

Project Title: Canola Planting Date and Population Study

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

Materials and Methods:

The factorial treatment arrangement consisted of three canola varieties, three seeding dates, and three plant densities. The three varieties selected were DKL30-42, HyClass 955, and InVigor L130, representing early, medium and late maturity groups, respectively. The seeding dates were April 17, May 9 and May 21. The first seeding date was selected when soil temperature reached 50°F at 2 inches. Subsequent planting dates were seeded at increments of 300 growing degree days (GDD32), which represents the number of GDD necessary for the first true leaves to emerge. The targeted plant populations were 4, 8 and 16 plants per square foot. Seeding rates were calculated using the following formula: (9.6 x desired plants per square foot x thousand kernel weight) / percent survival (Table 1). The experimental design was a randomized complete block with three replications.

Soil test results showed 202-6-162-38 pounds of available nutrients and a fertilizer blend of 0-40-40-20 was broadcasted and incorporated on April 9. Flea beetle pressure was high in early June and a single application of Warrior II was applied to the entire study on June 6. The third seeding date experienced severe deer grazing pressure at bolting.

Table 1. Seeding rates to achieve target plant density.

Variety	Thousand Kernel Weight (g)	Target plant/sqft	Seeding rate (lb/A)
DKL 30-42	6.8	4	3.5
DKL 30-42	6.8	8	7.0
DKL 30-42	6.8	16	13.9
InVigor L130	6.1	4	3.1
InVigor L130	6.1	8	6.2
InVigor L130	6.1	16	12.5
HyClass 955	5.3	4	2.7
HyClass 955	5.3	8	5.4
HyClass 955	5.3	16	10.9

Estimated survival rate: 75%

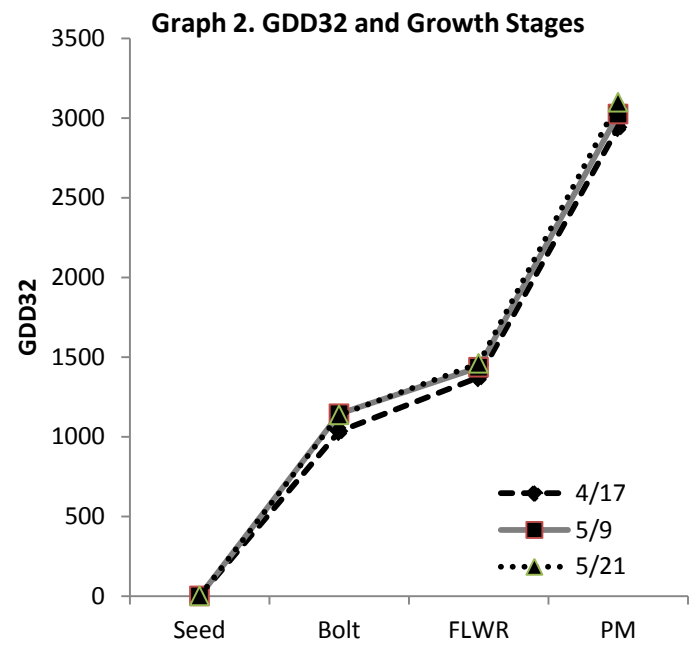
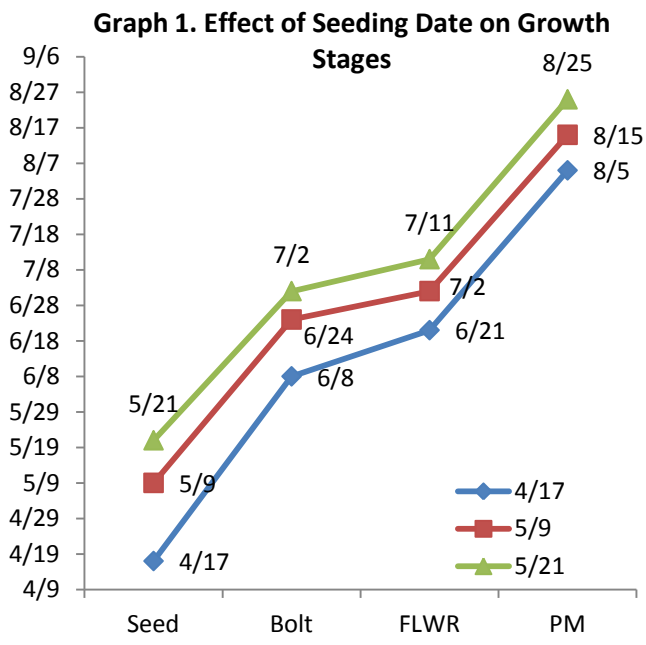
$$\text{lb/A} = (9.6 \times \text{plant/sqft} \times \text{tkw})/75$$

Results:

The main effect of variety had a significant effect on days to bolt, flower and physiological maturity, plants per square foot, percent lodging, height, percent oil, test weight and thousand kernel weights. DKL 30-42 and HyClass 955 were statistically equivalent and the required the least amount of days to bolt, flower and physiological maturity compared to InVigor L130. No statistical differences in yield were observed between varieties (Table 2).

Plant density impacted days to physiological maturity and lodging. As plant density increased, the rate of plant development increased and the degree of lodging increased (Table 3). However, lodging was minimal for InVigor L130, regardless of the plant density (Table 5). Of the treatment factors evaluated, the main effect of planting date had the most pronounced effect on canola growth and development (Table 4). Planting date impacted stand establishment. The second seeding date had the greatest percent survival and averaged 14 plants per square foot, regardless of targeted plant population. The third seeding date had the worse percent survival and averaged 4.6 plants per square foot.

Not surprisingly, crop development varied with planting date. The earlier planting provided for a longer growing season. As planting was delayed, the time interval between crop developmental stages became more compressed. That is, it took fewer days to reach maturity (Graph 1). However, planting date had no effect on crop developmental rates when expressed on a growing degree day basis (Graph 2).



FLWR: 50 % flower, PM: physiological maturity

Planting date had a significant impact on yield. Yields were similar for the first two seeding dates. However, yields declined dramatically with the third seeding date (Table 4).

Canola development varied by variety and seeding date (Table 6). All varieties displayed similar rates of development at the first seeding date. However, differences between varieties became more apparent as seeding was delayed, especially with the late maturing variety, InVigorL130. Interactions were observed between plant density and seeding date (Table 7) for plants per square foot, lodging, height, yield, and percent oil. The first seeding date achieved the targeted number of plants, while the second seeding date exceeded the target, and the third seeding date was significantly below the desired population. Yields declined as planting date was delayed, regardless of plant population. Eight plants per square foot at the first and second seeding dates afforded the highest yields at 58.3 bu/A and 53.3 bu/A respectively. The highest seeding rate produced the lowest yields at the first two seeding dates, but had the highest yields at the last seeding date.

Conclusion:

Seeding date and variety had the greatest impact on agronomic performance of canola, while plant population had minimal effect. Yield was considerably lower with the later seeding date and this may be attributed poor stand establishment, as well as adverse environmental conditions during flowering and pod filling. Further, the later seeding date was subject to severe deer grazing pressure at bolting. Overall, a mid-April to mid-May seeding date with a target plant population of four to eight plants per square foot appears to be the optimum conditions for canola production in northwestern Montana.

Table 2. Main effect of variety on agronomic performance of canola - 2013

Variety	BOLT			BOLT		PLNT sqft	DWT g	LOD %	HT in	YLD bu/A	OIL %	TWT lb/bu	TKW %	MC %
	BOLT Days	FLWR Days	to FLWR Days	PM Days	to PM Days									
DKL 30-42	45.8	55.7	9.9	100.9	55.1	8.0	231.5	19.3	50.0	40.9	47.5	49.6	4.5	9.7
HyClass 955	46.1	55.9	9.8	101.1	55.0	10.8	208.8	17.8	51.9	40.2	48.0	49.4	4.3	9.5
InVigor L130	48.5	57.8	9.3	102.9	54.4	10.2	228.1	5.3	56.6	40.5	45.7	50.2	3.9	11.6
LSD	0.7	1.7	2.0	1.4	1.8	1.8	64.1	7.0	4.6	2.7	0.8	0.6	0.3	1.3
Pr>F	0.0008	0.0517	0.7056	0.0301	0.5371	0.0240	0.6091	0.0097	0.0366	0.7715	0.0029	0.0405	0.0079	0.0198

Table 3. Main effect of plant density on agronomic performance of canola - 2013

4 plants/sqft	47.0	57.1	10.1	102.9	55.9	4.2	221.4	1.9	52.3	39.8	46.9	49.6	4.5	10.8
8 plants/sqft	46.7	56.6	9.8	101.7	55.0	9.1	238.8	6.2	54.1	42.6	47.1	49.8	4.2	10.2
16 plants/sqft	46.7	55.9	9.2	100.3	53.6	15.7	208.1	34.3	52.0	39.2	47.2	49.8	4.1	9.7
LSD	0.6	2.2	2.2	1.4	1.5	1.6	72.1	4.3	4.1	6.6	1.0	0.7	0.3	1.7
Pr>F	0.3699	0.3954	0.5672	0.0166	0.0328	0.0001	0.5475	0.0001	0.3839	0.3953	0.7036	0.7860	0.0617	0.3294

Table 4. Main effect of seeding date on agronomic performance of canola - 2013

4/17	52.2	64.8	12.6	110.4	58.2	10.3	296.9	24.4	54.4	55.1	48.7	50.3	3.5	11.1
5/9	46.4	54.1	7.7	98.2	51.8	14.0	244.5	18.0	56.6	50.1	47.6	49.3	4.6	9.7
5/21	41.9	50.6	8.8	96.4	54.6	4.6	126.9	0.0	47.4	16.4	44.9	49.6	4.7	9.9
LSD	1.4	3.6	3.9	1.6	2.9	3.0	81.5	9.3	4.4	7.6	1.0	0.6	0.4	1.8
Pr>F	0.0001	0.0009	0.0521	0.0001	0.0094	0.0024	0.0105	0.0043	0.0098	0.0003	0.0009	0.0270	0.0018	0.1638

Table 5. Effect of variety and density on agronomic performance of canola - 2013

Variety	BOLT			BOLT		PLNT sqft	DWT g	LOD %	HT in	YLD bu/A	OIL %	TWT lb/bu	TKW %	MC %
	BOLT Days	FLWR Days	to FLWR Days	PM Days	to PM Days									
Four plants/sqft														
DKL 30-42	45.8	55.9	10.1	102.3	56.6	3.2	245.8	1.7	48.4	41.4	47.2	49.4	4.8	10.3
HyClass 955	46.2	56.0	9.8	101.4	55.2	4.9	189.6	2.8	51.8	39.1	48.3	49.1	4.4	9.2
InVigor L130	49.0	59.3	10.3	105.0	56.0	4.6	228.8	1.1	56.6	38.8	45.1	50.4	4.2	13.0
Eight plants/sqft														
DKL 30-42	45.8	56.6	10.8	101.7	55.9	6.9	217.4	12.2	51.8	45.6	47.3	49.8	4.6	9.9
HyClass 955	46.1	56.1	10.0	101.1	55.0	9.9	232.1	5.0	52.6	43.4	48.0	49.3	4.3	9.6
InVigor L130	48.3	57.0	8.7	102.4	54.1	10.6	267.0	1.4	58.1	38.9	46.1	50.2	3.6	11.2
Sixteen plants/sqft														
DKL 30-42	45.9	54.8	8.9	98.8	52.9	13.9	231.3	43.9	49.7	35.8	47.9	49.5	4.3	8.8
HyClass 955	46.0	55.7	9.7	100.9	54.9	17.7	204.7	45.6	51.4	38.2	47.8	49.8	4.2	9.8
InVigor L130	48.1	57.1	9.0	101.2	53.1	15.4	188.4	13.3	55.0	43.7	45.8	50.0	3.9	10.6
LSD	1.0	1.9	2.2	2.9	2.9	3.3	90.3	11.2	4.3	8.4	1.4	0.7	0.5	2.5
Pr>F	0.5686	0.1626	0.3852	0.3279	0.3747	0.5494	0.4713	0.0074	0.7783	0.1492	0.4280	0.1852	0.2022	0.3881

FLWR: flowering, PM: physiological maturity, PLNT: plants, DWT: dry weight, LOD: lodging, HT: height, YLD: yield, TWT: test weight, TKW: thousand kernel weight, MC: moisture

Table 6. Effect of variety and seeding date on agronomic performance of canola - 2013

Variety	BOLT				BOLT				HT	YLD	OIL	TWT	TKW	MC
	BOLT Days	FLWR Days	to FLWR Days	PM Days	to PM Days	PLNT sqft	DWT g	LOD %						
First seeding date - April 17														
DKL 30-42	52.1	65.1	13.0	110.8	58.7	9.6	328.7	27.2	53.0	54.4	49.0	50.3	3.7	11.0
HyClass 955	51.8	64.3	12.6	110.7	58.9	10.7	253.6	30.0	52.4	55.5	49.5	50.1	3.6	11.1
InVigor L130	52.7	64.9	12.2	109.7	57.0	10.8	308.4	15.9	57.9	55.5	47.6	50.3	3.2	11.3
Second seeding date - May 9														
DKL 30-42	44.0	52.8	8.8	96.8	52.8	11.8	250.7	30.6	52.9	53.4	47.8	49.1	4.9	8.9
HyClass 955	45.4	54.2	8.8	98.0	52.6	15.4	231.4	23.3	56.8	46.6	48.4	48.8	4.6	8.9
InVigor L130	49.7	55.2	5.6	99.8	50.1	14.9	251.5	0.0	60.0	50.4	46.6	50.0	4.2	11.4
Third seeding date - May 21														
DKL 30-42	41.3	49.3	8.0	95.2	53.9	2.7	115.1	0.0	44.0	15.1	45.6	49.3	5.0	9.1
HyClass 955	41.1	49.2	8.1	94.8	53.7	6.3	141.3	0.0	46.6	18.5	46.3	49.2	4.7	8.5
InVigor L130	43.1	53.3	10.2	99.2	56.1	4.9	124.4	0.0	51.8	15.5	42.8	50.3	4.3	12.1
LSD	1.0	1.8	2.1	1.6	1.9	3.0	82.2	7.1	2.9	7.6	0.9	0.7	0.6	1.4
Pr>F	0.0003	0.0252	0.0159	0.0030	0.0110	0.5959	0.4306	0.0010	0.2132	0.3156	0.0626	0.1393	0.9454	0.0332

Table 7. Effect of plant density and seeding date on agronomic performance of canola - 2013

Density	BOLT				BOLT				HT	YLD	OIL	TWT	TKW	MC
	BOLT Days	FLWR Days	to FLWR Days	PM Days	to PM Days	PLNT sqft	DWT g	LOD %						
First seeding date - April 17														
4 plants/sqft	52.8	65.4	12.7	111.7	58.9	4.2	288.9	4.4	54.0	56.2	48.5	50.2	3.5	11.5
8 plants/sqft	51.9	64.7	12.8	110.3	58.4	9.9	326.6	12.0	55.9	58.3	49.1	50.2	3.6	11.2
16 plants/sqft	51.9	64.2	12.3	109.1	57.2	16.9	275.1	56.7	53.4	50.9	48.5	50.4	3.4	10.7
Second seeding date - May 9														
4 plants/sqft	46.6	54.3	7.8	99.0	52.4	6.0	240.5	1.1	58.3	50.5	47.9	49.4	5.0	10.5
8 plants/sqft	46.6	53.9	7.3	97.9	51.3	12.3	254.0	6.7	57.3	53.3	47.7	49.2	4.3	9.4
16 plants/sqft	46.0	54.0	8.0	97.7	51.7	23.8	239.1	46.1	54.0	46.5	47.2	49.4	4.3	9.3
Third seeding date - May 21														
4 plants/sqft	41.7	51.4	9.8	98.1	56.4	2.4	134.7	0.0	44.4	12.6	44.3	49.3	4.8	10.5
8 plants/sqft	41.8	51.1	9.3	97.0	55.2	5.1	135.9	0.0	49.2	16.2	44.6	50.0	4.7	10.0
16 plants/sqft	42.1	49.3	7.2	94.1	52.0	6.3	110.2	0.0	48.7	20.3	45.8	49.4	4.5	9.2
LSD	1.3	1.8	1.7	3.3	3.6	1.5	73.6	8.6	3.4	6.2	0.5	0.6	0.4	1.9
Pr>F	0.4469	0.4699	0.1135	0.6830	0.4780	0.0001	0.8884	0.0001	0.0383	0.0367	0.0007	0.1908	0.0869	0.9330

FLWR: flowering, PM: physiological maturity, PLNT: plants, DWT: dry weight, LOD: lodging, HT: height, YLD: yield, TWT: test weight, TKW: thousand kernel weight, MC: moisture

Table 8. Effect of variety, seeding date and population density on agronomic performance of canola - 2013

Variety	BOLT			BOLT			PLNT	DWT	LOD	HT	YLD	OIL	TWT	TKW	MC
	BOLT	FLWR	to FLWR	PM	to PM	sqft									
First seeding date - four plants/sqft															
DKL 30-42	52.0	65.3	13.3	112.3	60.3	4.0	382.4	5.0	52.0	54.2	48.4	50.3	3.8	11.4	
HyClass 955	52.7	64.7	12.0	112.0	59.3	4.3	227.0	5.0	52.3	54.1	49.8	50.0	3.5	11.0	
InVigor L130	53.7	66.3	12.7	110.7	57.0	4.3	257.5	3.3	57.7	60.2	47.2	50.3	3.2	12.1	
First seeding date - eight plants/sqft															
DKL 30-42	51.7	66.0	14.3	111.3	59.7	8.3	323.9	16.7	54.3	63.2	49.2	50.3	3.9	11.9	
HyClass 955	51.7	63.3	11.7	109.7	58.0	10.7	276.5	15.0	52.7	59.6	49.6	49.8	3.7	10.5	
InVigor L130	52.3	64.7	12.3	110.0	57.7	10.7	379.2	4.3	60.7	52.2	48.5	50.4	3.1	11.3	
First seeding date - sixteen plants/sqft															
DKL 30-42	52.7	64.0	11.3	108.7	56.0	16.3	279.7	60.0	52.7	45.7	49.4	50.3	3.4	9.9	
HyClass 955	51.0	65.0	14.0	110.3	59.3	17.0	257.4	70.0	52.3	53.0	49.1	50.6	3.7	11.7	
InVigor L130	52.0	63.7	11.7	108.3	56.3	17.3	288.4	40.0	55.3	53.9	47.0	50.3	3.3	10.6	
Second seeding date - four plants/sqft															
DKL 30-42	44.3	53.0	8.7	97.7	53.3	4.0	231.8	0.0	53.3	58.5	48.4	49.1	5.2	9.7	
HyClass 955	45.3	54.7	9.3	97.7	52.3	7.0	192.8	3.3	59.0	48.0	49.2	48.5	4.9	8.0	
InVigor L130	50.0	55.3	5.3	101.7	51.7	7.0	296.9	0.0	62.7	45.1	46.0	50.5	5.1	13.6	
Second seeding date - eight plants/sqft															
DKL 30-42	44.0	52.7	8.7	97.0	53.0	10.3	240.4	20.0	54.7	57.4	47.8	49.0	4.8	8.3	
HyClass 955	45.7	54.0	8.3	97.3	51.7	12.3	265.7	0.0	57.7	51.7	48.3	48.6	4.6	9.7	
InVigor L130	50.0	55.0	5.0	99.3	49.3	14.3	256.1	0.0	59.7	50.9	47.1	49.8	3.5	10.3	
Second seeding date - sixteen plants/sqft															
DKL 30-42	43.7	52.7	9.0	95.7	52.0	21.0	279.9	71.7	50.7	44.2	47.3	49.3	4.6	8.7	
HyClass 955	45.3	54.0	8.7	99.0	53.7	27.0	235.7	66.7	53.7	40.0	47.6	49.4	4.3	9.1	
InVigor L130	49.0	55.3	6.3	98.3	49.3	23.3	201.6	0.0	57.7	55.3	46.7	49.7	4.1	10.1	
Third seeding date - four plants/sqft															
DKL 30-42	41.0	49.3	8.3	97.0	56.0	1.7	123.1	0.0	40.0	11.7	44.8	48.8	5.3	9.9	
HyClass 955	40.7	48.7	8.0	94.7	54.0	3.3	148.9	0.0	44.0	15.2	46.0	48.7	4.9	8.4	
InVigor L130	43.3	56.3	13.0	102.7	59.3	2.3	132.2	0.0	49.3	11.1	42.2	50.5	4.4	13.2	
Third seeding date - eight plants/sqft															
DKL 30-42	41.7	51.0	9.3	96.7	55.0	2.0	88.0	0.0	46.3	16.2	44.9	50.2	5.1	9.5	
HyClass 955	41.0	51.0	10.0	96.3	55.3	6.7	154.0	0.0	47.3	18.9	46.1	49.6	4.8	8.6	
InVigor L130	42.7	51.3	8.7	98.0	55.3	6.7	165.7	0.0	54.0	13.4	42.6	50.3	4.1	12.0	
Third seeding date - sixteen plants/sqft															
DKL 30-42	41.3	47.7	6.3	92.0	50.7	4.3	134.3	0.0	45.7	17.4	47.1	48.8	4.8	7.8	
HyClass 955	41.7	48.0	6.3	93.3	51.7	9.0	120.9	0.0	48.3	21.5	46.7	49.3	4.6	8.6	
InVigor L130	43.3	52.3	9.0	97.0	53.7	5.7	75.3	0.0	52.0	22.0	43.7	50.2	4.3	11.2	
LSD	1.4	3.2	3.9	2.9	3.2	4.4	116.4	10.1	6.0	10.1	1.5	1.4	0.7	3.0	
Pr>F	0.3101	0.2692	0.4303	0.3264	0.4551	0.8871	0.3701	0.0001	0.9730	0.2255	0.5567	0.9026	0.5194	0.7500	

FLWR: flowering, PM: physiological maturity, PLNT: plants, DWT: dry weight, LOD: lodging, HT: height, YLD: yield, TWT: test weight, TKW: thousand kernel weight, MC: moisture