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Fertilizing Winter Rye

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North Dakota is one of the nation's top producers of rye.

About half of the rye produced is used for seed, mainly for cover crops, and the other half is harvested as grain. About half of the grain is used for livestock feed and the other half is used for human consumption.

Rye previously was grouped with wheat in fertility recommendations, but rye has unique nutrient requirements that separate it from other grains. Nitrogen requirements are not as high, even though yield may be comparable to wheat. Because economic return for rye is not as high as for wheat, other nutrient recommendations are more modest. A significant amount of rye is grown organically, so suggestions for fertilizing in an organic system also are included.

Conventional production with synthetic fertilizers

Nitrogen

Yields of rye within the state vary widely. If a grower has a history of rye production, choosing the relative productivity of a field or part of a field is relatively simple.

- Low productivity – 40 bu/acre or less
- Medium productivity – 41-60 bu/acre
- High productivity – more than 60 bu/acre

N rate based on historic productivity of soils

Low ..... 50 lb N/acre
Medium..... 100 lb N/acre
High ..... 150 lb N/acre

Adjustments to N

- Subtract the soil test nitrate-N to 2 feet in depth
- Subtract previous crop N credits provided in Table 1.
- Subtract 40 lb N/acre if in the Langdon region *(see Figure 1)*.

Phosphorus

- **Low productivity** – apply 25 lb P_2O_5/acre at seeding with the seed up to a soil test of 15 parts per million (ppm)
- **Medium and high productivity** – apply 40 lb P_2O_5 at seeding with the seed up to a soil test of 15 ppm.

Potassium

- **All productive ranges** – apply 50 lb/acre 0-0-60 (30 lb/acre K_2O) if soil test K is less than 100 ppm. Do not exceed rates of N + K_2O with the seed provided in Table 2.

Other nutrients

On sandy soils (loamy sand, sandy loams), especially those with low organic matter (less than 2 percent), sulfur may be a problem in some springs if snowmelt and/or fall or early spring rainfall has been normal to above normal. If these conditions are present, adding 5 to 10 pounds of S/acre as a soluble sulfate source would be advisable. If using ammonium thiosulfate as a source of S, do not broadcast apply but use stream bars instead.

No reports of micronutrient deficiency in rye in North Dakota have been received, so no other nutrients are recommended for general use.

Table 1. Previous crop N credits.

Previous crop	Credit
Soybean	40 lb N/acre
Edible bean	40 lb N/acre
Pea and lentil	40 lb N/acre
Chickpea	40 lb N/acre
Sweet clover that was harvested	40 lb N/acre
Alfalfa that was harvested and unharvested sweet clover:	
>5 plants/sq. ft.	150 lb N/acre
34 plants/sq. ft.	100 lb N/acre
12 plants/sq. ft.	50 lb N/acre
12 plants/sq. ft.	50 lb N/acre
<1 plant /sq. ft.	0 lb N/A
Sugar beet	
Yellow leaves	0 lb N/acre
Yellow/green leaves	30 lb N/acre
Dark green leaves	80 lb N/acre

Second-year N Credits
Half of credit given for the first year for sweet clover and alfalfa, none for other crops.

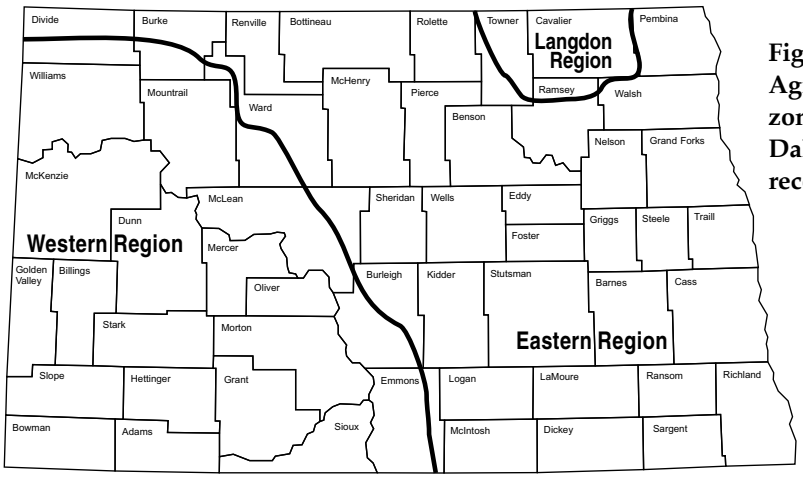

Figure 1. Agri-climatology zones for North Dakota to aid in N recommendations.

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Organic production

The two most important amendments and cultural practices that have been shown to be effective in providing nutrients to small grains, including rye, are manure application and the use of green manures prior to seeding.

Fresh manure application provides higher N content relative to P, but it also has a higher weed-seed risk. Composted manures provide lower N content relative to P, but if the manure has been composted correctly, the viable weed seed concentration in the manure will be low.

Manure is desirable whenever possible in a rotation because it is the only practical way to increase the nonmobile nutrients in the soil that are taken away at harvest. Rotations may make some nutrients more available, such as P after buckwheat, but they do not increase the amount of nutrients in soil, with the exception of N from the legume-nitrogen relationship. Manures differ in their nutrient content (Table 3).

Fresh manure also needs to be incorporated within a few hours of application to avoid loss of nitrogen as ammonia gas. The longer the manure sits undisturbed in the field, the less nitrogen will be available for crops later. Composted manure, however, can remain on the field undisturbed for much longer because much of its nitrogen already has been lost in the composting process. Sampling manure and having it tested for N, P and K content is suggested to better address crop nutrient needs.

Cover crops may provide N to a following rye crop if they are not N deficient themselves. Green-growing vegetation, regardless of whether they are legumes, most often contain at least 4 percent N. When this vegetation is incorporated into the soil, about one-third of the N often is released back into the soil during initial decomposition and can be used by plants.

Table 2. Maximum N + K_2O fertilizer rates with small-grain seed at planting based on row spacing, planter opener type and seedbed utilization (Deibert, 1986). SU = seedbed utilization.

		Row spacing, inches							
		6		7.5		10		12	
Planter opener type	Seed spread	SU	lb N+K_2O/ acre	SU	lb N+K_2O/ acre	SU	lb N+K_2O/ acre	SU	lb N+K_2O/ acre
	inches								
Double-disc	1	17%	20-30	13%	19-28	10%	17-23	8%	15-20
Hoe	2	33%	32-44	27%	27-38	20%	23-31	17%	20-27
	3	50%	44-58	40%	37-48	30%	30-40	25%	26-34
Airseeder	4	66%	56-72	53%	46-58	40%	37-48	33%	32-42
	5	83%	68-86	68%	56-68	50%	44-57	44%	38-49
	6	100%	80-100	80%	66-79	60%	51-55	50%	44-56
	7			94%	76-90	70%	58-74	58%	50-64
	8					80%	66-83	67%	56-71
	9					90%	73-92	75%	62-78
	10					100%	80-100	83%	68-86
	11							92%	74-93
	12							100%	80-100

Table 3. Approximate plant nutrient value of selected types of manure (Wiederholt, 2004).

Form of manure	N	P_2O_5	K_2O
	lb nutrient/ton		
Beef – solid dirt lot – cows	25	18	22
Dairy – solid dirt lot – cows	11	7	9
Swine – solid, finishing	13	13	9
Sheep – solid	20	13	27
Poultry – **turkey** – solid	55	63	40
	lb/1,000 gal		
Dairy – liquid – anaerobic storage	22	14	20
Swine – liquid – finishing	27	19	15

Source: "Determining Crop Available Nutrients from Manure." G97-1335A. University of Nebraska Cooperative Extension

Legumes are a preferred cover crop if given enough time to develop because they can add N to the cropping system through the activity of their symbiotic soil bacteria. Inoculation of legume seed is important before seeding for nitrogen fixation to occur.

Other organic amendments

Avoid the use of biological stimulators and low rates of organic-based materials such as fish/seaweed extracts or enzymes. A good rotation already supports a wealth of biological activators and microbes in the soil. Substantive research into the field activity of these products at commercial rates shows them to be largely ineffective.

References

R. Wiederholt. 2004. Manure application planning guide. NDSU Ext. Pub. AE-1187 (revised, 2004).

For more information on this and other topics, see www.ndsu.edu/extension