

Fertilizing Winter Wheat in Southern Alberta

Winter wheat has traditionally been grown using conventional tillage on summer fallow land in the southern prairies of western Canada. In the past, this cropping system provided ample moisture and nutrients to achieve economic yields.

However, with increasing concerns about decline in soil quality, farmers have been shifting to continuous cropping systems coupled with reduced or zero tillage.

When direct seeding winter wheat, most farmers would prefer to apply all their fertilizer at the time of seeding, rather than broadcasting nitrogen (N) in the following spring. However, with fall applied nitrogen, there have been concerns about reducing winter survival. Producers need to know if fall applied and/or seed-placed nitrogen fertilizer will significantly affect plant populations, over-winter hardiness, weed competition, crop yield and crop quality.

A four-year research study was conducted in southern Alberta in the Brown, Dark Brown and Thin Black soil areas to develop recommendations for best management practices for winter wheat production. This factsheet summarizes the research results to help farmers select the most effective strategy for their operation.

Objectives

This study had two objectives:

1. To examine the effects of conventional versus direct seeding to establish winter wheat.
2. To compare the effects of banded versus seed-placed N fertilizers in the fall with broadcast N fertilizer in the spring.

The winter wheat variety used in both studies was AC Readymade.

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Importance of soil sampling and testing

Soil sampling and testing can give an excellent inventory of plant available nutrients and other soil chemical factors important for winter wheat production. This inventory is the basis for recommending additional nutrients for crop production on an individual basis.

Soil nutrient levels vary from year to year and can vary even within fields that seem uniform. Producers need to follow certain recommended steps for soil sampling and testing to develop a sound ongoing soil fertility management program. Poor soil sampling technique is a major problem, which causes variation in fertilizer recommendations.

Soil test results are only as good as the quality of the soil samples. Fields should be sampled on an individual basis. Samples from different fields should not be mixed.

Begin by evaluating each field to determine representative areas. Major areas within fields that have distinctly different soil properties, such as texture, should be sampled and fertilized as separate fields because of the potential for different nutrient requirements. Samples should be taken at 0-6, 6-12, and 12-24 inch depths from 15 to 20 locations within each field. Then each depth should be bulked into composite samples, air dried and sent to a reputable soil testing lab.

Nitrogen Fertilizer Placement

Under the prevalent dry soil conditions in southern Alberta, there is an advantage to establishing winter wheat using direct seeding over conventional tillage and seeding. Banding N prior to conventional seeding can result in soil moisture loss and cause a lumpy, rougher seedbed resulting in poorer seed soil contact. This condition can result in reductions in germination, emergence and plant populations. These factors can lead to reduced plant stands, which may increase weed competition, and reduce yields.

The amount of N that can be safely seed-placed will differ with the amount of available soil moisture (Table 1). Direct seeding with a reduced seedbed utilization (SBU – is the per cent of the seedbed over which the fertilizer and seed has been spread) and high urea N rates and poor soil moisture conditions can lead to greatly reduced emergence.

Generally, seed-placed ammonium nitrate (34-0-0) will cause less fertilizer injury to winter wheat germination than urea (46-0-0) and can therefore be applied at higher rates. When seedbed soil moisture levels are low or when seedbed utilization is low, the amount of N that can safely be seed-placed must be reduced. However, as seedbed soil moisture increases or when seedbed utilization increases, the amount of N that can safely be seed-placed can be increased (Table 1).

Table 1. Safe rates of seed-placed nitrogen fertilizer using ammonium nitrate (34-0-0) and urea (46-0-0) at two seedbed utilization levels and three moisture levels.

Nitrogen Fertilizer ¹	% Available Soil Moisture	10% SBU ²	50% SBU
		— lb N/acre —	
Ammonium Nitrate (34-0-0)	>75%	65	80
	50-75%	50	65
	<50%	40	50
Urea (46-0-0)	>75%	55	70
	50-75%	40	50
	<50%	30	40

1. Available soil moisture is stated in per cent of field capacity for medium (loam) to fine textured (clay loam) soils. Assumes soil moisture will not change significantly during germination and emergence of winter wheat. If soil moisture decreases after seeding, then some fertilizer injury may occur.
2. SBU – seedbed utilization is the per cent of the seedbed over which fertilizer and seed are spread

Nitrogen Fertilizer Requirements

In this research study, reduced winter hardiness, reduced plant populations or reduced yield were not observed with increasing rates of fall applied N fertilizer. In fact, when seeding winter wheat in stubble fields low in soil N, the N fertilizer improved stand establishment and overwintering ability. Nitrogen applied at the time of seeding was generally as effective and often more effective than spring broadcast nitrogen.

All 13 research sites responded significantly to nitrogen fertilizer. Yield at 4 sites peaked at 30 kg Nha (27 lbs/acre), 5 sites peaked at 60 kg Nha (54 lbs/acre) and 4 sites peaked at 90 kg Nha (81 lbs/acre). Nitrogen fertilizer recommendations were developed from this information (Table 2).

Table 2. Nitrogen fertilizer recommendations in lb/ac for winter wheat in the Brown, Dark Brown and Thin Black soil areas at three soil moisture levels.

Soil Nitrogen (0-24 inches)	Brown + Dark Brown Soil Zone			Thin Black Soil Zone		
	Soil Moisture Level			Soil Moisture Level		
	Low	Medium	High	Low	Medium	High
0-10	40	60	90	50	70	100
10-20	30	50	80	40	60	90
20-30	20	40	70	30	50	80
30-40	10	30	60	20	40	70
40-50	0	20	50	10	30	60
50-60	0	10	40	0	20	50
60-70	0	0	30	0	10	40
70-80	0	0	20	0	0	30
80-90	0	0	10	0	0	20
90-100	0	0	0	0	0	10
>100	0	0	0	0	0	0

When comparing spring N application treatments, the 90 kg N/ha (81 lbs/acre) of broadcast ammonium nitrate (AN) (34-0-0) was the highest yielding treatment at all locations. This was followed by the 30/30 AN split application, where 30 kg N/ha (27 lbs/acre) was banded in fall and 30 kg N/ha (27 lbs/acre) of AN was broadcast in early spring. Generally, the 30/30 AN split application was often more effective than the 60 kg N/ha (54 lbs/acre) of AN broadcast in spring or 60 kg N/ha (54 lbs/acre) of urea broadcast in the spring.

When comparing the ammonium nitrate versus urea fertilizers, the 30 kg N/ha (27 lbs/acre) of urea and 60 kg N/ha (54 lbs/acre) of urea spring broadcast treatments were slightly lower yielding than the same rates of ammonium nitrate at sites in the Brown and Dark Brown zones in 3 of the 4 years of the study. This trend was not observed at sites in the Thin Black soil zone.

Limited response was observed with phosphate fertilizer treatments, so not enough data was available to develop new phosphate fertilizer response tables. However, Table 3 provides general recommendations for phosphate requirements for winter wheat grown in southern Alberta.

Table 3. Phosphorus fertilizer recommendations at various soil test levels using Kelowna or modified Kelowna soil test P method.

Soil Test Phosphorus (0-6") P (lb/ac)	Soil Zone		
	Brown	Dark Brown	Thin Black
	Recommended P ₂ O ₅ (lb/ac)		
0-10	30	35	40
10-20	25	30	35
20-30	20	25	30
30-40	15	20	25
40-50	15	20	20
50-60	15	15	20
60-70	15	15	15
70-80	0	15	15
80-90	0	0	15
>90	0	0	0

Summary

Generally, direct seeding proved to be quite successful in establishing winter wheat. In most years, germination and emergence of winter wheat was superior on direct seeded plots over conventionally tilled plots. This outcome was the result of improved seedbed soil moisture and more uniform seedbed in the undisturbed soil.

Results showed that nitrogen fertilizer can be successfully applied in the fall without reducing winter wheat survival. Applying all nitrogen fertilizer at the time of seeding in the fall is more effective than broadcasting all N fertilizer in the spring. Also, using a split application strategy can work reasonably well. This option is to apply a portion of the N fertilizer at the time of seeding, then broadcast the remaining N in the spring using ammonium nitrate fertilizer.

Continuously cropped Brown, Dark Brown and Thin Black soils are frequently very N deficient and are therefore quite responsive to N fertilizer. From the research data, a nitrogen fertilizer response chart was developed based on soil zone, soil test nitrogen and soil moisture levels.

Ideally, farmers should determine their N fertilizer requirements based on soil tests in the fall before planting. Then, depending on soil N levels, a producer could either apply all the N at the time of seeding or use a split application strategy. This approach would mean

applying a portion of the N in the fall, and then in the spring, applying the remaining N needed based on spring soil moisture conditions.

A new study is under way examining the differences in winter wheat varieties, seeding rates, methods of applying N fertilizer, new coated urea fertilizers as well as further examining the need for phosphate fertilizer.

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