NORTHWEST CROPS & SOILS PROGRAM

Influence of cutting height on forage quality and productivity

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INFLUENCE OF CUTTING HEIGHT ON FORAGE QUALITY AND PRODUCTIVITY

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Harvest management is an integral component of producing high-quality forage. Often harvest timing and speed are discussed but equally important is the cutting height. While many grazing farmers have adopted the practice of leaving more un-grazed material in the pasture, many hay fields are still harvested as low as possible. This, in combination with frequent harvesting, can stress stands causing loss in density, which can lead to declines in productivity, quality, and allow for weeds to proliferate. Furthermore, with more erratic rainfall patterns often leading to long periods of drought during the summer months, cutting at a higher height can help the plants recover faster and keep the ground cooler during these conditions following harvest. Understandably, farmers are harvesting low to harvest as much dry matter per acre as possible. But at what cost? Is the additional dry matter worth it? In 2022, the University of Vermont Extension Northwest Crops and Soils Program initiated a trial evaluating the impacts of varying cutting heights on forage yield and quality, as well as regrowth rates to better understand this trade-off.

MATERIALS AND METHODS

A pre-existing perennial forage trial was utilized for this experiment. The trial area contained a mixture of meadow fescue and alfalfa that was established in 2019. The plot design was a randomized complete block. Plots were 10' x 120' with four replications where treatments were three cutting heights, 1.5, 3, and 6 inches. Plots were harvested using a John Deere Disc Mower adjusted to each height on 3-Jun. Yields were measured by collecting and weighing the material in a 10' x 39" section of each plot's swath. A small plot Carter flail forage harvester was then used to chop the swath in each plot to obtain a uniform subsample for dry matter content and quality determination. Every week following harvest, height and ground cover were measured 10 and 5 times in each plot respectively. Ground cover was assessed using the Canopeo smartphone application in which the amount of green area out of each photo is calculated. Weekly measurements were made for four weeks post-harvest. A second harvest was made on 20-Jul, from which yields were collected again. No additional quality or growth measurements were taken at or following this harvest.

Mixtures of true proteins, composed of amino acids, and non-protein nitrogen make up the crude protein (CP) content of forages. The bulky characteristics of forage come from fiber. Forage feeding values are negatively associated with fiber since the less digestible portions of the plant are contained in the fiber fraction. The detergent fiber analysis system separates forages into two parts: cell contents, which include sugars, starches, proteins, non-protein nitrogen, fats and other highly digestible compounds; and the less digestible components found in the fiber fraction. The total fiber content of forage is contained in the neutral detergent fiber (NDF) which includes cellulose, hemicellulose, and lignin. This measure indicates the bulky characteristic of the forage and therefore is negatively correlated with animal dry matter intake. The portion of the NDF fraction that is estimated to be digestible after 30 hours of fermentation in rumen fluid is represented by the 30- hour NDF digestibility. The fraction of total NDF content which will remain undigested after 240 hours of incubation in rumen fluid is represented by the uNDF 240-hour.

Yield data and stand characteristics were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within trials were treated as random effects, and mixtures were treated as fixed. Treatment mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p<0.10$). Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among varieties is real or whether it might have occurred due to other variations in the field. At the bottom of each table a LSD value is presented for each variable (i.e. yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown. Where the difference between two hybrids within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure that for 9 out of 10 times, there is a real difference between the two varieties. Varieties that were statistically similar in performance to one another share a letter. In this example, variety C is significantly different from variety A but not from variety B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these varieties did not differ in yield. The difference between C and A is equal to 3.0, which is greater than the LSD value of 2.0. This means that these varieties yielded significantly different from one another.

Hybrid	Yield
A	6.0b
B	7.5ab
C	**9.0a**
LSD	2.0

RESULTS

Weather data was recorded with a Davis Instrument Vantage Pro2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT (Table 1). The 2022 growing season began wetter than normal with almost three inches of precipitation above normal accumulated. However, temperatures increased, and precipitation returned to approximately normal in May. Rain returned in June with almost four inches above normal being accumulated which was accompanied by cooler than normal temperatures. Precipitation again decreased through July with approximately 1 inch less than normal being accumulated. Overall, a total of 2497 Growing Degree Days (GDDs) were accumulated during the trial period. This equated to 24 fewer than normal GDDs. In general, the wet cool conditions were very conducive to the growth of the perennial cool season forages utilized in this trial.

Table 1. 2022 weather data for Alburgh, VT.

	Apr	May	Jun	Jul
Average temperature (°F)	44.8	60.5	65.3	71.9
Departure from normal	-0.81	2.09	-2.18	-0.54
Precipitation (inches)	5.57	3.36	8.19	3.00
Departure from normal	2.50	-0.40	3.93	-1.06
Growing Degree Days (base 41°F)	201	617	726	953
Departure from normal	-14	77	-67	-20

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.
Historical averages are for 30 years of NOAA data (1990-2021) from Burlington, VT.

We'd expect to see more growth immediately following harvest in the higher cutting height treatments as more material was left unharvested that could quickly begin photosynthesizing and growing compared to the shorter cut treatments which must mobilize crown and root energy reserves to initiate growth again.

However, this was not what was observed in this trial (Figure 1). In this trial, the shortest harvest height treatment produced the largest height gain during the first week post-harvest (13 cm) while the tallest harvest height treatment produced the smallest gain (3.9 cm). In subsequent weeks, growth was approximately equal across the treatments ultimately resulting in similar height accumulated after the four weeks. Ground cover also did not differ across the treatments over the four weeks post-harvest (Figure 2). As previously discussed, ample rainfall fell during the trial period. These trends may not have been observed in conditions that were less conducive to cool season perennial forage growth.

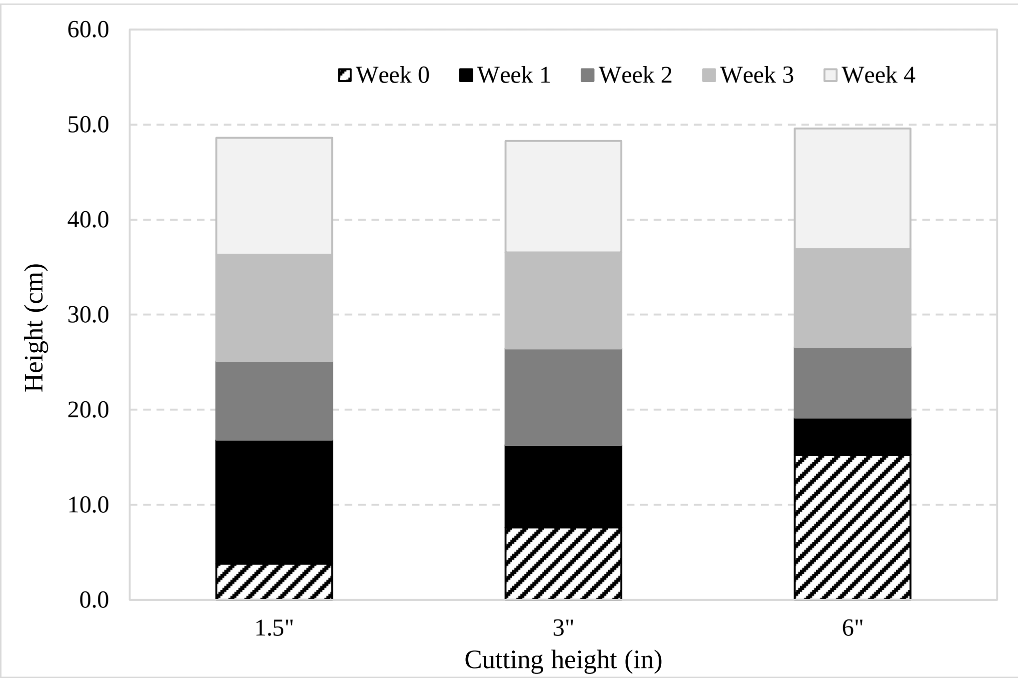

Figure 1. Weekly growth for four weeks post-harvest across three cutting height treatments.

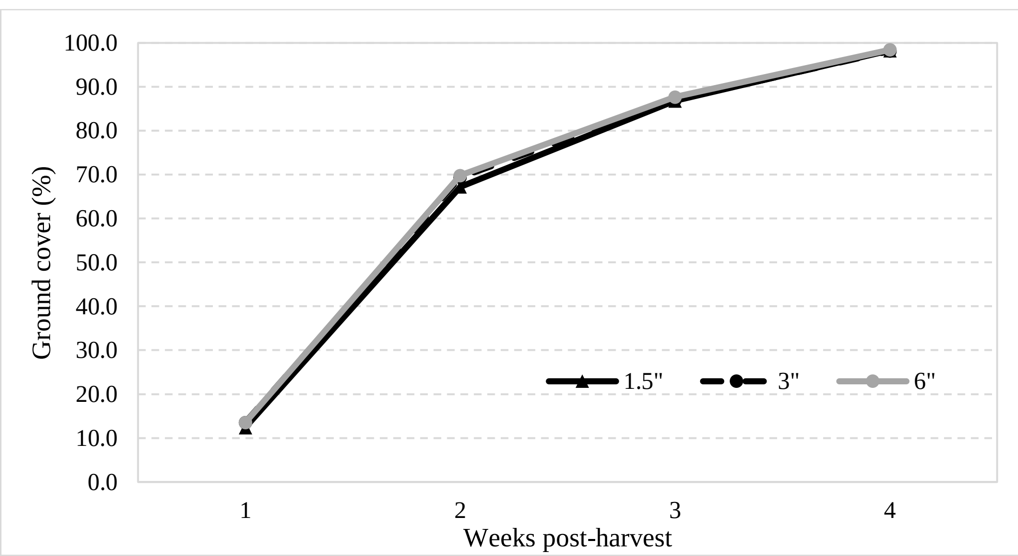

Figure 2. Weekly ground cover for four weeks post-harvest across three cutting height treatments.

Overall, dry matter yields of the two harvests ranged from 3.74 to 4.85 tons ac^{-1} but did not differ statistically (Figure 3). As expected, higher dry matter yield was obtained by cutting at a shorter height. Across the two harvests measured, yields were reduced by approximately 7% and 23% by increasing cutting height to 3" and 6" respectively. However, relative forage quality improved as cutting height was increased albeit not statistically significantly. Much of this increase in overall quality ranking can be explained by fiber digestibility (Figure 4). While the overall fiber content of the forage harvested in the cutting height treatments were equivalent (approximately 52%), the digestibility of the fiber significantly declined as cutting height was reduced to 1.5". Similarly, the portion of the fiber that would be left undigested after 240 hours in the rumen decreased as cutting height increased.

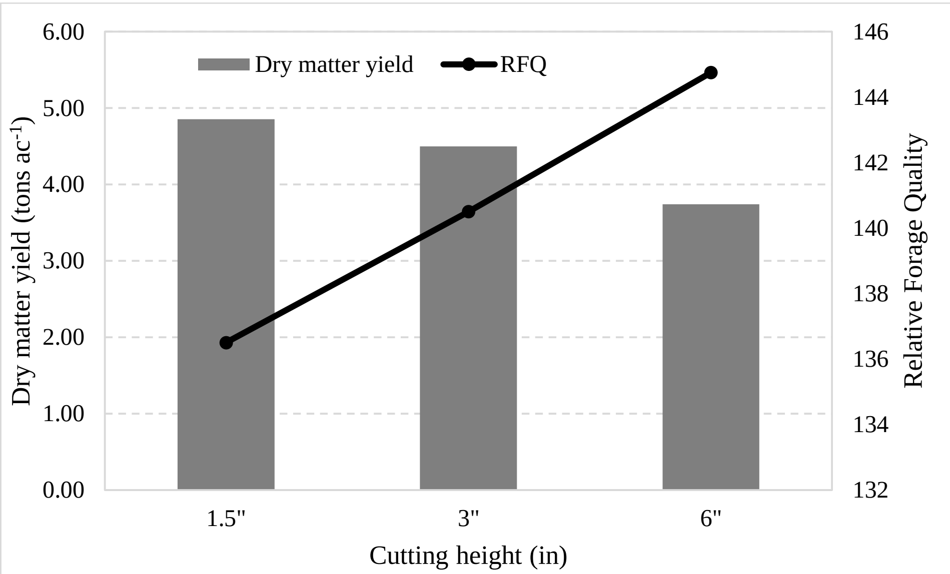

Figure 3. Dry matter yield and relative forage quality by cutting height treatment.

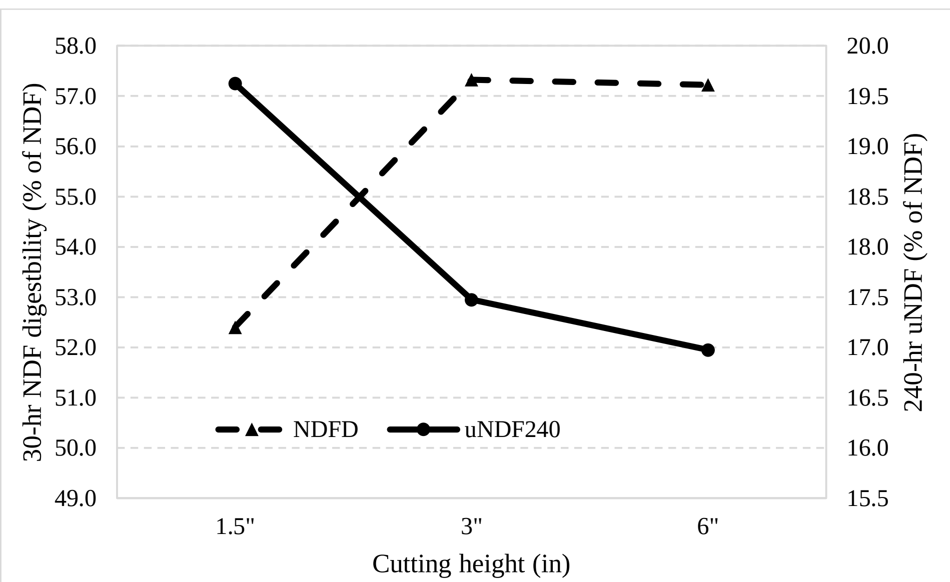

Figure 4. 30-hr NDF digestibility and 240-hr uNDF content by cutting height treatment.

DISCUSSION

While growth rates in this trial were higher in the lower cutting height treatment, the trial was conducted during a period of cool wet weather extremely conducive to cool season perennial forage production. Under drought conditions or after multiple years of continual stress from low cutting, these trends may be different. These data suggest that, while higher yields were obtained by reducing cutting height, cutting lower than 3” can result in lower quality forage. Feeding forage with lower fiber digestibility will result in lower forage dry matter intake, which can negatively impact milk production. Greater quantities of costly concentrates will need to be fed to provide adequate nutrition to the animals and support milk production.

ACKNOWLEDGEMENTS

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