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Nitrogen Rate, Type and Timing in Winter Wheat

By Matt Coffey, CCA

Nitrogen rate, type of nitrogen, and timing of application are popular topics in winter wheat production due to the cost, impact on yield and possible environmental implications. Outlined in this article are some of the more recent findings related to this topic.

Nitrogen's role in the plant

Plants take up most of their nitrogen as the ammonium (NH₄⁺) or nitrate (NO₃⁻) form. The majority of agronomic crops take up most of their nitrogen as nitrate. However, research has shown that crops use substantial amounts of ammonium (NH₄⁺) if it is present in the soil. Both corn and wheat have shown benefits of ammonium (NH₄⁺) nutrition. One reason for the higher yields is that nitrate (NO₃⁻) reduction in the plant requires energy when nitrate (NO₃⁻) is reduced to ammonium (NH₄⁺), then converted to amino acids inside the plant. The energy for this conversion is supplied by carbohydrates which could otherwise be used in grain formation.

Nitrogen is necessary for chlorophyll synthesis and, as a part of the chlorophyll molecule, is involved in photosynthesis. Lack of nitrogen and chlorophyll means the crop will not utilize sunlight as an energy source to carry on essential functions such as nutrient uptake. Nitrogen is also a component of vitamins, and energy systems in the plant. It is an essential component of amino acids, which form plant proteins. Nitrogen is directly responsible for increasing protein content.

Nitrogen Rate

The rate of nitrogen applied directly influences yield and profitability. Over application of nitrogen causes lodging which can reduce yield, quality and cause difficult harvesting. High protein content of soft red and soft white wheat (pastry wheat) is not desirable from most wheat millers' perspective, therefore the main driver of nitrogen rates on pastry wheat varieties is yield. Spring plant populations should also be taken into consideration when trying to determine nitrogen application rates. Below you will find on farm wheat yields over 3 years; 80 – 90 lbs per acre of actual

nitrogen per acre seems to be the rate to work toward for optimum soft red and soft white wheat yields. Past applications of manure or fertilizer to the field, soil type and crop rotation can also play a part in choosing nitrogen rates to winter wheat.

NITROGEN ON - FARM TRIALS 3 YEAR SUMMARY 2003 – 2005			
# Trials	Nitrogen Rate		
	60	90	120
41		84.8	86.6
38	78.3	83.7	85.6

Nitrogen Type

Listed below are a number of sources of nitrogen fertilizer, the chemical form they come in and the % actual nitrogen for each product.

N Source	Chemical Formula	Percent N
Ammonium sulfate	(NH ₄) ₂ SO ₄	21
Anhydrous ammonia	NH ₃	82
Ammonium nitrate	NH ₄ NO ₃	34
Urea	CO(NH ₂) ₂	46
Urea-ammonium nitrate solution (UAN)	CO(NH ₂) ₂ +NH ₄ NO ₃	28 - 32
Monoammonium phosphate (MAP)	NH ₄ H ₂ PO ₄	10
Diammonium phosphate (DAP)	(NH ₄) ₂ HPO ₄	18
Potassium nitrate	KNO ₃	13

Urea and 28% (UAN) are two of the most common nitrogen forms applied in bulk during the spring season. Below you will see 20 field size comparisons of 28% as compared to Urea over 2 years.

It is felt that the 28% gives a yield advantage in some cases for two reasons:

1. More uniform application with 28% depending on how the urea had been applied)
2. Less nitrogen loss due to:
 - a) very little or no loss from the ammonium nitrate portion in 28%.
 - b) 28% will give a more concentrated band of nitrogen possibly resulting in less nitrogen loss.

UREA vs 28%				
Year	Sites	28%	Urea %	Wins
2004	8	88.7	84.8	88
2005	12	85.8	83.4	73
Average	20	87.3	84.5	79

It is not recommended to apply herbicides with 28%.

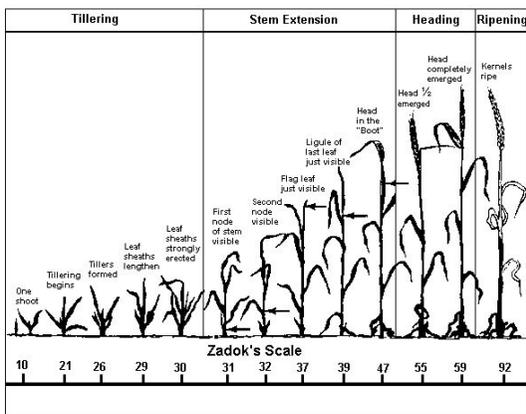
Nitrogen Application Timing

Outlined below is the Zadok's Scale for growth stages of cereals. These stages are critical in many management decisions that growers make including nitrogen fertilizer application, herbicide and fungicide applications. Knowing the growth stage of the crop is essential to determining proper timing of management decisions.

Spring nitrogen application to

winter wheat should be timed around Zadok's stage #25. Nitrogen applied at or near this time stimulates tiller growth and promotes the development of larger heads.

Nitrogen rate, type and timing of application on soft red and soft white winter wheat when managed well can add to the profitability of your farm operation.



Sources: 1. Yield data was collected by Peter Johnson (OMAFRA Cereal Specialist) funded by Ontario Wheat Producers Marketing Board 2. Soil Fertility Manual

Matt Coffey is a Certified Crop Adviser and Independent Sales Representative for Pioneer Hi-Bred Ltd. There are over 500 Certified Crop Advisers (CCA) in Ontario. Each CCA has demonstrated their knowledge about Ontario crop production by passing the required exams. In addition, they have the crop advisory experience, the education, the commitment to continuing education and have signed a comprehensive code of ethics, which places the grower's interests first.



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