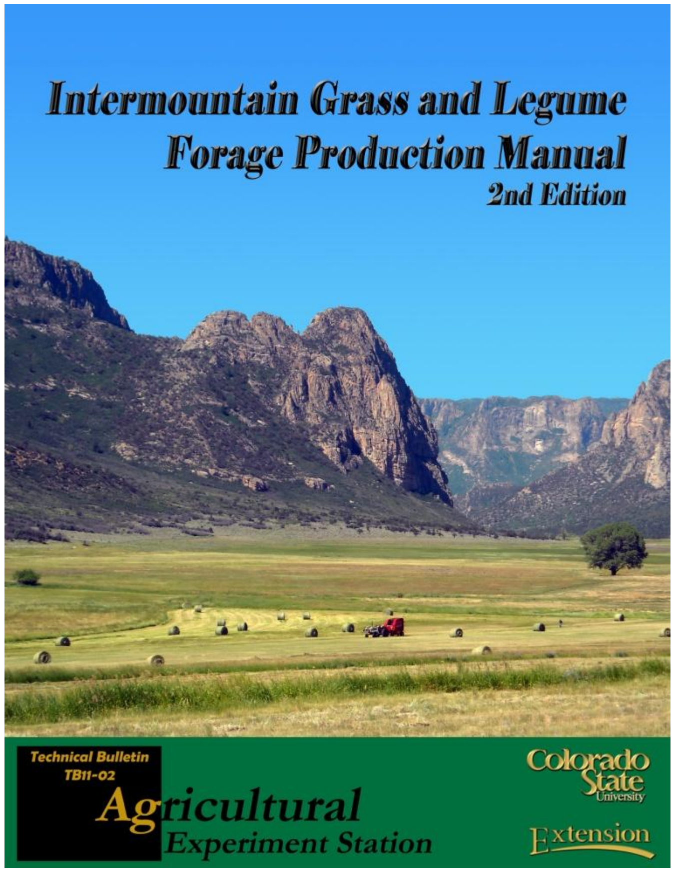

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Section II

Alfalfa

Chapter 14

Fertility Management

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Alfalfa Nutrient Management

Supplying alfalfa with those nutrients that are deficient is essential for producing profitable yields. As it grows, alfalfa continuously depletes soil nutrients. Each ton of alfalfa hay contains approximately 50 pounds of nitrogen (N), 10 pounds of phosphorus (P), 60 pounds of potassium (K), and 4 pounds of sulfur (S). These nutrients and other micronutrients are, therefore, removed from fields with each cutting. Plant deficiencies of other micronutrients, while rare, can occur in Colorado fields. Proper fertility management begins with assessing nutrient levels available in the soil and present in plant tissue.

Test soils for nutrient availability, prior to planting and each year afterward. In the West, phosphorus is needed more often in alfalfa, and in much greater amounts, than any other nutrient element. In addition, sulfur, potassium, zinc (Zn), boron (B), and molybdenum (Mo) are sometimes required. Laboratory soil analyses provide accurate information to assess nutrient availability and the potential for plant deficiencies. Plant tissue testing is used to assess nutrients taken up by the plants and is useful to determine in-season plant nutritional status. It is more accurate than soil testing for some nutrients, such as, sulfur, molybdenum, and boron. Soil and plant tissue testing are both useful to determine the nutrient needs of established alfalfa.

Tables 1 to 5 show Colorado State University's Soil and Plant Testing guidelines for alfalfa and recommended fertilizer application rates.

Closely follow the laboratory's recommended procedures for taking and handling soil and plant tissue samples. The depth of the surface soil samples varies by laboratory, as does the timing and the way they suggest taking plant samples for tissue testing. Each laboratory has calibrated their testing procedures for providing accurate results to their customers. Taking and handling samples differently may introduce errors in laboratory tests and reduce the consistency in their recommendation.

It is important to randomly collect soil or plant samples across several areas of the field or field partition to get a representative sample to analyze. Take numerous soil or plant sub-samples and combine them into a composite sample. Ten subsamples are the minimum number needed, but fifteen to twenty are recommended. Make sure to take samples well within the field, including areas around the center (Fig. 1). Avoid sampling close to field edges where field

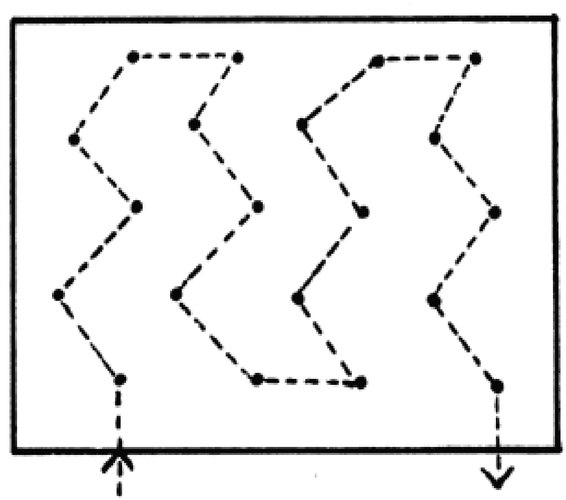

Fig. 1. The suggested sampling pattern for taking soil samples in a field.

traffic is greatest and where equipment slowing may result in greater fertilizer applications.

Colorado State University recommends splitting large fields, or fields with considerable soil variability, into smaller units for sampling. Take additional samples from areas of the field with different plant growth or a history of varying crop yield. At a minimum, collect a composite sample for every forty acres for irrigated fields and for every eighty acres for dryland fields. Colorado State's Soil and Crop Science Extension Newsletter, "From the Ground Up", provided one issue specifically on managing field variability. It contains an article on managing field fertility variability. A copy can be obtained on the Internet at: http://www.extsoilcrop.colostate.edu/Newsletters/2003.html, click on "volume 23 Issue 6: December.

Use the laboratory results as a guideline, apply and incorporate a 2- or 3-year supply of soil immobile nutrients, such as P, K, and Zn, prior to planting. When P or other soil immobile nutrients are required on established alfalfa, they can be topdressed or chemigated. When chemigating phosphorus fertilizers, pay attention to the water quality or precipitates that can form and clog the nozzles. Alfalfa roots readily can take up enough immobile nutrients near the soil surface for these topical applications to be effective.

Soil and plant testing laboratories use different soil phosphorus extraction methods. Two different phosphorus extraction methods (AB-DTPA & $NaHCO_3$) are included in Colorado State University's Soil and Plant Testing laboratory's recommendations (Tables 1, 2). As a result, laboratories may use different values to represent P availability in soil and consequently the quantity of fertilizer needed. For this reason, it is best to send samples to the same laboratory and use their fertility recommendations, for obtaining consistent results and comparable records from year to year.

Fields with a high pH usually contain excess lime that can react with phosphorus, reducing its availability to plants. This chemical reaction is slow in alkaline soils (above 7.6) or in acidic soils (below 5.5) and is fairly stable in soils with pH levels near neutral (7.0). Even in alkaline soils phosphorus applications are generally available in the first season after application. For this reason, phosphorus should be evaluated each year until the seasonal P availability pattern of a field has been established.

Table 1. Suggested P rates for irrigated alfalfa.

Parts per million (ppm) P in soil			Fertilizer rate, P_2O_5/A	
AB-DTPA	NaHCO	Relative level	New seedings	Established stands*
0-3	0-6	very low	200	100
4-7	7-14	low	150	75
8-11	15-22	medium high	50	0
>11	>22	high	0	0

*Suggested P rates for established stands should be based on new soil test results.

Table 2. Suggested P rates for dryland alfalfa.

Parts per million (ppm) P in soil			Fertilizer rate, P_2O_5/A	
AB-DTPA	NaHCO	Relative level	New seedings	Established stands*
0-3	0-6	low	60	45
4-7	7-14	medium	45	30
>7	15-22	high	0	0

*Suggested P rates for established stands should be based on new soil test results.

Alfalfa, as a legume, has a symbiotic relationship with nitrogen-fixing soil bacteria called *Rhizobia*. When present and active, these soil bacteria fix atmospheric nitrogen and supply all the nitrogen needs of alfalfa plants. Healthy alfalfa will develop pink nodules on the plant roots to facilitate good populations of these bacteria. Always inoculate the alfalfa seeds with *Rhizobium* bacteria prior to planting fields without a history of alfalfa production. A small application of N (20 to 40 lb/acre) at planting may be beneficial as well. Adding too much N can suppress the bacterial symbiosis and increase weed competition.

Table 3. Suggested N rates for new seedings of irrigated alfalfa.

	Companion crop	
ppm NO_3-N in soil	with	without
0-3	60	20
4-6	30	10
>6	0	0

New seedings of dryland alfalfa generally do not benefit from preplant N.
Note: Nitrogen fertilizers should not be applied to established stands of alfalfa. N fixation activity can be decreased.

Potassium and sulfur deficiencies most commonly occur on sandy soils with low organic matter. Irrigation water from groundwater wells or irrigation ditches, supplied by rivers downstream from cities, may have enough sulfur and boron to meet alfalfa nutrient needs. Sulfur deficiency may occur in rain-fed fields or fields irrigated with very pure mountain streams.

Phosphorus deficiencies are common throughout Colorado, so it is helpful to be able to recognize deficiency symptoms in the field. Phosphorus deficiency in alfalfa is expressed as thin, weak stands with stunted and grey-green foliage. Deficient areas can appear drought stressed, even when the field has sufficient moisture. Phosphorus deficiency may also appear as red to purple stems during warm weather periods. Use caution though, because purple-colored stems can also occur when alfalfa grows in cold soils or during long periods of cold weather. Leaves are frequently narrow and not fully expanded. Compare these plant symptoms with vigorous plants taken from areas of the field with good growth (see Figs. 2–4).

Table 4. Suggested K rates for irrigated alfalfa.

ppm K in soil AB-DTPA or NH_4OA_c	Relative level	Fertilizer rate, K_2O/A alfalfa
0-60	low	200
60-120	medium	100
>120	high	0

Rates are for 3 years of production.

A word of caution though, using visual plant symptoms to diagnose nutrient needs may not be reliable. Other factors can cause similar symptoms and, by the time visual symptoms are evident, yield may be lost. Soil or plant tissue analysis is far superior to diagnose a deficiency.

Further information on alfalfa nutrition management can be found at County Extension Offices located throughout Colorado. Office locations and research-based information on this and many other subjects are available on the Colorado State University Extension Website: www.ext.colostate.edu.

Fig. 2. Alfalfa plants on the left have adequate phosphorus compared to the plants on the right that are deficient.

Fig. 3. Healthy alfalfa stems (right) have a greenish-yellowish color. Alfalfa that is deficient in phosphorus may have purple stems.

Fig. 4. Alfalfa leaves also take on a new appearance when the plant is deficient of phosphorus. Note the folded leaves on the right.

Table 5. Suggested K rates for dryland alfalfa.

Ppm K in soil		Fertilizer Rate lb. K_20/A	
AB-DTPA or NH_4OA_c	Relative level	New seedings*	Established stands**
0-60	low	45	30
>60	high	0	0

*Suggested rates are for 3 years of production
**Suggested rates are for 1 year of production
Potassium applications on grass-legume mixtures are rarely economical under dryland conditions.

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