

Northern Idaho Fertilizer Guide

Alfalfa

by Robert L. Mahler

These fertilizer guidelines have been developed by the University of Idaho based on relationships obtained from soil tests and crop yield responses. The suggested fertilizer rates are designed to produce above-average yields if other factors are not limiting production. Thus, these fertilizer guidelines assume good management.

The suggested fertilizer rates will be accurate for your field provided that (1) the soil samples are properly taken and are representative of the field to be fertilized, and (2) the crop and fertilizer histories supplied are complete and accurate. For additional information on how to collect and process a soil sample, see University of Idaho Bulletin 704, *Soil Sampling*.

Harvested alfalfa removes large quantities of nutrients from the soil. Each ton of alfalfa removes about 60 pounds of nitrogen (N), 12 pounds of phosphorus (P), and 60 pounds of potassium (K). Incorporate fertilizer into the soil as you prepare the seedbed. Apply additional amounts periodically over the life of the stand to maintain optimal nutrient levels based on tissue or soil analysis.

Alfalfa is a desirable forage legume suitable for many areas of northern Idaho. However, alfalfa is not well adapted to low, wet areas; cutover forest soils; or acid soils (pH below 5.8). Whenever one of these conditions occurs, consider planting an alternative forage legume, such as birdsfoot trefoil, clover, or a grass pasture, in lieu of planting alfalfa.

Nitrogen

Alfalfa is a legume that should fix most of its own N requirement if it is sufficiently nodulated by viable *Rhizobium meliloti* inoculum. For additional information on inoculation and methods of inoculum application, see University of Idaho CIS 838, *Inoculation of Legumes in Idaho*. Efficiency of N fixation depends on adequate

plant levels of other nutrients—especially P, sulfur (S), and molybdenum (Mo)—and nontoxic levels of aluminum and manganese.

Excessive soil acidity and soil pH values less than 5.8 for alfalfa can disrupt N fixation. Consider seed inoculation with rhizobia when the soil pH is less than 6.2 or when alfalfa has not been grown on a field for more than 10 years.

At seeding, applying 30 to 35 pounds of fertilizer N per acre will aid seedling growth while root nodules are forming. However, excessive levels of inorganic N (NH_4^+ and NO_3^-) in soils will promote invasion by grassy plant species and also reduce nodulation and the quantity of N fixed by the alfalfa crop.

Phosphorus

When establishing seedlings, incorporate P fertilizer into the top 3 to 6 inches of the seedbed. An adequate amount of P is critical for rapid, successful stand establishment.

On established stands, fall or winter surface applications of P are preferred. Phosphorus may be incorporated into the seedbed or applied on established stands in large enough quantities to last for 1 to 3 years.

Phosphorus needs can be effectively determined with the aid of a soil test (Table 1). The P fertilizer application rates suggested in Table 1 should be increased by 25 percent if your soil contains large amounts of volcanic ash.

Tissue analysis can help to determine adequate levels of P in alfalfa. Samples should be collected from the top one-third of the plant before the first cutting. Tissue P concentrations should range between 0.30 and 0.35 percent. If tissue values are less than 0.22 percent, P fertilizer should be applied. Visual P deficiency symptoms are difficult to diagnose; consequently, tissue analysis is preferred.

Table 1. Phosphorus fertilizer rates for alfalfa based on a soil test.

Soil test P (0 to 12 inches) ¹			P ₂ O ₅ application rate ²		
			1-year supply	2-year supply	3-year supply
NaOAc	Bray I	NaHCO ₃	(lb/acre)	(lb/acre)	(lb/acre)
(ppm)	(ppm)	(ppm)			
0 to 2	0 to 20	0 to 8	60	105	150
2 to 4	20 to 40	8 to 14	40	66	92
4 to 8	40 to 80	14 to 20	15	25	50
over 8	over 80	over 20	0	0	15

¹ Soil test P can be determined by three different procedures: sodium acetate (NaOAc), Bray I method, or sodium bicarbonate (NaHCO₃). Sodium bicarbonate should not be used on soils with pH values less than 6.2. Use the column indicated by your soil test report.

² P₂O₅ x 0.44 = P, or P x 2.29 = P₂O₅.

Potassium

Alfalfa removes large amounts of K from the soil. When establishing seedlings, incorporate K fertilizer into the seedbed. On established stands, fall or winter top-dress applications of K are preferred, but spring applications are acceptable. Potassium may be incorporated into the seedbed or applied on established stands in large enough quantities to last for 2 to 3 years. A soil test can effectively determine K needs (Table 2).

As with P, tissue analysis can determine the status of K in alfalfa. Collect tissue samples from the top one-third of the plant prior to cutting the alfalfa. Tissue K concentrations should range between 1.7 and 2.0 percent. If concentrations of K are less than 1.5 percent, consider applying fertilizer in the fall.

Table 2. Potassium fertilizer rates based on a soil test.

Soil test K (0 to 12 inches) ¹	K ₂ O application rate ²		
	1-year supply	2-year supply	3-year supply
(ppm)	(lb/acre)	(lb/acre)	(lb/acre)
0 to 35	90	165	240
35 to 75	60	110	150
75 to 100	40	70	90
over 100	0	re-sample soil	

¹ Sodium acetate-extractable K in the 0- to 12-inch depth.

² K₂O x 0.83 = K, or K x 1.20 = K₂O.

Sulfur

Sulfur is essential for maximum production of alfalfa. Northern Idaho soils are often S deficient. Sulfur deficiency appears as a yellowing of the entire plant early in the growing season and resembles N deficiency. Sulfur deficiency can cause reductions in both alfalfa yield and quality.

Test soils annually for plant available S content. Do not use elemental S since it becomes available too slowly for plant growth and also acidifies the soil. Sulfur can be applied as gypsum or with liquid or dry fertilizer materials containing S. Gypsum is the most commonly used S

source on alfalfa in northern Idaho. Sulfur needs of alfalfa based on a soil test are shown in Table 3. The S application rates suggested in Table 3 should be increased to 35 from 25 pounds per acre if your soil contains large amounts of volcanic ash.

Table 3. Sulfur fertilizer needs of alfalfa based on a soil test.

Soil test S (0 to 12 inches)		S application rate
(ppm SO ₄ -S)	(ppm S)	(lb/acre)
0 to 10	0 to 4	25
over 10	over 4	0

Boron

Alfalfa grown in northern Idaho occasionally responds to applications of boron (B). Determine the need for B with a soil test. Treat a soil testing less than 0.5 ppm of B with 1 to 1.5 pounds of B per acre. Do not exceed B application rates of 2 pounds per acre.

Boron should be broadcast and not banded because it is toxic and could damage the alfalfa if banded. Use of banded gypsum is an effective and economical method of applying needed B and also S. For additional information on boron and boron fertilizer materials, see University of Idaho CIS 1085, *Boron in Idaho*.

Molybdenum

Alfalfa responses to molybdenum (Mo) have been frequently reported in northern Idaho. However, no soil test is available for Mo. Do not apply Mo unless there is evidence (such as rotation history or visual deficiency symptoms) that it is needed, since excess Mo in forage is toxic to many animals consuming the forage.

Since a soil test for Mo is not available, Mo fertilization is based on the cropping history of a field. Basically, Mo applications are recommended once every 5 to 7 years on fields where a legume (alfalfa, clovers, peas, lentils, chickpeas, birdsfoot trefoil) is in a rotation with small grain crops. When Mo is needed, apply 1 pound of either sodium molybdate or ammonium molybdate per acre. The fertilizer should be surface broadcast and incorporated into the seedbed prior to seeding. If the alfalfa is already established, rainwater will move surface-applied Mo into the root zone. For additional information on molybdenum and molybdenum fertilizer materials, see University of Idaho CIS 1087, *Molybdenum in Idaho*.

Other micronutrients

Zinc (Zn), copper (Cu), manganese (Mn), iron (Fe), cobalt (Co), and chlorine (Cl) deficiencies have never been observed in northern Idaho alfalfa. Consequently, adding these micronutrients to soils is not recommended for alfalfa production.

Lime

On acid soils (pH values less than 5.8), apply lime to obtain maximum alfalfa yields. An acid soil reduces the nitrogen-fixing potential of alfalfa root nodules. Soil pH values between 5.8 and 6.5 are desirable for alfalfa production on acid Idaho soils. In northern Idaho, pH values higher than 6.5 may promote P nutrition problems.

If soil pH is between 5.5 and 5.8 apply 1 ton of lime per acre and thoroughly incorporate into the soil prior to seeding alfalfa. If the soil pH is less than 5.4, apply 2 tons of lime and incorporate it into the soil prior to seeding alfalfa. For additional information on lime and liming materials, see University of Idaho CIS 787, *Liming Materials*.

Agronomy/Water quality considerations

- Weeds, insects, diseases, and environmental stress can influence the effectiveness of a fertilizer program and reduce yields.
- Alfalfa does not grow well in wet, poorly drained soils. Avoid planting alfalfa in this situation.
- Alfalfa grown in northern Idaho soils most often needs the elements P, S, and B. At times, applying K and Mo will also improve plant growth.
- Since P and K are relatively immobile in soils, incorporate these nutrients into the seedbed prior to seeding. Apply up to 3 years of the P requirement for alfalfa before seeding.
- Nitrogen fertilizer should be used only at the rate of 30 to 35 pounds per acre at seedling establishment. Nitrogen fixation should provide all the N required for the alfalfa crop after establishment.
- Inoculating the alfalfa seed with *Rhizobium meliloti* is essential to ensure good nitrogen fixation. Apply the inoculum either directly to the seed or to the soil. All fields planted to alfalfa in northern Idaho should be inoculated with this bacterium. Note that the rhizobia that produce nodules on the roots of alfalfa are different from the rhizobia found to produce nodules on peas, lentils, or chickpeas.
- Alfalfa grows poorly in acid soils. For satisfactory alfalfa growth, soil pH values greater than 5.7 are needed. Liming materials can be used to modify soil pH.

Further reading

- CIS 787, *Liming Materials*, 50 cents
CIS 838, *Inoculation of Legumes in Idaho*, 35 cents
BUL 704, *Soil Sampling*, \$2.00
CIS 1085, *Essential Plant Micronutrients: Boron in Idaho*, \$3.00
CIS 1087, *Essential Plant and Animal Micronutrients: Molybdenum in Idaho*, \$1.00

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Northern Idaho fertilizer guides are available online and may be downloaded from <http://info.ag.uidaho.edu/catalog/catalog.html>. Look under Fertilizers and Soils:

- CIS 447, *Alfalfa*
CIS 453, *Winter Wheat*
CIS 785, *Winter Rapeseed*
CIS 788, *Bluegrass Seed*
CIS 815, *Blueberries, Raspberries, and Strawberries*
CIS 820, *Grass Seedings for Conservation Programs*
CIS 826, *Chickpeas*
CIS 851, *Legume and Legume-Grass Pastures*
CIS 853, *Grass Pastures*
CIS 911, *Northern Idaho Lawns*, also available in print for \$1.00
CIS 920, *Spring Barley*
CIS 954, *Winter Barley*
CIS 1012, *Spring Canola*
CIS 1083, *Lentils*
CIS 1084, *Spring Peas*
CIS 1101, *Soft White Spring Wheat*

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