



Nutrient Deficiencies in Forage Crops

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Optimum growth of forage crops can only be achieved if adequate supplies of plant nutrients are present in the soil. Nutrient deficiencies are a common cause of loss in forage legumes and grass production. Recognizing a deficiency problem and selecting a workable solution is the best way to prevent or reduce the amount of forage biomass and quality losses. Observation of visual symptoms is a useful method of identifying the cause of the nutrient deficiency and the subsequent fertilizer requirements and application practices. Deficiency symptoms will differ depending on the species and the severity of the problem. Visual identification supplemented with chemical analysis of the soil both are necessary for determining the soil's nutrient status and fertilizer amount required for optimum forage yields. Plant tissue tests are also useful in providing specific information on the nutrient levels in the plants themselves.

Plants require 16 essential nutrients for growth (**Table 1**). Essential nutrients refer to those mineral elements which are required before a plant can complete its life cycle. There are two categories in which mineral nutrients are divided: macro and micro nutrients. Macronutrients are minerals required by forage crops in large quantities. Macronutrients are classified as primary and secondary nutrients. Micro nutrients are minerals required by forage crops in small quantity, but are equally essential to maintain chemical and physiological processes. The soil can usually supply most of the secondary macronutrients and well as the micronutrients, but in some cases the supply of one or more these nutrients might be insufficient for optimum growth and biomass production. Macronutrient deficiencies in forage crops are usually easy to observe. Micronutrient deficiency symptoms are less common and more challenging to identify correctly.

Nitrogen: It is usually the first limiting factor in grass production. Grasses are more sensitive to the nitrogen levels in the soil due to their lack of ability to fix atmospheric nitrogen. Obtaining optimum yields and quality requires hay fields and pastures receiving fairly large amounts of nitrogen. Applications of nitrogen should be made first, before or during periods of active growth.

Symptoms initially observed in older leaves are characterized by a general chlorosis (pale green) or yellowing. As the symptoms progress older leaves will die and fall off, while younger leaves begin to yellow. Nitrogen deficient grasses will respond rapidly to applications of nitrogen.

Phosphorus: Phosphorus plays an important role in both plant and animal growth. Phosphorus is especially critical for young developing seedlings. Deficiencies are more common in seedling grasses than established stands. Deficiency symptoms in young plants are variable and not easily identified. Typical symptoms include slow regrowth (plants appear stunted) accompanied by an abnormally dark green color, while stems and lower leaves acquire a red or purplish color. In some phosphorus deficient grasses, leaf blade margins tend to curl upward resulting in blade rolling and often purplish in color on the undersides. Roots are light brown and restricted in growth. Thin stands with coarse plants also characterize phosphorus deficiency. Since sparse stands can result from many other factors, diagnosis should not be based on this characteristic alone. Some forage grasses develop a more specific symptom where all leaves are uniformly dark green with purplish tinges occurring some distance back from the leaf tips. Recovery from phosphorus deficiency following fertilizer application is much slower than for nitrogen or potassium.

Table 1. Nutrients required by forage crops.

Non-mineral Nutrients	Macronutrients		Micronutrients
	Primary nutrients	Secondary Nutrients	
Carbon Hydrogen Oxygen	Nitrogen Phosphorus Potassium	Calcium Magnesium Sulfur	Boron Chloride Copper Iron Manganese Molybdenum Zinc



Potassium: Potassium is required in large amounts by forage grasses, playing a vital role in many plant functions including disease resistance. Potassium supply is much more important in maintaining established stands than young seedlings. As forage yields are increased, potassium is removed in greater quantities. Potassium is fairly mobile in sandy soils and can quickly become deficient. Symptoms are more pronounced on the lower plant parts as potassium is lost to the younger leaves. Deficiency symptoms are usually most obvious on second and third cuts. Split potassium applications are crucial in hay production since forage grasses tend to absorb much more potassium than actually needed if an excess is available (luxury consumption). Potassium supply should be monitored throughout the growing period since supplies can be depleted within one season. Winter injury is aggravated by potassium deficiency. Potassium deficiency symptoms are first observed in older leaves which take on a yellowish streaked appearance. This is followed by scorching of leaf tips. Plants will appear stunted with short narrow leaves. Leaf diseases may also be prevalent when potassium is deficient.

Calcium: Forage crops are most sensitive to calcium deficiency under acid soil conditions. Soils with low pH levels should be fertilized (a mixture of calcium or calcium and magnesium compounds) with time for proper root growth. Legume seeds coated with lime and inoculum are recommended when soil is moderately acid. Although calcium deficiency has not been reported in forage grasses, it is consumed in relatively large amounts by grasses. Calcium plays a vital role to the animal consuming the plant.

Magnesium: Magnesium, essential in the formation of chlorophyll, is important for both plant growth and animal dietary requirements. Magnesium also plays a role in nitrogen fixation and improves the utilization of phosphorus. Deficiencies of this element are more prevalent in acid, sandy soils particularly in wet seasons. Potassium, which tends to decrease magnesium uptake, is one of the most important factors in determining magnesium deficiency. Deficiency symptoms include interveinal chlorosis with the older leaves being affected first. Margins of leaves may turn a reddish brown color. Deficiency problems can be corrected by liming with dolomitic limestone. Low magnesium levels in forage grasses may result in a nutritional disease in livestock known grass tetany. This disease is caused by an imbalance of the ratio of potassium to the total amount of calcium plus magnesium $[K / (Ca + Mg)]$.

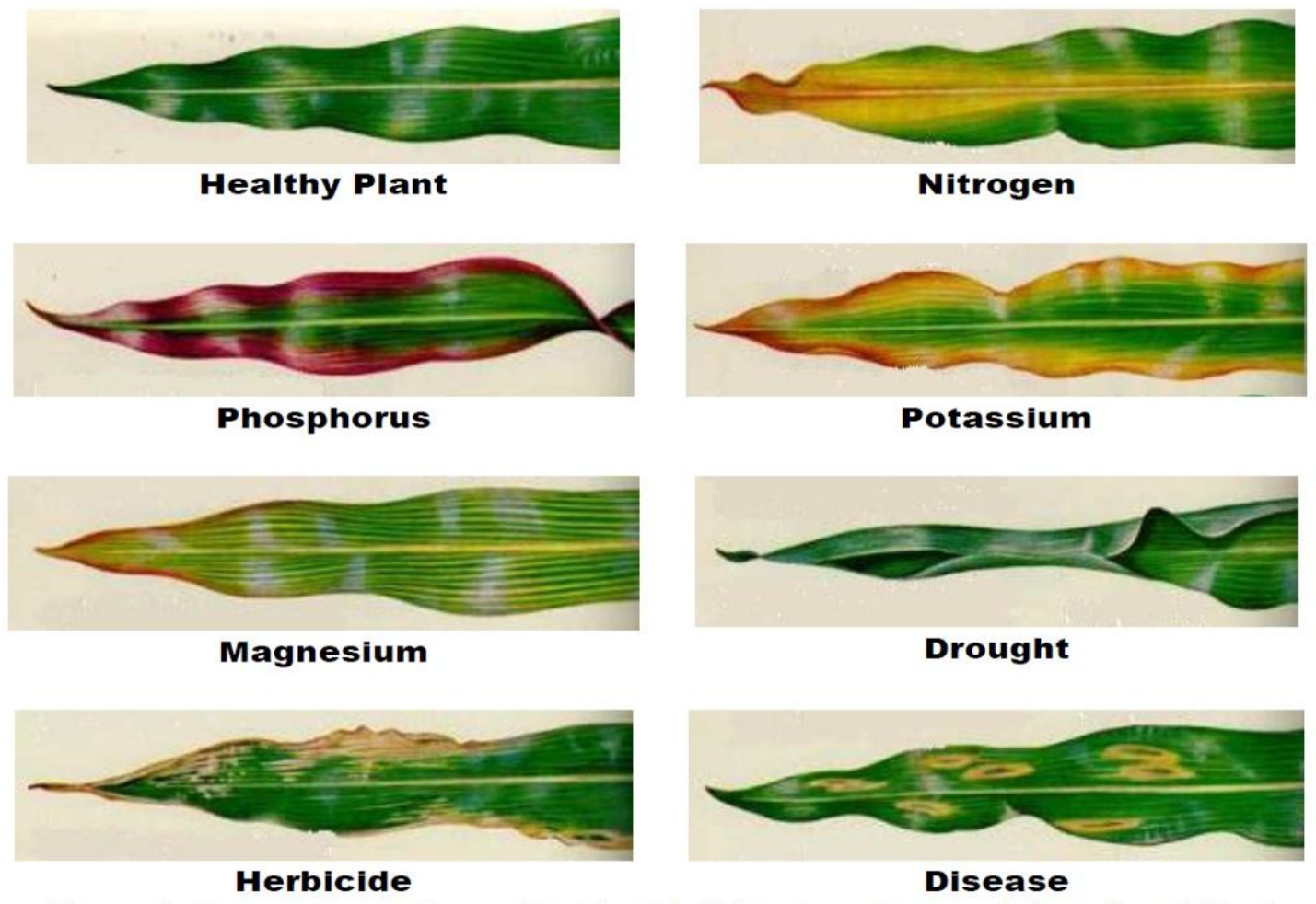


Figure 1. Common symptoms of nutrient deficiencies. Source: International Plant Nutrition Institute.

Sulfur: Sulfur plays an important role in the growth of forage grasses. Although forage grasses absorb small quantities of sulfur as compared to nitrogen, supplies may be limiting in soils low in organic matter, coarse textured, well drained soils. Sulfur deficiency may be observed under intensive hay or silage production. Sulfur deficient forages are characterized by a pale green to yellow discoloration of younger leaves and veins. The older leaves will remain alive for some time which is in contrast to the symptoms of nitrogen deficiency. Plants lacking sulfur will be small and slender with older leaves eventually turning yellow. Sulfur deficiency can be corrected quickly by the application of sulfur containing materials. Gypsum, ammonium sulfate, potassium sulfate, and calcium sulfate are among the most common sulfur bearing sources.



Drought stress sometimes causes confusion in diagnosing nutrient deficiencies in grasses. Although damage ranges from complete loss of a young, immature stand to seasonal loss of production from a mature, established stand. While severe drought stress is easily identified during periods of widespread drought, it might be harder to pinpoint in fields that vary greatly in soil moisture-holding capacity (usually variation is due to depth of soil, sandy or gravelly areas, or severely compacted areas). During seasons of marginally sufficient rainfall, areas of fields with good water-holding capacity can appear normal at the same time that adjacent areas with poor water-holding capacity show drought stress.

Avoiding nutrient deficiencies is a more positive approach than trying to correct problems after occurrence. Deficiency symptoms often appear too slowly, with the damage done and yields suffering by the time they are recognized. Most often, possible foliar symptoms of nutrient deficiencies on forage crops could be confused with foliar diseases. To determine nutrient deficiency issues in forage crops, it is important to: (1) know the characteristics of the plant when healthy to identify symptoms of distress, (2) identify where symptoms are appearing (new leaves, old leaves, edge of leaf, veins etc.), and (3) identify pattern of symptoms. It is important to collect samples and submit those for analysis to the Plant Disease Clinic. If nutrient deficiencies are observed, submitting tissue and soil samples to the MSU Soil Testing Laboratory is recommended. Tissue sampling should not substitute for a good soil testing program, but rather it is most effective when used in conjunction with soil testing. Contact your local County Extension office for information on how to collect and submit tissue and soil samples.

Upcoming Forage Events

2012 Mississippi Hay Contest

All Entries Must Be Received by 5:00 p.m. on Wednesday, January 11, 2013

Form and complete contest rules can be downloaded from the MSUCares website at:

<http://msucares.com/crops/forages/hay/index.html>