Effects of planting date, seeding rate, canola variety and weed management strategy on weed control in canola. Lueschen, William E., Ervin A. Oelke, Erik J. Levorson, Dave G. LeGare, Eric A. Ristau and Karen Andol. The objective of this study was to evaluate the effects of two planting dates, three seeding rates, three canola varieties and four weed management strategies on competitiveness of canola with weeds. This study was conducted near Roseau, MN on the Mike Baumgartner farm. The soil type was a Borup sandy clay loam with 3.0% organic matter, pH 8.0 and soil test P and K levels of 16 and 246 lb/A, respectively. Prior to planting, the site was fertilized with 110 lb N/A, 30 lb P_2O_5/A, 40 lb K_2O/A and 20 lb S/A. This study was designed as a randomized complete block experiment with a split-split plot arrangement of treatments, four replications and a plot size of 6 by 30 ft. Main plots were two planting dates, May 25 and June 11, subplots were four herbicide treatment regimes and the sub-subplots were a combination of three canola varieties and three seeding rates (6, 12 and 18 viable seeds/ft^2) planted in rows spaced 6 inches apart. The three canola varieties were selected based on rate of canopy closure from data obtained in 1996. The three varieties were: 'Hyola 401', 'Sponsor' and 'OAC Summit' which were characterized as having rapid, medium and slow rates of canopy closure, respectively. All canola seed was prepackaged for the appropriate seeding rate and was treated with granular carbofuran and benomyl. All herbicide treatments were applied with a CO_2 pressurized bicycle sprayer calibrated to deliver 20 gpa using 8002 flat-fan nozzles and a spray pressure of 22 psi. Canola and weed biomass samples were harvested from a 2 by 4 ft area near the end of each plot after end trimming to eliminate border effects. Canola and weed biomass was hand-separated and dried in a forced air oven before weighing. Samples for planting dates I and II were taken on June 24 and August 12, respectively. Information on treatment dates, environmental conditions, plant sizes and rainfall are listed below:

Planting Date	May 25		June 11	
Application	PPI	POST	PPI	POST
Date	May 29	June 19	June 11	July 2
Temperature (F)				
air	75	68	75	60
soil (4 inch)	70	72	70	60
Relative humidity (%)	40	60	60	60
Sky	Clear	Cloudy	Clear	Clear
Wind (mph:direction)	5-8:W	6:NE	Calm	10:W
Canola				
leaf no	---	3	---	2-3
height (in)	---	1.5	---	1.5-2
Wild mustard				
leaf no	---	3	---	3
height (in)	---	3	---	3-4
infestation (plants/ft^2)	---	7	---	5
Rainfall following application (in)				
1st week	0.96	1.01	0.52	0.02
2nd week	0.0	1.30	1.01	0.10
3rd week	0.52	0.20	1.30	0.06

Dry conditions prevailed for approximately 7 days following both planting dates. This caused some uneven emergence that made it difficult to access herbicide injury to canola. Endothall at 0.75 lb/A POST following trifluralin PPI resulted in increased canola injury (data not shown) compared to other herbicide treatments but the differences were very small. Canopy closure was influenced by planting date, herbicide treatment, variety and seeding rate. On average it took 9 days longer for the canola canopy to close for the May 25 planting date compared to the June 11 planting date. Averaged across planting dates, seeding rates and herbicide treatments, rate of canopy closure was fastest with Hyola 401, followed in order by Sponsor and OAC Summit. Application of trifluralin PPI at 1.0 lb/A followed by endothall at 0.75 lb/A POST reduced the rate of canopy closure compared to all other herbicide treatments. As the seeding rates were increased, percent canopy closure on July 15 averaged 76, 82 and 86% for the 6, 12 and 18 seeds/ft^2 seeding rates, respectively. Weed biomass, which was almost entirely wild mustard, was influenced by planting date, herbicide treatment, canola variety and seeding rate. Differences in weed biomass cannot

be compared directly for the two planting dates since they were harvested at different times. The lowest weed biomass was associated with treatments that received trifluralin at 1.0 lb/A PPI followed by POST endothall at 0.75 lb/A. The second lowest weed biomass was observed with endothall at 0.375 lb/A POST; the weedy check had the highest weed biomass. Although endothall did not provide very good control of wild mustard, it did stunt it enough to reduce biomass production. Weed biomass was also influenced by canola variety and seeding rates. The least weed biomass was produced with Hyola 401 followed in ascending order by Sponsor and OAC Summit. As seeding rate increased there was a linear decline in weed biomass, this rate of decline was slightly less with OAC Summit compared to the other varieties. The highest percentage oil content of canola seed was observed with the second planting date, which also resulted in the highest seed yield. The trifluralin PPI at 1.0 lb/A followed by endothall at 0.75 lb/A POST resulted in about 1% higher oil than the other herbicide treatments. This may have been due to less wild mustard seed contamination. Hyola 401 had a higher percentage oil (37.9%) compared to the other varieties (37.3 and 37.4%). As seeding rate was increased the percentage oil in canola seed also increased; 36.5, 37.7, and 38.4% for the 6, 12, and 18 seeds ft^2, respectively. Highest seed yields were observed for the second planting compared to the first. The only herbicide treatment that resulted in a significantly higher canola seed yield than the check was trifluralin PPI at 1.0 lb/A followed by endothall POST at 0.75 lb/A. Hyola 401 was the highest yielding variety followed in descending order by Sponsor and OAC Summit. Canola seed yield increased from an average yield of 1216 lb/A for the lowest seeding rate, 6 seeds/ft^2, to 1352 and 1365 lb/A for the 12 and 18 seeds/ft^2 rates. [MN Agri. Exp. Sta. Paper No. 97-1-13-0046, Misc. Journ. Series, University of Minnesota, St. Paul.]

Table. Effects of planting date, seeding rate, canola variety and weed management strategy on weed control in canola (Lueschen, Oelke, Levorson, LeGare, Ristau, and Andol).

Herbicide treatment[a]	Rate	Variety	Seed Rate	Canopy		Biomass Yield				Maturity	
						Wild Mustard		Canola			
				PD I[b]	PD II	PD I	PD II	PD I	PD II	PD I	PD II
	(lb/A)		(plts/ft^2)	------(%)------		----------(lb/A)----------				-----(DAP[c])-----	
Trifluralin	0.5	Hyola 401	6	94	70	1110	1209	2037	5067	87	94
		Hyola 401	12	92	84	780	1134	2298	5211	88	92
		Hyola 401	18	98	91	513	1086	2973	5400	88	93
		Sponsor	6	92	60	1191	1527	1845	4149	89	92
		Sponsor	12	91	76	1155	1263	1929	4893	89	91
		Sponsor	18	96	78	705	1167	2724	5121	89	93
		OAC Summit	6	88	64	1728	2085	1185	3804	88	93
		OAC Summit	12	92	83	1269	1755	2310	4116	87	91
		OAC Summit	18	91	81	1005	1506	1938	4839	88	93
Endothall	0.375	Hyola 401	6	88	75	852	1173	2139	4809	89	94
		Hyola 401	12	83	87	462	1149	2301	5313	88	93
		Hyola 401	18	86	87	492	1131	2703	4494	89	91
		Sponsor	6	86	70	1329	1581	1506	4554	89	93
		Sponsor	12	89	79	876	1524	2133	4761	89	91
		Sponsor	18	90	83	717	1155	2337	4740	89	90
		OAC Summit	6	79	65	1194	1458	1158	4320	88	94
		OAC Summit	12	92	74	885	1356	1761	4344	89	93
		OAC Summit	18	78	84	834	1038	1515	4548	89	90
Trifluralin/	1.0/	Hyola 401	6	86	66	570	1410	1992	4374	92	94
endothall	0.75	Hyola 401	12	85	78	516	1122	1812	5160	93	93
		Hyola 401	18	90	88	327	1044	2235	4845	89	92
		Sponsor	6	73	53	927	1548	1536	4119	93	96
		Sponsor	12	79	65	588	1200	1887	4836	91	93
		Sponsor	18	79	78	525	1080	2211	4872	92	91
		OAC Summit	6	65	45	693	1683	1095	3684	93	95
		OAC Summit	12	73	60	996	1824	1158	3789	93	93
		OAC Summit	18	79	71	435	1497	1389	4326	90	94
Weedy Check		Hyola 401	6	92	85	1368	1689	3348	4311	87	92
		Hyola 401	12	95	89	993	1659	2559	4332	87	90
		Hyola 401	18	92	91	459	1083	3039	4950	87	90
		Sponsor	6	89	85	1611	1779	1720	4647	88	92
		Sponsor	12	93	88	1083	1821	1962	4572	88	91
		Sponsor	18	92	87	876	1269	2739	5031	88	90
		OAC Summit	6	87	71	1563	2043	1251	3876	87	91
		OAC Summit	12	92	84	1116	1662	2559	4161	88	91
		OAC Summit	18	89	84	1071	1524	1932	4518	87	88

A. Planting date means:				
Date I	87	912	2025	89
Date II	77	1423	4580	92
B. Herbicide means:				
Trifluralin 0.5	84	1233	3436	90
Endothall 0.375	82	1067	3302	90
Trifluralin/endothall 1.0/0.75	73	999	3073	93
Weedy check	88	1371	3400	89
C. Variety x seeding rate means:				
Hyola 401 6 seeds/ft^2	82	1173	3510	91
Hyola 401 12 seeds/ft^2	87	977	3623	90
Hyola 401 18 seeds/ft^2	90	767	3830	90
Sponsor 6 seeds/ft^2	76	1437	3010	91
Sponsor 12 seeds/ft^2	82	1189	3372	90
Sponsor 18 seeds/ft^2	85	937	3722	90
OAC Summit 6 seeds/ft^2	71	1556	2547	91
OAC Summit 12 seeds/ft^2	81	1358	2987	91
OAC Summit 18 seeds/ft^2	82	1114	3126	90
Prof (>F):				
Main effects: A	0.02	0.003	0.001	0.1
Main effects: B	0.001	0.002	0.19	0.001
Main effects: C	0.001	0.001	0.001	0.001
Interactions: AB	0.37	0.15	0.36	0.05
Interactions: AC	0.001	0.59	0.18	0.01
Interactions: BC	0.008	0.01	0.95	0.14
Interactions: ABC	0.5	0.86	0.74	0.17

[a]Herbicide treatments: trifluralin = Treflan 4E and endothall = Herbicide 273 3L.
[b]PD = planting date; PD I = May 25, PD II = June 11
[c]DAP = days after planting when 90% of the pods are brown.

Table. Con't. Effects of planting date, seeding rate, canola variety and weed management strategy on weed control in canola (Lueschen, Oelke, Levorson, LeGare, Ristau, and Andol).

Herbicide treatment[a]	Rate	Variety	Seed Rate	Protein		Oil		Yield	
				PD I[b]	PD II	PD I	PD II	PD I	PD II
	(lb/A)		(plts/ft^2)	(%)				(lb/A)	
Trifluralin	0.5	Hyola 401	6	26.7	24.9	35.6	37.6	1132	1452
		Hyola 401	12	25.8	24.0	37.4	39.3	1254	1637
		Hyola 401	18	25.6	24.2	38.4	39.4	1422	1658
		Sponsor	6	27.6	25.8	34.9	36.1	1049	1399
		Sponsor	12	27.0	25.1	36.4	37.7	1318	1485
		Sponsor	18	26.0	25.1	37.2	39.0	1387	1532
		OAC Summit	6	26.6	25.6	35.7	36.9	1013	1331
		OAC Summit	12	26.7	24.8	35.8	38.2	1142	1370
		OAC Summit	18	26.2	24.4	37.1	39.1	1082	1243
Endothall	0.375	Hyola 401	6	27.6	24.7	33.8	38.7	981	1509
		Hyola 401	12	26.8	24.9	35.7	38.8	1119	1640
		Hyola 401	18	25.5	24.6	38.2	39.5	1167	1637
		Sponsor	6	27.9	26.0	33.6	37.6	849	1364
		Sponsor	12	27.0	25.4	35.6	38.2	1002	1552
		Sponsor	18	26.2	24.8	37.6	39.4	1182	1465
		OAC Summit	6	27.6	26.7	33.3	36.9	805	1086
		OAC Summit	12	26.2	25.2	37.9	38.8	1063	1385
		OAC Summit	18	26.9	25.0	36.1	38.0	838	1403
Trifluralin/	1.0/	Hyola 401	6	25.6	25.2	37.7	37.9	1330	1444
endothall	0.75	Hyola 401	12	26.3	24.9	37.8	39.0	1301	1742
		Hyola 401	18	25.2	24.9	39.0	39.4	1274	1769
		Sponsor	6	26.2	26.7	37.5	37.1	1213	1456
		Sponsor	12	26.0	25.9	38.1	37.4	1305	1484
		Sponsor	18	26.0	24.9	38.7	39.2	1434	1567
		OAC Summit	6	26.1	25.9	37.1	38.9	1239	1355
		OAC Summit	12	26.1	25.7	37.9	39.5	1205	1513
		OAC Summit	18	25.2	25.1	39.1	39.1	1309	1535
Weedy Check		Hyola 401	6	26.6	25.1	35.2	37.2	1212	1308
		Hyola 401	12	24.6	24.7	37.8	38.4	1245	1559
		Hyola 401	18	25.1	24.3	37.7	39.7	1126	1712
		Sponsor	6	26.4	25.4	35.4	37.5	1023	1398
		Sponsor	12	26.1	25.7	37.4	37.7	1244	1468
		Sponsor	18	25.2	25.4	37.5	38.7	1201	1438
		OAC Summit	6	26.7	25.4	35.6	37.5	948	1280
		OAC Summit	12	26.4	25.1	36.7	38.3	1041	1373
		OAC Summit	18	26.0	25.3	36.7	37.5	1031	1346

A. Planting date means:				
	Date I	26.2	36.7	1152
	Date II	25.2	38.3	1469
B. Herbicide means:				
	Trifluralin 0.5	25.7	37.3	1328
	Endothall 0.375	26.0	37.1	1225
	Trifluralin/endothall 1.0/0.75	25.6	38.3	1415
	Weedy check	25.5	37.4	1275
C. Variety x seeding rate means:				
	Hyola 401 6 seeds/ft^2	25.8	36.7	1296
	Hyola 401 12 seeds/ft^2	25.2	38.0	1437
	Hyola 401 18 seeds/ft^2	24.9	38.9	1470
	Sponsor 6 seeds/ft^2	26.5	36.2	1219
	Sponsor 12 seeds/ft^2	26.0	37.3	1357
	Sponsor 18 seeds/ft^2	25.5	38.4	1401
	OAC Summit 6 seeds/ft^2	26.3	36.5	1132
	OAC Summit 12 seeds/ft^2	25.8	37.9	1261
	OAC Summit 18 seeds/ft^2	25.5	37.8	1223
Prob (>F):				
	Main effects: A	0.2	0.08	0.003
	Main effects: B	0.5	0.08	0.10
	Main effects: C	0.001	0.001	0.001
	Interactions: AB	0.24	0.20	0.53
	Interactions: AC	0.45	0.36	0.24
	Interactions: BC	0.29	0.14	0.98
	Interactions: ABC	0.32	0.41	0.94

[a]Herbicide treatments: trifluralin = Treflan 4E and endothall = Herbicide 273 3L.
[b]PD = planting date; PD I = May 25, PD II = June 11
[c]DAP = days after planting when 90% of the pods are brown.