a challenge for producers. Warm weather and moist soil conditions often occur throughout most of October, this causing premature germination and detrimental stand loss. Therefore, seeding operations must be conducted just prior to soil freeze-up to avoid premature germination. Research and producer experience has indicated this most favorable seeding window is often narrow (last few days of October and first few days of November) and is frequently associated with wet and freezing weather conditions that make seeding operations difficult. Polymer seed coatings that prevent premature germination may extend fall seeding dates into early October, thus reducing the risks associated with inclement climatic conditions and stand loss. A water insoluble, freeze sensitive polymer seed coating that controls germination in the fall is commercially available and is sold under the trade name Extender (Zaychuk and Enders 2001).

Extender was evaluated at five locations across Western Canada in 1999 and 2000. Extender treated seed was compared to unprotected seed (Guard Coat) at weekly seeding intervals beginning in early October and continuing until soil freeze-up. Guard Coat is a commercial highly water soluble film-forming coating for spring seeded canola (GrowTec, 2002).

Extender coating improved canola seedling density when the canola was fall seeded in October (Figure 2). When seeding was delayed until early November, the Extender polymer offered no advantage. Canola yields showed similar trends as seedling density (data not shown).

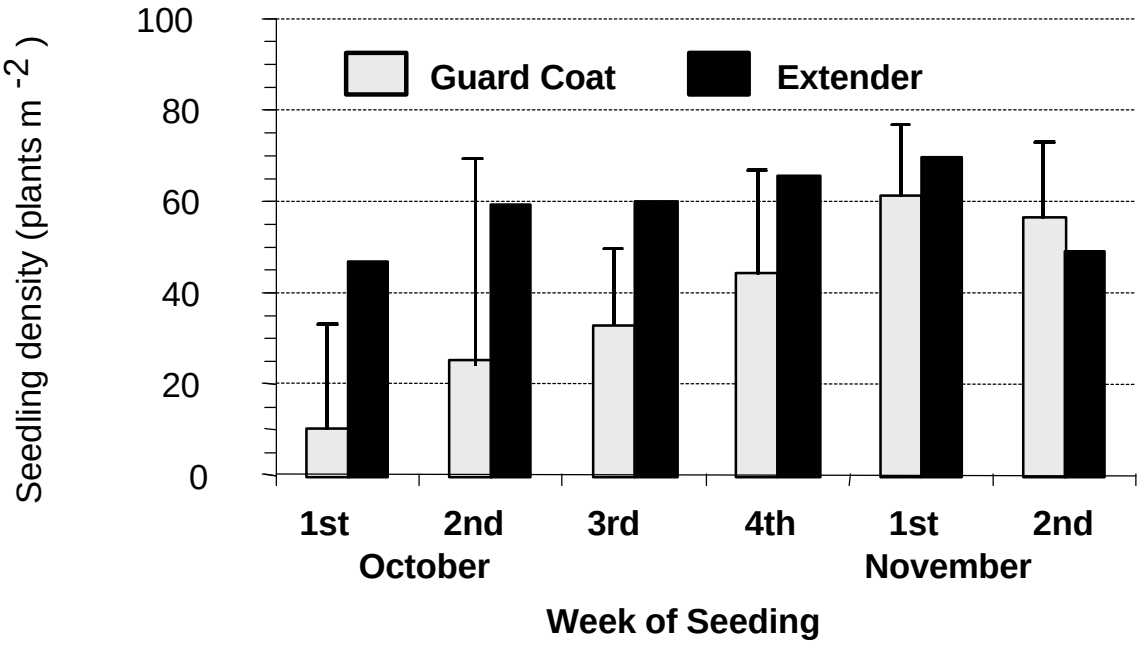

Figure 2: Effect of Extender coating on fall seeded canola emergence seeded weekly starting the first week of October. Mean of 5 locations in Saskatchewan and Alberta, 1999-2000.

Field studies conducted in 2000-2001 showed a different trend. Under extremely dry fall soil conditions, the Extender coating resulted in a decline in canola seedling density as seeding approached soil freeze-up (Figure 3). Similar results were reported in Ellerslie and Swift Current in 2001 (Topinka, personal communication; Gan, 2002). Yields showed similar trends as the plant density data (data not shown).

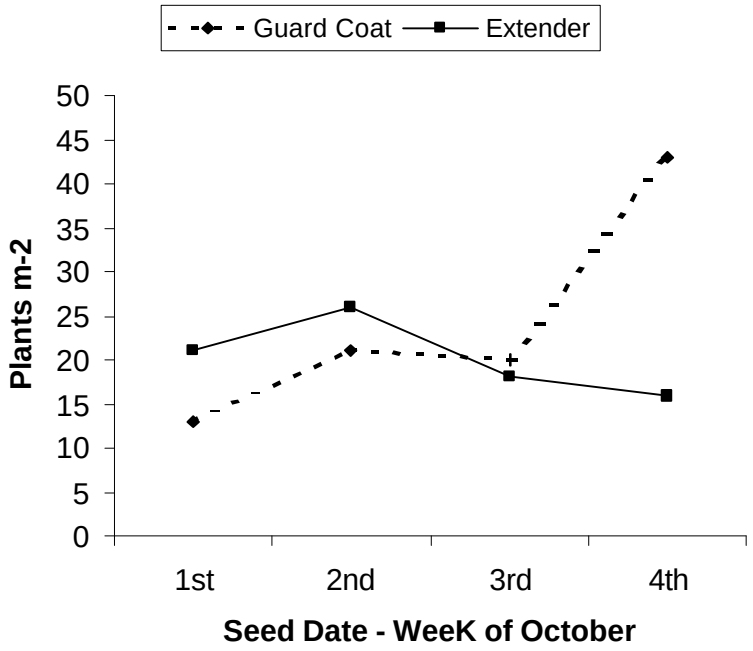

Figure 3: Effect of October seed date and seed coating on emergence of fall seeded canola, Scott, 2001.

To further investigate the interaction of Extender and soil water, controlled environment studies were initiated at the University of Saskatchewan. Preliminary results suggest that declining water potentials result in a much greater reduction in the final germination percentage of Extender coated seed, relative to uncoated or Guard Coat treated seed (Figure 4). Results were even more dramatic under cooler germination temperatures of 5° C (data not shown). The Extender treatment had lower germination percentages than the uncoated or Guard Coat treatment at all water potentials; however, exposure to freezing temperatures fractures the coating resulting in improved germination of Extender coated seed (Zaychuk and Enders, 2001). In this study, the seed was not exposed to freezing temperatures prior to the germination tests. However, in order to freeze the coating must first imbibe water, which likely did not occur in the fall of 2000. Therefore, the treatment structure in this controlled environment study is considered a valid model to simulate field conditions.

To summarize, Extender enables a producer to seed two to three weeks prior to soil freeze-up and obtain a satisfactory plant stand. Under dry fall soil conditions, growers should avoid the use of Extender if seeding in late October or early November.

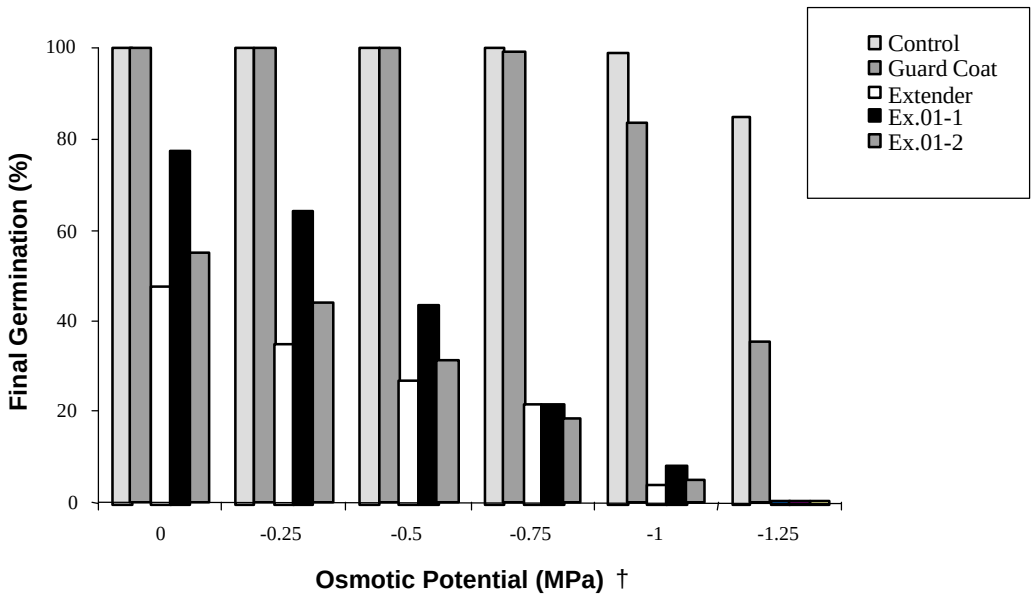

Figure 4: Effect of osmotic potential and coatings on final germination of canola seeds at 15°C. Coatings Ex.01-1 and Ex.01-2 are experimental analogues of Extender. † LSD for mean comparisons: OMPa = 0.47; -0.25MPa = 0.43; -0.50MPa = 0.51; -0.75MPa = 0.63; -1.00MPa = 0.73; -1.25MPa = 0.84.

Challenges

Acreage of fall seeded canola has fluctuated since 1993 with highest acreages being seeded in the fall of 1999. Acreage has declined since then with current acreage estimated at 5000 to 10,000 acres. Producer adoption has been low, primarily due to inconsistent plant stands, and problems with spring frost in some locations. Kirkland and Johnson (2000) reported that fall seeded canola generally resulted in lower plant stands; however, the stands did not affect crop yield. Thin stands tend to delay maturity, and many growers have observed little or no maturity advantage with fall seeding. Spring frost has not been a problem at Scott; however, it decimated fall seeded canola stands at Swift Current in 1998 and at Melfort in 2000. Technologies that improve the emergence and frost tolerance of fall seeded canola are required to further reduce these production risks.

References

Gan, Y. 2002. Fall seeded canola: Interactions between seeding dates and seed coating. *In* Proceedings of the 2002 Soils and Crops Workshop. Extension Divison, University of Saskatchewan. Saskatoon, SK.

GrowTec. 2002. Our Products. [Online]. Available: http://www.growtec.ca/products.htm. [Feb. 20, 2002].

Gusta, L.V., Nesbit, N.T., Johnson, E.N. and Kirkland, K.J.. 2000. Effect of canola seed date on canola seed quality. *In* Proceedings of the 2000 Soils and Crops Workshop. Extension Division. University of Saskatchewan, Saskatoon, SK.

Johnston, A.M. Johnson, E.N., Kirkland, K.J. and Stevenson, F.C. 2002. Nitrogen fertilizer placement for fall and spring seeded *Brassica napus* canola. Can. J. Plant Sci. 82: 15-20.

Karamanos, R.E., Harapiak, J.T. and Flore, N.A.. 2002. Fall and early spring seeding of canola (*Brassica napus* L.) using different methods of seeding and phosphorus placement. Can. J. Plant Sci. 82: 21-26.

Kirkland, K.J. and Johnson, E.N. 2000. Alternative seeding dates (fall and April) affect *Brassica napus* canola yield and quality. Can. J. Plant Sci. 80: 713-719.

Zaychuk, K.S. and N. Enders. 2001. Water insoluble, freeze sensitive seed coatings. United States Patent 6230438. US Patent and Trademark Office. May 15, 2001.