

Grant Progress Report and Invoice

January 1, 2021 – June 30, 2021

Title of project: **Management Practices to Maximize Canola Profitability**

Program or Agency Name: MDA Grant to Minnesota Canola Council

Purpose and scope of the monitoring: The grant monitoring serves three general purposes: to foster a partnership approach to the monitoring process through an open discussion between the state office staff and the grantee staff, to gain a general overview, or “big picture,” of the grantee’s work and to verify compliance with funding source rules and regulations.

1. List the objectives of this project.

Objective 1: Canola Variety and Systems Comparisons. To establish agronomic and economic criteria for canola varieties with the pod shatter trait under their respective herbicide options for use in direct harvest canola production systems.

Objective 2: Direct Harvest and Swathing Trial. To compare harvesting methods in canola - swathing (standard) vs. direct harvest alone or with a desiccant.

Objective 3: Nitrogen Fertility Rate, Source, and Timing Trial. To evaluate canola growth, development, and yield from several rates of nitrogen (N) applied preplant incorporated (PPI) alone and combinations of PPI + post emergence timings.

Objective 4: Canola Management Strategies to Improve Return on Investment (ROI). To compare various management strategies (seeding rates, nitrogen fertility, fungicide applications) in canola to improve ROI.

2. List **all** outcomes from this project that were produced during the duration of this grant. Please include brief (1-2 sentence) accounts of all the research and outreach efforts. Examples include but are not limited to experiments, releasing cultivars, patents, publications, presentations, and field days. **Chronological** order is preferred.

Research Activities:

2018 Research Activities:

Objective 1: To evaluate agronomic characteristics of canola varieties with different herbicide production systems (Liberty Link (LL), Roundup Ready (RR), and Sulfonyleurea (SU) grown under the climatic conditions of northern Minnesota.

In 2018, 23 canola lines were evaluated in the replicated small plot research trial and included 16 RR, 4 LL, and 3 SU canola varieties. Canola yields ranged from 1,986 to 2,742 lbs/A (Table 1). The trial average yield was 2,468 lbs/A which was 20% lower than our yield target of 3,000 lbs/A and about 30% lower than previous years. Hot and dry conditions during flowering caused some flower and pod abortion, especially on the upper portion of the canola plant reducing the yields of all varieties.

Objective 2: Direct Harvest and Swathing Trial. To compare harvesting methods in canola - swathing (standard) vs. direct harvest alone.

In 2018, two seeding rates (6 PLS/ft vs. 9 PLS/ft) were used to compare direct harvesting to swathing using commercial field equipment. The field was managed using best management practices for canola. Canola yields were similar for both seeding rates and harvest methods. Averaged over both planting rates canola yields were 2,519 lbs/A from swath and harvest compared to 2,511 lbs/A from direct harvest (Table 2). Results from this trial suggest direct harvest is a viable option for canola growers that do not have access to a swather. Direct harvest canola appears to be a management practice that should be considered by canola growers using precision planting equipment.

Objective 3: Nitrogen Fertility Rate, Source, and Timing Trial. To evaluate canola growth, development, and yield from several rates of nitrogen (N) applied pre-plant incorporated (PPI) alone and combinations of PPI and post emergence timings.

In 2018, ten nitrogen fertility treatments were investigated ranging from 0 to 160 lbs/A total nitrogen (Table 3) in a small plot replicated trial. The PPI treatments were applied on 5/22/18, canola was seeded on 5/23/18, and post emergence fertility treatments were applied on 6/12/18 when canola was in the 3 to 5 leaf stage. In general, higher nitrogen rates increased canola seed yields. However, the highest yield (2990 lbs/A, 111% of the trial mean) was achieved with 80 lbs/A N PPI followed by 40 lbs/A N applied early post emergence capitalizing on higher nitrogen use efficiency by the actively growing canola crop.

Objective 4: Canola Management Strategies to Improve Return on Investment (ROI). To compare various management strategies in canola to improve ROI.

In 2018, the ROI study investigated high versus low seeding rates, nitrogen rates, and fungicide treatments with the objective to determine which canola inputs have the greatest impact on the growers return per acre. The three canola management variables evaluated in this trial are:

Seeding rate - H: 12 PLS in 6" rows vs. L: 6 PLS in 12" rows (conventional seeding)

Nitrogen rate - H: 160 lbs/A vs. L: 120 lbs/A

Fungicide application – H: Proline at 10% bloom plus Priaxor late vs. L: Topsin M at 10% bloom

The trial was conducted at two locations in 2018. Treatment combinations, yield, and other agronomic data are presented in Table 4. The two location mean canola yield was 2,894 lbs/A. The combined location data indicated two treatments produced less canola yield (LLL: 6 PLS in 12 inch rows/120 lbs/A nitrogen/Fungicide Topsin M at 10% bloom and LLH: : 6 PLS in 12 inch rows/120 lbs/A nitrogen/Fungicide Proline at 10% bloom and Priaxor late application) than the rest of the treatments. All other treatments were similar with canola yields ranged from 2,826 to 3,035 lbs/A. This narrow yield range resulted in no differences in treatment means being detected from the various management options tested.

2019 Research Activities:

Objective 1: To evaluate agronomic characteristics of canola varieties with different herbicide production systems (Liberty Link (LL), Roundup Ready (RR), Truflex (next generation Roundup Ready), and Clearfield (CL)) grown under the climatic conditions of northern Minnesota.

In 2019, 24 canola lines were evaluated in the replicated small plot research trial and included 11 RR, 5 LL, 6 Truflex, and 3 CL canola varieties. Canola yields ranged from 1,949 to 2,902 lbs/A (Table 5). The trial average yield was 2,443 lbs/A which was similar to the 2018 yields and about 18% lower than our yield target of 3,000 lbs/A (Table 5). Warm and dry conditions during flowering caused some flower and pod abortion, especially on the upper portion of the canola plant reducing the yields of all varieties.

Objective 2: Direct Harvest and Swathing Trial. To compare harvesting methods in canola - swathing (standard) vs. direct harvest alone or with a desiccant.

A small plot canola trial was seeded May 29, 2019, in a randomized complete block design with 4 replications. Best management practices were utilized. Treatments were 1) swathing and combining; 2) direct combining; 3) Reglone desiccant and direct combining; and 4) Roundup plus Sharpen desiccants and direct combining. The results from this trial show canola yields in the swathed canola averaged 2,180 lbs/A compared to an average of 2,659 lbs/A for the three direct harvest treatments (Table 6). Canola was seeded in 22 inch rows and when swathed, the canola roller pushed the plants down between the rows which resulted in some of the canola not being picked up by the combine header. If a canola grower was planting canola in 22 inch rows, direct harvest would most likely be the recommended harvest method. No difference in yield was detected between the two desiccant treatments and the undesiccated direct combined canola. At the time of harvest, no visual difference in canola maturity was observed from the two desiccants compared to the untreated. This data suggests that weather conditions in 2019 were conducive

for canola dry down as the untreated canola looked similar to the two desiccants. Like in 2018, direct harvest canola appears to be a management practice that should be considered by canola growers using precision planting equipment.

Objective 3: Nitrogen Fertility Rate, Source, and Timing Trial. To evaluate canola growth, development, and yield from several rates of nitrogen (N) applied pre-plant incorporated (PPI) alone and combinations of PPI and post emergence timings.

In 2019, the same ten nitrogen fertility treatments were investigated ranging from 0 to 160 lbs/A total nitrogen (Table 7) in a small plot replicated trial. The PPI treatments were applied prior to canola being seeded on 5/16/19, and post emergence fertility treatments were applied on 6/15/18 when canola was in the 3 to 5 leaf stage. In general, higher nitrogen rates increased canola seed yields. The highest yield (3,506 lbs/A, 116% of the trial mean) was achieved from 65 lbs/A nitrogen applied PPI followed by 80 lbs/A applied early post emergence capitalizing on higher nitrogen use efficiency by the actively growing canola crop.

Objective 4: Canola Management Strategies to Improve Return on Investment (ROI). To compare various management strategies in canola to improve ROI.

In 2019, the ROI study investigated high versus low seeding rates, nitrogen rates, and fungicide treatments with the objective being determine which canola inputs have the greatest impact on the growers return per acre. The three canola management variables evaluated in this trial are:

Seeding rate - H: 12 PLS in 6" rows vs. L: 6 PLS in 12" rows (conventional seeding)

Nitrogen rate - H: 160 lbs/A vs. L: 120 lbs/A

Fungicide application – H: Proline at 10% bloom plus Priaxor late vs. L: Topsin M at 10% bloom

The ROI trial was repeated in 2019. Treatment combinations, yield, and other agronomic data are presented in Table 8. Canola seed yields ranged from 2,695 to 3,157 lbs/A with the mean canola yield of 3,021 lbs/A. Treatments that resulted in canola seed yields of less than 100% were L/L/L, L/L/H and L/H/L. All other treatments gave canola seed yield that ranged from 101-105% of the trial mean yield. In 2019, limited disease pressure was present in the plots regardless of row space, seeding rate or fertility rate resulting in no observed benefits from the fungicide treatments.

2020 Research Activities:

In addition to the difficulties of conducting research during the global COVID-19 pandemic, the 2020 growing season was challenging. The fall of 2019 was extremely wet followed by excessive rainfall in June and July (over 14.5 inches which is twice the normal rainfall) which negatively impacted the canola plots with saturated soil and standing water for long periods of time during critical growing periods. The trial data should be interpreted using caution based on the abnormal growing season and the high degree of variability in the data.

Objective 1: To evaluate agronomic characteristics of canola varieties with different herbicide production systems (Liberty Link (LL), Roundup Ready (RR), Truflex (next generation Roundup Ready), and Clearfield (CL)) grown under the climatic conditions of northern Minnesota.

In 2020, 21 canola lines were evaluated in the replicated small plot research trial and included 4 RR, 8 LL, 5 Truflex, 1 Truflex + LL, 1 RR + LL, and 2 CL canola varieties. Canola yields ranged from 472 to 1,194 lbs/A (Table 9). The trial average yield was 801 lbs/A which was 32% of the 2019 yields and significantly lower than our yield target of 3,000 lbs/A. The depressed canola yields in 2020 can be attributed to saturated soil conditions in the fall of 2019, incomplete tillage in the fall of 2019, delayed planting in 2020, and extended saturated soil conditions from mid-June into July during the 2020 growing season.

Objective 3: Nitrogen Fertility Rate, Source, and Timing Trial. To evaluate canola growth, development, and yield from several rates of nitrogen (N) applied pre-plant incorporated (PPI) alone and combinations of PPI and post emergence timings.

In 2020, the canola yield response from various rates of urea alone and a 50/50 blend of urea + ESN applied PPI and a split nitrogen strategy of PPI urea followed by a post emergence (3-5 leaf canola) application of Agrotain coated urea and liquid nitrogen was investigated. Canola yields ranged from 1,221 to 2,421 lb /A (Table 10). Generally, canola yields tended to increase as the nitrogen rate increased from 60 to 160 lbs/A. Further, canola yields tended to increase at a given level of nitrogen from a 50/50 blend of urea + ESN applied PPI compared to urea applied alone. This suggests that in a year of above average rainfall, a 50/50 blend of urea and ESN is more efficient than urea applied PPI alone. When applied postemergence, 28% nitrogen tended to be a more efficient nitrogen source than Agrotain Ultra coated urea. The trial had several areas of extended ponded water and saturated soil conditions and will be repeated in 2021 to validate the results under more normal environmental conditions.

Outreach Activities:

2018 Outreach Activities:

Canola Growers Field Day, Roseau, MN: July 11, 2018

Contributor to the Red River Farm Network "Canola Minute" which is broadcast to local stations to provide an update on growing conditions and other information that is of interest to canola growers in MN, ND & SD.

Minnesota-North Dakota Canola Research Meeting, Fargo, ND: November 15, 2018

Canola Growers Annual Meeting, Roseau, MN: December 5, 2018

Minnesota Canola Growers website houses annual research summaries: mncanola.org

2019 Outreach Activities:

Canola Growers Field Day, Roseau, MN: July 10, 2019

Contributor to the Red River Farm Network "Canola Minute" which is broadcast to local stations to provide an update on growing conditions and other information that is of interest to canola growers in MN, ND & SD.

Minnesota-North Dakota Canola Research Meeting, Fargo, ND: November 7, 2019

Canola Growers Annual Meeting, Roseau, MN: December 4, 2019

Minnesota Canola Growers website houses annual research summaries: mncanola.org

2020 Outreach Activities:

Minnesota-North Dakota Canola Research Meeting, Virtual: November 5, 2020

Canola Growers Annual Meeting, Virtual: December 3, 2020

Minnesota Canola Growers website houses annual research summaries: mncanola.org

3. List any outcomes from this project that you expect to result after the final report is submitted. We do not anticipate any outcomes after the final report.

4. Provide a paragraph or two describing or elaborating on the results from your project that demonstrate improvement of agricultural product quality, quantity, or value. Feel free to include a discussion of any measurable outcomes of your research and outreach such as cultivars released, numbers of farmers trained, or management guides distributed.
Over the last two decades, Minnesota canola acres have declined significantly from 200,000 (1998) to 14,500 (2014). Several factors for the decline include soybean acreage expansion, high canola input costs (fertilizer), and additional management costs (swathing). A recent advancement in high-yielding canola varieties is pod shatter technology, paving the way for farmers to consider a direct harvest strategy. Our research was conducted to identify new management strategies to reduce input costs and increase yields to assist the Minnesota canola industry to more effectively compete with other cropping choices and to meet demand at the relatively new CHS crushing facility in Hallock, MN. Currently it imports most of its canola from Canada and North Dakota. In the last number of years, we have seen an increase in acres to 50,000 in 2020 and information generated by this research project can help this upward trend continue.
Swathing canola prior to harvest is considered a standard management practice and costs \$11.93/acre (NDSU Survey). Direct harvest varieties can be more cost effective for farmers by

saving swathing cost. In addition, with direct harvest canola, acreage can be promoted outside the traditional canola growing area as direct harvest canola can be harvested with small grain/soybean straight headers potentially increasing canola acreage.

Canola farmer surveys highlight priority areas of research to increase canola profitability in Minnesota. Priority research areas include direct harvest strategies, evaluation of canola genetics with pod shatter traits, nitrogen management, and management practices improving return on investment (ROI). To address these priorities, those four applied research areas were investigated with an overall goal of maximizing profitability to canola farmers. This 3-year project through large on-farm locations and small plot replicated research trials provided valuable information on direct harvest canola production and management strategies to maximize canola profitability. We were able to provide canola producers with timely information on the highest performing varieties in northern Minnesota. We successfully demonstrated that direct combining of canola can be a viable option for growers. Finally, we were able to provide nitrogen fertility recommendations for increasing the profitability of canola.

5. If possible, describe any economic impacts of your project that were estimated or measured by your organization.

Research and Economic Impacts 2018:

In the 2018 systems trial, 7 of the 23 canola varieties produced seed yield of 105 to 111% of the mean. Using the trial average of 2,468 lbs/Ac, and canola price of \$0.16/lb, the gross dollar return in 2018 would be of \$394.88/ac. All varieties exhibited good early season vigor. First flower date ranged from June 30th to July 5th with the end of flowering ranging from July 15th to July 25th. Plant height ranged from 43 to 61 inches. Oil content ranged from 46.1% to 53%.

In 2018, the comparison between direct harvesting to swathing suggest direct harvest is a viable option for canola growers that do not have access to a swather. Direct harvest canola has the potential to save growers the approximately \$12 per acre cost of swathing.

Nitrogen can account for over 36% of the direct costs of canola production. By utilizing split applications of nitrogen, the canola crop can better utilize it when the crop is actively growing at the 3 to 5 leaf stage. In the 2018 nitrogen fertility trial, fertilizer was applied from 0 to 160 lbs/A as PPI or PPI plus post emergence applications. Net return for the various nitrogen fertilizer costs for rates applied over the base rate of 9-40-40 is presented in Table 11. With cost basis used in this table, 80 lbs/Ac urea PPI followed by 40# urea applied early post emergence returned \$221.50 to the grower. This was \$33/A more than the next highest return treatment of 160 lbs/A (\$188.5) when nitrogen was applied PPI only. Liquid fertilizer as 28% and ammonium thiosulfate gave net returns in the \$18-128/A range. Results from this fertility trial suggest that a split application of 80 lbs/A nitrogen applied followed by 40 lbs/A post emergence can increase the nitrogen use efficiency and increase the net return/A compared to nitrogen applied PPI only. Applications of nitrogen all at once prior to planting is an easy option preferred by many growers. However, split applications of nitrogen will offer increased nitrogen use efficiencies and may lead to higher profits compared to a PPI only option for nitrogen applications in canola.

The 2018 Return on Investment Trial showed few differences among the treatments (Table 12). When estimating economic returns on investment, retail cost estimates were used. Only two treatment combinations gave a positive return on investment to the grower: L/H/L at \$40.41/A and H/L/L at \$3.20/A. Using any of the other higher management treatments the grower would have lost money based on the growing conditions in 2018.

Growers should consider the pros and cons of narrow versus wide rows for canola. Narrow rows canopy the ground more rapidly, have higher photosynthetic potential early in the season, and provide better weed competition. Wider rows are better able to be productive with lower seeding rates, leave sufficient space to allow field equipment to operate between rows and maybe less susceptible to white mold by allowing better air flow. White mold and other disease pressure were generally low in 2018. In years with moderate to heavy disease pressure, canola would respond to fungicide multiple treatments.

Research and Economic Impacts 2019:

In the 2019 systems trial, 6 of the 24 canola varieties produced seed yield of 105 to 119% of the trial mean. Using the trial average of 2,443 lbs/A, and canola price of \$0.20/lb, the gross dollar return in 2019 would be of \$488.60/A. All varieties exhibited good early season vigor. First flower date ranged from June 28th to July 4th with the end of flowering ranging from July 15th to July 21th. Oil content ranged from 45.8% to 52.3%.

In 2019, the comparison between direct harvesting to swathing suggests direct harvest is a viable option for canola growers that do not have access to a swather. Direct harvest canola has the potential to save growers the approximately \$12 per acre cost of swathing. In addition, under favorable dry down conditions, the direct combined treatment yielded 339 lbs/A more seed than the swathed treatment resulting in an additional economic return of \$54.24 per acre for a \$66.24 per acre greater return.

Nitrogen is a significant input cost for canola production accounting for over 36% of the direct costs of production. By utilizing split applications of nitrogen, the canola crop can better utilize it when the crop is actively growing at the 3 to 5 leaf stage. The 2019 nitrogen fertility trial was a repeat of the 2018 trial with fertilizer applied from 0 to 160 lbs/A as PPI or PPI plus post emergence applications. Net return for the various nitrogen fertilizer costs for rates applied over the base rate of 9-40-40 is presented in Table 13. With cost basis used in this table, 80 lbs/Ac urea PPI followed by 40 lb urea applied early post emergence returned \$221.50 to the grower. This was \$33/A more than the next highest return treatment of 160 lbs/A (\$188.5) when nitrogen was applied PPI only. Liquid fertilizer as 28% and ammonium thiosulfate gave net returns in the \$18-128/A range. Results from this fertility trial suggest that a split application of 80 lbs/A nitrogen applied followed by 40 lbs/A post emergence can increase the nitrogen use efficiency and increase the net return/A compared to nitrogen applied PPI only. Applications of nitrogen all at once prior to planting is an easy option preferred by many growers. However, split applications of nitrogen will offer increased nitrogen use efficiencies and may lead to higher profits compared to a PPI only option for nitrogen applications in canola.

The 2019 Return on Investment Trial showed few differences among the treatments (Table 14). When estimating economic returns on investment, retail cost estimates were used. Only one treatment combination gave a positive return on investment to the grower: L/H/L at \$2.40/A and it was the same treatment with the highest economic returns in 2018. All other management treatments the grower would have lost money 2019.

Research and Economic Impacts 2020:

In the 2020 systems trial, 21 canola lines were evaluated in the replicated small plot research trial and included 11 RR, 8 LL, and 2 SU canola varieties. The extremely poor canola yields in 2020 can be attributed to saturated soil conditions in the fall of 2019 limiting tillage operations in the fall of 2019, delayed planting in 2020, and extended saturated soil conditions from mid-June into July during the 2020 growing season. The high degree of variability and the stressful growing conditions resulting in low yields makes interpretation of the data suspect.

By utilizing split applications of nitrogen including environmentally sensitive nitrogen (ESN), the canola crop may be better able to utilize nitrogen when the crop is actively growing at the 3 to 5 leaf stage. With nitrogen being a significant input cost, maximizing nitrogen use efficiency and nitrogen rates is important to growers. Canola yields were low in the trial and the trial averaged only 1,872 lbs/A due to the poor growing conditions of excess rainfall and saturated soils (Table 10). Canola tended to benefit from a 50/50 blend of urea plus ESN compared to urea applied alone and the highest yielding treatment was 160 lbs/A nitrogen applied as 80 lbs/A urea and 80 lbs/A ESN PPI (2,421 lbs/A vs. 2,180 lbs/A). This suggests that in a year of above average rainfall, a 50/50 blend of urea and ESN is more efficient than urea applied PPI alone.

6. List and briefly describe any challenges that have slowed the progress or impacted the budget of the project.

The COVID-19 global pandemic prevented us from doing some of the on-farm research described in the grant and limited our access to canola fields. We were unable to host a grower Field Day in 2020. The annual canola growers meeting was held virtually in December 2020 which was challenging.

7. If you changed the scope or objectives of your project, please provide a short summary and justification of the changes.

No changes to the scope or objectives of the project.

Table 1.

2018 Spring Canola Variety Trial

Location- Rice Farms NW of Roseau, Mn.

University of Minnesota

Herbicide			Seeding **	Yield ¹		Protein and Oil components(%) ²										% ground		Flowering			
Company	Tolerance*	Variety	Rate (#/ac)	lb/acre	% of mean	% oil	% protein	Palmitic	Stearic	Oleic	Linoleic	Unoleic	Lodging ³	ESV ⁴	cover ⁵	Ht(in.)	begin day	end day	# of days		
Cibus	SU	C5507	4.4	2013	82	46.1	19.9	3.9	1.9	74	18	8.0	7.0	7.0	71	45	7/5	7/23	18		
Cibus	SU	exp201803	4.7	1986	80	49.6	17.7	3.9	1.7	78	19	8.5	1.5	6.0	65	48	7/3	7/19	16		
Cibus	SU	exp201801	3.9	2580	105	48.7	18.1	4.0	1.7	75	19	8.0	2.5	5.0	48	52	7/5	7/25	21		
Dekalb-Monsanto	RR	DKL70-10	7.3	2348	95	50.2	16.2	4.2	1.8	78	19	8.3	4.0	8.5	88	45	6/30	7/15	15		
Dekalb-Monsanto	RR	DKL 75-42CR	4.4	2475	100	50.0	16.0	4.0	1.9	82	18	7.2	2.0	7.5	79	48	7/2	7/20	18		
Dekalb-Monsanto	RR	DKL35-23	5.8	2315	94	51.1	16.3	4.1	1.7	77	20	8.6	3.5	8.0	85	47	6/29	7/15	16		
Dekalb-Monsanto	RR	DKL71-14BL	6.5	2714	110	51.0	15.8	4.0	1.8	69	20	8.0	1.5	8.0	84	46	6/30	7/19	19		
DuPont Pioneer	RR	45M35	5.0	2669	108	52.5	14.0	4.0	2.0	64	19	8.0	1.5	7.5	84	50	7/1	7/18	16		
DuPont Pioneer	RR	45H33	5.0	2514	102	50.4	15.6	4.0	1.9	81	17	7.5	1.0	7.5	76	51	7/1	7/20	19		
BrettYoung	RR	6074 RR	5.2	2708	110	49.6	14.5	4.2	1.8	78	18	8.2	1.0	8.0	85	47	6/30	7/22	22		
BrettYoung	RR	6090 RR	5.6	2512	102	49.9	15.4	4.1	1.8	77	18	8.6	1.0	7.5	80	61	7/4	7/25	21		
BrettYoung	RR	4187 RR	5.6	2665	108	50.1	15.4	4.0	2.0	82	17	5.5	1.0	7.5	80	53	7/4	7/23	19		
Integra Seed/Wilbur Ellis	RR	7257R	4.4	2278	92	50.6	16.3	4.3	1.6	76	21	9.3	4.0	7.5	78	45	6/30	7/15	15		
Star Specialty Seed	RR	Star 402	4.6	2562	104	53.0	14.1	4.0	1.8	73	19	8.4	2.0	7.0	75	48	7/2	7/17	15		
Proseed	RR	300 Magnum	5.6	2455	99	51.8	15.1	4.1	2.0	71	19	6.9	5.0	7.5	76	45	6/30	7/18	18		
Proseed	RR	PS 5000	5.3	2426	98	49.3	15.7	4.0	1.8	78	18	8.3	1.5	8.5	89	53	7/3	7/23	20		
Winfield United	RR	HyClass 955	4.7	2289	93	51.4	15.5	4.2	1.7	76	20	8.0	6.5	8.5	86	45	6/30	7/16	16		
Winfield United	RR	HyClass 730	4.9	2280	92	52.1	15.2	4.1	1.8	71	20	8.1	5.0	8.5	83	43	6/30	7/15	16		
Winfield United	RR	HyClass 930	4.9	2546	103	52.1	14.9	4.1	1.9	67	20	7.9	2.0	7.5	76	46	6/30	7/15	16		
Bayer CropScience	LL	InVigor L140P	5.4	2442	99	48.0	16.4	3.9	1.8	77	18	8.6	1.5	9.0	81	52	7/1	7/16	15		
Bayer CropScience	LL	InVigor L233P	5.7	2675	108	48.4	16.0	4.1	1.9	77	18	8.0	1.5	9.0	91	47	7/1	7/15	15		
Bayer CropScience	LL	InVigor L255P	6.0	2563	104	51.0	13.7	3.4	1.9	87	21	9.0	1.0	9.0	91	48	7/2	7/19	17		
Bayer CropScience	LL	InVigor L252	5.4	2742	111	51.5	14.2	4.2	1.7	74	20	8.6	1.0	7.0	81	51	7/3	7/21	18		
LSD @ 5% Level				222	9	0.9	0.9	0.3	0.1	8.0	0.6	0.4	1.7	1.1	9.6	4.0	1.5	1.3	1.9		
CV(%)				6	6	1	4	6	5	7	2	4	47	10	8	6	3	5	7		

Experimental Design: RCB w/4reps

*Herbicide Tolerance--LL=Liberty Link, RR=Roundup Ready and SU=Sulfonated Urea

**Seeding rate=12PLS/Ft.²(using company provided PLS/lb)¹Clean Seed Yields corrected to 8.5% moisture

Trial Mean yield =2468#/acre

²Seed components on dry matter basis³Lodging at harvest-1=Upright ; 9=flat⁴ESV(early season vigor)-June 13 -- 9= best;1=leastAverage⁵% ground cover June 14

Pod fill information or random pods picked at maturity--

	Pod Length	Seed wt per pod(GM)
Top portion	5cm	0.03
Middle portion	6.5cm	0.07
Lower portion	6.8cm	0.09

Top pods only had only 43% seed quantity of middle pods and 33% of bottom pods

Herbicide Treatments:	Where applied	Date of Application
Draft- .3oz. + .5% NIS	SU lines	6/12
Liberty-- 22oz.+ 2.5%AMS	LL lines	6/13
Roundup PowerMax--16oz.+2.5%AMS	RR lines	6/13
Section 2 --5oz. + 1%COG+1.5oz. Warrior	all plots	6/7

Soil Test=	PH	%OM	Olsen P	K	NO3-ppm
0-6"	8.2	5	3	107	5.8
6-24"					2.8

Table 2.

2018 Harvest Methods on Precision planted Canola

Rice Farms-Roseau, Mn

Trt#	Row spacing	Seeding Rate (PLS)	<u>lb/acre</u>	
			Direct Harvest	Swath and combine
1	22"	6	2758	2553
2	22"	9	2264	2485
LSD @5% level			NS	NS
CV(%)			11	8

Seeding Date- 6/1/2018

Variety- InVigor L140-P

Planter-RDK Enterprises- Precision planting in 22" rows

Seeding Rates = 6PLS (261,360 seeds/A) and 9PLS (392,040 seeds/A)

Table 3.

2018 Canola Fertility Trial

Rice Farms-Roseau,Mn

Rice Farms Research, Inc.																			
Total			PPI ¹	Post fertilizer ^{1a}			Yield*	Leaf		% Ground	Bloom		Stalk		Test wt.				
TRT#	Added N	N-Urea	PPI S	Sulfur**	urea	28%N	lb/acre	%mean	Burn ²	ESV ³	Cover ⁴	Begin	End	Lodging ⁵	dia. ⁶	Ht(in.)	#/bu.	Protein	Oil
0	0	0	0				1798	67	NA	7.0	83	1-Jul	16-Jul	1.5	1.0	40	50.7	16.6	48.1
1	0	0	20#AMS				1598	59	NA	7.5	77	30-Jun	16-Jul	1.0	1.0	42	50.5	16.5	48.1
2	80	80	20#AMS				2646	98	NA	8.5	85	1-Jul	17-Jul	2.5	4.0	51	51.0	18.0	46.9
3	120	120	20#AMS				2563	95	NA	8.0	86	30-Jun	16-Jul	3.0	3.5	50	51.0	18.4	46.4
4	160	160	20#AMS				2884	107	NA	8.5	84	1-Jul	18-Jul	7.5	4.0	51	51.3	20.0	44.9
5	120	80	20#AMS		40#		2990	111	NA	8.0	85	30-Jun	17-Jul	6.5	4.0	51	51.1	19.4	45.6
6	160	80	20#AMS		80#		2871	106	NA	8.5	86	1-Jul	17-Jul	5.5	3.5	49	51.3	20.3	45.0
7	120	80		20#am.t		31#	2497	93	14	7.5	79	1-Jul	18-Jul	2.5	2.5	50	51.0	18.1	46.7
8	160	80		20#am.t		71#	2641	98	18	7.5	80	1-Jul	19-Jul	4.5	3.0	50	50.8	18.3	46.6
9	120	120	0				2497	93	NA	8.5	86	1-Jul	18-Jul	2.0	3.0	50	51.0	18.2	46.4
10	160	160	0				2702	100	NA	7.5	85	1-Jul	17-Jul	4.5	3.0	48	50.9	19.2	45.8
LSD @5%level							319	12	NS	1.4	7	NS	2	2.8	1.2	4	0.3	1.5	1.4
CV(%)							8.7	8.7	2	12	6	2	8	52	27	6.2	0.4	6	2
#/acre mean (trt2-10 only)							2699												

Experimental design= RCB with 4 reps

Variety=InVigor L-140P

Seeded and rolled 5/23/2018

*Yield- clean seed #/acre corrected to 8.5% moisture- yield mean does not include 0 N rate

**Sulfur -Post emergent ammonium thiosulfate(12-0-0-26s) source @ 7gallons per acre

¹PPI- urea and sulfur application rates 5/22/2018 prior to final seedbed prep^{1a}Post fertilizer applied per acre 6/12--urea =dry application OR streamer=streamer jet nozzle applications with 28%UAN + amm.thiosulfate²Leaf burn- Visual rating of leaf desiccation 6/16/2018 from streamer thiosulfate applications³ESV-Early season vigor visual rating 6-13-18⁴%Ground cover-visual rating 6-14-18⁵Lodging at harvest- 1=Upright; 9=flat⁶Stalk diameter at harvest- 1=1/8" , 3=1/8"-1/4" , 5=1/4"-1/2"(larger number=thicker stem)

Background soil test-5/12/2018

Soil	Olsen P	NH ₄ OAc-K	LOI OM	Water	EC	SO ₄ -S	NO ₃ -N
Depth	mg/kg	(mg/kg)	(%)	pH	(mmhos/cm)	#/acre	#/ac
0-6"	6	96	4.5	8.3	0.3	9	5.91
6-24"							7.62

Table 4.

2018 Canola Return on Investment- Bang for the Buck

2 Locations- Rice Farms and Magnusson Research Farm

				Yield lb/acre ¹		Yield		ESV ²		% Ground cover ³		% Days ⁴	Ht.(in.)	Lodging ⁵		%Protein		% Oil		Test Wt./Bu		
Trt#	Management	Seed Rate	Fertilizer	Fungicide	Rice	Magnusson	Mean	% mean	Rice	Mag.	Rice	Mag.	In Bloom	Rice	Rice	Mag.	Rice	Mag.	Rice	Mag.	Rice	Mag.
1	L/L/L	6PLS/ft.2- 12"rows	120-40-40-20s	Topsin M WSB	2275	2970	2622	91	8.0	7.5	60	59	18	51	2.5	9.0	17.7	21.1	47.8	43.8	50.6	50.7
2	L/L/H	6PLS/ft.2- 12"rows	120-40-40-20s	Proline/Priaxor	2651	2908	2779	96	6.5	8.0	50	58	19	54	3.5	9.0	18.9	20.8	46.9	44.1	50.3	50.5
3	L/H/L	6PLS/ft.2- 12"rows	160-40-40-20s	Topsin M WSB	2772	3353	3063	106	7.0	6.5	61	53	18	52	6.5	9.0	19.7	21.4	46.1	43.4	50.0	50.7
4	L/H/H	6PLS/ft.2- 12"rows	160-40-40-20s	Proline/Priaxor	2491	3162	2826	98	8.0	7.0	63	60	18	51	4.0	9.0	19.2	21.8	46.3	43.0	50.6	50.8
5	H/L/L	12PLS/ft.2-6" rows	120-40-40-20s	Topsin M WSB	2775	2934	2854	99	7.5	7.5	75	79	18	51	3.5	9.0	18.3	20.7	47.3	43.8	50.6	50.8
6	H/L/H	12PLS/ft.2-6" rows	120-40-40-20s	Proline/Priaxor	2798	3282	3040	105	7.0	7.0	80	81	18	50	2.0	9.0	18.4	20.8	47.1	43.8	50.5	50.5
7	H/H/L	12PLS/ft.2-6" rows	160-40-40-20s	Topsin M WSB	2841	2886	2863	99	7.5	8.0	79	84	18	51	6.0	9.0	19.6	21.9	46.0	42.8	50.9	51.0
8	H/H/H	12PLS/ft.2-6" rows	160-40-40-20s	Proline/Priaxor	2777	3108	2942	102	7.5	8.0	80	84	17	48	4.5	9.0	18.5	21.2	47.2	43.6	50.3	50.8
9	H/H/H+I	12PLS/ft.2-6" rows	160-40-40-20s	Warrior/Proline/Priaxor	2986	3085	3035	105	8.0	8.0	89	76	17	50	6.5	9.0	19.1	22.0	46.4	42.8	50.3	51.0
10	H/H/H+F	12PLS/ft.2-6" rows	160-40-40-20s	Quadris/Proline/Priaxor	2818	3010	2914	101	8.0	7.5	85	81	17	51	5.5	9.0	19.3	21.3	46.2	43.3	50.5	50.8
LSD @5% level					393	384	269	9	NS	NS	14	12	NS	3	2.7	NS	1.1	0.8	1.1	0.8	NS	NS
CV(%)					10	9	6	6	14	17	14	11	1	4	41	0	4	3	2	1	1	1
Overall Mean Yields--#/acre					2718	3070	2894															
					Yield #/acre			Soil test 5-15-2018						Olsen								
2018 means					TRT Mean	Rice	Magnusson	Mean	Magnusson		PH	%OM	P	K	NO3-ppm							
Row space/Seed rate					6"row 12PLS	2798	3053	2925	0-6"		8.1	2.8	9	91	19							
					12"row 6PLS	2547	3098	2823	6-24"		7											
Fungicide					Topsin	2666	3036	2851	Rice													
					Proline+Priaxor	2679	3115	2897	0-6"		8.2	4.6	5	103	8.9							
Fertility					120-30-30-20s	2625	3023	2824	6-24"		2.5											
					160-40-40-20s	2720	3127	2924														

Experimental Design=RCB with 4 reps

TRT#9&10 (Warrior or Quadris) 6/6/2018 7:00pm sse 5-7 2 leaf growth stage 7:00pm sse 5-7mph

Topsin(low management) or Proline(high management) applied to all plots 7/9/2018 -- 50% bloom 5:00pm nw 4-6mph

TRT#2,4,6,8,9,10- Priaxor in addition to Proline in high management plots applied 7/13/2018 late bloom 9:00am 70F wsw 2-6mph

¹Yield- clean seed #/acre corrected to 8.5% moisture²ESV-Early season vigor visual rating 6-13-18³%Ground cover-visual rating 6-14-18⁴# Days in Bloom -Rice farm only⁵Lodging at harvest- 1=Upright; 9=flat

Pesticide Application rate

Topsin M WSB 20oz.

Proline 5.7oz.

Priaxor 6oz.

Warrior 1.5oz.

Quadris 6oz.

Table 5.

2019 Spring Canola Variety Trial
Northern Resources -West Plant-Roseau,Mn

Herbicide			Seeding **	Yield ¹		Test			ESV ⁴	ESV ⁴	% ground cover		Flowering				
Company	Tolerance*	Entry	Rate (#/ac)	#/acre	% of mean	oil ²	protein ²	Weight	Lodging ³	13-Jun	19-Jun	13-Jun	19-Jun	Ht(in.)	begin day	end day	# of days
BASF	LL	InVigor L252	6.7	2902	119	47.8	17.9	51.7	3.5	5.0	6.5	45	83	51	2-Jul	18-Jul	15
BASF	LL	InVigor L255P	5.8	2768	113	47.8	17.8	51.7	2.5	6.0	7.0	60	81	52	2-Jul	19-Jul	13
BASF	LL	InVigor L233P	5.3	2654	109	46.1	18.0	51.0	2.5	6.0	8.0	50	84	49	30-Jun	15-Jul	15
Wilbur Ellis	TruFlex	Integra 7389RT	5.0	2615	107	48.1	17.7	51.5	3.5	4.5	8.5	40	85	50	30-Jun	18-Jul	12
BrettYoung	RR	6074 RR	4.7	2587	106	47.8	16.1	51.6	2.0	4.5	8.0	38	88	51	2-Jul	19-Jul	13
BASF	LL	InVigor L234P	6.0	2556	105	45.8	18.4	50.5	3.0	5.0	7.5	50	83	50	1-Jul	16-Jul	15
Pioneer	RR	45M35	3.3	2533	104	50.7	16.4	51.0	2.0	4.5	6.0	48	73	54	2-Jul	18-Jul	14
Winfield United	RR	CP9982RR	5.0	2528	103	46.0	17.2	51.9	3.5	5.5	7.5	53	83	51	2-Jul	21-Jul	11
Winfield United	TruFlex	CP9978TF	4.9	2523	103	48.7	17.5	51.6	4.5	4.5	8.0	43	81	49	1-Jul	18-Jul	13
BASF	LL	InVigor L230	6.1	2514	103	47.7	17.2	51.7	2.0	4.5	7.0	45	76	50	30-Jun	16-Jul	15
Canterra/Meridian s	CL	CS2500 CL	5.1	2495	102	49.6	16.0	51.5	2.0	6.5	7.0	53	81	53	30-Jun	15-Jul	15
Star Specialty Seed	TruFlex	StarFlex	5.0	2490	102	50.1	16.3	51.1	4.0	5.0	6.0	35	78	48	1-Jul	16-Jul	14
Dekalb	RR	DKL71-14BL	6.4	2442	100	49.4	16.8	50.7	2.5	4.5	7.0	43	79	47	30-Jun	16-Jul	14
BrettYoung	CL	5545 CL	6.4	2405	98	48.4	15.8	51.3	1.5	7.5	8.5	73	88	56	30-Jun	16-Jul	14
Star Specialty Seed	RR	Star 402	4.6	2405	98	52.3	15.1	50.8	3.0	4.5	7.0	35	70	51	30-Jun	16-Jul	14
BrettYoung	RR	6090 RR	4.7	2403	98	48.6	16.5	50.9	4.5	4.5	8.0	38	83	53	2-Jul	17-Jul	15
Dekalb	RR	DKL70-10	5.7	2394	98	47.7	17.2	50.4	4.5	4.5	7.5	38	78	46	1-Jul	17-Jul	14
Proseed	RR	300 Magnum	5.3	2371	97	50.5	16.1	51.3	2.0	4.5	7.0	35	80	49	30-Jun	17-Jul	14
Proseed	RR	PS 5000	5.3	2331	95	47.6	16.7	50.5	5.0	5.0	7.0	40	80	50	1-Jul	16-Jul	15
Canterra/Meridian s	TruFlex	CS2600 CR-T	5.3	2323	95	49.8	15.5	51.2	3.5	4.5	7.5	40	84	47	30-Jun	16-Jul	14
Dekalb	TruFlex	DKTF92SC	6.4	2320	95	49.1	16.8	50.5	3.0	4.5	8.5	48	85	49	29-Jun	15-Jul	14
BrettYoung	RR	4187 RR	5.2	2313	95	46.3	18.4	51.5	3.0	4.0	6.0	35	76	54	4-Jul	22-Jul	12
Dyna-Gro Seed	CL	DG 200CL	6.9	2202	90	47.2	16.7	50.9	3.0	4.5	6.5	45	78	54	2-Jul	20-Jul	12
Pioneer	RR	45CM39	3.7	2064	84	50.4	16.1	49.1	3.5	3.0	5.5	33	74	53	2-Jul	17-Jul	16
Dekalb	TruFlex	DKTF91SC	6.9	1949	80	49.6	16.5	50.9	2.5	4.5	7.5	43	84	45	28-Jun	15-Jul	14
LSD @ 5% Level				266	11	1.4	1.6	0.3	1.5	1.2	1.7	16	10	2	1	2	2
LSD @ 10% Level				222	9	1.2	1.3	0.3	1.3	1	1.4	13	8	2	1	2	2
CV(%)				7	7	2	7	1	36	18	16	26	9	3	2	8	9

Experimental Design: RCB w/4reps Planting Date- 5/17/2019

*Herbicide Tolerance--LL=Liberty Link, RR=Roundup Ready,

TruFlex=Next level Roundup Ready and CL=Clearfield

**Seeding rate=12PLS/Ft.²(using company provided PLS/#)¹Clean Seed Yields corrected to 8.5% moisture. Varieties arranged in order of yield.

Trial Mean yield =2443#/acre

² Protein and oil reported on dry matter basis³Lodging at harvest-1=Upright ; 9=flat⁴ ESV(early season vigor) 9= best;1=least

Fertilizer application- 140-40-40-20s applied PPI

Herbicide Treatments:		Where applied	Date of Application	
Beyond- 4oz. + .25%NIS+2.5%AMS		CL lines	6/11	
Liberty-- 22oz. + 2.5%AMS		LL lines	6/11	
Roundup PowerMax--16oz.+2.5%AMS		RR and TruFlex	6/13	
Section 2 --5oz. + 1%COC+1.5oz. Warrior		all plots	6/6	
Soil Test=		Olsen P	NH ₄ OAc-K	nitrate
	PH	%OM	ppm	ppm
0-6"	8.3	4	5	123
6-24"				7
				18

Table 6.

2019 Canola Direct Harvest Methods
Northern Resources-West Plant- Roseau,Mn

Harvest method	Yield ¹	Harvest	Test	Protein ²	Oil ²	Stand ³	Ht(in.)
		Moisture	Weight				
Swath-combine	2180	7.3	49.5	20.0	47.6	5.6	56
Desiccate-Reglone-combine	2764	8.2	50.2	20.2	46.8	5.4	56
no desiccate-combine	2519	7.7	50.3	20.3	46.6	5.8	56
Desiccate-Roundup+Sharpen	2696	7.5	50.6	20.2	46.5	5.8	56
LSD @5% level	234	0.6	0.5	NS	NS	NS	NS
CV(%)	5.7	5.1	0.7	4.0	1.7	0.9	5.1

Experimental Design: RCB with 4 reps

Variety=InVigor L234P

Plot size=35' x 30'

Precision planted with RDK Precision Planter in 22" rows at 3.3#/acre

Occasionally in the wider rows, canola plants are pushed down with the swather roller and not picked up by combine.

¹Clean seed Yield corrected to 8.5% moisture²Protein and oil on dry matter basis³Stand= Plant counts after harvest per foot of row

Reglone rate= 1.5pt.+ .5%NIS

Roundup+Sharpen= 1.5pt+2oz.+1%MSO+2.5%- AMS

Swath date= 7-Sep

Spray dates= Reglone 9/14 Roundup +Sharpen 9/11

Combine dates= 9/17 swath 9/18 direct

Table 7.

2019 Canola Fertility Trial
Northern Resources -West Plant-Roseau,Mn

Total		PPI ¹		Post fertilizer ²		Yield*		ESV ³		% Ground cover		Bloom		Test wt.				
TRT#	Added N	N-Urea	PPI S	Sulfur urea	28%N	lb/acre	%mean	6/13	6/19	6/13	6/19	Begin	End	Lodging ⁴	Ht(in.)	#/bu.	Protein	Oil
1	0	0	20#AMS			2028	67	6.5	6.5	10	74	7/2	7/21	2.0	41	50.9	19.1	43.7
2	80	65	20#AMS			3243	107	6.5	7.0	10	80	7/2	7/21	2.0	49	51.3	19.0	43.9
3	120	105	20#AMS			3208	106	6.0	7.0	10	79	7/2	7/21	3.0	50	51.4	19.4	43.3
4	160	145	20#AMS			3397	112	5.0	6.5	9	73	7/2	7/22	4.5	49	51.5	20.2	42.7
5	120	65	20#AMS	40#		3355	111	6.5	6.5	11	79	7/2	7/22	4.0	51	51.4	19.9	43.0
6	160	65	20#AMS	80#		3506	116	6.5	7.0	13	80	7/2	7/22	3.5	50	51.7	20.4	42.6
7	120	65		20#am.t	31#	3113	103	6.5	6.5	9	75	7/2	7/22	2.5	51	51.5	19.2	43.7
8	160	65		20#am.t	71#	3315	109	6.5	7.5	10	79	7/2	7/22	3.5	49	51.5	19.7	43.0
9	120	120	0			3298	109	6.5	6.5	9	73	7/2	7/21	3.0	50	51.3	19.4	43.4
10	160	160	0			3212	106	6.0	6.0	9	71	7/2	7/22	3.0	51	51.5	20.1	42.6
11	0	0	0			1700	56	6.0	5.5	9	43	7/5	7/23	2.5	36	51.1	19.3	43.4
LSD @5%level						326	11	0.8	1	4	9	1	1	1.2	2	0.2	0.6	0.7
CV(%)						7.4	7.4	9.3	10.3	26	8.2	19.8	2.1	28.3	3.6	0.3	2.3	1.1
#/acre mean (trt2-10)						3034												

Experimental design= RCB with 4 reps Variety=InVigor L234P

Seeded and rolled 5/16/2019

*Yield- clean seed #/acre corrected to 8.5% moisture- yield mean does not include 0 N rate

**Sulfur -Post emergent ammonium thiosulfate(12-0-0-26s) source @ 7gallons per acre

¹PPI- urea and sulfur application rates 5/22/2018 prior to final seedbed prep

²Post fertilizer application-

Sulfur-ammonium thiosulfate+28%UAN- stream jet application 6-12-2019 @ 7GPA

Urea-dry urea applied 6-15-2019

³ESV-Early season vigor visual rating 1=poor; 9=best

⁴Lodging at harvest- 1=Upright; 9=flat

Background soil test-5/7/19

Soil	Olsen P	NH ₄ OAc-K	LOI OM	Water	salts	SO ₄ -S	NO ₃ -N
Depth mg/kg)	(mg/kg)	(%)	pH	(mmhos/cm)	#/acre	#/ac	
0-6"	5	123	4.0	8.3	0.3	24	7
6-24"							18

Table 8.

2019 Canola Return on Investment- Bang for the Buck
West Plant-Northern Resources

Trt#	Management	Seed Rate	Fertilizer	Fungicide	Yield ¹		ESV ²		% Ground cover ³		Bloom		Lodging ⁴	Ht(in.)	Test wt.		
					lb/acre	%mean	6/13	6/19	6/13	6/19	Begin	End			#/bu.	Protein	Oil
1	L/L/L	6PLS-12"rows	120-30-30-20s	None	2820	93	5.5	7.5	5	68	2-Jul	21-Jul	2.5	52	50.9	19.8	44.1
2	L/L/H	6PLS-12"rows	120-30-30-20s	Proline only	2695	89	6.0	5.0	5	51	2-Jul	21-Jul	3.0	54	51.0	19.4	44.4
3	L/H/L	6PLS-12"rows	160-40-40-20s	None	2960	98	6.0	8.0	6	71	2-Jul	22-Jul	3.0	53	50.9	20.4	43.7
4	L/H/H	6PLS-12"rows	160-40-40-20s	Proline only	3009	100	5.5	7.0	5	64	3-Jul	22-Jul	3.0	50	51.0	20.2	43.7
5	H/L/L	12PLS-6"rows	120-30-30-20s	None	3033	100	6.5	7.0	15	84	2-Jul	20-Jul	3.0	50	50.9	19.2	44.6
6	H/L/H	12PLS-6"rows	120-30-30-20s	Proline only	3048	101	6.5	6.5	15	81	3-Jul	21-Jul	4.0	51	50.9	19.3	44.8
7	H/H/L	12PLS-6"rows	160-40-40-20s	None	3185	105	6.0	6.0	13	80	2-Jul	21-Jul	4.5	51	50.9	20.1	43.9
8	H/H/H	12PLS-6"rows	160-40-40-20s	Proline only	3151	104	5.5	6.0	11	75	3-Jul	22-Jul	5.0	49	51.0	20.3	43.9
9	H/H/H+I	12PLS-6"rows	160-40-40-20s	Warrior/Proline	3156	104	5.5	7.5	10	81	2-Jul	21-Jul	5.0	50	51.0	20.6	43.5
10	H/H/H+F	12PLS-6"rows	160-40-40-20s	Quadris/Proline	3157	105	6.0	6.5	10	78	2-Jul	21-Jul	3.5	51	51.0	20	43.9
LSD @5%level					284	9	NS	1.9	5	10	NS	1	1.1	3	NS	0.6	0.7
CV(%)					6	6	15	20	37	10	24	2	20	3	0.4	2	1

Experimental Design=RCB with 4 reps
 Fertilized and planted 5/16/2019

Trial Mean Yield = 3021 lb/A
 Variety=InVigor L234P

TRT#9&10 (Warrior or Quadris) 6/12/2019 - 3 leaf stage
 No fungicide(low management) or Proline(high management)

¹Yield- clean seed #/acre corrected to 8.5% moisture

²ESV-Early season vigor visual rating 1=poor ; 9=best

³%Ground cover-visual rating

⁴Lodging at harvest- 1=Upright; 9=flat

6/12/2019 Warrior or Quadris applied to trt#9-10

3-leaf stage 65F wind nnw wind 5-10

7/11/2019 Proline applied as needed at midflower

Table 9.

2020 Canola Variety Trial

Northern Resources -West Plant-Roseau,Mn

										% ground	Begin	End	harvest				
Company	Entry	PLS/#	Herbicide tolerance*	Maturity	Yield #/acre ¹	Protein ²	Oil ²	Test wt./bu.	cover= 21DAP	Bloom Date	Bloom Date	Days of bloom	height (in)	Lodging ³	ESV- 21DAP ⁴	% stand at harvest	
BrettYoung	BY 19-6284CL	94,500	CL	M/L	626	21	43.5	52.4	48	10-Jul	28-Jul	19	32	9.0	4.0	63	
Pioneer	P502CL	94,696	CL	M/L	801	21	45.0	51.4	50	7-Jul	25-Jul	18	31	9.0	4.5	56	
Wilbur Ellis	Integra 7361RC	115,000	RR	ML	798	21	44.9	52.1	38	7-Jul	27-Jul	19	30	9.0	3.5	50	
Winfield United	CP9919RR	81,720	RR	L	507	20	43.9	51.7	38	8-Jul	26-Jul	18	26	9.0	3.5	31	
Winfield United	CP9978TF	97,200	TruFlex	L	784	22	44.0	52.0	48	7-Jul	27-Jul	20	29	9.0	4.0	38	
Dekalb	DKTF91SC	97,281	TruFlex	E	639	21	45.3	51.8	43	6-Jul	24-Jul	18	30	9.0	5.0	63	
Dekalb	DKTF96SC	82,382	TruFlex	L	983	21	44.6	52.3	60	8-Jul	29-Jul	22	33	9.0	5.5	63	
Pioneer	45CM39	67,282	RR	M/L	721	18	48.6	50.3	53	8-Jul	26-Jul	19	32	9.0	5.5	63	
Dekalb	DKTFLL21SC	100,322	TF + LL	L	1080	19	47.4	51.8	60	5-Jul	25-Jul	20	33	9.0	6.0	63	
Proseed	TF Exp 1	100,000	RR/LL	M	642	19	45.6	52.5	28	10-Jul	29-Jul	19	31	8.5	3.0	69	
Star Specialty Seed	StarFlex	105,000	TruFlex	M	1194	19	47.4	51.7	53	7-Jul	27-Jul	20	33	8.0	6.0	81	
BrettYoung	6090 RR	119,000	RR	M/L	472	21	41.2	52.0	48	13-Jul	1-Aug	20	37	8.5	5.0	63	
BrettYoung	BY 6204TF	103,000	TF	M	634	21	41.7	51.5	53	10-Jul	27-Jul	17	33	8.5	5.5	81	
BASF	InVigor L233P	100,800	LL	E	930	20	43.4	51.3	58	9-Jul	26-Jul	16	31	8.5	5.5	69	
BASF	InVigor L255PC	84,000	LL	L	760	20	44.6	52.1	48	10-Jul	27-Jul	18	33	8.5	5.0	69	
BASF	InVigor L234PC	96,500	LL	E	613	20	42.6	51.6	40	9-Jul	26-Jul	17	32	9.0	4.0	44	
BASF	InVigor L345PC	89,000	LL	E	990	20	43.3	52.2	48	9-Jul	28-Jul	18	33	8.5	5.0	63	
Dekalb	DKLL82SC	103,445	LL	L	834	20	46.9	51.2	55	8-Jul	27-Jul	18	32	9.0	4.5	56	
Pioneer	P501L	82,818	LL	M/L	957	20	44.3	50.2	53	9-Jul	29-Jul	20	33	8.5	5.5	63	
Meridian Seeds	CSEXP20-1	76,000	LL	L	944	19	46.0	51.3	63	6-Jul	25-Jul	19	34	9.0	6.0	38	
Meridian Seeds	CSEXP20-2	105,000	LL	L	917	18	46.4	51.2	50	8-Jul	26-Jul	18	35	9.0	5.5	63	
LSD @5% level					377	1	1.6	0.9	20	1.5	2.6	3	5	0.9	1.8	27	
CV(%)					33	5	2	1	30	13	7	10	11	7	26	33	

Seeding rate=12PLS/Ft.2

Trial Mean yield =801#/acre

Experimental Design: RCB w/4reps

Planting Date- 5/30/2020

*Herbicide Tolerance--LL=Liberty Link, RR=Roundup Ready,

TruFlex=Next level Roundup Ready and CL=Clearfield

¹ Pounds per acre seed yield corrected to 8.5% moisture.

Statistical analysis indicate a high degree of yield variability based on field location making variety comparisons difficult.

² Oil and protein reported on dry matter basis.³ Lodging at harvest-1=flat ; 9=upright⁴ ESV(early season vigor) 9= best;1=least

Table 10.

2020 Canola Nitrogen Use Efficiency Trial

Northern Resources -West Plant-Roseau,Mn

Trt.#	Total Nitrogen added	PPI-urea ¹	PPI ¹ urea + ESN	# N Post emerge ⁶	Yield ²	% oil	% Protein	test weight	RCI ³	Lodging ⁴	Harvest Ht.(in.)	ESV ⁵ 21DAP	% ground cover- 21DAP	days of bloom
1	0				1221	44.3	18.2	52.1	176	8	35	5.0	53	19
2	60	60			1461	42.1	19.4	52.3	192	8	37	5.7	53	19
3	90	90			1618	42.2	19.7	52.4	199	8	43	5.7	60	20
4*	12	120			NH	NA	NA	NA	NA	NA	NA	NA	NA	NA
5	160	160			2180	42.0	20.2	52.6	260	8	42	7.0	70	20
6	60		30+30		1934	43.8	18.8	52.2	263	8	42	7.7	73	20
7	90		45+45		2106	42.6	19.9	52.4	275	9	44	7.7	80	21
8	120		60+60		1877	41.9	20.1	52.5	213	8	42	7.0	70	20
9	160		80+80		2421	42.7	19.9	52.3	287	8	44	7.7	77	21
10	90	40		50+ Agrotain Ultra	1867	43.4	19.1	52.4	275	8	41	7.0	70	20
11	120	40		80+Agrotain Ultra	1749	42.3	19.7	52.4	246	8	41	5.7	60	20
12	90	40		50+ 28% UAN 4 leaf streamer	2152	41.9	19.7	52.3	217	9	42	7.7	73	20
13	120	40		80+ 28% UAN 4 leaf streamer	1879	42.8	19.6	52.5	236	8	37	6.3	63	20
LSD @5% level					600	1.5	1.3	0.3	70	NS	6	NS	19	1
CV(%)					19	2	4	1	18	11	8	23	17	3

Experimental Design: RCB with 4 reps(only 3 reps used because of water damage)

Variety=L345P planted on May 30,2020

*- Treatment 4 had sufficient water damage to not permit reasonable data and yield data collection.

¹PPI- urea application rates 5/29 prior to final seedbed prep

²Yield- clean seed #/acre corrected to 8.5% moisture

³RCI-Relative Chlorophyll Index- higher number = more chlorophyll

⁴Lodging at harvest- 1=flat; 9=upright

⁵ESV-Early season vigor visual rating 1=poor; 9=best

⁶Liquid fertilizer applications made 6/26/2020

Table 11.

2018 Nitrogen Fertility Economic Returns**Rice Farms – Roseau, MN**

Total			PPI	Post fertilizer		Yield	Fertilizer ¹	Net \$\$ ²
TRT#	Added N	N-Urea	PPI S	Sulfur*urea	28%N	#/acre	cost	Return
0	0	0	0			1798	\$0.00	\$88.00
1	0	0	20#AMS	77#		1598	\$13.00	\$43.00
2	80	80	20#AMS			2646	\$40.50	\$182.50
3	120	120	20#AMS			2563	\$56.50	\$153.50
4	160	160	20#AMS			2884	\$72.50	\$188.50
5	120	80	20#AMS	40#		2990	\$56.50	\$221.50
6	160	80	20#AMS	80#		2871	\$72.50	\$186.50
7	120	80		20#am.thi	31#	2497	\$71.08	\$128.92
8	160	80		20#am.thi	71#	2641	\$104.43	\$118.57
9	120	120	0			2497	\$47.00	\$153.00
10	160	160	0			2702	\$63.00	\$169.00

¹Cost of added urea, AMS, liquid 28%N, and ammonium thiosulfate²Net return = Plot yield x \$.16/LB minus \$200/acre + the cost of fertilizerFertilizer-Cost basis used

Urea \$360/Ton
 28% Liquid N \$275/Ton
 Ammonium Sulfate \$340/Ton
 Ammonium thiosulfate \$2.19/gallon

Table 12.

2018 Canola Return on Investment Budgets*

2 Locations- Rice Farms and Magnusson Research Farm

Trt#	Management	Seed Rate	Fertilizer	Fungicide	Yield lb/acre			Gross ¹	Net return/ac	Management ² return
					Rice	Magnusson	Mean			
1	L/L/L	6PLS/ft.2- 12"rows	120-30-30-	Topsin M WSB	2275	2970	2622	419.52	199.52	\$0.00
2	L/L/H	6PLS/ft.2- 12"rows	120-30-30-	Proline/Priaxor	2651	2908	2779	444.64	188.96	-\$10.56
3	L/H/L	6PLS/ft.2- 12"rows	160-40-40-	Topsin M WSB	2772	3353	3063	490.08	239.93	\$40.41
4	L/H/H	6PLS/ft.2- 12"rows	160-40-40-	Proline/Priaxor	2491	3162	2826	452.16	166.3	-\$33.22
5	H/L/L	12PLS/ft.2-6" rows	120-30-30-	Topsin M WSB	2775	2934	2854	456.64	202.72	\$3.20
6	H/L/H	12PLS/ft.2-6" rows	120-30-30-	Proline/Priaxor	2798	3282	3040	486.4	196.8	-\$2.72
7	H/H/L	12PLS/ft.2-6" rows	160-40-40-	Topsin M WSB	2841	2886	2863	458.08	174.01	-\$25.51
8	H/H/H	12PLS/ft.2-6" rows	160-40-40-	Proline/Priaxor	2777	3108	2942	470.72	150.97	-\$48.55
9	H/H/H+I	12PLS/ft.2-6" rows	160-40-40-	Proline/Priaxor+Warrior	2986	3085	3035	485.6	160.85	-\$38.67
10	H/H/H+F	12PLS/ft.2-6" rows	160-40-40-	Proline/Priaxor+Priaxor	2818	3010	2914	466.24	138.49	-\$61.03

Production cost basis for low management regime=\$220/acre

*Means of both locations used to calculate profit margins

¹Gross revenue per acre= yield x \$.16/LB²Management return= profit or loss realized by adding the higher input variables

Variable	Added cost	
	of higher management	lb/ac extra seed needed to break even
seed	\$33.92	212
fertilizer	\$30.15	188
fungicide	\$35.68	223

Fungicide	Rate	cost per acre
Topsin M WSB	20oz.	\$11.25
Proline	5.7oz.	\$23.65
Priaxor	6oz.	\$23.28
Warrior	1.5oz.	\$6.50
Quadris	6oz.	\$8.00
<u>Product</u>	<u>Cost basis</u>	
Urea Fertilizer	\$380/Ton	
InVigor L140P Seed	\$13.30/LB	

Table 13.

2019 Nitrogen Fertility Trial Northern Resources – West Plant, Roseau, MN

TRT#	Total Added N	20# sulfur source	Post fertilizer		Yield	Fertilizer ¹ cost	Net \$\$ ² Return
		PPI	S	Sulfur*urea 28%N	#/acre		
1	0	AMS	20#AMS		2028	\$14.11	\$60.84
2	80	AMS	20#AMS		3243	\$38.54	\$230.34
3	120	AMS	20#AMS		3208	\$55.20	\$208.08
4	160	AMS	20#AMS		3397	\$70.85	\$222.67
5	120	AMS	20#AMS	40#	3355	\$55.20	\$231.60
6	160	AMS	20#AMS	80#	3506	\$70.85	\$240.11
7	120	Am.thiosulfate	20#am.t	31#	3113	\$55.98	\$192.10
8	160	Am.thiosulfate	20#am.t	71#	3315	\$75.63	\$204.77
9	120	NONE			3298	\$46.96	\$230.72
10	160	NONE			3212	\$62.60	\$201.32
11	0	NONE			1700	\$0.00	\$22.00

¹Cost of added urea, AMS, liquid 28%N, and ammonium thiosulfate

²Net return = Plot yield x \$.16/LB minus \$250/acre + the cost of fertilizer

Fertilizer-Cost basis used			2019
Urea	\$360/Ton		375
28% Liquid N	\$275/Ton		250
Ammonium Sulfate	\$340/Ton	21-0-0-24s	330
Ammonium thiosulfate	\$2.19/gallon	12-0-0-26s	300 1.67/gal
	486		

Table 14.

2019 Canola Return on Investment- Bang for the Buck
West Plant-Northern Resources

Trt#	Management	Seed Rate	Fertilizer	Fungicide	Yield ¹ lb/acre	Gross ¹	Net return per acre ²	Management return ³
1	L/L/L	6PLS/ft.2- 12" rows	120-30-30-20s	None	2820	\$451.20	\$221.20	\$0.00
2	L/L/H	6PLS/ft.2- 12" rows	120-30-30-20s	Proline only	2695	\$431.20	\$177.20	-\$44.00
3	L/H/L	6PLS/ft.2- 12" rows	160-40-40-20s	None	2960	\$473.60	\$223.60	\$2.40
4	L/H/H	6PLS/ft.2- 12" rows	160-40-40-20s	Proline only	3009	\$481.44	\$207.44	-\$13.76
5	H/L/L	12PLS/ft.2-6" rows	120-30-30-20s	None	3033	\$485.28	\$214.78	-\$6.42
6	H/L/H	12PLS/ft.2-6" rows	120-30-30-20s	Proline only	3048	\$487.68	\$193.10	-\$28.10
7	H/H/L	12PLS/ft.2-6" rows	160-40-40-20s	None	3185	\$509.60	\$219.10	-\$2.10
8	H/H/H	12PLS/ft.2-6" rows	160-40-40-20s	Proline only	3151	\$504.16	\$190.16	-\$31.04
9	H/H/H+I	12PLS/ft.2-6" rows	160-40-40-20s	Warrior/Proline	3156	\$504.96	\$184.46	-\$36.74
10	H/H/H+F	12PLS/ft.2-6" rows	160-40-40-20s	Quadris/Proline	3157	\$505.12	\$183.12	-\$38.08

Production cost basis for low management regime=\$230/acre

¹Gross revenue per acre=#/acre yield x \$.16/LB

²Net return after all inputs have been deducted

³Management return= profit or loss realized by adding the higher management input variables

Variable	Added cost of higher lb/ac extra seed management needed to break even
seed(+3#)	\$40.50 312
fertilizer(+40-10-10)	\$20.00 154
fungicide(+Proline)	\$24.00 185
fungicide(+Proline+Warrior)	\$30.50 235
fungicide(+Proline+Quadris)	\$32.00 246

Fungicide	Rate	cost per acre
Proline	5.7oz.	\$24.00
Warrior	1.5oz.	\$6.50
Quadris	6oz.	\$8.00

Product	Cost basis
Urea Fertilizer	\$380/Ton
InVigor L234P Seed	\$13.50/LB