

Project Title: Canola planting date and population study.

Objective: To identify the optimum canola planting date and density for northwestern Montana.

Materials and Methods:

The factorial treatment arrangement consisted of two canola varieties, three seeding dates and three plant densities. The two varieties selected were DKL 30-03 and DKL 70-07, representing early and late maturity groups, respectively. The three seeding dates were April 22, May 14 and May 29. The first seeding date was the earliest date we could get into the field. Subsequent planting dates were seeded at increments of 300 growing degree days at base 32F (GDD32), which represents the number of GDD necessary for the first true leaves to emerge. Targeted plant densities were 4, 8 and 16 plants per square foot. Seeding rates were calculated using the following formula: $\text{lb/A} = (9.6 \times \text{desired plant density per sqft} \times \text{thousand kernel weights}) / \text{percent survival}$ (Table 1). The experimental design was a split plot randomized complete block with three replications, where the main plot factor was seeding date, and the sub plot factor consisted of plant density and variety combinations.

Soil test results showed 246-24-178 pounds of available nutrients and a fertilizer blend of 50-30-40-20 was broadcasted and incorporated one day prior to each seeding date. Each seeding date was treated with Warrior II for flea beetles and Endura for Sclerotinia.

Table 1. Seeding rates (lb/A) to achieve target plant density

Variety	Thousand Kernel Weight (g)	Plant Density #/sqft	Seeding Rate (lb/A)
DKL 30-03	4.7	4	2.4
DKL 30-03	4.7	8	4.8
DKL 30-03	4.7	16	9.6
DKL 70-07	5.1	4	2.6
DKL 70-07	5.1	8	5.2
DKL 70-07	5.1	16	10.4

Estimated survival rate: 75%

$$\text{lb/A} = (9.6 \times \text{TKW} \times \text{Plant Density}) / 75$$

Results:

The main effect of variety was significant for physiological development, lodging and oil content (Table 2). DKL 30-03, the earlier maturing variety, required fewer growing degree days to progress through all phenological stages than DKL 70-07, the late maturing variety (Table 2). DKL 30-03 demonstrated a greater degree of lodging at 45.1% compared to 36.1% for DKL 70-07. Oil content averaged 49.0% for DKL 30-03 and 48.2% for DKL 70-07.

The main effect of plant density was a significant effect on lodging (Table 3). As plant density increased, so too did percent lodging. The lowest plant density averaged 17.4% lodging compared to 70.8% for the highest plant density.

The main effect of seeding date was significant for physiological development, height, yield, biomass and oil content (Table 4). The April 22nd seeding date required the greatest number of days to achieve emergence, flowering, and physiological maturity. This most likely can be attributed to cooler temperatures in April and less accumulated growing degree days.

The first seeding date afforded the greatest yield at 78.8 bu/A compared to 38.7 bu/A from the last seeding date. The yield reductions observed in both the second and third seeding dates are likely a function of heat stress during flowering and pod development. The first seeding date achieved 50% flowering on June 23, while the second and third seeding dates reached 50% flower on July 5 and July 15, respectively. The 7 day average high and low temperatures that correspond with the 50% flowering dates for the three seeding dates were: 74/48°F, 81/53°F and 84/54°F. It is known that prolonged high temperatures near flowering can have a negative impact on yield, biomass and oil content.

Interactions occurred between variety and planting date resulting in significant differences for both yield and test weight (Table 6). The earlier seeding date provided the highest test weights and yields. As seeding date was delayed yields decreased for both varieties. However, the magnitude of the response was more dramatic for DKL 70-07 with a yield reduction of 60% compared to 40% for DKL 30-03. This suggests that DKL 30-03 is a more stable variety with regard to seeding date. No interactions were observed between variety and plant density, plant density and seeding date, or variety by plant density by seeding date (Tables 5, 7 and 8).

In summary, the greatest yield was afforded with the earliest seeding date despite the overall delay in crop development (Table 4). When faced with the decision of having to plant late or re-plant a field, one needs to know what the expected yield is for a particular field and estimate a yield reduction of 15-25% for a mid-May seeding date and a 30-50% yield reduction for a late May seeding date.

Table 2. Main effect of variety on agronomic performance of canola - 2014

	EMERG	FLWR	PM	STAND 1	STAND 2	LOD	HT	YIELD	BIO	OIL	TWT
	DAP	DAP	DAP	SQFT	SQFT	%	in	BU	g/sqft	%	lb/bu
DKL 30-03	8.6	52.4	95.7	12.9	12.4	45.1	56.1	61.9	109.6	49	48.7
DKL 70-07	9.1	53.8	98.5	12.1	11.5	36.1	56.7	59.2	104.3	48.2	48.9
LSD	0.4	0.8	0.6	ns	ns	5.2	ns	ns	ns	0.5	ns
Pr>0.05	0.0118	0.0012	0.0001	0.3615	0.3116	0.0019	0.1819	0.0677	0.4269	0.0028	0.3573

Table 3. Main effect of plant density on agronomic performance of canola - 2014

4 plants/ sqft	9.1	53.3	97.2	5.6	5.3	17.4	57.0	60.1	98.7	49.1	48.6
8 plants/sqft	8.8	52.9	97.1	10.9	10.7	33.7	56.7	63.2	110.8	48.4	48.8
16 plants/sqft	8.6	53.0	97.0	21.1	19.8	70.8	55.5	58.3	111.3	48.3	49.0
LSD	ns	ns	ns	1.9	1.8	15.0	ns	ns	ns	ns	ns
Pr>0.05	0.0849	0.2871	0.9397	0.0001	0.0001	0.0001	0.3759	0.2478	0.1319	0.1006	0.2446

Table 4. Main effect of planting date on agronomic performance of canola - 2014

4/22	13.8	61.8	107.3	11.2	10.7	46.9	56.6	78.8	107.0	49.2	49.4
5/14	6.9	50.7	93.3	12.7	12.1	45.0	59.5	64.1	130.3	48.2	48.9
5/29	5.8	46.8	90.7	13.6	13.1	30.0	53.1	38.7	83.6	48.4	48.0
LSD	0.9	1.1	0.8	ns	ns	ns	3.7	7.8	19.4	0.5	ns
Pr>0.05	0.0001	0.0001	0.0001	0.0753	0.0631	0.1643	0.0226	0.0003	0.0068	0.0097	0.1592

Table 5. Effect of variety and plant density on agronomic performance of canola - 2014

	EMERG	FLWR	PM	STAND 1	STAND 2	LOD	HT	YIELD	BIO	OIL	TWT
	DAP	DAP	DAP	SQFT	SQFT	%	in	BU	g/sqft	%	lb/bu
DKL 30-03											
4 plants/ sqft	8.8	52.7	95.8	5.7	5.4	19.6	56.6	60.4	97.1	49.8	48.7
8 plants/sqft	8.7	52.3	95.7	10.8	10.9	39.4	56.2	64.8	108.6	48.9	48.5
16 plants/sqft	8.3	52.1	95.7	22.3	20.8	76.4	55.4	60.6	123	48.4	48.8
DKL 70-07											
4 plants/ sqft	9.4	54.0	98.6	5.4	5.2	15.3	57.4	59.9	100.3	48.4	48.4
8 plants/sqft	9.0	53.6	98.6	11.1	10.6	27.9	57.2	61.6	113.1	47.9	49.1
16 plants/sqft	8.9	53.9	98.3	19.8	18.8	65.2	55.6	56.0	99.6	48.2	49.1
LSD	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Pr>0.05	0.7590	0.8190	0.9480	0.3756	0.6183	0.4124	0.7167	0.4841	0.1682	0.2079	0.1585

Emerg: emergence, DAP: days after planting, FLWR: 50% flowering, PM: physiological maturity, STAND 1: plant density prior to bolt, STAND 2: plant density at pod fill, LOD: lodging, HT: height, BIO: biomass, TWT: test weight

Table 6. Effect of variety and planting date on agronomic performance of canola - 2014

	EMERG DAP	FLWR DAP	PM DAP	STAND 1 SQFT	STAND 2 SQFT	LOD %	HT in	YIELD BU	BIO g/sqft	OIL %	TWT lb/bu
DKL 30-03											
4/22	13.3	61.4	106.1	11.4	10.9	51.7	56.2	75.8	107.4	49.8	49.1
5/14	6.8	49.8	91.9	12.4	12.0	50.0	59.9	65.1	132.9	48.5	48.6
5/29	5.7	45.9	89.1	14.9	14.2	33.8	52.1	44.9	88.4	48.9	48.3
DKL 70-07											
4/22	14.3	62.2	108.4	11.0	10.6	42.2	57.0	81.9	106.5	48.7	49.7
5/14	7.1	51.6	94.8	13.0	12.1	40.0	59.1	63.1	127.6	48.0	49.2
5/29	5.9	47.7	92.2	12.3	11.9	26.2	54.1	32.6	78.8	47.8	47.7
LSD	ns	ns	ns	ns	ns	ns	ns	5.1	ns	ns	0.7
Pr>0.05	0.2072	0.4738	0.5113	0.3509	0.4462	0.9151	0.0871	0.0002	0.8596	0.5425	0.0357

Table 7. Effect of plant density and seeding date on agronomic performance of canola - 2014

	EMERG DAP	FLWR DAP	PM DAP	STAND 1 SQFT	STAND 2 SQFT	LOD %	HT in	YIELD BU	BIO g/sqft	OIL %	TWT lb/bu
4 plants/ sqft											
4/22	13.8	62.2	108.2	4.8	4.5	21.7	59.0	76.4	105.7	49.8	49.2
5/14	7.2	50.7	93.0	5.5	5.3	25.0	60.3	67.9	114.9	49.1	48.6
5/29	6.3	47.2	90.3	6.3	6.2	5.7	51.7	36.1	75.6	48.5	47.8
8 plants/ sqft											
4/22	13.8	61.7	107.7	10.2	9.5	48.3	56.2	83.7	108.7	49.1	49.4
5/14	6.8	50.7	93.7	11.0	11.2	39.2	61.0	65.5	138.7	47.6	49.1
5/29	5.8	46.5	90.0	11.7	11.5	13.5	53.0	40.4	85.1	48.5	47.8
16 plants/ sqft											
4/22	13.8	61.7	106.0	18.7	18.2	70.8	54.7	76.4	106.5	48.9	49.4
5/14	6.8	50.7	93.3	21.7	19.7	70.8	57.2	59.0	137.1	48.0	48.9
5/29	5.2	46.7	91.7	22.8	21.5	70.8	54.7	39.5	90.3	48.1	48.5
LSD	ns	ns	1.8	ns	ns	ns	ns	ns	ns	ns	ns
Pr>0.05	0.2501	0.8249	0.0565	0.6809	0.9021	0.3480	0.0886	0.4000	0.6371	0.5502	0.5850

Emerg: emergence, DAP: days after planting, FLWR: 50% flowering, PM: physiological maturity, STAND 1: plant density prior to bolt, STAND 2: plant density at pod fill, LOD: lodging, HT: height, BIO: biomass, TWT: test weight

Table 8. Effect of variety, seeding date and plant density on agronomic performance of canola -2014

	EMERG DAP	FLWR DAP	PM DAP	STAND 1 SQFT	STAND 2 SQFT	LOD %	HT in	YIELD BU	BIO g/sqft	OIL %	TWT lb/bu
4/22 - 4 plants/ sqft											
DKL 30-03	13.0	61.7	106.7	4.7	4.3	26.7	59.3	71.8	102.6	50.6	48.8
DKL 70-07	14.7	62.7	109.7	5.0	4.7	16.7	58.7	81.0	108.8	48.9	49.7
4/22 - 8 plants/ sqft											
DKL 30-03	13.7	61.3	106.7	9.7	8.7	53.3	55.0	79.0	98.4	49.6	49.2
DKL 70-07	14.0	62.0	108.7	10.7	10.3	43.3	57.3	88.4	119	48.6	49.6
4/22 - 16 plants/ sqft											
DKL 30-03	13.3	61.3	105.0	20.0	19.7	75.0	54.3	76.5	121.2	49.0	49.2
DKL 70-07	14.3	62.0	107.0	17.3	16.7	66.7	55.0	76.3	91.8	48.7	49.7
5/14 - 4 plants/sqft											
DKL 30-03	7.0	50.0	91.7	6.0	5.7	25.0	59.3	68.7	120.6	49.6	48.4
DKL 70-07	7.3	51.3	94.3	5.0	5.0	25.0	61.3	67.1	109.2	48.5	48.8
5/14 - 8 plants/sqft											
DKL 30-03	6.7	49.7	92.3	10.3	11.7	46.7	63.0	66.8	131	47.6	48.8
DKL 70-07	7.0	51.7	95.0	11.7	10.7	31.7	59.0	64.2	146.5	47.6	49.4
5/14 - 16 plants/sqft											
DKL 30-03	6.7	49.7	91.7	21.0	18.7	78.3	57.3	59.9	147.1	48.1	48.6
DKL 70-07	7.0	51.7	95.0	22.3	20.7	63.3	57.0	58.0	127.2	47.8	49.3
5/29 - 4 plants/sqft											
DKL 30-03	6.3	46.3	89.0	6.3	6.3	7.0	51.0	40.6	68.3	49.0	49.0
DKL 70-07	6.3	48.0	91.7	6.3	6.0	4.3	52.3	31.6	82.8	47.9	46.7
5/29 - 8 plants/sqft											
DKL 30-03	5.7	46.0	88.0	12.3	12.3	18.3	50.7	48.6	96.3	49.5	47.4
DKL 70-07	6.0	47.0	92.0	11.0	10.7	8.7	55.3	32.3	73.8	47.5	48.2
5/29 - 16 plants/sqft											
DKL 30-03	5.0	45.3	90.3	26.0	24.0	76.0	54.7	45.4	100.7	48.1	48.7
DKL 70-07	5.3	48.0	93.0	19.7	19.0	65.7	54.7	33.7	79.9	48.1	48.3
LSD	ns	ns	ns	ns	ns	ns	3.0	ns	ns	ns	ns
Pr>0.05	0.6408	0.9088	0.5708	0.5933	0.4652	0.8167	0.0175	0.5039	0.4688	0.5405	0.0609

Emerg: emergence, DAP: days after planting, FLWR: 50% flowering, PM: physiological maturity, STAND 1: plant density prior to bolt, STAND 2: plant density at pod fill, LOD: lodging, HT: height, BIO: biomass, TWT: test weight