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4. **Abstract/ Summary**:
Wheat is a staple in many Canadian prairie crop rotations, yet as years pass net profitability of this crop has declined, despite significant breeding improvements in yield. Unfortunately, new or updated agronomic research in wheat has been minimal. Yet, if management practices are tailored to individual market classes and varieties it may be the key to enhancing the profitability of this crop. This project was designed to incorporate components of intensive wheat management in order to enhance wheat profitability. The first objective was to identify how wheat market classes and varieties are affected by enhanced management. The second objective was to identify how genetic characteristics of wheat interact with the varying soil and climate conditions across Saskatchewan. Small plot research projects were conducted at Indian Head, Melfort, Scott, Swift Current, and Yorkton, SK from 2017 to 2019. Six wheat varieties from three market classes were selected based on genetic differences in Fusarium Head Blight resistance, lodging resistance, maturity, yield, and protein content. Each variety was grown under three progressively intensified management levels. Results indicate that CWRS varieties tended to be more responsive to Intensive management, on the count of a larger response to seed treatment, than CPSR or CSWSW varieties. Enhanced management often led to hastened maturity across all varieties, while varietal selection is also important in order to prevent delayed maturity with Conventional and Intensive management. Intensive management resulted in maximum yield for CWRS and CPSR varieties, while CWSWS were less responsive to this management level. Conversely, CWRS and CPSR varieties were less responsive to management level, while CWSWS benefited the most from Intensive management for building protein. Test weight and seed size differences were largely attributed to genetic differences and any responses to management were of little practical agronomic importance. FDK values were largely reflective of genetic differences, with Enhanced management providing increased control. In the end, CWRS varieties tended to be more profitable than CWSWS and CPSR varieties, with Conventional management providing the best net returns. Overall, CWRS varieties tend to be more responsive to changes in management intensity. Although intensive management resulted in the largest yields, Enhanced management hastened maturity and reduced FDK more consistently. However, Enhanced management did not always out perform Conventional economically. Therefore, the results of this experiment indicate that Conventional management of wheat in Saskatchewan continues to provide the best return on investment. Although under some circumstances, Enhanced management can be beneficial and profitable.

5. **Extension Messages:**

a) Enhanced the understanding of yield and quality responses by wheats of differing market classes to varying levels of management
b) Developed new knowledge about the relative importance of N fertility and genetic characteristics on wheat protein content
c) Developed new knowledge about genetic resistance to lodging and the interaction with plant growth regulators to minimize yield losses
d) Improved the understanding of the contribution of genetic disease resistance and fungicide application, alone and in combination, to enhance wheat yield and quality.

6. **Introduction:**

Wheat acreage in Saskatchewan has declined from over 16 million acres in 1995 to an average of 12 million acres or less in 2019 (Statistics Canada 2019); Yet wheat continues to remain a staple in crop rotations. Recently, this crop has become less financially lucrative to grow in Canada. This leads producers to question, how competitors in other wheat growing regions, continue to grow this crop profitability.

Plant breeding has made significant progress in improving wheat yields (Thomas and Graf 2014). Breeders have also been able to meet new market requirements by modifying end use quality traits in order to develop several new varieties. Unfortunately, agronomic research of wheat has been minimal, and producers lack new information as to how these new varieties and market classes are best managed (Pourazari et al. 2015; Munger et al. 2014). Tailoring management practices to individual market classes and varieties, may be the key to enhancing the profitability of growing wheat. At present, all spring wheat varieties are managed similarly, despite differences in a variety's agronomic traits such as disease, lodging resistance, etc. By not tailoring management practices to these deficiencies, the producer's ability to take full advantage of a variety's yield and quality is potentially limited. For example, protein premiums are paid in some wheat classes; while in other wheat classes protein is less influential on the crops value. For high protein levels to be achieved, the supply of nitrogen fertilizer needs to exceed the amount required to optimize yield. However, high rates of nitrogen fertilizer can promote negative responses, such as increased lodging. Therefore, it could be beneficial to use a variety with genetic resistance to lodging, or use alternative practices such as growth regulators. Thereby allowing for a producer to compensate for the variety's deficiency in order to enhance profitability through higher yields and/or improved quality.

The challenge for wheat producers is that there is an array of crop inputs to choose from in the marketplace. This makes it difficult to decide which combination of inputs will optimize both yield and quality, while minimizing costs. Furthermore, by leveraging a variety's genetic potential, and applying inputs only where needed in the quantities required, the over-use of inputs is avoided; Thus, reducing the impact on the environment. Input studies in other crops, such as canola, barley, and field pea, has revealed the role multiple inputs play in supporting yield optimization. However, these studies reveal alternative input use is most crucial when specific problems exist. In wheat, this type of input research has not been extensively conducted, although Strydhorst et al. 2016 has done some work in this context.

Previous research at several Agri-ARM sites has confirmed fungicide application between 75% head emergence and 50% bloom, is optimal for the control of fusarium head blight (FHB) in spring wheat (Holzapfel 2014). Although yield losses are protected, these studies found seed quality is rarely improved. Other research at Agri-ARM sites indicate that the most effective strategy for obtaining higher protein levels, is to select a variety with high protein levels genetically. However, this genetic advantage is commonly associated with a yield penalty (Weber and Issah 2015). Further research at these sites indicate that increased seeding rates can help to improve crop uniformity, which in turn helps to enhance fungicide efficacy, as there is a shorter window for disease infection to occur. Further yet, other research indicates that wheat responds well to increased fertility, but the risk of lodging is also increased (Pratchler and Brandt 2015). The risk and severity of lodging can be minimized with the use of crop protection products such as plant growth regulators (PGR). Despite several different positive outcomes of these research projects, there is a downfall. The negative outcome of these research projects is that only one or two agronomic factors/inputs were being manipulated, while others remained constant. Although this research is a good indication of expected individual outcomes, producers are faced with manipulating more than one or two inputs in any given year. How multiple input factors influence each other, as an entire management package, is relatively unknown.

Varietal selection and effective agronomic management, is crucial for improving the economic performance of wheat in crop rotations on the prairies. In order to maximize yield and quality, it requires an understanding of how genetic differences, between varieties and classes, interact with various management practices and the environment. This research project will provide producers with the knowledge to choose the most appropriate combination of genetic traits and management practices in order to maximize the yield, quality, and economic returns of wheat production in Saskatchewan.

7. Objectives and the progress towards meeting each objective.

Objectives	Progress
a) To enhance wheat profitability by incorporating some or all components of intensive wheat management.	Completed
b) To identify how wheat classes and varieties are affected by enhanced wheat management.	Completed
c) To identify how interactions of wheat genetic characteristics respond to varying soil and climate conditions across Saskatchewan.	Completed

8. Methodology:

This small plot research study was conducted at Indian Head, Melfort, Scott, Swift Current, and Yorkton, SK in 2017, 2018, and 2019. Each of these five locations are Agri-ARM sites, which represent the differing soil and climatic conditions found in Saskatchewan. The study consisted of six wheat varieties from three wheat classes: Canada Western Red Spring (CWRS), Canada Western Soft White Spring (CWSWS), and Canada Prairie Spring Red (CPSR). The varieties from these classes differ in Fusarium Head Blight (FHB) resistance, lodging resistance, maturity, yield, and protein content (Table 1). Each variety was grown under three progressively intensified management levels (Table 2). Together, the six varieties and three management levels were combined to develop a 6 by 3 factorial study with a total of 18 treatments (Table 3).

Table 1: Variety attributes for the Input Study: Intensive Wheat Management at five locations from 2017 to 2019. Source: Saskatchewan Varieties of Grain Crops Guide 2019.

Variety	Class	FHB Resistance	Lodging Resistance	Maturity (days to) [a]	Yield (%) [a]		Protein (%) [a]
					Area 1 & 2	Area 3 & 4	
Carberry	CWRS	Moderately Resistant	Very Good	99	100	100	14.6
AAC Cameron VB	CWRS	Intermediate Resistance	Fair	-2	108	118	-0.6
CDC Utmost VB	CWRS	Moderately Susceptible	Fair	-3	108	112	-0.4
AC Andrew	CWSWS	Intermediate Resistance	Very Good	+2	130	137	NA
SY Rowyn	CPSR	Moderately Resistant	Fair	0	101	106	-0.9
AAC Ryley	CPSR	Moderately Susceptible	Poor	-1	103	110	-1.2

[a] Relative to Carberry

Table 2: Management level descriptions for the Input Study: Intensive Wheat Management at five locations from 2017 to 2019.

Management Level	Seed Treatment	Seeding Rate (seeds/m^2)	Nitrogen Rate (lb N/ac)	Phosphorus Rate (lb P_2O_5/ac)	Fungicide at Flag Leaf	Fungicide at Anthesis	PGR Application
Conventional	No	200	75	25	No	No	No
Enhanced	No	300	98	33	No	Yes	No
Intensive	Yes	360	120	40	Yes	Yes	Yes

Table 3: Six varieties by three management levels for a total 18-treatments in the Input Study: Intensive Wheat Management at five locations from 2017 to 2019.

Treatment #	Variety	Management
1	Carberry	Conventional
2	AAC Cameron VB	
3	CDC Utmost VB	
4	AC Andrew	
5	SY Rowyn	
6	AAC Ryley	
7	Carberry	Enhanced
8	AAC Cameron VB	
9	CDC Utmost VB	
10	AC Andrew	
11	SY Rowyn	
12	AAC Ryley	
13	Carberry	Intensive
14	AAC Cameron VB	
15	CDC Utmost VB	
16	AC Andrew	
17	SY Rowyn	
18	AAC Ryley	

The Indian Head site was located in the Thin Black soil zone, with high organic matter, and was slightly alkaline. Melfort was situated in the Thick Black soil zone with a slightly acidic, very high organic matter soil. The Scott site was the only site located in the Dark Brown soil zone, which was medium to high in organic matter, and slightly acidic. Swift Current was located in the Brown soil zone with low organic matter soil, which was slightly acidic in 2017 & 2019 and slightly alkaline in 2018. The Yorkton site was located in the Thin Black soil zone with high to very high organic matter and was slightly alkaline.

Prior to seeding each trial area, the location was soil sampled to determine residual soil nutrient levels. Residual soil nitrogen levels were very low at Melfort and Scott all three years (Table 4). Indian Head and Yorkton had very low to low residual nitrogen. Swift Current had low residual N in 2018 and very high in 2018 and 2019. Residual soil phosphate was very low to low in Indian Head, low to high in Melfort, high to very high in Scott, very low to high in Swift Current, and medium to very high in Yorkton. Residual potassium levels were very high in all 15 site-years. Residual S was low to medium at all site-years, except Scott 2017 and Yorkton 2019 where levels were high.

Table 4: Residual soil nutrient levels and soil attributes at 0 - 24" depth for N and S, and 0 – 6" depth for all other nutrients and attributes at the five locations from 2017 to 2019.

Location	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH
			2017			
Indian Head (INDH)	21	3	545	34	5.1	7.8
Melfort (MLFT)	29	9	606	58	9.3	5.9
Scott (SCTT)	35	21	458	194	5.1	6.7
Swift Current (SWFT)	60	7	327	52	2.6	6.3
Yorkton (YKTN)	39	8	190	98	4.8	7.8
			2018			
Indian Head (INDH)	24	7	613	74	4.8	7.8
Melfort (MLFT)	20	7	364	54	8.5	6.2
Scott (SCTT)	17	13	220	78	3.4	5.6
Swift Current (SWFT)	177	2	273	54	2.8	7.7
Yorkton (YKTN)	25	11	275	74	5.7	7.3
			2019			
Indian Head (INDH)	43	4	547	34	5.6	7.7
Melfort (MLFT)	19	15	500	68	9.4	5.9
Scott (SCTT)	32	13	242	98	3.9	5.4
Swift Current (SWFT)	111	13	213	48	2.6	6.9
Yorkton (YKTN)	32	15	482	178	7.0	7.7

In most cases, seeding and fertilization were completed in the same operation. Nitrogen was applied in a side-band or mid-row band as 46-0-0 and phosphorus was applied as 11-52-0 in the seed-row or side-band. Both nitrogen and phosphorus were applied at rates dictated by the management treatments (Table 2). The total amount of nitrogen applied was balanced for all nitrogen provided by other fertilizers. Scott was the only location that required additional sulphur fertilization, using 21-0-0-24 at 10 lb/ac, all three years.

All sites were seeded between May 2nd and 27th, except Melfort 2019 which was re-seeded on June 12th (Table B1). Plot sizes varied between locations due to equipment differences, with a minimum plot size of 2m by 6m. Row spacing varied between locations, with Melfort and Indian Head using 12-inch row spacing, Scott and Yorkton 10-inch, and Swift Current on 9-inch. The trials were seeded into either oilseed or pulse stubble, between 0.75 to 1.5 inches deep. Each of the three seeding rates were corrected for the germination (%) and seed weight (g/1000 seeds) of each seed lot (Table 2). Raxil Pro, Cruiser Maxx Vibrance Cereals, and Cruiser Vibrance Quattro were the seed treatments applied, at their respective recommended rates, and varied between locations and years.

Manipulator™ (Chlormequat-chloride) plant growth regulator was applied at 700 mL/ac in 40 L/ac of water to the Intensive management treatment when the wheat was between GS31-39 (1 node to flag leaf emergence) (Table B1). At the flag leaf stage, Acapella foliar fungicide was applied at 350 mL/ac in 45 L/ac of water to control foliar leaf disease in the Intensive management treatments (Table B1). The Enhanced and Intensive management treatments received an additional foliar fungicide application of Caramba at 400 mL/ac in 40 L/ac at heading to control Fusarium Head Blight (Table B1). General applications of herbicide, insecticide, and pre-harvest products were site dependent to ensure non-limiting yield conditions were met (Table B2). All foliar applications were made using the most appropriate spray equipment available at each location. After the last plot was physiologically mature, harvesting occurring between August 27th and October 10th. Some sites required the use of a pre-harvest aid to help with late season weed control (Table B2).

Data collection included plant populations, days to maturity, grain yield, grain quality, and economics. Plant populations were calculated based on the number of wheat seedlings along two 1-meter crop rows per plot. Each plot was considered mature when the majority of wheat kernels were at the hard dough stage and could no longer be dented with a finger nail. The date that this occurred, minus the date of seeding, was used to determine the number of days to reach maturity. Wheat grain yield was determined from a cleaned, weighed sample, and adjusted for 14.5% moisture content. Quality measurements consisted of thousand kernel weight

(TKW), test weight, protein content (%), and % fusarium damaged kernels (FDK). TKW and test weights were collected based on CGC methodology. A 500g sub-sample from each plot was sent away to Seed Solution Labs in Swift Current for protein content and % FDK via NIR and CGC methodology, respectively. Originally, there was to be DON content measured on sites with the highest FDK. However, as all sites and years had low FDK values, and this costly test was forgone.

A simple economic analysis was completed using the full three-year data set. This analysis was based on 2019 Crop Planner, as published by the Saskatchewan Ministry of Agriculture. Where costs and/or prices differed between wheat treatments, the following assumptions were made:

- Grain revenue at $7.00/bu CWRS, $5.00/bu CWSWS, and $5.35/bu CPSR.
- Prices were adjusted for the actual protein content of the treatments, deducting or adding $0.02 for each 0.1% point from the standard 13.5% protein, $0.01 for CPSR varieties from the standard 11.5% protein, and there was no protein adjustment used for the CWSWS wheat.
- Cost of each seeding rate was calculated based on 90% germination, the typical seed weight for each variety as reported in the 2019 Varieties of Grain Crops Guide, and $0.23/lb.
- Seed treatment at $6.95/ac
- Manipulator™ PGR at $14.00/ac

Net returns above total fixed and variable costs were calculated for each treatment, at each location, and reported as an indicator of economic performance. It is only an indicator, as prices and costs, change for each producer's operation.

For statistical analysis, variety and management were considered fixed effects, while replicate within site-year, site-year, variety by site-year, management by site-year, and variety by management by site-year were all considered random effects. There were significant fixed effects by site-year interactions for all seven variables measured (economics were not statistically analyzed). These significant fixed by site-year interactions indicate that the effects variety selection, management practices, and their interaction have on the measured variables is dependent on the study site and year. For this reason, the dataset was analyzed on a site-year basis. All means were separated using Tukey's LSD at $p<0.05$.

9. Results and discussion:

Growing Season Conditions

Overall, the 2017 and 2018 five-month growing period (May to September) was similar or slightly warmer than the long-term average for all five locations; while 2019 was similar or cooler (Table B1). In 2017, Indian Head, and Scott were similar, while Melfort, Swift Current, and Yorkton were all warmer by 0.5°C or more. In 2018, Indian Head, Melfort, and Scott were all similar, while Swift Current and Yorkton were warmer by 0.5°C or more. In 2019, Yorkton was the only site to be similar to the long-term average, while the rest were cooler by 0.5°C or more. These deviations from the long-term average temperature, along with variations in precipitation, could have a considerable impact on the data collected in this study.

All five locations tended to be drier in 2017, and drier to within 25 mm (1 inch) of the long-term average in 2018 and 2019 (Table C2). In 2017, Swift Current was the most impacted by dry conditions with 71% less precipitation than normal over the five-month growing period. Melfort, Indian Head, and Yorkton were also drier in 2017 compared to their long-term average by roughly 50%. Scott was also on the drier side but only had 22% less precipitation than normal in 2019. In 2018, Swift Current received the least amount of precipitation once again, with 51% of their normal precipitation received that year. Indian Head, Scott, and Yorkton were within 33%, 27%, and 23%, of their normal precipitation, respectively. Melfort was near normal, with only 10% less precipitation than the long-term average. In 2019, Indian Head, Melfort, Scott, and Swift Current were within 5-11% of their long-term average precipitation, with Yorkton receiving 28% less.

Generally, 2017 and 2018 were warm dry years, while 2019 was cooler with precipitation closer to long-term totals. The hot and dry conditions in May were largely favourable for seeding in a timely fashion. However, this could have had an impact on initial plant populations if precipitation was not timely, or soil moisture reserves were short. The average temperatures and dry to normal precipitation in June likely supported the emerging stands. However, at locations such as Scott and Swift Current where moisture was less than average, plant stands and initial plant growth could have been affected. Continued reductions in normal moisture into July and August likely affected yield and protein. This affect is likely greater in 2017 where July temperatures were above average. The warm, dry environment in September 2017 likely aided maturity and harvest conditions but did little to affect yield and quality. Near normal precipitation in September 2018 and 2019, and warmer temperatures in September 2019, could have a positive effect on yield and quality. These conditions could have been especially beneficial on treatments that were later to mature. Furthermore, cooler temperatures in September 2018 could have contributed towards delayed maturity. It is important to note that the substantial moisture at Indian Head and Swift Current in September 2019 was too late to have any significant effects as the experiments had already been harvested. Additional detailed explication on growing season conditions can be found in Appendix E.

Plant Population

As expected, management had a significant effect on plant population in all 15 site-years of data (Table 5). Somewhat unexpectantly, there was a significant difference in the plant population between varieties in 13 site-years of data. There was also a significant effect by the interaction between variety and management at 6 site-years. On average, Yorkton had the highest plant populations, followed by Indian Head, Scott, and Melfort, and Swift Current having the lowest (Table D1).

Table 5: Statistical summary of treatment effects on plant population (plants/m^2) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

	Indian Head (INDH) [z]	Melfort (MLFT) [z]	Scott (SCTT) [z]	Swift Current (SWFT) [z]	Yorkton (YKTN) [z]
			2017		
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Management	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Variety * Management	0.0032**	0.1798	0.1557	0.0136*	<0.0001***
			2018		
Variety	<0.0001***	<0.0001***	0.2630	0.0010**	0.6281
Management	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Variety * Management	0.0033**	0.3373	0.1853	0.0729	0.2665
			2019		
Variety	<0.0001***	0.0259*	<0.0001***	<0.0001***	<0.0001***
Management	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Variety * Management	<0.0001***	0.0588	0.0124*	0.0883	0.2540

[z] *** p<00.0001' **0.01<p>0.0001; * 0.05<p>0.01

At Scott 2018, where the plant populations were similar across varieties, May and June were warm and dry. Meanwhile in Yorkton 2018, May was also dry and warm, while June was warm and wet; However, the moisture likely came too late. This resulted in the spring of 2018, at both locations, to be considerably warmer and drier than the other springs and subsequently resulted in the lowest population of the three years, at each location. This suggests that when seed bed moisture is limiting, germination rates are similar across varieties. Where there were significant differences, AAC Cameron VB had the highest average plant population, while AC Andrew had the lowest (Table 6 & D1). Generally, in 2017 and 2019, the CWRS varieties had greater populations than the CWSWS and CPRS varieties. In 2018, population differences were similar between market classes. In 2017, AAC Cameron VB had a significantly higher population than the other 5 varieties at 3 site-years, while AAC Ryley had the lowest population at all 5 site-years (Table 6). In 2018, AAC Ryley had populations similar to the CWRS varieties but was in most cases also similar to the other varieties tested (Table 6). In these cases, where AAC Ryley had higher populations, May and June at these locations were warm and dry. In 2019, Carberry and AAC Cameron VB had some of the greatest plant densities (Table 6). This finding suggests that CWRS varieties can have better rates of plant establishment, in years where spring conditions range from typical to wet and cool.

However, when May and June are warm and dry, some CPSR varieties can establish at rates similar to CWRS varieties. Furthermore, SY Rowyn and AC Andrew (CWSWS) in most cases, have low to moderate populations across a range of growing conditions. This suggests that these two varieties may benefit from higher seeding rates for establishment purposes. Lastly, it was not anticipated that there would be significant differences between the varieties at each location and year. This suggests that there were small seed quality differences between the seed lots of each variety (ie. Disease), as seed weight was accounted for in the seeding rate of each treatment. As the seed lots were the same at all locations, and the lots were not submitted for disease testing, we cannot speculate on these varietal differences any further.

Table 6: Influence of variety on plant population (plants/m^2) in the Input Study: Intensive Wheat Management at five locations from 2017 to 2019.

		Carberry [z]	AAC Cameron VB [z]	CDC Utmost VB [z]	AC Andrew [z]	SY Rowyn [z]	AAC Ryley [z]
Indian Head	**2017**	254 b	307 c	236 ab	232 ab	228 a	219 a
	2018	227 bc	218 ab	205 a	221 abc	222 abc	239 c
	2019	266 c	243 bc	196 a	214 ab	218 ab	230 b
Melfort	**2017**	126 ab	146 b	120 a	119 a	109 a	105 a
	2018	252 b	258 b	247 b	202 a	227 ab	235 ab
	2019	183 ab	197 b	192 ab	172 a	193 ab	185 ab
Scott	**2017**	270 b	304 c	248 b	197 a	214 a	208 a
	2018	181 a	175 a	177 a	170 a	177 a	178 a
	2019	212 bc	221 c	212 bc	189 a	204 abc	194 ab
Swift Current	**2017**	80 bc	77 b	86 c	71 ab	79 bc	65 a
	2018	112 a	126 ab	125 ab	109 a	114 a	140 b
	2019	192 c	182 bc	180 bc	179 bc	157 a	173 ab
Yorkton	**2017**	234 a	331 c	297 b	273 b	270 b	240 a
	2018	249 a	238 a	240 a	236 a	236 a	236 a
	2019	353 c	290 b	285 b	252 a	279 ab	349 c
Three Year Average		213	221	203	189	195	200

[z] Values with the same letter are statistically similar to each other at $p<0.05$.

As expected, as management intensified, plant populations increased (Figure 1; Table D1). At all 15 site years, the Conventional management treatment had the lowest plant populations, while the Intensive management treatment had the highest. On average, Conventional management had 156 plants/m^2, Enhanced 211 plants/m^2, and Intensive 247 plants/m^2. This reflects the increase in seeding rates between the three management levels. At all 15 site years, the increase between Conventional and Enhanced management was statistically different. Interestingly, the increase between Enhanced and Intensive management was significant at only 11 of 15 site years. At the 4 site years where this difference was not significant, May and June were warm and dry. Therefore, the insignificance between the Enhanced and Intensive likely reflects the need for additional moisture in order to germinate the larger amounts of seed. Additionally, it is not uncommon for seedling mortality to increase at higher seeding rates, which may partly explain the larger differences in plant populations between the Conventional and Enhanced treatments, compared to between the Enhanced and Intensive management treatments.

Generally, the change between management levels was proportional to the change in seeding rate. For example, between Conventional and Enhanced levels, the seeding rate increased by 100 seeds/m^2 and populations increased by 20 to 77 plants/m^2. Whereas, when the seeding rate increased by 60 seeds/m^2 between Enhanced and Intensive levels, populations increased by 3 to 60 plants/m^2. Where plant populations were lower (under 200 plants/m^2 on average), such as Melfort and Swift Current, the average increase was 34 plants/m^2 between Conventional and Enhanced and 16 plants/m^2 between Enhanced and Intensive. Whereas at higher plant population sites, like Yorkton and Indian Head, the increase was 69 and 48 plants/m^2, respectively. This rate of change between high and low population sites reflects the climate and soil moisture levels at the sites. Sites with low precipitation and soil moisture, did not have the moisture requirements to germinate the additional seeds planted with each management level and resulted in low plant populations overall. Furthermore, results suggest that within a location, responses to increasing management (seeding rate) are very similar year to year, despite differences in early season environments. Consequently, differences in plant population responses to changes in management level are likely due to location differences such as soil type, soil moisture, fertilizer burn, seeding methodology, rather than precipitation and temperature. Furthermore, results suggest that when conditions are unfavourable for high plant establishment, increases to seeding rate may not be the most effective strategy for compensating for the probability of low establishment.

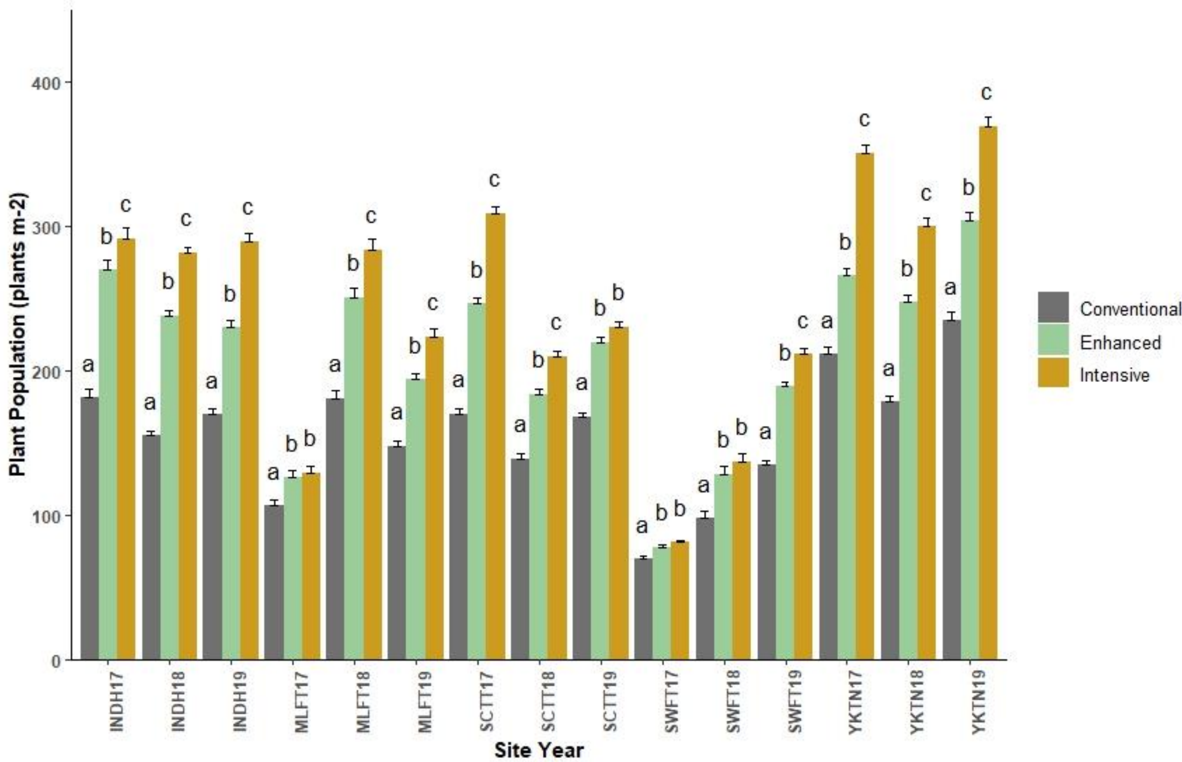

Figure 1: Management effect on plant population (plants/m^2) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

The interaction between variety and management was significant at 6 site-years, INDH17, INDH18, INDH19, SCTT19, SWFT17, and YKTN17. Depending on the site year either Carberry, AC Cameron VB, or CDC Utmost VB under Intensive management, had the highest plant population of the 18 treatments (Figure 2; Table D1). At INDH17, AAC Cameron under both Enhanced and Intensive management had similarly high populations. In 2018 at Indian Head, all of the Intensive treatments, as well as AAC Ryley Enhanced, had statistically similar plant populations. At INDH19, the same effect was found, except Carberry Enhanced was also similar. In SCTT19, the populations in the Enhanced and Intensive treatments were all statistically similar, except AC Andrew Enhanced. At Swift Current, the treatments with similarly high populations were more variable. CDC Utmost VB under all three management levels, and Carberry, CDC Utmost VB, SY Rowyn under Enhanced and Intensive were all similar. In YKTN17, AAC Cameron VB and CDC Utmost VB under Enhanced and Intensive management, along with Carberry and SY Rowyn Intensive were all similar. In Indian Head and SCTT19, all six varieties under Conventional management had low plant populations and statistically similar to each other. At SWFT17, all Conventionally managed varieties, along with AC Andrew and SY Rowyn under Enhanced and Intensive management, had similarly low populations. Once again, at YKTN17, all of the Conventional managed varieties and Carberry Enhanced had low populations.

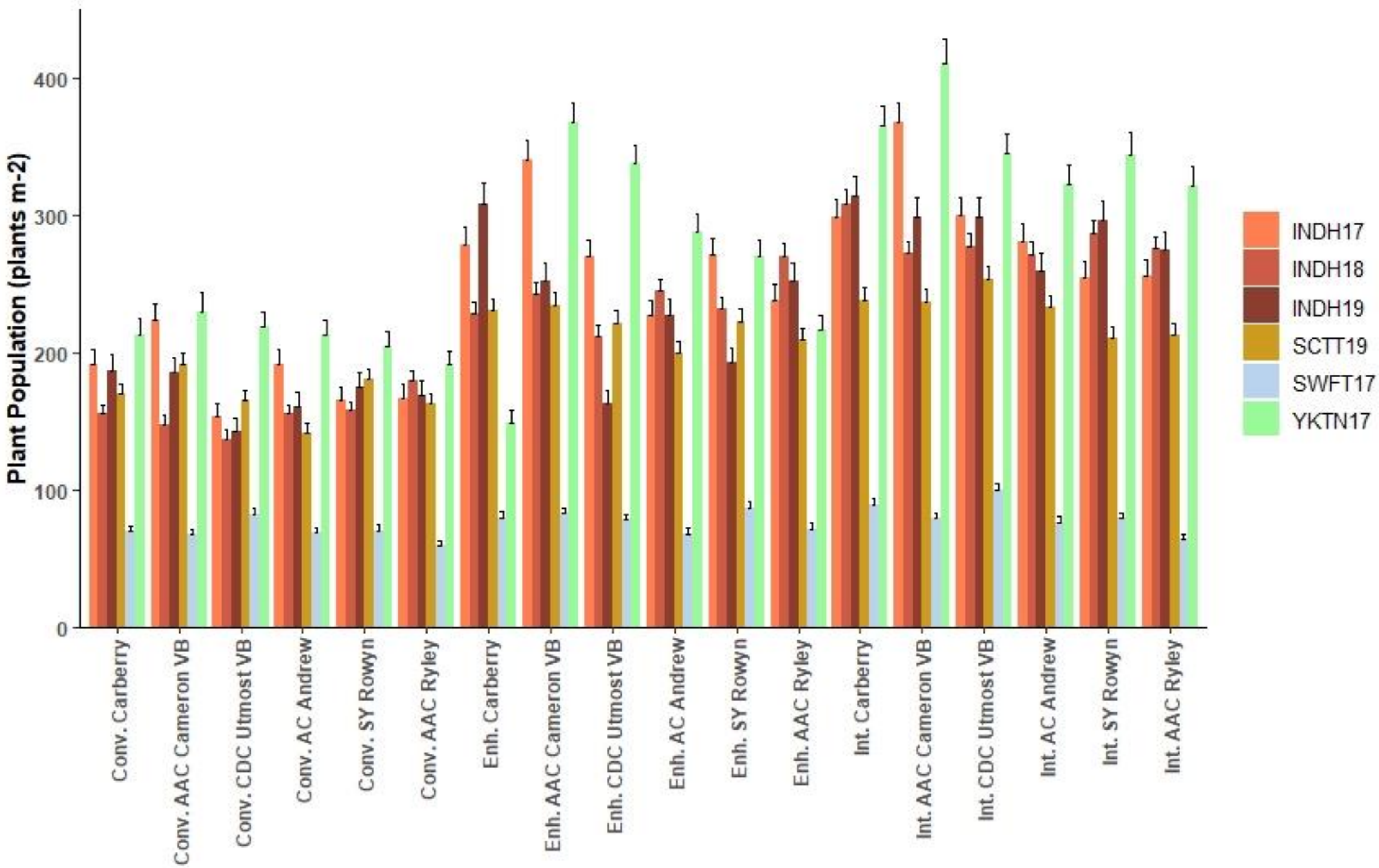

Figure 2: The effect of variety and management interaction on plant population (plants/m^2) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Combined data from the six site-years with a significant two-way interaction, indicate that the three CWRS varieties had populations increased by an average 103 to 112 plants/m^2 between the Conventional and Intensive treatments (Table D1). In the CWSWS and CPSR varieties, this increase was lower and ranged from 79 to 86 plants/m^2. This suggests that CWRS varieties may be more responsive to the seed treatment applied in the Intensive treatments than the other two market classes. It also suggests that CWRS varieties may also be less affected by inter-plant competition caused by increasing seeding rates.

Overall, plant populations were similar to expected, except MLFT17, SCTT18, SWFT17, SWFT18, and SWFT19 where populations were lower. At these locations, dry seed bed conditions at the time and shortly after seeding, likely had a negative effect on total germination. Each variety tended to respond similarly between management level with no variety doing better under one management level than another. Results suggest that management level was the largest driver for established plant populations, as expected due to increasing seeding rate. Furthermore, most often Enhanced management resulted in improved populations, with only slight improvements made by increasing to Intensive management. The significant interaction at 6 of 15 site-years suggests that CWRS cultivars can be slightly more responsive to Intensive management than the CPSR or CWSWS varieties, when compared to Conventional management. Interestingly, Indian Head was the only location, where the interaction was significant all three years. This suggests that this site may be more responsive to Intensive management than the other sites.

Maturity

As expected, there was a significant difference in the maturity of the six varieties at 14 of the 15 site years, while management had a significant effect at 8 of 15 (Table 7). At MLFT17, SCTT17, SWFT17, INDH18, and SWFT18, there was also a significant two-way interaction. Further to expectations, days to maturity were on average shortest at Swift Current (88 days) and longest at Melfort (114 days). The remaining sites matured within 1 to 4 days of each other. The number of days to maturity differed between the years, with averages of 100, 96, and 108 in 2017, 2018, and 2019, respectively. Delayed maturity in 2019, is likely due to the below average temperatures throughout July and August at all five locations (Table C1 & C2).

Table 7: Statistical summary of treatment effects on maturity (days to) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

	Indian Head (INDH) [z]	**Melfort (MLFT)** [z]	**Scott (SCTT)** [z]	**Swift Current (SWFT)** [z]	**Yorkton (YKTN)** [z]
	------------	------------	**2017**	------------	------------
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Management	<0.0001***	<0.0001***	0.0103*	0.5883	0.3546
Variety * Management	0.0908	<0.0001***	0.0457*	0.0290*	0.6826
	------------	------------	**2018**	------------	------------
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	0.0280*
Management	<0.0001***	0.9458	0.0047**	0.3012	0.4618
Variety * Management	<0.0001***	0.7853	0.7146	<0.0001***	0.5116
	------------	------------	**2019**	------------	------------
Variety	<0.0001***	<0.0001***	<0.0001***	0.5981	<0.0001***
Management	<0.0001***	0.2204	<0.0001***	0.9652	<0.0001***
Variety * Management	0.0528	0.1976	0.2396	0.5816	0.7388

[z] *** p<00.0001’ **0.01<p>0.0001; * 0.05<p>0.01

At 80% of site years, AAC Cameron VB and CDC Utmost VB matured significantly earlier than the other 4 varieties (Table 8). This was anticipated and over the three-year study period these two varieties matured up to 2 days earlier than the others (Table D2). Conversely, AC Andrew was one of the latest maturing varieties, followed closely by AAC Ryley, which occurred at 80% of site years. On average, the CWRS cultivars matured 1 to

3 days sooner than the CWSWS and CPSR varieties. At all site years, except ME18 and YK17, the six varieties matured within 1 to 4 days of each other. At ME18, ME19, and YK17, there was a 6 to 10 day difference between the earliest and latest maturing varieties.

Table 8: Influence of variety on maturity (days to) in the Input Study: Intensive Wheat Management at five locations from 2017 to 2019.

		Carberry [z]	AAC Cameron VB [z]	CDC Utmost VB [z]	AC Andrew [z]	SY Rowyn [z]	AAC Ryley [z]
Indian Head	**2017**	101 bc	100 a	100 a	102 d	101 b	101 cd
	2018	93 bc	93 a	93 ab	95 d	94 c	94 c
	2019	101 ab	101 a	102 b	102 bc	101 a	102 c
Melfort	**2017**	109 ab	108 a	109 ab	110 bc	110 c	109 bc
	2018	121 b	111 a	111 a	112 a	120 b	114 a
	2019	119 b	115 a	114 a	120 b	119 b	119 b
Scott	**2017**	106 b	104 a	105 a	106 b	106 b	106 b
	2018	93 a	96 b	93 a	97 b	92 a	96 b
	2019	112 bc	109 a	111 ab	114 d	112 bc	113 cd
Swift Current	**2017**	86 ab	85 a	85 a	88 b	85 a	86 a
	2018	82 ab	83 ab	82 a	84 bc	83 ab	85 c
	2019	95 a	95 a	95 a	96 a	95 a	95 a
Yorkton	**2017**	104 b	99 a	102 ab	105 b	102 ab	105 b
	2018	98 ab	96 ab	96 a	96 ab	98 b	97 ab
	2019	114 b	111 a	111 a	115 b	115 b	113 ab
Three Year Average		96	94	94	96	96	96

[z] Values with the same letter are statistically similar to each other at $p<0.05$.

It was anticipated that by increasing management inputs, a delay in maturity would occur. This is due to increased tillering caused by increasing fertilizer rates and possibly fungicide application(s). However, it was also anticipated that these effects on increased tillering, would be offset by increasing seeding rate. Increasing seeding rate is known to minimize tillering and hasten maturity. The various outcomes between the maturity dates of the three management levels, suggest that these offsetting factors have different affects. This is likely a reflection of the environment at each site and year, whereas warm, dry environments lead to decreased maturity regardless of the inputs applied. At INDH18 & INDH19, Conventional managed varieties matured 1 day later than Enhanced; Whereas in INDH17 & INDH18, Intensive managed varieties matured 0.5 to 1 day later than Enhanced (Figure 3). Although one would have expected the Conventional to mature faster than the other two treatments, the dry conditions in July through September at this site likely lead to the statistically significant difference. However, the difference of 0.5 to 1 day is of little agronomic importance. In Melfort, significant differences in maturity only occurred in 2017, where the Enhanced managed treatments were 1 to 2 days earlier than the other management levels. Scott 2017 and 2018, Conventional management was 1 day later than the Intensive treatment, while in 2019 the Intensive treatments were 3 days later. Due to the dry conditions in Swift Current all three years, there was no significant effect of management on days to maturity. In Yorkton, management level did not have an effect on maturity in 2017 and 2018. Yet in 2019, Enhanced management delayed maturity by 1 day compared to the Conventional level, while Intensive management was delayed by 3 days. The delay in maturity associated with Intensive management at SCTT19 & YKTN19 is likely attributed to the higher fertility, two fungicide applications, and late season rainfall. Generally, the difference between management levels was small (1-3 days) and inconsistent. Results suggest that when fertilizer and seeding rates are both increased, they can have a synergistic effect on hastening maturity, compared to when fertilizer is increased alone. Therefore, the effect of management level on maturity is likely of little agronomic or practical significance.

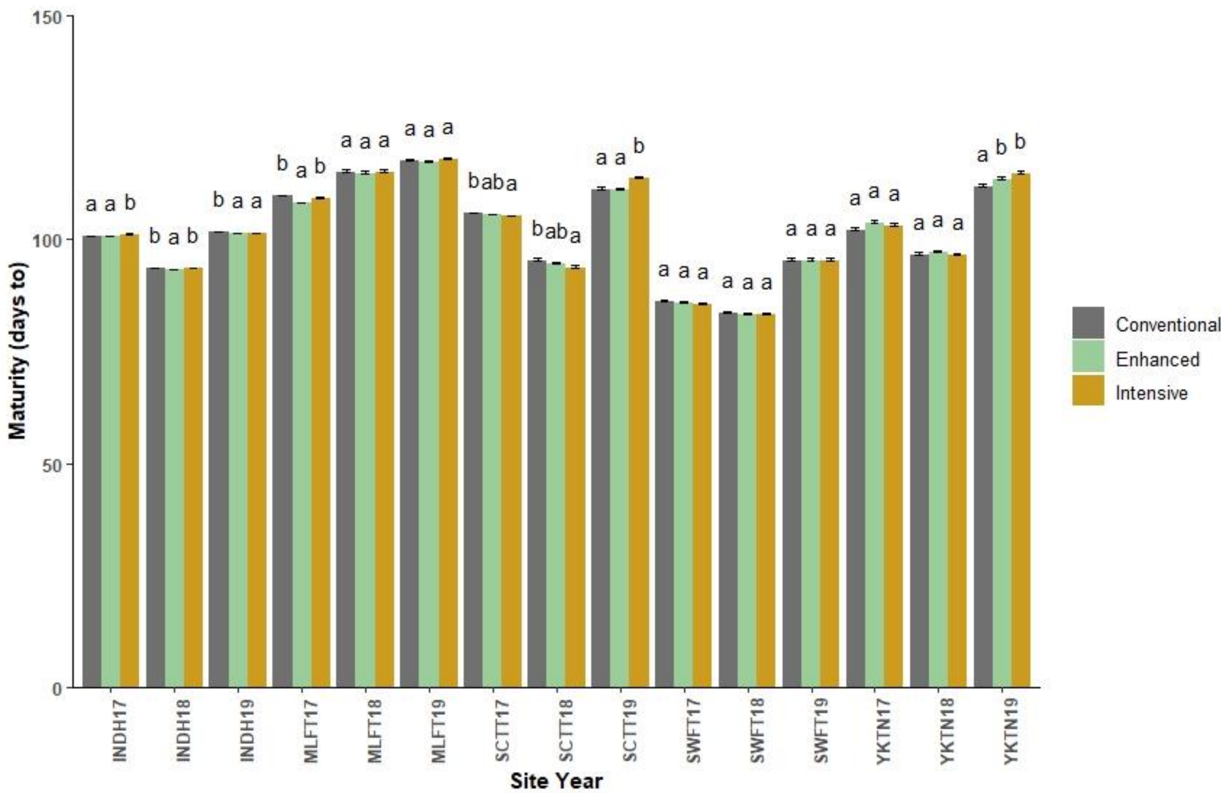

Figure 3: Management effect on maturity (days to) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

At the five site years where there was a significant variety by management interaction, AAC Cameron VB had similar days to maturity between the three management levels (Figure 4; Table D2). At INDH18 and MLFT17, Carberry matured 1 to 2 days earlier under Enhanced and Intensive management, compared to Conventional. At SCTT17, Carberry matured similarly across management levels. In SWFT17, Carberry matured 4 days earlier under Enhanced management, and 5 days earlier under Intensive management compared to Conventional. In 2018 at Swift Current, Carberry matured similarly under Conventional and Enhanced management, and 1 day later under Intensive. CDC Utmost VB matured similarly across management levels at all five sites. AC Andrew, SY Rowyn, and AAC Ryley matured earlier under Enhanced Management at all five sites, although it was not statistically different from the Intensive treatment at INDH18 and MLFT17. Furthermore, at SWFT18, AAC Ryley matured 3 days sooner under Intensive management compared to Conventional. Across all five locations, AAC Cameron VB Intensive was one of the earliest treatments to mature, while AC Andrew Conventional was one of the latest to mature.

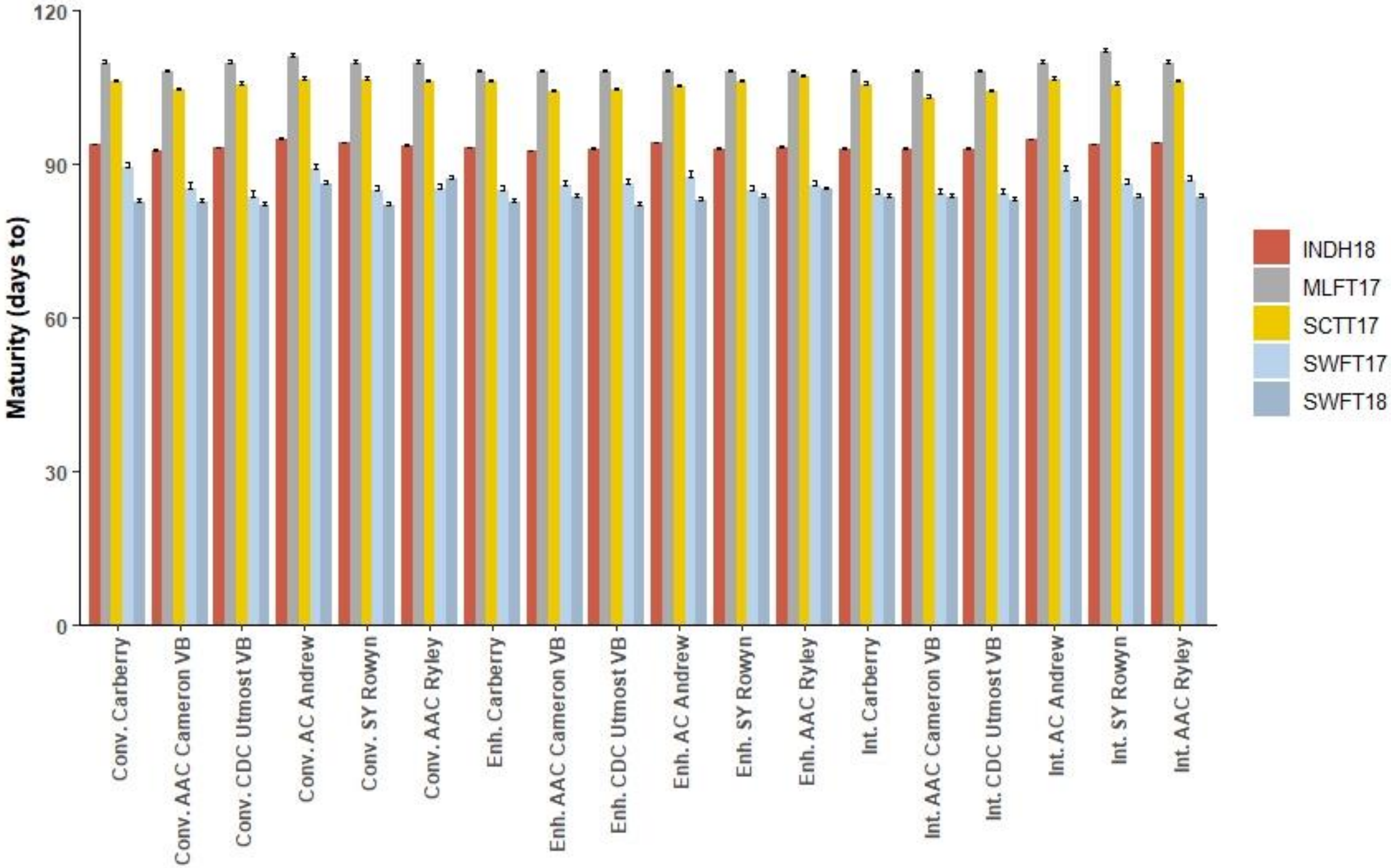

Figure 4: The effect of variety and management interaction on maturity (days to) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

As expected, the CWRS varieties tended to mature earlier than the CWSWS and CPSR varieties. From the Saskatchewan Seed Variety Guide (2019), it was expected that AAC Cameron VB and CDC Utmost VB would mature 2 to 3 days earlier than Carberry. However, this trend only occurred at 6 of 15 site years, while it was similar to Carberry at the other 9 site years. One would have also expected SY Rowyn to have similar maturity to Carberry and this was found true at 12 site years. It was only at 3 site years where AC Andrew did not mature significantly later than Carberry. It was also at three site years where the maturity of AAC Ryley was not similar to AC Andrew. These two varieties were expected to be similar, as they are both later maturing than Carberry. Although management effects were statistically significant and had mixed outcomes, the 1-2 day delay in maturity is of little practical importance. This likely reflects the cancelling out effect of using increased seeding and nitrogen rates in the same treatments. Results also suggest that CWSWS and CPSR varieties, respond positively to Enhanced management by decreasing the days to maturity. However, CWRS varieties are less responsive to changes in management. Therefore, in regards to maturity, variety selection may be less important under Enhanced management, than it is for Conventional or Intensive management.

Grain Yield

As expected, grain yield was significantly affected by variety and management at 80% of site years (Table 9). In Swift Current, variety had a significant effect on grain yield in 2017 and 2018, while management did not significantly affect yield over the three years. The two-way interaction between variety and management was significant at 7 of 15 site-years. Over the three-year study period, wheat yield averaged 69 bu/ac (Table D3). Yorkton had the highest average yield (89 bu/ac), with yields increasing over the three-year study period. Melfort and Scott had similar average yields of 77 and 71 bu/ac, respectively. In Melfort, yields were similar in 2018 and 2019, and lower in 2017. While at Scott, yields were highest in 2017, lowest in 2018, and moderate in 2019. Indian Head had an average yield of 63 bu/ac, with highest yields in 2017 and lowest in 2019. Swift Current had an average yield of 44 bu/ac with a difference of 15 bu/ac between years. The low yields at Swift Current are largely attributed to their warm, dry climate.

Table 9: Statistical summary of treatment effects on yield (bu/ac) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

	Indian Head (INDH) [z]	**Melfort (MLFT) [z]**	**Scott (SCTT) [z]**	**Swift Current (SWFT) [z]**	**Yorkton (YKTN) [z]**
			2017		
Variety	<0.0001***	<0.0001***	<0.0001***	0.0103*	<0.0001***
Management	<0.0001***	<0.0001***	<0.0001***	0.1557	<0.0001***
Variety * Management	0.0149*	0.1187	0.0104*	0.1344	0.0471*
			2018		
Variety	<0.0001***	<0.0001***	<0.0001***	0.0054**	<0.0001***
Management	<0.0001***	<0.0001***	<0.0001***	0.2346	<0.0001***
Variety * Management	<0.0001***	0.7280	0.0079**	0.0208*	0.9797
			2019		
Variety	<0.0001***	<0.0001***	<0.0001***	0.0810	<0.0001***
Management	<0.0001***	<0.0001***	<0.0001***	0.1547	<0.0001***
Variety * Management	0.0687	0.0446*	0.2196	0.6928	0.9452

[z] *** p<00.0001’ **0.01<p>0.0001; * 0.05<p>0.01

Over the three-year study period, AC Andrew had the highest yield, with an average of 80 bu/ac (Table D3). This led the variety to be significantly higher yielding, than the other five varieties, at all locations except Swift Current. This was anticipated as AC Andrew is known to yield 130 to 131% of Carberry (Sask. Seed Guide 2019). At Swift Current, AC Andrew was only significantly greater than SY Rowyn in 2017, Carberry and AAC Cameron

VB in 2018, and similar to all varieties tested in 2019 (Table 10). On average, the CPSR varieties yielded 2 bu/ac greater than the CWRS varieties. This was expected, as the Saskatchewan Seed Variety Guide (2019) states that SY Rowyn and AAC Ryley yield 101 to 110% of Carberry. However, it was only at SCTT17, YKTN17, and YKTN19 where this trend was statistically true. At INDH19, MLFT17, MLFT19, SWFT17, SWFT18 the CWRS and CPSR varieties had statistically similar yields. At Indian Head 2017 and 2018 and YKTN18, the CPSR varieties were similar to both Carberry and CDC Utmost VB. In MLFT18 and SCTT19 Carberry yielded more similar to the CPSR varieties. This was expected as AAC Cameron VB and CDC Utmost VB are known to yield 108 to 118% of Carberry. Lastly, at SCTT18, the CPSR varieties were similar to AAC Cameron VB.

Table 10: Influence of variety on grain yield (bu/ac) in the Input Study: Intensive Wheat Management at five locations from 2017 to 2019.

		Carberry [z]	AAC Cameron VB [z]	CDC Utmost VB [z]	AC Andrew [z]	SY Rowyn [z]	AAC Ryley [z]
Indian Head	**2017**	68 ab	68 a	68 ab	81 c	71 b	69 ab
	2018	59 ab	57 a	60 b	69 c	60 b	61 b
	2019	55 a	54 a	54 a	62 b	54 a	56 a
Melfort	**2017**	65 a	68 a	68 a	84 b	67 a	70 a
	2018	70 a	80 b	84 b	104 c	71 a	71 a
	2019	76 a	77 a	79 a	91 b	78 a	80 a
Scott	**2017**	87 a	86 a	88 a	108 c	95 b	96 b
	2018	39 a	44 b	40 a	57 c	45 b	43 b
	2019	69 a	77 c	76 bc	87 d	72 ab	70 a
Swift Current	**2017**	45 ab	43 ab	44 ab	47 b	39 a	46 b
	2018	33 a	33 a	36 ab	42 b	37 ab	40 ab
	2019	53 a	48 a	53 a	52 a	51 a	55 a
Yorkton	**2017**	69 a	70 a	68 a	96 c	80 b	80 b
	2018	83 a	89 ab	88 ab	106 c	88 ab	90 b
	2019	93 a	95 a	94 a	116 c	98 ab	105 b
Three Year Average		64	66	67	80	67	69

[z] Values with the same letter are statistically similar to each other at p<0.05.

As expected, yields increased as management intensified (Table D3). Over the three-year study period, there was a 4-5 bu/ac increase between the three management levels, with a total 9 bu/ac increase between Conventional and Intensive Management. At 60% of site years, the yield increase between the three management levels was significantly different from each other. At INDH18, both Conventional and Enhanced management had an average yield of 60 bu/ac (Figure 5). Whereas in INDH19, Enhanced and Intensive management were similar at 57 bu/ac. The largest increase between Conventional and Enhanced management treatments occurred at YKTN18, with a 12 bu/ac difference. Increases between these two treatments were also significant at MLFT19 and SCTT17, where the difference was 10 bu/ac. The largest increase between Enhanced and Intensive management occurred at YKTN17 with 10 bu/ac, followed closely by MLFT17 and SCTT17 at 9 bu/ac. Therefore, by intensifying management from Conventional to Intensive, there was an average yield increase of 3 to 9 bu/ac at 60% of sites years and 12 to 19 bu/ac at the remaining 40%.

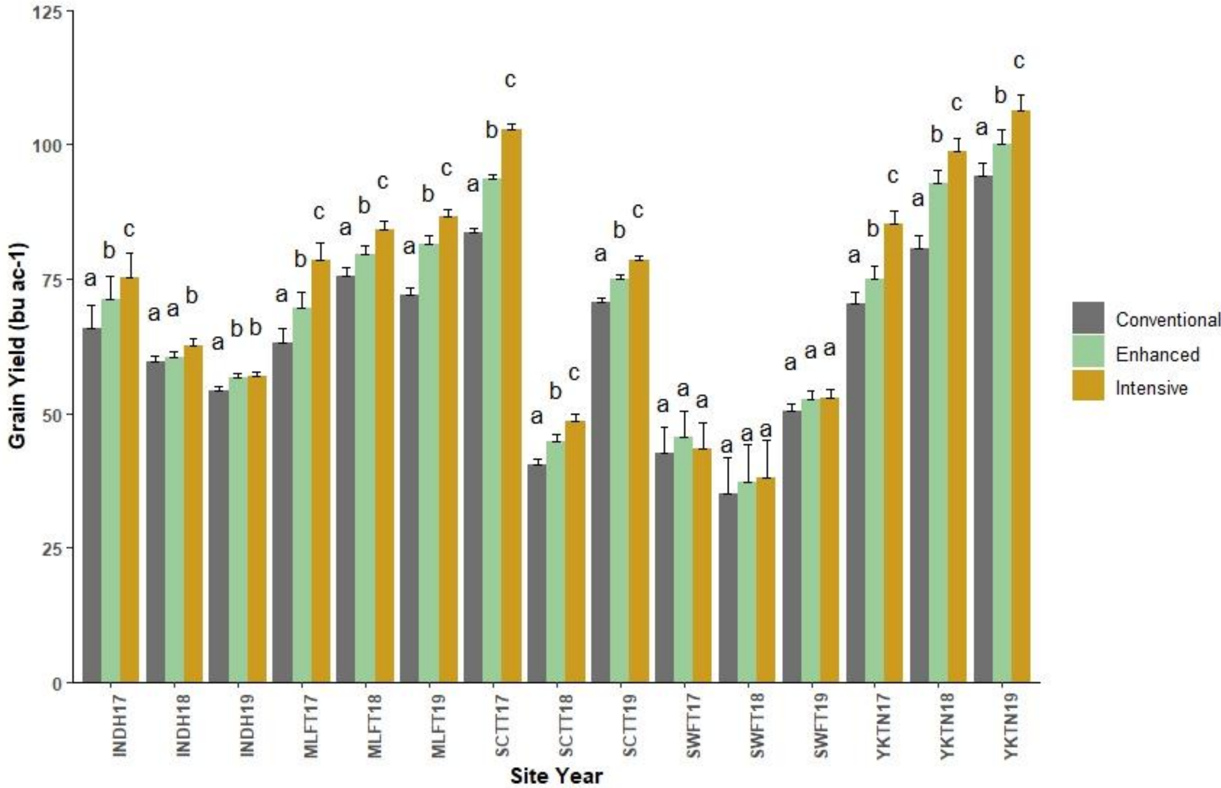

Figure 5: Management effect on yield (bu/ac) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

At the 7 site years where there was a significant variety by management interaction, AC Andrew Enhanced was the highest yielding treatment at 2 site years, AC Andrew Intensive at 2 site years, and AC Andrew Conventional at 2 site years (Figure 6). At INDH17, INDH18, and SWFT18, AC Andrew under all three management levels were high yielding and statistically similar. In INDH18 and SCTT17, AAC Ryley Intensive was also similar to AC Andrew Intensive. At MLFT19 and SCTT18, AC Andrew Enhanced and Intensively managed were the highest yielding and statistically similar. However, these treatments were also similar to CDC Utmost VB, and the two CPSR varieties under Intensive management. At YKTN17, AC Andrew Intensive was the highest yielding treatment and statistically greater than any other treatment at this site year. At all 7 site years Carberry Conventional was consistently lower yielding, and numerically had the lowest yield at 3 site years. AAC Cameron VB Conventional was lower yielding at INDN18 and SWFT18, but was similar when under Enhanced management at INDH18. AAC Ryley Conventional and CDC Utmost VB Conventional were the lowest yielding treatments, at 1 site year each. CDC Utmost VB was similarly lower yielding to Carberry at INDH17, and these treatments were also similar to the Conventional CPSR and AAC Cameron VB. At INDH18 all varieties under Conventional and Enhanced management, except AC Andrew, were lower yielding. All the Conventional management treatments, except AC Andrew and AAC Ryley Enhanced were similar at MLFT19. The Conventional managed CWRS and CPSR varieties at SCTT17 and SCTT18, as well as AAC Cameron VB Enhanced, tended to be lower yielding.

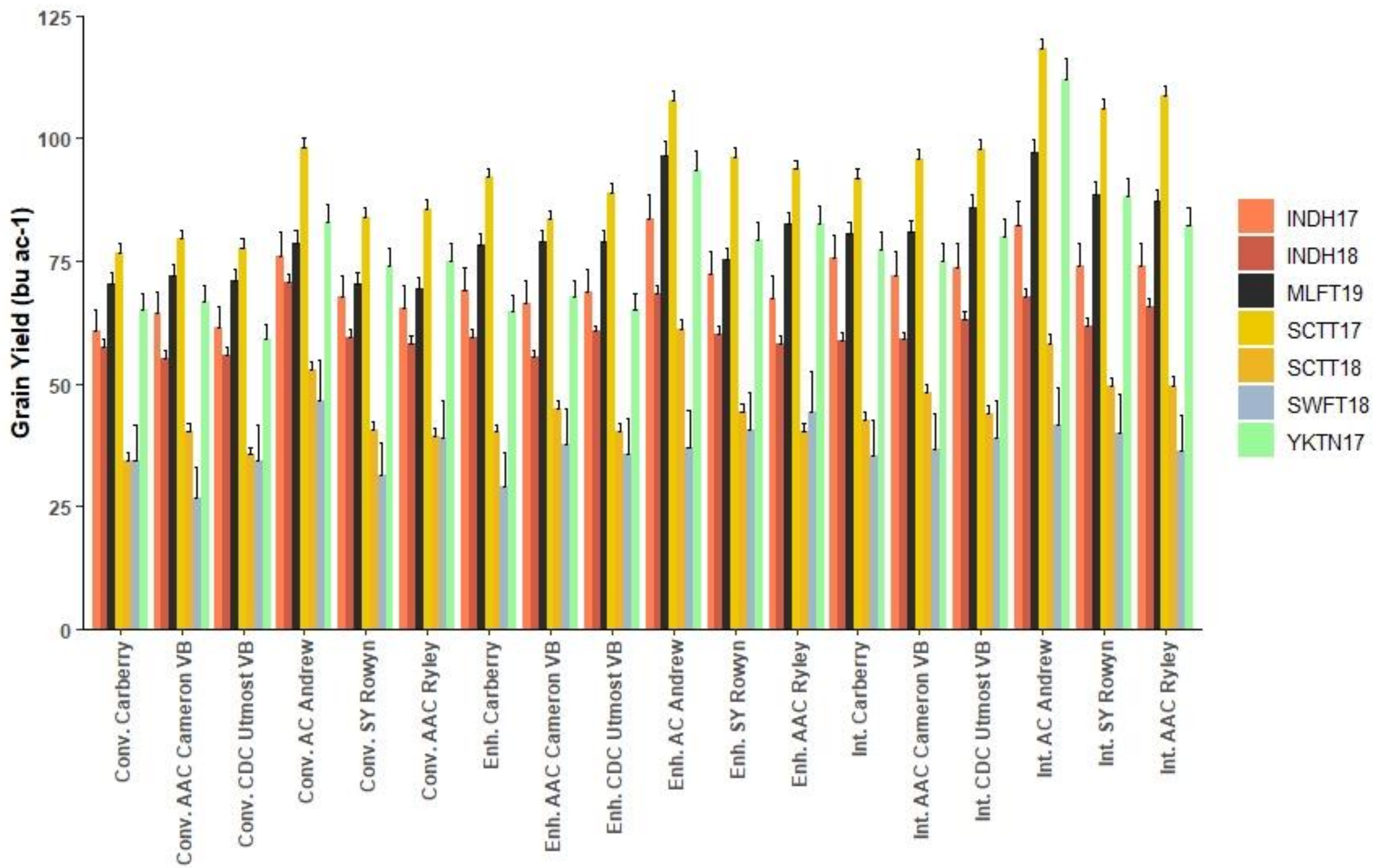

Figure 6: The effect of variety and management interaction on grain yield (bu/ac) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

At the 7 site years where there was a significant variety by management interaction, Carberry achieved maximum yield under Intensive management and Enhanced management 71% and 29% of the time, respectively (Table 11). Maximum yield of AAC Cameron VB, CDC Utmost VB, and SY Rowyn occurred under Intensive management at all sites, except SWFT18 respectively, where it was found with Enhanced management. AC Andrew did not achieve maximum yield consistently under one management level. It was found under Conventional management at INDH18 and SCTT18, Enhanced at MLFT19, SCTT18, INDH17, and Intensive at SCTT17 and YKTN17. AAC Ryley achieved maximum yield under Intensive management at 71% of site years. At SWFT18 and YKTN17, AAC Ryley had highest yields under Enhanced management. Generally, the maximum yield of CWRS and CPSR varieties is very consistent under Intensive management. Conversely, the maximum yield CWSWS varieties, like AC Andrew, tend to be more variable and more likely a reflection of the year's growing conditions or other environmental factors.

In terms of the magnitude of a variety's response to management, as expected, it was largest under Intensive management for all 6 varieties (Table 11). With Enhanced management, a variety's yield increased by 4 to 7 bu/ac on average, compared to Conventional management. While the yield of any given variety under Intensive management increased by 9 to 13 bu/ac on average. AAC Cameron VB was the only variety in which increasing management from Enhanced to Intensive did not increase yield by 50% or greater. This indicates that one variety is not considerably better under one management level than another. At INDH18, yield did not increase with Enhanced management from Conventional, and only had a 3 bu/ac increase between Conventional and Intensive. At INDN18, the growing season was dry with average temperatures, which indicates that water was a limiting factor on yield and both lodging and disease pressure were negligible. SCTT18 was also dry with average temperatures, however, Enhanced management increased yield by 4 bu/ac compared to Conventional, while there was no yield increase between Conventional and Intensive. Additionally, SCTT17 was also dry with average temperatures yet interestingly, there was a 10 bu/ac increase between Conventional and Enhanced, and 19 bu/ac between Conventional and Intensive. The difference between SCTT17 and SCTT18, is that there were higher plant populations in 2017 and residual soil levels of P, K, and S. Furthermore, residual soil nutrient levels and plant populations at Indian Head were also similarly higher in 2017 and 2018. However, there were yield responses between management levels in 2017 but not in 2018. In 2017 however, precipitation was 54% less than average. This suggests that the soil environment had more to do with response to management level than precipitation and temperature. Therefore, at some sites, fertility was a limiting factor for yield. Yet, at Swift Current in 2018 and 2019, residual nitrogen levels were high at 177 and 111 lb N/ac and the magnitude of the response to management level was quite different between years. In 2018, it was very dry and hot and plant populations were slightly lower than in 2019. Yet 2019 was wet and cool. This resulted in an 8 bu/ac increase with Enhanced and 3 bu/ac with Intensive compared to Conventional management; Whereas in 2019, there was no significant difference between the management levels. This suggests that other factors such as insect damage, disease, lodging, etc. played an influence on the yield responses of the management classes. Interestingly, the largest yield responses occurred at MLFT19 and SCTT17. In both of these site years, soil residual phosphorus levels were high to very high, while residual nitrogen was low. This further suggests that residual nutrient levels, especially nitrogen, have a large influence on the magnitude of the yield response of wheat between management levels, as one might expect. Additionally, when soil residual levels are high, environment and plant population seem to have a greater influence on the magnitude of the response to intensifying management.

Overall, it was expected that all cultivars would be higher yielding than Carberry, with AC Andrew being the best yielding, followed by AAC Cameron VB, CDC Utmost VB, AAC Ryley, and SY Rowyn, respectively. Averaged across 15 site years, AC Andrew was the highest yielding variety as expected. The CPSR and two other CWRS varieties were higher yielding than Carberry as expected; however, unexpectantly the two CPSR varieties had slightly higher yields than AAC Cameron VB and CDC Utmost VB. The expected yield trend, with the CPSR yields similar to Carberry, only occurred at MLFT18. At Indian Head, Swift Current, MLFT17, MLFT19, SCTT19, and YKTN18 the CPSR and CWRS varieties tended to have similar yields. The CPSRs tended to yield greater than CWRS at SCTT17, STTC18, YKTN17, and YKTN19. In cases where there were a few similarities between the market classes, the site year was either very dry, or cool throughout the growing season. Further to expectations, yields increased with intensifying management. Yield increases of 3 to 9 bu/ac occurred at 9 of 15 site years, and 12 to 19 bu/ac at 6 of 15 site years, when management increased from Conventional to Intensive management. Where there was a significant two-way interaction, AC Andrew Intensive had the highest yield while Carberry Conventional had the lowest. The CWRS and CPSR varieties tended to best respond to Intensive management; while the yield response of the CWSWS varieties tended to vary between site years. These yield responses suggest that one wheat market class and/ or variety is not more responsive to a single management level over another. Furthermore, naturally higher yielding varieties continue to be higher yielding. However, the level in which maximum yield is achieved may be more affected by the growing conditions at a given site.

Table 11: Influence of the interaction between variety and management on grain yield (bu/ac) in the Input Study: Intensive Wheat Management at seven site years. Asterix denotes the management level which yielded the greatest per variety at that specific site year.

Variety	Variable	IH17	IH18	ME19	SC17	SC18	SW18	YK17	Avg.
Carberry	Conventional (C)	61	58	70	77	35	34	65	57
	Enhanced (E)	69	59*	78	92*	40	29	65	62
	Intensive (I)	76*	59*	81*	92*	43*	35*	77*	66
	E minus C	8	1	8	15	5	-5	0	5
	I minus C	15	1	11	15	8	1	12	9
AAC Cameron VB	Conventional (C)	64	55	72	80	40	27	67	58
	Enhanced (E)	66	55	79	83	45	38*	68	62
	Intensive (I)	72*	59*	81*	96*	48*	37	75*	67
	E minus C	2	0	7	3	5	11	1	4
	I minus C	8	4	9	16	8	10	8	9
CDC Utmost VB	Conventional (C)	61	56	71	78	36	34	59	56
	Enhanced (E)	69	61*	79	89	40	36	65	63
	Intensive (I)	74*	63	86*	98*	44*	39*	80*	69
	E minus C	8	5	8	11	4	2	6	7
	I minus C	13	7	15	20	8	5	21	13
AC Andrew	Conventional (C)	76	71*	79	98	53	47*	83	72
	Enhanced (E)	84*	68	97*	108	61*	37	94	78
	Intensive (I)	82	68	97	118*	58	41	112*	82
	E minus C	8	-3	18	10	8	-10	11	6
	I minus C	6	-3	18	20	5	-6	29	10
SY Rowyn	Conventional (C)	68	59	71	84	41	31	74	61
	Enhanced (E)	72	60	75	96	44	41*	79	67
	Intensive (I)	74*	62*	89*	106*	49*	40	88*	73
	E minus C	4	1	4	12	3	10	5	6
	I minus C	6	3	18	22	8	9	14	12
AAC Ryley	Conventional (C)	66	58	69	86	39	39	75	62
	Enhanced (E)	67	58	83	94	40	44*	83*	67
	Intensive (I)	74*	66*	87*	109*	50*	36	82	72
	E minus C	1	0	14	8	1	5	8	5
	I minus C	8	8	18	23	11	-3	7	10
Average	Conventional (C)	66	60	72	84	41	30	71	61
	Enhanced (E)	71	60	82	94	45	38	76	67
	Intensive (I)	75	63	87	103	41	33	86	72
	E minus C	5	0	10	10	4	8	5	6
	I minus C	9	3	15	19	0	3	15	11

Grain Quality

<u>*Grain Protein*</u>

As expected, there were significant differences between the protein content of all six wheat varieties, at all 15 site years (Table 12). Management had a significant effect at 80% of site years, while the two-way interaction was significant at 4 of 15 site years. On average, Yorkton had the highest protein and Melfort the lowest (Table D4). Furthermore, 2018 tended to have higher protein content than 2017 and 2019. As expected, protein content reflected the yield differences between and within locations. For example, yields were high and protein was low at Yorkton, whereas in Swift Current yield was low but protein was high (Table D4).

Table 12: Statistical summary of treatment effects on grain protein (%) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

	Indian Head (INDH) [z]	**Melfort (MLFT)** [z]	**Scott (SCTT)** [z]	**Swift Current (SWFT)** [z]	**Yorkton (YKTN)** [z]
			2017		
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Management	<0.0001***	<0.0001***	0.0622	0.2026	0.0187*
Variety * Management	0.0689	0.9686	0.9573	0.2130	0.1886
			2018		
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Management	<0.0001***	<0.0001***	<0.0001***	0.5589	<0.0001***
Variety * Management	<0.0001***	0.5904	0.0104*	0.0038**	0.0821
			2019		
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Management	<0.0001***	0.0077**	<0.0001***	0.0265*	<0.0001***
Variety * Management	<0.0001***	0.5198	0.9083	0.1260	0.4408

[z] *** p<00.0001’ **0.01<p>0.0001; * 0.05<p>0.01

Over the three-year testing period Carberry had the highest average protein level, 14.1% (Table 13). However, it was only significantly higher than any other variety tested at 31% of sites. At INDH19, MLFT17, MLFT19, YKTN17, and YKTN18, Carberry had similar protein levels to one or both of the other CWRSs. This was expected as AAC Cameron VB and CDC Utmost VB are known to have 0.6 and 0.4% less protein than Carberry, respectively. SY Rowyn could potentially have similar protein levels as Carberry as it is known to have 0.9% less protein. Although this is relatively unlikely, it did occur at SCTT17. AAC Ryley was expected to have some of the lowest protein levels of the varieties tested, as it has 1.2% less protein than Carberry. It was the second lowest at 75% of site years, and unexpectantly similar to Carberry at 4 site years. As expected, AC Andrew had significantly lower protein than any other variety tested, with an average protein content of 11.2%. Overall, protein levels were similar to expectations, with CWRS varieties averaging 13.8% protein, 0.5 to 0.6 % points greater than the CPSR varieties, and both CWRS and CPSR market classes having greater protein than the CWSWS.

Table 13: Influence of variety on grain protein (%) at the Input Study: Intensive Wheat Management at five locations from 2017 to 2019.

		Carberry [z]	AAC Cameron VB [z]	CDC Utmost VB [z]	AC Andrew [z]	SY Rowyn [z]	AAC Ryley [z]
Indian Head	**2017**	13.5 d	12.9 c	13.1 c	10.5 a	12.5 b	12.8 bc
	2018	14.0 d	13.4 b	13.7 c	11.5 a	13.3 b	13.4 b
	2019	14.8 c	14.4 b	14.9 c	13.0 a	14.3 b	14.4 b
Melfort	**2017**	12.1 c	11.0 b	11.7 c	8.9 a	10.8 b	10.8 b
	2018	14.6 d	14.0 b	14.1 bc	10.9 a	13.9 b	14.5 cd
	2019	11.1 d	10.8 cd	11.0 d	8.1 a	10.6 bc	10.4 b
Scott	**2017**	12.1 c	11.6 bc	11.3 bc	8.9 a	11.4 bc	11.0 b
	2018	16.3 c	15.6 b	16.3 c	13.3 a	15.7 b	16.2 c
	2019	15.7 c	14.4 b	14.7 b	11.8 a	14.7 b	14.7 b
Swift Current	**2017**	14.3 cd	14.8 d	13.9 bc	11.6 a	14.1 bc	13.7 b
	2018	16.7 c	16.3 bc	16.1 bc	14.7 a	15.8 b	15.9 bc
	2019	15.3 b	15.3 b	15.3 b	14.6 a	15.3 b	15.7 b
Yorkton	**2017**	14.0 d	13.1 c	14.3 d	10.3 a	13.1 c	12.3 b
	2018	13.4 d	12.9 cd	13.0 cd	10.2 a	12.7 c	12.0 b
	2019	13.3 e	12.4 cd	12.6 d	10.1 a	12.0 bc	11.8 b
Three Year Average		14.1	13.5	13.7	11.2	13.3	13.3

[z] Values with the same letter are statistically similar to each other at $p<0.05$.

At 58% of site years, where management had a significant effect on wheat protein content, there were significant differences between the three management levels (Figure 7). At 33% of these significant site years, there were significant differences between the protein levels of the Conventional and Enhanced treatments, yet protein levels were similar between Enhanced and Intensive. It was only at SWFT19, that the Enhanced treatment had similar levels of protein to the other two levels, with Conventional and Intensive being significantly different. On average, protein increased by 0.4%, 0.3%, and 0.7% points between Conventional and Enhanced, Enhanced and Intensive, and Conventional and Intensive management levels, respectively.

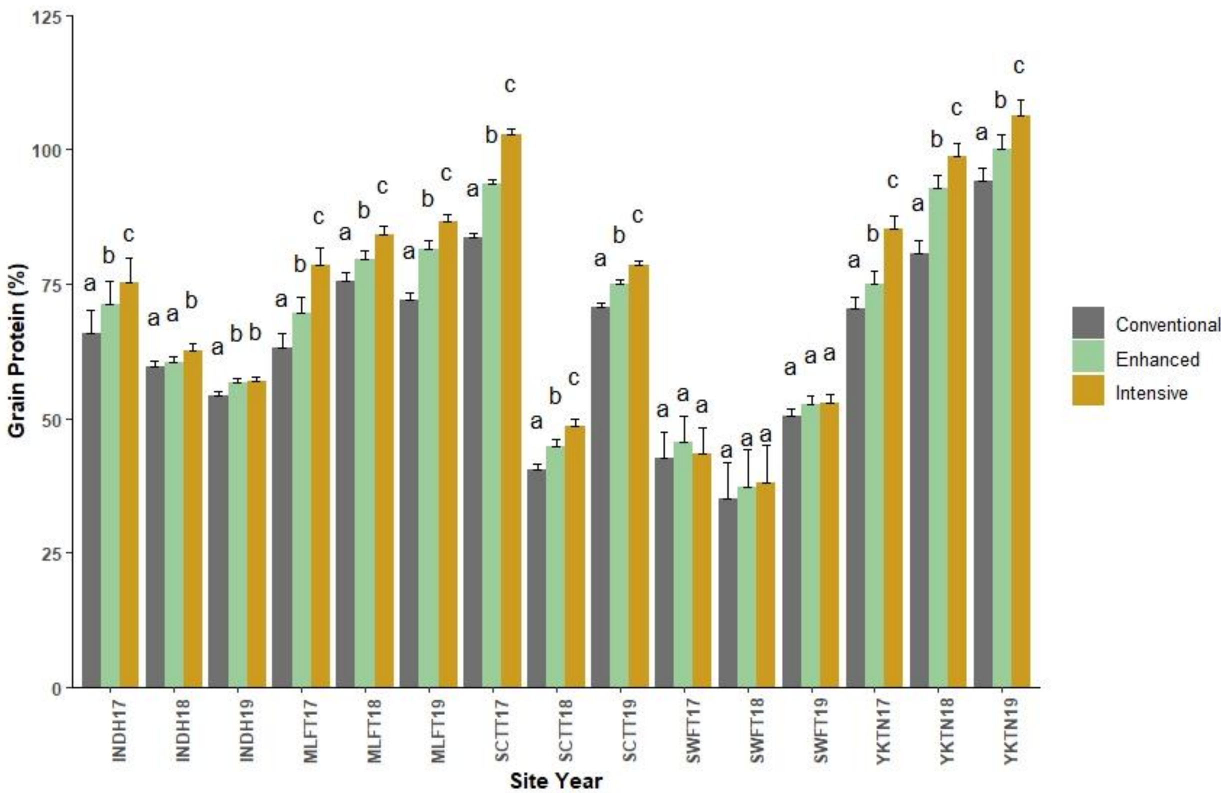

Figure 7: The effect of management level on grain protein (%) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

There were four site years where there was a significant difference between the protein levels of the 18 treatments (Table 12). In INDH18, Carberry Intensive had the highest protein content of the 18 treatments, but was similar when under Enhanced management (Table D4; Figure 8). In 2019 at Indian Head, AC Cameron Intensive had the highest protein, but was only 0.1% point higher than Carberry Intensive and AAC Ryley Intensive. Protein levels where much more similar across treatments at this site, which resulted in AAC Cameron VB being statistically similar to all other Intensive treatments (other than AC Andrew), CDC Utmost VB and Carberry both under Enhanced and Conventional management, as well as AAC Ryley Enhanced. At SCTT18, similar trends occurred, with Carberry Intensive having the highest protein, yet being within 0.1% point of two other high protein treatments, and similar to other Intensive treatments (minus AC Andrew), and 5 other treatments. At SWFT18, Carberry Enhanced had the highest protein, which was only significantly greater than that found in AC Andrew Conventional. At all four of these site years, AC Andrew Conventional had the lowest protein content, as expected. At two of these four site years, AC Andrew had similarly low protein under Enhanced management as well.

Overall, differences in protein were largely attributed to genetic differences between varieties, with protein levels increasing with management intensity. Varieties with lower protein were consistently lower across management levels, while those with higher protein had minimal changes to protein content as management intensified. Therefore, varieties with lower protein levels genetically, are best when managed intensively, in order to increase protein content. Whereas, those with high genetic protein levels, do not appear to benefit from further intensified management.

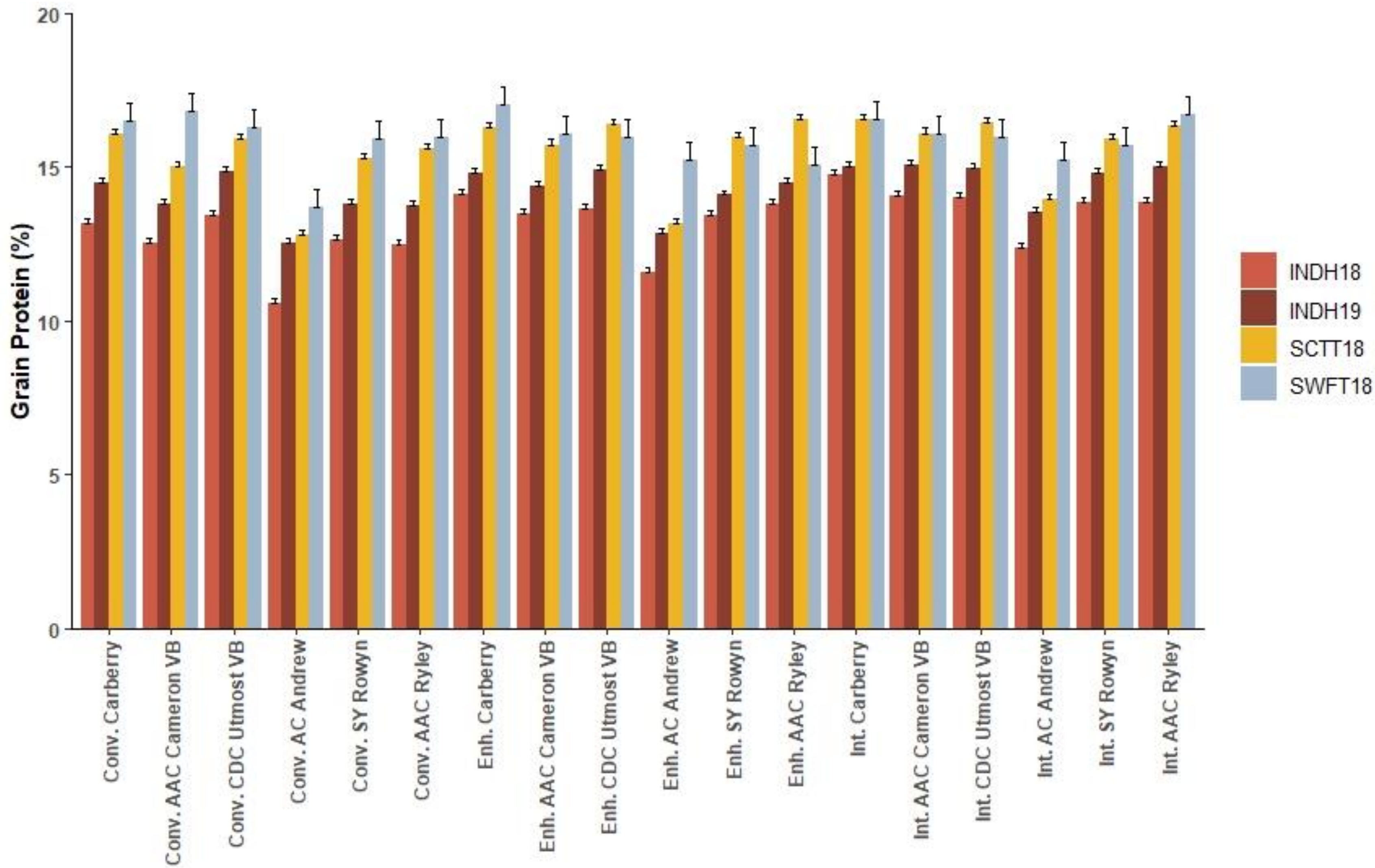

Figure 8: The effect of variety by management level interaction on grain protein (%) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Test Weight

As expected, there were significant differences in the test weight of each variety tested, except at Swift Current where this result was unexpected (Table 14). Management had a significant effect on test weight at 12 of 15 site years, while the interaction was significant at 8 site years. Test weights were comparable at Swift Current and Melfort, which were about 10 g/0.5L lower than at Indian Head, Scott, and Yorkton (Table D5). On average, AAC Ryley and AC Andrew had the lowest test weights (383 g/0.5L), while Carberry had the highest (396 g/0.5L), all as expected.

Table 14: Statistical summary of treatment effects on test weight (g/0.5 L) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

	Indian Head (INDH) [z]	**Melfort (MLFT)** [z]	**Scott (SCTT)** [z]	**Swift Current (SWFT)** [z]	**Yorkton (YKTN)** [z]
			2017		
Variety	<0.0001***	<0.0001***	<0.0001***	0.4274	<0.0001***
Management	<0.0001***	0.4664	<0.0001***	0.0414*	0.0149*
Variety * Management	<0.0001***	0.3098	0.0018**	0.0995	0.0026**
			2018		
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Management	<0.0001***	<0.0001***	0.0091**	0.8149	0.0111*
Variety * Management	0.0079**	0.0468*	0.8774	0.0289*	0.0869
			2019		
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Management	<0.0001***	<0.0001***	<0.0001***	0.3206	<0.0001***
Variety * Management	0.3235	<0.0001***	<0.0001***	0.1215	0.0633

[z] *** p<00.0001' **0.01<p>0.0001; * 0.05<p>0.01

At 36% of site years, Carberry had significantly higher test weight than any other variety (Table D5). At Yorkton and MLFT17, Carberry had similar test weight to SY Rowyn. At MLFT18 and MLFT19, AAC Cameron VB had the highest test weight, although in 2019, it was similar to Carberry. Interestingly, at SCTT19, AAC Ryley had the highest test weight of any variety tested. Furthermore Carberry, was also similar to AC Andrew at SCTT19, and CDC Utmost VB at SWFT19. At 70% of site years, AC Andrew and AC Ryley both had significantly lower test weights. At SCTT17 AC Andrew was the lowest, SCTT18 it was AC Ryley, and both AC Andrew and AAC Ryley were similar to SY Rowyn at SCTT18. At the locations where there was a significant difference between the three management levels, results were mixed. At INDH18, Conventional management resulted in the greatest test weights (Figure 9). In contrast at SCTT19, it was the Intensive management level that resulted in the highest test weights. There were three site years, where the test weight of the Conventional and the Enhanced levels were similar or lower than the Intensive. A similar trend occurred in SCTT18 and YKTN17, although the Enhanced was similar to the other two levels. At MLFT18 and YKTN19, test weight increased between Conventional and Enhanced, with no further increase found under Intensive management. Test weight was maximized under Enhanced management in MLFT19 and YKTN18, with Conventional and Intensive being similar. Interestingly, when averaged across the 3 years, there were no significant differences in the test weights of the three management treatments. Where there was a significant two-way interaction, the response to management of the six different varieties, was mixed between site-years. For example, at INDH17, AC Andrew had similar test weights under Conventional and Enhanced management, and lower under Intensive. Yet at MLFT19, AC Andrew had higher test weights under Enhanced management compared to Conventional, and similar to Conventional under Intensive. Given that any differences between the varieties under any management level were small, 3 to 5 g/0.5L, and thus these trends are likely of little practical agronomic significance.

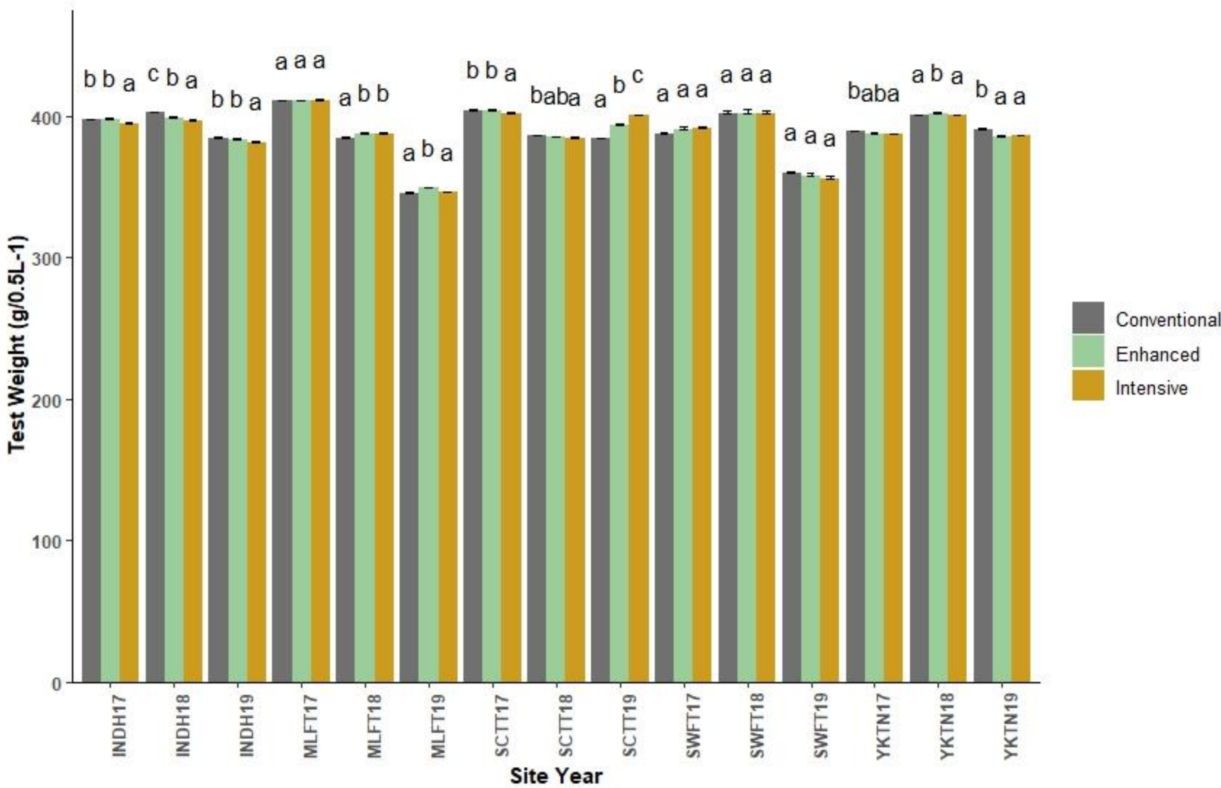

Figure 9: The effect of management level on test weight (g/0.5L) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Seed Weight (TKW)

As expected, the thousand kernel weight (TKW) of each of the six varieties tested were significantly different from each other at all 15 site years (Table 15). Management level had a significant effect at 7 of 15 site years, while the two-way interaction was significant at 33% of site years. On average, AAC Ryley had the largest TKW (45 g/1000 seeds) and was significantly greater than any other variety tested (Table D6). Conversely, SY Rowyn had the smallest TKW (31 g/1000 seeds), yet it was similar to CDC Utmost VB in SCTT18 & SCTT19 and AC Andrew in SWFT19.

Table 15: Statistical summary of treatment effects on seed weight (g/1000 seeds [TKW]) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

	Indian Head (INDH) [z]	Melfort (MLFT) [z]	Scott (SCTT) [z]	Swift Current (SWFT) [z]	Yorkton (YKTN) [z]
			2017		
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Management	<0.0001***	0.2317	0.2056	<0.0001***	0.0228*
Variety * Management	0.0140*	0.5115	0.0048**	0.2845	0.0132*
			2018		
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Management	<0.0001***	0.0305*	0.3428	0.5848	0.1342
Variety * Management	<0.0001***	0.2555	0.3094	0.1449	0.1112
			2019		
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Management	<0.0001***	0.3062	0.1926	0.0974	<0.0001***
Variety * Management	0.0512	0.0236*	0.3845	0.0948	0.2687

[z] *** p<00.0001’ **0.01<p>0.0001; * 0.05<p>0.01

At 4 of 7 site years, where there was a significant effect of management on TKW, Intensive management resulted in lower TKW than the Conventional and Enhanced, with Conventional and Enhanced being similar to each other (Table D6). Conversely, at INDH18, Conventional management resulted in TKWs to be significantly greater than the Enhanced and Intensive management levels, which were similar. Furthermore, at MLFT18, Enhanced management increased TKW over Conventional management; while the TKW under Intensive management was similar to both Conventional and Enhanced. As well, in YKTN17, Intensive management had a significantly greater TKW than Conventional but similar to Enhanced.

At the five locations where there was a significant two-way interaction, SY Rowyn had significantly lower TKW under all three management levels than any other variety. The exception was at MFLT19 where AAC Ryley was significantly higher TKW under Enhanced and Intensive management. At two site years, SY Rowyn Intensive had the lowest TKW but was statistically similar under Enhanced and Conventional management. Conversely, AAC Ryley had significantly higher TKW under all three management levels, than any other variety. TKW at YKTN18, was also similar to the two aforementioned site years, although CDC Utmost VB Enhanced was similar to all three SY Rowyn treatments. At INDH18, SY Rowyn Intensive had the lowest TKW numerically, yet was similar under Enhanced, and AC Andrew and CDC Utmost VB both under Intensive management. Meanwhile, AAC Ryley was significantly higher under Conventional management than Enhanced, yet similar to the TKW under Intensive management. As for the other 4 varieties, their thousand kernel weight was relatively unchanged due to management levels. Although there were some instances where the TKW decreased with increasing management level. Overall, seed weight did not provide much added insight into defining treatment responses.

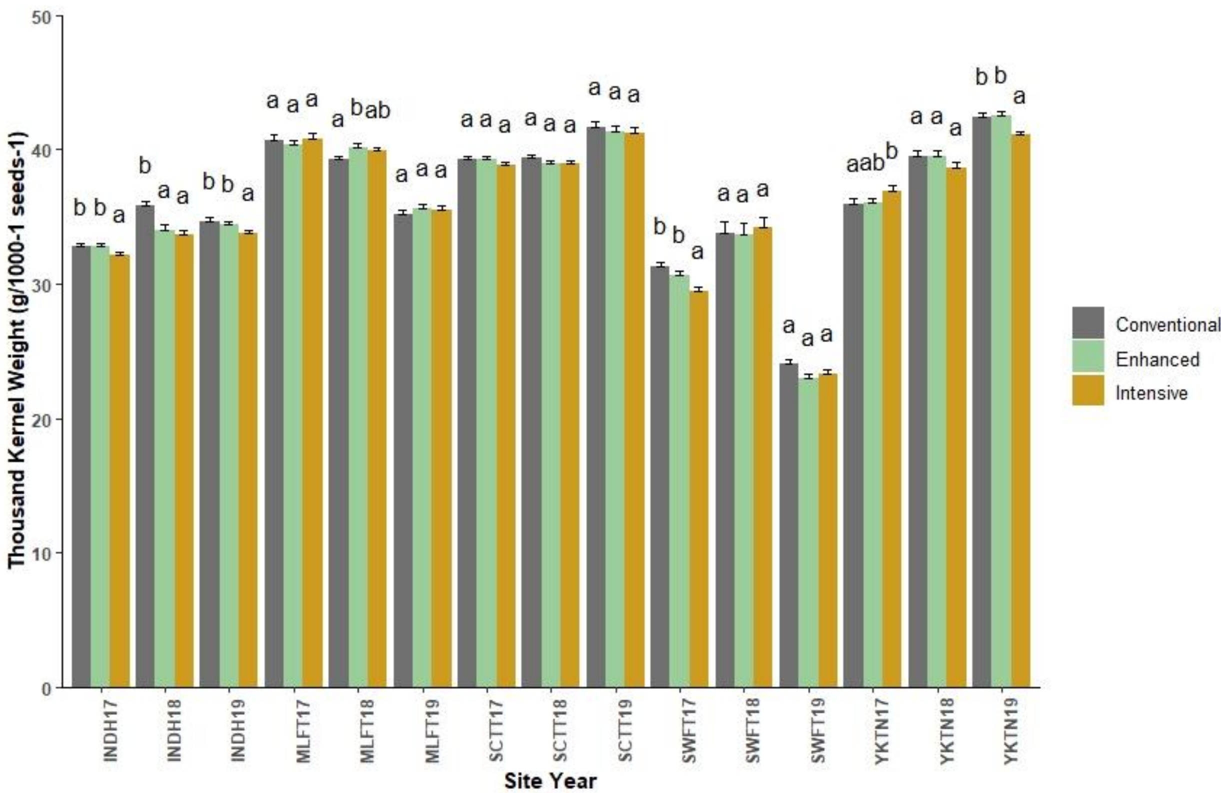

Figure 10: The effect of management level on thousand kernel weight (g/1000 seeds) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Fusarium Damaged Kernels

Across all 15 site years, Fusarium Damaged Kernel (FDK) levels were very low with less than 1% on average, in all treatments (Table D7). It was only in 2019, at Melfort and Scott, where there were some treatments with 1 to 2% FDK. The low levels of FDK are largely attributed to the drier conditions during the three growing seasons, especially July when the wheat is flowering. The lack of statistics at Swift Current, is due to only two plots in the whole experiment, having FDK present in 2017 and there were no plots that had any FDK accounted for in 2019. As expected at the remaining site years, there was a significant difference between the FDK levels of each variety tested (Table 16). Management had a significant effect on FDK at 7 site years, while the two-way interaction was significant at 8. In general, FDK levels were greatest in Scott and Melfort and least in Swift Current. Furthermore, 2017 and 2019, levels were nearly twice as great than in 2018.

Table 16: Statistical summary of treatment effects on Fusarium Damaged Kernels (%) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

	Indian Head (INDH) [z]	Melfort (MLFT) [z]	Scott (SCTT) [z]	Swift Current (SWFT) [z]	Yorkton (YKTN) [z]
			2017		
Variety	<0.0001***	<0.0001***	<0.0001***	NA	0.0039**
Management	0.3612	0.0018**	0.0790	NA	0.0200*
Variety * Management	0.5657	0.0172*	0.9153	NA	0.7862
			2018		
Variety	<0.0001***	<0.0001***	<0.0001***	<0.0001***	<0.0001***
Management	0.0012**	0.0392*	0.1968	0.6567	0.3780
Variety * Management	0.0026**	0.6345	0.3596	<0.0001***	0.0194*
			2019		
Variety	<0.0001***	<0.0001***	<0.0001***	NA	<0.0001***
Management	<0.0001***	<0.0001***	<0.0001***	NA	0.1244
Variety * Management	<0.0001***	<0.0001***	<0.0001***	NA	0.0135*

[z] *** p<00.0001' **0.01<p>0.0001; * 0.05<p>0.01

At 10 of 15 site years, AAC Ryley had significantly greater Fusarium damaged kernels than any other variety, 0.46% (Table 17). This was expected, as AAC Ryley is rated as moderately susceptible to fusarium. At SCTT17 and YKTN19, AC Andrew had similar FDK levels to AAC Ryley. This was unexpected, as AC Andrew is rated as intermediately resistant to fusarium and one would have expected CDC Utmost VB to be more similar to AAC Ryley. It was only at YKTN17 that AAC Ryley and AC Andrew were significantly higher, but they were also similar to all other varieties other than AAC Cameron VB. At 4 of 15 site years, the other 5 varieties had statistically similar levels of FDK. At INDH18, Carberry had moderate levels of FDK, yet had levels higher than the other four varieties. At INDH19 and SCTT19, SY Rowyn, Carberry, and AAC Cameron VB had the lowest FDK levels, with CDC Utmost VB and AC Andrew having increasingly higher levels. This reflects expectations well, as both Carberry and SY Rowyn are rated as marginally resistant to FHB, while AAC Cameron VB is intermediately resistant. At MLFT18 and YKTN18, SY Rowyn had similar FDK levels to the other four varieties, except CDC Utmost VB. At SCTT17, YKTN17, and YKTN19 the three CWRS varieties had similar FDK levels to SY Rowyn. At SCTT18, AAC Cameron VB, AC Andrew, and SY Rowyn had similar levels, yet were lower than CDC Utmost VB and Carberry which were similar to each other. Generally, the trends found here followed expectations, except for the aforementioned switch in expectations between CDC Utmost VB and AC Andrew.

Table 17: Influence of variety on Fusarium Damaged Kernels (%) at the Input Study: Intensive Wheat Management at five locations from 2017 to 2019.

		Carberry [z]	AAC Cameron VB [z]	CDC Utmost VB [z]	AC Andrew [z]	SY Rowyn [z]	AAC Ryley [z]
Indian Head	**2017**	0.27 a	0.18 a	0.20 a	0.30 a	0.32 a	0.50 b
	2018	0.16 b	0.06 a	0.06 a	0.05 a	0.06 a	0.43 c
	2019	0.01 a	0.01 ab	0.09 b	0.24 c	0.01 a	0.45 d
Melfort	**2017**	0.34 a	0.19 a	0.21 a	0.24 a	0.31 a	0.59 b
	2018	0.09 ab	0.03 ab	0.15 b	0.12 ab	0.01 a	0.49 c
	2019	0.12 a	0.05 a	0.25 a	0.17 a	0.03 a	1.43 b
Scott	**2017**	0.16 a	0.20 a	0.17 a	0.42 c	0.24 ab	0.37 bc
	2018	0.05 b	0.02 a	0.05 b	0.02 a	0.01 a	0.11 c
	2019	0.15 a	0.18 a	0.42 b	1.34 c	0.07 a	1.74 d
Swift Current	**2017**	0.00 a	0.00 a	0.00 a	0.04 a	0.00 a	0.05 a
	2018	0.00 a	0.01 a	0.01 a	0.01 a	0.00 a	0.08 b
	2019	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
Yorkton	**2017**	0.08 ab	0.04 a	0.14 ab	0.19 b	0.14 ab	0.16 b
	2018	0.04 a	0.02 a	0.13 b	0.16 b	0.01 a	0.32 c
	2019	0.02 ab	0.01 ab	0.04 b	0.20 c	0.00 a	0.18 c
Three Year Average		0.10	0.07	0.13	0.23	0.08	0.46

[z] Values with the same letter are statistically similar to each other at p<0.05.

Intensifying management to the Enhanced level significantly decreased FDK compared to Conventional management at 5 of 7 site years (Figure 11). At 4 of these 5 site years, there was no benefit to increasing management beyond Enhanced in order to reduce FDK levels. This was expected as the Enhanced and Intensive treatments both included one fungicide application at anthesis to target the control of FHB and thus reduce the amount of FDK. At MLFT18 and SWFT18, due to the variability in the FDK levels between replicates of a treatment, statistically there were no significant differences between the management levels. However, trends were similar to previously mentioned, whereas Enhanced decreased FDK, with no advantage associated with Intensive management. Once again, there was no benefit associated with Intensive management at SCTT19 and MLFT17; and levels were statistically similar to the Conventional. It was also somewhat unexpectant that there were significant differences in the FDK levels between Enhanced and Intensive managements, as they had the same FHB control applications. It could be that the higher seeding rates in this treatment, allowed for fungicide to be applied to a more uniformly staged crop or just generally reduced the window for infection to occur. However, because Conventional and Intensive treatments were statistically similar, this trend further points to the variability in the FDK levels between replicates of the same treatments. Generally, Enhanced management resulted in protection against FHB and subsequent FDK, with no additional benefits resulting from Intensive management.

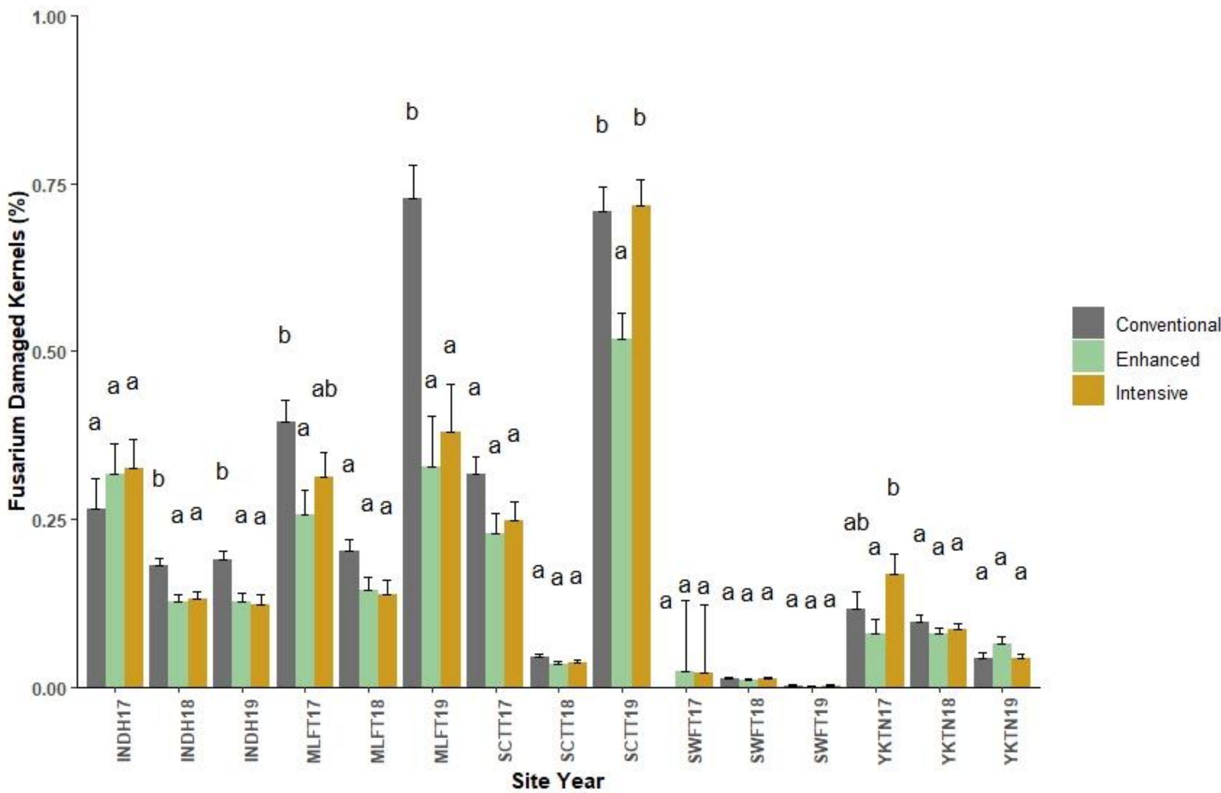

Figure 11: The effect of management level on FDK (%) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

At the 8 site years where there was a significant two-way interaction, AAC Ryley Conventional had the greatest or some of the greatest levels of FDK of any treatment (Table D7). At INDH19, MLFT19, and SWFT19, AAC Ryley Conventional had the highest FDK levels of any other treatment. In INDH18, MLFT17, and YKTN18, AAC Ryley Intensive was similar to when managed Conventionally. At INDH18, these treatments were also similar to Enhanced management and at SCTT19 AC Andrew Intensive was as well. At YKTN18, AAC Ryley Conventional and Intensive had similar levels to various of other treatments. The results at YKTN19, were contrary to expectation, as AC Andrew Intensive had the greatest FDK levels numerically. However, it was statistically similar to the other two management levels, all three AAC Ryley treatments, and Carberry Enhanced. Despite significant treatment effects, along with the low levels of FDK throughout the trial, the trends found likely have little agronomic impact. However, they do provide a good indication of what might occur when conditions are highly conducive to Fusarium Head Blight development.

Overall grain quality parameters were largely different due to genetic differences and were relatively unresponsive to intensifying management. Carberry had some of the greatest protein levels, followed by the other CWRS varieties, with AC Andrew having the least. The CPSR varieties tended to have lower protein levels, but not always significantly different from one or more of the CWRS varieties. Furthermore, where yields were high, protein was low due to the principle of yield dilution. Differences in test weight and thousand kernel weight were largely attributed to genetic differences rather than management level. Thousand kernel weight generally increased with management intensity, while test wights decreased. Due to minimal changes within the two-way interaction, there was no discernable advantage to managing varieties differently in order to significantly increase test weights or kernel weight and subsequently increase yield. Fusarium levels were low at all 15 site years of data, with FDK levels of <2% in any treatment. Despite minimal levels, there were still significant differences between the varieties, as expected, with Enhanced management showing reductions in FDK levels. Lastly, due to the minimal % FDK all three years, it was decided that DON testing would not be completed as it is expensive and it is not anticipated that there would also be any significant findings.

Economic Analysis

Expenses differed between varieties and classes due to small differences in seed costs, as the seeding rate was correcting for average seed weight (Appendix F [Excel Sheet Attached]). Total expenses increased between management levels due to increased fertilizer and seeding rates, fungicide, and PGR applications. Expenses also differed between locations due to differences in both the fixed and variable expenses associated within their respective soil zones. Generally, variable expenses were lowest in Swift Current, higher in Scott, and highest in Indian Head, Melfort, and Yorkton. Averaged across the three-year study period, total returns above expenses were variable across treatments, ranging from losses of $66/ac to profits of $91/ac (Table 18). The lowest average return for growing wheat occurred in Swift Current, largely due to their dry growing conditions and lower yields. In this scenario, Indian Head also experienced economic losses to growing wheat. However, depending on the expenses for individual producers in this area, wheat production may be a break-even proposition or have small gains. Melfort and Scott both showed small positive gains in this experiment. Yorkton had nearly twice the profit of both Melfort and Scott, largely due to the site having greater yields all three years.

Table 18: Influence of variety and management on the 3-year average net return ($/ac) above variable and fixed costs for the Input Study: Intensive Wheat Management at five locations from 2017 to 2019.

Variety	Management	Indian Head	Melfort	Scott	Swift Current	Yorkton	3 Year Avg.
Carberry	Conventional	57.22	108.66	100.60	17.82	175.14	86.52
AAC Cameron VB		46.73	112.49	126.36	-15.80	190.87	85.99
CDC Utmost VB		51.68	145.98	110.79	12.64	174.94	91.44
AC Andrew		2.71	66.21	61.96	-61.68	139.21	32.71
SY Rowyn		-12.07	4.63	37.63	-84.40	97.34	0.13
AAC Ryley		-22.75	12.11	21.96	-54.01	106.98	85.93
Carberry	Enhanced	38.72	77.19	129.08	-31.68	183.74	67.28
AAC Cameron VB		9.45	112.34	113.36	-23.66	179.05	64.45
CDC Utmost VB		41.45	126.28	125.78	-25.03	189.63	76.75
AC Andrew		-35.86	75.64	64.89	-116.70	135.64	9.14
SY Rowyn		-50.26	-7.99	34.28	-93.34	93.98	-17.02
AAC Ryley		-61.15	1.10	19.63	-61.50	102.29	-14.43
Carberry	Intensive	-12.45	48.69	86.40	-84.72	153.61	20.93
AAC Cameron VB		-19.95	67.41	121.62	-98.92	163.19	24.43
CDC Utmost VB		-2.55	88.91	116.94	-67.60	177.35	43.11
AC Andrew		-116.16	48.84	36.09	-173.45	113.84	-41.16
SY Rowyn		-111.45	-25.41	18.94	-144.38	69.20	-57.74
AAC Ryley		-102.70	-40.96	17.46	-162.79	64.08	-66.35
Carberry	Average	27.83	78.18	105.36	-32.86	170.83	58.24
AAC Cameron VB		12.08	97.41	120.45	-46.13	177.70	58.29
CDC Utmost VB		30.19	120.39	117.84	-26.66	180.64	70.43
AC Andrew		-49.77	63.56	54.31	-117.28	129.56	0.23
SY Rowyn		-57.93	-9.59	30.28	-107.37	86.84	-24.88
AAC Ryley		-62.20	-9.25	19.68	-92.77	91.12	1.72
Average	Conventional	20.59	75.01	76.55	-30.91	147.41	63.79
	Enhanced	-9.61	64.09	81.17	-58.65	147.39	31.03
	Intensive	-60.88	31.25	66.24	-121.98	123.55	-12.80
Total	Average	-16.63	56.78	74.65	-70.51	139.45	27.34

Over the three years, Ryley Intensive had the lowest net return per acre, while CDC Utmost VB had the greatest (Table 18). As well, as management intensified, net return per acre decreased between $15 to $24/ac under Enhanced, and $48 to $74/ac under Intensive compared to Conventional. The largest losses consistently occurred in AC Andrew as management intensified. Conversely, CDC Utmost VB consistently had the smallest losses as management intensified. Generally, the CWRS varieties continued to be profitable under Intensive management. The CPSR varieties broke even under Conventional management, and were not profitable as management intensified. Furthermore, AC Andrew, was profitable under Conventional, broke even with Enhanced, and not profitable under Intensive management.

At Yorkton, AAC Cameron VB had the highest net return, with the net return decreasing as management intensified. CDC Utmost VB Enhanced had the next highest return, with a $12 to $15/ac advantage over Conventional and Intensive management of the variety. Carberry had the greatest profits under Enhanced management, and was nearly $30 greater than when Intensively managed. AC Andrew, SY Rowyn, and AAC Ryley all had their highest profits under Conventional management and had similar, albeit slightly less profits, with Enhanced management. AC Andrew and SY Rowyn had $25 to $28/ac losses when management was Intensive compared to Conventional. AC Ryley Intensive was the least profitable treatment in this experiment, and had a loss of $43 when compared to Conventional management. At this highly profitable location, net returns generally decreased with intensifying management, with Intensive management resulting in losses between $21 and $43/ac compared to Conventional, across all 6 varieties. The exception is Carberry and CDC Utmost VB, which had net returns greater under Enhanced management. However, Carberry had losses under Intensive management, while CDC Utmost VB had profits similar to Conventional.

For Scott, Carberry Enhanced had the largest net return while AAC Ryley had the smallest. Like Yorkton, Scott also did not have individual treatments with negative net returns. Of the CWRS varieties, Carberry and CDC Utmost VB had the highest return under Enhanced, while AC Cameron VB occurred under Conventional management. AC Andrew and SY Rowyn were similar under Conventional and Enhanced, but net profit decreased with Intensive management. At this site, AC Ryley had similar net returns across management levels. At Melfort, Rowyn Enhanced and Intensive, as well as, AAC Ryley Intensive had negative net returns. AC Ryley Intensive was the least profitable, while CDC Utmost VB Conventional was the most. All varieties experienced decreasing returns as management increased, except AAC Cameron VB which was similar under Conventional and Enhanced. In most cases, the decrease in profit margins was 2x or greater when management increased from Enhanced to Intensive.

Indian Head and Swift Current were the two locations where wheat production was least profitable in this experiment. At Indian Head, CPS wheat production had negative net returns/ac under all three management levels, AC Andrew under Enhanced and Intensive, and CWRS varieties under Intensive. Therefore, Intensive management of any wheat class was unprofitable at this site. Management of the CWRS varieties can be profitable under Conventional and Enhanced management, however, it appears that AC Cameron VB maybe slightly less profitable than the other two varieties. CWSWS production at Indian Head appears to have break even or negative net returns across management levels. Swift Current was the least profitable location, with only 2 individual treatments, Carberry and CDC Utmost VB Conventional, having small positive net returns. The negative net return of AC Cameron VB, SY Rowyn, and AC Ryley were similar to Conventional ($7 to $9) and significantly less than those of Carberry, CDC Utmost VB, and AC Andrew ($38 to $55). Under Intensive management, the negative net return was more similar across varieties and ranged from $60 to $112/ac.

Overall, the CWRS varieties under Conventional management seemed to have the greatest net return per acre. However, Carberry and CDC Utmost VB tend to be more profitable than AC Cameron VB in most cases. Conversely, AC Andrew and AC Ryley under Intensive management consistently have lower net returns of the 18 treatments. Largely, the CWRS varieties are more profitable than CWSWS and CPSR varieties. This occurs in spite of their higher yields and higher than standard proteins, as their on-farm market price and protein premiums are lower than CWRS values. On average, profitability is lower with Intensive management and can even result in consistent negative returns per acre across varieties. Enhanced management can provide some increased profitability in some circumstances, but is most often similar to or lower than Conventional management. Therefore, Conventional management consistently provides the best net returns per acre across varieties and market classes. At 3 of 5 locations, Conventional management resulted in positive net returns across the 6 varieties tested; while at the remaining two sites, the CPSR varieties consistently had negative net returns under this management level. Therefore, it appears CWRS varieties tend to be more profitable than CWSWS and CPSR varieties, and varietal selection can be an important factor for elevating the profitability of CWRS wheats. As always, this economic analysis is just an indication of treatment performance. Prices and costs should be tailored to individual price/cost scenarios to each operation to better assess treatment performance.

10. Conclusions and Recommendations:

In this experiment, we were able to incorporate components of intensive wheat management in order to understand the role they play in enhancing wheat profitability in Saskatchewan. The way varieties respond to management is different throughout Saskatchewan as a result of differing soil and climatic conditions. Despite these significant differences, some similarities could be found. Results indicate that CWRS plant populations are more responsive to Intensive management, than CPSR or CSWSW varieties, likely due to the seed treatment applied. Enhanced management often led to hastened maturity across all varieties. However, under Conventional and Intensive management, varietal selection is important for hastening maturity. Intensive management resulted in maximum yield for CWRS and CPSR varieties, while CWSWS were less responsive to management level. Conversely, protein levels of CWRS and CPSR varieties were less responsive to management, while CWSWS benefited the greatest from Intensive management. Test weight and seed size differences were largely attributed to genetic differences and any responses to management were of little practical agronomic importance. FDK values were also largely reflective of genetic differences, with Enhanced management providing increased control relative to Conventional management. In the end, CWRS varieties tended to be more profitable than CWSWS and CPSR varieties, with Conventional management providing the best net returns. Overall, CWRS varieties tended to be more responsive to changes in management intensity. Although Intensive management resulted in the largest yields, Enhanced management hastened maturity and reduced FDK more consistently. However, across the data measured, Enhanced management did not always out preform Conventional. Therefore, the results of this experiment indicate that the Conventional management of wheat in Saskatchewan continues to provide the best return on investment. Lastly, CWRS varieties tend to be more profitable, than CPSR and CWSWS varieties, despite having lower yields due to their higher on farm market prices and potential protein premiums.

Enhanced and Intensive management practices can provide significant benefits for increasing wheat yields; However, the intensity of increased management needs to be considered for each individual operation. In this experiment, many assumptions were made regarding the price and costs associated with wheat production, across various growing areas. Yet each individual farming operation has its own expenses and sale prices. Therefore, it is recommended that each producer uses the economic excel sheet attached to develop their own price and cost matrix, using the yields and protein levels provided. This will allow producers to develop an expectation as to how varieties and management levels may perform at their operation. Then for the most profitable scenario, use the practices listed in this experiment, to test on farm. Every year continue to do a quick economic analysis to what improvements are made over the producers' typical practices.

11. Is there a need to conduct follow up research?

Future research projects should consider testing more varieties within a market class, to determine how varieties with similar genetics respond to the same management level. Additional projects should also consider more aggressive nutrient applications, such as split nitrogen applications, micronutrients, and soil test recommendation for base levels. In addition varying crop inputs individually, in a large experiment would also allow us to better determine which inputs are the most critical for optimizing wheat yield, quality, and profit.

12. Patents/ IP generated/ commercialized products:

There were no patents, IP, or commercialize products developed during the course of this experiment.

13. List technology transfer activities:

In 2017, this ADF project was featured at the NARF, ECRF, and WCA Research Foundation's individual field days, reaching an approximate 200 people. At Indian Head, there were three smaller industry tours featuring this project. Jessica Slowski (NARF) presented the first-years findings at the Western Canadian Crop Production Show (January 11, 2018), as part of the Annual Agri-ARM Update. She also presented these findings at the Annual AgUpdate in Melfort (February 8th, 2018) and the ThinkWheat Meeting in Tisdale SK (March 14th, 2018). The presentation at all three meetings was titled "Let's Make Wheat Great Again" and is posted on the NARF website (neag.ca). Jessica Weber (WARC) also presented these findings to the Independent Crop Consultants (February 7th, 2018), P & H Producer Meetings (February 8th, 2018), and Crop Opportunity (March 11, 2018) events. In addition, Mike Hall (ECRF) created a YouTube video encompassing the year one findings from Yorkton.

In 2018, this project was featured at the NARF, ECRF, WARC and IHARF Research Foundation's individual field days, reaching approximately 500 people. Jessica Slowski also featured this project as part of a presentation given at the SIA NE Branch's AgUpdate in Melfort (February 7th, 2019). The project was also featured in TopCrop Magazine's December 2018 issue titled: "Intensive Wheat Management: Does it pay to use an intensive management system to optimize wheat production?" Lastly, Mike Hall (ECRF) created another YouTube video encompassing the two-year findings from Yorkton.

In 2019, the project was featured once again on the NARF, IHARF, and ECRF field days, reaching approximately 350 people. It was also featured by WCA on the CKSW radio program called "Walk the Plots". The project was also shown at an additional field day hosted by IHARF for the Federated Co-op on July 12, 2019 (60 attendees). Chris Holzapfel was also able to present project highlights at the Think Wheat meetings in Moose Jaw and Yorkton on March 12-13, in addition to CropSphere 2020 (January 15, 2020).

14. List any industry contributions or support received.

Industry contributions were received from SeCan and Alliance Seeds and Belchim. SeCan generously donated all of the AC Ryley and Alliance Seeds the SY Rowyn seed to be used at all five locations, for the three-year period. Belchim also generously donated all of the Manipulator required for the Intensive treatments for all 15 site years.

15. Acknowledgements.

We would like to thank both the Agricultural Development Fund and the Saskatchewan Wheat Development Commission for their generous financial support for this project. This support has been continuously noted through signage at each of the research sites, and when results are presented and discussed at technology transfer events.

16. Appendices:

Appendix A

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Appendix B

Table B1: Seeding, foliar treatment application, and harvest dates for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Location	Seeded	Plant Growth Regulator	Flag Leaf Fungicide	Anthesis Fungicide	Harvested
			2017		
Indian Head	May 9	June 25	June 29	July 11	August 27
Melfort	May 12	June 26	June 30	July 17	September 8
Scott	May 9	June 23	July 4	July 14	September 5
Swift Current	May 27	July 6	July 10	July 18	August 29
Yorkton	May 11	June 20	July 5	July 9 & 13	August 31
			2018		
Indian Head	May 5	June 16	June 25	July 5	August 14
Melfort	May 16	June 27	June 29	July 13	October 4
Scott	May 16	June 25	June 28	July 5	September 30
Swift Current	May 8	June 21	June 21	July 5	August 14
Yorkton	May 7	June 13	June 29	July 2	August 25
			2019		
Indian Head	May 2	June 24	July 1	July 8	September 1
Melfort	June 12	July 10	July 29	August 8	October 10
Scott	May 14	June 26	July 2	July 15	September 16
Swift Current	May 6	June 24	June 27	July 9	August 29
Yorkton	May 7	June 25	July 3	July 11 & 14	September 8 & 18

Table B2: Herbicide, insecticide, and pre-harvest aid applications for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

	Indian Head	Melfort	Scott	Swift Current	Yorkton
			2017		
Pre-seed Herbicide	Glyphosate 540 @ 0.67 L/ac	N/A	Glyphosate 540 @ 1 L/ac + Bromoxynil @ 0.4 L/ac	Glyphosate 540 @ 0.67 L/ac	Glyphosate 540 @ 1 L/ac + Heat @ 59 mL/ac
In-crop Herbicide	Stellar (0.41 L/ac A + 0.24 L/ac B) + Simplicity 0.2 L/ac	N/A (Hand-weeded)	Axial @ 0.5 L/ac + Infinity @ 0.33 L/ac	Traxos @ 500 mL/ac + Buctril M @ 400 mL/ac	Frontline XL @ 0.5 L/ac
Insecticide	N/A	N/A	N/A	N/A	N/A
Pre-harvest Aid	Glyphosate 540 @ 0.67 L/ac	Glyphosate 540 @ 0.67 L/ac	N/A	N/A	Glyphosate 540 @ 0.67 L/ac
			2018		
Pre-seed Herbicide	Glyphosate 540 @ 0.67 L/ac	Glyphosate 540 @ 0.5 L/ac + Heat LQ 21 mL/ac	Glyphosate 540 @ 1 L/ac + Aim @ 35 mL/ac	Glyphosate 540 @ 0.67 L/ac	Glyphosate 540 @ 0.66 L/ac
In-crop Herbicide	Buctril M @ 0.41 L/ac + Simplicity GoDRI 28 g/ac	Prestige XL (0.17 L/ac A + 0.8 L/ac B)	Buctril M @ 0.4 L/ac + Axial @ 0.5 L/ac	Traxos @ 500 mL/ac + Buctril M @ 400 mL/ac	Prestige XL @ 0.71 L/ac + Axial @ 0.5 L/ac
Insecticide	N/A	N/A	N/A	N/A	N/A
Pre-harvest Aid	Glyphosate 540 @ 0.67 L/ac	N/A	Glyphosate 540 @ 0.67 L/ac	N/A	N/A
			2019		
Pre-seed Herbicide	Glyphosate 540 @ 0.67 L/ac	Glyphosate 540 @ 0.51 L/ac	Glyphosate 540 @ 1 L/ac + Aim @ 35 mL/ac	Glyphosate 540 @ 0.67 L/ac	N/A
In-crop Herbicide	OcTTain XL @ 0.45 L/ac + Simplicity GoDRI @ 28 g/ac	Axial @ 0.5 L/ac + Prestige XC (0.13 L/ac A + 0.6 L/ac B)	Axial @ 0.5 L/ac + Buctril M @ 0.4 L/ac	Varro @ 200 mL/ac + OcTTain XL @ 450 mL/ac	Simplicity @ 28 g/ac + Prestige (0.13 L/ac A + 0.6 L/ac B) + MCPA @ 200 mL/ac
Insecticide	N/A	N/A	N/A	N/A	N/A
Pre-harvest Aid	Glyphosate 540 @ 0.67 L/ac	N/A	Glyphosate 540 @ 0.67 L/ac + Heat LQ @ 42.8 mL/ac	N/A	Glyphosate 540 @ 0.66 L/ac

Appendix C

Table C1: Mean temperature (°C) values at the five locations from 2017 to 2019, compared to the long-term climate normal. Data from the nearest Environment and Climate Change Canada location.

Location	Period	May	June	July	August	September	Average
Indian Head	**2017**	11.6	15.5	18.4	16.7	11.3	14.7
	2018	13.9	16.5	17.5	17.6	7.6	14.6
	2019	8.9	15.7	17.4	15.8	11.9	13.9
	Long-Term	10.8	15.8	18.2	17.4	11.5	14.7
Melfort	**2017**	10.8	15.2	18.7	17.2	12.5	14.9
	2018	13.9	16.8	17.5	15.9	6.9	14.2
	2019	8.8	15.3	16.9	14.9	11.2	13.4
	Long-Term	10.7	15.9	17.5	16.8	10.8	14.3
Scott	**2017**	11.5	15.1	18.3	16.6	11.5	14.6
	2018	13.6	16.1	17.4	16.2	6.5	14.0
	2019	9.1	14.9	16.1	14.4	11.3	13.2
	Long-Term	10.8	15.3	17.1	16.5	10.4	14.1
Swift Current	**2017**	13.0	15.7	20.7	18.4	13.3	16.2
	2018	15.2	17.1	18.7	19.0	10.4	16.1
	2019	9.6	15.7	17.6	16.7	12.2	14.4
	Long-Term	10.9	15.4	18.5	18.2	12.0	15.0
Yorkton	**2017**	11.2	16.1	19.3	17.5	13.6	15.5
	2018	14.0	17.7	18.3	18.1	8.0	15.2
	2019	8.6	16.0	18.3	16.1	12.2	14.2
	Long-Term	10.4	15.5	17.9	17.1	11.1	14.4

Table C2: Total precipitation (mm) values at the five locations from 2017 to 2019, compared to the long-term climate normal. Data from the nearest Environment and Climate Change Canada location.

Location	Period	May	June	July	August	September	Average
Indian Head	**2017**	10.4	65.6	15.4	25.2	12.4	129.0
	2018	23.7	90.0	30.4	3.9	39.6	187.6
	2019	13.3	50.4	24.3	96.0	120.8	304.8
	Long-Term	51.7	77.4	63.8	51.2	35.3	279.4
Melfort	**2017**	46.4	44.1	33.3	3.1	13.2	140.1
	2018	38.5	46.6	69.5	43.2	42.0	239.8
	2019	18.8	87.4	72.7	30.7	43.0	252.6
	Long-Term	42.9	54.3	76.7	52.4	38.7	265.0
Scott	**2017**	69.0	34.3	22.4	53.0	18.9	197.6
	2018	29.6	29.6	48.2	23.3	52.1	182.8
	2019	12.7	97.7	107.8	18.0	41.8	278.0
	Long-Term	36.3	61.8	72.1	45.7	36.0	251.9
Swift Current	**2017**	15.4	31.9	9.3	12.7	3.2	72.5
	2018	8.8	23.6	15.1	28.3	45.4	121.2
	2019	10.9	113.9	2.9	38.3	110.7	276.7
	Long-Term	48.5	72.8	52.6	41.5	34.1	249.5
Yorkton	**2017**	4.9	52.9	56.0	34.7	14.0	162.5
	2018	0.8	120.1	53.8	21.1	48.9	244.7
	2019	11.1	81.6	49.1	32.2	53.8	227.8
	Long-Term	51.3	80.1	78.2	62.2	44.9	316.7

Appendix D

Table D1: Influence of variety and management level on plant populations (plants/m^2) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	Indian Head 2017	Indian Head 2018	Indian Head 2019	Melfort 2017	Melfort 2018	Melfort 2019	Scott 2017	Scott 2018	Scott 2019
Carberry	**All**	254	227	266	126	252	183	270	181	212
AAC Cameron VB		307	218	243	146	258	197	304	175	221
CDC Utmost VB		236	205	196	120	247	192	248	177	212
AC Andrew		232	221	214	119	202	172	197	170	189
SY Rowyn		228	222	218	109	227	193	214	177	204
AAC Ryley		219	239	230	105	235	185	208	178	194
All	**Conventional**	182	155	170	106	181	148	170	139	168
	Enhanced	270	238	230	126	251	194	247	184	220
	Intensive	292	282	290	129	284	224	309	210	231
Carberry	**Conventional**	192	156	187	113	200	147	188	144	170
AAC Cameron VB		224	148	185	150	202	164	217	131	192
CDC Utmost VB		153	137	143	104	183	144	174	133	165
AC Andrew		192	155	161	103	167	130	146	135	141
SY Rowyn		165	158	175	95	152	162	150	148	181
AAC Ryley		167	179	169	79	186	140	152	146	163
Carberry	**Enhanced**	278	229	309	130	274	188	277	188	231
AAC Cameron VB		340	243	252	150	267	189	312	186	235
CDC Utmost VB		270	212	163	121	276	210	262	188	222
AC Andrew		227	245	227	120	207	198	199	179	199
SY Rowyn		271	232	193	112	257	181	233	184	223
AAC Ryley		239	270	252	125	227	197	207	179	209
Carberry	**Intensive**	299	309	314	135	288	217	396	215	238
AAC Cameron VB		368	272	299	139	310	242	360	215	237
CDC Utmost VB		300	277	298	135	290	228	319	217	254
AC Andrew		281	271	260	135	235	192	252	200	233
SY Rowyn		254	287	296	120	283	241	269	203	211
AAC Ryley		256	276	274	113	301	224	273	212	212
All	**All**	249	225	231	121	239	189	244	178	206

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Table D1 [Continued]: Influence of variety and management level on plant populations (plants/m^2) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	Swift Current			Yorkton			3-Year
		2017	2018	2019	2017	2018	2019	Average
Carberry	**All**	80	112	192	234	249	353	213
AAC Cameron VB		77	126	182	331	238	290	221
CDC Utmost VB		86	125	180	297	240	285	203
AC Andrew		71	109	179	273	236	252	189
SY Rowyn		79	114	157	270	236	279	195
AAC Ryley		65	140	173	240	236	349	200
All	**Conventional**	70	98	135	212	179	235	156
	Enhanced	78	129	189	266	248	304	211
	Intensive	81	137	212	351	300	369	247
Carberry	**Conventional**	70	97	150	213	202	306	169
AAC Cameron VB		68	90	141	230	175	219	169
CDC Utmost VB		83	98	126	218	170	221	150
AC Andrew		69	100	129	213	173	176	146
SY Rowyn		71	85	126	205	170	220	151
AAC Ryley		59	118	137	191	182	280	157
Carberry	**Enhanced**	80	120	201	149	255	340	217
AAC Cameron VB		83	138	204	368	242	294	233
CDC Utmost VB		78	136	193	337	243	298	214
AC Andrew		68	102	198	288	246	272	198
SY Rowyn		87	140	168	270	251	269	205
AAC Ryley		71	139	172	216	248	355	207
Carberry	**Intensive**	90	119	231	365	293	415	261
AAC Cameron VB		80	155	206	411	307	369	265
CDC Utmost VB		100	143	229	345	319	343	253
AC Andrew		77	125	216	323	298	319	228
SY Rowyn		80	164	178	344	298	357	239
AAC Ryley		64	120	213	321	284	419	237
All	**All**	76	122	179	278	242	304	206

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Table D2: Influence of variety and management level on maturity (days to) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	------------ Indian Head ------------			-------------- Melfort --------------			----------------- Scott -----------------		
		2017	2018	2019	2017	2018	2019	2017	2018	2019
Carberry	**All**	101	93	101	109	121	119	106	93	112
AAC Cameron VB		100	93	101	108	111	115	104	96	109
CDC Utmost VB		100	93	102	109	111	114	105	93	111
AC Andrew		102	95	102	110	112	120	106	97	114
SY Rowyn		101	94	101	110	120	119	106	92	112
AAC Ryley		101	94	102	109	114	119	106	96	113
All	**Conventional**	101	94	102	110	115	118	106	95	111
	Enhanced	101	93	101	108	115	117	105	95	111
	Intensive	101	94	101	109	115	118	105	94	114
Carberry	**Conventional**	101	94	102	110	121	120	106	94	112
AAC Cameron VB		100	93	101	108	112	115	105	97	109
CDC Utmost VB		100	93	102	110	111	114	106	94	111
AC Andrew		101	95	102	111	113	120	107	98	113
SY Rowyn		101	94	102	110	120	118	107	93	111
AAC Ryley		101	94	102	110	113	120	106	97	112
Carberry	**Enhanced**	101	93	101	108	121	119	106	94	111
AAC Cameron VB		100	93	101	108	111	115	104	96	108
CDC Utmost VB		100	93	101	108	113	115	105	93	110
AC Andrew		101	94	102	108	111	120	105	97	115
SY Rowyn		101	93	101	108	119	119	106	93	111
AAC Ryley		101	93	102	108	113	118	107	95	112
Carberry	**Intensive**	101	93	101	108	122	119	106	92	114
AAC Cameron VB		101	93	101	108	111	117	103	95	112
CDC Utmost VB		100	93	101	108	110	115	104	93	113
AC Andrew		102	95	102	110	111	120	107	98	115
SY Rowyn		101	94	101	112	121	120	106	91	114
AAC Ryley		102	94	102	110	115	119	106	95	116
All	**All**	101	93	101	109	115	118	105	94	112

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Table D2 [Continued]: Influence of variety and management level on maturity (days to) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	--------------- Swift Current ---------------			------------------- Yorkton -------------------			3-Year
		2017	2018	2019	2017	2018	2019	Average
Carberry	All	86	82	95	104	98	114	96
AAC Cameron VB		85	83	95	99	96	111	94
CDC Utmost VB		85	82	95	102	96	111	94
AC Andrew		88	84	96	105	96	115	96
SY Rowyn		85	83	95	102	98	115	96
AAC Ryley		86	85	95	105	97	113	96
All	Conventional	86	84	95	102	97	112	102
	Enhanced	86	83	95	104	97	113	102
	Intensive	86	83	95	103	97	115	102
Carberry	Conventional	89	83	96	105	97	112	103
AAC Cameron VB		85	83	94	97	96	111	100
CDC Utmost VB		84	82	95	100	95	111	100
AC Andrew		89	86	97	104	96	114	103
SY Rowyn		85	82	94	104	97	113	102
AAC Ryley		85	87	95	104	98	111	102
Carberry	Enhanced	85	83	96	104	98	115	102
AAC Cameron VB		86	84	96	100	96	112	101
CDC Utmost VB		86	82	94	102	96	112	101
AC Andrew		88	83	97	105	96	114	102
SY Rowyn		85	84	94	104	100	115	102
AAC Ryley		86	85	95	107	96	114	102
Carberry	Intensive	84	84	95	104	97	116	102
AAC Cameron VB		84	84	94	100	96	112	101
CDC Utmost VB		84	83	97	103	95	112	101
AC Andrew		89	83	96	106	97	117	103
SY Rowyn		86	84	96	100	97	117	103
AAC Ryley		87	84	95	105	97	114	103
All	All	86	83	95	103	97	113	102

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Canada

Table D3: Influence of variety and management level on plant grain yield (bu/ac) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	------------ Indian Head ------------			-------------- Melfort --------------			----------------- Scott -----------------		
		2017	2018	2019	2017	2018	2019	2017	2018	2019
Carberry	All	68	59	55	65	70	76	87	39	69
AAC Cameron VB		68	57	54	68	80	77	86	44	77
CDC Utmost VB		68	60	54	68	84	79	88	40	76
AC Andrew		81	69	62	84	104	91	108	57	87
SY Rowyn		71	60	54	67	71	78	95	45	72
AAC Ryley		69	61	56	70	71	80	96	43	70
All	Conventional	66	60	54	63	75	72	84	40	71
	Enhanced	71	60	57	70	79	82	94	45	75
	Intensive	75	63	57	79	84	87	103	49	79
Carberry	Conventional	61	58	53	64	67	70	77	35	66
AAC Cameron VB		64	55	53	60	75	72	80	40	74
CDC Utmost VB		61	56	52	65	82	71	78	36	71
AC Andrew		76	71	61	72	94	79	98	53	81
SY Rowyn		68	59	52	55	68	71	84	41	70
AAC Ryley		66	58	54	63	68	69	86	39	64
Carberry	Enhanced	69	59	56	61	69	78	92	40	71
AAC Cameron VB		66	55	53	69	81	79	83	45	74
CDC Utmost VB		69	61	55	70	83	79	89	40	76
AC Andrew		84	68	64	80	106	97	108	61	86
SY Rowyn		72	60	55	70	70	75	96	44	71
AAC Ryley		67	58	57	70	71	83	94	40	72
Carberry	Intensive	76	59	55	71	73	81	92	43	70
AAC Cameron VB		72	59	57	74	84	81	96	48	82
CDC Utmost VB		74	63	57	71	88	86	98	44	80
AC Andrew		82	68	61	100	112	97	118	58	93
SY Rowyn		74	62	54	78	76	89	106	49	74
AAC Ryley		74	66	57	78	75	87	109	50	74
All	All	71	61	56	71	80	80	93	45	75

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Table D3 [Continued]: Influence of variety and management level on grain yield (bu/ac) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	--------------- Swift Current ---------------			------------------- Yorkton -------------------			3-Year
		2017	2018	2019	2017	2018	2019	Average
Carberry	All	45	33	53	69	83	93	64
AAC Cameron VB		43	33	48	70	89	95	66
CDC Utmost VB		44	36	53	68	88	94	67
AC Andrew		47	42	52	96	106	116	80
SY Rowyn		39	37	51	80	88	98	67
AAC Ryley		46	40	55	80	90	105	69
All	Conventional	43	35	50	70	81	94	64
	Enhanced	46	37	53	75	93	100	69
	Intensive	43	38	53	85	99	106	73
Carberry	Conventional	46	34	51	65	74	87	61
AAC Cameron VB		43	27	47	67	81	88	62
CDC Utmost VB		43	34	53	59	77	89	62
AC Andrew		48	47	50	83	95	111	75
SY Rowyn		35	31	48	74	77	93	62
AAC Ryley		41	39	53	75	81	99	64
Carberry	Enhanced	45	29	54	65	85	96	65
AAC Cameron VB		43	38	52	68	89	95	66
CDC Utmost VB		45	36	51	65	91	95	67
AC Andrew		46	37	55	94	110	115	81
SY Rowyn		41	41	50	79	91	97	68
AAC Ryley		55	44	55	83	93	104	70
Carberry	Intensive	43	35	53	77	90	96	68
AAC Cameron VB		42	37	47	75	98	103	70
CDC Utmost VB		44	39	56	80	98	98	72
AC Andrew		47	41	52	112	112	124	85
SY Rowyn		42	40	55	88	97	105	73
AAC Ryley		44	36	56	82	98	114	73
All	All	44	37	52	77	91	100	69

Table D4: Influence of variety and management level on grain protein (%) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	------------ Indian Head ------------			-------------- Melfort --------------			----------------- Scott -----------------		
		2017	2018	2019	2017	2018	2019	2017	2018	2019
Carberry	All	13.5	14.0	14.8	12.1	14.6	11.1	12.1	16.3	15.7
AAC Cameron VB		12.9	13.4	14.4	11.0	14.0	10.8	11.6	15.6	14.4
CDC Utmost VB		13.1	13.7	14.9	11.7	14.1	11.0	11.3	16.3	14.7
AC Andrew		10.5	11.5	13.0	8.9	10.9	8.1	8.9	13.3	11.8
SY Rowyn		12.5	13.3	14.3	10.8	13.9	10.6	11.4	15.7	14.7
AAC Ryley		12.8	13.4	14.4	10.8	14.5	10.4	11.0	16.2	14.7
All	Conventional	11.9	12.5	13.9	10.5	13.4	10.2	10.8	15.1	14.0
	Enhanced	12.7	13.3	14.3	10.9	13.7	10.4	11.0	15.7	14.2
	Intensive	13.0	13.8	14.7	11.3	13.9	10.4	11.3	15.9	14.6
Carberry	Conventional	13.0	13.2	14.5	11.6	14.1	11.0	11.7	16.1	15.5
AAC Cameron VB		11.9	12.6	13.8	10.6	13.9	10.3	11.3	15.0	14.1
CDC Utmost VB		12.7	13.5	14.9	11.4	14.0	10.9	11.2	15.9	14.3
AC Andrew		9.8	10.6	12.5	8.5	10.7	8.1	8.7	12.8	11.4
SY Rowyn		11.9	12.7	13.8	10.3	13.6	10.4	11.3	15.3	14.0
AAC Ryley		12.0	12.5	13.8	10.7	14.1	10.4	10.9	15.6	14.4
Carberry	Enhanced	13.6	14.1	14.8	12.1	14.9	11.1	12.3	16.3	15.5
AAC Cameron VB		13.2	13.5	14.4	11.1	13.9	11.0	11.7	15.7	14.3
CDC Utmost VB		13.0	13.6	14.9	11.7	14.2	11.1	11.2	16.4	14.7
AC Andrew		10.6	11.6	12.9	8.9	11.0	8.2	9.1	13.2	11.9
SY Rowyn		12.6	13.4	14.1	10.9	13.8	10.6	10.9	16.0	14.5
AAC Ryley		13.1	13.8	14.5	10.7	14.6	10.5	10.9	16.6	14.7
Carberry	Intensive	14.0	14.8	15.0	12.6	14.9	11.2	12.5	16.6	16.2
AAC Cameron VB		13.5	14.1	15.1	11.5	14.1	11.0	11.8	16.1	14.7
CDC Utmost VB		13.5	14.0	15.0	12.2	14.3	11.1	11.5	16.5	15.0
AC Andrew		11.0	12.4	13.6	9.2	11.1	8.1	9.0	14.0	12.2
SY Rowyn		12.9	13.9	14.8	11.2	14.4	10.7	11.9	15.9	14.9
AAC Ryley		13.3	13.9	15.0	11.1	14.7	10.3	11.3	16.4	14.9
All	All	12.5	13.2	14.3	10.9	13.7	10.3	11.0	15.6	14.3

Table D4 [Continued]: Influence of variety and management level on grain protein (%) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	Swift Current 2017	Swift Current 2018	Swift Current 2019	Yorkton 2017	Yorkton 2018	Yorkton 2019	3-Year Average
Carberry	**All**	14.3	16.7	15.3	14.0	13.4	13.3	14.1
AAC Cameron VB		14.8	16.3	15.3	13.1	12.9	12.4	13.5
CDC Utmost VB		13.9	16.1	15.3	14.3	13.0	12.6	13.7
AC Andrew		11.6	14.7	14.6	10.3	10.2	10.1	11.2
SY Rowyn		14.1	15.8	15.3	13.1	12.7	12.0	13.3
AAC Ryley		13.7	15.9	15.7	12.3	12.0	11.8	13.3
All	**Conventional**	13.7	15.9	15.1	12.5	11.9	11.3	12.8
	Enhanced	13.7	15.9	15.2	13.0	12.6	12.1	13.2
	Intensive	13.9	16.0	15.5	13.0	12.6	12.7	13.5
Carberry	**Conventional**	14.2	16.5	15.2	13.7	12.5	12.6	13.7
AAC Cameron VB		14.7	16.8	15.2	13.1	12.5	12.0	13.2
CDC Utmost VB		13.7	16.3	15.1	14.3	12.7	12.0	13.5
AC Andrew		11.2	13.7	14.3	9.9	10.2	9.4	10.8
SY Rowyn		14.3	15.9	15.4	12.3	12.1	11.3	13.0
AAC Ryley		13.9	16.0	15.5	12.0	11.3	10.7	12.9
Carberry	**Enhanced**	14.2	17.0	15.4	14.6	13.9	13.3	14.2
AAC Cameron VB		14.8	16.1	14.9	13.2	13.2	12.4	13.6
CDC Utmost VB		14.1	16.0	15.1	14.5	13.3	12.6	13.8
AC Andrew		11.5	15.3	14.4	10.2	10.0	10.2	11.3
SY Rowyn		14.0	15.7	15.5	13.3	13.1	12.1	13.4
AAC Ryley		13.4	15.1	15.7	12.2	12.0	11.8	13.3
Carberry	**Intensive**	14.5	16.5	15.4	13.9	13.9	13.9	14.4
AAC Cameron VB		14.7	16.1	15.9	13.0	12.9	12.8	13.8
CDC Utmost VB		14.0	16.0	15.7	14.0	13.1	13.3	13.9
AC Andrew		12.1	15.2	15.0	10.7	10.5	10.7	11.6
SY Rowyn		14.0	15.7	15.0	13.7	12.9	12.7	13.6
AAC Ryley		13.8	16.7	15.8	12.8	12.7	12.8	13.7
All	**All**	13.7	15.9	15.2	12.8	12.4	12.0	13.2

Table D5: Influence of variety and management level on test weight (g/0.5L) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	Indian Head 2017	Indian Head 2018	Indian Head 2019	Melfort 2017	Melfort 2018	Melfort 2019	Scott 2017	Scott 2018	Scott 2019
Carberry	**All**	405	409	396	418	388	356	413	389	389
AAC Cameron VB		399	401	385	412	394	359	404	385	392
CDC Utmost VB		398	401	384	410	389	348	403	382	393
AC Andrew		388	391	374	404	379	334	395	391	394
SY Rowyn		403	404	385	418	389	351	408	385	395
AAC Ryley		388	392	374	404	380	335	398	381	397
All	**Conventional**	398	403	384	411	385	346	404	387	384
	Enhanced	398	399	384	411	388	349	404	385	394
	Intensive	395	397	382	411	388	346	402	385	401
Carberry	**Conventional**	404	411	396	418	386	354	414	390	379
AAC Cameron VB		401	405	387	414	393	360	406	387	383
CDC Utmost VB		398	402	385	409	388	347	403	383	384
AC Andrew		389	395	376	402	378	331	398	392	385
SY Rowyn		405	407	386	417	387	351	409	386	387
AAC Ryley		390	395	374	404	375	330	397	381	389
Carberry	**Enhanced**	406	409	396	419	389	360	414	389	392
AAC Cameron VB		400	400	386	411	393	361	405	385	393
CDC Utmost VB		399	401	385	409	389	346	404	382	394
AC Andrew		391	392	376	405	380	340	396	391	394
SY Rowyn		403	404	385	418	392	349	410	385	395
AAC Ryley		390	390	375	404	383	340	399	380	396
Carberry	**Intensive**	405	406	395	419	390	354	412	388	398
AAC Cameron VB		397	398	383	413	394	356	403	383	399
CDC Utmost VB		397	399	383	411	389	351	403	382	400
AC Andrew		384	386	371	405	380	329	393	390	402
SY Rowyn		401	402	383	418	389	352	406	385	403
AAC Ryley		385	392	375	403	384	335	398	381	405
All	**All**	397	400	383	411	387	347	404	386	393

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Table D5 [Continued]: Influence of variety and management level on test weight (g/0.5L) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	--------------- Swift Current ---------------			------------------ Yorkton ------------------			3-Year
		2017	2018	2019	2017	2018	2019	Average
Carberry	All	391	411	373	394	408	396	396
AAC Cameron VB		390	403	357	390	403	391	391
CDC Utmost VB		390	401	365	387	403	387	389
AC Andrew		391	400	344	383	394	379	383
SY Rowyn		387	399	361	393	406	394	392
AAC Ryley		390	397	348	384	394	380	383
All	Conventional	388	402	360	389	401	391	389
	Enhanced	391	402	358	388	402	386	389
	Intensive	391	402	356	387	401	386	389
Carberry	Conventional	383	413	376	396	407	398	395
AAC Cameron VB		393	401	362	391	404	394	392
CDC Utmost VB		389	402	372	386	402	391	389
AC Andrew		387	396	343	386	393	382	382
SY Rowyn		384	399	358	395	407	398	392
AAC Ryley		389	399	349	383	392	382	382
Carberry	Enhanced	393	410	373	393	410	394	396
AAC Cameron VB		387	403	361	390	402	389	391
CDC Utmost VB		388	400	366	387	403	383	389
AC Andrew		395	400	345	384	397	377	384
SY Rowyn		391	399	362	393	406	393	392
AAC Ryley		393	400	344	382	395	380	383
Carberry	Intensive	397	410	371	393	408	395	396
AAC Cameron VB		392	405	349	389	403	389	390
CDC Utmost VB		394	402	358	386	403	386	390
AC Andrew		392	403	343	378	391	387	382
SY Rowyn		386	399	364	392	405	391	392
AAC Ryley		389	391	353	386	393	379	383
All	All	390	402	358	388	401	388	389

Table D6: Influence of variety and management level on seed weight (g/1000 seeds) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	------------ Indian Head ------------			-------------- Melfort --------------			----------------- Scott -----------------		
		2017	2018	2019	2017	2018	2019	2017	2018	2019
Carberry	All	33	35	35	39	36	34	38	36	40
AAC Cameron VB		34	35	36	42	40	37	40	38	42
CDC Utmost VB		31	32	31	38	35	35	36	35	38
AC Andrew		31	32	33	41	40	34	37	41	41
SY Rowyn		28	30	28	35	32	30	34	34	37
AAC Ryley		39	42	43	49	55	43	49	49	51
All	Conventional	33	36	35	41	39	35	39	39	42
	Enhanced	33	34	34	40	40	36	39	39	41
	Intensive	32	34	34	41	40	36	39	39	41
Carberry	Conventional	33	36	34	39	36	34	38	37	40
AAC Cameron VB		33	37	37	43	40	38	41	39	43
CDC Utmost VB		31	33	32	38	34	35	36	36	38
AC Andrew		31	34	34	40	39	34	38	42	41
SY Rowyn		29	32	29	35	32	30	34	34	37
AAC Ryley		39	43	43	50	55	42	48	49	51
Carberry	Enhanced	33	35	35	39	37	34	39	36	40
AAC Cameron VB		34	35	36	41	40	37	41	36	42
CDC Utmost VB		31	32	31	38	35	34	35	35	37
AC Andrew		31	32	33	40	41	34	37	41	41
SY Rowyn		29	30	29	35	32	29	34	35	37
AAC Ryley		39	41	43	49	56	45	49	50	51
Carberry	Intensive	33	34	34	38	37	34	38	37	39
AAC Cameron VB		34	34	35	42	40	37	39	38	42
CDC Utmost VB		30	31	31	38	36	35	36	36	38
AC Andrew		30	30	32	42	40	34	37	41	40
SY Rowyn		27	29	27	35	33	30	33	34	36
AAC Ryley		38	43	43	50	54	44	50	49	52
All	All	33	35	34	41	40	35	39	39	41

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Government of Saskatchewan
Ministry of Agriculture
Canada

Table D6 [Continued]: Influence of variety and management level on seed weight (g/1000 seeds) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	---------------- Swift Current ----------------			-------------------- Yorkton --------------------			3-Year
		2017	2018	2019	2017	2018	2019	Average
Carberry	**All**	31	35	24	35	37	39	35
AAC Cameron VB		32	34	24	37	41	44	37
CDC Utmost VB		29	32	23	33	38	38	34
AC Andrew		28	33	21	37	38	42	35
SY Rowyn		25	27	20	31	33	35	31
AAC Ryley		39	44	29	45	49	54	45
All	**Conventional**	31	34	24	36	40	42	36
	Enhanced	31	34	23	36	40	43	36
	Intensive	30	34	23	37	39	41	36
Carberry	**Conventional**	32	35	24	35	37	40	35
AAC Cameron VB		32	33	26	36	43	45	38
CDC Utmost VB		29	32	25	34	38	38	34
AC Andrew		30	32	22	37	38	43	35
SY Rowyn		26	27	20	30	33	35	31
AAC Ryley		39	45	28	43	49	53	45
Carberry	**Enhanced**	30	33	24	35	38	39	35
AAC Cameron VB		32	34	24	35	40	45	37
CDC Utmost VB		29	31	22	32	39	38	33
AC Andrew		28	33	21	38	39	42	35
SY Rowyn		25	27	20	31	34	36	31
AAC Ryley		40	44	27	45	48	55	45
Carberry	**Intensive**	29	34	23	35	37	39	35
AAC Cameron VB		31	35	23	39	40	43	37
CDC Utmost VB		28	32	22	34	37	38	33
AC Andrew		27	34	21	37	36	40	35
SY Rowyn		24	27	21	32	32	34	30
AAC Ryley		37	42	31	46	50	54	45
All	**All**	31	34	23	36	39	42	36

Table D7: Influence of variety and management level on fusarium damaged kernels (%) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	Indian Head			Melfort			Scott		
		2017	2018	2019	2017	2018	2019	2017	2018	2019
Carberry	**All**	0.27	0.16	0.01	0.34	0.09	0.12	0.16	0.05	0.15
AAC Cameron VB		0.18	0.06	0.01	0.19	0.03	0.05	0.20	0.02	0.18
CDC Utmost VB		0.20	0.06	0.09	0.21	0.15	0.25	0.17	0.05	0.42
AC Andrew		0.30	0.05	0.24	0.24	0.12	0.17	0.42	0.02	1.34
SY Rowyn		0.32	0.06	0.01	0.31	0.01	0.03	0.24	0.01	0.07
AAC Ryley		0.50	0.43	0.45	0.59	0.49	1.43	0.37	0.11	1.74
All	**Conventional**	0.26	0.18	0.19	0.39	0.20	0.73	0.32	0.04	0.71
	Enhanced	0.32	0.13	0.13	0.26	0.14	0.33	0.23	0.03	0.52
	Intensive	0.32	0.13	0.12	0.31	0.14	0.38	0.25	0.04	0.72
Carberry	**Conventional**	0.26	0.26	0.02	0.35	0.13	0.19	0.19	0.05	0.24
AAC Cameron VB		0.12	0.10	0.01	0.20	0.04	0.07	0.30	0.02	0.30
CDC Utmost VB		0.15	0.08	0.11	0.25	0.20	0.36	0.19	0.06	0.57
AC Andrew		0.22	0.08	0.23	0.28	0.14	0.21	0.48	0.03	1.22
SY Rowyn		0.20	0.05	0.01	0.37	0.02	0.03	0.34	0.02	0.15
AAC Ryley		0.57	0.45	0.61	0.78	0.58	1.86	0.36	0.12	1.78
Carberry	**Enhanced**	0.34	0.12	0.00	0.38	0.10	0.10	0.13	0.06	0.14
AAC Cameron VB		0.16	0.04	0.02	0.17	0.02	0.03	0.12	0.01	0.17
CDC Utmost VB		0.17	0.05	0.09	0.14	0.10	0.16	0.14	0.05	0.22
AC Andrew		0.36	0.03	0.28	0.16	0.13	0.07	0.36	0.02	1.12
SY Rowyn		0.39	0.10	0.00	0.26	0.01	0.03	0.19	0.01	0.02
AAC Ryley		0.45	0.37	0.32	0.39	0.44	1.07	0.40	0.09	1.45
Carberry	**Intensive**	0.22	0.03	0.01	0.28	0.04	0.05	0.16	0.03	0.07
AAC Cameron VB		0.25	0.03	0.01	0.19	0.02	0.04	0.17	0.03	0.06
CDC Utmost VB		0.27	0.03	0.07	0.22	0.14	0.23	0.18	0.05	0.46
AC Andrew		0.33	0.05	0.20	0.27	0.10	0.21	0.41	0.02	1.70
SY Rowyn		0.37	0.02	0.02	0.30	0.02	0.02	0.19	0.01	0.05
AAC Ryley		0.48	0.48	0.39	0.57	0.45	1.15	0.34	0.11	1.98
All	**All**	0.30	0.13	0.13	0.31	0.15	0.33	0.26	0.04	0.65

Table D7 [Continued]: Influence of variety and management level on fusarium damaged kernels (%) for the Input Study: Intensive Wheat Management at five locations in 2017, 2018, and 2019.

Variety	Management	Swift Current			Yorkton			3-Year
		2017	2018	2019	2017	2018	2019	Average
Carberry	All	0.00	0.00	0.00	0.08	0.04	0.02	0.10
AAC Cameron VB		0.00	0.01	0.00	0.04	0.02	0.01	0.07
CDC Utmost VB		0.00	0.01	0.00	0.14	0.13	0.04	0.13
AC Andrew		0.04	0.01	0.00	0.19	0.16	0.20	0.23
SY Rowyn		0.00	0.00	0.00	0.14	0.01	0.00	0.08
AAC Ryley		0.05	0.08	0.00	0.16	0.32	0.18	0.46
All	Conventional	0.00	0.01	0.00	0.12	0.10	0.04	0.22
	Enhanced	0.02	0.01	0.00	0.08	0.08	0.07	0.16
	Intensive	0.02	0.01	0.00	0.17	0.09	0.04	0.18
Carberry	Conventional	0.00	0.00	0.00	0.08	0.03	0.01	0.12
AAC Cameron VB		0.00	0.00	0.00	0.04	0.02	0.00	0.08
CDC Utmost VB		0.00	0.00	0.00	0.16	0.18	0.06	0.16
AC Andrew		0.00	0.00	0.00	0.19	0.11	0.13	0.22
SY Rowyn		0.00	0.01	0.00	0.07	0.03	0.00	0.09
AAC Ryley		0.00	0.20	0.00	0.24	0.38	0.16	0.54
Carberry	Enhanced	0.00	0.01	0.00	0.06	0.06	0.07	0.10
AAC Cameron VB		0.00	0.01	0.00	0.02	0.03	0.04	0.05
CDC Utmost VB		0.00	0.01	0.00	0.07	0.10	0.02	0.09
AC Andrew		0.13	0.01	0.00	0.12	0.16	0.22	0.21
SY Rowyn		0.00	0.01	0.00	0.15	0.01	0.00	0.08
AAC Ryley		0.00	0.02	0.00	0.09	0.23	0.16	0.37
Carberry	Intensive	0.00	0.00	0.00	0.09	0.03	0.00	0.07
AAC Cameron VB		0.00	0.01	0.00	0.07	0.02	0.00	0.06
CDC Utmost VB		0.00	0.01	0.00	0.22	0.11	0.03	0.13
AC Andrew		0.00	0.02	0.00	0.27	0.20	0.26	0.27
SY Rowyn		0.00	0.00	0.00	0.23	0.00	0.22	0.10
AAC Ryley		0.13	0.08	0.00	0.18	0.38	0.00	0.45
All	All	0.01	0.02	0.00	0.13	0.12	0.08	0.18

Appendix E

Additional Weather Condition Details

Generally, May 2017 and 2018, June 2018, July 2017, and September 2017 across all locations were similar or warmer than the long-term average. May 2017 temperatures were within 1°C of normal, except Swift Current where it was 2.1°C warmer. May 2018 had average temperatures ranging from 2.8°C (Scott) to 4.3°C (Swift Current) greater than the long-term average. June 2018 was notably warmer in Swift Current and Yorkton with temperatures 1.7°C and 2.2°C warmer, respectively; while the remaining sites were within 1°C of normal. June 2017 had average temperatures ranging from 1.2 to 1.4°C at Melfort, Scott, and Yorkton to 2.2°C warmer in Swift Current; while Indian Head was only 0.2°C warmer. September 2018 ranged from 1.1°C (Scott) to 2.5°C (Yorkton) warmer. September 2018, and May, July, and August 2019 were notably cooler than the long-term average. September 2018 at Indian Head, Melfort, and Scott were all 3.9°C cooler than the long-term average, while, Yorkton was 3.1°C, and Swift Current was 1.6°C. May 2019 ranged from 1.3°C to 1.9°C cooler at all five locations. June 2019, ranged from 0.4°C to 1.0°C cooler at all five locations. August 2019 was considerably cooler at all five locations, where temperatures ranged from 1.0°C (Yorkton) to 2.1°C (Scott) below normal.

May 2018 and 2019, June 2017, July 2017 and 2019, and September 2017 were drier months on average; while, May 2017, June 2018 and 2019, July 2019, and August 2019 had variable precipitation across the province. September 2019 was the only time period in which generally more precipitation on average was received. In Indian Head, Melfort, and Yorkton, all three years, precipitation in May was 54%, 68%, and 78% or less, respectively, than the long-term average. In Melfort, May 2017 and 2018 had rainfall within 12.7 mm (0.5 inch) from the long-term normal, while precipitation in May 2019 was 56% less. In Scott, May 2017 had 90% more rainfall than normal, while 2018 was within 0.5 inch, and 2019 had 65% less. June 2017 rainfall was 45%, 56%, and 34% less at Scott, Swift Current, and Yorkton, respectively; while Indian Head and Melfort were within 12.7 mm of the long-term normal. Scott and Swift Current both had less than half of normal precipitation in June 2018, Indian Head and Melfort were within 12.7mm, and Yorkton had 50% more precipitation. In June 2019, Melfort, Scott, and Swift Current all had 50% or greater precipitation than the normal, while Yorkton was similar, and Indian Head had 35% less. On average July was drier than normal, all three years, at the five different locations. Indian Head had 52 to 76% less precipitation in July, Melfort 5 to 57%, Scott 33 to 69%, Swift Current 71 to 94%, and Yorkton 22 to 37% less. The exception was Scott 2019 when there was 49% more rainfall than normal. August was within 12.7mm or the normal in Melfort 2018, Scott 2017, and Swift Current 2018 and 2019. August 2019, in Indian Head was wetter than average with 88% more rainfall. Indian Head 2017, Melfort 2019, Scott 2018 and 2019, Swift Current 2017, and all three years at Yorkton, the total rainfall received ranged from 22 to 66% of normal. August at Indian Head 2018 and Melfort 2017, was exceptionally dry with only 92% and 94% of normal rainfall occurring inside this time period. Precipitation was less than average, in September, at all five site years. In September 2017, Swift Current had 91% less precipitation, while the other sites were 48 to 69% drier than normal. Scott 2018 had 45% more precipitation in September, whereas the other four sites were within 12.7 mm of the average. September 2019 was also within 12.7 mm of the average at three sites; while Indian Head and Swift Current were exceptionally wet, with 85.5 mm and 76.6 mm more rainfall than normal, respectively.