University of Idaho
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CIS 851

Northern Idaho Fertilizer Guide

Legume and Legume-Grass Pastures

by Robert L. Mahler

These fertilizer guidelines have been developed by the University of Idaho and Washington State University based on relationships between soil tests and crop yield responses to applied fertilizers. 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.

These suggested 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 history supplied is complete and accurate. For help in obtaining a proper soil sample, see University of Idaho Bulletin 704, *Soil Sampling*, or consult your county extension educator.

Harvested legumes and legume-grass mixtures remove large quantities of nutrients from the soil. Incorporate fertilizer into the soil as the seedbed is prepared, and apply additional amounts periodically over the life of the stand.

Established non-irrigated legumes and legume-grass mixtures

Nitrogen (N), phosphorus (P), potassium (K), sulfur (S), boron (B) and molybdenum (Mo) are essential for plant growth but often deficient in northern Idaho pastures. Deficiencies of other essential nutrients—calcium (Ca), magnesium (Mg), copper (Cu), chlorine (Cl), manganese (Mn), iron (Fe), and zinc (Zn)—are rare.

Nitrogen—Pure stands of legumes such as alfalfa, birdsfoot trefoil, and clovers should not require N fertilizer because legumes have the capacity to fix their N requirement when sufficiently nodulated with rhizobia. Nitrogen fixation efficiency depends on adequate levels of other nutrients (especially S) and acceptable soil pH (nontoxic levels of aluminum and manganese). Excessive soil acidity can interfere with N fixation.

Nitrogen fertilization is often beneficial when the pasture contains a legume-grass mix. When the legume stand is sparse and the grass stand is dense, apply 35 to 55 pounds of N per acre in the early spring. Thirty-five pounds per acre should be used on sandy soils, while 55 pounds per acre is recommended for finer-textured soils, such as loams, silt loams, silty clay loams, silty clays, and clay loams. When legumes compose up to 60 percent of the stand, apply 10 to 25 pounds of N per acre. Excessive N applications in this situation will lower the legume percentage in the stand.

Phosphorus—Conduct a soil test to assess the P status of pastures. Apply P while preparing the seedbed for pasture establishment. On established stands, fall or winter surface P applications are most beneficial. Phosphorus may be applied in sufficient quantity on established stands to last 2 or 3 years (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.

Table 1. Phosphorus fertilizer rates for legume and legume-grass pastures based on a soil test.

Soil test P (0 to 12 inches)[1]			P_2O_5 application rate[2]		
NaOAc	Bray I	$NaHCO_3$	1-year supply	2-year supply	3-year supply
(ppm)	(ppm)	(ppm)	(lb/acre)	(lb/acre)	(lb/acre)
0 to 2	0 to 20	0 to 8	70	100	140
2 to 4	20 to 40	8 to 14	45	60	80
4 to 8	40 to 80	14 to 20	20	30	40
over 8	over 80	over 20	0	0	0

[1] Soil test P can be determined by three different procedures: sodium acetate (NaOAc), Bray I method, or sodium bicarbonate ($NaHCO_3$). 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] P_2O_5 x 0.44 = P, or P x 2.29 = P_2O_5.

Potassium—Legume and legume-grass pastures remove large quantities of K from the soil. On established stands, fall or winter topdress applications of K

are most beneficial.Most northern Idaho soils contain enough K for optimal forage production, but deficiencies occur in localized areas. Determine K needs with a soil test (Table 2).

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

Soil test K[1]	Application rate[2]	
	K_2O	K
(ppm)	(lb/acre)	(lb/acre)
0 to 35	80	65
35 to 75	60	50
75 to 100	40	33
more than 100	0	0

[1] Sodium acetate-extractable K in the 0- to 12-inch depth.
[2] K_2O x 0.83 = K, or K x 1.20 = K_2O.

Sulfur—Northern Idaho soils are often S deficient. An S deficiency in plants appears as a yellowing of the entire plant early in the growing season. This symptom is indistinguishable from an N deficiency. Sulfur deficiency can reduce both forage yield and quality.

Sulfur can be applied as gypsum or with liquid or dry fertilizer materials containing S. Use materials containing sulfate (SO_4). Since S is mobile and subject to leaching in soils, make S applications in early spring. Applying S in the fall is not recommended. Sulfur needs of legume and legume-grass pastures based on a soil test are shown in Table 3. The S fertilizer application rates suggested in Table 3 should be increased to 30 from 20 pounds per acre if your soil contains large amounts of volcanic ash.

Table 3. Sulfur fertilizer needs of legume and legume-grass pastures 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	20
over 10	over 4	0

Boron—Legumes have a greater B requirement than grasses. Consequently, in B-deficient soils, legume forage production decreases in relation to the grass yield. Legumes grown in northern Idaho will respond to B applications when soils are deficient.

Use a soil test to determine the need for B. A soil testing less than 0.5 ppm of B requires 1 to 2 pounds of B per acre. *Do not exceed the 2 pounds per acre rate*. Boron should be broadcast and not banded. High concentrations of B are toxic and could damage the legume.

Using borated gypsum is an effective and economical method of applying needed B and S. An application of 100 pounds of borated gypsum (1 percent B and 20 percent S) per acre supplies 1 pound of B and 20 pounds of S per acre. For more information on B and availability of specific fertilizer materials, see University of Idaho CIS 1085, *Boron in Idaho*.

Lime—On highly acid soils (soil pH less than 5.6), apply lime to obtain maximum legume yields. A highly acid soil reduces the nitrogen-fixing potential of legume root nodules. Legume yields are highest when soil pH values are higher than 5.8. Yet, grass production in pastures is not reduced until soil pH values fall below 5.1. For more information on acid soils, see University of Idaho CIS 787, *Liming Materials*, and CIS 811, *Relationship Between Soil pH and Crop Yields in Northern Idaho*.

Established irrigated legumes and legume-grass mixtures

The P, K, S, B, and lime recommendations for irrigated legumes and legume-grass mixtures are similar to recommendations for nonirrigated legumes and legume-grass mixtures. Nitrogen recommendations, however, are different. When the legume composes less than 60 percent of the stand, N fertilizer applications will improve both forage quality and yield.

It is best to apply between 60 and 80 pounds per acre of N annually. This recommended rate of N should be applied in split applications with one-half applied in the fall and the rest between mid-May and the middle of June. If late growth is desired, apply an additional 20 to 30 pounds of N per acre in late July.

Where forage yield potential exceeds 5 tons per acre annually, it may be desirable to apply 80 to 120 pounds of N per acre. These high N rates will decrease legume competitiveness and may increase the potential for grass tetany (magnesium deficiency) in the spring.

New forage seedings

Consider soil fertility needs before establishing new forage crops. Both P and K are particularly important because these nutrients are immobile in the soil and more available when worked into the seedbed before seeding. Before seeding, incorporate 80 pounds of P_2O_5 per acre and appropriate amounts of K (based on soil test; see Table 2) into the seedbed. Add S according to soil test levels. Sulfur can incorporated, but does not need to be. In addition, 20 to 30 pounds of N per acre will aid legume establishment until the plants are able to fix their own N.

Inoculate legume seed with the compatible strain of rhizobia inoculant and coated with Mo just before planting. For additional information on Mo, see University of Idaho CIS 1087, *Molybdenum in Idaho*. For additional information on inoculation see University of Idaho CIS 838, *Inoculation of Legumes in Idaho*.

Agronomy/Water quality considerations

- Weeds, insects, diseases, and environmental stress can influence the effectiveness of a fertilizer program and reduce yields.
- Phosphorus, sulfur, and boron are the elements northern Idaho legumes and legume-grass pastures most often need. At times, applying nitrogen and potassium will also improve growth.
- Because phosphorus and potassium are relatively immobile in soils, it is best to incorporate these nutrients into the seedbed before seeding.
- When the pasture is established, apply molybdenum as a seed coat on legumes. Apply the rhizobia inoculant to the legume seed just before planting.
- Legumes grow poorly in soils with pH values less than 5.6. Lime applications may be necessary to correct soil acidity. Apply and incorporate lime into the soil before the forage is established.
- Acid soils and high levels of soil nitrogen will favor grass growth at the expense of legumes.
- Wet, poorly drained pastures will favor grass growth at the expense of legumes.
- Using nitrogen fertilizers will tend to reduce the proportion of legumes in a legume-grass mixture, while using phosphorus will tend to increase the proportion of legumes.
- Seed the best-adapted legume and grass varieties for your area.
- Legume-grass mixtures often yield more than grass alone, have higher protein contents, and are less prone to grass tetany problems.
- Sulfur and nitrogen can increase protein content of forages, thus improving their quality.

Further reading

BUL 704, *Soil Sampling*, $2.00
CIS 787, *Liming Materials*, 50 cents
CIS 811, *The Relationship of Soil pH and Crop Yields in Northern Idaho,* 35 cents
CIS 1085, *Essential Plant Micronutrients: Boron in Idaho*, $3.00
CIS 1087, *Essential Plant and Animal Micronutrients: Molybdenum in Idaho*, $1.00
CIS 1088, *Essential Plant Micronutrients: Zinc in Idaho*, $3.00

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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*

The author—Robert L. Mahler is a soil scientist in the University of Idaho Department of Plant, Soil and Entomological Sciences, Moscow.

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