

# **EFFECT OF CUTTING HEIGHT ON ALFALFA YIELD AND TISSUE K LEVELS**

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Current recommendations regarding cutting height of alfalfa are designed to maximize yield while maintaining high quality forages and stand longevity. Forage growers frequently cut forages at a height of three or more inches. However, recent reports indicate that there may be an advantage to cutting alfalfa closer, leaving an inch or less of stubble height (@griculture Online, 1999). Research indicates that dry matter yields and nutrient yields are higher for shorter cutting heights as compared to leaving taller stubble (Sheaffer et al., 1988). Obtaining higher yields requires that the plants are healthy and that carbohydrate root reserves are adequate for plant regrowth following harvest. Early Wisconsin studies using Vernal alfalfa showed that forages harvested three or four times per season produced more total forage when cut at a 1-inch height versus cutting at 3 inches or more (Kust and Smith, 1961, Smith and Nelson, 1967). North Dakota research looking at cutting height since the mid-1960s shows similar results where shorter cutting height leads to higher yields.

Potassium is a critical nutrient for the growth, development, and persistence of alfalfa. Recent work in Wisconsin demonstrates the yield response of alfalfa to K (Peters and Kelling, 2000). While the critical concentration of K in the alfalfa plant for optimum yield is 1.5-2%, recent studies show that K concentrations more frequently range from 3-5% or higher. When K concentration is at a very high levels in alfalfa, alfalfa-based dairy cows diets may become too alkaline and the incidence of milk fever increases (Oetzel, 1991). Dairymen with this problem need to find management solutions to reduce the K concentration in alfalfa. Some crop management factors influence K content in alfalfa including stage of maturity at harvest, time of year, grass or weed competition, fertilization, and soil and environmental conditions. Another factor that may influence K content of alfalfa is cutting height. By reducing alfalfa cutting height, forage yields may be higher, and K concentrations lower.

Research was initiated at the Marshfield Agricultural Research Station during 1999 to explore the relationships among cutting height, forage yield and tissue K levels. This paper will discuss the influence of cutting height on yield and tissue K levels of alfalfa.

## **MATERIALS AND METHODS**

During the summer of 1999, two research trials were conducted at Marshfield, WI that evaluated the effects of cutting height on alfalfa yield and nutrient content. One trial was harvested using small-plot equipment (Small-Plot Trial) and a second trial was harvested using a self-propelled haybine (Field-Scale Trial).

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Each trial was replicated three times and had four cutting height treatments applied including:

- 1) 2-inch height for all cuts during the season,
- 2) 2-inch height for the 1<sup>st</sup> cut, 3-inch height for 2<sup>nd</sup> and 3<sup>rd</sup> cuts,
- 3) 3-inch height for all cuts during the season,
- 4) 6-inch height for all cuts during the season.

While we had hoped for our lowest cutting height to be 1-inch, the lowest our equipment and soil conditions would allow was about 2-inches. Actual cutting height was determined by measuring stubble height from 35 random locations within each harvested plot. Data will be reported on based on actual cutting height for these trials. For each harvest period, the field-scale plots were harvested about 1 week earlier than the small plots so that we could measure forage quality changes among the various cutting heights at early and late harvest times within a cutting.

**Small-scale plots** measuring 3-ft wide by 25-ft long were established on in an existing alfalfa field. These plots were harvested using a small-plot harvester and electronic weighing system. On each harvest date, a subsample was taken from each plot to determine forage quality and nutrient content. Harvest dates for these plots were June 8, July 13, and August 16.

**Field-scale plots** measuring 12-ft wide by 150-ft long were established in an existing alfalfa field (1996 seeding, weed free stand). Cutting height treatments were made using a self-propelled haybine and forage was immediately chopped and weighed after cutting. Electronic pad scales were used to weigh each plot and a 1-lb subsample was taken from each plot for nutrient analysis. Harvest dates for these plots were May 25, July 1, and August 20.

A **K-level by cutting height trial** was incorporated into a larger soil pH by K treatment study currently being conducted at the Marshfield Agricultural Research Station (Peters and Kelling, 2000). In this study, three replicates of the blocks with a pH of 6.8 were harvested. Each of these pH blocks had four K treatments (annual topdress applications of 0, 100, 200 or 400 lbs K<sub>2</sub>O/acre). Within each K treatment level, plots were harvested at low (2-3 inches), medium (3-4 inches), and high (5-7 inches) cutting heights. Plots measured 3-ft wide by 28-ft long, and were harvested with a small-plot harvester. On each harvest date, a subsample was taken from each plot to determine forage quality and nutrient content. Harvest dates for these plots were June 3, July 7, and August 27.

## **RESULTS AND DISCUSSION**

Results from the small plot and field-scale trials were similar for both forage yield and nutrient content. Measurement of forage yield and quality from the field-scale trial was more variable, while trial precision was highest for the small-plot trial. Because trends and magnitudes of differences were similar between the two trials, only data from

the small-plot trial will be presented. In addition, data from the cutting height by K treatment level study will be discussed.

### **Forage Yield**

For each cutting, forage yield increased as cutting height was reduced (Figure 1). The largest differences among cutting height treatments were measured in the first cut of the season. Significant yield differences were measured for each harvest, however the smallest differences tended to be in the third cut. On average, total alfalfa yield for the season increased by 0.5 ton DM/acre for each 1-inch reduction in cutting height. This is similar to the findings of researchers in North Dakota.

In the K-level by cutting height study, total forage yield for the season increased with reductions in cutting height (Figure 2). On average, total alfalfa yield for the season increased by 0.35 ton DM/acre for each 1-inch reduction in cutting height. This yield increase was similar at all levels of K treatment (0-400 lbs K<sub>2</sub>O/ac). In addition, alfalfa yield response to K treatments was similar at all cutting heights.

### **Tissue K Concentration**

As part of this paper, we wanted to examine the effect of cutting height on alfalfa tissue K concentrations. In designing the study with different K treatments, we felt that our ability to measure differences between both cutting heights and annual K application levels would be maximized. Lab results from this study for alfalfa tissue K levels have been mixed. There appears to be a large enough variation in tissue K levels that treatment differences are being masked. We have detected small differences among cutting height treatments in the K treatment study, but not of the magnitude expected.

Data from the small-plot cutting height study for tissue K concentrations shows a more definitive trend of decreasing K content with reductions in cutting height (Figure 3). Overall, the three studies conducted during 1999 at Marshfield indicate that forages cut high (5-6 inches) will average 0.2 % units higher in K content than forages cut low (2-3 inches). In at least one of the studies, the difference between high and low cutting heights averaged 0.5 % units of K.

It is our intention to continue these studies and to refine our sampling techniques to improve our ability to determine mineral differences among cutting height treatments. In addition, we want to study the influence of plant maturity (cutting date) on K concentrations in the alfalfa plant.

## **SUMMARY**

This preliminary research from Marshfield, WI indicates that alfalfa yield is highest when cutting at the lowest possible height. Other data not presented in this paper, shows that forage quality declines slowly with lower cutting heights. However, the large

increases in forage yield outweigh the small declines in forage quality with lower cutting heights.

These initial studies were done on healthy, weed-free stands of alfalfa and soil moisture conditions were adequate during most of the growing season. Additional studies will be conducted in Wisconsin during the 2000 growing season.

Current recommendations for alfalfa cutting height in Wisconsin include the following:

- 1) Cut healthy, non-stressed alfalfa fields at 1-2 inch heights to achieve maximum dry matter and nutrient yields.
- 2) Growers may reduce the K concentration of harvested alfalfa forages by cutting lower.
- 3) In fields where plants are experiencing moisture or flooding stress, or where the crop has been cut early and frequently, root carbohydrate reserves may be low and cutting height should be adjusted upward to avoid additional stress or plant death.
- 4) Adjust cutting height to avoid injuring plants, contaminating the forage with soil, or picking up rocks.
- 5) If harvesting forages in the fall, growers should leave a 4-inch or greater stubble to help capture snow.

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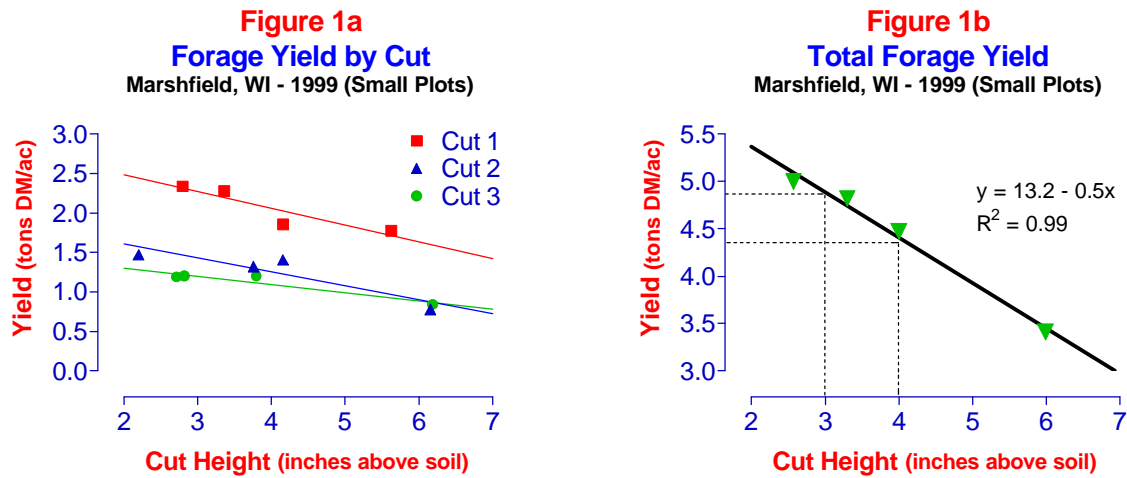
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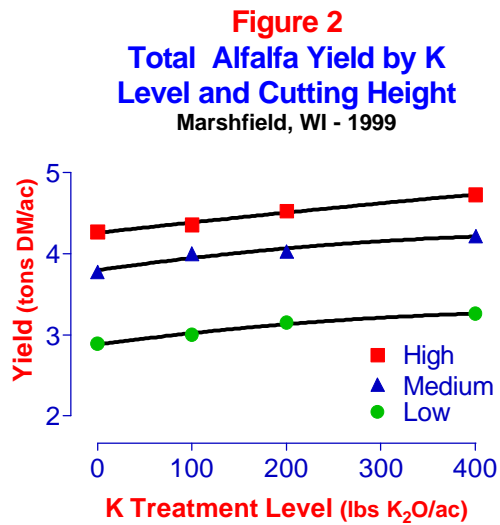
**Figure 1**

Forage yield of alfalfa at various cutting heights in small-plot trials at Marshfield, WI during 1999.



**Figure 2**

Forage yield of alfalfa for low, medium and high cutting heights in plots with different levels of K treatments at Marshfield, WI during 1999.



**Figure 3**

K concentration of alfalfa forages cut at various cutting heights in a trial at Marshfield, WI during 1999.

