CIS 954

Northern Idaho fertilizer guide

Winter barley

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The following fertilizer guidelines were developed through research conducted by the University of Idaho and Washington State University. The guidelines are based on relationships between soil test data and yields of winter barley. The suggested fertilizer rates are designed to produce above-average yields if other factors such as pests, soil moisture, planting date, and stand are not limiting production. Thus, the fertilizer guidelines assume the use of sound management practices.

The suggested fertilizer rates will be accurate for your field if (1) soil samples are properly taken and represent the area to be fertilized and (2) the crop history you supply is complete and accurate. For assistance in obtaining a good soil sample, refer to EXT 704, *Soil Sampling*.

Nitrogen

Nitrogen (N) rates for optimal winter barley production depend on previous fertilizer applications, soil type, level of soil organic matter, soil depth, length of growing season, pest control, and other management practices.

In addition, the amount of N fertilizer needed depends on:

- The potential yield of the variety based on its historical yield in your location and at your management level.
- The amount of usable N in the soil profile. This includes mineralizable N released from organic matter during the growing season and inorganic N in the forms of nitrate (NO_3^-) and ammonium (NH_4^+).
- Total annual precipitation and other climatic factors.
- The density and vigor of the plant stand.
- The potential lodging of the variety.
- The use of yield-sustaining inputs such as fungicides to control diseases and plant growth regulators to reduce lodging.
- The type and yield of the previous crop.

In areas of low annual precipitation (18 inches or less), determine soil moisture in the profile and adjust N fertilizer rates accordingly. In these low-moisture areas and in areas with shallow soil (2 to 3 feet maximum depth), adjust the recommended N fertilizer rate to fit the yield potential limited as by available soil moisture. For information on adjusting N fertilizer rates in areas of low precipitation contact the Extension agricultural agent in your county.

Fertilizer nitrogen based on soil testing

Use the following equation to determine the amount of fertilizer N to apply to meet your crop's need:

$$\text{Fertilizer N needed} = \left[\begin{array}{l}\text{N needed based on potential yield (Table 1)} \\ + \\ \text{N needed for residue breakdown (Table 2)}\end{array}\right] - \left[\begin{array}{l}\text{Mineralizable N (Table 3)} \\ + \\ \text{Soil test N (Table 4)}\end{array}\right]$$

Nitrogen needed based on potential yield — Estimates of N needed to produce a crop of winter barley should be based on potential yield. This potential yield should be the long-term average yield for the selected field adjusted to reflect management changes that influence yield potential. Assume 4 pounds N per acre are required to produce 100 pounds of winter barley with the optimum protein content for feed barley (Table 1).

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Table 1. Total nitrogen needed for winter barley based on potential yield.

Potential yield	N need
(lb/acre)	(lb/acre)
2,000	80
2,250	90
2,500	100
2,750	110
3,000	120
3,250	130
3,500	140
3,750	150
4,000	160

Note: Four pounds N per acre are needed to produce each 100 lb of barley.

Nitrogen needed for residue breakdown — Nitrogen is needed to break down straw from the previous cereal crop. Apply 15 pounds available N for each ton of straw incorporated into the soil up to 50 pounds N per acre (Table 2). Remember, 1 ton of residue is produced for each 20 bushels of wheat or 1,400 pounds of barley grain produced.

Table 2. Nitrogen needed for cereal straw (residue) breakdown.

Residue	N need
(tons)	(lb/acre)
0	0
0.5	7.5
1	15
2	30
3	45
4	50
More than 4	50

Note: One ton of residue is produced for each 20 bu of wheat or 1,400 lb of barley grain produced.

Mineralizable nitrogen — Soils vary in their capacities to release N from organic matter during the growing season. The amount of N released depends on factors such as the amount of soil organic matter, past soil erosion, available soil moisture, and soil temperature during the growing season.

Four different mineralizable N release rates are used for northern Idaho soils (Table 3). Low N release rates are found on severely eroded clay knobs and hilltops, in cutover timberland soils, in soils in areas of low precipitation, in soils with low water-holding capacities, and in soils with low organic matter contents.

Table 3. Mineralizable N release rates for northern Idaho soils.

Organic matter content	Release rate	N released during growing season
(%)		(lb/acre)
Less than 2	Low	25
2 to 3	Medium	45
3 to 4	Moderately high	60
More than 4	High	75

Soil test nitrogen — The amount of available N in the soil can be evaluated most effectively with a soil test. Soil samples should represent the rooting depth of the crop because nitrate-nitrogen (NO_3-N) is mobile in soil. Winter barley is capable of removing N to a depth of 3 feet.

Soil test values include both NO_3-N and ammonium-nitrogen (NH_4-N). To convert soil test NO_3-N and NH_4-N values in parts per million (ppm) to pounds per acre, add the N values (ppm) for each foot of sampling depth and multiply by 4 (Table 4).

Table 4. Example of calculation to convert N soil test results in parts per million to pounds per acre.

Depth	NO_3-N	NH_4-N	Total N	Factor	Total N[1]
(inches)	(ppm)	(ppm)	(ppm)		(lb/acre)
0 to 12	5	1	6	× 4	= 24
12 to 24	2	2	4	× 4	= 16
24 to 36	2	1	3	× 4	= 12
Total	9	4	13	× 4	= 52

[1]ppm × 4 = lb/acre.

Nitrogen fertilizer — The calculation for fertilizer N needed is:

Total N needed (lb/acre) (Table 1 + Table 2) _____
Minus mineralizable N (lb/acre) (Table 3) − _____
Minus soil test N (lb/acre) (Table 4) − _____
Equals fertilizer N needed (lb/acre) = _____

For example, with a potential yield of 3,500 pounds per acre, 2.5 percent organic matter, no straw residue, and soil test values from the example in Table 4, you would need 43 pounds N per acre:

Total N needed (Table 1 + Table 2)	(140 + 0)	140
Minus mineralizable N (Table 3)	−	45
Minus soil test N (Table 4)	−	52
Equals fertilizer N needed	=	43

Nitrogen fertilizer based on the previous crop

You also can estimate the N fertilizer requirement on the basis of the previous crop. The values in Table 5 are generalized recommendations based on field experiments and observations of winter barley production after the production of various crops. *Note:* Fertility recommendations based only on the previous crop are not as accurate as recommendations based on good soil tests.

Table 5. Nitrogen fertilizer rates for winter barley based on potential yield and previous crop.

Potential yield	Application rate (lb/acre)		
	Grain (residue returned)	Grain (residue removed), peas, lentils, fallow	Alfalfa or green manure crop
2,000	30 to 50	20 to 30	0 to 20
3,000	50 to 70	30 to 40	20 to 30
4,000	70 to 90	40 to 50	30 to 45

Note: The range in fertilizer rate values allows for varying levels of mineralizable N.

Phosphorus

Winter barley has a relatively moderate phosphorus (P) demand, but an adequate amount must be available for use by the plant (Table 6). Thus, if the soil level of P is low, the crop will respond to applied P.

Phosphorus should be either banded or incorporated into the seedbed before or at planting. Broadcast-plowdown, broadcast-seedbed incorporated, and drill-banding are commonly used methods of application. Drill-banding P is usually the most efficient application method, allowing placement with, below, or to the side of the seed. Choose whichever application method is most convenient. *Note:* If the P material banded with the seed contains N, do *not* apply more than 20 pounds N per acre.

Table 6. Phosphorus fertilizer rates for winter barley based on a soil test.

Soil test P (ppm) (0 to 12 inches)[1]		Application rate[2]	
NaOAc	$NaHCO_3$	P_2O_5	P
0 to 2	0 to 8	60	26
2 to 3	8 to 10	40	18
3 to 4	10 to 12	20	9
More than 4	More than 12	0	0

[1]Soil test P can be determined by two procedures — sodium acetate (NaOAc) and sodium bicarbonate ($NaHCO_3$). Use the column indicated by your soil test report.

[2]$P_2O_5 \times 0.44 = P$, or $P \times 2.29 = P_2O_5$.

Potassium

Winter barley has a relatively low demand for potassium (K). Few soil samples have soil test values low enough to warrant the use of K fertilizer. Those that do are usually from eroded areas of hilltops, clay knobs, or both. Apply K fertilizer as needed according to a soil test (Table 7).

Potassium should be incorporated into the seedbed before or at planting. Broadcast-plowdown, broadcast-seedbed incorporated, and drill-banding are effective methods of application. Drill-banded fertilizer can be placed with, below, or to the side of the seed. Choose whichever application method is most convenient. The total of N plus K (as K_2O) applied with the seed should not exceed 20 pounds per acre due to potential harm to the seed.

Table 7. Potassium fertilizer rates for winter barley based on a soil test.

Soil test K (ppm) (0 to 12 inches)	Application rate[2] (lb/acre)	
	K_2O	K
0 to 35	80	66
35 to 75	60	50
More than 75	0	0

[1]Sodium acetate extractable K.

[2]$K_2O \times 0.83 = K$, or $K \times 1.20 = K_2O$.

Sulfur

Sulfur (S) requirements for winter barley are influenced by soil texture, soil organic matter content, the previous crop, and fertilizer history. A soil testing less than 10 ppm SO_4-S should receive 15 to 20 pounds S per acre. Avoid using elemental S. Use a material containing sulfate. Sulfur deficiency appears as a yellowing of the plant early in the growing season and is visually indistinguishable from N deficiency. Have the soil tested if you suspect a deficiency.

Micronutrients and lime

Winter barley responses to micronutrients have been uncommon in northern Idaho. If you are in doubt about your soils needs, have the soil tested and consult the Extension agricultural agent in your county.

Try experimental lime applications on highly acid soils (less than pH 5.3) to determine whether the crop gives an economical response. Apply lime at a rate of 1 to 2 tons per acre and mix it well into the soil. For additional information see CIS 811, *The Relationship of Soil pH and Crop Yields in Northern Idaho.*

General comments

- Weeds, insects, diseases, and environmental stress can influence the effectiveness of a fertilizer program and reduce yields.
- Nitrogen applied to winter barley after jointing or at excessive rates can increase lodging hazard and produce higher protein levels.
- Lodging of winter barley is a common production hazard with recommended production practices. Reduced N rates may help to minimize lodging losses in highly productive fields.
- Early planting of winter barley usually produces higher yields; however, it can increase the potential for disease.
- Starter or pop-up fertilizers have had limited success. Starter fertilizers have been most effective when soils were cold and root growth could be stimulated by a readily available supply of both P and N.
- Avoid banding high amounts of fertilizer close to the seed. High amounts of N and K can result in salt damage during germination.
- Banding fertilizer improves N and P use efficiency. Consequently, if applying N, P, or both in a band, cut the recommended fertilizer application rates by 10 to 15 percent.

Further reading

CIS 811, *The Relationship of Soil pH and Crop Yields in Northern Idaho*, 35 cents

EXT 704, *Soil Sampling*, 50 cents

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