Effect of Tillage System and Nitrogen Source and Fertility on Canola Performance in Central North Dakota

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Objective
To determine the effect of tillage system, N fertility, and a soybean previous crop on canola establishment, yield and quality, disease incidence and severity, and weed management.

Materials and Methods
The trial was conducted at Carrington in 2007. The experimental design for the trial was a split-split-plot design with three replicates.

The proposed treatments utilized Roundup Ready® soybean as the previous crop. Therefore, we used Liberty Link canola to be competitive across tillage systems and to reduce the potential for building herbicide resistance.

Farm-equipment-sized tillage systems, 60 feet wide by 300 feet long, have been established since 1987. The tillage systems are conventional, minimum, and no till. The conventional tillage system is defined by multiple tillage (~3) operations resulting in less than 30 percent residue cover after seeding. The minimum tillage system generally has two tillage operations (non-inversion) resulting in greater than thirty percent residue cover after seeding. The no-till has zero tillage other than disc openers from the drill resulting in greater than eighty percent residue cover after seeding.

Four N fertility treatments were imposed perpendicularly across the tillage systems. Fertility treatments were urea applied with the drill each spring to plots at 0, 50, and 100 actual pounds of N per acre. An additional N treatment was a composted manure application designed to make available 50 pounds of N per year for the duration of the four-year rotation. This created a split-split-plot design with crop as the whole plot (1.25 acres) tillage system as the subplot (.42 acre) and N fertility treatment as the sub-sub-plot (.10 acre). The large size allowed for adequate sampling area for data collection of the numerous parameters without confounding data.

Liberty Link hybrid canola seed was planted on May 3 at 500,000 seeds / acre. The trial was harvested August 9.

Results:
In the Carrington region, the 2008 growing season started out with below-average temperatures and precipitation except for the month of June which had above-average precipitation. The limited spring rainfall coupled with the dry fall of 2007 led to seedbed conditions where soil moisture was marginal for crop establishment. Consequently, canola stands were reduced due to dry conditions at planting and flowering and the yields suffered consequently (Tables 1,2,3). Canola yields ranged from 619 to 1,366 lbs / acre (Table 3). Total above ground biomass ranged for 3,649 to 5,928 lbs / acre (Table 3).

Table 1.The effect of tillage system across N fertility treatments on canola performance.

Tillage System	Biomass Weight	1000 KWT	Oil	Grain Yield	Straw Weight	Stand	Plant Height	Beginning Bloom	End Bloom
	lb/ac	gram	%	lb/ac	lb/ac	plants/ac	cm	J. day	J. day
M	4,757	3	43.1	1,006	3,268	435,074	88	175	191
N	4,181	3	43.7	829	2,900	434,493	89	175	191
T	4,079	3	43.1	988	2,699	438,559	96	175	191
Average	4,339	3	43.3	941	2,956	436,042	90.9	174.9	190.9
C.V.	36	6.4	3.1	42	44	2	11.8	0.5	3
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. The effect of N fertility treatments across tillage systems on canola performance.

N Fertility	Biomass Weight	1000 KWT	Oil	Grain Yield	Straw Weight	Stand	Plant Height	Beginning Bloom	End Bloom
	lb/ac	gram	%	lb/ac	lb/ac	plants/ac	cm	J. day	J. day
0	3,974	2.9	44.1	854	2,733	432,686	81	176	197
50	4,030	2.9	43.3	727	2,847	431,653	89	176	189
100	5,072	3.1	42	1,082	3,453	440,689	93	175	189
M	4,280	14.9	43.9	1,101	2,789	439,140	100	174	189
Average	4,339	5.9	43.3	941	2,956	436,042	90.9	174.9	190.9
C.V.	36	6.4	3.1	42	44	2	11.8	0.5	3
LSD 0.05	NS	NS	1.3	258	NS	7,769	10.5	0.8	5.5

Effect of tillage, nitrogen source and fertility in canola.

Table 3. The effect of tillage systems and N fertility treatments on canola performance.

Tillage System	N Fertility	Biomass Weight	1000 KWT	Oil	Grain Yield	Straw Weight	Stand	Plant Height	Beginning Bloom	End Bloom
		lb/ac	gram	%	lb/ac	lb/ac	plants/ac	cm	J. day	J. day
M	0	4,437	3	44.2	996	3,081	429,071	83	176	197
M	50	4,401	2.9	43.7	757	3,117	430,620	79	176	189
M	100	5,928	3.1	41.8	1,366	3,969	440,689	93	175	189
M	M	4,261	2.9	42.8	905	2,904	439,914	98	174	189
N	0	3,837	2.9	45	619	2,745	434,493	79	176	196
N	50	3,716	2.8	42.7	731	2,617	426,748	89	175	189
N	100	4,691	3	42	922	3,246	444,561	92	175	189
N	M	4,482	3.1	45.1	1,043	2,993	432,169	94	174	189
T	0	3,649	2.9	43.1	946	2,373	434,493	82	176	196
T	50	3,972	2.9	43.6	695	2,806	437,591	98	176	189
T	100	4,597	3.1	42.2	958	3,145	436,816	94	174	189
T	M	4,098	3	43.7	1,354	2,470	445,336	109	174	189
Average		4,339	3	43.3	941	2,956	436,042	90.9	174.9	190.9
C.V.		36	6.4	3.1	42	44	2	11.8	0.5	3
LSD 0.05		2,260	NS	2.3	446	NS	13,456	18	1	NS

Tillage system did not significantly affect any of the parameters measured across all N fertility treatments (Tables 1, 4).

Table 4. The economics associated with canola production as influenced by tillage system.

Tillage System	Tillage	Seeding	Chemical	Total Cost of Production*	Grain Yield	Grain Price**	Net
	--------------------	$/ac	--------------------		lb/ac	$/lb	$/ac
M	$8.01	$12.83	$21.00	$205.48	917	$143.93	($61.55)
N	$0.00	$15.00	$26.00	$204.64	1,154	$181.23	($23.41)
T	$14.56	$12.83	$21.00	$212.03	953	$149.65	($62.38)

Urea at $.36/lb and Manure at $.10/lb of N
* Includes Fertilizer ($19.67 avg), Seed $28.50, Tillage, Seeding, Chemical, Swathing ($7.92), Combining ($20.55), Overhead ($32), and Land ($55).
**Grain price $15.70/cwt

As N fertility across all tillage systems increased so did plant stand, plant height, and yield (Table 2). However, higher N fertility treatments across all tillage systems began flowering sooner and had lower seed oil content than the lower N fertility treatments (Table 2). Manure is a viable alternative source of crop nutrients that does not have a negative impact on yield verses commercial fertilizer (Tables 2,3,6).

The interaction of tillage and N fertility shows an increased response to N fertilizer in the reduced-tillage systems and that manure had a greater response in the conventional-tillage system (Table 3).

Impact
This research project has begun assessment of an alternative fertilizer source along with the impact of tillage systems on canola production (Tables 4,5,6).

Table 5. The economics associated with canola production as influenced by N fertility and source.

Fertility Treatment	Fertilizer*	Total Cost of Production**	Grain Yield	Grain Price***	Net
	--------------- $/ac	--------------	lb/ac	$/lb	$/ac
0	$0.00	$185.07	788	$123.66	($61.41)
50	$18.00	$203.07	869	$136.49	($66.58)
100	$36.00	$221.07	1,118	$175.56	($45.51)
M	$5.00	$190.07	1,257	$197.37	$7.30

* Urea at $.36/lb and Manure at $.10/lb of N
** Includes Fertilizer, Seed $28.50, Tillage ($4.88 avg), Seeding ($13.55 avg), Chemical, Swathing ($7.92), Combining ($20.55), Overhead ($32), and Land ($55).
***Grain price $15.70/cwt

Conclusions
By utilizing manure as a fertilizer source we are able to show that canola can achieve the same yields as applying N as synthetic fertilizer, thereby proving that manure is an economically viable way to decrease input costs. Also, there is no statistical difference in canola yield across tillage systems so reducing tillage is also an economically viable way to decrease input costs. In addition, with soybean as a previous crop, we can take advantage of the legume N credit, further reducing input costs and potentially increasing canola acreage. A word of caution, however, always be mindful of herbicides used in the soybean crop that can have a detrimental carryover effect in the canola crop.