2019 Minnesota Canola Production Center (CPC)

Cooperative Project with the Minnesota Canola Council and the University of Minnesota

2019 Research Summary Report

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Minnesota Production Center Results

Acknowledgements

The Minnesota Canola Production Center (CPC) is a public-private partnership between the Minnesota Canola Council and the University of Minnesota.
The efforts of many individuals, companies, organizations and agencies make it possible to conduct this field research in support of the canola industry. The financial, products, services and information provided by local and regional sponsors are, in large part, responsible for the success of the CPC. This generous support has made the Minnesota CPC a research project that benefits, not only canola growers in Minnesota, but canola growers in the entire region.

A special thank you goes to Northern Resources Cooperative for providing the land for canola research trials in 2019 and hosting the summer field day.

SITE INFORMATION - 2019 MN Canola Production Center (CPC)

Location: North of the Northern Resources West Plant along MN Hwy 11

Cooperator: Northern Resources Cooperative

Previous Crop: Spring wheat

Soil Test Results:

Nitrogen - 0-6'	7 #/acre
Nitrogen - 6-24"	18 #/acre
Phosphorous -	5 ppm
Potassium -	123 ppm
Target Yield Goal	2,500#/ac
Fertilizer Applied (#/ac):	N - 140; P - 40; K - 40; S - 20s
%Organic Matter:	4.0
Soil pH:	8.3

Tillage Operations: A single pass with a chisel plow in the fall of 2018, followed by a vertical tillage tool (Joker) in the spring of 2019. All plots were rolled after seeded to improve seed-soil contact.

Fertilizer Applied: All small plot trials received 140-40-40-20S except the Fertility, Phosphorous, and Bang for the Buck trials. These trials had variable N rates, sources and timings as listed on trial protocols.

Seeding Method: Small plot trials were seeded a 5' Hege plot seeder. Precision planted plots were planted with a custom made planter, with 22 inch row spacing, manufactured by RDK Enterprises in Hillsboro, ND.

Herbicides Applied: Section 2 at 5 oz./ac + 1% crop oil + Warrior 1.5 oz./ac was applied to the entire area for general grass and flea beetle control on 6/6/2019. The herbicides listed below were applied to the appropriate canola varieties.

A) Liberty Link (LL) hybrids - Liberty 280SL @ 22 fl. oz./ac + AMS @ 2.5% on 6-11 on early seeded and 7/1 for late seeded canola.

B) Roundup Ready (RR) and Truflex hybrids - Roundup Power ax @ 16 fl. oz./ac + AMS @ 2.5% on 6-13.

C) Clearfield canola - Beyond 4 oz./ac+ 0.25% + 2.5% AMS on 6/11.

Comments: Early spring soil moisture conditions were below normal, but timely precipitation in May and June was a factor in good early season canola growth and development (NDAWN). Accumulated rainfall for July and August was above average. Daily high temperatures during the first few days of canola flowering averaged 5 degrees cooler, but the reminder of the flowering period was 5 degrees or more higher than average (Source: NDAWN). The number of flowering days in canola were compressed into a short window of 12-15 days in 2019, Table 1. The warm, dry conditions during the canola flowering and seed fill period resulted in pod and flower abortion on the upper portion of the canola plant.

Canola stands were generally good with adequate soil moisture level and timely rainfalls after planting. Once fields dried out in the spring, planting proceeded at a rapid pace with no prolonged periods of rainfall. With the canola planting in May, the emergence of canola and flea beetle occurred at the same time. Consequently, many canola fields developed flea beetle populations above threshold levels and required a post emergence insecticide treatment.

Due to the dry spring and summer, the infestations of white mold were low at the CPC in 2019. Other diseases and insect problems were generally at low levels, with the exception of early season flea beetles which were controlled with an application of Warrior. Canola planting dates in 2019 were: two early planting dates (5/16&17) for the small plot replicated trials and a single date for the precision planting on May 29. All canola trials were located at the Northern Resources field research site on the west side of the city of Roseau along MN Hwy 11.

The public canola trials conducted at the 2019 CPC included:

- Small plot canola variety trials
- Small plot canola shatter trial
- Small plot fertility nitrogen source, rate and timing trial
- Small plot bang for the buck trial
- Small plot micronutrient trial
- Canola tolerance to sulfentrazone
- Small plot conventional vs singulation precision planting row spacing seeding rates
- Precision planting phosphorus trial
- Large plot straight harvest canola seeded in 22 inch rows with and without desiccants

Variety and Systems Trial

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

Background:
Canola varieties with new and emerging technologies traits have given canola growers several options for weed control. Further, CL canola varieties are considered a non-genetically modified (GMO) crop and may provide producers with a marketing advantage. Yield, lodging resistance, maturity, and crop quality are important traits for growers to consider when making canola variety selections. Canola seed companies were invited to submit current and pending varieties for entry in the trial for comparison in a small plot replicated research trial.

Methods:
All varieties were seeded at 12 PLS/ft.^{2} on May 17, 2019. The experimental design was a randomized complete block (RCB) with four replications. Fertility applied was 140-40-40-20s. Individual plot size was 6 x 27 ft. and end-trimmed to a harvest area of 5 x 20 ft. The LL, RR and CL canola varieties were seeded in separate blocks with buffers to reduce potential herbicide drift. A post emergence grass herbicide (Section 2) was applied for grass control to all plots on 6/6. Warrior was added to Section at 1.5 oz./ac for flea beetle control. Roundup was applied on 6/13. Liberty and Beyond were applied on 6/11. Proline at 5.7 oz./ac was applied to all plots at first petal drop (approximately 30% bloom) for white mold control. Approximately 50% of plots were harvest on 8/31 and after a rain delay the remainder harvested in 9/4. Harvested canola was cleaned and weighted and a sub-sample taken from each plot for moisture, percent oil content and other quality factors. Canola yields are adjusted to 8.5% moisture.

Results:
A total of 24 canola lines were entered in the 2019 CPC (Table 1). A breakdown of the canola varieties: 16 RR, 5 LL and 3 CL canola varieties were evaluated in this small plot replicated trial. Canola yields ranged from 1,949 to 2,902#/ac. The trial average yield was 2,443#/ac. The 2019 canola trial mean was similar to 2018, but less than 2017. Warm and dry conditions during flowering caused some flower and pod abortion, especially on the upper portion of the canola plant.

Thirteen canola varieties produced seed yields of 100 to 119% of the mean. Using the trial average of 2,443 lb/ac, and canola price of $0.16/lb, the gross dollar return in 2019 would be of $390.88/ac. 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 22th. Plant height ranged from 45 to 56 inches. Oil content ranged from 46.3% to 52.3%. Seed quality and agronomic information is summarized in Table1.

Canola Variety Trial Shattering Evaluation

Objective

The ability of canola plant to hold pods and not dehisce (shatter) seed, is a desirable trait in current canola varieties, especially when considering direct harvest. The direct harvest trait will eliminate a pass across the field which will save time, reduce production costs and increase canola acreage to where swathers are not available.

Background:

In the last couple years, canola producers have expressed an interest in direct harvest of canola. In 2016, the CPC conducted the first trial to evaluate canola seed shattering and pod drop in the environmental conditions of northern Minnesota. Canola seed companies that entering lines in the variety trial were invited to enter lines in the shattering trial.

Materials and Methods:

In 2019, 10 canola lines were submitted for testing using the canola shatter trial protocol used since 2016. Canola varieties were seeded in 12 inch rows at 9PLS/ft^2 on May 17th. Plots were maintained using best management practices in the same manner as the variety and systems trial. On August 17th, 2 plastic 7" x 13" collection trays were placed between rows of each variety. One pan was placed in the front and one in the back of each plot for a total of eight trays/variety.
Seed trays were inspected at weekly intervals with the seeds and pods collected from the trays at three dates (8/28, 9/6 and 9/15). Canola seed loss/ac was calculated from both the seed that shattered directly to the ground (seed) and seed contained in the pods which dropped from the plants to the ground (pod). Data from this trial is presented in Table 2.

Results:

Collection trays were placed between the canola rows on August 17 which would be the approximate date of swathing. In the first two weeks, limited canola seeds or pods were observed in the collection pans (Table 2). Eleven days (August 28) after trays were placed between canola rows was the first date canola seeds and pods were observed in the collection trays. Canola seeds and pods were collected from the pans at two other dates (9/6 and 9/15). Total canola seed collection (seeds and pods) on 9/15 (four weeks from swathing) ranged from 46 to 655#/ac. Total seed loss after the four weeks ranged 1.8 to 25.9% of total yield.

Weather conditions recorded at the NDAWN station at the U of MN Magnusson Research Farm (Fox) during the four weeks of this shatter trial had reported wind speeds of over 25 mph on ten days and one day had wind gusts of 33 (8/27). Measurable rainfall was recorded on 8/20, 8/26, 8/29, 8/30, 9/5, 9/10 and 9/13. Results from this canola shatter trial suggest that canola varieties adapted for direct harvest can withstand wind and rain and still keep the majority of the seeds and pods on the plant. The incorporation of pod shatter reduction technology will allow more canola growers to consider a direct harvest strategy for their farms.

Nitrogen Fertility Trial

Objective:
To evaluate canola yield response from various rates of urea applied PPI and post emergence (3-5 leaf canola) dry and liquid nitrogen and liquid AMS.

Background:
Canola requires high levels of nitrogen and often times shows yield increases with higher levels of soil available nitrogen. However, high spring application rates of nitrogen can be subject to environmental losses. One strategy to reduce nitrogen losses into the environment is to delay nitrogen applications until just before peak uptake demand by the canola plant. This delay in nitrogen availability can be accomplished by an early post emergence (three to five leaf) application of urea (dry or liquid). This trial was initiated to evaluate the canola yield response to various rates, timings and combinations of urea (46-0-0 and 28%) and dry and liquid sulfur.

Methods:
The canola variety L234P was seeded at 12 PLS/ft.^{2} on 5/16/2019. Harvested plot size was 5 x 20 ft. The experimental design was a RCB with four replicates. The entire plot area had a background nitrogen level (0-24 inch) of 25#/ac. All plots received an application of 9-40-40. Nitrogen treatments included PPI only compared to PPI + dry urea and liquid AMS, or 28% nitrogen. Final nitrogen rate was 0, 80, 120 and 160#/ac. The split application treatments included: Urea applied PPI plus post emergence dry urea treated with a nitrogen stabilizer applied at 40 and 80#/ac, liquid 28% nitrogen at 31 and 71#/ac and liquid ammonium thiosulfate at 20#/ac. Dry urea was applied post emergence to canola in the three to five leaf stage on 6/15. The liquid 28% and ammonium thiosulfate were applied post emergence with streamer nozzles on 6/12. All plots were swathed on 8/13 and harvested on 8/31. Harvested canola plots were individually cleaned, weighted and sampled for moisture and oil content.

Results:
Limited canola leaf injury was observed from liquid 28% or ammonium thiosulfate applied with streamer nozzles in 2019 (Table3). In 2018, treatments caused canola leaf burn of 14 to 18% was observed from liquid 28% and ammonium thiosulfate. The canola plants recovered as no differences in canola flowering date was observed from any of the treatments. In 2019, the average canola fertility trial yield from supplemental nitrogen was 3,034#/ac. Generally, canola yields tended to increase as the nitrogen rate increased to a rate of 160#/ac, regardless of nitrogen formulation, or time of application. However, optimum canola yields (116% of mean) were achieved from 65 #/ac nitrogen applied PPI followed by 80#/ac applied early post emergence. Net return for the various nitrogen fertilizer costs for rates applied over the base rate of 9-40-40 is presented in Table 3a. With cost basis used in this table, 160#/ac of urea and AMS applied PPI gave a return of $245.44. The other treatment that returned over $240/ac was urea only at 120#/ac without AMS. This site tested high in sulfur and as a result plants didn't respond to sulfur. In production canola fields, it would be considered high

risk not to apply sulfur. In-field variability and canola is a high user of sulfur are two reasons to apply sulfur when raising a canola crop. Results from this fertility trial had canola yields that ranged from 3,208 to 3,506#/ac from the various fertility treatments. This yield level would suggest that nitrogen losses were not a limiting factor in 2019. These results are contrary to results from previous year's results which suggested that a split application of 80#/ac nitrogen PPI followed by 40#/ac post emergence increased nitrogen use efficiency and the net return/ac compared to nitrogen applied PPI only. Further, prior years fertility results suggested that a split N (pre-emergent +post emergent) applications and a portion of the pre-emergent N applied as ESN has had the highest nitrogen use efficiency (NUE). Rainfall patterns, amounts and application timings have a large impact on when nitrogen is available for plant growth and development. Applications of nitrogen planting (PPI) is an option preferred by many growers. However, in years with nitrogen losses a 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.

Canola Micronutrient Trial

Objective:

The objective of this trial was to evaluate several micronutrients applied to flowering canola.

Background:

With a high yield goal and intensive crop production management the probability that micronutrient are limiting crop yields is greater than crop production using average management strategies. The canola yield goal in this trial was 3,000#/ac which is a high, but attainable, canola yield goal for northwest Minnesota. A complete soil analysis in the spring of 2019 indicated that copper, sodium and zinc were testing in the low category based on a 3,000#/ac yield goal.

Methods:

The canola variety Star 402 was seeded at 12 PLS/ft.^{2} on 5/18/2019. Soil type at this location was a clay loam with an organic matter of 4.0% and a pH of 8.3. Fertility applied was 140-40-40-20s. Plot size was 6x27 feet and end trimmed to a harvest plot size of 5 x 20 ft. The experimental design was a RCB with four replicates. Section 2 at 5 oz.ac + Warrior at 1.5 oz./ac was applied for general grass and flea beetle control on 6/6. Roundup PowerMax at 16 oz./ac + AMS at 2.5% was applied on 6/13. Proline at 5.7 oz./ac was applied at first petal fall for general disease control. The first micronutrient application was 7/11 and included four treatments: Nutri-sync Zn @ 2 pints/ac, Nutri-sync copper at 1 pint/ac, Ele-max Sulfur at 2 pints/ac and X-cyte at 0.5 pints/ac. A second application of X-cyte was applied at 0.5 pints/ac on 7/19. Tissue samples were taken 10 days after the first micronutrient application date and sent to AGVISE Labs for analysis. All plots were swathed on 8/13 and harvested on 8/30. Harvested canola plots were individually cleaned, weighted and sampled for moisture and oil content.

Results:
Canola yields in the untreated was 3,208#/ac which would be considered a high yield in the growing conditions of northwest MN (Table 4). The statistical analysis for yield was non-significant at the 5% confidence level. However, canola yield showed a trend for more canola yield from an application of the micronutrient copper. Tissue test results indicate that canola plant tissue levels of copper and zinc were higher in the treated canola compared to the untreated. Further, plant tissue results indicated that supplemental zinc increased the plant tissue concentrations of nitrogen, phosphorus and iron compared to the untreated. This was the first year of a micronutrient trial in canola. The results of this trial suggest that micronutrients may have the potential to improve canola yields. This research effort with micronutrients in high yield canola will be continued in 2020.

Canola Return on Investment (Bang for the Buck) Trial

Objective:
The objective of this trial is to compare 3 high and 3 lower cost management options in canola and to determine the impact of these input costs on return on investment (ROI).

Background:
The three canola management variables evaluated in this trial are seeding rate, nitrogen rate and choice of fungicide treatment. Each variable will have a high and low option as listed below with high management option listed first:

- Seeding rate -12 PLS in 6" rows vs. 6 PLS in 12" rows(conventional seeding)
- Nitrogen rate -160#/ac vs 120#/ac
- Fungicide application - Proline @ 30%bloom vs none

Methods:
Experimental design was a RCB with four replications. The canola variety in this trial was L234P seeded on 5/16/2019. Individual plot size was 6' wide by 27' long, end trimmed to 5' x 20' harvest area. An application of 9-40-40 was applied to the entire area and incorporated into the soil. Individual plots were staked out and supplemental urea was hand spread per trial plan to each individual plot. Stakes were then pulled and fertilizer incorporated with a Rau Combi (s-tine with rolling basket). Plots were re-staked and plots seeded according to row space and seeding rates trial plan. Post emergence fungicides were applied with hand boom sprayer with flat fan nozzles delivering 17 gpa @ 28psi. The treatments were applied as listed in Table 4.

Results:
Yield results and other agronomic data for individual treatment groupings are presented in Table 5. Canola seed yields ranged from 2,695 to 3,157#/ac. The mean canola yield

was 3,021#/ac. 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 to 105% of the trial mean yield. In 2019, limited disease pressure was observed in any of the plots regardless of row space, seeding rate or fertility rate

The yields and economic return of individual main plot treatment means is listed in Table 5. Also listed are seed, fertilizer and fungicide costs used to achieve the net return and the return to management. In a comparison of the main effects:
12 inch rows @ 6 PLS = 2,871#/ac
6 inch rows @ 12 PLS = 3,104#/ac
Fungicide treated 3,096 compared to none 3,000#/ac
120-30-30-20s = 2,899 #/ac
160-40-40-20s = 3,076 #/ac
The main treatment effects suggest that the higher yield obtained by the higher seeding rate of would result in a net gain of $1.96/ac. With limited disease pressure in 2019 the fungicide treatment would have resulted in a loss to the grower. The higher fertilizer rate would have given the grower a net gain of $11.55/ac compared to the low fertilizer treatment.

Narrow vs. wide rows each have advantages. Narrow rows will have a more rapid canopy closure, have higher early season photosynthetic potential and provide better weed competition compared to wide rows. Wider rows can 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. Also, in wider rows canola plants may be better suited for direct harvest. White mold and other disease pressure was generally low in 2019. It would be expected that in years with moderate to heavy disease pressure canola would respond to fungicide treatments. It should also be noted that prices quoted are retail cost estimates. It is certainly possible better pricing may be obtained making some of the treatments more economical.

Canola Tolerance to Sulfentrazone

Objective:
The objective of this trial was to evaluate canola tolerance to the herbicide sulfentrazone(Spartan) at two rates and four timings.

Background:
This trial was conducted in cooperation with the North Dakota researchers in Minot and Langdon. In the last few years resistant weeds to Roundup have been identified in canola growing areas of western North Dakota. Certain small seeded broadleaf weeds have developed resistance to Roundup. Sulfentrazone applied preemergence, or as an

early post emergence treatment would provide an option to this developing weed problem.

Methods:
The canola variety L234P was seeded at 12 PLS/ft.^{2} on 5/18/2019. Soil type at this location was a clay loam with an organic matter of 4.0% and a pH of 8.3. Fertility applied was 140-40-40-20s. Plot size was 6x27 feet and end trimmed to a harvest plot size of 5 x 20 ft. The experimental design was a RCB with four replicates. Sulfentrazone(Spartan FL 4F) at 2 and 4 ounces/ac was applied to canola at four timings. Preemergence on 5/18, cotyledon stage canola on 5/28, two leaf canola on 6/4 and three leaf canola on 6/12. All plots were swathed on 8/13 and harvested on 8/30. Harvested canola plots were individually cleaned, weighted and sampled for moisture and oil content.

Results:
Canola yield data suggests that sulfentrazone applied preemergence produced similar seed yield as the Liberty Link check (Table 6). However, early season vigor was less from sulfentrazone applied preemergence than Liberty Link check. Further, the data suggests canola may be sensitive to sulfentrazone rates above 2 oz./ac applied preemergence. When applied post emergence, canola yields were reduce by both rates of sulfentrazone at all three timings, expect the 2 oz./ac rate applied to 3 leaf canola (Table 6). Canola symptomology from sulfentrazone was a general stunting and a white cast to the canola leaves. The data suggests that canola tolerance to sulfentrazone may be marginal, especially at the 4 ounce rate. This data may be useful to reduce canola plant back restrictions from sulfentrazone applied to other crops in a canola rotation.

Convention vs. Precision Planted Row Spacing and Seeding Rates

Objective:
The objective of this trial was to compare canola seed yield from various row widths and seeding rates.

Background:
Until recently, most canola has been planted with conventional type seeding equipment (press drill, air seeder). With the high cost of seed and interest in direct harvest, additional information on yield and other effects regarding planting method, seeding rates and row spacing is needed. In 2015 and 2016, conventional plantings only were done with inconclusive results. In 2017, 2018 and 2019 this trial was expanded to include precision planting technology with conventional plantings methods in canola.

Materials and Methods
The canola variety used in this trial was L234P and was seeded at various row widths

and seeds/ft. on 5/29. The experimental design was a RCB with four replicates. Individual plot size was 6 x 27 and end trimmed to 5 x 20 for harvest. The entire plot area had a background nitrogen level (0-24 inch) of 25#/ac. A broadcast application of 140-40-40-20s was applied to the entire plot area. All plots were swathed on 8/29 and harvested on 9/18. Harvested canola plots were individually cleaned, weighted and sampled for moisture and oil content.

The conventional seeding methods was accomplished with a Hege small plot seeder in either 6, 12, or 24" rows. Seeding rates in this trial will be 3, 6, 9, and 12 PLS/ft^2. The precision planting component for this trial was done in cooperation with RDK Enterprises in Hillsboro, ND. The seeder used was 11' wide with precision depth control with 22" row spacing. The seeder also precisely removes individual seeds from planting plates making possible precise, singulation planting. The seeding rate was either 3, 6, or 9PLS/ft.^{2} in 22 inch rows.

Results:
The results from 2019 canola row space seeding rate trial can be found in Table 9. The mean canola yield in this trial was 2,654#/ac. Canola seeded in 22 inch rows resulted in a seed yield from the three seeding rates that ranged from 2,435 to 2993#/ac. The data indicates that when seeding in 22 inch rows 3 PLS/ft^2 (1.5#/ac) is too low a seeding rate in canola. No difference was detected from the 6 or 9 PLS/ft^2 (3.0 or 4.5 #/ac). When seeded in 6 inch rows canola yield from the four seeding rated ranged from 2,485 to 2,876#/ac. When canola was seeded in 6 inch rows only the high seeding rate of 12PLS/ft2 (6#/ac) gave produced yields over 100% of the trial mean. In 12 inch row spacings only one seeding rate 9PLS/ft^2 gave canola yields over 100% of trial mean However, when seeded in 24 inch rows only the low seeding rate of 3PLS/ft^2 produced canola yields less than 100% of trial mean.

The five year average yields from the conventional seeded row space seeding rate canola trials are presented in Table 9a. The five year average canola mean yield was 2,801#/ac. The data suggests that canola is a crop that will respond to a wide range of row widths and seeding rates. The five year average canola yield suggests that 3PLS/ft $^{2.}$ may not provide consistent yields or sufficient stands in 6, 12 or 24" rows. Further, the five year summary indicates that for highest canola yields the seeding rate for all row spacings will have to be on the upper end of the rates tested.

Late Fungicide and Micronutrients in Precision Planted Canola

Objective:
To compare swathing and direct harvest, with and without a late fungicide treatment in canola seeded in 22 inch rows.

Background:
In the last two years, precision planting of canola in 22 inch rows has gained interest, especially with farmers that have sugarbeets as a rotational crop. This trial was conducted at the Northern Resources Research Site, near Roseau, MN. University of

MN personnel assisted with all aspects of this canola research from seeding, data collection and plot harvest.

Methods:

The canola variety L234P was seeded in 22 inch rows at 3.3 #/ac on 5/29. The precision planting equipment used in this trial was in cooperation with RDK enterprises in Hillsboro, ND. The experimental design was a randomized complete block (RCB) with three replications. Fertility applied was 140-40-40-20s. Individual plot size was 35 x 30 ft. with alleys cut with a 5 foot rotary mower. Liberty at 22 oz./ac + 2.5% AMS was applied for weed control and Proline at 5.7 oz./ac was applied to all plots at first petal fall for white mold control. A late fungicide application (Priaxor) was applied with and without a micronutrient mix at approximately 70% bloom. The three treatments were an untreated, Priaxor at 6oz/ac + NIS at 0.25%v/v and Priaxor 6oz/ac + NIS 0.25% + 2 pints/ac of Ele-Max Sulfur. Canola was swathed on 8/29 and harvested on 9/18. All direct harvest canola was harvested on 9/17. Harvested canola was cleaned and weighted and a sub-sample taken from each plot for moisture, percent oil content and other quality factors. Canola yields are adjusted to 8.5% moisture.

Results:

The results from this trial is listed in Table 8. Canola yields in the untreated swathed canola averaged 2,190 compared to 2,491 from Priaxor alone and 2,725 #/ac from Priaxor + the micronutrient tank mixture. Canola in this trial 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 picked up by the combine pickup header. Most likely, if a canola grower was planting canola in 22 inch rows, direct harvest would be the most likely harvest method. In the direct harvest canola the untreated canola yield was 2,879 Priaxor 2,817 and Priaxor + the micronutrient mix was 3,420#/ac. Medium levels of Alternaria was observed in the untreated plots with a light infestation in the Priaxor treated plots. In this trial a desiccant was not used as environmental conditions were conducive for canola dry down. One confounding factor in this trial is a couple of the untreated plots were in the first pass of the field that was precision planted. After the first pass the planter was set lower which resulted in over 1 plant/ft of row more than the untreated. All Priaxor + micronutrients treatments were in the canola with a better stand counts. Results from this trial suggest that a late season fungicide with a micronutrient mixture may have potential to reduce late season diseases and may improve canola growth, development and yield.

Precision Planted, Liquid Phosphorus and Direct Harvest Canola

Objective:

The objective of this trial was to evaluate phosphorus (P) applied in-furrow at planting and to compare swathing and direct harvest in precision planted 22’ canola.

Background:
The precision planter from RDK Enterprises has the capability of applying liquid fertilizer over the row at planting. Previous research has suggested that phosphorus applied with canola will improve early season emergence and growth, especially in the cold, high pH soils of northern MN. Further data is limited on the response of canola in 22' rows to swathing and harvest compared to direct harvest canola.

Methods:
This trial was conducted at the Northern Resources Research Site in Roseau, MN. This trial was seeded with a precision planter from RDK Enterprises that had 6- 22" rows. Plot size was 11 x 100 feet and treatments were arranged in a RCB design with four replications. Canola L234P at 3#/ac (6PLS/ft^2) was seeded on 5/29. Two P treatments were included in this trial:

- Dry 11-52-0 at 77#/ac surfaced applied and incorporated prior to seeding
- Liquid 10-34-0 at 2 gallons/ac applied in-furrow

A broadcast application of 140-0-40-20s was applied to the entire plot area. Plots were swathed on 8/28 and harvested on 9/17. Best management practices were followed for pest control and canola management. Harvested canola plots were individually cleaned, weighted and sampled for moisture and oil content.

Results:
No treatment differences were detected in canola yield, test wt., protein, oil and stand counts (Table10). Canola yield ranged from 2,296 in the untreated to 2,525 from 10-34-0 in-furrow and 2,711 #/ac from 11-52-0. The statistical analysis indicated no difference in canola yield a trend was observed from more canola seed yield with both forms of phosphorus compared to the untreated. Background soil test levels for P was 5 ppm which is in the low category. The results of this trial suggest that canola will respond to supplemental P applied either in-furrow or broadcast, especially with low soil test levels for P

Swath and Direct Harvest Canola in Precision Planted Canola

Objective:
To compare swathing and direct harvest, with and without desiccants, in canola seeded in 22 inch rows.

Background:
In the last two years, precision planting of canola in 22 inch rows has gained interest, especially with farmers that have sugarbeets as a rotational crop. This trial was conducted at the Northern Resources Research Site, near Roseau, MN. University of MN personnel assisted with all aspects of this canola research from seeding, data collection and plot harvest.

Methods:

The canola variety L234P was seeded in 22 inch rows at 3.3 #/ac on 5/29. The precision planting equipment used in this trial was in cooperation with RDK enterprises in Hillsboro, ND. The experimental design was a randomized complete block (RCB) with four replications. Fertility applied was 140-40-40-20s. Individual plot size was 6 x 27 ft. and end-trimmed to a harvest area of 5 x 20 ft. Liberty at 22 oz./ac + 2.5% AMS was applied for weed control and Proline at 5.7 oz./ac was applied to all plots at first petal fall for white mold control. Canola desiccants used were Reglone and a tankmix of Roundup + Sharpen. Roundup/Sharpen at 1.5 pt/ac + Sharpen at 2 oz./ac + 1% MSO + 2.5% AMS was applied on 8/29. Reglone at 1.5 pt/ac + 0.5% NIS was applied on 9/11. Canola was swathed on 8/29 and harvested on 9/18. All direct harvest canola was harvested on 9/18. Harvested canola was cleaned and weighted and a sub-sample taken from each plot for moisture, percent oil content and other quality factors. Canola yields are adjusted to 8.5% moisture.

Results:

The results from this trial is listed in Table 7. Canola yields in the swathed canola averaged 2,180#/ac compared to over 2,500#/ac from direct harvest canola. Canola in this trial 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 picked up by the combine pickup header. Most likely, if a canola grower was planting canola in 22 inch rows, direct harvest would be the most likely harvest method. No difference in yield was detected between the two desiccants and the untreated canola. Weed control in this trial was excellent with no visible weeds were observed above the canola canopy. 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. Results from this trial suggest direct harvest is a viable option for canola growers using precision planting equipment and don’t have access to a swather.

2019 Canola Production Center Research Data Summaries

Northwest Minnesota

This summary and previous annual research summaries are on the Web at:
http://www.mncanola.org/CPC.php

Table 1.

2019 Spring Canola Variety Trial

Northern Resources -West Plant-Roseau,Mn

Company	Herbicide Tolerance*	Entry	Seeding ** Rate (#/ac)	Yield[1] #/acre	Yield[1] % of mean	oil[2]	protein[2]	Test Weight	Lodging[3]	ESV[4] 13-Jun	ESV[4] 19-Jun	% ground cover 13-Jun	% ground cover 19-Jun	Ht(in.)	Flowering begin day	Flowering end day	Flowering # 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/#)

[1]Clean 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 basis

[3]Lodging at harvest-1=Upright ; 9=flat

[4] 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=	PH	%OM	Olsen P ppm	NH_4OAc-K ppm	nitrates #/ac	SO_4-S #/ac
0-6"	8.3	4	5	123	7	24
6-24"					18	

Table 2.

2019 Canola Shattering Variety Trial

Northern Resources -West Plant-Roseau,Mn

Company	Herbicide tolerance	Entry	Yield[1] lb/acre	% loss[2]	Lost[3] Total	8/28	9/6	9/15	8/28 seed[4]	8/28 pod[5]	9/6 seed[4]	9/6 pod[5]	9/15 seed[4]	9/15 pod[5]
Bayer CropScience	LL	InVigor L233P	2654	3.2	**86**	22	51	13	46	110	65	300	34	55
Bayer CropScience	LL	InVigor L234P	2556	3.9	**99**	18	65	17	96	30	185	280	78	40
Bayer CropScience	LL	InVigor L255P	2768	2.5	**70**	12	38	19	84	0	174	100	129	10
Winfield United	RR	CP9982RR	2528	25.9	**655**	146	239	270	940	100	1258	450	1770	160
Winfield United	TF	CP9978TF	2523	1.8	**46**	8	23	15	17	100	36	125	49	60
Dekalb	RR	DKL70-10	2394	7.5	**180**	44	67	69	247	70	210	265	413	80
Dekalb	RR	DKTF91SC	1949	6.2	**120**	37	44	39	100	165	148	165	172	105
Dekalb		DKTF92SC	2320	8.8	**204**	37	101	65	128	135	240	485	345	120
Star Specialty Seed	RR	Star Flex	2490	6.3	**158**	21	74	64	56	95	118	405	276	180
Brett Young	RR	6090	2403	10.6	**255**	45	115	95	240	80	494	330	574	100
		LSD @5% level	266	7.5	**161**	62	95	55	406	101	437	288	403	102
		LSD @10% level	222	6.7	**134**	52	79	46	337	84	362	239	335	85
		CV(%)	7	41	**59**	111	81	57	143	85	103	68	72	78

Experimental Design-RCB with 4 reps

Shattered seed collected in 2 - 7" x 13" trays/plot

Seeding rate(12" row)=9PLS/Ft.[2]

Shatter pans placed in each plot 8/17/2019

[1] Seed yields taken from variety trial

[2]% loss= Yield lost / total yield

[3] Total #/acre of pod seed + shattered seed lost (85000 seeds/pound)

[4]Seed shattered directly from the plant to the ground collection pans

[5]Seed contained in pods shattered from the plant to the ground collection pans(20 seeds/pod)

Table 3.

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

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

[2]Post fertilizer application-

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

Urea-dry urea applied 6-15-2019

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

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

Backround soil test-5/7/19

Soil Depth	Olsen P mg/kg)	NH_4OAc-K (mg/kg)	LOI OM (%)	Water pH	salts (mmhos/cm)	SO_4-S #/acre	NO_3-N #/ac
0-6"	5	123	4.0	8.3	0.3	24	7
6-24"							18

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Table 3a.

	Total	20# sulfur		Post fertilizer			Yield	Fertilizer[1]	**Net $$[2]**
TRT#	Added N	source	PPI S	Sulfur[4]	urea	28%N	#/acre	cost	**Return**
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**

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

[2]Net 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 4.

2019 Canola MicroNutrients Application Trial
West Plant-Northern Resources

trt#	Element	Per acre Rate	Yield	Protein	Oil	Vigor 6/19	% ground cover 6/19	Harvest Height	Harvest Lodging	Total-N %	P %	K %	S %	Ca %	Mg %	Zn ppm	Fe ppm	Cu ppm	B ppm
										Plant tissue samples 7-21-2019									
1	Nutri-sync Zinc	2pt	**3271**	20.6	46.9	8.0	87	48	4	3.2	0.21	1.00	1.5	4.8	1.8	27	71	2.0	38
2	Nutri-sync Copper	1pt	**3512**	18.9	47.9	8.5	87	47	4	3.1	0.20	0.90	1.5	4.7	1.9	12	68	6.5	35
3	Ele-Max Sulfur LC	2pt	**3376**	19.8	47.3	8.5	86	47	4	3.2	0.20	0.94	1.5	4.6	1.9	12	69	1.5	36
4	X-cyte	.5pt+.5pt	**3241**	18.2	48.8	8.5	85	47	4	3.0	0.19	0.97	1.6	5.0	1.8	13	66	1.5	36
5	No treatment		**3258**	20.1	46.7	7.0	81	47	4	2.8	0.18	0.88	1.5	4.7	1.9	11	62	1.5	38
	LSD @5% level		**NS**	2.2	1.9	NS	4	NS	NS	0.3	0.02	NS	NS	NS	NS	2.2	8	2.1	NS
	CV(%)		7	7	2	12	3	3	25	3	4	8	4	5	3	5	4	30	3

Experimental Design: RCB with 4 reps(only 2 reps sampled for tissue tests)
6 nozzel 6' spray boom -18 GPA @ 28psi Variety= Star 402
Applications 7/11 -78F 209ssw 11-15 63%RH,canola full bloom
X-cyte trt date 2=7/19/2019
Soil samples-complete analysis on 0-6" & 6-24" composite
Tissue sampling- All plots sampled at mid flowering
Proline at 5.7oz/ac first flower drop. All plots used best management practices

X-cyte	Cytokinin .04%	Stoller Inc.
Ele-Max Sulfur LC	10-5-0-10s-.04bo	Helena Agri-Enterprises
Nutri-Sync Copper	8-0-0-4.5Cu	Loveland Ind.
Nutri-Sync Zinc	0-0-0-6Zn	Loveland Ind.

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table 5.

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

Trt#	Management	Seed Rate	Fertilizer	Fungicide	Yield[1] lb/acre	Yield[1] %mean	ESV[2] 6/13	ESV[2] 6/19	% Ground cover[3] 6/13	% Ground cover[3] 6/19	Bloom Begin	Bloom End	Lodging[4]	Ht(in.)	Test wt. #/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 Trial Mean Yield = 3021#/acre
Fertilized and planted 5/16/2019 Variety=InVigor L234P

TRT#9&10 (Warrior or Quadris) 6/12/2019 - 3 leaf stage
No fungicide(low management) or Proline(high management)
[1]Yield- clean seed #/acre corrected to 8.5% moisture
[2]ESV-Early season vigor visual rating 1=poor ; 9=best
[3]%Ground cover-visual rating
[4]Lodging 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 5a.

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

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

2Net return after all inputs have been deducted

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

Variable	Added cost of higher management	lb/ac extra seed 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

table 6.

2019 Canola Tolerance to Sulfentrazone Applications

West Plant -Northern Resources Roseau,Mn

				Test			Vigor[3]		%ground cover		Harvest	
TRT#	Rate	Timing	**Yield[1]**	Weight	Protein[2]	Oil[2]	vigor 611	vigor619	11-Jun	19-Jun	Ht.(in)	Lodging[4]
1	Liberty only	none	**3021**	50.9	17.6	46.3	5.0	7.5	38	85	50	2.0
2	2oz.	pre	**2995**	51.2	17.6	46.1	3.5	5.5	28	78	52	2.5
3	4oz.	pre	**2853**	51.6	17.9	45.6	3.0	3.0	20	60	50	3.0
4	2oz.	cotyledon	**2712**	51.0	17.2	46.5	4.0	7.0	33	81	50	2.5
5	4oz.	cotyledon	**2729**	51.0	17.5	46.4	5.0	7.5	38	88	50	2.0
6	2oz.	2-leaf	**2692**	51.0	17.4	46.4	3.0	5.5	28	80	49	3.0
7	4oz.	2-leaf	**2773**	51.1	17.3	46.3	3.0	4.5	25	68	50	2.5
8	2oz.	2-3 leaf	**2888**	50.9	17.4	46.2	5.0	8.0	33	84	50	3.0
9	4oz.	2-3 leaf	**2690**	51.0	17.2	46.5	5.0	8.0	35	89	48	1.5
	LSD @5% level		**244**	0.2	0.4	0.3	0.7	1.2	7	9	2	1.2
		CV(%)	5.9	0.3	1.6	0.5	12	13	15	8	3	35

Experimental Design: RCB with 4 reps

Variety=L234P

Seeded and rolled 5/18/2019

[1]Clean seed yield adjusted to 8.5% moisture

[2]Protein and oil on dry matter basis

[3]Plant vigor 1= least ; 9=best

[4]Lodging- 1=erect ; 9=flat

Soil	Olsen P	NH_4OAc-K	LOI OM	Water	Zinc	SO_4-S	NO_3-N
Depth	(mg/kg)	(mg/kg)	(%)	pH	ppm	#/acre	#/ac
0-6"	5	123	4.0	8.3	0.36	24	7
6-24"							18

Soil texture= clay loam

Herbicides

Spartan SL 4F --2 or 4 ounce per acre at different timing.

Liberty-- 22oz.+ 2PT AMS-- 6/13/2019--applied to all plots

1	Liberty only	
2	2oz.	5/18 dry soil 6:00 pm wind se 6mph- at planting
3	4oz.	5/18 dry soil 6:00 pm wind se 6mph-at planting
4	2oz.	5/28 dry soil 75F west 4-8mph cotyledon growth stage
5	4oz.	5/28 dry soil 75F west 4-8mph cotyledon growth stage
6	2oz.	6/4/2019 2 leaf stage 6mph SSE wind
7	4oz.	6/4/2019 2 leaf stage 6mph SSE wind
8	2oz.	6/12/19 dry soil sunny 65F 5-10mph NNW 28%RH 3-leaf
9	4oz.	6/12/19 dry soil sunny 65F 5-10mph NNW 28%RH 3-leaf

Spartan FL 4F= sulfentrazone 4#/gal.

6' hand boom backpack sprayer @ 20GPA @27PSI

L234P seeded @ 12 pls/ft.2

140-40-40-20S fertility applied prior to final seedbed prep

Standard best management practices used throughout the season

table 7.

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

Harvest method	Yield[1]	Harvest Moisture	Test Weight	Protein[2]	Oil[2]	Stand[3]	Ht(in.)
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.

[1]Clean seed Yield corrected to 8.5% moisture

[2]Protein and oil on dry matter basis

[3]Stand= 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 8.

2019 Canola Late Fungicide/Micronutrient Application + Direct harvest vs. Swath

Northern Resources-West Plant Roseau,Mn

Swath-harvest Treatment Mean	Yield[1]	Harvest moisture	test weight	Protein[2]	Oil[2]
No treatment	2190	5.8	49.6	22.3	45.1
Priaxor+Elemax	2725	6.2	49.8	22.7	44.4
Priaxor	2491	6.7	50.0	21.5	45.0
LSD @5% level	270	NS	NS	NS	0.7
CV(%)	4	17	0.3	7.0	0.6

Direct harvest Treatment Mean	Yield[1]	Harvest moisture	test weight	Protein[2]	Oil[2]
No treatment	2879	8.7	50.3	22.5	45.9
Priaxor+Elemax	3420	8.3	50.2	22.1	46.3
Priaxor	2817	7.4	50.5	21.7	46.3
LSD @5% level	NS	NS	NS	NS	NS
CV(%)	17	27	0.3	7.0	3.0

Treatment Mean	Yield[1]	Harvest moisture	test weight	Protein[2]	Oil[2]	Stand[3]	Ht(in.)
No treatment	2534	7.3	50.0	22.4	45.5	4.8	55.0
Priaxor+Elemax	3073	7.3	50.0	22.3	45.4	6.2	56.0
Priaxor	2654	7.1	50.2	21.6	45.6	5.5	55.0
LSD @5% level	285	NS	NS	NS	NS	NS	NS
CV(%)	5	17	0.2	6.0	1.0	18.9	1.5

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Mean of Swath vs. direct harvest	Yield[1]	moisture	test weight	Protein[2]	Oil[2]
Swath - all	2469	6.2	49.8	22.2	44.8
Direct harvest-all	3039	8.1	50.3	22.1	46.2

Experimental Design: RCB with 3 reps — Variety=InVigor L234P

Swath date= 7-Sep

Combine dates= 18-Sep

[1]Yield- Clean seed yield @ 8.5% moisture

[2]Protein and oil- on dry matter basis

[3]Stand-Plants/ft. row--First seeder pass too shallow and had lower stand count
May have influenced yields?

Fungicide/fertilizer: 7/20/2019 75%bloom 9pm 3-5mph nw

Priaxor 6oz./acre +2pts. Preference(NIS)/100 gal

Priaxor 6oz./acre + Ele-Max Sulfur LC 2 pts./ac +2pts. Preference(NIS)/100 gal

No treatment=no late fungicide

Priaxor- fluxapyroxad 1.39# - pyraclostrobin 2.78#

Ele-Max Sulfur LC 10-5-0-10s-.04boron

all treatments received Proline 5.7oz +.25%NIS 7/10/2019

Table 9.

2019 Canola Conventional vs. Precision Planting at 4 Seeding Rates
Northern Resources-West Plant Roseau,Mn

	Row	Seeding Rate		Yield				Test		%ground	Begin	End		Stand[4]		Seed	LB/acre
TRT#	Spacing1	PLS/Ft2	#/acre	lb/acre	% of mean	Protein	Oil	Wt./Bu	ESV[2]	cover[3]	Bloom	Bloom	Ht(in.)	13-Jun	harvest	Cost[5]	Break even[6]
1	22"	3	1.5	**2435**	**92**	19.6	45.3	49.7	5.5	6	11-Jul	28-Jul	50	3	2	$20.25	0
2	22"	6	3.0	**2993**	**113**	18.9	45.8	49.3	8.0	10	11-Jul	28-Jul	52	5	4	$40.50	156
3	22"	9	4.5	**2871**	**109**	19.6	45.5	49.3	7.5	10	11-Jul	27-Jul	51	6	6	$60.75	312
4	6"	3	1.5	**2485**	**93**	19	45.6	49.1	4.0	10	11-Jul	27-Jul	48	4	3	$20.25	0
5	6"	6	3.0	**2517**	**95**	19	45.4	49.5	3.5	8	11-Jul	29-Jul	50	6	5	$40.50	156
6	6"	9	4.5	**2581**	**97**	18.9	45.7	49.4	4.0	10	11-Jul	28-Jul	51	9	8	$60.75	312
7	6"	12	6.0	**2876**	**108**	20.1	45	49.2	5.5	26	11-Jul	28-Jul	52	12	11	$81.00	468
8	12"	3	1.5	**2616**	**98**	19.4	45.3	49.7	2.5	7	11-Jul	29-Jul	50	3	2	$20.25	0
9	12"	6	3.0	**2271**	**86**	19.3	45.6	49.4	3.0	5	11-Jul	29-Jul	49	8	6	$40.50	156
10	12"	9	4.5	**2708**	**102**	19.4	45.4	49.4	3.0	9	11-Jul	28-Jul	51	8	6	$60.75	312
11	12"	12	6.0	**2583**	**97**	19.2	45.5	49.4	5.5	12	11-Jul	28-Jul	51	10	9	$81.00	468
12	24"	3	1.5	**2448**	**92**	20.1	44.8	50	1.5	4	11-Jul	30-Jul	48	2	2	$20.25	0
13	24"	6	3.0	**2796**	**105**	20.9	44	49.8	3.5	6	11-Jul	30-Jul	51	4	3	$40.50	156
14	24"	9	4.5	**2899**	**109**	20	44.8	49.7	4.5	9	11-Jul	29-Jul	48	6	5	$60.75	312
15	24"	12	6.0	**2728**	**103**	19.8	44.9	49.5	4.3	9	11-Jul	29-Jul	49	7	5	$81.00	468
LSD @5% level				**352**	**13**	0.7	0.7	0.4	2.2	11	NS	2	3	2	2		
CV(%)				9	9	3	1	1	35	84	0	4	4	23	25		

Trial Mean=2654

Experimental Design=RCB with 4 reps Variety=InVigor L234P

[1]Row spacing- 22" rows were precision,singulation seeded with RDK planter
All other planting was done with a Hege plot seeder

[2]ESV- Early Season Vigor 6/13/2019

[3]%Ground cover-visual rating 6/13/2019

[4] Stand- plants per square foot

[5]Cost of seed per acre @ $13.50/LB

[6]Added Yield needed to cover seed cost over lowest seeding rate @ $.13/LB

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Table 9a.

2015-19 Canola Conventional Planting Row Space x Seeding Rate Trial
Various Locations in the Roseau,Mn. Vicinity

Row	Seeding Rate	Seed Yield(lb/ac.)[1]					5Yr. Ave.	
Spacing	PLS/Ft.2	2015	2016	2017	2018	2019	#/ac.	% of mean
6"	3	2518	2706	2886	2815	**2485**	**2682**	**96**
6"	6	2636	2787	3524	3113	**2517**	**2915**	**104**
6"	9	2850	2533	3312	2793	**2581**	**2814**	**100**
6"	12	3194	2590	3454	2774	**2876**	**2978**	**106**
12"	3	2692	2498	2971	2733	**2616**	**2702**	**96**
12"	6	2972	2310	3071	2889	**2271**	**2703**	**96**
12"	9	2901	2695	3688	2920	**2708**	**2982**	**106**
12"	12	3337	2500	3591	2563	**2583**	**2915**	**104**
24"	3	2898	2568	2502	2904	**2448**	**2664**	**95**
24"	6	2561	2391	2778	2727	**2796**	**2651**	**95**
24"	9	2822	2376	2916	3024	**2899**	**2807**	**100**
24"	12	3018	2475	3043	2726	**2728**	**2798**	**100**
LSD @5% level		518	318	366	279	**352**	**265**	9
CV(%)		12	8	8	7	9	6	6

Experimental design= RCB with 4 reps

2015 Canola variety- InVigor L 252 ; 2016-18 InVigor L 140P

[1]Yield=Cleaned seed yield corrected to 8.5% moisture

5 year #/acre trial mean= 2801

Table 10.

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

Treatment[1]	Application Rate[1]	Yield(#/acre)[2] 2019	Yield(#/acre)[2] 2018	Test wt. #/bu.	Protein[3]	oil[3]	Stand[4]
none	0	2296	2563	48.5	20.2	44.7	4.2
11-52-0	9-40-0	2711	2540	48.6	19.9	44.3	4.4
10-34-0	2gal	2525	2599	48.4	19.5	44.9	4.2
LSD @5% level		NS	NS	NS	NS	NS	NS
CV(%)		13	9	0.7	2.5	1	12

Experimental design= RCB with 4 reps Variety=InVigor L234P

[1]11-52-0 applied dry before final seedbed prep;
10-34-0 liquid applied below seed at planting

[2]Clean Seed Yields corrected to 8.5% moisture

[3]Protein and oil on dry matter basis

[4]Stand-plant counts per ft.2 on 6-26-2019

Planted 5/29/2019 in 22" rows @ 3#/acre (6PLS/Ft.2) with RDK Precision Planter

Fertilizer applied to all plots 5/15/2019 =140-0-40-20s

Rate/ac	formulation		N-P-K per acre	Trade name
2gallons	Liquid	10-34-0	2-8-0	ammonium polyphosphate
77#	Dry	11-52-0	9-40-0	monoammonium phosphate(2019)
87#	Dry	0-46-0	0-40-0	Super phosphate (2018)