

## Rye and Oats

### Crop Highlights

- Target pH: 6.0
- Split nitrogen (N) application to increase N use efficiency in rye and oats. Apply a small amount at planting or in late winter and the bulk of the N requirement when growth resumes in the spring.
- Monitor crop for manganese (Mn) deficiency, **especially** when soil test Mn is less than 3.4 lb/ac.

### Yield Goal

Rye yields are influenced by many factors, including the cultivars selected, planting date, winter weather, soil type and water-holding capacity, nutrient and water availability, weed, insect and disease pressure and crop management practices. **On most Delaware soils, typical yields in a good to average year range from 40 to 50 bu/ac for rye and 100 to 150 bu/ac for oats.** Typical yields may be slightly higher for rye or oats grown on black soils (>6% organic matter) or silt loams, or if the crop is produced with irrigation.

Delaware growers should use field history to determine the yield goal for each field and use that information to adjust management decisions and fertility programs accordingly. Delaware nutrient management law requires the use of optimal rolling average for determining the yield goal for a specific field when field history is available. To calculate the optimal rolling average yield, see University of Delaware Extension Fact Sheet [Estimating Yield Goal for Crops](#).

### Soil pH and Liming

#### Target pH: 6.0 for most soils

Soils that are high in organic matter (e.g., "black" soils; soil organic matter >6.0%) have a lower target pH (5.6) because organic matter moderates some of the negative effects of excessive soil acidity (e.g., aluminum toxicity).

The lime recommendation for a specific field is calculated from the soil pH and Adam-Evans buffer pH measurements using the steps outlined in University of Delaware Extension Fact Sheet [Calculating the Lime Requirement Using the Adams-Evans Soil Buffer](#). Avoid over-liming to prevent deficiency of micronutrients such as manganese (Mn).

The recommended liming source is dependent upon Mehlich-3 (M3) soil test calcium (Ca) and magnesium (Mg) reported in University of Delaware fertility index value (FIV) and can be determined using Table 1.

**Table 1. Recommended type of lime as a function of Mehlich-3 soil test calcium and magnesium concentrations.**

Soil Test Levels	Recommended Lime Type
M3-Mg is less than 50 FIV	Dolomitic
M3-Mg between 50 and 100 FIV AND M3-Mg is less than M3-Ca	Dolomitic
M3-Mg greater than 100 FIV	Calcitic
M3-Mg is greater than 50 FIV AND M3-Mg is greater than M3-Ca	Calcitic

## Nitrogen

The University of Delaware recommends a total nitrogen (N) rate of 40 to 70 lb/ac per growing season for rye and 50 to 90 lb/ac for oats. When a single N application is planned, N should be topdressed in early spring when growth resumes (e.g., "green-up"). For greatest response, N should be split into two or more applications. Apply a small portion of the total N requirement at planting (25%) or in late winter (50%). Apply the remaining N (50 to 75%) in early spring when growth resumes ("green-up").

The higher end of the N range should be utilized for sandy soils or for management systems where a single N application will be made to compensate for higher leaching losses. Split applications have been shown to increase N use efficiency, thus requiring less total N to achieve the same grain yield. In general, increasing N rate may increase grain production, but may also increase lodging that may reduce harvestable and economic yield.

## Phosphorus

**Table 2. Broadcast phosphorus application rates for rye and oats.**

	M3-P (FIV)										
	0	10	20	30	40	50	60	70	80	90	100
lb P <sub>2</sub> O <sub>5</sub> /ac	140	120	100	80	60	40	30	30	30	20	20

1. If M3 soil test phosphorus (M3-P) is "Low" (e.g., 25 FIV or less), broadcast and plow down the recommended rate of phosphate prior to planting in the fall.
2. If M3 soil test P is "Medium or "Optimum" (e.g., 26 to 100 FIV), phosphate can topdressed in the fall or the spring.
3. If M3 soil test P is "Excessive" (e.g., greater than 100 FIV), the application of phosphorus in fertilizers or manures is NOT RECOMMENDED.
4. If P fertilizers are banded, reduce the rates in Table 2 by one-half.
5. Soil test P may decline more rapidly when straw is removed than when straw is left behind as stubble since straw removal also removes P from the site. Growers may wish to soil test more frequently to monitor changes in soil test P when straw is removed.

## Potassium

**Table 3. Recommended potassium application rates for rye and oats.**

	M3-K (FIV)										
	0	10	20	30	40	50	60	70	80	90	100
lb K <sub>2</sub> O /ac	140	120	100	80	60	40	30	30	30	20	20

1. Broadcast and incorporate or band potash prior to planting.
2. For banded applications, reduce the rates in Table 3 by one-half.
3. To avoid salt injury to seedlings, do not band more than 75 lb K<sub>2</sub>O/ac at planting. When N and K<sub>2</sub>O are banded together, the sum of the N rate and the K<sub>2</sub>O rate should not exceed 75 lb/ac.
4. Soil test K may decline more rapidly when straw is removed than when straw is left behind as stubble since straw removal also removes K from the site. Growers may wish to soil test more frequently to monitor changes in soil test K.

## Magnesium

**Table 4. Recommended application rates of soluble magnesium as a function of soil test magnesium.**

Soluble Mg	M3-Mg (FIV)								
	0	5	10	15	20	25	30	35	40
lb soluble Mg/ac	80	70	60	50	40	30	20	10	0

1. Magnesium (Mg) is recommended when M3 soil test Mg is less than 40 FIV.
2. If M3 soil test Mg is less than 40 FIV and lime is recommended, use dolomitic limestone.
3. If M3 soil test Mg is less than 40 FIV and lime is not needed, apply soluble Mg according to the rates in Table 4.

## Sulfur

Sulfur (S) deficiency is occasionally observed in rye and oats grown on Delaware soils. Symptoms include reduced growth and a general yellowing of the plant. To confirm diagnosis, have a tissue test run. Cut the whole plant ½ inch above the soil line at Feekes' 5 growth stage and submit to a reputable lab for analysis.

1. If the N:S ratio is greater than 15:1, apply 25 to 35 lb/ac of S with the first N application in the spring.

## Manganese

Manganese (Mn) needs are predicted by an availability index that includes M3 soil test Mn and soil pH. Interpretation is crop specific.

$$\text{MnAI} = 101.7 - (15.2 \times \text{soil pH}) + (2.11 \times \text{M3-Mn})$$

Where:

- MnAI = Mn availability index  
 Soil pH = Soil pH measured in water (1:1 V:V)  
 M3-Mn = Mehlich 3 soil test Mn in lb/ac

**Table 7. Interpretation of manganese availability index.**

Mn Availability Index	Interpretation
Less than 25	Mn deficiency is likely at this soil pH and soil test Mn concentration
25 to 35	Mn deficiency is possible at this soil pH and soil test Mn concentration. Monitor the crop for symptoms, especially if liming has been recommended.
Greater than 35	Mn deficiency is unlikely.

1. If Mn deficiency is predicted or was observed in the previous growing season, broadcast 20 to 30 lb/ac elemental Mn.
2. In some cases, broadcast applications of acid forming fertilizers may correct Mn deficiency without the application of Mn; however, acid-forming fertilizers may be less effective than Mn fertilizers.
3. If Mn deficiency symptoms appear during the growing season or after an application of lime, a foliar application of Mn sulfate or Mn oxide at a rate of 1.0 to 2.0 lb/ac elemental Mn or chelated Mn (Mn-EDTA) at a rate of 0.5 to 1.0 lb/ac elemental Mn can alleviate the symptoms and restore yield potential. **Apply only when adequate growth is present to aid absorption of foliar Mn.**

## Zinc

Zinc (Zn) deficiency is predicted by an availability index that includes M3 soil test Zn, soil pH, and M3 soil test P. It is most common on soils with a pH of 6.5 or higher and high soil test P concentrations but may also be induced by environmental conditions such as cold, wet soils that may limit root growth.

**Table 8. Interpretation of zinc availability index.**

Soil Test Criteria	Interpretation
M3-Zn is less than 1.9 lb/ac	Zn deficiency is predicted
M3-Zn is less than 3.1 lb/ac <b>AND</b> soil pH is higher than 7.0	Zn deficiency is predicted
M3-Zn is less than 3.1 lb/ac <b>AND</b> soil pH is 6.6 or higher <b>AND</b> M3-P is 100 FIV or higher	Zn deficiency is predicted
M3-Zn is 3.2 lb/ac or higher	Zn deficiency is unlikely

If zinc deficiency is predicted by the availability index or was observed the previous year, one of the following treatments can be applied:

1. Broadcast Zn sulfate or Zn oxide at a rate of 10 to 12 lb/ac elemental Zn or Zn chelate (Zn-EDTA) at a rate of 2 to 3 lb/ac elemental Zn. Broadcast applications should correct Zn deficiency for several years.
2. Foliar application of Zn sulfate or Zn oxide at a rate of 1 lb/ac elemental Zn or Zn chelate (Zn-EDTA) at a rate of 0.5 lb/ac elemental Zn in 20 to 50 gallons of water. **Apply only when adequate growth is present to aid in the adsorption of foliar Zn.** Foliar Zn application should be repeated if symptoms re-appear.

**Boron**

Boron (B) deficiency is not usually observed in this crop. If B deficiency symptoms appear, contact your county agent for assistance with diagnosis and corrective recommendations.

**Copper**

Copper (Cu) deficiency has been observed in this crop when grown in other regions. If Cu deficiency symptoms appear, contact your county agent for assistance with diagnosis and corrective recommendations.