Project Identification

Project Title: Managing Canary seed Through Agronomy

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Producer Group Sponsoring the Project: Northeast Agriculture Research Foundation

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

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Objectives and Rationale:

Project objectives: To demonstrate the key agronomic practices required to grow a high yielding canary seed crop and to demonstrate any potential differences amongst the two market classes of canary seed in response to various agronomic inputs.

Project Rationale: Canary seed is often considered a low input cereal crop. It has a dense shallow root system that grows best on heavy clay or clay loam soils, which is characteristic of the Northeast growing region. As growers look to diversify their crop rotations canary seed has become of increasing interest. For many decades canary seed has been grown and sold into the bird seed market and the varieties grown for this purpose are considered hairy or non-glabrous. In recent years, new varieties have been developed in hopes of a potential human market. These varieties are hairless or glabrous and have been adopted by some canary seed producers in the last few years. Many producers are apprehensive to adopt these glabrous varieties as they are often lower yielding than non-glabrous varieties. As there is

currently no market advantage for growing glabrous varieties, this yield loss comes as a cost to producers.

Previous grain crop research has indicated that different grain crop varieties or market classes often respond differently to various agronomic inputs. This has been demonstrated in many crops such as wheat, barley and oats. Therefore, it can be speculated that bird seed marketed varieties may respond differently to various inputs as compared to human marketed varieties of canary seed. Past research has found that canary seed is responsive to a variety of different crop inputs, despite often being considered a low-input crop. For example, it has not been found to consistently respond to increased fertility, although responses to a moderate supply of nitrogen have been documented in previous research done in Saskatchewan. Canary seed has also demonstrated positive yield responses to additional chloride in the form of KCl. Although this crop does well on clay-based soils, canary seed is a later maturing cereal crop, which makes it less practical to grow in the Northeast due to the shorter growing season. Increased seeding rates are often used in other cereal crops to decrease tillering in hopes of hastening maturity. Thus, increasing the seeding rate of Canary seed may be a useful agronomic input to hasten maturity, especially for shorter growing season areas. The current recommended provincial seeding rate is 30 lbs/ac, however anywhere from 20-40 lbs/ac is considered adequate depending on weed prevalence and seeding conditions. Overall, all three of these factors including: additional nitrogen, increased seeding rate and supplemental chloride were combined in this demonstration to evaluate the effects these various inputs have on the two different market classes of canary seed, grown in NE Saskatchewan.

Methodology and Results

Methodology:

This small plot demonstration was located at SE 31-44-18 W2 in the RM of Star City, near Melfort, SK. The demonstration was set up as a 2X2X2 factorial in a randomized complete block design with 4 replicates. Treatments varied based on the 2 market classes grown at 2 seeding rates, and with or without additional potassium fertilization. The two market classes were represented by a single variety: CDC Calvi for the human consumption market and Cantate for the birdseed market. The two seeding rates reflect the current recommended seeding rate for Saskatchewan at 35 lb/ac and 2.0X the recommended rate at 70 lb/ac. The additional potassium fertilization was completed using 40 lb/ac of potassium chloride (KCl). These factors were combined to generate 8 treatments (Table 1).

Table 1. Treatments used in Managing Canary seed Through Agronomy in Melfort, SK 2020.

Treatment #	Variety	Seeding rate (lb/ac)	Fertility (lb/ac)
1	Human (CDC Calvi)	35	50N
2			50N + 40 KCl
3		70	50N
4			50N + 40 KCl
5	Birdseed (Cantate)	35	50N
6			50N + 40 KCl
7		70	50N
8			50N + 40 KCl

At Melfort plots were 2-meters wide by 7-meters long. Prior to seeding the test site was soil sampled for residual nutrient levels (Table 2). Results of the soil test were used for phosphate and sulphur fertilizer recommendations. Just prior to seeding on May 23, 2020, potassium chloride was broadcast as 0-0-60 at 40 lbs of K/ac. All plots were seeded at a 0.5-inch depth into canola stubble. Seeding was completed using a 6-row Fabro plot seeder on 12-inch row spacing. The seeding rate was as per treatment requirements and was adjusted for germination and thousand kernel weight (TKW) of each variety. CDC Calvi had a germination of 92% and a TKW of 8.8-grams, while Cantate had a 90% germination and an 8.0-gram TKW. Each plot also received nitrogen applied as 46-0-0 that was side-banded at 50 lbs of N/ac. Phosphorus and Sulphur were also supplemented as required for a 1900 lbs/ac yield goal. Phosphorus was applied at 8 lbs of P/ac as 11-52-0 in the side-band, and sulphur was side-band at 5 lbs of S/ac as 21-0-0-24.

Table 2: Residual soil nutrient levels (0-12") found in Managing Canary seed Through Agronomy in Melfort, SK 2020.

Residual Soil Levels			
Nitrogen (lb/ac)	*Phosphorus (ppm)*	*Potassium (ppm)*	*Sulphur (lb/ac)*
54	19	477	48

The trial received crop protection products as required. A pre-emergent application of Heat LQ at 59 mL/ac and Glyphosate 540 at 0.61L/ac in a tank mix was applied on May 24th, 2020. An in-crop herbicide application of Buctril M at 400 mL/ac was applied on June 26th. No fungicide was applied although there was some presence of Septoria Leaf Mottle. No insecticides or desiccants were required. Lastly, all plots were harvested on September 22, 2020 where 5 full crop rows were collected using a plot combine.

To assess treatment differences, data collection consisted of plant density, maturity, and yield. Lodging was also recorded, as differences were noticed between the two varieties. Methodology for this data collection is described below. The single site year of data was analyzed using a three-way Factorial Anova in Statistix 10.

Results

Environmental Conditions:

Average growing season temperature was comparable to the long-term average, whereas total precipitation was 42.5mm less than the long-term average (Table 3). May and June were 0.6°C and 1.6°C cooler than the long-term average whereas July and August were 1.3°C and 0.8°C warmer. The slightly cooler temperatures in May and June coincided with similar to wet conditions, particularly in June where precipitation was much greater than the long-term average. This resulted in good plant emergence shortly after seeding. Warmer temperatures in July followed by slightly lower average precipitation supported good plant development. Reduced precipitation in both August and September, and above average temperatures in August, allowed for early to normal crop maturity, dry down, and great harvesting conditions with minimal delays.

Table 3: Mean temperatures and precipitation collect from the Environment Canada Weather Station at Melfort SK., from May to September 2020.

	May	**June**	**July**	**August**	**September**	**Average/Total**
			--- Mean Temperature (°C) ---			

2020	10.1	14.3	18.8	17.6	10.8	14.3
Long-Term[x]	10.7	15.9	17.5	16.8	10.8	14.3
			--- Total Precipitation (mm) ---			
2020	26.7	103.7	52.4	18.5	21.2	222.5
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

Plant Density:

Plant Density was assessed on June 16th by counting the seedlings along 2 1-meter crop rows per plot. As expected, plant density was only statistically different($p<0.0481$) due to changes in seeding rate (Table 4). When seeding rate increased from 35 lbs/ac to 70 lbs/ac plant density was increased by an average of 78 plants/m^2. This suggests that seedbed conditions and precipitation in June was adequate for emergence, especially when 2.0x of the recommended seeding rate was used. Although, variety did not significantly impact plant density, the density for Cantate was slightly greater than CDC Calvi by an average of 58 PPMS (Table 5). It was also expected that KCl application would not have an effect on plant density, as it was broadcasted prior to seeding, thus reducing the risk of fertilizer injury. The two and three-way interactions did not significantly affect plant density, as well. The small difference in the variety X seeding rate interaction was driven by the random difference between varieties. Overall, increasing the seeding rate increased plant density as anticipated. This should in turn decrease the number of tillers and help to hasten maturity.

Table 4: Statistical summary for Managing Canary seed Through Agronomy in Melfort, SK 2020.

	Plant Density (plants/m^2)[z]	**Lodging[z]**	**Yield (lbs/ac)[z]**
Variety (V)	0.2290	<0.0001***	0.8473
Seeding Rate (SR)	0.0481*	0.2342	0.2481
Fertility (F)	0.8974	0.2342	0.2471
V*SR	0.5283	0.2342	0.9588
V*F	0.8905	0.2342	0.7800
SR*F	0.9008	0.0232*	0.3146
V*SR*F	0.6616	1.0	0.9236
Grand Mean	393.6	2.5	1712.6
CV	32.8	57.74	19.65

[z] *** p<0.0001; ** p<0.01; * p<0.05; NS – Not significant

Table 5: Treatment means for Managing Canary seed Through Agronomy in Melfort, SK 2020.

	Plant Density (Plants/m^2)	Maturity (Julian Date)	Lodging (0-10)	Yield (lbs/ac)
Variety (V)				
CDC Calvi (Glaborous)	364.6a	254a	0.6a	1701.0a
Cantate (non-Glaborous)	422.8a	254a	4.4b	1724.2a
Seeding Rate (SR)				
35 lbs/ac	344.4b	254a	2.2a	1642.0a
70 lbs/ac	422.8a	254a	2.8a	1783.3a
Fertility (F)				
50 lbs/ac of N	396.7a	254a	2.2a	1641.0a
50 lbs/ac of N + 40 lbs/ac of KCl	390.6a	254a	2.8a	1784.3a
*V*SR*				
CDC Calvi 35 lbs/ac	330.4b	254a	0.6b	1633.5a
CDC Calvi 70 lbs/ac	398.8ab	254a	0.6b	1768.6a
Cantate 35 lbs/ac	358.4ab	254a	3.8a	1650.5a
Cantate 70 lbs/ac	486.8a	254a	5.0a	1798.0a
*V*F*				
CDC Calvi 50N	370.9a	254a	0.6b	1612.6a
CDC Calvi 50N + 40KCl	358.3a	254a	0.6b	1789.5a
Cantate 50N	422.4a	254a	3.8a	1669.4a
Cantate 50N + 40KCl	422.8a	254a	5.0a	1779.1a
*SR*F*				
35 lbs/ac & 50N	350.4a	254a	1.3b	1509.0a
35 lbs/ac & 50N + 40KCl	338.4a	254a	3.1a	1774.9a
70 lbs/ac & 50N	442.9a	254a	3.1a	1772.9a
70 lbs/ac & 50N+40KCl	442.7a	254a	2.5ab	1793.7a
*V*SR*F*				
CDC Calvi; 35 lbs/ac; 50N	329.3a	254a	0.0c	1489.5a
CDC Calvi; 35 lbs/ac; 50N+40KCl	331.6a	254a	1.3bc	1777.5a
CDC Calvi; 70 lbs/ac; 50N	412.6a	254a	1.3bc	1735.6a
CDC Calvi; 70 lbs/ac; 50N+40KCl	385.1a	254a	0.0c	1801.6a
Cantate; 35 lbs/ac; 50N	371.6a	254a	2.5b	1528.6a
Cantate; 35 lbs/ac; 50N+40KCl	345.3a	254a	5.0a	1772.4a
Cantate; 70 lbs/ac; 50N	473.3a	254a	5.0a	1810.2a
Cantate; 70 lbs/ac; 50N+40KCl	500.3a	254a	5.0a	1785.8a

Maturity:

Maturity was first assessed on September 10th. All plots were determined to have reached maturity (Zadoks 87) on Julian Date 254 or September 10th. No differences were noted amongst the

different treatments and thus no statistical analysis could be completed. This does suggest that despite increasing the seeding rate to 70 lb/ac, the increasing seeding rate reduced the number of tillers, and had a positive effect on hastening maturity. However, the reduction in tillering to hasten maturity in a short growing season, did not appear to be an effective management strategy further than the recommended seeding rate.

Lodging:

Lodging was a measured variable that was not planned to be evaluated in this demonstration, however noticeable differences were observed and thus lodging was rated. A 0-10 scale was used for rating lodging where 0 was equivalent to no lodging and 10 was equivalent to the whole plot laying flat. Lodging was rated on September 10th and was found to be significant between varieties ($p<0.0001$) and when seeding rate and fertility were combined (Table 4). When comparing varieties, Cantate had a much higher incidence of lodging than CDC Calvi. It is important to note that only two plots of CDC Calvi were documented as having lodging and lodging on Cantate ranged from 0 to 5. The interactions between variety and fertility were significant as well ($p<0.0232$). When the recommended seeding rate was used and 40 lbs/ac KCl was applied, lodging increased. This was some what unexpected. Additional fertilizer application is known to increase tillering; However, KCl was expected to decrease lodging as potassium is an important nutrient for supporting stem strength. Overall, varietal differences were the largest factor to impact lodging in 2020. However, at lower seeding rates additional applications of fertilizer can increase the rate of lodging.

Yield:

Yield was determined on October 22nd by cleaning and weighing all harvested plot samples and converting to lbs/ac equivalents, while correcting for a consistent moisture. Yield was not significant amongst the different treatments (Table 4). Generally, yields were slightly greater for Cantate, higher seeding rates, and KCl application. As expected, Cantate had slightly greater yields than CDC Calvi. Under recommended seeding rates, the addition of 40 lb/ac of KCl resulted in slightly increased yields. The slight yield increase was not found when 2.0x the recommended seeding rate was used. This suggests that the increased plant densities in this treatment offset any yield advantages that the fertilizer could provide. When all treatment factors were combined adding 40 lbs/ac of KCl resulted in average yield gains for both varieties, regardless of seeding rate (Table 5). Additionally, regardless of variety yield was generally greater at the higher seeding rate of 70 lbs/ac and when 40 lbs/ac of KCl was applied. Overall, yields were more responsive to additional fertilizer at lower seeding rates, while increasing seeding rates only resulted in slight yield increases. Furthermore, it does not appear that the yields of either market class are affected by one or more crop inputs than the other.

Conclusions and Recommendations

Although some significance was found when comparing the different agronomic inputs used on two different market classes of canary seed, the two varieties used responded similarly overall. Plant density was significantly impacted by seeding rate, with greater densities at a 2.0X seeding rate. While, average plant densities were lower for CDC Calvi as compared to Cantate the only significant factor that affected plant density was seeding rate. Although, it was hypothesized that increasing seeding rate would hasten maturity, the maturity of the two seeding rates were found to be similar. Yield was not found to be significantly different amongst all treatments. However, it does appear that when 35 lb/ac

of seed is used, the crop may be more responsive to additional fertilizer than when the seeding rates is 70 lbs/ac. Overall, both market classes can be positively impacted by higher seeding rates and fertility, although it may not always be a significant response. Furthermore, it appears that these two market classes can be managed agronomically similar.

Supporting Information

Acknowledgements

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Abstract

Abstract/Summary

Canary seed is an alternative cereal crop that can be used to diversify crop rotations. Canary seed has two different market classes for either bird seed or human consumption, however only the birdseed market primarily exists. Traditional varieties of canary seed were developed to be hairy or non-glabrous and were developed to enter the bird seed market. However, newer varieties have been developed that are defined as hairless or glabrous, and are intended to be grown for the human market. These newer glabrous varieties are known to be lower yielding than the non-glabrous varieties, and can be less desirable for producers to grow. Different market classes of canary seed may also respond differently to different agronomic inputs, and thus more intensive management of glabrous varieties may allow for greater yields to be achieved that are more similar to non-glabrous varieties. To demonstrate the effects of various agronomic inputs on the two different market classes of canary seed a small plot demonstration was set-up to evaluate the effects of variety, seeding rate and KCl application on plant density, maturity, lodging and yield of canary seed. Plant densities significantly increased when seeding rate was increased. Lodging was also significantly higher in the non-glabrous variety than the glabrous. Maturity was comparable amongst all treatments, despite higher seeding rates utilized to hasten maturity. Yield was not significant amongst all treatments, although there was a trend for KCl application to increase yields at recommended seeding rates as compared to higher seeding rates. Overall, both market classes may benefit from intensive management, although it may not always result in significant yield increases. Furthermore, this demonstration illustrates that glabrous and non-glabrous varieties can be managed agronomically similar.

Finances

Budget Report

See attached excel spreadsheet