Seeding Date Influence on Winter Canola Performance in North Dakota

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Abstract

Recently developed winter canola (*Brassica napus* L.) genotypes exhibit improved winter hardiness and the potential for good crop performance in regions with more severe winters. The study objective was to evaluate seeding date influence on winter canola performance in eastern North Dakota. The study was a RCBD with three seeding dates (main plot), three genotypes (subplot), and three replicates conducted at Prosper, ND, during 2007/2008. Seed yield was 40% higher from the early (14 Sept.; 2560 kg/ha) compared with the two later seeding dates (27 Sept. and 3 Oct.) when averaged across genotypes. Genotype KS9135 produced approximately 20% greater seed yield than the two other genotypes when averaged across seeding dates. There was not a seeding date by genotype interaction for seed yield. Based on these results early seeding and genotype choice are both important for optimizing crop performance.

Introduction

Production risk with winter annual crops, especially in regions with severe winters, are poor spring stands due to winter-kill. Previous evaluations of winter canola in North Dakota during the early to mid 1980s indicated inadequate winter hardiness and essentially zero plant survival. However, more recently developed cultivars offer greater winter hardiness and the potential for good crop performance.

Objective

To evaluate seeding date influence on winter canola genotypes in eastern North Dakota (Fig. 1).

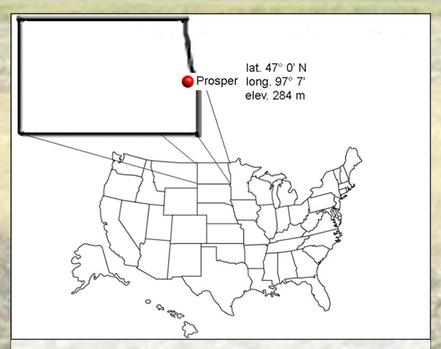

Fig. 1. Field location at Prosper, ND.

Materials & Methods

Experimental Design

RCBD in a split-plot arrangement with three replicates

Main plot – Seeding dates
- 14 September
- 27 September
- 3 October

Subplot – Genotypes – Open pollinated (Fig. 2)
- BSX567 – Conventional
- CWH683 – Glyphosate resistant
- KS9135 – Conventional

Study Parameters

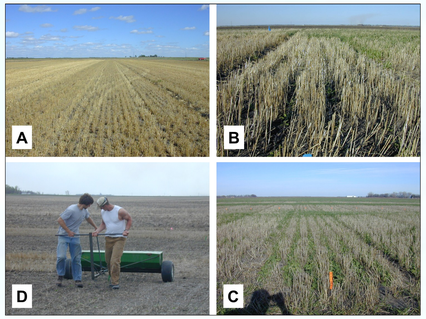

Fig. 2. Field study overview: (A) previous crop HRSW (B) seedbed – notill, stubble 20 cm (C) plots 6 rows spaced 30.5 cm and 7.6 m in length (D) spring fertilizing N, P, K, and S for 2,500 kg/ha yield goal

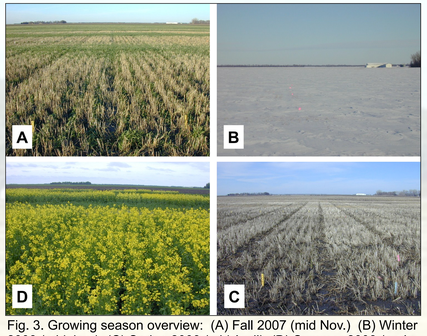

Fig. 3. Growing season overview: (A) Fall 2007 (mid Nov.) (B) Winter 2008 (mid Jan.) (C) Spring 2008 (mid April) (D) Summer 2008 (early June)

Characters Evaluated

- Fall stand – visual rating from 0 to 10 of established plant stands, where 10 is excellent and 0 is no stand (Fig. 3A)
- Winter survival – percent of established plants surviving the winter and resuming growth in the spring (Fig. 3B, C)
- Flowering (1st) – date 10% of plants have one or more open flowers (Fig. 3D)
- Flowering duration – days between first flowering and end of flowering
- Plant height (cm) and seed yield (kg/ha)
- Stand density at harvest determined from the center two plot rows (plants/m^2)

ANOVA performed by SAS

- Character means separation by *F*-protected LSD comparisons at $P \leq 0.05$.

Crop Development and Management

- Canola plant stages at the beginning of the winter dormant period (Fig. 4) for seeding dates 14 Sept., 27 Sept., and 3 Oct. were V4, V2, and early VC-V1, respectively, in mid Nov. at the beginning of the dormant winter period.
- Plot stands from the two earlier seeding dates were swathed on 14 July and combined on 21 July. The late seeding date plots were swathed on 21 July and combined on 28 July.

Results & Discussion

Seeding date effects

- Fall stands statistically decreased as seeding date was delayed (Table 1).
- Winter survival of plants decreased dramatically as seeding date was delayed (Table 1). Smaller plant development prior to fall dormancy likely contributed to lower plant winter survival from the later two seeding dates (Fig. 4 and 5).
- Flowering date occurred later as seeding date was delayed; although flowering duration was similar among seeding dates at approximately 35 d (Table 1 and Fig. 6).
- Stand density at harvest was markedly lower for the latest seeding date compared with the two earlier seeding dates that were similar (Table 1).
- Plant height was lower and seed yield was greater at the early seeding date compared with the later seeding dates that were similar.
- Greater stands at the early seeding date and earlier flowering likely benefited seed yield compared with the latest seeding date where stands were lower and flowering occurred later.
- Although stand density at harvest was similar for the early- and mid-seeding dates, lower yield at the mid-seeding date may be related to lower seedling vigor, smaller plant size, and later development of the mid-seeding date stands.
- Yield decline for spring canola becomes evident at 60 plants/m^2 and rapidly decreases with further stand reductions.
- Similar stand densities, at harvest, for the early- and mid-seeding dates suggests greater plant mortality during the season at the early seeding date likely due to higher stands and greater plant competition.

Genotype effects

- Genotype differences were noted for only plant height and seed yield when averaged across seeding dates (Table 1).
- Genotype KS9135 was taller and higher yielding compared with BSX567 and CWH683 which produced similar height and yield.
- The genotype by seeding date interaction was not significant for any characters.

Table 1. Mean main-effect character values for the winter canola study conducted at Prosper, ND, in the 2007/2008 season.

Main effect	Fall stand†	Winter survival‡	First flower§	Flower duration	Stand density	Plant height	Seed yield
Date		%		d	plants/m^2	cm	kg/ha
14 Sept.	9.4	86	28 May	34	59	108	2560
27 Sept.	9.3	45	1 June	36	51	114	1860
3 Oct.	9.2	23	10 June	34	34	117	1840
LSD (0.05)	0.1	11	0.5	NS	10	6	470
Genotype							
KS9135	9.3	57	2 June	36	49	120	2340
BSX-567	9.3	47	2 June	35	48	111	1950
CWH683	9.3	50	2 June	34	49	108	1980
LSD (0.05)	NS	NS	NS	NS	NS	7	350
CV, %	0.6	21	1.5	6.5	20	6	16

† Visual rating from 0 to 10 of established stand, where 10 is excellent and 0 is no stand
‡ Percent of established plants surviving the winter and resuming growth in the spring
§ Date that 10% of plants have one or more open flowers

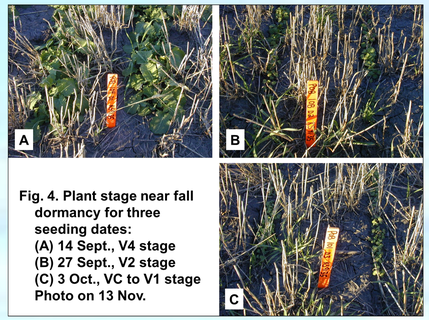

Fig. 4. Plant stage near fall dormancy for three seeding dates:
(A) 14 Sept., V4 stage
(B) 27 Sept., V2 stage
(C) 3 Oct., VC to V1 stage
Photo on 13 Nov.

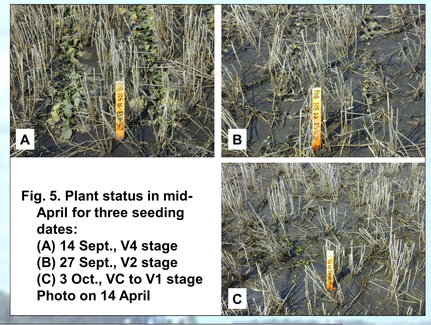

Fig. 5. Plant status in mid-April for three seeding dates:
(A) 14 Sept., V4 stage
(B) 27 Sept., V2 stage
(C) 3 Oct., VC to V1 stage
Photo on 14 April

Fig. 6. Flowering for three seeding dates:
(A) 14 Sept., on 28 May
(B) 27 Sept., on 1 June
(C) 3 Oct., on 10 June
Photo on 5 June

Conclusions

- Current winter canola genotypes have greater winter hardiness than those evaluated in the mid 1980s in North Dakota.
- Genotype influenced yield and consequently genotype selection would be an important factor to assure optimum crop performance.
- Although genetics is part of the improvement in winter hardiness, environmental conditions also influence winter survival.
- Environmental conditions produced low snowfall and cold temperatures during the 2006/2007 winter at Prosper and the study was abandoned due to almost complete winter-kill. In comparison, good snowfall and warmer temperatures were observed at Prosper in the 2007/2008 winter resulting in good crop performance.
- Early seeding helps assure greater plant development in the fall prior to winter and enhances winter survival, spring stand density, plant vigor, growth and development, and crop performance.
- Earlier seeding dates in late August and early September should also be evaluated.
- In addition, further research is recommended to determine seeding date and genotype effects on seedbed microclimate and plant development as they relate to winter survival, plant vigor, and crop performance.

Acknowledgements

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