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Dryland Agronomic Management of Soft White Spring Wheat and Canada Prairie Spring Wheat in Alberta

The production of soft white spring wheat (SWSW) and Canadian Prairie spring wheat (CPSW) is increasing in central and north-central Alberta on Thin Black, Black and Gray soil types.

Background

SWSW has traditionally been grown under irrigation in southern Alberta for end uses in pastry flour markets. In the past, CPSW production has gone primarily to the Canadian Wheat Board and domestic feed markets, but some production has gone into processing into a variety of products including ethanol.

These two wheat types have excellent potential for use in the production of ethanol as they generally have the highest starch content of the various cereal crops grown on the Canadian Prairies.

Success with these wheat types offers producers new options.

Significant advances have been made in the breeding programs of SWSW and CPS wheat by Agriculture and Agri-Food Canada, Lethbridge, and the University of Alberta, Edmonton.

With the appropriate nitrogen fertilizer management and seeding rates, these wheat types can be grown successfully in central and north-central Alberta. Success with these wheats offers producers in these agro-ecological areas of Alberta the option of including a uniquely different cereal crop in their crop rotation for domestic ethanol markets.

Dryland SWSW/CPSW research

A dryland agronomic study was conducted at five locations across Alberta to examine SWSW and CPS wheat grain yield as well as protein and starch yield and quality.

The agronomic factors examined in this study included the following:

- nitrogen fertilizer rates and management with SWSW and CPS for yield and quality
- seeding rates with SWSW and CPS for yield and quality

The research study was conducted for four years, from 2009 to 2012. Trial sites were located near Lethbridge (Dark Brown soil zone), High River (Thin Black soil zone – southern Alberta), Vegreville (Thin Black soil zone – central Alberta), St. Albert (Black soil zone) and Westlock/Barrhead (Gray soil zone).

The nitrogen fertilizer rates used in the study at each site for both SWSW and CPS wheat:

- 0, 20, 40, 60, 80, 120 and 160 kg/ha – (0, 18, 36, 54, 82, 118 and 144 lb N/ac)

The seeding rates used at each site for both SWSW and CPS wheat:

- 100, 200, 300, 400 and 500 viable seeds/m^2 – (approximately 9, 19, 28, 37 and 47 viable seeds/ft^2)

SWSW (variety – AC Andrew in 2009 and Sadash in 2010-2012) and CPSW (variety – 5701) were grown at 20 sites over the four-year study. One site was lost to flooding and two sites were damaged by hail.

Study results

Canadian soft white spring wheat and Canadian Prairie spring wheat were successfully grown every year in the Dark Brown, Thin Black, Black and Gray soil areas of southern and central Alberta. The central Alberta region has productive soils, generally good spring soil moisture conditions and growing season precipitation in the range of 200 to 300 mm.

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Seeding of SWSW and CPS wheat trials was completed at central Alberta sites by May 11, 2009, May 15, 2010, May 20, 2011, and May 15, 2012. Trials were seeded in mid-May each year. All sites reached maturity and were unaffected by fall frost.

Generally, SWSW and CPS wheat were grown successfully, and yields were generally good to excellent at all sites. Results from this four-year study show that SWSW and CPS wheat can be grown successfully in the Parkland region of central Alberta and in the Dark Brown and Thin Black soil zones of southern Alberta.

Nitrogen fertilizer

SWSW and CPS wheat were very responsive to nitrogen (N) fertilizer in each soil zone and in each year.

Increasing nitrogen fertilizer rate significantly increased grain yield and improved the grain quality of SWSW and CPSW across all sites and years. However, the magnitude of N fertilizer response varied widely among site years depending on the soil test N level, soil organic matter content and effective growing season precipitation. Maximum grain yields were generally high.

In 2010, CPSW yield at 4 of 5 sites was at 100 bu/ac or higher, and for SWSW, was over 90 bu/ac. Generally, CPSW was slightly higher yielding than SWSW at the same locations. The unfertilized grain yields ranged from 30 to 60 bu/ac for SWSW and ranged from 40 to 70 bu/ac for CPSW, depending on the soil test N level and soil organic matter content.

The economically optimum nitrogen rate was approximately 100 lb N/ac based on the average yield response to N fertilization, but among site years, the rate ranged from 30 to more than 145 lb N/ac. Yield was strongly correlated with growing season precipitation, but was not necessarily related to soil test N level.

From the results of this study, N fertilizer rates for SWSW and CPSW should be based on the range in expected growing season precipitation for a given location, with less emphasis on soil test N.

Table 1 provides the recommended rates of N fertilizer based on the assumption of 4 inches of stored soil moisture plus increasing rates of precipitation at low, medium and high soil test nitrogen levels. This table can be used for developing N fertilizer recommendations for both SWSW and CPSW.

Table 1. Recommended nitrogen fertilizer rates for all soil zones at 3 soil test N levels and increasing rates of growing season precipitation from 8 to 20 inches, assuming 4 inches of initial stored soil moisture.

Soil N level rating (0-24 inches) (lb N /ac)	Expected growing season precipitation (inches)						
	8	10	12	14	16	18	20
	Recommended N fertilizer rate (lb N/ac)						
Low (0-30)	60	75	90	105	120	135	150
Moderate (30-60)	30	45	60	75	90	105	120
High (60-90)	0	15	30	45	60	75	90

Results from this study show that N fertilization increased kernel weight and protein concentration. Nitrogen fertilizer had little effect or precipitated just a very slight decline in starch concentration, but the very slight decline was small compared to the considerable grain yield benefit from increased N fertilizer.

Generally, CPS wheat had a slightly higher starch content than SWSW. Therefore, N fertilizer rates suitable for optimum grain production were also suitable for starch production.

Optimum seeding rates

SWSW and CPS wheat responded significantly to increased seeding rates in each soil zone in each year.

The average grain yield was about 15 bu/ac (17%) higher at 500 seeds/m^2 than at 100 seeds/m^2. Increasing the seeding rate was often beneficial to increasing grain yield.

Site years with low precipitation did not benefit from higher seeding rates while site years with more than 200 mm of precipitation consistently benefitted from higher seeding rates. These findings are consistent with results obtained for other cereals in western Canada.

In this study, the seeding rate at optimum yield at site years with a significant effect of seeding rate for SWSW ranged from 300 to 400 seeds/m^2 across all soil zones. For CPS wheat, the optimum seeding rates ranged from 275 to 375 seeds/m^2 in the Dark Brown soil zone to 350 to 450 seeds/m^2 in the Black soil zone. Table 2 provides the optimum seeding rate range for SWSW and CPS wheat in each soil zone.

Table 2. Optimum seeding rate range for soft wheat and CPS wheat in each soil zone.		
Soil region	**CSWS wheat**	**CPS wheat**
	Optimum seed rate range (seeds/m^2)	
Dark Brown	300 - 400	275 - 350
Thin Black	300 - 400	300 - 425
Black	300 - 400	350 - 450
Gray	300 - 400	300 - 425

Protein and starch concentrations were unaffected by seeding rate, and thus, management practices for optimum yield are also suitable for maximum starch productivity. Generally, CPS wheat had a slightly higher starch content than SWSW.

Summary

SWSW and CPS wheat are attractive crops for biofuel production due to the higher grain yield potential, weed competitiveness and starch content. From 2009 to 2012, field plot studies were conducted at five different soil zone/agro-ecological locations (Dark Brown, Thin Black – south, Thin Black – central, Black and Gray soil zones) in Alberta, with a focus on the Parkland Region. The study showed that SWSW and CPS wheat types can be grown successfully under dryland conditions in southern and central Alberta.

Optimum N fertilizer rates for grain production increased with growing season precipitation, but fertilizer N response was not strongly correlated with pre-seeding soil test N levels. A nitrogen fertilizer recommendation table was developed that can be used for both wheat types.

Significant yield benefits from increasing seeding rates from 100 to 500 viable seeds/m^2 were obtained and were most effective when more than 200 mm of growing season precipitation was received, but results were inconsistent at sites with less than 200 mm of growing season precipitation. A seeding rate recommendation table was developed for each crop for each soil zone.

Starch concentrations were either unaffected or only slightly affected by seeding rate or N fertilizer rate. Thus, agronomic practices that are optimum for SWSW and CPSW grain production were also optimum for starch production.

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For more detailed information on this study, please see the final research study report:

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