Cornell University
Cooperative Extension

**Agronomy Fact Sheet Series** **Fact Sheet 65**

# Fertility Management of Winter Wheat

## Introduction

Winter wheat is an annual small grain grown in New York State mostly for grain and straw production. Winter wheat is typically planted from mid-September until late October and harvested in July. For optimal yield or biomass production, winter wheat must be provided with essential nutrients. This factsheet provides an overview of the nitrogen (N), phosphorus (P), potassium (K), and sulfur (S) requirements and management of winter wheat for New York State.

## pH

Soil pH affects the availability of all nutrients. The optimal pH for winter wheat is 6.5. Lime application is recommended to keep the pH above 6.4 for both growth and for efficient use of fertilizers. See Fact Sheets 5-7, 48, and 54 for information on pH management.

## Nitrogen (N)

Application of the right amount of N to winter wheat is critical as both N deficiency and excess will impact yield and quality. Nitrogen deficiency in wheat is exhibited as pale green and yellowing of older leaves (Figure 1). Although rare in New York State, deficiency symptoms can be seen in late May at the end of rapid growth and development stage when wheat takes up most of its N. Inadequate N can limit tillering and shoot growth. Excess N can result in lodging, which can cause yield and harvest losses. Recommended N application rates vary depending on soil type, crop rotation and/or manure application history. Planting wheat following a sod in the rotation is not recommended due to uncertainty of N release from sod decomposition in April and May (temperature and moisture dependent).

In general, the recommended N rate for grain production is 60-80 lb N/acre (Table 1). Studies conducted in New York State have indicated that for straw production, only 20 lbs N/acre are needed. Winter wheat should receive 10-20 lbs N/acre of the recommended amount of N as a banded application at planting. The remainder should be topdressed in April when the crop is in the tillering stage prior to rapid stem elongation. Avoid applying N to wet or frozen soil as it will not be effectively utilized by the plant. If lodging is a common problem, reduce topdress N rates by 20-40 lbs N/acre; if lodging occurs only sometimes, reducing the N rate by 10-20 lbs N/acre may correct the problem without causing yield decline.

Growers interested in intensive management of wheat for grain production should consider a split-application of N. The first application of N should be applied in early April to promote tillering. The second application should be in late April or early May, just before rapid growth to insure N availability during the period of maximum uptake. Limit the total application to 90 lbs N/acre.

The N fertilizers popularly used for winter wheat are urea, urea ammonium nitrate and ammonium sulfate. Urease inhibitors can be used to reduce the risk of volatilization loss commonly associated with topdressing of urea or urea-containing fertilizers.

Table 1: Cornell N recommendations for winter wheat.

| Soil Group | Sod plowed under < 1 year ago | Sod plowed under 1-2 years ago | Sod plowed under >2 years ago |
|---|---|---|---|
| | ----------Lbs N/acre---------- | | |
| 1-4 | 20 | 50 | 60 |
| 5 | 20 | 60 | 70 |
| 6 | 20 | 70 | 80 |

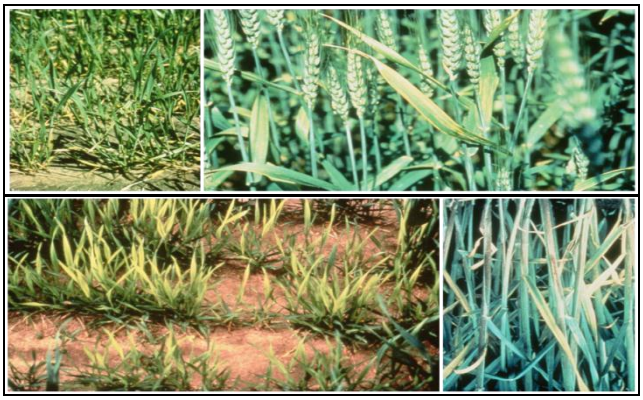

Figure 1. Select nutrient deficiencies in winter wheat; upper left: Nitrogen; upper right: potassium; lower left: sulfur; lower right: phosphorus. Photos courtesy of the International Plant Nutrition Institute (IPNI).

## Phosphorus (P)

Adequate P is required for winter wheat to initiate growth in the fall and establish winter hardiness. Cold moist soils reduce the availability of P. Phosphorus deficiency will cause the older leaves of winter wheat to turn yellow, orange, and sometimes brown (Figure 1). It is recommended to analyze fields for soil test P to determine if there will be sufficient P available prior to planting. Cornell P fertility guidelines are based on the Morgan soil test (see Agronomy Fact Sheet 15 for more information). If the soil test suggests additional P is needed (Table 2), band P fertilizer to maximize availability or broadcast at a somewhat higher rate before seeding. Excess P does not typically impact wheat grain or straw production but increases the risk of P loss to the environment.

Table 2: Cornell P recommendations for winter wheat.

| Soil Test P (lbs P/acre) | Recommendation (lbs $P_2O_5$/acre) |
|---|---|
| 1 | 65 |
| 2 | 60 |
| 3 | 55 |
| 4 | 50 |
| 5 | 45 |
| 6 | 40 |
| 7 | 35 |
| 8 | 30 |
| 9-39 | 25 |
| 40 or more | 20 |

## Potassium (K)

Potassium-deficient winter wheat will have pale green wilted leaves and yellowing along the leaf margins of the older leaves (Figure 1). A deficiency in K will reduce standability and resistance to diseases.

Table 3: Cornell K recommendations for winter wheat.

| Soil Test K3 (lbs K/acre) | Recommendation (lbs $K_2O$/acre) |
|---|---|
| ≤6 | 75 |
| 7-13 | 70 |
| 14-20 | 65 |
| 21-27 | 60 |
| 28-35 | 55 |
| 36-42 | 50 |
| 43-49 | 45 |
| 50-56 | 40 |
| 57-63 | 35 |
| 64-70 | 30 |
| 71-77 | 25 |
| 78-165 | 20 |
| >165 | 0 |

The Cornell Morgan soil test is the basis for K guidelines (Table 3). Potassium, if needed, can be broadcasted in the fall or applied in the band at seeding. The most common K fertilizer is muriate of potash (KCl).

## Sulfur (S)

Sulfur is required in adequate amounts for winter wheat development. With the reduction in atmospheric S deposition in recent years, S deficiencies may occur, especially on coarse textured (sandy) soils low in organic matter (<2%). Sulfur deficiency symptoms include yellowing of leaves (Figure 1). If an S deficiency is suspected, consider using an S-containing fertilizer such as ammonium thiosulfate, potassium-magnesium-sulphate, ammonium sulfate, or gypsum. Limited research exists on S needs of winter wheat but if a deficiency is anticipated, an application of 10-15 lbs S/acre will be sufficient as (1) winter wheat typically removes less than 5 lbs of S per 50 bushels of yield, and (2) soil organic matter mineralization and S deposition will supply at least a moderate amount of S.

## Summary

Winter wheat grows best at a soil pH around 6.5. To ensure optimum yield, N, P, K, and S applications should be applied where needed, at the proper time, using the right method, and application rate.

## Additional Resources

- 2012 Cornell Guide for Integrated Field Crops Management. Electronically accessible at: http://ipmguidelines.org/Fieldcrops/.
- Cornell agronomy fact sheet series. Downloadable from: http://nmsp.cals.cornell.edu/guidelines/factsheets.html.

## Disclaimer

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information

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Nutrient Management Spear Program
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Joe Killian, Quirine Ketterings, Karl Czymmek, Mike Stanyard, and Bill Cox

2011