PNW Canola Research Project Progress Report -- 2004

I. Project Title: Variety Selection and Agronomic Technology to Reduce Heat, Water, and Pest Stress of Canola in Central Montana

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IV. Objectives:

1. Evaluate selected canola varieties for their adaptation to field sites in north central and central Montana.

2. Determine the optimum seeding date and rate to avoid or reduce heat and water stress without risking seedling mortality due to freezing or seed decay in cold soils.

3. Determine the optimum seeding date and rate to avoid or reduce pest damage.

V. Results:

1). Variety Evaluation

Fourteen varieties and breeding lines, including regular and Clear-Field canola, were obtained from Dr. Jack Brown's canola breeding program at University of Idaho, and three Roundup-Ready canola varieties were received from Monsanto Company and Interstate Seed Company. The canola was planted at the Central and Western Triangle Agricultural Research Centers (CARC and WTARC) of Montana State University. The trials were planted into a tilled re-cropped field on 13 April and 14 April of 2004 at WTARC and CARC, respectively. The experiment was a randomized complete block design with four replications. The seeding rate (plant density) was 67 plants m^{-2}. Fertilizer was applied after the canola grew to two true leaves stage at a rate of 75 kgN and 25 kgP_2O_5 per hectare using the broadcast method. With an early seeding date and reasonable precipitation distribution in 2004, the canola seed yields were very good in 2004 (Table 1). Variations were found among the cultivars both on seed yield and oil content. Several cultivars from Idaho had similar or greater seed yield than the commercial Roundup-Ready cultivars that commonly planted in this region. Canola had higher seed yield and oil content at WTARC than at CARC site because of the deeper soil profile and more precipitation in the summer at WTARC than at CARC.

Table 1. Canola seed source, yield and oil content at CARC and WTARC in 2004.

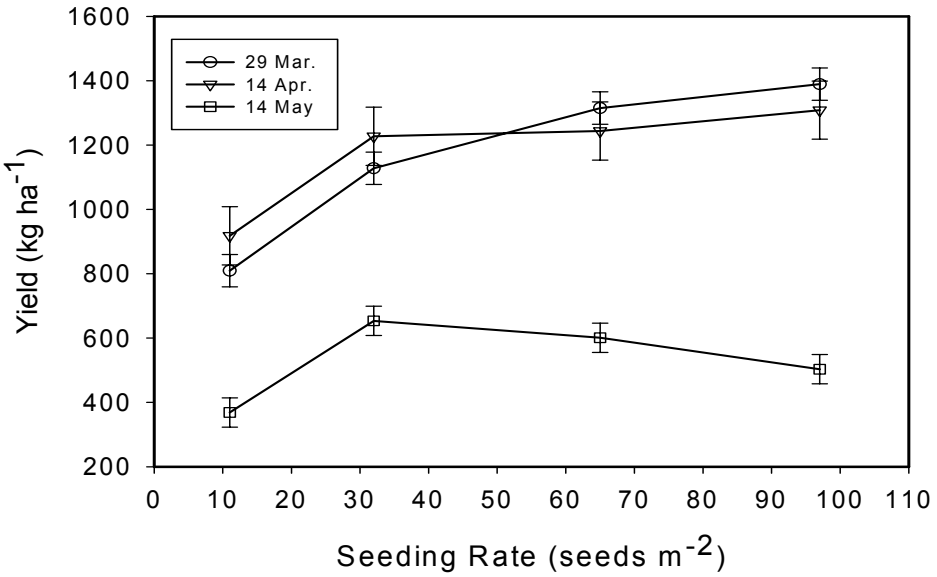
Variety	Source	Note	CARC2004 Yield (kg ha^{-1})	CARC2004 Oil (%)	WTARC2004 Yield (kg ha^{-1})	WTARC2004 Oil (%)
Hyola357	Interstate	Roundup-Ready	1244.4 abc	38.4fgh	2310.0 ab	44.3abcd
95SH2511017	U of I		983.5 cd	41.6abc	2197.6 abc	46.0a
96SI510312	U of I		1054.7 bcd	40.3bcde	2479.3 ab	43.5bcd
Clearwater	U of I	Clear-Field	989.4 cd	40.3bcde	2226.3 abc	44.5abcd
DKL223	Monsanto	Roundup-Ready	1165.6 abcd	38.3fgh	2568.8 a	43.3cd
DKL3455	Monsanto	Roundup-Ready	884.2 d	41.7ab	2363.6 ab	45.4ab
Garnet	U of I		1049.3 bcd	41.3abc	2061.9 bc	45.3abc
Impact	U of I		1179.2 abcd	41.9ab	2083.2 bc	44.8abc
Premier	U of I		1109.2 abcd	37.8gh	2165.2 abc	44.1abcd
Sterling	U of I		1075.2 abcd	40.5bcde	2189.6 abc	44.9abc
Sunrise	U of I		1074.5 abcd	40.0cdef	1835.1 c	44.4abcd
UISC00135	U of I		1352.1 a	37.7gh	2604.9 a	42.8d
UISC00317	U of I		1266.7 abc	39.4defg	2157.5 abc	45.9a
UISC0038DE	U of I		1292.9 ab	39.0efgh	1803.8 c	43.7bcd
UISC02314	U of I		1199.4 abc	42.5a	2074.6 bc	45.2abc
UISH0031923	U of I		1237.3 abc	40.7bcd	2317.2 ab	44.7abc
UISH003197	U of I		1089.0 abcd	40.3bcde	2487.1 ab	45.1abc

Data in the same column followed by different letters indicate significantly different according to Fisher's protected LSD at $P \leq 0.05$.

2). Seeding Date and Rate Study

A seeding date and rate study was continued at CARC and WTARC in 2004. Two glyphosate-tolerant canola varieties, Hyola 357 (Interstate Seed Company, West Fargo, ND)[1] and DK 223 (Monsanto Company, St. Louis, MO), were direct-seeded into winter wheat stubble on three seeding dates using a no-till plot drill with a 0.3 m row spacing. The seeding dates were 29 March, 14 April, and 15 May at CARC, and were 30 March, 13 April, and 30 April at WTARC. The canola plots were planted at seeding rates of 11, 33, 67, and 100 seeds m^{-2}. The experiment was a split-split plot design with four replications. Planting dates were assigned to whole plots, varieties were assigned to subplots, and plant densities were assigned to sub-sub plots. Plot dimension was 1.5m x 9 m. After seedlings grew to 2 true leaves stage, 67 kgN ha^{-1} plus 22 kgP_2O_5 ha^{-1} was applied using the broadcast method. Glyphosate was applied for weed control as needed. Canola seed was harvested by direct combining using a plot combine.

Seeding date and plant density significantly affected canola seed yield ($P<0.05$). At CARC, the two Glyphosate resistant canola varieties, Hyola 357 and DKL 233, performed equally. Therefore, we pooled the two cultivars and presented the average yield data in Fig. 1. Yields were similar for 29 March and 14 April seeding dates, and were significantly greater than 14 May seeding date. Seed yield increased with seeding rate increasing and reached a plateau when seeding rate reached 33 to 67 plants m^{-2} for 29 March and 14 April seeding dates, but yield decreased when seeding rate was greater than 33 plants m^{-2} for 14 May seeding date.



[1] Mention of trade name does not constitute an endorsement.

Fig. 1. Average seed yield of DKL 223 and Hyola 357 as affected by seeding date and plant density at CARC in 2004.

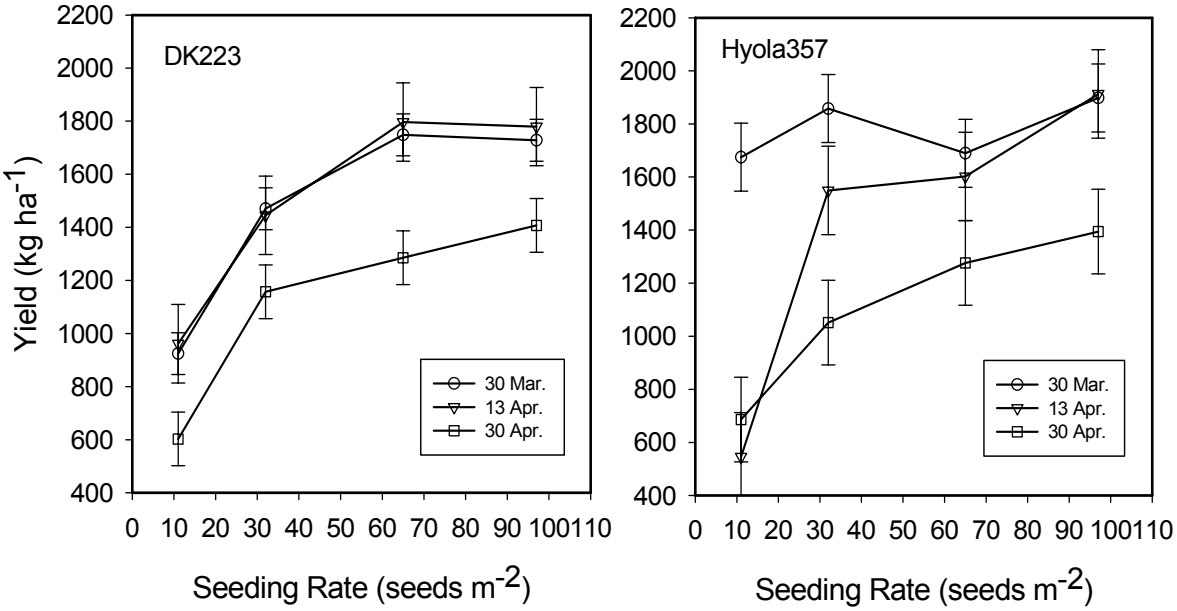


Fig. 1. Seed yield of DKL 223 and Hyola 357 as affected by seeding date and plant density at WTARC in 2004.

Similar responses of yield to seeding date and plant density were founded at WTARC, except the first seeding date of Hyola 357 at 11 plants m^{-2} seeding rate had a unusually high yield, which likely due to a great yield plasticity of Hyola 357 to seeding rate under favorable moisture conditions. Yields were similar at 30 March and 13 April seeding dates, but were greater than at 30 April seeding date. Yield plateau was reached at a seeding rate of 33 to 67 plants m^{-2}. There was no visual pest damage throughout the growing season in 2004.

3). Cold tolerant measurement of canola cultivars

Because canola yield is significantly higher at early seeding date (late March to early April) in Montana, selected canola cultivars for this region must be able to emerge in a cool soil and tolerate frequent frost damages in the early spring. We did some preliminary measurements for cold tolerance of the seventeen cultivars in Experiment 1 and results are shown in Table 2. Great variations were found among the cultivars on photosynthesis (measured by fluorescence Fv/Fm) and electrolyte leakage after a snow storm, indicating differences in cold tolerance.

Table 2. The F_v/Fm depression {$\Delta(F_v/F_m)$} and electrolyte leakage (EL) after cold stress of seventeen canola cultivars planted at the Central Agricultural Research Center (CARC) in 2004.

Variety	$\Delta(F_v/F_m)$	EL ($\mu s\ cm^{-1}$)
Hyola357	0.077 ab	16.9 ab
95SH2511017	0.053 bc	15.6 ab
96SI510312	0.049 bc	14.4 ab
Clearwater	0.044 bc	20.4 a
DKL223	0.028 c	15.7 ab
DKL3455	0.038 bc	14.8 ab
Garnet	0.054 bc	15.9 ab
Impact	0.041 bc	15.7 ab
Premier	0.069 abc	18.0 ab
Sterling	0.052 bc	17.8 ab
Sunrise	0.032 c	15.3 ab
UISC00135	0.028 c	13.7 b
UISC00317	0.042 bc	12.7 b
UISC0038DE	0.062 abc	16.0 ab
UISC02314	0.098 a	13.9 b
UISH0031923	0.064 abc	18.7 ab
UISH003197	0.028 c	17.5 ab

Data in the same column followed by different letters indicate significantly different according to Fisher's protected LSD at $P \leq 0.05$.

VI. Summary:

Canola seed yield is significantly affected by seeding date and rate. Early seeding date is a key for obtaining a high and stable yield. Canola should be seeded in late March to early April with a seeding rate of 33 to 67 plants m^{-2} in central and north central Montana. Several breeding lines from Dr. Jack Brown's breeding program at University of Idaho showed promising in yield and oil content. However, selected cultivars for early seeding in Montana must be able to emerge in cool soils and tolerate frequent frost damages in early spring. Our preliminary study in variety evaluation and cold tolerance screening showed promising results (Table 2). Therefore, I ask the PNW Canola Research Program Committee to continue supporting my research on variety evaluation and cold tolerance screening.

VII. Future Plans:

A manuscript on canola seeding date and rate for Montana has been submitted to Agronomy Journal for publication. The PI and co-PIs ask the PNW Canola Research Program to continue supporting our research until suitable cultivars were selected for semi-arid Northern Great Plains, these selected cultivars must be able to germinate and emerge in cool soils, tolerate cold weather in the early spring, and produce high seed yield and high oil content. We acknowledge the PNW Canola Research Program for funding support in the pat two years for this project.