Canola Dormant Seeding in North Dakota

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ABSTRACT

Dormant (frost) seeding is the practice of planting a crop in the fall, close enough to freeze-up to prevent germination before winter. The principle advantage to this practice is time management, reducing planting time in spring and spreading out the spraying and harvesting operations in summer. However, dormant seeding involves considerable risk of premature germination and poor stand establishment. Planting immediately before fall freeze-up is ideal, but difficult to predict, and large acreages reduce flexibility. Also, periods of warm weather in winter may result in germination. Polymer seed coatings have been developed to reduce the risk of premature germination and permit planting up to three weeks before freeze-up. Field experiments were conducted at North Dakota State University research extension centers and research sites to evaluate the effects of polymer coating and planting date on performance of canola (*Brassica napus* L.). Although dormant seeding resulted in advancing harvest-year field operations up to 2.5 weeks, reduced stands and significant yield reductions compared to spring seeding were observed in almost all site-years.

Spring planted canola in bloom.

INTRODUCTION

Canola (*Brassica napus* L.) production in North Dakota has expanded tremendously in recent years. From 1990 to 2002, statewide acreage increased from 8,005 to 1,291,804 acres (North Dakota Farm Service Agency, 1990 and 2002). As disease problems with scab in small grains and sclerotinia in broadleaf crops (especially sunflower and dry bean) continue to plague growers, the outlook for canola remains bright.

Previous NDSU research has shown the importance of early planting to maximize canola yield (Berglund and McKay, 1998). However, timely planting of cool-season crops, like canola, is often complicated by late spring warm-ups, wet springs, time-consuming spring tillage operations, planting other cool-season crops, and large acreages. Fall (dormant) seeding of canola insures that the crop is in the ground in early spring and spreads out the spring workload. Due to earlier emergence, the crop may avoid some insect and disease pests, flowering and podfilling periods may coincide with more favorable moisture and temperature regimes, the crop matures earlier, spreading out the harvest workload, and market prices at harvest may be higher (Endres and Berglund, 1999). Weed control can be accomplished by planting herbicide-tolerant cultivars. However, fall germination must be avoided or severe stand failures will occur. One method to avoid fall germination is seeding immediately before soil freeze-up, but timing is critical and often difficult to achieve. Polymer seed coatings (e.g. 'Extender,' from Grow Tech, Inc., Alberta, Canada) may protect the seed from fall germination and allow more flexibility (up to 21 days before freeze-up) in timing the seeding operation.

Research in Saskatchewan has shown that, compared to spring planting, dormant seeding of canola advanced flowering date up to 35 days, swathing date up to 21 days, and combining date up to 25 days (Kirkland and Johnson, 1998). Early-emerging canola exhibited good frost tolerance (down to - 9°C), but wide temperature fluctuations result in higher susceptibility to frost. Data from Manitoba also indicate that early planting results in plants with increased cold-hardiness, resisting temperatures down to – 5-6°C (D. Berglund, personal communication).

Stand establishment from fall planting is frequently poorer than from spring planting and a 10-15% increase in seeding rate is recommended for dormant seeding (Endres and Berglund, 1999). Stands in Saskatchewan were better in stubble than in tilled fallow in 1996 and 1997 (Kirkland and Johnson, 1998). The risk of premature germination is higher in tilled fields than in stubble, due to increased temperature fluctuations. In addition to moderating temperature fluctuations from crop residue coverage and increased snow catch, stubble also reduces the potential for crusting and sandblasting of seedlings. From 1996 to 1998, yields from fall planting into stubble and into tilled soil averaged 58% and 16% higher, respectively, than May planting. The relatively lower yield with tillage was attributed to reduced stands. Averaged across tillage treatments, dormant seeding resulted in a 25% yield increase over May planting. Over six experiments, fall planting also resulted in a more than 1% increase in oil content, due to cooler temperatures during the reproductive phase. Also, fall planting consistently resulted in shorter plants and less susceptibility to lodging.

Previous research at the NDSU North Central Research Extension Center in Minot showed yields of Crusher and Hyola 401 planted in fall to be lower, but statistically similar, to those from spring planting (M. Zarnstorff, unpublished data). However, dormant seeding at the NDSU North Central, Carrington, and Langdon Research Extension Centers in the fall of 1998 all resulted in unacceptable stands in the spring of 1999.

OBJECTIVES

The general objective of this project is to determine the viability of fall (dormant) seeding of canola in North Dakota. Specific objectives include evaluation of the importance of the following factors in dormant seeding:

- **Commercial polymer seed coating to reduce premature germination,**
- **Seed size (hybrid vs. open-pollinated),**
- **Planting date (relative to fall freeze-up),**
- **Seeding rate,**
- **Residue coverage (tillage effects), and**
- **Geographic area within the state.**

MATERIALS & METHODS

This research was conducted in the periods 1999-2000 and 2001-2002 at the North Dakota State University (NDSU) Carrington, Langdon, North Central (Minot), Williston, Dickinson, and Hettinger Research Extension Centers and the NDSU field site at Prosper. Plot size at the different sites varied around 1.5 m wide by 7.0 m long. Row spacing was 0.15-0.18 m. Fall-planting with polymer seed coating ('Extender' from Grow-Tec, Inc., Alberta, Canada) was compared to uncoated seed planted in fall and in spring. The effect of seed size was studied by comparing an open-pollinated cultivar ('Minot') to a hybrid ('Hyola 357'). Glyphosate-tolerant cultivars were planted to facilitate weed control. Fall planting dates included shortly before the date of normal freeze-up and 2-3 weeks earlier. The performance of a spring planting of each cultivar was compared to the fall plantings. A standard seeding rate of 1,482,000 live seeds ha^{-1} was compared to 1,976,000 and, at some sites, 2,470,000.

RESULTS & DISCUSSION

Plant Stand. Independent of cultivar, seed treatment, and seeding rate, spring planting resulted in higher plant stands than fall seeding in all instances (Table 1). Increasing the fall seeding rate by 33% resulted in improved spring stands in three out of 15 cultivar x site-year combinations, but stands were still inferior to spring seeding. Stand was not appreciably affected by seed size (open-pollinated vs. hybrid cultivar). In 2000, no-till resulted in better plant stands in Carrington, but the effect of tillage treatment in Langdon was minimal. Seed treatment with Extender improved stands under both tillage systems in Langdon in 2000 (L /'00), but in no other site-years. Delaying fall planting until close to freeze-up was more effective than planting Extender-treated seed 2-3 weeks earlier (data not shown). In Hettinger, plots seeded in the fall of 1999 resulted in stands so low that the trial was abandoned.

Table 1. Plant stand (plants m^{-2}) of dormant- vs. spring-seeded canola, NDSU, 1999-2000 and 2001-02.

			Site[1] / Year										
Cultivar / Seed Treatment	Planting	Seeding Rate (live seeds ha^{-1})	C /'00 (tilled)	C /'00 (no-till)	C /'02 (tilled)	L /'00 (tilled)	L /'00 (no-till)	L /'02 (no-till)	H /'00 (no-till)	H /'02 (no-till)	W /'00 (no-till)	**Mean (6 sites)**	**Mean (9 sites)**
Minot / Fungicide	Fall	1,482,000	27	43	---	6	11	---	2	---	11	**17**	**---**
Minot / Fungicide+Extender	Fall	1,482,001	23	42	---	39	23	---	2	---	13	**24**	**---**
Minot / Fungicide	Fall	1,976,000	22	38	---	47	37	---	2	---	20	**28**	**---**
Minot / Fungicide	Spring	1,482,000	112	160	---	84	100	---	62	---	94	**102**	**---**
Hyola357 / Fungicide	Fall	1,482,001	50	55	25	22	13	16	1	55	24	**27**	**29**
Hyola357 / Fungicide+Extender	Fall	1,482,001	32	29	29	22	25	15	3	51	16	**21**	**25**
Hyola357 / Fungicide	Fall	1,976,000	43	65	53	29	25	22	3	41	16	**30**	**33**
Hyola357 / Fungicide	Spring	1,482,001	115	124	69	93	99	147	58	109	88	**96**	**100**
Mean[2]	---	---	53	71	29	39	37	20	16	65	31	**41**	**40**
C.V. (%)	---	---	36.7	24.8	35.3	20.2	25.1	36.4	35.6	30.7	43.1	---	---
LDS (0.05)	---	---	28	26	23	11	13	11	9	29	19	---	---
LSD (0.01)	---	---	38	34	31	15	18	15	12	39	26	---	---

[1]C = Carrington, L = Langdon, H = Hettinger, W = Williston [2]Includes treatments not shown

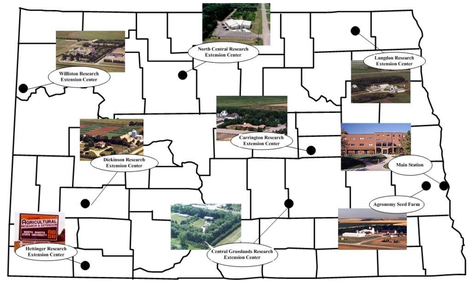
Growth and Development. Compared to spring planting, dormant seeding in Carrington resulted in earlier emergence, beginning bloom, end bloom, and harvest in 2000. Dormant-seeded plants reached physiological maturity up to 17 days before those that were spring-seeded (Table 2).

In Langdon in 2000, fall-seeded plants reached maturity only a few days before those planted in early May. At both sites in 2002, fall seeding tended to delay physiological maturity compared to spring seeding. This was probably due to late frosts, which killed the first dormant-seeded plants to emerge. In Carrington, Langdon, and Williston, spring seeding tended to produce taller plants, but less lodging, than fall seeding (data not shown).

Table 2. Julian day of physiological maturity in the dormant- vs. spring-seeded canola trial, NDSU, 1999-2000 and 2001-02.

			Site[1] / Year							
Cultivar / Seed Treatment	Planting	Seeding Rate (live seeds ha^{-1})	C/'00 (tilled)	C/'00 (no-till)	C/'02 (tilled)	L/'00 (tilled)	L/'00 (no-till)	L/'02 (no-till)	**Mean (4 sites)**	**Mean (6 sites)**
Minot / Fungicide	Fall	1,482,000	200	199	---	222	220	---	**210**	**---**
Minot / Fungicide+Extender	Fall	1,482,000	201	199	---	217	219	---	**209**	**---**
Minot / Fungicide	Fall	1,976,000	204	202	---	218	219	---	**210**	**---**
Minot / Fungicide	Spring	1,482,000	215	214	---	224	224	---	**219**	**---**
Hyola357 / Fungicide	Fall	1,482,000	198	198	212	220	222	229	**209**	**213**
Hyola357 / Fungicide+Extender	Fall	1,482,000	200	200	216	220	220	228	**210**	**214**
Hyola357 / Fungicide	Fall	1,976,000	201	196	218	219	219	228	**209**	**213**
Hyola357 / Fungicide	Spring	1,482,000	214	213	214	222	222	214	**218**	**216**
Mean[2]	---	---	205	203	211	223	224	228	**214**	**216**
C.V. (%)	---	---	1.5	1.2	3.1	1.5	1.0	1.5	---	---
LDS (0.05)	---	---	4	4	4	2	1	5	---	---
LSD (0.01)	---	---	6	5	5	2	1	7	---	---

[1]C = Carrington, L = Langdon [2]Includes treatments not shown



Yield. Within seed treatments and planting times, Hyola 357 outyielded Minot at all sites (Table 3). With the exception of Carrington no-till in 2000, spring seeding generally resulted in significantly higher yields than dormant seeding. The use of Extender seed coating improved yield in only one instance (Langdon tilled plots in 2000), due to a dramatic improvement in plant stand (Table 1). In Langdon, yields of both cultivars planted on 22 November 1999 were similar to the spring planting (data not shown). Planting on 25 October generally resulted in lower yields than spring planting, although the use of Extender or increasing the seeding rate tended to reduce this difference (Table 3).

Table 3. Seed yield (kg ha^{-1}) of dormant- vs. spring-seeded canola, North Dakota State University, 1999-2000 and 2001-02.

			Site[1] / Year										
Cultivar / Seed Treatment	Planted	Seeding Rate (live seeds ha^{-1})	C /'00 (tilled)	C /'00 (no-till)	C /'02 (tilled)	L /'00 (tilled)	L /'00 (no-till)	L /'02 (no-till)	D /'00 (no-till)	W /'00 (no-till)	**Mean (6 sites)**	**Mean (8 sites)**
Minot / Fungicide	Fall	1,482,000	914	1498	---	1666	2030	---	1050	754	**1319**	**---**
Minot / Fungicide+Extender	Fall	1,482,000	871	1357	---	3081	2378	---	1253	908	**1641**	**---**
Minot / Fungicide	Fall	1,976,000	867	1336	---	2381	2759	---	954	1006	**1550**	**---**
Minot / Fungicide	Spring	1,482,000	1314	1147	---	3090	3024	---	1692	992	**1876**	**---**
Hyola357 / Fungicide	Fall	1,482,000	1281	1458	408	2308	2354	1799	1457	1140	**1666**	**1526**
Hyola357 / Fungicide+Extender	Fall	1,482,000	976	1236	574	2660	2617	1483	1336	1107	**1655**	**1499**
Hyola357 / Fungicide	Fall	1,976,000	986	1372	731	2988	3054	1737	1517	1116	**1839**	**1688**
Hyola357+Fungicide	Spring	1,482,000	1478	1390	750	3547	3786	2157	2274	1588	**2344**	**2121**
Mean[2]	---	---	1085	1302	584	2565	2380	1534	1442	1064	**1640**	**1495**
C.V. (%)	---	---	30.1	18.4	46.8	10.6	14.1	18.0	---	20.2	---	---
LSD (0.05)	---	---	474	NS	387	390	482	395	---	310	---	---
LSD (0.01)	---	---	NS	NS	515	522	647	530	---	418	---	---

[1]C = Carrington, L = Langdon, D = Dickinson, W = Williston [2]Includes treatments not shown

Dormant (mature) and spring seeded (green) canola.

SUMMARY

- In general, fall-seeded canola produced significantly poorer stands and lower yields than spring-seeded. The data suggest that the minimum plant stand to equal spring planting varies with tillage, site, and year;
- Seed coating with Extender or increasing the seeding rate generally had a minimal effect on stand and yield, but the effects were inconsistent. Further improvements in seed coating technology and residue management which lead to improved stands should increase yields and the viability of dormant seeding;
- No-till generally provided a more favorable environment for dormant seeding due to the buffering effect on soil moisture and temperature. The residue improves soil surface characteristics, snow catch, and protects seedlings from wind. This result is especially meaningful for the typically drier western part of North Dakota where no-till is a common practice. Traditional crops in this region are normally harvested by early fall and farmers have more time available for seeding in the late fall;
- As a time management tool, dormant seeding effectively distributes labor and equipment demands at planting, however it did not significantly advance crop development and subsequent field operations in all site-years;
- Dormant seeding involves considerable risk. Inadequate stands and reduced yields were common in these research plots. Growers interested in this practice need to be aware of the risks and avoid over-committing resources.

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Canola plants during initial stage of flowering.

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