Digital Canola Canopy Analysis: Effect of Cultivar and Seeding Date

K. Neil Harker[1], George W. Clayton[1], John T. O'Donovan[2], Robert E. Blackshaw[3], Alan K. W. Tong[1], and Tong Lui[1]

[1]Agriculture and Agri-Food Canada, Lacombe Research Centre, 6000 C & E Trail, Lacombe, Alberta, Canada T4L 1W1. Phone: (403) 782-8134, Facsimile: (403) 782-6120, E-Mail: harkerk@agr.gc.ca

[2]Agriculture and Agri-Food Canada, Beaverlodge Experimental Farm, Research Road, P. O. Box 29, Beaverlodge Alberta, Canada T0H 0C0. Phone: (780) 354-5144, Facsimile: (780) 354-8171, E-Mail: O'Donovanj@agr.gc.ca

[3]Agriculture and Agri-Food Canada, Lethbridge Research Centre, P.O. Box 3000, Lethbridge, Alberta, Canada T1J 4B1. Phone: (403) 327-2268, Facsimile: (403) 382-3156, E-Mail: blackshaw@agr.gc.ca

ABSTRACT

Experiments were conducted at Lacombe and Beaverlodge, Alberta, Canada to determine canopy development in three canola cultivars seeded at three seeding dates. Canola cultivars were InVigor 2663 (glufosinate-tolerant hybrid *Brassica napus*), Q2 (conventional open pollinated *B. napus*), and Hysyn 110 (conventional open pollinated *B. rapa*). Seeding date targets were late fall (dormant-seeded), late April (early spring), and mid May (normal). Canola canopy was determined by destructive biomass samples every 2 weeks and by digital photos of a selected area in each plot every week. A C++ program for Windows was written to determine percent green in the digital photos. At both locations canopy development was more rapid for InVigor 2663 than the other cultivars. At Beaverlodge, fall-seeded canola covered the ground most quickly early in the growing season but fell behind the spring seeded canola later in the season. At Lacombe, spring frosts damaged the fall-seeded canola more than the canola seeded in the spring and the early spring seeded canola canopy developed most quickly. Canopy development ranking among cultivars remained constant across the three seeding dates (the variety x seeding date interaction was not significant at any evaluation date). Digital canopy analysis can be utilized to quickly determine the influence of agronomic and environmental factors on the growth and vigour of canola genotypes.

Key Words: digital photos – competition – fall-seeding – growth analysis

INTRODUCTION

Weed management in canola has continued to improve over the last few years. We have progressed from having few weed management options in canola to herbicide-tolerant canolas where most weeds can be managed with herbicides (Harker et al. 2000). However, herbicides have provided such wonderful activity on weeds that agronomic practices that augment herbicide performance are often neglected or forgotten. Here, we focus on seeding date and cultivar effects on canola canopy closure. Agronomic practices that promote rapid canopy closure will improve herbicide performance and reduce the need for additional applications. We employ digital photo analyses to determine treatment combinations that lead to rapid canopy closure.

Our objective was to determine optimal combinations of seeding date and canola cultivar that would lead to rapid closure of the canola canopy. These practices would enhance crop competitiveness with weeds, reduce reliance on repeated herbicide applications, and provide opportunities for integrated weed management.

MATERIALS AND METHODS

Experiments were conducted at two Alberta locations (Lacombe and Beaverlodge) in 2002. Three canola cultivars [glufosinate-tolerant hybrid 'InVigor 2663' (*Brassica napus*), Q2 (*B. napus*), and Hysyn 110 (*B. rapa*)] were seeded at three times (Fall, April, and May) at 150 seeds m^{-2} and fertilized according to soil test recommendations. Plots were maintained weed-free throughout the growing season (herbicides and hand-weeding). Experiments were a factorial arrangement of treatments (3 x 3) in a RCBD with 4 replications. Data collection included: crop stand counts, weekly canopy photos, bi-weekly biomass sampling, and canola yield and quality. A C++ program for Windows was written to determine percent green in the digital photos. Early % canola canopy data before significant canola flowering are shown here. Data were subjected to analysis of variance and means from significant sources of variation were separated by LSD (0.05).

RESULTS

Although extremely dry conditions prevailed at both locations in 2003, crop stands and yields were higher at Lacombe than at Beaverlodge (Table 1). Fall seeding led to lower crop stands and yields at both sites. Seeding date effects on crop stands were much greater at Lacombe than Beaverlodge due to repeated frosts at the former site. The frosts reduced fall-seeded crop stands more than stands seeded in the spring. Low crop stands for all seeding dates at Beaverlodge were mostly due to dry soil conditions at planting.

Table 1. Crop stand and yield data from Beaverlodge and Lacombe (2002).

	Crop stand (plants/m^2)						Yield (kg/ha)					
	Beaverlodge			Lacombe			Beaverlodge			Lacombe		
Cultivar	Fall	April	May	Fall	April	May	Fall	April	May	Fall	April	May
Hysyn 110	24	38	33	33	95	69	500	743	1120	486	1098	1908
Q2	11	19	27	38	98	95	607	1173	1212	1413	2089	2652
InVigor 2663	16	32	38	48	109	93	864	1745	1557	2252	3231	3202
LSD (0.05)[1]	8			9			238			444		

[1]LSD = Least Significant Difference for crop stand or yield means within a location.

As expected, % canopy development was closely correlated with dry matter accumulation (data not shown). The seeding date x cultivar interaction for canopy data was not significant at either site for any evaluation date (ANOVA), therefore main effect seeding date and cultivar means are presented (Table 2).

Table 2. The effect of cultivar and seeding date on percent canola canopy closure early in the growing season at Beaverlodge and Lacombe (2002).

	% Canopy closure						
	Seeding date			Cultivar			
Site	Fall	April	May	Hys	Q2	InV	LSD[1]
Beaverlodge							
June 11	6	3	2	4	2	5	1.1
June 18	19	12	9	13	9	17	3.9
Jun 25	42	38	32	36	30	45	7.7
Lacombe							
June 5	3	4	1	2	2	3	0.7
June 12	5	13	3	6	5	10	2.1
June 19	17	41	11	20	19	31	6.4
June 26	33	64	31	34	39	54	8.4

[1]LSD = Least Significant Difference for seeding date or cultivar means within a row.

At Beaverlodge, fall seeding usually resulted in the greatest canopy closure at any evaluation date. April seeding tended to have greater canopy closure than May seeding, but these tendencies were not significantly different. InVigor 2663 always had greater canopy closure than the other varieties. In addition, Hysyn 110 usually developed a canola canopy more quickly than Q2.

At Lacombe, April seeding led to greater canopy closure than fall or May seeding. Fall seeding usually led to greater canopy closure than May seeding for a given evaluation date. As was the case in Beaverlodge, InVigor developed canola canopy more quickly than either Q2 or Hysyn 110. However, in contrast to Beaverlodge, Q2 usually had greater canopy closure than Hysyn 110 for a given evaluation date.

DISCUSSION

Digital canopy analyses can quantify effective crop canopy closure, and in conjunction with other agronomic indices, can be a useful tool to predict crop/weed competition.

Seeding date effects on canopy closure were related to site and environment. At Beaverlodge, soil moisture limitations probably impacted stand counts, canopy closure, and yield more than any other environmental conditions. Although fall seeded canola at Beaverlodge usually had the greatest canopy development for a given evaluation date, lower yields after fall seeding (in this and other studies) make this practice less desirable at that site.

At Lacombe, though spring soil moisture was very limited, several spring frosts probably had an even greater influence on canola canopies. Accordingly, the fall seeded plots that can lead to the most rapid canopy closure, were negatively impacted by repeated frosts, and had less canopy development than plots seeded in April. Although fall seeding has several advantages over spring-seeded canola (Kirkland et al. 2000), it is not a practice for the risk averse.

InVigor 2663 consistently led to more rapid canopy closure than either of the other cultivars. Plants that grow rapidly are generally good competitors (Clements et al. 1929); and, for that reason, InVigor hybrids are particularly good competitors (Zand and Beckie 2002). Seeding a vigorous cultivar such as InVigor 2663 at the appropriate time will improve crop competition with weeds and enhance opportunities to manage weeds in a more integrated manner.

ACKNOWLEDGEMENTS

The authors thank the Alberta Canola Producers Commission, Bayer CropScience, and AAFC-MII for funding support. We also thank the Agronomy/Weeds Technical Staff at Lacombe and Beaverlodge.

REFERENCES

Clements, F.E., J.E. Weaver, and H.C. Hanson. 1929. Plant competition – an analysis of community function. Publ. No. 398. Carnegie Institute, Wash., D.C. 340 pp.

Harker, K.N., Blackshaw, R.E., Kirkland, K.J., Derksen, D.A. and Wall, D. 2000. Herbicide-tolerant canola: weed control and yield comparisons in western Canada. Can. J. Plant Sci. 80, 647-654.

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

Zand, E. and Beckie, H.J. 2002. Competitive ability of hybrid and open-pollinated canola (*Brassica napus*) with wild oat (*Avena fatua*). Can. J. Plant Sci. 82, 473-480.