
**Project Identification**

**Project Title:** Camelina: A new crop option for Northeast Saskatchewan

**Project Number:** ADOPT 20190452

**Producer Group Sponsoring the Project:** Northeast Agriculture Research Foundation

**Project Location(s):** RM of Star City no. 428 SE 31-44-18 W2

**Project start and end dates (month & year):** April 2021 to February 2022

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## Objectives and Rationale:

**Project objectives:** To demonstrate basic agronomic practices for camelina production in Northeast Saskatchewan

**Project Rationale:** Camelina (*Camelina sativa* L.) is an oilseed crop that is a member of the Brassicaceae family. It has many uses in pet and livestock feeds in addition to a growing market as fish food in aquaculture. It is a relatively minor crop in Saskatchewan with 5,000-6,000 acres estimated to have been grown in 2021 (Arnason, 2021). However, industry is looking to expand contracted acres in the coming years. With features like relatively early crop maturity and frost tolerance, camelina could be an alternative crop that farmers in Northeast Saskatchewan could include in their crop rotations. To promote the adoption of the crop, farmers must have access to information regarding the agronomic practices that make growing camelina profitable. The goal of this demonstration was to understand how seeding date, seeding rate, and nitrogen fertilizer rate affect the stand establishment, grain yield, and profitability of growing camelina in Northeastern Saskatchewan.

## Methodology and Results:

**Methodology:** This small plot demonstration was conducted in 2021 at SE 31-44-18 W2 in the RM of Star City near Melfort, SK. The demonstration was set up as a split-plot factorial with 4 replications. Treatments varied based on seeding date, seeding rate, and nitrogen rate (Table 1). The split-plot was divided by a seeding date of early, which targeted the 1st week of may, or late, which targeted the 3rd week of may. Within the split-plot treatments varied by a seeding rate and nitrogen rate with seeding rate consisting of 500 seeds/$m^2$ or a 1X recommended seeding rate and 750 seeds/$m^2$ or a 1.5X recommended seeding rate, while nitrogen rate consisted of 60 kg/ha or 120 kg/ha of applied N.

**Table 1:** Treatments used in Camelina: A new crop option for Northeast Saskatchewan in Melfort, SK 2021.

| Treatment Number | Seeding Date[z] | Seeding Rate (seeds/$m^2$) | Applied N (kg/ha) |
|---|---|---|---|
| 1 | Early | 500 | 60 |
| 2 | | 500 | 120 |
| 3 | | 700 | 60 |
| 4 | | 700 | 120 |
| 5 | Late | 500 | 60 |
| 6 | | 500 | 120 |
| 7 | | 700 | 60 |
| 8 | | 700 | 120 |

[z]Early date was to target the 1st week of May, and the late date was to target the 3rd week of May.

At Melfort, plots were 2-m wide by 7-m long. Prior to seeding, the test site was soil sampled for residual nutrient levels (Table 2). Results of the soil test were used to determine rates of P, K, and S to be non-limiting. Nitrogen was applied as 46-0-0 in a side band at rates of 60 and 120 kg/ha as per treatment (Table 1). Phosphorus was the only other supplemented nutrient and was applied at 28kg $P_2O_5$/ha in the seed row. Plots were seeded to a 0.25-inch depth into canola stubble using a 6-row Fabro plot seeder on 12-inch row spacing. The early seeded treatments were seeded on May 4th while the late seeded treatments were seeded on May 19th. Seeding rate was adjusted for a 98% germination and a 1.6g TKW.

**Table 2:** Residual soil nutrient levels found in Increasing the adoption of new green and yellow pea varieties in Melfort, SK 2020. Residual nitrogen and sulphur are measurements from 0-12'' while phosphorus and potassium are measurements from 0-6''.

| Residual Soil Levels | | | |
|---|---|---|---|
| *Nitrogen (lb/ac)* | *Phosphorus (ppm)* | *Potassium (ppm)* | *Sulphur (lb/ac)* |
| 32 | 7 | 474 | 24 |

The trial received crop protection products as required. A post-emergent herbicide application of Assure II (0.3L/ac) was applied for early and late seeded treatments on June 14th. Plots were also hand-weeded to control weeds the were not controlled by the post-emergent herbicide application. No pre-emergent herbicide, fungicide, insecticides or desiccants were applied to the trial area. Early seeded plots were harvested on August 11th while late seeded plots were harvested on August 17th with a plot combine, in which 5 crop rows were collected.

To assess treatment differences, data measurements consisted of plant density, seed yield, and economics. Methodology for this data collection was described below. The single site year of data was analyzed using Randomized Complete Block in Statistix 10.

**Results**

*Environmental Conditions*

The environmental conditions of 2021 were marked by being warmer and dryer than the long-term average for several months of the growing season. The mean temperature was greater than the long-term average from June-September (Table 3). The deviation from the long-term mean temperature was most pronounced in September and July when the temperature was 3.2°C and 2.6°C greater than the mean, respectively. May was the only month that was cooler than average temperature with a monthly mean of 9.6°C relative to the long-term mean of 10.7°C (Table 3). Across the growing season, Melfort received 55% of the long-term average for precipitation. From May-September, all months except August (16.9mm above normal) received below average precipitation. This deficit was most pronounced in July and September which received 76.5mm and 31.2mm of precipitation less than the long-term average.

**Table 3**: Mean temperatures and precipitation collected from the Environment Canada Weather Station at Melfort SK., from May to September 2021.

| | **May** | **June** | **July** | **August** | **September** | **Average/Total** |
|---|---|---|---|---|---|---|
| | | | --- Mean Temperature (°C) --- | | | |
| 2021 | 9.6 | 18.2 | 20.1 | 16.9 | 14 | 15.8 |
| Long-Term[x] | 10.7 | 15.9 | 17.5 | 16.8 | 10.8 | 14.3 |
| | | | --- Total Precipitation (mm) --- | | | |
| 2021 | 31.4 | 37.6 | 0.2 | 69.3 | 7.5 | 146 |
| Long-Term[x] | 42.9 | 54.3 | 76.7 | 52.4 | 38.7 | 265.0 |

[x] Long-term climate normal from Environment Canada Weather Station located at Melfort SK., from 1981-2010

**Table 4:** Statistical analyses and treatment means for Camelina: A new crop option for Northeast Saskatchewan in Melfort, SK 2021.

| | Plant Density (plants/m$^2$) | | Yield (kg/ha) | | Yield (bu/ac) | |
|---|---|---|---|---|---|---|
| Seeding Date | 0.0032** | | 0.0302* | | 0.0302* | |
| Seeding Rate | 0.11 | | 0.3657 | | 0.3657 | |
| Nitrogen Rate | 0.44 | | 0.4144 | | 0.4144 | |
| Date*SR | 0.73 | | 0.6326 | | 0.6326 | |
| Date*NR | 0.94 | | 0.0933 | | 0.0933 | |
| NR*SR | 0.044* | | 0.0132* | | 0.0132* | |
| Date*SR*NR | 0.16 | | 0.5026 | | 0.5026 | |
| Grand Mean | 111.65 | | 962.04 | | 17.151 | |
| CV | 25.99 | | 9.22 | | 9.22 | |
| **Seeding Date** | | | | | | |
| Early | 68.39 | b | 1053.30 | a | 18.78 | a |
| Late | 154.92 | a | 870.80 | b | 15.52 | b |
| **Seeding Rate** | | | | | | |
| 500 seeds/m2 | 103.65 | a | 944.83 | a | 16.84 | a |
| 750 seeds/m2 | 119.65 | a | 979.24 | a | 17.46 | a |
| **Nitrogen Rate** | | | | | | |
| 60kg/ha N | 116.06 | a | 952.11 | a | 16.97 | a |
| 120 kg/ha N | 107.24 | a | 971.96 | a | 17.33 | a |
| **Date*SR** | | | | | | |
| Early*500 seeds | 61.93 | b | 1027.2 | ab | 18.31 | ab |
| Early*700 seeds | 74.74 | b | 1079.3 | a | 19.24 | a |
| Late*500 seeds | 145.38 | a | 862.4 | b | 15.38 | b |
| Late*700 seeds | 164.45 | a | 879.1 | b | 15.67 | b |
| **Date*N Rate** | | | | | | |
| Early*60N | 72.38 | b | 1021.90 | ab | 18.22 | ab |
| Early*120N | 64.39 | b | 1084.60 | a | 19.34 | a |
| Late*60N | 159.74 | a | 882.30 | bc | 15.73 | bc |
| Late*120N | 150.1 | a | 859.30 | c | 15.32 | c |
| **SR*N Rate** | | | | | | |
| 500 seeds*60N | 120.57 | ab | 969.00 | ab | 17.28 | ab |
| 500 seed*120N | 86.74 | b | 920.60 | b | 16.41 | b |
| 750 seeds*60N | 111.55 | ab | 935.20 | b | 16.67 | b |
| 750 seeds*120N | 127.75 | a | 1023.30 | a | 18.24 | a |
| **Date*SR* N Rate** | | | | | | |
| Early*500 seeds *60N | 70.13 | cd | 1021.90 | ab | 18.22 | ab |
| Early*500 seeds *120N | 53.72 | d | 1032.50 | ab | 18.41 | ab |
| Early*750 seeds *60N | 74.64 | cd | 1022.00 | ab | 18.22 | ab |
| Early*750 seeds *120N | 75.05 | cd | 1136.70 | a | 20.26 | a |
| Late*500 seeds *60N | 171.01 | a | 916.20 | bc | 16.33 | bc |
| Late*500 seeds *120N | 119.75 | bc | 808.70 | c | 14.42 | c |
| Late*750 seeds *60N | 148.46 | ab | 848.40 | c | 15.13 | c |
| Late*750 seeds *120N | 180.45 | a | 909.90 | bc | 16.22 | bc |

* significant p<0.05, ** significant p<0.01, *** significant p<0.001

*Plant Density:*

Plant density was assessed on June 4th for all treatments by counting the number of emerged seedlings along two 1-meter crop rows per plot. The analysis of variance (ANOVA) identified that there were significant differences in plant density based on seeding date ($p<0.01$) and the interaction between seeding rate (SR) and nitrogen rate (NR) with $p=0.044$ (Table 4). Pairwise comparison identified that the late seeding date had a significantly higher plant density (154.9 plants/$m^2$) than the early seeding date (68.4 plants/$m^2$). For the two-way interaction between NR and SR, the high SR with high NR (127.8 plants/$m^2$) had a significantly greater plant density than the lower SR and high NR treatment (86.7 plants/$m^2$). There were no significant differences between the remaining combinations of SR and NR.

*Seed Yield:*

Seed yield was assessed by cleaning and weighing every harvested plot sample. Plot weights were converted in kg/ha and bu/ac equivalents while correcting to 8% seed moisture. ANOVA results identified that seeding date ($p<0.05$) and the interaction between SR and NR ($p<0.05$) had significant effects on grain yield (Table 4). The yield of the early seeding date treatments (1053.30 kg/ha & 18.78 bu/ac) was significantly higher than the late seeding date treatments (870.80 kg/ha & 15.52 bu/ac). For the two-way interaction between SR and NR, the high SR with high NR treatment had significantly greater yield than the lower SR with high NR treatment (920.60 kg/ha & 16.41 bu/ac) and the high SR with lower NR treatments (935.20 kg/ha & 16.67 bu/ac). The highest average grain yields were attained with a seeding date in the first week of May and with a high SR of 750 seeds/$m^2$ in combination with a high NR of 120 kg/ha.

*Economics:*

Economic analysis was conducted using the 2021 Saskatchewan Crop Planning Guide, price history for urea from indexmundi.com, and quotes from Smart Earth Camelina (Saskatoon, SK). Costs that varied between treatments were urea and seed costs.

An early seeding date resulted in higher net profitability than a late seeding date. All of the early seeded treatments had a positive net profit, while one of the four late seeded treatments with a low SR and low NR had a positive net profit of $14.26/ha (Table 5). Among the early seeded treatments, the low SR and low NR treatment had the highest net profit of $84.02/ha, while the high SR and low NR treatment had the lowest net profit of $34.70/ha. A similar trend was seen for net profit and grain yield among early seeded treatments when looking at the interaction between SR and NR. At a low SR, a higher yield and net profit were achieved with a low NR. However, with a high SR the highest yield and net profit were achieved with a high NR. This interaction between SR and NR was not observed for the profit of late seeded treatments as a higher profitability was consistently achieved with a low nitrogen rate (Table 5). Overall, the greatest net profit was achieved with an early seeding date. The relative level of seeding rate and nitrogen rate should be matched at either low-low or high-high respectively for optimum yield and net profit.

**Table 5**: Economic analysis of treatments to determine net profitability for Camelina: A new crop option for Northeast Saskatchewan, Melfort, 2021.

| Seeding Date | Early | | | | Late | | | |
|---|---|---|---|---|---|---|---|---|
| Seeding Rate (seeds/m2) | 500 | | 700 | | 500 | | 700 | |
| Total Supplied N (kg N/ha) | 60 | 120 | 60 | 120 | 60 | 120 | 60 | 120 |
| Total Urea Cost ($/ha) | $48.37 | $101.66 | $48.37 | $101.66 | $48.37 | $101.66 | $48.37 | $101.66 |
| Total Seed Costs ($/ha) | $98.78 | $98.78 | $148.16 | $148.16 | $98.78 | $98.78 | $148.16 | $148.16 |
| Other Costs ($/ha) | $443.29 | $443.29 | $443.29 | $443.29 | $443.29 | $443.29 | $443.29 | $443.29 |
| Total Cost ($/ha) | $590.44 | $643.72 | $639.82 | $693.11 | $590.44 | $643.72 | $639.82 | $693.11 |
| Yield (kg/ha) | 1021.9 | 1032.5 | 1022 | 1136.7 | 916.2 | 808.7 | 848.4 | 909.9 |
| Gross Revenue ($/ha) | $674.45 | $681.45 | $674.52 | $750.22 | $604.69 | $533.74 | $559.94 | $600.53 |
| Net Profit ($/ha) | $84.02 | $37.73 | $34.70 | $57.11 | $14.26 | -$109.98 | -$79.88 | -$92.58 |

**Conclusions and Recommendations**

Diversifying crop rotations has many benefits for producers that include the management of risk for their businesses, herbicide resistance for weeds, disease cycles, and soil health. Camelina (*Camelina sativa* L.) is a relatively new crop to northeastern Saskatchewan with uses that include pet food, livestock feed, and fish meal. This project was undertaken to demonstrate the basic agronomic practices for Camelina production in NE Saskatchewan. Based on the 2021 results, an early seeding date in the first week of May is recommended for camelina production to achieve high yields and profitability. While a late seeding date resulted in a significantly greater plant density than an early seeding date, this did not result in higher yield or profitability. There was a significant interaction between seeding rate and nitrogen rates. When comparing the effect of nitrogen rate at an early seeding date based on yield and net profit, a low seeding rate responded best to a low nitrogen rate, while a high seeding rate responded best to a high nitrogen rate. The highest net profit of the eight treatments was $84.02/ha for the early seeded, 500 seeds/$m^2$ seeding rate, and 60 kg/ha nitrogen rate treatment. If producers must seed camelina in late May, our results suggest that a low seeding rate and low nitrogen rate will result in the highest net profit. With proper seeding date, seeding rate and nitrogen rate, given current market conditions, camelina can be a profitable crop for farmers in Northeastern Saskatchewan.

*Extension Activities*

The results of this project will be posted on neag.ca, and will be shared at winter meetings and on social media whenever possible.

## Supporting Information

**Acknowledgements**
The Northeast Agriculture Research Foundation would like to express our gratitude to the Saskatchewan Ministry of Agriculture's ADOPT program for funding this demonstration and for providing signage. We would like to thank Jessica Slowski (Formerly of NARF), Brianne McInnes, and David Mactaggart of NARF for coordinating the project protocol, data analysis and report writing for this project. Finally, NARF would like to thank Gayelene Dagenais, Caitlyn Hartman, and Carter Fettes for their hard work and dedication in completing this project.

**Works Cited:**
Arnason, R. 2021. Camelina drops acreage to canola as price loses ground. Online. Available: https://www.producer.com/markets/camelina-drops-acreage-to-canola-as-price-loses-ground/ [January 24, 2022].

## Abstract

**Abstract/Summary**

Camelina (*Camelina sativa* L.) is an annual oilseed crop from the Brassicaceae family that can be used in a variety of products for human and animal consumption. As camelina is a relatively new crop to Western Canada, little is known about the agronomics needed for the crop's optimum yield and profitability. The objective of this project was to demonstrate the basic agronomic practices for Camelina production in NE Saskatchewan. To do so a small-plot demonstration was conducted in the R.M. of Star city near Melfort, SK during the 2021 growing season. A split-plot factorial with four replications was used to demonstrate the impact of seeding date, seeding rate, and nitrogen rate on the plant density, grain yield, and economics of growing camelina. A later seeding date (3$^{rd}$ week of May) resulted in a higher plant density than an early seeding date (1$^{st}$ week of May). A high seeding rate of 750 seeds/m$^2$ only resulted in a higher plant density under high nitrogen conditions (120 kg N/ha). An early seeding date resulted in a significantly higher yield and net profit than a later seeding date. All early seeded treatments had a positive net profit ranging from $34.70/ha-$84.02/ha. Given an early seeding date, the highest yield resulted from a treatment of high seeding and nitrogen rates, while the greatest net profit was from a treatment of a recommended seeding rate (500 seeds/m$^2$) and moderate nitrogen rate (60 kg N/ha). Considering an early seeding date, camelina at a recommended seeding rate has the highest yield and profit with a lower nitrogen rate, while camelina at a high seeding rate has the highest yield and profit with a high nitrogen rate. If producers must seed camelina late, our results show that it is best to use a recommended seeding rate of 500 seeds/m$^2$ and a 60 kg/ha nitrogen rate over a higher SR and 120 kg/ha of N. Based on one year of research, camelina can be a profitable crop for farmers in Northeast Saskatchewan when seeded early with optimized seeding and nitrogen rates.

## Finances

**Budget Report**

See attached excel spreadsheet