

Summary of Research Results 2020

Our summer was extremely hot and dry with day temperatures touching 31° C in June and 34° C in July with a rainfall of only 102.6 mm during the two months. As a result, yields of most crops were poor; except edible beans and soybeans, which did exceptionally well. Summer heat and sufficient rain in August (103.7 mm) helped the beans to grow and yield very well (average yield ~5 MT/ha – highest ever!).

2.1 Screening of crop varieties:

2.1.1 Spring Cereals:

Wheat Varieties:

- Thirty three varieties were evaluated; 21 of which were CWRS (mostly new).
- Grain yield with a trial mean of 2.83 MT/ha was extremely low this year (very hot and dry summer!).
- Highest grain yield (4.46 MT/ha) was obtained with *Easton*. The next best two varieties in grain yield were *AAC Starbuck* (3.63 MT/ha) and *AAC Russell VB* (3.59 MT/ha).
- *AAC Prevail* and *CDC Credence* had the highest straw yield (7.07 and 7.04 MT/ha) and *CDC Credence* the highest biomass yield (10.13 MT/ha).
- Averaged over 2019 and 2020, three varieties that topped in the grain yield were *Easton* (5.18 MT/ha), *AAC Wheatland* (4.78 MT/ha) and *AAC Starbuck* (4.68 MT/ha). Grain yield from *Prosper* was 4.40 MT/ha.
- Grain protein content in *AAC Wheatland* last year was 17.8 % as compared to 16.6 %, in *Prosper*.
- Since *Easton* is not considered HRW by the Grain Elevators, *AAC Wheatland* and *AAC Starbuck* (both CWRS) can be recommended for cultivation on farms in 2021!

Barley Varieties:

- Fourteen barley varieties (4 two row and 10 six row) were compared for their production potential.
- *Synasolis* (5.16 MT/ha) among 6 row and *TR1867* (5.00 MT/ha) among 2 row barley produced the highest grain yields. *Chambly* (4.89 MT/ha) was the third best grain yielding variety.
- Straw yield was highest with *AB Advantage* (6.80 MT/ha), *AAC Bell* (2 row; 6.47 MT/ha) and *Amberly* (6.32 MT/ha).
- *AB Advantage* (11.1 MT/ha), *Chambly* (11.0 MT/ha) and *TR1867* (10.7 MT/ha) recorded the highest biomass yields.
- Averaged over 2019 and 2020, grain yields were in the order of *Synasolis* (6.40 MT/ha) ≥ *Boroe* (6.05 MT/ha) ≥ *Chambly* (5.98 MT/ha). However, only 7 varieties were common in 2019 and 2020.

Malting Barley Varieties:

- Thirteen varieties were evaluated. *AB Brewnet* and *CDC Churchill* were the new varieties this year.
- Three top grain yielding varieties were *Lowe* (6.54 MT/ha), *AB Brewnet* (6.31 MT/ha) and *CDC Fraser* (5.96). *CDC Bow* that has been producing the highest grain yield in the past, lagged behind in grain yield last year and this year too (5.53 MT/ha). It seems that *CDC Bow* didn't like the heat in June-July this year. *OAC 21* had the lowest grain yield (4.03 MT/ha). *AB Brewnet* recorded the highest straw yield (5.89 MT/ha), followed by *CDC Copeland* (5.74 MT/ha) and *Lowe* (5.33 MT/ha).
- Grain yield of other varieties ranged from 4.35 MT/ha (*CDC Kindersley*) to 5.86 MT/ha in *AAC Synergy*.
- Averaged over 2017-2020 (excluding *AB Brewnet* and *CDC Churchill* that had only one year data), *CDC Bow* produced the highest grain (6.29 MT/ha), straw (8.31 MT/ha) and biomass (14.6 MT/ha) yields. Two second best varieties in (i) grain yield were *AAC Synergy* (5.90 MT/ha) and *AAC Connect* (5.75 MT/ha) and (ii) in straw yield were *Bentley* (6.86 MT/ha) and *AAC Synergy* (6.52 MT/ha).

- *OAC21* had the highest grain protein content (14.7 %). Ten other varieties had higher than 13 % protein. Only *CDC Curchill* (12.5 %) and *CDC Copeland* (12.95 %) had grain protein lower than 13.0 %.

Oat Varieties:

- Eleven oat varieties were evaluated for their yield potential.
- *CDC Arborg* produced the highest grain (6.05 MT/ha) and biomass (11.71 MT/ha) yields, and *Vitality* the highest straw yield (6.10 MT/ha). Two other equally good varieties in grain yield were *AC Rigodon* (5.83 MT/ha) and *AC Douglas* (5.79 MT/ha).
- Grain yields from the two milling oat varieties *Ore 3541M* and *Ore 3542M* were 5.25 and 5.17 MT/ha, respectively.
- Averaged over 2019 and 2020, *CDC Arborg* (6.01 MT/ha) and *AC Rigodon* (5.93 MT/ha) recorded the highest grain yield!

2.1.2 Winter Cereals:

Winter Wheat Varieties (seeded on August 26, 2019):

- Twelve winter wheat varieties from the west and east of Canada, including *Gallus*, *AAC Icefield*, *JDC78* and *AAC Wildfire*, were compared for their production potential.
- *AAC Wildlife* (5.10 MT/ha), *Keldin* (4.97 MT/ha) and *Gallus* (4.88 MT/ha) were the three highest grain yielding varieties; though the grain yield differences between the tested varieties weren't significant. The grain yields this year were much lower than that during the last year due to hot and dry weather during June-July this year.
- *Goldrush*, *Moats*, *CDC Buteo*, *AAC Wildlife* and *Gallus* had straw yield above 7.0 MT/ha.
- *AAC Wildlife* (12.13 MT/ha), *Gallus* (11.93 MT/ha) and *Keldin* (11.57 MT/ha) recorded the highest Biomass yields.
- Averaged over 2019 and 2020, *Keldin* (6.57 MT/ha), *Gallus* (6.27 MT/ha) and *AAC Gateway* (5.63 MT/ha) produced the highest grain yields. Straw yield (8.97 MT/ha) was highest with *CDC Buteo*.
- *JDC 78* was the most dwarf (76 cm tall) and *CDC Buteo*, *Moats* and *Swainson* the tallest varieties (95-96 cm). *AAC Gateway* with a height of 84 cm was a medium variety.

Late seeded Winter Wheat Varieties (seeded on September 17, 2019):

- Six varieties were tested under late seeding.
- *Adrianus* (5.90 MT/ha), *PRO 81* (5.73 MT/ha) and *CDC Falcon* (5.48 MT/ha) produced the highest grain yields. The yield differences between the varieties were not statistically significant though.
- Straw (7.84 MT/ha) and biomass (12.87 MT/ha) yields were highest with *AAC Gateway*. *CDC Falcon* was the next best/equally good variety in straw (7.33 MT/ha), and biomass (12.81 MT/ha) yields.
- *AAC Gateway* was the most dwarf (76 cm tall) and *CDC Falcon* the tallest variety (82 cm).

2.1.3 Grain Legumes and Oil Seeds Varieties:

Soybean Varieties:

- Twenty six varieties were compared for their grain production potential.
- *Bourke R2X* (5.39 MT/ha), *Akras* (5.25 MT/ha), and *Mahony R2* (5.00 MT/ha) recorded the highest grain yields! *Lono R2* had given the highest grain yield during the past two years.
- *Mani R2X* (23.1 g), *PV16 S004 RR2X* (22.8 g) and *Amiran R2* (22.5 g) topped in 100 kernel weights.
- Averaged over 20 varieties that were common during 2019 and 2020, highest grain yields were produced by *Bourke R2X* (3.57 MT/ha), *Lono R2* (3.45 MT/ha), *NSC Tilston RR2Y* (3.36 MT/ha), *PV16 S004 RR2X* (3.32 MT/ha) and *Mahony R2* (3.30 MT/ha).
- *Lono R2* (124 cm) was the tallest and *Bourke R2X* (92 cm)/*Akras* (91 cm) the medium tall varieties.

Edible Bean Varieties:

- Ten edible bean varieties from different classes and of different colours (mostly new from last year) were evaluated for grain yield.

- Grain yield differences between the varieties were statistically not significant. However, *AAC Scotty – Cranberry beans* (5.91 MT/ha), *AAC Y015* (5.83 MT/ha) and *AAC Whitehorse* (5.71 MT/ha) seemed to have better grain yields than all other varieties (4.63 MT/ha in *AAC Earlired* to 5.61 MT/ha in *AAC Argosy*). *AAC Earlired* has been the highest yielding variety during the past several years.
- Averaged over 2019 and 2020, *AAC Scotty* (4.02 MT/ha), and *AAC Argosy*/and *AAC Shock* (both 3.87 MT/ha) registered the highest grain yields.
- Overall, the edible beans grain yield was very good this year.

Edible beans (easy weed control with Basagram Forte) if they fetch a good price in the market could be an integral part of the cropping systems in northwestern Ontario!

Pea Varieties:

- Ten field pea varieties (6 yellow, 3 green and 1 brown/specialty pea) were evaluated.
- Pods were eaten by geese and deer; hence no grain yield could be recorded. Therefore only biomass yield is reported.
- *CDC Lewochko – new this year* (3.82 MT/ha), *CDC Forest* (3.39 MT/ha) and *CDC Spruce* (3.31 MT/ha) produced higher biomass yield than other varieties.
- Last year too, *CDC Forest* and *CDC Spruce* were among the top biomass producing varieties.

Lentil Varieties:

- Three lentil varieties (two yellow and one green) were evaluated. Grain yield was very poor (< 1 MT/ha).
- Averaged over 2019-2020, grain yield was in the order of *CDC Impulse CL* (green; 2.02 MT/ha) = *Lima* (2.00 MT/ha) > *CDC Rosetown* (1.50 MT/ha). Straw yield depicted a trend similar to the grain yield and was 3.63 MT/ha in *CDC Impulse CL*, 3.48 MT/ha in *Lima* and 3.14 in *Rosetown*.

Linseed Flax Co-op Trial (Varieties/Biotypes):

- Twenty varieties/biotypes (7 varieties and 13 biotypes) were compared.
- Flax was seeded on May 21 and was soon caught up in the extremely hot and dry weather in June and hence didn't grow well this year. The seed yield was too low and ranged from 0.28 to 0.74 MT/ha (trial mean 0.46 MT/ha). The yield was too low to properly evaluate the varieties.

Liberty Canola Varieties:

- Nine varieties were evaluated; 7 of which had Clubroot resistance and 5 of them had shatter reduction trait.
- Seed yield was extremely low (trial mean 2.02 MT/ha) because of extremely hot and dry weather in June and hot and dry weather at flowering. Growth as seen from straw yield didn't get converted into seed yield.
- Seed yield was in the order of *LR344PC* (2.42 MT/ha) ≥ *L352C* (2.23 MT/ha) = *L252* (2.21 MT/ha). However, seed yield differences between the varieties were not significant.
- *LR344PC* (two in one LibertyLink® and TruFlex™ canola with Roundup Ready® Technology) recorded the highest straw yield (5.40 MT/ha) followed closely by *L241C* (5.36 MT/ha) and *L345PC* (5.13 MT/ha). Straw yield differences between the varieties too were not significant.
- Four varieties (*L255PC*, *L241C*, *L230* and *L252*) were common during 2018-2020. Averaged over 2018-2020, *L252* produced the maximum seed yield (4.45 MT/ha) and *L241C* produced the maximum straw yield (7.25 MT/ha).
- *P* stands for 'Shatter Reduction' and *C* for Clubroot resistance.

Other Canola Varieties (seeded on May 14, 2019):

- Seven varieties were compared; four Roundup, two Clearfield and one Liberty (as a check).
- Seed yield was extremely low (trial mean 2.04 MT/ha) because of extremely hot and dry weather in June and hot and dry weather at flowering. Growth as seen from straw yield didn't get converted into seed yield.

- Seed yield was in the order of *5545CL* (2.53 MT/ha) = *L241C* (2.52 Mt/ha) ≥ *BY6204TF* (2.32 MT/ha). However, seed yield differences between the varieties were not significant.
- Straw yield followed a bit different trend to the seed yield; *L241C* (6.01MT/ha) > *5545CL* (5.21 MT/ha) > *BY6204TF* (4.79 MT/ha). Straw yield differences between the varieties too were not significant.

Winter Canola Varieties:

- Two winter canola varieties, *Mercedes* and *Inspiration*, were seeded on September 6, 2019 and none survived the winter of 2019-2020.
- This is the second year when these two varieties failed to survive during the winter at LUARS.

Mustard Varieties:

- Four varieties were compared. Due to scant stand the seed yield was very poor and ranged from 0.52 MT/ha (*Adagio*) to 0.86 MT/ha (*AAC Brown 120*).
- Last year, *AC 200* (Oriental mustard; 2.33 MT/ha) and *AC Vulcan* - Oriental mustard (2.15 MT/ha) produced higher seed yield than *AAC Brown 120* (1.65 MT/ha) and *Adagio* (1.41 MT/ha).
- Compared to canola, mustard is a low input crop, is used for culinary purposes, can be sold in retail and could fetch a higher market price than canola!

2.1.4 Forage Crops/Varieties:

Comparative Performance of Alfalfa and Galega: Two cuts were taken!

- Dry matter yields from Galega seeded @ 25, 35 or 45 kg seed/ha and alfalfa seeded @ 13 kg/ha in 2011 were compared.
- Alfalfa (mostly volunteer grasses; there wasn't much of alfalfa left in alfalfa plots) recorded highest dry matter yield (5.092 kg/ha) this year. Galega dry matter yield at different seed rates ranged from 3,297 kg/ha to 3,747 kg/ha and these differences in yield were not significant.
- Galega @ 25-45 kg/ha had ~2-3 higher % points in protein content in the first cut and ~1-2 higher % points in protein content in the second cut.
- Averaged over 2012-2020, Galega seeded @ 35 kg/ha produced over 500 kg/ha/year (= over 4,500 kg/ha) higher dry matter yield than alfalfa. Protein content in Galega was 2 % point higher in the first cut and 3 % point higher in the second cut as compared to alfalfa.
- *Higher yield and higher protein content in Galega than in alfalfa, could make Galega a better fodder than alfalfa!*

Optimizing Seeding Rate in Kernza and Comparing its Forage Production Potential with Perennial Rye and in Mixture with Alfalfa:

- Regrowth was too poor to take the second cut. Therefore, only one cut was taken.
- Optimum seed rate of *Kernza* appeared to be 90 seeds/m². At this rate, it produced 4,384 kg/ha dry matter yield. Dry matter yield from *Kernza* at other populations (70, 110 and 130 seeds/m²) varied from 3,460 kg/ha to 3,877 kg/ha.
- *Alfalfa + Kernza* (80:20 mixture) recorded the highest dry matter yield (5,761 kg/ha) in 2020 and also highest total dry matter yield over three years (2018-2020 – 14.2 MT/ha). Dry matter yield from *alfalfa + Ace 1* (*Perennial Rye*) 80:20 mixture was 4,676 kg/ha. However, *Ace 1* did not survive beyond winter 2018-2019 and *alfalfa + Ace 1* was virtually alfalfa alone.
- In the first cut, protein content was higher in *alfalfa + Ace 1* (80:20) mixture (17.4 %) followed by *alfalfa + Kernza* 80:20 mixture (16.7 %). Protein content in *Kernza* at varying populations (70-130 seeds/m²) ranged from 10.6 % to 11.8 %.
- RFV was highest (130) in *alfalfa + Ace 1* (80:20 mixture) followed by *alfalfa + Kernza* 80:20 mixture (119). RFV in *Kernza* varied from 94 to 101.

Comparative Performance of Kernza, Perennial Rye, RR Alfalfa, Conventional Alfalfa, Sainfoin and Chicory:

- Perennial Rye, Chicory, and Sainfoin didn't survive and *Kernza* regrowth after the first cut was too poor to take the first cut.

- Dry matter yield from the two cuts ranged from 4,960 kg/ha (*Kernza*) to 8,475 kg/ha (RR Alfalfa variety *WL319HQ*).
- Other two Roundup Ready alfalfa varieties *WL354HQ* (6,732 kg/ha) and *Mission HVXRR* (6,170 kg/ha) produced lower dry matter yield than the two conventional alfalfa varieties; *135* (7,777 kg/ha) and *Instinct* (7,521 kg/ha).
- First cut protein content in *Kernza* was 16.4 % and ranged from 16.7 to 17.7 % in almost all alfalfa varieties. In the second cut (alfalfa only), the protein content ranged from 18.7 % to 19.4 %. *Protein content in the Roundup ready alfalfa wasn't higher than that in the conventional alfalfa.*
- *Mission HVXRR* that gave the lowest dry matter yield had the highest RFV (136) in the first cut. In the second cut, RFV was highest (145) in *WL354HQ* (Roundup Ready).
- In the three years total dry matter yield, *WL319HQ* had the highest yield (18.0 MT/ha), followed by the two conventional alfalfa varieties (*135* and *Instinct*; both 16.7 MT/ha).

Therefore, RR Alfalfa variety WL319HQ could be recommended for cultivation on farms!

2.2 Fertilizer Management Practices and Soil Amendments (Grain/Seed crops):

2.2.1 Cereals:

Nitrogen and Sulphur Management for Malting Barley (Cultivar CDC Bow) production:

- N from urea and urea + ESN (3:1 on N basis) at 3 rates (35, 70 and 105 kg N/ha along with a check – zero N) was compared at 3 rates of S (0, 8, and 16 kg S/ha).
- Due to hot and dry weather in June, crop growth and the grain yield were poor (trial mean grain yield of only 2.29 MT/ha). It seems the crop couldn't get benefit from ESN due to dry weather.
- Grain yield continued to increase with both urea and urea + ESN up to 70 kg/ha (with each increment of N from zero to 70 kg/ha). Grain yield after 70 kg N/ha either leveled off (urea) or tended to decline (urea + ESN). Averaged over S rates grain yield from urea and urea + ESN was the same.
- Grain yields from urea and urea + ESN (3:1 on N basis) @ 105 kg N/ha, without S, were 2.84 MT/ha and 3.03 MT/ha, respectively (~0.2 MT/ha higher grain yield with urea + ESN than with urea alone). Straw yield increased with every increment of N from 0 to 105 kg N/ha; both with urea and urea + ESN. Straw yields with urea and urea + ESN @ 105 kg/ha were 2.11 and 2.29 MT/ha.
- Grain (3.03 MT/ha) and straw (2.68) yields were highest with urea + ESN @ 105 kg/ha.
- Application of S @ 8 or 16 kg S/ha didn't improve the grain yield (even though the available S at seeding was only 5.75 ppm), but increased the straw yield by over 18 %. This means that the vegetative growth was not translated grain yield (most likely due to high temperature).
- *Averaged over 2018-2020, (i) highest grain (5.51 MT/ha) and straw (5.56 MT/ha) yields were obtained with urea + ESN @ 105 kg N/ha. Urea at the same level of N produced 4.93 MT/ha grain and 4.77 MT/ha straw yield, and (ii) application of S didn't affect the grain/or the straw yield. The results clearly indicate that it pays to use urea + ESN rather than urea alone!*
- Grain protein content appeared to be within limits for malting quality and increased from 10.9 % without N application to 12.1-13.3 % with N application at different rates from urea (average 12.8 %) and urea + ESN (average 12.9 %). Application of S didn't impact grain protein content.

Evaluation of Fish Waste (a liquid product) as a Source of N for Spring Wheat (Prosper) Production:

- Urea + ESN (3:1 on N basis), fish waste and 50:50 N blend of fish waste and (urea + ESN) were compared at 4 rates of N; 0, 40, 80 and 120 kg/ha (applied at seeding).
- Seeding was done on June 3. June and July turned out to be hot and exceptionally dry. The plot range was of relatively poor fertility. Therefore the crop growth in this experiment and consequently the grain yield was extremely poor (trial mean of only 1.13 MT/ha).
- Averaged over 2018-2020, grain yields were in the order of urea + ESN (3.97 MT/ha) \geq 50 % N from fish waste + 50 % N from urea + ESN (3.83 MT/ha) \geq fish waste (3.50 MT/ha). Straw yield exhibited a trend similar to the grain yield.

- Grain yield increased up to 80 kg N/ha and leveled off thereafter.

Winter Wheat Survival:

- Effect of agrochemicals (seed treatment with fungicide + insecticide and spray of Abscisic acid, Seaweed Extract and Headline at tillering) at two rates of potassium application (recommended rate and double the recommended rate) was studied on winter wheat survival and yield. However, winter wheat survived very well in all treatments and the treatments' effect on grain and straw yield was non-significant. None of the treatments gave higher grain or straw yield than the check (no fungicides, insecticides or other chemicals with 20 kg K₂O/ha).
- Grain and straw yields in the check treatment were 4.96 MT/ha and 8.05 MT/ha.
- Doubling the rate of K₂O from 20 to 40 kg/ha didn't improve grain or straw yield.
- Averaged over 2019 and 2020 the results were similar to those during 2020. Which means that none of the treatments was better than the check in grain or straw yield.

Population and NPK fertilizer regimes for Winter Rye: effect was studied on 4 varieties with spring barley (after fall fallow) as a check.

- Grain yield was in the order of *Guttino* (5.47 MT/ha) > *Hazlet* (4.71 MT/ha) > *Brasetto* (4.03 MT/ha) > *Bono* (3.55 MT/ha). Straw yield was in the order of *Hazlet* (6.60 MT/ha) > *Guttino* (5.65 MT/ha) > *Brasetto* (4.86 MT/ha) > *Bono* (4.77 MT/ha). Averaged over 2019 and 2020, grain and straw yield trends were the same as in 2020.
- Lowering the rate of NPK fertilizers application from 100 %, but not the lowering of seed rate, lowered the grain, straw and biomass yields. Highest grain yield (5.56 MT/ha) was obtained with 100 % of recommended NPK fertilizers. Among the seed rates, 75 % of recommended seed rate seemed to give the highest grain (4.59 MT/ha) and biomass (10.09 MT/ha) yields; though the yields at 50 or 100 % seed rates were not significantly different from those at 75 % of recommended seed rate. Averaged over 2019 and 2020, 100 % of recommended NPK fertilizers/and seed rate recorded the highest grain, straw and biomass yields.
- Spring barley kept as a check treatment yielded only 2.90 MT grain/ha and 2.83 MT straw/ha this year, because we were late to seed barley (on June 16).

Residual Effect of Winter Rye Cover Crop – Different Seeding and NPK Fertilizer Rates on Canola:

- Winter rye cover crop was seeded in the fall 2019 at different seed and NPK fertilizers rates with a check (fallow plot without seeding rye) and its effect was studied on canola in 2020.
- The canola seed yield was not significantly affected by the cover crop treatments and ranged from 2.87 to 4.24 MT/ha. The seed yield in the fallow (check) plot was 3.43 MT/ha; not significantly less than any of the other treatments. Seed yields this year were only about half of those in the last year due to hot and dry weather in June-July this year.
- The results indicated that there was no benefit of winter rye cover cropping and the fertilizers applied to it on the seed yield of the following canola crop!
- Straw yield ranged from 4.73 MT/ha in 75% seeding rate + 0% NPK to winter rye to 9.31 MT/ha with 50% seeding rate + 50% NPK fertilizers to winter rye.
- Soil analyses data in spring 2020 indicated that winter rye cover crop at any of the seed or fertilizers rates didn't affect organic matter, pH or available nutrients.

2.2.2 Grain Legumes and Oil Seeds:

Evaluation of NK21 as a Source of N and K for Soybean (25-10RY) Production:

- NK21 (a relatively new fertilizer with 21 % N and 21 % K₂O) was compared @ 21, 42, 63 and 84 kg/ha N and K₂O/ha with urea + MOP (muriate of potash; 0-0-60) at equal rates of N and K₂O along with three checks (No N, No K₂O and No N or K₂O).
- Grain yield ranged from 5.24 MT/ha in control (no N and K₂O) to 5.80 MT/ha with NK21 @ 84 kg N/ha and 84 kg K₂O/ha. The grain yield with N and K₂O each @ 21 kg/ha from urea + MOP

was 5.75 MT/ha. However, these yield differences were statistically not significant. This means that soybeans could be grown without N and K₂O application at Thunder Bay.

- Grain yields were similar with urea + MOP and NK21.
- Averaged over 2018-2020, the responses to NK21, urea + MOP and rates of N and K₂O were similar to those in 2020.
- *It may be kept in mind that NK21 has the advantage of applying two nutrients from one source.*

Response of Canola (L252) to High Rates of N Application from Different Sources:

- Application of N @ 90, 180, 240 and 360 kg/ha from urea, urea + ESN (2:1 ratio on N basis), urea superU, urea + urea superU (2:1 ratio on N basis) and urea + ESN + urea superU each @ 60 kg N/ha (total 180 kg N/ha) significantly improved the canola seed yield as compared to the check.
- Maximum seed yield (4.63 MT/ha) was obtained with urea @ 270 kg N/ha followed by urea + ESN + urea superU (4.53 MT/ha) @ 180 kg N/ha (60 kg N/ha from each) and urea superU @ 360 kg N/ha (4.28 MT/ha). However, the increase in seed yield beyond 180 kg N/ha (either as urea or as urea + ESN) wasn't significant.
- Averaged over sources of N, seed yield increase beyond 90 kg N/ha was not significant and averaged over rates of N, all sources/or blends of N had equal seed yield. Low response to N and lack of response to different N sources this year is ascribed to dry weather leading to relatively poor yields.
- Straw yield was highest with urea @ 270 kg N/ha (8.93 MT/ha) followed by urea superU @ 360 kg N/ha (8.10 MT/ha).
- Averaged over 2019 and 2020, urea + ESN @ 180 kg N/ha gave as much seed yield as urea @ 270 kg N/ha (4.78 MT/ha). Urea superU @ 360 kg N/ha was a bit better in seed yield (5.05 Mt/ha) than urea @ 270 kg N/ha/or urea + ESN @ 180 kg N/ha. Straw yield was highest (8.72 MT/ha) with urea superU @ 360 kg N/ha.
- But for the heat and moisture stress in June and July, seed yields and response to N could be better!

Effect of Apex, Top Phos, EXCELIS MAXX and Bio-Stimulants on Canola:

- Apex (30 % N - 5 % ammoniacal N and 25 % urea N, 2.9 % Ca, 1.2 % Mg and 8 % S), or Top Phos (8 % N, 30 % P₂O₅, 0 % K₂O and 4.8 % S) applied at equivalent rates of N/or P from other fertilizers (urea, ESN, ammonium sulphate and 0-45-0) didn't give higher canola seed yield than the fertilizers used by our growers.
- Out of the Biostimulants (FA Starter, IRYS, FL Gold and Genea), FA Starter and IRYS seemed to improve the seed yield.
- Treatment of urea with EXCELIS MAXX equaled in yield (4.39 MT/ha) from farmers' practice of applying N from a blend of urea, ESN and ammonium sulphate (4.35 MT/ha), when 48 kg S/ha was applied in both the treatments.
- The experiment was seeded on 1st June and June (and July) had been very hot and extremely dry. Hence the seed yield was relatively low (trial mean of 4.27 MT/ha) and ranged from 3.86 MT/ha (with FL Gold spray @ 3l/ha at first petal falling) to 4.77 MT/ha (with FA Starter spray @ 3 L/ha at 2-3 leaves); seed yield with farmers' practice was 4.35 MT/ha.
- Highest straw yield (7.41 MT/ha) was recorded with Apex.

Evaluation of Gypsum and Ammonium Sulphate as Sources of S for Barley, Canola and Pea production (Gypsum was applied @ 19.5 kg S/ha in the seed row and ammonium sulphate at the same rate of S was broadcast incorporated at seeding in 2019!) – Residual Effect on Wheat:

- Grain yield of wheat was extremely low this year (hot and dry summer and the plot range wasn't all that fertile) – trial mean of < 1 MT/ha.
- Averaged over three years (2018-2020) grain yield of wheat after canola (3.82 MT/ha) was ≥ that after pea (3.52 MT/ha) ≥ that after barley (3.35 MT/ha). Straw yield followed a trend similar to that of grain yield.
- There was no residual effect of gypsum or ammonium sulphate applied to the previous crops on wheat (grain or straw yield).

- Soil analysis in spring 2020 indicated that the nutrients contents (P, K, Ca and Mg) and CEC were somewhat higher after pea than after canola or barley (grown in the previous year). P content was lowest after barley, which means that barley removed more P than canola and pea.

Effect of Nitrogen and Sulphur on Lentils Grain Yield:

- Treatments included all combinations of 3 rates of N (0, 22.5 and 45 kg N/ha) and 4 rates of S (0, 8, 16 and 24 kg S/ha).
- Grain yield was extremely poor due to hot and dry summer (trial mean of 0.78 MT/ha only; compared to 3.48 MT/ha last year).
- Averaged over 2019-2020, grain yield from check plot (no N or S) was 1.81 MT/ha. Application of N or S didn't improve the grain yield over check.

Effect of P and K on Lentils Grain Yield:

- Treatments included all combinations of 3 rates of P₂O₅ and 3 rates of K₂O each @ 0, 20 and 40 kg/ha).
- Grain yield was very poor due to hot and dry summer (trial mean of <1 MT/ha).
- Application of P or K had no significant effect on lentils grain yield. In other words, lentils didn't respond to application of P and K; may be because of low yield (1.40 MT/ha averaged over 2019-2020).
- From the two nutrient management experiments on lentils, it appears that the lentils could be grown without application on N, P, K and S!

2.2.3 Forages:

Galega:

Comparative Performance of Gypsum and Lime for Galega Production:

- Only one cut was taken this year because of poor regrowth after the first cut.
- Application of gypsum at varying rates (1.25-3.75 MT/ha) didn't improve dry matter yield of Galega. Lime @ 2.14 MT/ha brought a marginal increase in dry matter yield of Galega (by 325 kg/ha). However, this yield increase was statistically not significant.
- Unlike last year, the two amendments didn't improve the first cut protein content this year as compared to the check (no lime/or gypsum application).
- Total yield of the two years (2019 and 2020): Gypsum @ 2.5 MT/ha increased Galega yield by ~700 kg/ha and lime @ 2.14 MT/ha resulted in more than 950 kg/ha increase in yield as compared to the check (no lime/or gypsum application).
- Averaged over 2019 and 2020, gypsum @ 2.5 MT/ha increased first cut Galega protein content by 2 % points and lime @ 2.14 MT/ha by 1.3 % points as compared to the check (no lime/or gypsum application).

Maximizing Yield and Quality of Galega:

- Only one cut was taken this year because of poor regrowth after the first cut.
- Maximum dry matter yield of Galega was obtained with the application of 60 kg N + 36 kg S + 2 kg B + 7 kg Zn + 2 kg Mn/ha (1,853 kg/ha; ~750 kg/ha increase over check – no nutrients application). The next best treatments were 45 kg N + 24/or 36 kg S + 1/or 3 kg B + 7 kg Zn + 2 kg Mn/ha (1,625-1,690 kg/ha). These three treatments were also best in two years (2019 and 2020) total yield.
- Protein content and RFV in the first cut was not affected by the nutrients application.
- Averaged over the two years (2019 and 2020), protein content in the first cut was highest (18.6 %; 1.1 % point higher than the check-no nutrient application) with the application of 60 kg N + 36 kg S + 2 kg B + 7 kg Zn + 2 kg Mn/ha.

2.3 Other Agronomic Practices:

Effect of Fungicides on Diseases and Yield in Spring Cereals:

- Stratego (sprayed at tillering), Prosaro (sprayed at anthesis) and Cramba sprayed a week later than Prosaro were used to control foliar fungal diseases and FHB in spring cereals – wheat, barley and oats (total 12 treatments).
- There was hardly any disease incidence because of very hot and dry summer; FHB score in particular was zero. Consequently, none of the fungicides treatments gave higher grain yield than no fungicide spray (4.39 MT/ha; averaged over three cereals). Though Septoria score came down from 3 with no fungicide spray to 2 with Stratego, 1 with Stratego and Prosaro and 0 with Stratego, Prosaro and Cramba.
- The three cereals had statistically similar grain yields; wheat (*AAC Wheatland*) – 4.04 MT/ha, barley (*CDC Bow*) – 4.16 MT/ha and oat (*AC Rigodon*) – 4.33 MT/ha. Barley produced the highest straw yield (4.82 MT/ha). Straw yield in wheat and oat was equal (3.85 MT/ha).

Winter Rye (Cultivar Hazlet) Date of Seeding:

- Winter rye was seeded at 10 days interval from August 25 to October 15.
- Plant height (126 cm), and grain (5.40 MT/ha), straw (6.84 MT/ha) and biomass (12.24 MT/ha) yields were highest with September 15 seeding. Delay in each consecutive seeding from August 25 to September 15 increased the yields and reduced the yields thereafter.
- Seeding on October 15, with only 2.51 MT/ha grain yield, wasn't worth it.
- Averaged over 2018-2020, September 15 seeding produced the highest grain (7.25 MT/ha), straw (7.82 MT/ha) and biomass (15.07 MT/ha) yields. Delay in seeding from September 15 to 25 reduced the grain and straw yields by 1.85 MT/ha (185 kg/ha/day) and 1.59 MT/ha, respectively.

Winter Rye Date and Rate of Seeding:

- Possibility of getting good yield from winter rye by increasing seed rate with delay in seeding was explored.
- Increasing seed rate by 25-50 % with delay in seeding from September 25 to October 25 didn't help arresting the consistent decline in yield with each successive delay in seeding date.
- Grain, straw and biomass yields of winter rye with September 25 seeding were 3.95, 4.82 and 8.77 MT/ha. Corresponding values for October 25 seeding were 1.51, 2.03 and 3.54 MT/ha.

Effect of Winter Rye Cover Cropping on Spring Crops:

- Winter rye as a cover crop was grown in 2019-2020 fall-winter with and without fertilizers and compared with fallow (no cover cropping) for its effect on six spring crops (wheat, barley, canola, soybean, lentils and flax) production.
- Spring crops were seeded on June 6 and were caught in hot and dry weather. The crops didn't reach maturity. Hence only biomass yields were recorded.
- Winter rye with or without fertilizers didn't produce higher biomass yield of the following spring crops than the fallow (no cover cropping). Among crops (averaged over cover crop treatments), canola recorded the highest biomass yield (6.0 MT/ha), followed by barley (4.02 MT/ha). Biomass yields of other crops were: wheat 0.81 MT/ha, soybean 0.92 MT/ha, lentils 1.13 MT/ha and flax 2.80 MT/ha.

Optimizing Seeding Rate in Kernza and Comparing its Grain Production Potential with Perennial Rye:

- *Kernza* was seeded @ 70, 90, 110 and 130 seed/m².
- *Ace 1* (perennial rye) didn't survive to produce any grain yield.
- *Kernza* grain yield was extremely poor this year due to extremely hot and dry summer.
- Highest grain (0.36 MT/ha), straw (10.41 MT/ha) and biomass (10.77 MT/ha) yields were obtained with a seeding rate of 110 seed/m². Same was true for average grain (1.30 MT/ha), straw (12.86 MT/ha) and biomass (14.15 MT/ha) yields over three years (2018-2020).

Alternate Forage Legumes:

- Alfalfa, red clover, Galega, birdfoot trefoil and sainfoin (last one at 4 seeding rates; 20-50 kg/ha) were compared for their forage production potential and feed quality.
- Dry matter yields were in the order of alfalfa (3,444 kg/ha) ≥ red clover (2,939 kg/ha) ≥ birdfoot trefoil (2,385 kg/ha) ≥ Galega (1,854 kg/ha) = sainfoin (> 1,880 kg/ha) @ 30-40 kg seed/ha.

- First cut protein content was > 19 % in birdfoot trefoil, sainfoin and red clover and was close to 19 % in alfalfa. Other treatments had 13.4 % or less protein content.
- RFV was higher in alfalfa (130), birdfoot trefoil (128) and sainfoin (128) than other crops (117-122).

Galega Establishment under Weed Pressure:

- Seeding in the experiment and herbicides spraying was done only in 2018 to work out suitable strategies for weed control in Galega. Only one cut was taken this year, because the crop didn't grow well after the first cut due to hot and dry weather.
- Top dry matter yields of Galega (2,052 kg/ha) were obtained by seeding Galega as early as possible in early spring or after pre plant incorporation of Rival (Trifluralin) @ 3L/ha (2,008 kg/ha).
- Treatments that gave over 20 % protein in Galega were; seeding Galega as early as possible in spring or seeding after killing emerged weeds/or after harvesting barley at boot stage and post emergence spray of Basagram Forte @ 1.75L/ha/or Pursuit @ 210 ml/ha + Ag-Surf @ 0.25% v/v.
- RFV was highest in Galega seeded after harvesting barley (127)/and seeding Galega after pre plant incorporation of Rival (Trifluralin) @ 3L/ha (126).

2.4 Extension and Outreach:

A proactive approach to extension and outreach activities was adopted by LUARS for Dissemination of Technology to the end users (farmers, extension scientists and researchers not only in northwestern Ontario, but also in the other parts of the province, and the country/other countries). The impact of our Extension and Outreach activities could be seen in the form of favourable changes as follows:

- Thunder Bay Co-op brought in 88 MT of CDC Bow barley, some Maverick, a Truck load of Brandon, lots of different corn, 7 MT of Akras soybean, L252, L233P (most popular) and L255PC canola, a bit of alfalfa from General Seeds, a few 4010 peas and barley mix.
- Ryan and Fritz Jaspers seeded 190 acres Brandon wheat (tested at LUARS), 100 acres corn under biodegradable plastic mulch, 210 acres canola (160 acres Liberty 233P and 50 acres Liberty 255PC), 90 acres Synasolis barley under seeded with alfalfa and timothy, and 40 acres soybeans (Akras). Jaspers created a new record by getting 2.4 MT grains and 90 small straw bales/acre from his 90 acre Brandon wheat field grown after canola. Wheat at LUARS was found to give higher yield after canola than after other crops! They had a record 1.7 MT/acre seed yield from a 53 acres canola field. Their overall canola seed yield averaged at ~1.6 MT/acre. Their silage corn (20 MT/acre) and soybean grain (1.23 MT/acre) yields were good too! Jaspers have been applying part of N to their crops as ESN in the seed rows.
- Fred Breukelman seeded 170 acres canola and obtained 1.5 MT seed yield/acre. Fred Breukelman also grew Sorghum Sudangrass, tested at and recommended by LUARS in 40 acres.
- Ed Breukelman seeded 150 acres CDC Bow barley (out of which 50 acres were under seeded with alfalfa and 40 acres were seeded after winter rye that had significant winter kill), 90 acres corn under biodegradable plastic mulch, and 50 acres of Liberty 233P canola. Ed Breukelman got ~2 MT/acre average grain yield from barley and 1.5 MT/acre from canola. Almost all area growers got at least 1.5 MT/acre seed yield from canola this year.
- Bernie Kamphof planted 205 acres of corn, 165 acres of Austenson barley and 60 acres of alfalfa – all for forage/feed.
- Evan Grootenboer applied wood ash in 121 acres and seeded Tabasco Fababeans in 16 acres.
- Mark Veurink seeded 25 acres winter wheat, 150 acres corn, 100 acres AAC Penhold spring wheat, 95 acres canola and 140 acres 2 row barley. Mark Veurink created a new record by getting a very high grain (2.8 MT/acre) and straw (6 large scale bales/acre) yield from winter wheat. His barley and wheat grain yields were ~2 MT/acre and he got 1.5 MT/ha seed yield from canola.
- Gert Brekveld continued trial cultivation of lentils at his farm in ~20 acres for the second year.

- Gerrit Cramer seeded Bono hybrid winter rye (tested at LUARS) first time in 90 acres. He has applied ESN to winter rye in the seed row. He also seeded 300 acres under cover crops (a mixture of turnip, barley and peas) for the first time.
- Allan and Henry Mol seeded canola for the first time this year in 64 acres and recorded 90 MT seed production, which equaled ~1.5 MT/acre seed yield. Mols also seeded winter wheat (variety AAC Gateway recommended by LUARS) in 42 acres for the first time this year.
- Henry and Peter Aalbers seeded winter rye in 25 acres for the first time this year.
- Land clearing and tile drainage on farms continued!
- Farmers continued to use multiple sources of N (urea, ESN and ammonium sulphate) for crop production. Farmers have also started applying ESN in the seed row; a practice recommended by LUARS. Jaspers applied ESN in seed row in over 400 acres for spring wheat, canola, barley, and corn production! Research at LUARS has proved that use of multiple sources of N instead of a single source of N was conducive to high yields.
- Inspired by research at TBARS/LUARS dairy farmers around Calgary continued to expand their acreage under MasterGraze corn. TBARS pioneered in research on MasterGraze corn that produces 8 MT dry matter yield/ha in 80 days. Its feeding to dairy cows improved milk yield by 3l/cow/day and butter fat yield from 3.93 % to 4.40 %.
- Richardson International Limited procured 12,926 tonnes grains/seeds from local producers as at November 25, 2019 at a value of ~3.8 million dollars from Thunder Bay and Rainy River Districts. This is 4,126 tonnes more than that in 2018 and over 7,100 tonnes more than that in 2017 (see also Figure 1). I believe at least one more Grain Elevator procured grains from the area as well (volumes not known). This is in addition to some malting barley procured by the Canada Malting Company from our area.

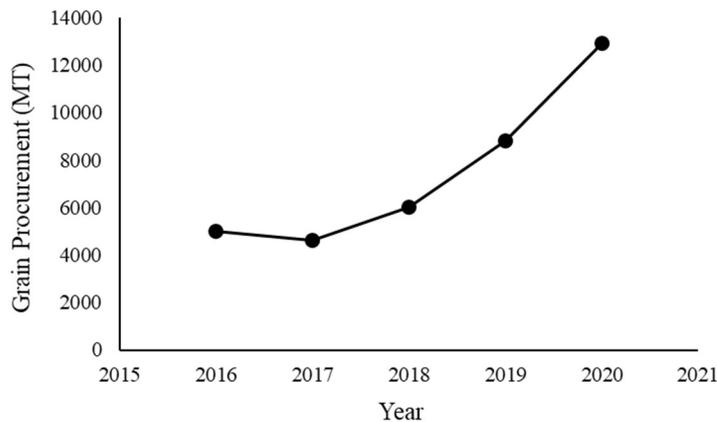


Figure 1: Grain procurement from NWO by Richardson International Limited
Thunder Bay producers are continuing to diversify their cropping systems, renovate, expand/or make additions to their fields and dairy operations! At least one dairy farmer installed a super modern Robot Milk Barn!

T. Sahota

**Dr. Tarlok Singh Sahota CCA
 Director LUARS Thunder Bay**

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