YIELD RESPONSE TO NITROGEN FERTILIZER BY APPLICATION TIMING IN HYBRID- AND OPEN-POLLINATED CANOLA VARIETIES

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Six of the seven locations planted in 2003 were successful in producing data. Only the Williston location environment produced yields too low to measure a response to nitrogen treatments. Variability in soil nitrogen at Langdon caused no significant yield differences but because plots were soil sampled individually for nitrogen they will be useful for regression analysis. The 2003 environment limited yields so we missed getting data in very high yield situations. This data will be vital to develop the top end of the nitrogen response curve.

The full combined data set of all locations will be analyzed in early January using total nitrogen by plot as a continuous variable. This report includes data by location and discussion of the data based on the split-plot in RCBD analysis of individual location.

Research Objectives

1. Evaluate efficiency of split applied nitrogen at the canola five leaf stage compared to pre-plant incorporated.
2. Re-evaluate the nitrogen response curve for canola and adjust to fit current varieties which may require lower nitrogen fertilization than currently recommended.
3. Compare lower cost seed of open pollinated canola varieties to hybrid varieties in lower yielding environments that may not support the expense of hybrid seed.

Research Procedures

The 2003 research sites were located at Hettinger, Williston, Minot, Wishek, Valley City, Carrington and Langdon. The statistical design was a split plot with fertility treatments as main plots and varieties as sub-plots with four replications. All locations had 11 base treatments with seven nitrogen (N) rates with all N applied pre-plant incorporated (PPI) and four treatments with all N applied post-emergence (post) at the 4-5 leaf stage. Treatments by location are in Table 1.

The PPI-N treatments were the urea source. Ammonium nitrate was the post applied N source to reduce the chance of undocumented volatilization differences between sites. Each site was sampled early to verify a uniform soil series and to obtain baseline fertility values for macro- and micro-nutrients. Detailed soil sampling at each site was conducted just prior to applying treatments and planting. Each main plot was sampled in 0-6 and 6-24 inch increments and 16 plots were sampled for the 24-48 inch increment, in a grid pattern.

Fertility plot size across locations ranged from 15 to 20+ feet wide by 25 to 30 feet in length. The varieties include one hybrid ('Hyola 357 Magnum') and one OP ('Minot'); both Roundup Ready. Seed was provided from one seed source for all locations and was treated with Helix Xtra. Production inputs other than N varied by location but were applied uniformly across all N treatments. Twenty lbs. S/acre as sulfate was applied at all locations and phosphorus as needed. Fungicide and post-applied insecticide varied over locations. No location was affected by serious insect or disease problems. Hettinger received early frost damage.

Table 1. Nitrogen Fertility Treatments 2003

Lower Yield Potential Locations Minot, Hettinger, Williston, Wishek				Higher Yield Potential Locations Carrington, Langdon, Valley City			
	Nitrogen Applied		Total		Nitrogen Applied		Total
Treatment	PPI	4-5 leaf	Nitrogen*	Treatment	PPI	4-5 leaf	Nitrogen*
	lb N/ac	lb N/ac	lb N/ac		lb N/ac	lb N/ac	lb N/ac
1	0	0	30	1	0	0	30
2	15	0	45				
3	30	0	60	2	30	0	60
4	45	0	75				
5	60	0	90	3	60	0	90
6	90	0	120	4	90	0	120
7	120	0	150	5	120	0	150
				6	150	0	180
				7	180	0	210
8	0	30	60	8	0	30	60
9	0	60	90	9	0	60	90
10	0	90	120	10	0	90	120
11	0	120	150	11	0	120	150

* Total Nitrogen includes soil test and nitrogen applied with P or S fertilizer.

Results and Discussion

Objective 1

Evaluate efficiency of nitrogen applied at the canola five-leaf stage compared to pre-plant incorporated.

There is split nitrogen application data available from five ND locations in 2001 and 2002. The 2002 data set includes all N applied at the canola five-leaf stage which performed equal to the split applications. To reduce the size of the experiments, only treatments with all N fertilizer applied PPI or post were included in this work. Responses to post-applied N are variable by site and year. Yields were increased at Carrington by post applying N in all three years. The increases were statistically significant in two years at 500 and 600 lbs seed per acre. The post applied N compared to PPI-N had significant decreases in yield at Wishek in 2003 and at some rates at Valley City and Hettinger in 2003. The other five sites over years had no significant difference between PPI and post-applied N.

The use of post-applied N appears to be a viable management option for canola producers. The major risk with post N is that, regardless of N source, rain for incorporation is needed. Also, conflicts with herbicide application may be a factor as a tank mix will likely cause high foliage burn. The biggest advantage of post-applied N would be time to evaluate stand establishment, flea beetle damage, weed problems and moisture situation before determining the level of investment in N fertility for a given field.

Objective 2

Re-evaluate the N response curve for canola and adjust to fit current varieties which may require lower N fertilization than currently recommended.

Preliminary data from 2001 and 2002 indicated that the current NDSU recommendations for N fertilizer on canola were higher than necessary when canola yields were below 1500 lbs./acre That data also indicated that the current NDSU recommendation of N fertilizer on canola yielding 2000 lbs./acre was accurate. The 2003 data supports this, though some special circumstances are appearing as more site-data are accumulated. Examples: in 2003 Langdon raised 1800 lbs./acre canola on treatments with only 30 lbs. N/acre fertility; Carrington had very low yield responses to high rates of N. Extra N not detected by the soil test from ground water at

Langdon and leaching of PPI N at Carrington are the likely explanations.

The economic importance of the data is that in low-yield environments less N is needed to produce a crop than shown by current NDSU recommendations. The data indicate that only 66 lbs. N/acre is needed for a 1500 lbs./acre yield when the current recommendation is 98 lbs. N/acre (soil test plus all applied N). If N costs $0.20/lb., a producer in a low-yield region could save $6.40 in N input cost. There are probably about 300,000 acres of canola grown in North Dakota alone that would fit the lower yield category. If the grower decides before the 5-leaf growth stage that there is more yield potential, more N can be added as a post treatment.

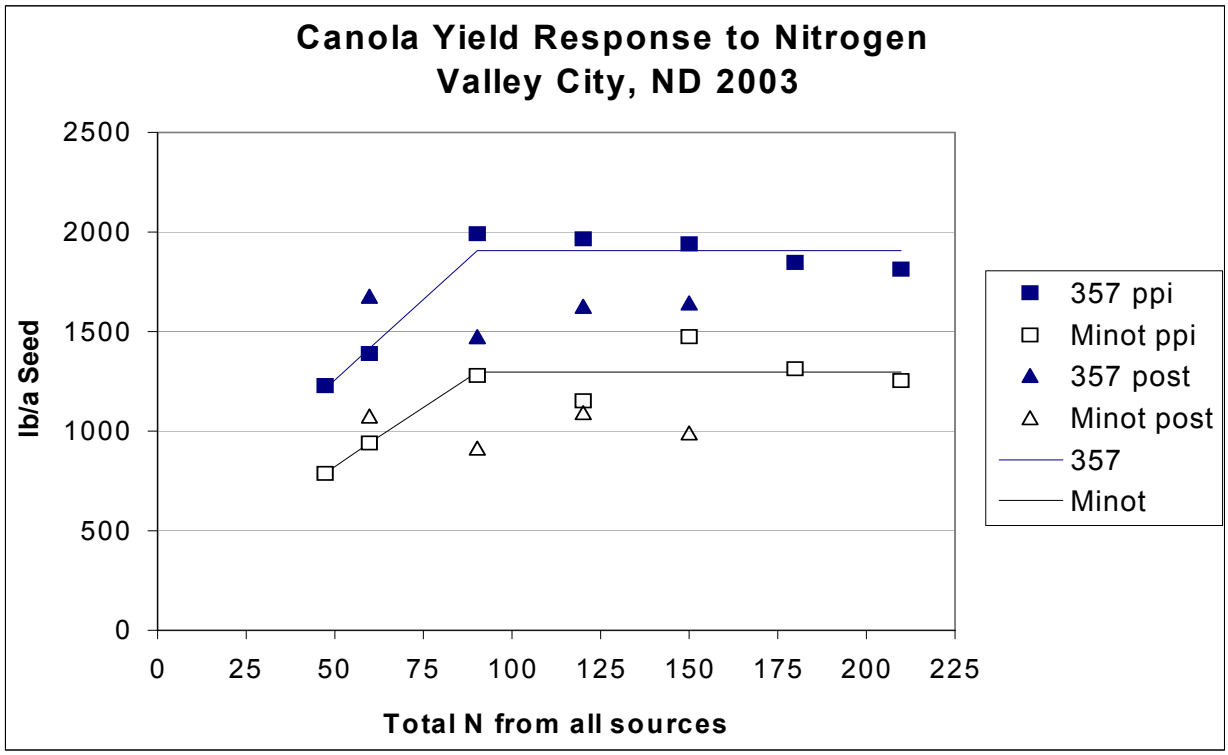
Caution will need to be observed with lower fertilizer rates because this fertilizer program would remove more N with the seed than is added as fertilizer. For canola with a 4 percent N concentration, 1000, 1500 and 2000 lbs./acre yields would remove 40, 60 and 80 lbs. N/acre, respectively.

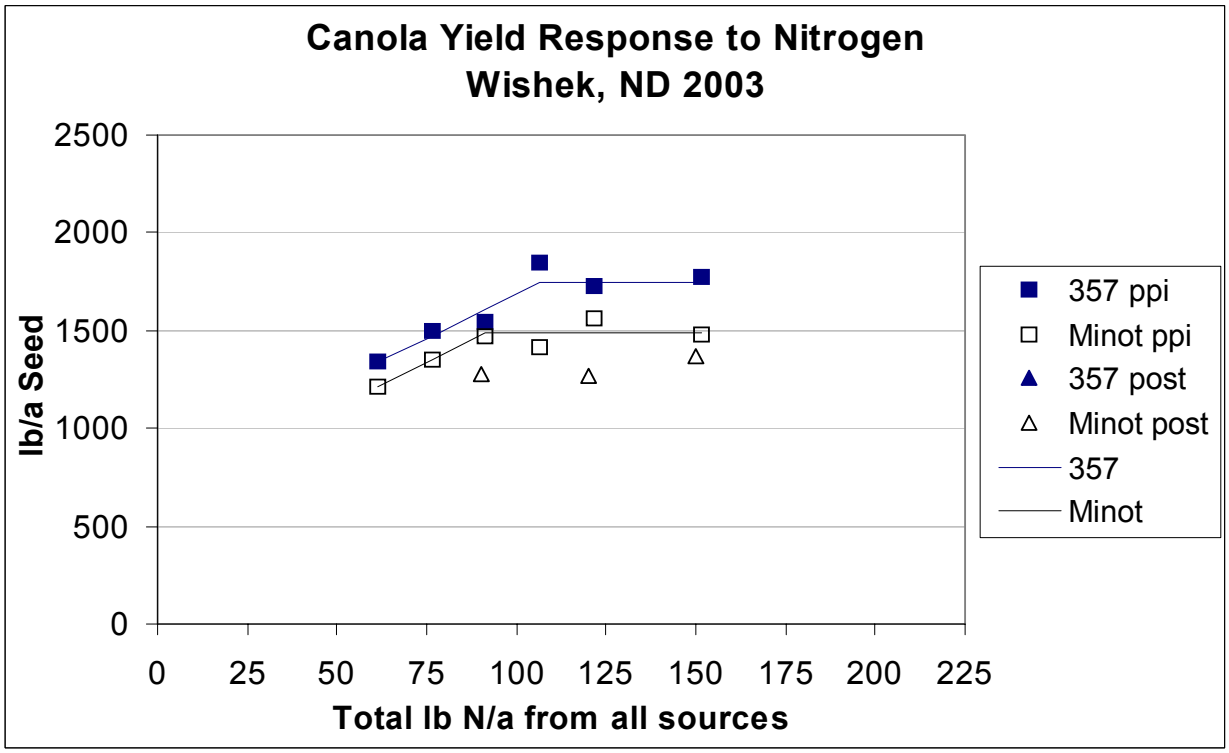
Objective 3
Compare lower cost seed of open-pollinated canola varieties to hybrid varieties in lower yielding environments that may not support the expense of hybrid seed.

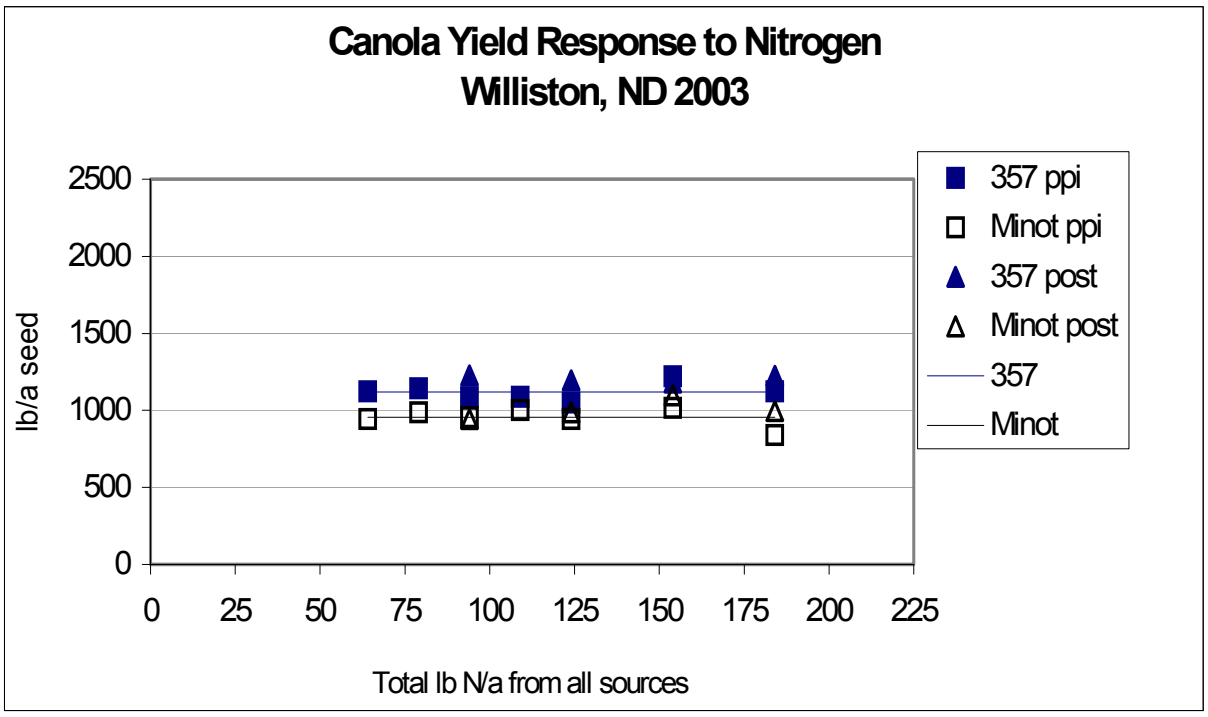
Comparison of hybrid and open-pollinated canola varieties in standard variety trials always use high fertility and input rates. The hybrids in this situation will most of the time have an economic advantage over open-pollinated varieties. For lower yield situations with lower fertility levels, the 2003 data indicate less difference in yield potential between the hybrid and open-pollinated lines than if higher N rates are applied. This was clearly the situation at the Valley City and Wishek locations but was not apparent at Hettinger.

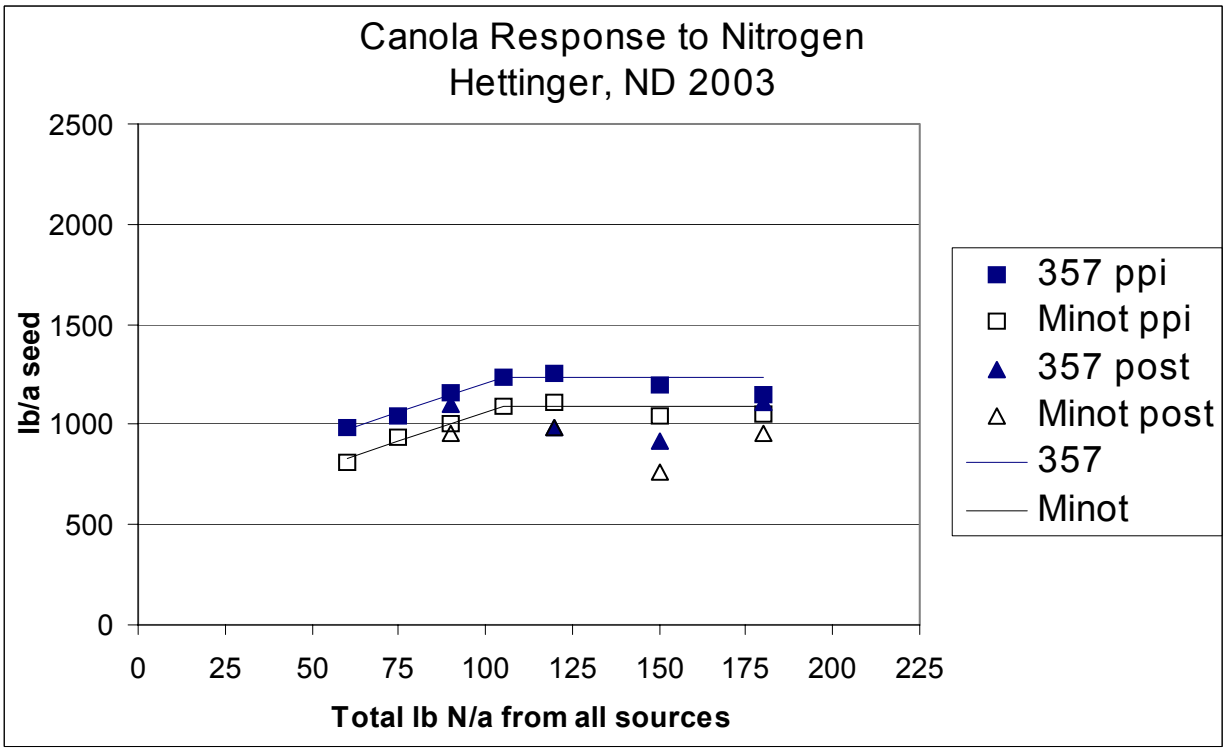
The economic evaluation is variable by seed cost, seeding rate and price received for the harvested crop. Assume canola seed without seed treatment is $2.00/lb cheaper than hybrid seed and a 5 lbs./acre seeding rate is used. The hybrid has to produce enough additional yield to make up for $10.00 additional input cost. If you sell your seed for $10.00/cwt or $6.50/cwt the hybrid has to yield 100 or 154 lbs./acre more to break even.

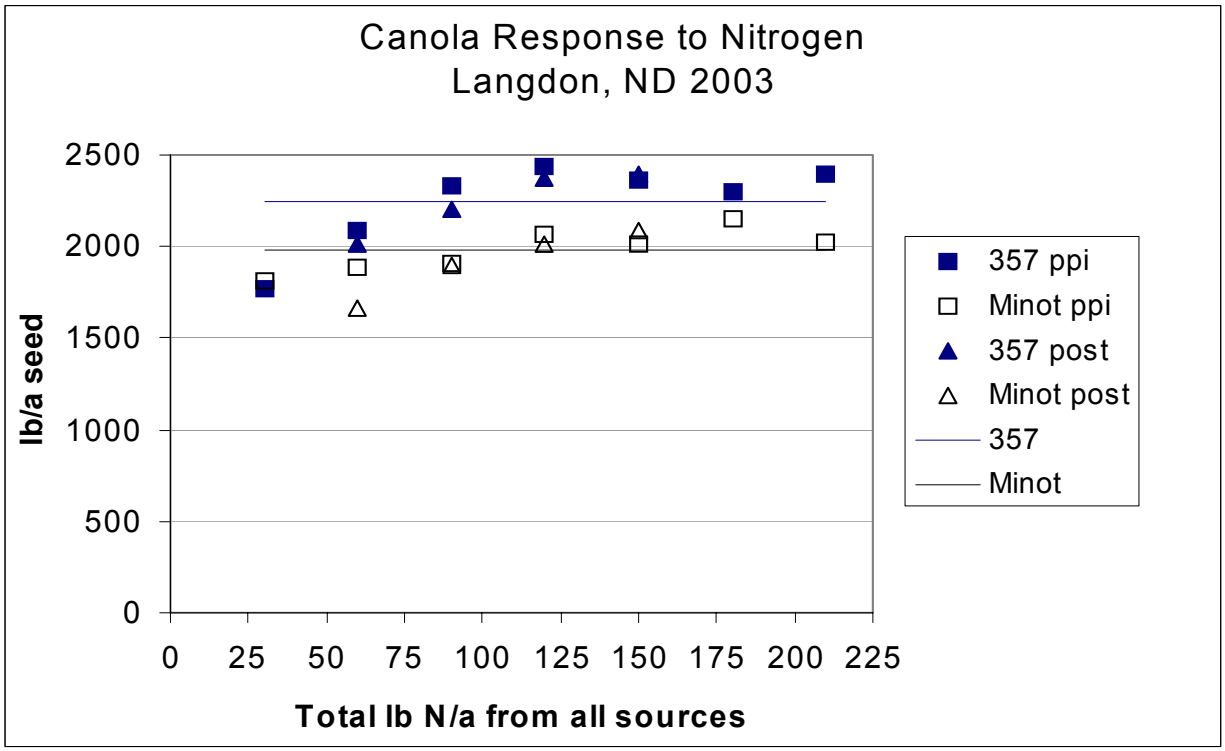
Yield data charts, by location for 2003, are presented on the following pages. The Minot location was lost and the full data set is not yet available from Carrington, only analyzed averages. Agronomic data will be presented in the final report.

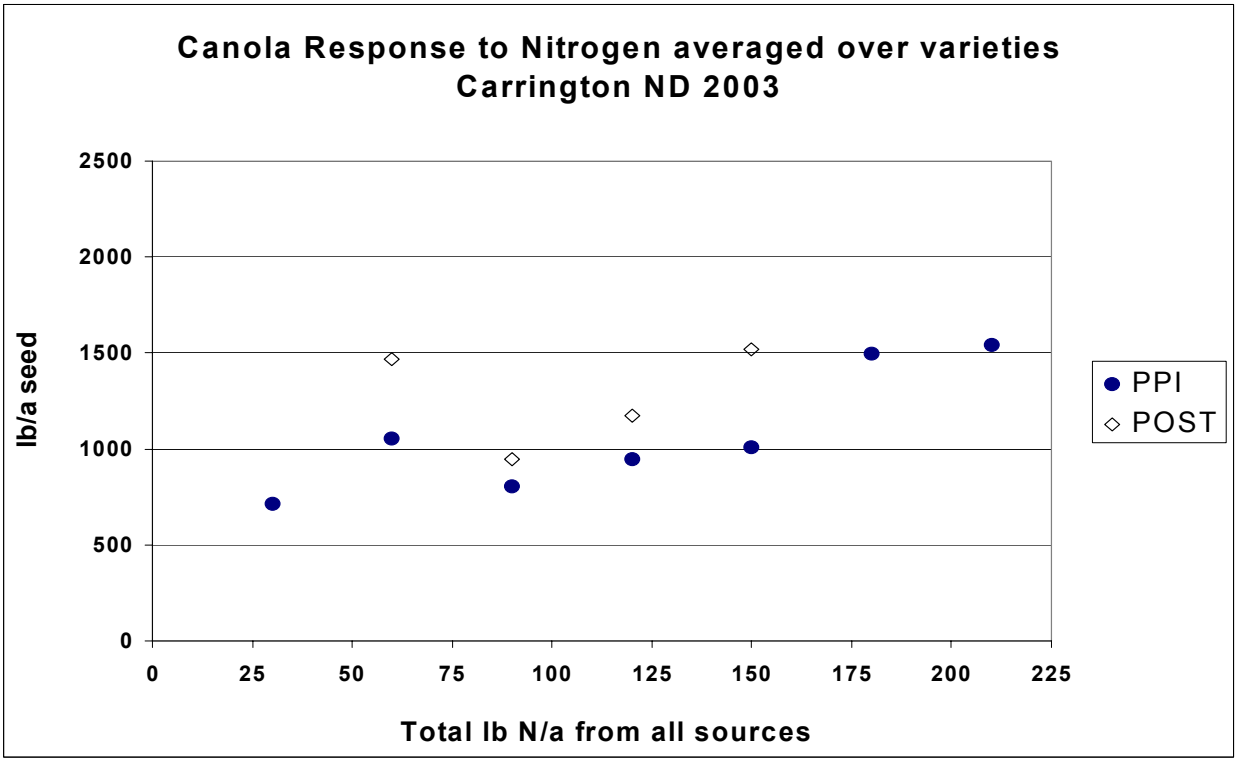

Canola Yield Response to Nitrogen
Valley City, ND 2003
lb/a Seed
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
Total N from all sources
357 ppi
Minot ppi
357 post
Minot post
357
Minot


Canola Yield Response to Nitrogen
Wishek, ND 2003
lb/a Seed
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
Total lb N/a from all sources
357 ppi
Minot ppi
357 post
Minot post
357
Minot


Canola Yield Response to Nitrogen
Williston, ND 2003
lb/a seed
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
Total lb N/a from all sources
357 ppi
Minot ppi
357 post
Minot post
357
Minot


Canola Response to Nitrogen
Hettinger, ND 2003
lb/a seed
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
Total lb N/a from all sources
357 ppi
Minot ppi
357 post
Minot post
357
Minot


Canola Response to Nitrogen
Langdon, ND 2003
lb/a seed
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
Total lb N/a from all sources
357 ppi
Minot ppi
357 post
Minot post
357
Minot


Canola Response to Nitrogen averaged over varieties
Carrington ND 2003
lb/a seed
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
Total lb N/a from all sources
PPI
POST