

MAKING YOUR FERTILIZER DOLLAR GO FURTHER

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Introduction

Alfalfa is a high quality, valuable forage crop that can be successfully produced on most well drained soils in Kentucky, for hay and silage, and for grazing. Fertilizing alfalfa can be uniquely challenging because it is a perennial crop. In addition, high-yielding alfalfa removes a tremendous amount of soil nutrients when compared to other crops grown in Kentucky. A thorough understanding of alfalfa's growth habits, nutrient requirements, and the soil nutrient supply mechanisms for alfalfa is necessary to effectively manage fertilizer inputs and maximize profitability while minimizing the environmental impact.

Fertilizing Perennial Crops

The goal of any fertilizer management program should be to maximize the profitability of the crop. Growers should be aware, however, maximum yield and maximum profit are seldom the same. Often, additional yield can be obtained with additional inputs, but the cost of these inputs may exceed the value of the additional yield. Consider the example of an alfalfa producer who could increase his alfalfa yield by five bales per acre by adding 50 lbs of potassium fertilizer. The additional fertilizer would only be a wise decision if the value of the five bales exceeds the cost of the 50 lbs of fertilizer.

Perennial crops, like alfalfa, present an added challenge: one year's productivity is not the only topic of concern, but also the overall longevity of the crop. Often, early management decisions will determine the number of years the stand will remain productive. Fertilizer decisions prior to planting are particularly of importance, since this is the only opportunity the producer will have to incorporate immobile soil nutrients such as P and K. After planting, annual fertilizer applications can only be broadcast to the soil surface.

Alfalfa Establishment

One of the most common mistakes producers make is not properly preparing for alfalfa establishment. Soil samples should be collected from perspective alfalfa fields at least the fall prior to planting. Actually, it is much better to sample a year and a half (two falls) before establishing. Early sampling gives the producer time to correct nutrient deficiencies and make adjustments in soil pH. Soil pH is probably the most important soil test measurement; the solubility of all other plant nutrients is a function of pH

(Figure 1). In addition to nutrient solubility, the survival of rhizobium (nitrogen fixing) bacteria is dependent on soil pH. If the soil pH is below 6.4, lime should be applied according to the soil test recommendation. Soil test recommendations should be adjusted depending on the quality of limestone that is available and the depth of mixing into the soil. Your local county extension agent can help make the needed adjustments. Added lime should always be incorporated into the soil. If more than 4 tons of lime are required, the lime should be mixed into the soil by applying ½ of the recommended rate before plowing and the other ½ after plowing followed by disking. The reaction of limestone is not immediate, so if the soil is extremely acidic (pH 5.3 or lower), it is advisable to collect new soil samples in the spring to reassess pH and the feasibility of planting. If the spring pH is below 6.2, the producer has four options: 1) delay planting for one year to allow the limestone more time to react, or 2) apply 1 lb sodium molybdate (6.4 oz of molybdenum) per acre 3). drill 400lb aglime per acre with seed. 5) use lime-coated seed. Uniform distribution of sodium molybdate can be achieved by broadcast application of 20 to 40 gallons of water per acre, followed by disking it into the soil. It is important not to add more than 2 lbs of sodium molybdate per acre during a given five-year period of time.

A productive stand of alfalfa removes many pounds of phosphorus (P) and potassium (K) per acre per year. The goal of your P and K fertilizer program should be to maintain soil test (Mehlich III) P at or above 60 lbs/acre and soil test K at or above 300 lbs/acre. Because of this goal, it is imperative to have soil test values at or above these levels at planting. If fall soil tests show low or very low levels of P or K, the producer should apply the recommended fertilizer in the fall, then resample in the spring and apply additional fertilizer if needed. Phosphorus and K are very immobile in the soil, so incorporation of these elements is also beneficial. Once the alfalfa is established, rhizobium bacteria living on the roots may supply all of the nitrogen (N) required by the crop. However, research has shown that 30 lbs N/acre applied at planting is needed for crop establishment.

Fertilizing Established Stands

Adequately fertilized alfalfa removes approximately 14 lbs P₂O₅ and 55 lbs K₂O per harvested ton. This is a much higher nutrient removal rate than grain crops or pastures. However, nutrient removal rates alone cannot be used as the basis for fertilizer recommendations. Soils contain a large amount of nutrients in primary and secondary minerals. For example, a Crider silt loam in Princeton has 32,600 lbs/acre of total mineral K just in the surface 7 inches. The nutrients in these minerals are not extracted by the soil test solution, but are slowly available to the plant. Additional nutrients can be taken up from the subsoil and are also not measured in a routine 6 inch soil sample. For these reasons, soil test results are not absolute measurements of plant available nutrients, they only give an indication of the amount of fertilizer that is required for maximum productivity. Soil tests have been calibrated in Kentucky based on alfalfa yield response research trials. The results of these calibration studies are the foundation to the fertilizer recommendations (Kentucky Lime and Nutrient Recommendations AGR-1

found at <http://www.ca.uky.edu/agc/pubs/agr/agr1/agr1.pdf>). When soil test levels are above 50 lbs P/acre and 300 lbs K/acre research studies show that yield is not limited by these nutrients. In order to assure that yield is not limited, we recommend fertilization until soil test values (for the composite field sample) are 60 lbs P/acre and 450 lbs K/acre. Phosphorus and K recommendations in AGR-1 are designed to maintain soil test levels near 60 lbs P/acre and 300 lbs K/acre. Unfortunately, not all soils in the state have the same ability to supply nutrients (especially K) to the crop. Soils in the Pennyroyal region of the state, like the Crider mentioned above, have a tremendous amount of mineral potassium and do not require as much fertilizer to maintain the 300 lb/acre soil test level. Soils in the Bluegrass (especially outer Bluegrass) have an ability to convert fertilizer K to unavailable forms (K fixation), so these soils often require more potassium to maintain 300 lbs of soil test K. In order to accurately monitor soil test levels for crops like alfalfa, it is important for alfalfa producers to sample soil annually. With good sampling procedures, the producer will be able to fine-tune the fertilizer recommendations for the specific cropping system/soils. These changes should be made when a clear downward or upward trend is observed.

Avoid Luxury K Consumption

Luxury consumption of potassium by forage crops is a phenomenon that should concern all forage producers. Simply put, luxury consumption occurs when a plant is supplied with more than adequate amounts of K. When an alfalfa plant is adequately fertilized, the K concentration in the tissue is usually between 2.5 and 3%. If the soil supply of K exceeds the needs of the crop, tissue K concentrations can be as high as 4.5%. For grain crops, like corn or wheat, luxury consumption is not a problem, because excessive K remains in the tissue (leaves and stalk) and is returned to the soil with the fodder. For alfalfa (and any other crop where the entire plant is harvested), the excessive K is removed as hay or silage and is not recycled in the soil. Luxury consumption can increase K removal rates to 90 lbs K₂O per ton (55 lbs is normal removal). Probably the main drawback to luxury consumption is that fertilizer applied to increase soil test K can be immediately removed with the first harvest, leaving low soil test K and possibly causing future K deficiency.

There are several ways to limit the risk of luxury consumption. First, try to maintain soil test K near 300 lbs/acre, thus limiting the supply of K to the plant. At this soil test level, only small rates of K fertilizer will be recommended. Second, avoid applying any K fertilizer between the last fall harvest and the first cutting the following spring. The freezing and thawing of the soil through winter months usually releases enough K (from soil fixation sites) to supply crop needs for the first cutting. The first cutting is also the highest yielding cutting, so more hay harvested with a higher K concentration equals more lbs of K removed from the soil. If soil test K is allowed to slip below the medium range, then split applications during the summer months should also reduce the effects of luxury consumption.

Conclusions

Properly managed alfalfa stands can provide profitable yields for 6 or more years, while poorly managed fields may not last more than three years. Understanding and managing the fertilizer input is one of the keys to alfalfa stand longevity. Analysis of UK soil tests relative to age of stand has indicated that many alfalfa stands failed (i.e. low stand count and weed encroachment) because soil K levels were not maintained by fertilization. It is critically important to have the appropriate soil pH, P and K levels prior to planting to obtain maximum plant density. Additionally, delaying nutrient application until after the crop has been established usually results in high fertilizer application rates, and increases the need for split application as well as the risk of luxury K consumption. Because of the valuable nature of alfalfa and the high rate of nutrient removal, soil samples should be collected in the fall of each year after establishment. Lime and phosphorus fertilizer can be added anytime, but K fertilizer should not be applied in the period between the last fall cutting and the first spring cutting. Taking these steps will maximize nutrient use efficiency and help to minimize the effects of rising fertilizer prices.

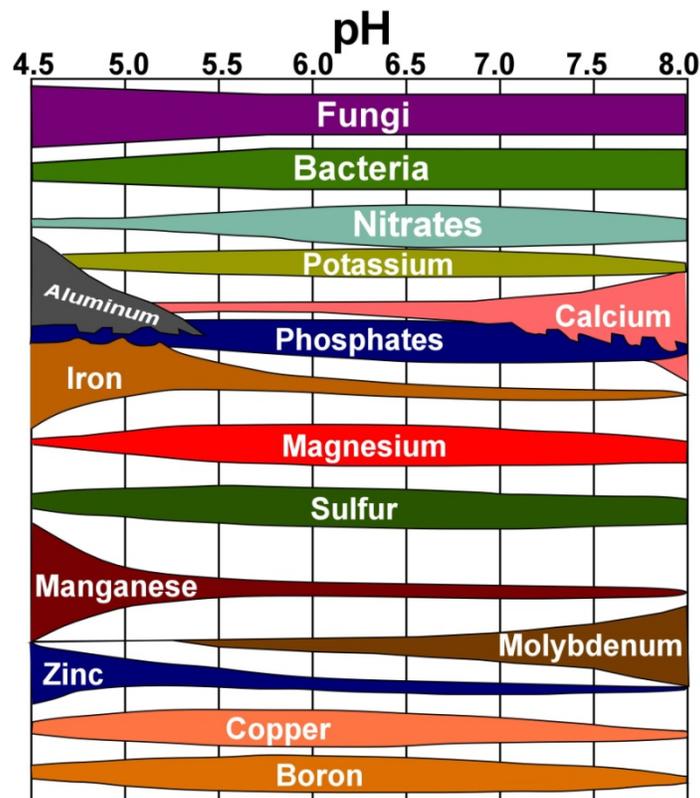


Figure 1. The availability of plant nutrients, toxic elements and microbial activity as influenced by soil pH. Wider bars indicate increased availability (activity).