

**Effect of Phosphorus Placement and Rate on Canola  
NDSU Carrington and Langdon Research Extension Centers  
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2005, 2006 and 2008**

Projects were initiated at the Carrington Research Extension Center to evaluate the effect of phosphorus placement and rates on canola planted in 14 inch rows.

**Materials and Methods**

2005 and 2006: Studies were established using conventional tillage practices at two sites. The soil series is a Heimdal-Emrick loam soil at Q and a Fram-Wyard loam at Landon E. Heimdal-Emrick soils are well drained while Fram-Wyard soils tend to be poorly drained. The phosphorus was placed: 1) in-row, 2) mid-row band, 3) every-row (in-row + mid-row band), and 4) broadcast. The phosphorus rates were: 1) 0, 2) 11.25, 3) 22.5, and 4) 45 lb of P<sub>2</sub>O<sub>5</sub>/acre in 2005 and 1) 0, 2) 22.5, 3) 45, and 4) 90 lb P<sub>2</sub>O<sub>5</sub>/acre in 2006. Soil tests indicated 10-11 ppm (Olsen) phosphate at Q and 3-4 ppm at Landon E. Canola ‘Invigor 4870’ was seeded May 16, 2005 and April 25, 2006 at a rate of 8 pure lives seeds/ft<sup>2</sup> in 14-inch rows. The in-row band applications were applied at seeding while the mid-row band applications were made shortly after seeding. The broadcast applications were incorporated prior to seeding. The trials were harvested August 15, 2005 and August 3, 2006.

2008: Individual trials were conducted at three sites at the Carrington Research Extension Center; low P site medium P site, and an irrigated site, and at the Langdon Research Extension Center in 2008. The soil P<sub>2</sub>O<sub>5</sub> level and applied P<sub>2</sub>O<sub>5</sub> at each site are listed in Table 1. ‘Invigor 5550’ was planted at each site in 7- and 14-inch rows at 14 pure live seed per acre. Two plots for each treatment were planted. One plot was used to evaluate plant growth and yield parameters while the second plot was used for destructive plant tissue samples. Plant tissue samples were collected weekly for 4 weeks starting 10 to 14 days after emergence and analyzed for phosphorus concentrations.

Table 1. Soil test, yield goal and applied P<sub>2</sub>O<sub>5</sub> at each site.

Site	Soil test P <sub>2</sub> O <sub>5</sub> ppm	Yield goal lb/ac	Applied P <sub>2</sub> O <sub>5</sub> lb/a
Low	5	2000	17
Medium	10	2000	9
Irrigated	9	4000	22
Langdon	9	3200	17

**Results**

2005: The phosphorus rate, independent of placement, had the greatest impact on crop performance. No stand loss was observed at either location (personal observation). At Landon E a statistically significant phosphorus rate by placement interaction occurred for plant height (Table 2). Plant height averaged 39.5 inches with no phosphorus and increased to 46 to 47 inches when 11.25 lb P<sub>2</sub>O<sub>5</sub>/ac was applied in-furrow or broadcast incorporated. Plant height tended to increase as the phosphorus rate increased for the every-row application. The 1000 kernel weight decreased and seed yield increased as the phosphorus rate increased at Landon E (Table 3). At Q seed yields increased as the phosphorus rate increased to 22.5 lb P<sub>2</sub>O<sub>5</sub>/ac then leveled off. There were no differences in physiological maturity, test weight or oil content at either location or seed weight at Q (data not shown).

Phosphorus placement	Phosphorus rate (lb P <sub>2</sub> O <sub>5</sub> /ac)			
	0	11.25	25	45
	Plant height (inch)			
In-row	41	47	47	47
Mid-row	40	41	45	41
Every-row	39	42	43	48
Broadcast	38	46	46	46
LSD (P=0.05)	4			

Phosphorus rate	Landon E		Q
	1000 KWT	Seed yield	Seed yield
lb P <sub>2</sub> O <sub>5</sub> /ac	gram	lb/ac	lb/ac
0	3.15	1171	1215
11.25	3.09	1434	1385
22.5	3.02	1585	1546
45	2.96	1914	1560
LSD (P=.05)	0.13	153	85

2006: The percentage of ground cover and stand loss were visually estimated on June 16. There was a placement by rate interaction for stand loss at both locations. Significant stand losses were observed at both locations when 90 lb P<sub>2</sub>O<sub>5</sub>/ac (19 lb N/ac) was applied in-row (Table 4). At Q stand losses were also observed when 45 lb P<sub>2</sub>O<sub>5</sub>/ac (9.5 lb N/ac) was applied in-row and when 90 lb P<sub>2</sub>O<sub>5</sub>/ac (9.5 lb N/ac in-row) was applied in every row. Soil moisture conditions were drier at Q at planting.

Phosphorus placement	Landon E				Q			
	Phosphorus rate (lb P <sub>2</sub> O <sub>5</sub> /ac)							
	0	22.5	45	90	0	22.5	45	90
	% Stand reduction							
In-row	0	3	8	28	0	0	19	55
Mid-row	0	0	0	0	0	0	0	0
Every-row	0	5	10	10	0	0	0	23
Broadcast	0	0	0	0	0	0	0	0
LSD (P=0.05)	6				14			

At Landon E percent ground cover was reduced with the mid-row band application but it did not impact seed yield (Table 5). Percent ground cover increased as the phosphorus rate increased at 22.5 lb P<sub>2</sub>O<sub>5</sub>/ac then leveled off while seed yield increased as the rate increased to 45 lb P<sub>2</sub>O<sub>5</sub>/ac (Table 6). Seed yields were lower in 2006. Heat and drought stress reduced bloom duration from 25 days in 2005 to 18 days in 2006.

At Q there was a placement by rate interaction for ground cover (Table 7). The 45 and 90 lb P<sub>2</sub>O<sub>5</sub>/ac in-row treatments and 90 lb P<sub>2</sub>O<sub>5</sub>/ac every-row treatment had lower ground cover ratings when compared to broadcast applications of equal rates. While there was no placement by rate interaction for seed yield (P=0.1395), the three treatments (45 and 90 lb P<sub>2</sub>O<sub>5</sub>/ac in-row and 90 lb P<sub>2</sub>O<sub>5</sub>/ac every-row) that reduced stand and ground cover also had lower seed yields (Table 8). When averaged over placement, 22.5 lb P<sub>2</sub>O<sub>5</sub>/ac provided the highest seed yield.



**Canola flowering and height response to phosphorus rate and placement**

Table 5. Ground cover and seed yield averaged over rate phosphorus at Landon E, 2006.

Phosphorus placement	Ground Cover	Seed Yield
	%	lb/ac
In-row	50	1169
Mid-row	43	1104
Every-row	48	1277
Broadcast	48	1131
LSD (P=0.05)	6	NS

Table 6. Ground cover and seed yield averaged over placement at Landon E, 2006.

Phosphorus Rate	Ground cover	Seed yield
lb P <sub>2</sub> O <sub>5</sub> /ac	%	lb/ac
0	41	834
22.5	48	1148
45	49	1382
90	50	1316
LSD 0.05	6	213

Table 7. Ground Cover, Q, 2006.

Phosphorus placement	Phosphorus rate (lb P <sub>2</sub> O <sub>5</sub> /ac)			
	0	22.5	45	90
	% Ground Cover			
In-row	69	66	64	43
Mid-row	63	68	70	71
Every-row	68	83	80	65
Broadcast	63	78	82	83
LSD (P=0.05)	14			

Table 8. Seed yield, Q, 2006.

Phosphorus placement	Phosphorus rate (lb P <sub>2</sub> O <sub>5</sub> /ac)				
	0	22.5	45	90	Mean
	Seed yield (lb/ac)				
In-row	1199	1315	1190	870	1144
Mid-row	1102	1284	1303	1225	1229
Every-row	1258	1498	1452	1140	1337
Broadcast	1235	1333	1338	1360	1317
Mean	1199	1358	1321	1149	
Placement and rate LSD (P=0.05) = 143					
Placement by rate P=0.1395					

The days to bloom and bloom duration were delayed one day when no fertilizer was applied at both locations (Data not shown).

2008: Plant tissue sample results are listed in table 9. Variability within the data set was high resulting in few significant differences. It is difficult to draw any conclusions from the plant tissue data set.

Phosphorus placement had an impact on canola yield at the low P site at Carrington (Table 10). The high variability in the yield data is due to dry seedbed conditions at planting causing poor and uneven emergence. Canola yields were greatest when the canola was planted in 14-inch rows with an in-row starter fertilizer. The row spacing and phosphorus placement did not affect seed weight, test weight, or oil content. The row spacing and phosphorus placement did not affect any of the parameters measured at Langdon or the medium P site and irrigated site at Carrington.

Phosphorus placement	Low P Site				Medium P Site				Irrigated Site			
	Plant tissue sampling date											
	6/5	6/11	6/19	6/24	6/5	6/11	6/19	6/24	6/5	6/11	6/19	6/24
14 " Rows	Canola plant tissue phosphorus concentration (ppm)											
In-row	5220	4881	3586	4583	5593	4665	4746	4349	6355	4325	4342	4384
Mid-row	3858	4463	2933	4126	4077	4107	4781	3700	5870	4728	3598	4333
Jumpstart	3901	4453	3763	4207	4964	5027	4879	3227	5985	5322	4156	4281
Jumpstart + Mid-Row	3903	4987	5128	3935	4200	4995	4341	4554	5456	5340	3141	4162
In-row + Avail	4715	4851	4687	4763	5958	4923	4611	3512	6643	4794	4126	4779
Untreated	4633	4333	3525	4423	5020	4318	4226	3172	5320	4920	3821	4011
7" Rows												
In-row	4826	5331	2821	4423	4551	5028	4636	3619	6027	5721	3832	4746
In-row + Avail	5219	4836	3307	4195	5602	5530	4423	4129	6329	4924	3499	4925
In-row + Jumpstart												
Untreated	4244	5418	3690	4633	4273	5156	3799	3698	5317	4692	3668	4337
LSD (P=0.05)	1006	NS	1280	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV %	15.3	22.0	23.5	14.6	19.8	23.5	19.3	23.4	18.3	16.3	19.4	11.2
Mean	4502	4839	3716	4365	4949	4861	4493	3773	5922	4974	3798	4440

11-52-0 starter fertilizer Placement	Carrington												1000	Test	Seed
	Low P Site				Medium P Site				Irrigated Site						
	seed wt.	weight	Oil	yield	seed wt.	weight	Oil	yield	seed wt.	weight	Oil	yield			
14 " Rows	gms	lb/bu	%	lb/ac	gms	lb/bu	%	lb/ac	gms	lb/bu	%	lb/ac	gms	lb/bu	lb/ac
In-row	2.7	52.2	44.8	1104	2.8	51.9	45.5	2414	3.1	52.3	46.5	3260	3.0	51.5	2120
Mid-row	2.6	52.5	43.9	976	2.8	51.9	45.6	2488	3.1	52.5	46.0	3460	3.0	51.5	2116
Jumpstart	2.6	51.8	42.0	959	2.8	52.0	44.8	2127	3.1	52.4	46.4	3390	2.9	51.4	2060
Jumpstart + Mid-row	2.7	52.2	43.2	880	2.7	52.0	45.2	2268	3.1	52.4	46.5	3367	3.0	51.9	2207
In-row + Avail	2.8	52.3	44.3	1235	2.8	51.9	45.4	2201	3.1	52.3	46.7	3278	3.0	51.8	2200
Untreated	2.7	52.6	43.1	812	2.7	52.0	45.5	2148	3.2	52.3	44.3	3386	3.0	51.0	2042
7" Rows															
In-row	2.7	52.1	42.8	536	2.8	51.9	45.1	1929	3.3	52.2	46.7	3587	3.0	51.1	2250
In-row + Avail	2.7	52.1	43.4	697	2.7	52.0	44.7	2086	3.1	52.3	47.2	3534	3.0	51.3	2257
In-row + Jumpstart													3.1	52.1	2213
Untreated	2.8	51.9	44.4	703	2.8	52.0	45.1	1936	3.2	52.2	47.4	3540	3.0	51.4	2024
LSD (P=.05)	NS	NS	NS	283	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV %	4.2	0.9	3.7	22.0	3.4	0.4	1.5	13.7	3.0	0.3	2.9	10.8	4.1	1.2	6.1
Mean	2.7	52.2	43.5	878	2.8	52.0	45.2	2177	3.1	52.3	46.4	3422	3.0	51.5	2149