2022 Annual Report

for the

Saskatchewan Ministry of Agriculture's

Agricultural Demonstration of Practices & Technologies (ADOPT) Program

Project Title: Spring Cereal Re-Seeding Options for Poor Stands of Winter Wheat

(Project #20210958)

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Project Identification

1. **Project Title:** Spring cereal re-seeding options for poor stands of winter wheat
2. **Project Number:** 20210958
3. **Producer Group Sponsoring the Project:** Indian Head Agricultural Research Foundation
4. **Project Location(s):** Indian Head, Saskatchewan, R.M. #156
5. **Project start and end dates(s):** September-2021 to February-2023
6. **Project contact person & contact details:**

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Objectives and Rationale

7. **Project Objectives:**
The objective of this project was to demonstrate the agronomic and economic performance of a wide range of winter wheat stands relative to a selection of agronomically suitable spring cereal re-seeding options. More specifically, we intended to provide information on what the minimum plant populations were where winter wheat yields were likely to be compromised and to look at the economics of reseeding to either barley, oat, or canary seed.

8. **Project Rationale:**
There are numerous advantages to growing winter wheat and other fall-seeded cereals, especially from longer-term agronomic and environmental perspectives; however, unfavorable conditions for fall establishment have taken a toll on this crop in recent years. In some years and regions, wet weather has created challenges with harvesting the preceding crops in a timely manner, thus greatly diminishing the window for fall seeding. Alternatively, many regions have experienced severe drought and, extremely dry soil conditions in the fall have either created doubt regarding the viability of winter cereals or led to poor fall establishment and subsequently delayed crops or suboptimal stands. When poor establishment does occur, producers must make the difficult decision of whether to nurture the existing crop and hope that it is profitable or to terminate it and reseed to a suitable spring crop, taking on additional expenses (due to reseeding) and often seeding late in May or early June, past the ideal seeding window in many cases.

In addition to the fact that spring crops seeded in late May or June do not usually perform as well as with earlier seeding, the decision to re-seed is especially challenging because poor stands of winter wheat can often still be viable if weed control and fertility is adequate. Detailed information on assessing overwinter survival and spring stands is provided by the Western Winter Wheat Initiative, a collaboration between Bayer, Ducks Unlimited Canada, and Richardson International Ltd (www.growwinterwheat.ca/growing-winter-wheat/spring-assessment). According to this resource, the optimum plant stand is over 20 plants/square foot (213 plants/m^2); however, 10-15 plants/square foot (107-160 plants/m^2) can still produce a profitable crop and even stands as low as 8 plants/square foot can yield surprisingly well. If the decision to reseed is made, options are frequently limited either by disease considerations (i.e., spring wheat is not recommended due to wheat streak mosaic virus) or herbicide issues (i.e., fall 2,4-D or florasulam can negatively impact many broadleaf options). With these factors, along with basic rotational considerations, this project focussed on barley, oat, and canary seed as the most viable options to re-seed to after termination of the winter wheat.

This project intended to benefit producers by demonstrating winter wheat response to a wide range of plant densities, to simulate preferred versus poor stand establishment, along with the relative economic and agronomic performance of taking a sub-optimal stand of winter wheat to harvest versus reseeding to either barley, oat, or canary seed at the tail end of the optimal seeding window.

Methodology and Results

9. Methodology:

A field demonstration with winter wheat was established on canola stubble in the fall of 2021. The treatments were arranged in a four replicate RCBD and were simply six different winter wheat seeding rates (50, 100, 200, 300, 400, and 500 seeds/m^2). Three additional treatments were seeded to 100 seeds/m^2 and destined to be terminated and re-seeded to spring cereal options.

Selected agronomic details and dates of operations are provided in Table 6 of the Appendices. Winter wheat seeding was completed on September 15 and the variety was AAC Goldrush. The winter wheat was treated with a seed-applied fungicide to improve establishment and overwinter survival. Fertility was held constant at 125-40-20-20 kg N-P_2O_5-K_2O-S/ha across all treatments and was intended to be non-limiting. All fertilizer was side-banded and the nutrient sources were urea, monoammonium phosphate, potash, and ammonium sulphate. The entire site was sprayed with 894 g glyphosate/ha plus 5 g florasulam/ha on September 19, after seeding but prior to emergence. In the spring of 2023, the three treatments that were slated for re-seeding were terminated with glyphosate on May 21 and re-seeded to either barley, oat, or canary seed on May 23. This was considered late enough to reasonably evaluate winter wheat establishment and winter kill, yet still early enough to re-seed with a high probably of success for the spring seeded crops. The target seeding rates and varieties of the spring seed crops were AAC Synergy barley at 300 seeds/m^2, CDC Arborg oat at 350 seeds/m^2, and Keet canary seed at 45 kg/ha. No additional fertilizer was applied with the spring seeded crops. For all crops, weeds and disease were managed using registered herbicide and fungicide options that were considered typical for the region. Insecticides were utilized as required with the entire site over-sprayed for grasshoppers in early July and the canary seed sprayed for aphids in early August. Pre-harvest glyphosate was applied on the winter wheat and canary seed for late-season weed control and to assist with crop drydown, but not in the barley or oats where such applications are not permitted by end users. The centre rows of each plot were straight-combined using a plot harvester as soon as possible after it was fit to do so.

Data collection included assessments of winter wheat plant densities and grain yield. Final winter wheat plant densities were estimated from destructive counts where plants in 2 x 1 m sections of crop row were dug up, separated at the roots, and counted with the values converted to plants/m^2. Grain yields for all crops were adjusted for dockage and to a uniform seed moisture content of 14.5% for winter wheat, 13.5% for barley and oat, and 13% for canary seed.

The winter wheat establishment and yield data were analyzed using the GLIMMIX procedure of SAS Studio with the effects of seeding rate (SR) treated as fixed and replicate effects treated as random. Individual treatment means were separated using Fisher's protected L.S.D. test and orthogonal contrasts were utilized to test whether responses to seeding rate were linear or quadratic (curvilinear). Additionally, a non-linear regression analyses was completed using SigmaPlot 14.5 to establish the relationship between the actual winter wheat plant densities and grain yield. Treatment effects and differences between means were considered significant at $P \leq 0.05$; however, p-values ≤ 0.1 may also be acknowledged as marginally significant. Spring cereal yield data were not statistically analyzed; however, the standard deviation was calculated and provided as an indicator of the overall yield variability for each plot.

A marginal economic analyses was completed to demonstrate the relative economic implications of re-seeding to each of the spring cereal options compared to simply nurturing the winter wheat crop, regardless of establishment, and taking it to harvest. For this analyses, several assumptions had to be made and only the expenses that were assumed to vary between treatments were included. Grain prices and costs of operations were primarily estimated using the 2022-23 Saskatchewan Crop Planning Guide (publications.saskatchewan.ca/api/v1/products/120059/formats/138604/download) and the 2022-23 Farm Machinery Custom Rental Rate Guide (publications.saskatchewan.ca/api/v1/products/76527/formats/85808/download). The assumed grain prices were $315, $281, $389, and $771/Mt for winter wheat, barley, oat, and canary seed, respectively. Gross revenues were estimated using these price assumptions and the actual, observed grain yields. The expenses associated with terminating the poor stands of winter wheat included both the cost of the application and 894 g glyphosate/ha and was assumed to be $30/ha in total (approximately $15/ha each for the product and application cost). Re-seeding costs for all crops were set to $58/ha while the cost of the seed itself was assumed to be $100/ha, $120/ha, and $60/ha for barley, oats, and canary seed, respectively. For simplicity, crop protection costs were assumed to be similar for all crops with the exception of herbicide costs for oats being $45/ha less than other options due to there being no wild oat herbicide options. Marginal net income was estimated by subtracting any applicable estimated expenses from the estimated gross revenues. We recognize that actual revenues and expenses will vary from farm-to-farm or year-to-year and encourage readers to substitute these numbers with their own if they see value in doing so.

10. Results:

Growing season weather and residual soil nutrients

Mean monthly temperatures and total precipitation amounts for May-August are presented in Table 1 for the 2022 growing season at Indian Head alongside the long-term (1981-2010) averages. Information from the preceding fall months is also provided to coincide with establishment of the winter wheat and aid in the interpretation of results. In the fall , essentially no rain fell in September; however, October was wetter and warmer than average. Winter snowfall was abundant and the spring melt was later than normal. Precipitation for the month of May was nearly twice the long-term average and, overall, conditions were suitable for successful establishment and early-season growth of winter cereals. While soil moisture was higher than ideal for seeding the spring cereal options, the crops were seeded in the last week of May and established by early June. With abundant moisture and approximately normal temperatures, yields for all crops, regardless of when they were seeded, were quite high.

Table 1. Mean monthly temperatures and precipitation amounts along with long-term (1981-2010) averages for the 2021 and 2022 growing seasons at Indian Head, SK. Data for the fall period (September through October) were also reported.

Year	Prev. Sep	Prev. Oct	May	June	July	August	May-Aug
	------------ Mean Temperature (°C) ------------						
2022	14.5	6.8	10.9	16.1	18.1	18.3	15.8 (101%)
LT	11.5	4.0	10.8	15.8	18.2	17.4	15.6
	------------ Total Precipitation (mm) ------------						
2022	0.4	43.0	97.7	27.5	114.5	45.9	286 (117%)
LT	35.3	24.9	51.8	77.4	63.8	51.2	244

Table 2 provides the results from the overall tests of fixed effects for winter wheat plant densities and grain yield while Table 3 provides the treatment means and orthogonal contrast results. The overall F-test for both variables was highly significant (*P* < 0.001). Focussing on winter wheat plant populations, establishment was excellent overall and the observed plant densities increased significantly with each incremental increase in seeding rate. As is commonly observed, seedling mortality appeared to increase with seeding rate. For example, an estimated 92-97% of the live seeds planted became established plants for the lowest two seeding rates (50-100 seeds/m^2), while survival was only 67-73% at the two highest rates (400-500 seeds/m^2). With this, the actual winter wheat plant densities ranged from 46-333 plants/m^2 in the first year of this demonstration. Due to the higher seedling mortality at the highest seeding rates, the quadratic orthogonal contrast for seeding rate effects on plant densities was significant (*P* = 0.006). Overall, establishment was better than anticipated and, based on past research and recommendations, it was unlikely that any but the lowest observed winter wheat populations would be limiting to yield.

Table 2. Tests of fixed effects of seeding rate on winter wheat establishment and grain yield at Indian Head in 2021-22. Data were analysed using the GLIMMIX procedure of SAS Studio with the effects of seeding rate considered fixed and replicate effects treated as random

Effect	Num DF	Den DF	F-Value	Pr > F (p-value)
	------------ Plant Density ------------			
Seed Rate (SR)	5	15	122.26	**<0.001**
	------------ Grain Protein ------------			
Seed Rate (SR)	5	15	11.51	**<0.001**

Table 3. Treatment means and orthogonal contrast results for seeding rate effects on final plant populations and grain yield of winter wheat at Indian Head in 2022. The percentage of viable seeds that established as plants is also provided for interest's sake. Means followed by the same letter do not significantly differ (Fisher's protected LSD test, *P* ≤ 0.05).

Seeding Rate	Final Plant Density	Mortality	Grain Yield
viable seeds/m^2	-------- plants/m^2 --------	-------------- % --------------	----------- kg/ha -----------
50	46 f	92	4623 c
100	97 e	97	5641 a
200	168 d	84	5619 a
300	244 c	81	5392 ab
400	291 b	73	5487 ab
500	333 a	67	5267 b
S.E.M.	11.4	–	158.7
Pr > F (p-value)	<0.001	–	<0.001
	-------------------- p-value --------------------		
SR - linear	<0.001	–	0.053
SR - quadratic	0.006	–	<0.001

The winter wheat yield response to the various seeding rates was more or less as expected given the excellent establishment and overwinter survival. Yields were lowest (4623 plants/m^2) at the lowest seeding rate and actual plant densities of 46 plants/m^2. Overall yield variability was quite high and, despite a range of approximately 250 kg/ha (5392-5641 kg/ha), mean yields did not significantly differ between plant populations 97-291 plants/m^2, which corresponded to the seeding rates of 100-400 seeds/m^2. While still substantially and significantly greater than those observed with <50 plants/m^2, yields tended to declined slightly at the highest plant densities. This resulted in the quadratic response (P < 0.001) being considerably stronger than the linear response (P = 0.053). In addition to looking at seeding rate effects on establishment and yield, winter wheat yields were plotted against the actual plant observed plant populations and a non-linear regression analyses was conducted. The quadratic function was chosen based on the results of the orthogonal contrasts. While this test was found to be statistically significant (P = 0.050) and reflected the observed yield reductions at the lowest and highest plant populations, the relationship was somewhat weak due to the relatively high variability (R^2 = 0.269). Again, overall winter wheat establishment was better than expected and maximum yields were achieved at lower actual plant densities than anticipated; however, this may be largely attributable to conditions being conducive to successful establishment and moisture being abundant through the entire growing season, thus allowing the crop to tiller and fill especially well. Visually, the winter wheat at the lowest seeding rate stood out as being quite delayed in maturity, weedier, and more variable overall relative to the more optimal populations (Fig. 2, Appendices). Visual differences between the 100-500 seeds/m^2 seeding rates were negligible by the time the crop was finished heading and beginning to mature.

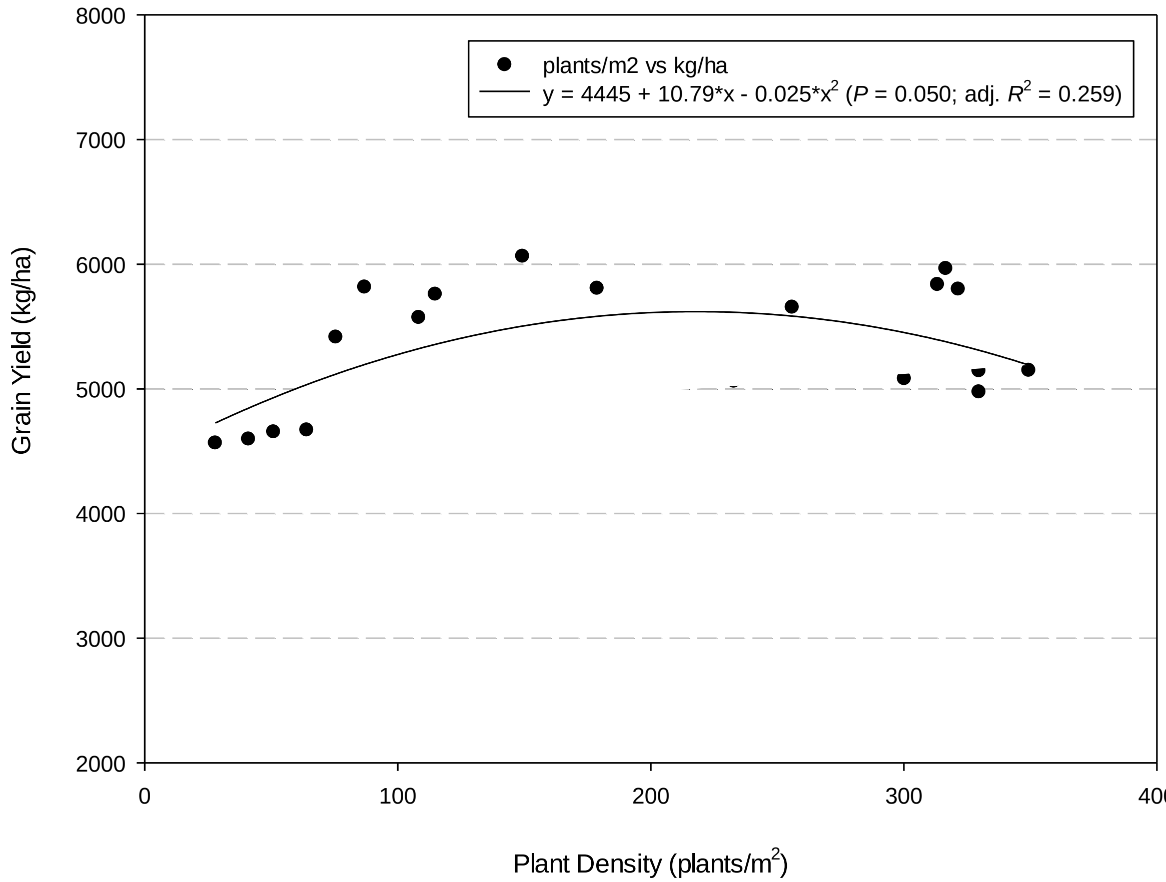

Figure 1. Relationship between plant density (plants/m2) and grain yield for individual winter wheat plots at Indian Head in 2022. Data were analyzed using a non-linear regression in SigmaPlot 14.5. While statistically significant (*P* = 0.050), the relationship was somewhat weak (adjusted R^2 = 0.259).

Having established the maximum yield potential of the winter wheat and response to a wide range of plant populations, the next step was to evaluate the agronomic and economic performance of the spring seeded crops. With re-seeding completed in the last week of May, abundant soil moisture and precipitation, adequate weed control, and no early-fall frost events, all of the spring cereals performed well and yields were considered above-average. The mean yields were 6702 kg/ha, 5977 kg/ha, and 2712 kg/ha for barley, oats, and canary seed at Indian Head in 2022 (Table 4). Based on the standard deviations of the yield relative to the means, canary seed yields were most variable followed by oats and then barley.

Table 4. Treatment means and standard deviation for yields of spring cereal options for reseeding into poor stands of winter wheat.

Spring Cereal	Grain Yield	SD
	--------------- kg/ha	---------------
Barley	6702	115.3
Oat	5977	114.1
Canary seed	2712	171.0

Results of the economic analyses are summarized in Table 5. While we recognize that grain prices and the costs of re-seeding will vary and that the assumptions used may not apply in all cases, the intent was to provide a reasonably robust comparison of the treatments and to be transparent so that interested people may easily revise these assumptions for their own operations, if necessary. Again, only expenses that were assumed to vary across treatments were accounted for and we did not include winter wheat seed costs since the intent was to provide information that would aid in assessing establishment and overwinter survival as opposed to demonstrating optimal seeding rates. Furthermore, success of the re-seeding options may also vary widely depending and when re-seeding can be completed and the environmental conditions that follow.

In 2022 at Indian Head, the marginal net economic returns of winter wheat were reasonably similar for actual plant populations ranging from 97-333 plants/m^2 ($1,659-1,777/ha) but did trend lower at the top end of this range. At 46 plants/m^2, the relative economic returns were substantially lower at $1,456. One thing for growers or agronomists to consider when assessing winter wheat stands is the overall uniformity of plant populations. If the average plant populations in a field are approximately 100 plants/m^2, but stands are uniform throughout the field, the risk of agronomic issues and yield loss will likely be less than if the overall field average is 100 plants/m^2, but variability is high with substantial portions of the field having populations lower and higher than this. Furthermore, the winter wheat was likely better able to compensate in the high yielding, non-moisture limiting environment realized at Indian Head, 2022 as opposed to under less optimal conditions.

Focussing on the re-seeding options, all performed remarkably well, even after the costs of terminating the winter wheat and re-seeding were accounted for. Barley was the least profitable option, even with the high yields that were achieved. At $1,695/ha, re-seeding to barley consistently resulted in similar or slightly lower net returns than winter wheat in all cases except when winter wheat populations fell below approximately 100 seeds/m^2. Oats were the most profitable re-seeding option, coming in at $2,162/ha. This was considerably higher than winter wheat across the full range of plant populations under the conditions encountered. Net returns for re-seeding to canary seed were intermediate at $1,943; however, this was, similar to the oats, still considerably more profitable than any of the winter treatments. Aside from the observed net returns, there are advantages and disadvantages to each of the re-seeding options to consider. The greatest advantage to barley is that it will generally be the earliest to mature of the options considered and there are reasonably good options available for controlling wild oats if this weed is a concern. Oats are also relatively early to mature; however, quality and yields can decline with late seeding and no in-crop herbicide options are available to control grassy weeds such as wild oats or green foxtail. The latter may not be a concern if these weeds are not present in the field being considered or if they were already mostly emerged and could be burnt off prior to re-seeding. Canary seed can be a viable option for many producers which is profitable and has limited options for wild oat control. However, this crop is considerably later to mature than either barley or oats which has potential to be problematic, depending on when re-seeding can be completed, how quickly the crop emerges, and when the first killing frost occurs.

Table 5. Estimated economic returns associated with winter wheat at varying plant populations relative to terminating the winter wheat and re-seeding to various spring cereal options. Only the expenses that were explicitly assumed to differ between treatments were included and actual expenses will vary for individual operations and years. Winter wheat seeding rates were not accounted for in this economic analyses since they were only varied to simulate varying levels of establishment resulting from adverse conditions during seeding and/or winter kill.

Treatment [Z]	Grain Price [Y]	Gross Income [X]	Termination Cost [W]	Re-Seeding Cost [V]	Seed Cost [U]	Crop Protection [T]	Marginal Net Income [S]
	---- $/Mt ----	$/ha					
Winter Wheat: 46 plants/m^2	$315	$1,456	–	–	–	–	$1,456
Winter Wheat: 97 plants/m^2	$315	$1,777	–	–	–	–	$1,777
Winter Wheat: 168 plants/m^2	$315	$1,770	–	–	–	–	$1,770
Winter Wheat: 244 plants/m^2	$315	$1,698	–	–	–	–	$1,698
Winter Wheat: 291 plants/m^2	$315	$1,728	–	–	–	–	$1,728
Winter Wheat: 333 plants/m^2	$315	$1,659	–	–	–	–	$1,659
Re-seeded to Barley	$281	$1,883	$30	$58	$100	–	$1,695
Re-seeded to Oat	$389	$2,325	$30	$58	$120	($45)	$2,162
Re-seeded to Canary seed	$771	$2,091	$30	$58	$60	–	$1,943

[Z] Treatments are crop type and plant populations based on the observed winter wheat densities and spring cereals include costs of seeding and terminating winter wheat

[Y] Grain prices are approximated from the 2022 Saskatchewan Crop Planning Guide

[X] Gross incomes are based on actual yields and the assumed grain prices

[W] Termination cost is associated with killing the winter wheat prior to re-seeding and estimated from the average custom rate for a high clearance sprayer in the 2022-23 Farm Machinery Custom and Rental Rate Guide (approximately $15/ha each for the product and application cost)

[V] Re-seeding cost is estimated from the average custom rate for a high clearance sprayer in the 2022-23 Farm Machinery Custom and Rental Rate Guide

[U] Seed costs are estimated from the 2022 Saskatchewan Crop Planning Guide

[T] Crop Protection Costs may vary widely but assume similar costs for all crops except oats where no grassy weed herbicide options are available

[S] Marginal Net Income estimates only include the input costs that were assumed to vary between treatments, actual net income will always be lower

Extension Activities

This demonstration was scheduled to be shown during the 2022 Indian Head Crop Management Field Day on July 19; however, the event was rained out and moved indoors. Nonetheless, Chris Holzapfel (IHARF) presented a general overview of the trial to approximately 120 people indoors. Going forward, results will be presented where appropriate through oral presentations and other extension materials in the winter of 2022-23 and beyond and this report will be made available online through the IHARF website.

11. Conclusions and Recommendations

This project has demonstrated the tremendous ability of winter wheat to compensate for sub-optimal plant populations provided that fertility, moisture, and the length of the growing season are not limiting. Overall mortality of the winter wheat was better than expected with 92-97% of the live seeds planted becoming established plants at the lowest seeding rates and 67-73% survival at the highest rates. Unexpectedly, the highest winter wheat yields and economic returns were achieved with as few as 100 plants/m^2; however, when populations fell below this level, yields declined substantially and serious issues with maturity and weeds began to materialize. Focussing on the re-seeding options, all performed remarkably well in terms of the yields achieved and their relative profitability. Yields for all of the spring re-seeding options were well above-average and all easily reached maturity despite being seeded somewhat later than optimal. Re-seeding was completed early in the last week of May and soil moisture was abundant; therefore, the spring seeded options got off to a fast and strong start. Depending on the specific weather conditions going forward, this will undoubtedly not always be the case and these results should be considered a best-case scenario. Despite exceptional yields, barley was the least profitable option and, when costs of terminating the winter wheat and re-seeding were accounted for, resulted in slightly lower profits than the most profitable winter wheat treatments. That said, terminating the winter wheat and re-seeding to barley was considerably more profitable than the poorest winter wheat stands of less than 50 plants/m^2. Oats were the most profitable re-seeding option; however, moisture was abundant and the season was reasonably cool which was ideal for this crop. Oats are generally less tolerant to drought and high temperature stress than barley. Oat quality and yield can also be negatively impacted by late seeding, something to consider when considering options to re-seed into poor stands of winter wheat. Another factor to consider before re-seeding to oats is weed pressure, since the only way to control certain grassy weed species (i.e., wild oats, green foxtail), is through crop competition (best with early seeding) or a pre-seed burn-off (best with late seeding). At Indian Head 2022, re-seeding to oats resulted in substantially greater net returns than even the most profitable winter wheat treatments. With above-average yields and intermediate net returns, canary seed also proved to be a viable re-seeding option under the conditions encountered. Again, one drawback of canary seed relative to the other options is that it is considerably later maturing; however, this was not problematic in the current demonstration and re-seeding to canary seed resulted in higher profits than all winter wheat treatments, regardless of the stands and even after accounting for the extra costs associated with doing so.

While this project has demonstrated that terminating and re-seeding poor stands of winter wheat to other, spring seeded, cereal options can be quite viable, several factors should be considered before committing to do so. First, while winter wheat stands as low as 100 plants/m^2 performed well under the conditions encountered, the uniformity of stands must be considered when assessing the crop. For example, it is likely that a field with consistently marginal stands will be easier to manage and more successful overall than a crop where the overall average population is marginal, but substantially variability exists. This variability could result in sizeable portions of the field suffering substantial yield loss in addition to wide variation in maturity within the field. Furthermore, it should be recognized that plant densities as low as 100 plants/m^2 will not always perform as well as they did in the current demonstration, particularly under drought conditions or heavy weed pressure. The other factor to consider is the actual calendar date by which re-seeding could be completed and soil moisture conditions at this time. In the current project, re-seeding was completed on May 23, not unreasonable from a practical perspective but not especially late. Our results could have been quite different if re-seeding have been postponed until the second week of June. Furthermore, soil moisture was abundant at the time re-seeding was completed; thus, allowing for rapid establishment and subsequent development of the spring seeded crops. In a dry spring, re-seeding into an established, albeit poor, winter cereal stand could be extremely risky with successful establishment being dependant upon timely and sufficient precipitation after re-seeding is completed. In conclusion, growers faced with a sub-optimal stand of winter wheat need to consider the viability of the existing crop, costs associated with terminating and re-seeding, the probability of successfully establishing a spring seeded option, and the likelihood of the re-seeded crop reaching maturity in a timely manner. This project is being repeated in the 2022-23 growing season to build upon these results for a wider range of growing conditions.

Supporting Information

12. Acknowledgements:

This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture. IHARF has a strong working relationship and a memorandum of understanding with Agriculture and Agri-Food Canada which should be acknowledged and IHARF provided the land, equipment, and infrastructure required to complete this project. Special thanks are extended to all the IHARF staff who worked on the project.

13. Appendices:

Table 6. Selected agronomic information and dates of operations for canola cover crop and nitrogen response demonstration at Indian Head in 2021 and 2022.

Factor / Operation	2021-22
Previous Crop	Canola
Winter Wheat Seeding Date	Sep-15-2021
Winter Wheat Variety	AAC Goldrush
Winter Wheat Seed Treatment	1 g tebuconazole + 5 g prothioconazole + 2 g metalaxyl / 100 kg seed
Fertility	125-40-20-20 kg N-P_2O_5-K_2O-S/ha
Fall Herbicide	894 g glyphosate + 5 g flurasulam/ha (Sep-19-2021)
Winter Wheat Termination	894 g glyphosate (May-21-2022)
Spring Cereal Seeding Date	May-23-2022
Spring Cereal Varieties / Rates	Barley (AAC Synergy – 300 seeds/m^2) Oat (CDC Arborg – 350 seeds/m^2) Canary seed (Keet – 40 kg/ha)
Spring Plant Density (Winter Wheat)	May-26-2022
In-Crop Herbicides	<u>Winter Wheat (Jun-6-2022)</u> 129 g fluroxypyr + 90 clopyralid + 503 g MCPA ester + 15 pyroxsulam/ha <u>All Spring Cereals (Jun-19-2022)</u> 129 g fluroxypyr + 90 clopyralid + 503 g MCPA ester/ha <u>Barley (Jun-20-2022)</u> 62 g pinoxaden/ha <u>Canary seed (Jun-20-2022)</u> 92 g penoxaprop p-ethyl/ha
Foliar Fungicide	<u>Winter Wheat (Jul-1-2022)</u> 100 g prothioconazole + 100 g tebuconazole/ha <u>All Spring Cereals (Jul-10-2022)</u> 74 g azoxystrobin + 124 g propiconazole + 30 g benzovindiflupyr/ha
Foliar Insecticide	<u>All Crops (Jul-9-2022)</u> 7.4 g deltamethrin/ha (grasshoppers) <u>Canary seed (Aug-2-2022)</u> 240 g dimethoate/ha (aphids)
Pre-harvest herbicide	<u>Winter Wheat (Aug-15-2022)</u> 894 g glyphosate/ha <u>Canary seed (Sep-16-2022)</u> 894 g glyphosate/ha
Harvest Dates	Winter Wheat: Aug-22-2022 Barley: Sep-6-2022 Oat: Sep-15-2022 Canary seed: Sep-16-2022

Figure 2. Delayed maturity and poor canopy closure of winter wheat at less than 50 established plants/m^2 (July 29, 2022 at Indian Head).

Figure 3. Oat (left), canary seed (centre), and barley (right) reseeded into poor stands of winter wheat (July 29, 2022 at Indian Head).

Abstract

14. Abstract/Summary

A field demonstration was established near Indian Head, Saskatchewan, in the fall of 2021 to demonstrate the viability of winter wheat under a wide-range of plant densities and to evaluate several crop options for re-seeding if stands are considered inadequate. The winter wheat treatments were simply six different seeding rates ranging from 50-500 seeds/m^2. Additional plots which were destined to be terminated and re-seeded to either barley, oat, or canary seed were planted at 100 seeds/m^2. Data collection included destructive, spring assessments of plant density for the winter wheat and grain yield for all crops. The relative economic performance of all treatments was also considered, with consideration given to gross revenues and the costs associated with re-seeding. The weather in the fall and early-spring were conducive to winter wheat establishment. Not unexpectedly, seedling mortality increased with seeding rate, with 92-97% of the viable seeds establishing into viable plants at the lowest seeding rates and 67-73% survival at the highest seeding rates. The final winter wheat populations ranged from 46-333 plants/m^2. While overall establishment was better than expected, the results were reasonably consistent with past research and recommendations in that winter wheat stands of 100 plants/m^2, or even less, can yield remarkably well. When populations fell below this level, yields declined substantially and agronomic issues such delayed maturity and weeds began to emerge. Re-seeding was completed on May 23 and, with abundant moisture, all of the options evaluated established and yielded remarkably well. Oats were the most profitable re-seeding option, followed by canary seed, and finally barley. Re-seeding to barley resulted in slightly lower economic returns than the most profitable winter wheat stands but was more profitable than winter wheat at less than 100 plants/m^2. Oats and canary seed were more profitable than all winter wheat treatments, even after the cost of re-seeding was accounted for. Factors to consider when deciding how to manage a sub-optimal winter wheat crop include the overall uniformity and viability of the winter wheat, the calendar date when re-seeding can be completed and soil moisture conditions at that time, and the likelihood of the re-seeded crop maturing in time. This project is being repeated in 2022-23 in order to build upon these result for a wider range of environmental conditions.