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Higher, more stable yield with ultra-early seeded wheat

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Seed wheat as soon as feasible after soil temperatures reach 0C, and prior to soils reaching 7.5–10C, with an optimal seeding rate of 40 seeds/ft^2, and at a shallow seeding depth. Ultra-early seeded wheat increased grain yield and stability compared to current seeding practices. Using 0-2.5C as a soil temperature trigger for seeding produced 6 bushels per acre higher yield than when soils reached 10C.

Ultra-early seeded spring wheat can produce greater grain yield by capturing the benefits of longer frost-free periods: early season growing degree-day accumulation, increased vegetative growth periods, early season precipitation, increased day-length at anthesis and reduced average temperatures at grain fill.

Collier et al. (2020) investigated ultra-early spring wheat seeding on the northern Great Plains using conventional CWRS and cold-tolerant spring wheat lines and seeding times based on soil temperature triggers of 0C through 10C. The research found that yield was maintained with ultra-early seeding and did not require the development of cold tolerant spring wheat genetics. https://www.frontiersin.org/articles/10.3389/fpls.2020.00089/full

The objective of this research was to evaluate the responses of grain yield and grain quality in ultra-early seeded systems based on planting temperature dates in combination with cold-tolerant spring wheat genetics, seeding rate and seeding depth, and whether the optimum agronomic practices would produce higher yield than conventional seeding practices.

This study was conducted at 6 sites in western Canada over 4 years from 2015 to 2018, with 13 total site-years: Dawson Creek, BC; Edmonton, and Lethbridge, AB; and Regina, Scott and Swift Current, SK. Seeding date was based on soil temperature triggers of 0–2.5, 5, 7.5 and 10C. Sites located in southern Alberta and Saskatchewan were generally able to seed at 0-2.5C while some sites in central and northern Alberta were not seeded at the earliest soil temperature because of excess moisture and saturated soils. If seeding was delayed, each seeding date was adjusted so there was a 2.5C temperature difference for the remaining seeding dates.

Two experimental, cold-tolerant, spring wheat lines, LG1299A and LQ1315A, were seeded at 20 seeds/ft^2 (200 seeds/m^2) to represent a suboptimal rate and at 40 seeds/ft^2 (400 seeds/m^2) as the optimal seeding rate. Seeding rates were adjusted to compensate for germination percentage. The wheat was seeded directly into standing stubble at 1 or 2 inches (2.5 and 5 cm) deep with a no-till drill with knife openers on 9.5 inch (24 cm) row spacing. All seed was treated with a fungicide seed treatment to control common seedling diseases.

Calendar seeding date varied by location and year. For example, the earliest seeding occurred on February 16 at Lethbridge in 2016 when soil temperature reached 0-2.5C. But in the same year, the first seeding date at Dawson Creek was not until 21 April.

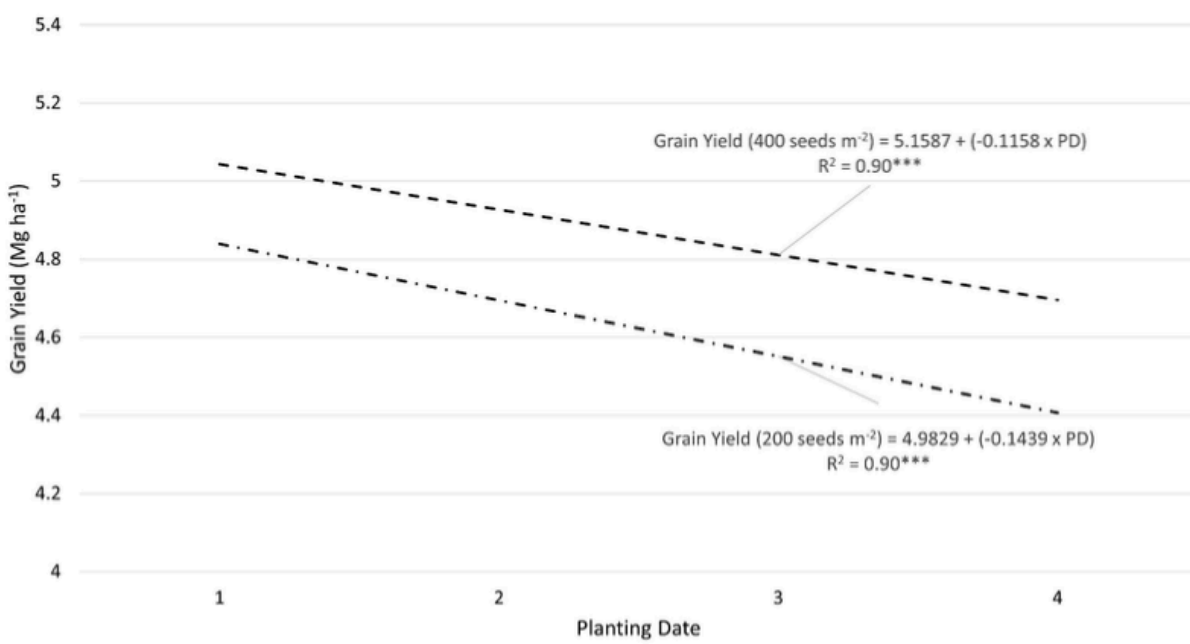
In all but one site-year, air temperatures below 0C were recorded after seeding with the lowest temperature of -10.2C. Eight of 13 sites recorded air temperatures below -5C after the initial seeding date with the lowest at -10.2C at Lethbridge in 2016 and -9.8C at Scott in 2016.

Similarly, all but one site-year experienced many days of air temperature below 0C after the earliest seeding date, ranging from 2 days to a maximum of 37 days of frost after seeding. Eleven of 13 sites recorded more than ten nights with air temperatures below 0C.

Higher yield with ultra-early seeding

The highest average wheat yield at 74 bu/ac (4.95 tonne/ha) occurred with the earliest seeding date, while the latest seeding date at 10C had the lowest average yield at 68 bu/ac (4.57 tonne/ha). Yield decreased linearly from the earliest to the latest seeding date. Seeding depth and wheat experimental line did not significantly affect grain yield.

Wheat grain yield as a function of seeding date and seeding rate



Collier et al. 2021

The optimum seeding rate of 40 seeds/ft^2 resulted in almost 4 bu/ac higher yield than the lower seeding rate of 20 seeds/ft^2.

Grain protein content increased by 0.3% from the earliest to the latest seeding date, and by 0.1% from the optimum to low seeding rate. Seeding depth did not affect protein content.

Greater yield stability with ultra-early seeding

All combinations of seeding rate, seeding depth and seeding date were analyzed for yield stability. Data was organized into four Groups: (Group I) high yield and low variability, (Group II) high yield and high variability, (Group III) low yield and high variability, and (Group IV) low yield and low variability.

The greatest yield stability was due to combinations of optimum seeding rate, early planting, and to a lesser extent, shallow seeding depth.

To highlight the benefits of ultra-early seeding at 0-2.5C soil temperature, the researchers projected the economic benefit of ultra-early seeding at the optimum seeding rate compared to a traditional seeding date at Lethbridge on May 1 with a sub-optimal seeding rate. Seeding on May 1 was projected to result in an 11% yield loss of 7.6 bu/ac (0.51 tonnes/ha). Using an average 2019 CWRS wheat price of $6.72/bu ($246/tonne) for 13.5% protein wheat, ultra-early seeding at 40 seeds/ft^2 would have generated an extra $83/acre ($206/ha).

The results of these two studies show that adopting ultra-early CWRS wheat seeding systems on the northern Great Plains will lead to higher yield, and do not require the development of cold-tolerant CWRS wheat varieties.

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Collier, G.R.S.; Spaner, D.M.; Graf, R.J.; Beres, B.L. Optimal Agronomics Increase Grain Yield and Grain Yield Stability of Ultra-Early Wheat Seeding Systems. Agronomy 2021, 11, 240. OPEN ACCESS: https://doi.org/10.3390/agronomy11020240

Collier GRS, Spaner DM, Graf RJ and Beres BL (2020) The Integration of Spring and Winter Wheat Genetics With Agronomy for Ultra-Early Planting Into Cold Soils. Front. Plant Sci. 11:89. OPEN ACCESS: https://doi.org/10.3389/fpls.2020.00089

