

**Increase the Oat Acres in Alberta by Finding a High Yielding Oat Variety that maximizes
Producer Income and Meets the Demands of the Millers.
“Year Three 2018”**

Summary

This study is a continuous effort to collect data on 11 milling variety oats and 4 feed oat varieties in Central and Northern Alberta. The goal was to determine how variety and growing location will influence the yield and functional property attributes linked to beta-glucan levels of the oats. There was noticeable varietal differences between the two location for the yields as well as beta-glucan content. 2018 was third year for collecting the data for the trial. In 2018 the average yield were higher for peace location compared to Westlock location, but the beta glucan content and test weight were higher for the Westlock site.

Background

Oat production in Alberta has been on a relatively steady decline since 2011. Oats has earned the status of major Canadian export crop from a domestic crop status. According to Prairie Oat Grower's Association (POGA), an estimate of 3.1 million acres of oat were seeded in year 2015-16 but there is a decline in Alberta due to lack of markets and non-competitive pricing with other crops. Many major millers will not accept oats from Alberta, or look to Alberta only after Manitoba and Saskatchewan's supply is gone, because the main two oat varieties grown in Alberta, Morgan and Derby contain low amounts of Beta Glucan (β -glucan). A minimum of 4% β -glucan is required for companies to be able to label their products with the Heart Healthy Claim and both Morgan and Derby are consistently below that amount. Therefore, oat producers in Alberta need an oat variety that can consistently beat the yields of Morgan and Derby but has the higher β -glucan amounts that the oat miller desire. To emphasize this fact, since 2015 two millers are helping to fund this variety trial to get it started before outside funding can be located to make oats in Alberta more competitive.

Oats are a valuable part of crop rotation and are therefore beneficial to producers. They provide disease and insect breaks for wheat, barley, and canola. Their rapid establishment and growth provide excellent weed suppression. Oats also work well as a “catch crop” for taking up and storing excess nitrogen, and the straw provides a nutrient source for the following year's crop. The straw also protects against soil erosion and contributes to an increase in the soils organic matter content (Campbell et al., 1991). A well-planned management and appropriate selection of variety makes oats a profitable crop due to their low input requirements and favorable effects on succeeding crops in a rotation.

Test weight is the most commonly used indicator of grain quality. High test-weight varieties should be chosen by growers who intend to market oat grain. However, the functional attribute such as β -glucan solubility and viscosity are main criteria for the processing industry. Many studies have shown that oat β -glucan can lower blood cholesterol levels, glucose and insulin response and therefore decrease the risk of cardiovascular diseases and prevention of diabetes (Wang and Ellis, 2014).

Oats are regularly affected by crown rust in other parts of Western Canada, but this issue is moving west, towards Alberta. Neither Morgan nor Derby varieties have crown rust resistance but selecting new disease resistant varieties can overcome the problem. The information for producer to choose the newer and higher yielding varieties specific to their region is therefore very important step to stay

profitable in the oat production. The β -glucan content in oat may varies with change in growing conditions (Perez Herrera et al., 2016). The current trial will provide the valuable agronomic information for the producers in Alberta to grow oat varieties with higher yield and increased functional properties (β -glucan) attribute.

Objective

To investigate the impact of genotype and growing condition on the yield and β -glucan content of milling oat varieties in Alberta.

Methodology

Eleven milling oat varieties and four forage oat varieties were tested in 2016 (Table 1). Based on the soil fertility recommendations, fertilizers were added to maintain the optimal levels growing condition. Seeding rates were calculated based on 1000 kernel weight of each variety with a Seed Counter, desired plant density and germination percentage. A 9-inch spaced 6 row Fabro small plot seeder was used for the seeding. Each plot of a variety occupied 10.96 sq. m. (1.37 m width and 8 m long) and there were three replications. The trial site was maintained weed-free with use of herbicides or hand weeding method (Table 1). The trial was harvested with a Wintersteiger Nursery Mate Elite combine (5 foot header) and grain yield from each plot were measured using Electronic Scales at the site. A clean composite sample (500 g) was collected and sent to laboratory analysis for the β -glucan estimation. The growing season of 2018 was little drier compared to 2016 and 2017.

Table 1: Agronomic details for the POGA Trail 2018

Location:	Peace region	Westlock
Seeding Date:	May 24th, 2018	May 18th, 2018
Harvest Date:	Sept 25th, 2018	Sept 27th, 2018
Soil Temp:	16.9 Celsius	10.4 Celsius
Soil Moisture:	adequate	Very good
Seeding Depth:	1.5 inch	¾ inch
Fertility total Nutrients Lbs/acre	107N-30P2O5-25K2O-25S	107N- 25P2O5- 84K2O- 8S
Herbicides applied to trial	Pre-burn Transorb 0.5L/Ac and Express pro 7 gm/Ac on May 22	Pre-burn Roundup 1L/Ac on May 17
Herbicides applied to trial	In crop Broad leaf: stellar A (400 ml/ Acre) + stellar B (240 ml/ Acre) on 21 June	In crop Broad leaf: Curtail M (600 ml/ Acre) on 7 June and Buctril M (400 ml/ Acre) on 19 June
Fungicides applied to trial	none	none
Rainfall (mm)	311	247.5
Comment:	Snow fall in September first week	Snow fall in September first week

Results and Discussion

At Westlock site, there was no statistical difference between the yields obtained for 11 milling varieties, except OT 3087 had higher yield compared to CDC Ruffian. The CDC Arborg and Triactor had higher yield than AC Morgan at Westlock.

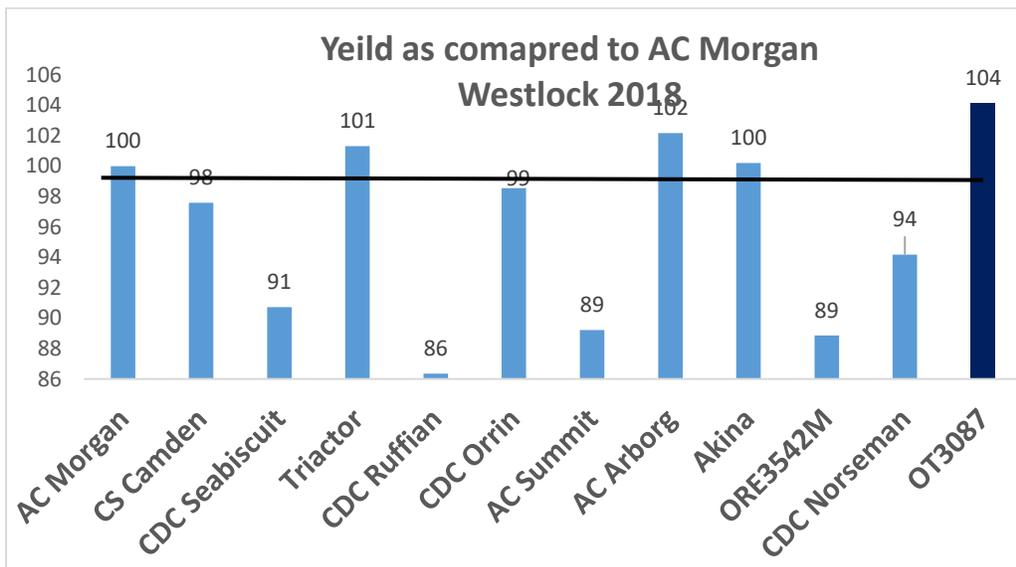
Test weight is an important indicator of grain milling quality. OT3087 and AC Morgan were among top two for test weight at Westlock.

Table.2: POGA OAT trial 2018 (Westlock Region Site: Yield Data)

Variety	HEIGHT		Yield		Yield		Test weight		1000 Kernel
	cm		t/ha		Bu/ac		Kg/Hl		Weight (g)
AC Morgan	107	ab	7.12	ab	199	ab	53	a	46.6
CS Camden	105	ab	6.94	ab	195	ab	52	ab	46.3
CDC Seabiscuit	106	ab	6.52	ab	181	ab	49	b	47.0
Triactor	102	ab	7.20	ab	202	ab	49	b	46.0
CDC Ruffian	95	b	6.16	b	172	b	52	ab	44.3
CDC Orrin	105	ab	7.05	ab	196	ab	50	ab	43.4
AC Summit	93	b	6.41	ab	178	ab	51	ab	44.1
CDC Arborg	111	a	7.26	ab	204	ab	52	ab	45.8
Akina	100	ab	7.10	ab	200	ab	49	b	45.9
ORE3542M	99	ab	6.35	ab	177	ab	50	ab	44.6
CDC Norseman	113	a	6.69	ab	188	ab	49	b	44.4
OT3087	111	a	7.42	a	208	a	53	a	45.8
Standard Deviation	6.3		0.509		14.2		1.0		2.7
CV	6.0		7.4		7.4		2.0		6.0

*Varieties that share a letter did not differ significantly from one another ($p>0.05$).

*Yields reported are on a 32 lb/bushel basis with moisture adjustments at 14%.



At Peace region, in previous two years, CDC Ruffian was higher milling oat type than most of the other varieties. However, this year Morgan has out yield CDC ruffian and most other oat varieties. Although Triactor was highest yielding oat variety at peace region for 2018. See the table for the detailed results for 2018.

Table.3: POGA OAT trial 2018 (Peace Region Site: Yield Data)

Variety	HEIGHT		Yield		Yield		Test weight	1000 Kernel
	cm		t/ha		bu/ac		Kg/Hl	Weight (g)
AC Morgan	113	a	9.05	a	252	a	49 a	34.3
Akina	103	c	8.69	ab	242	ab	47 b	33.0
CDC Arborg	112	a	8.49	ab	237	ab	49 a	34.6
CS Camden	106	bc	7.79	b	217	b	47 b	31.0
CDC Norseman	112	a	8.54	ab	238	ab	47 bc	32.2
ORE3542M	103	c	8.09	ab	225	ab	48 b	34.7
OT3087	112	a	8.71	ab	243	ab	49 a	33.4
CDC Orrin	110	ab	8.59	ab	239	ab	50 a	34.5
CDC Ruffian	106	bc	8.65	ab	241	ab	47 b	34.7
CDC Seabiscuit	114	a	8.68	ab	242	ab	45 bc	30.7
AC Summit	97	d	8.20	ab	228	ab	49 a	32.6
Triactor	112	a	9.20	a	256	a	46 c	31.8
Standard Deviation	2.9		0.476		13.3		0.6	3.0
CV	2.7		5.6		5.6		1.2	9.0

*Varieties that share a letter did not differ significantly from one another ($p>0.05$).

*Yields reported are on a 32 lb/bushel basis with moisture adjustments at 14%.

Oat grain dehulling and beta glucan estimation.

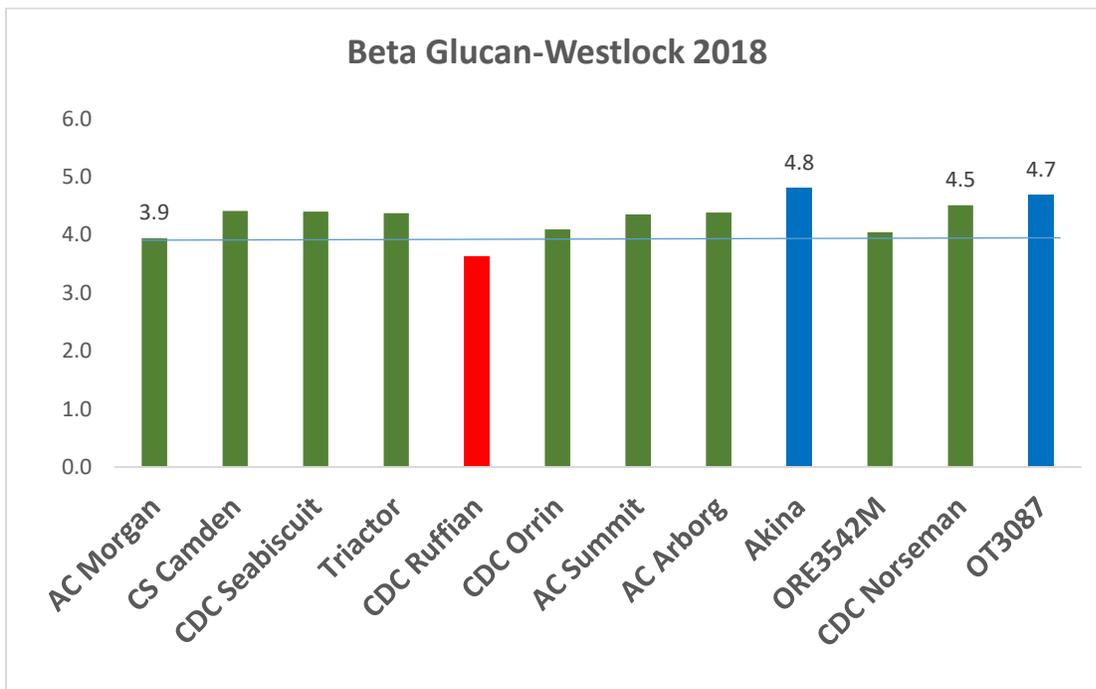
The oat seeds were dehulled with an impact huller (Warner Control Techniques), aspirated to remove most of hulls, and further hand-picked to obtain hull-free groat samples. Heat treatment was applied to dehulled oat groats to inactivate the native enzymes. Oat groats (100 g) were steamed in a kitchen vegetable steamer with a lid by placing the groats on the metal shelf (layered with a cheese cloth) over boiling water for 20 min. After steaming, the samples were dried in a forced air oven at 78 °C for 1h, 63 °C for 30 min and 50 °C for overnight. The oat groats were then ground using the Retsch ZM 200 sample mill (Retsch GmbH, Rheinische Straße 36, 42781 Haan, Germany) equipped with a 0.5 mm screen into flours. Beta-glucan content was determined using the mixed-linkage beta-glucan assay kit (Megazyme International Ireland Ltd., Wicklow, Ireland). All the determination was done in duplicate and beta-glucan content was reported on dry matter basis.

Beta Glucan results: The beta-glucan content of the 11 different milling varieties ranged between 2.74% and 4.8%, with the lowest reported for Ruffian at both sites.

At Westlock, Except CDC Ruffian, most oat varieties had higher beta glucan level as compared to AC Morgan. Akina, OT3087 and CDC Norseman had more than 4.5% of beta glucan level.

Table 4: The beta-glucan analysis results from the POGA trial Westlock 2018.

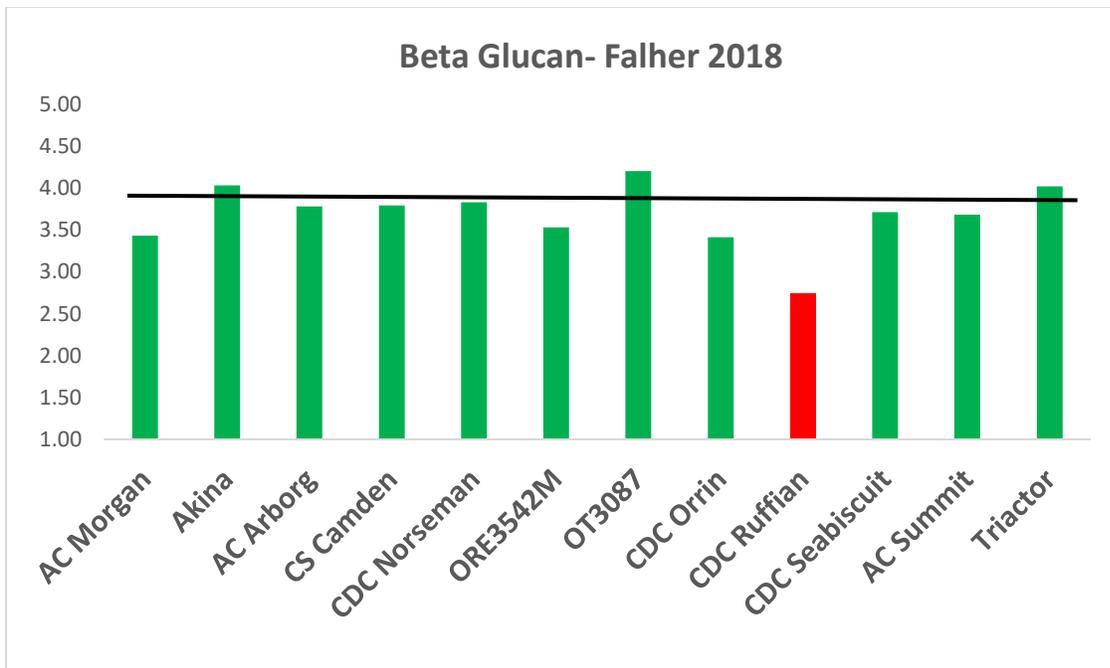
Variety	Hull percentage	Flour Moisture	Beta Glucan	Beta glucan increase compared to AC Morgan
	(%)	(%)	(%, db)	%
AC Morgan	18.0	4.9	3.9	0
CS Camden	22.8	4.9	4.4	12
CDC Seabiscuit	19.6	5.1	4.4	12
Triactor	22.9	5.2	4.4	11
CDC Ruffian	18.2	5.1	3.6	-8
CDC Orrin	28.5	4.6	4.1	4
AC Summit	20.4	5.0	4.4	10
CDC Arborg	22.9	4.9	4.4	11
Akina	28.3	4.9	4.8	22
ORE3542M	22.7	4.9	4.0	3
CDC Norseman	17.6	5.0	4.5	14
OT3087	26.7	4.5	4.7	19



Akina, Triactor and OT3087 were only varieties to cross the grain millers preferred level of 4% beta glucan at Peace region. CDC ruffian had consistently the lowest beta glucan levels for both the sites similar to the previous two year's results.

Table 5: The beta-glucan analysis results from the POGA trial Peace region 2018.

Variety	Hull percentage (%)	Flour Moisture (%)	Beta Glucan (% db)	Beta glucan increase compared to AC Morgan %
AC Morgan	21.83	4.23	3.43	0
Akina	26.96	3.70	4.03	17
CDC Arborg	23.91	4.07	3.78	10
CS Camden	26.72	4.12	3.79	10
CDC Norseman	17.60	3.64	3.83	12
ORE3542M	12.09	3.98	3.53	3
OT3087	23.55	4.11	4.20	22
CDC Orrin	21.03	4.21	3.41	-1
CDC Ruffian	15.38	3.97	2.74	-20
CDC Seabiscuit	23.41	3.91	3.71	8
AC Summit	19.74	3.44	3.68	7
Triactor	24.91	3.77	4.02	17



Conclusion

The yield results from two years suggests that there is potential for the varieties to out compete Morgan. From previous two years results, we had observed a visible difference of location on yields and that yields output changes among the varieties at that location too. Ruffian was continuously highest yielding variety at Peace region from last two year and Westlock in 2017 too. However, the Ruffian has lowest levels of beta-glucan at both location in year 2016 as well as 2017. Based on year 2016 data, Seabiscuit performed very well at both locations in 2016 with staying in top 3 varieties for yield and average above 4.5% of beta-glucan content. However, in 2017, Ruffian was the top yielding variety at both locations and Seabiscuit had issues with lodging at Westlock site. So it is harder to choose one variety out these two who had shown potential to give strong competition to most popular and with highest acres variety of Alberta, Morgan.

Year 2018 was little bit different for the trial as we added few newer entries. OT3087 had shown to be great milling oat with high yield and high beta glucan and high test weight, which are preferred characteristic for the grain millers.

That being said, as environment and disease conditions can fluctuate greatly from year to year, so it is important to consider yields averaged over multiple years. We hope with more data available, we would able to speculate for best suited varieties compared to Morgan for the specific regions of Alberta. Acc. to Andersson and Börjesdotter (2011), the effect of environment was much greater on molecular weight (71%) than on β -glucan content (42%), while the effect of variety was greater on β -glucan content (23%) than on molecular weight (4%).

The present study clearly suggests that in order to supply oat flour with consistent composition and physicochemical properties, there needs to be an oat grain “binning and blending” strategy established based on β -glucan content, aqueous solubility, and viscosity. Furthermore, contract grain production outside the blending approach is also recommended for those products specifically targeted to meet the requirements for including a health claim on the package regarding the risk reduction for cardiovascular diseases.

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