

# The Effect of Clipping Interval and Height on Yield and Chemical Composition of Alfalfa (*Medicago sativa L.*)

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## 刈取間隔 및 刈取高가 알팔파의 収量 및 營養成分 含量에 미치는 影響

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### 摘 要

本 試驗은 飼料의 價値가 매우 높은 알팔파의 Du Puits을 供試品種으로 하여 刈取間隔 및 刈取高가 収量, 乾物含量, 葉收量, 粗蛋白質 含量 및 無機物 含量에 미치는 影響을 究明하고자 1978年 6月부터 9月까지 忠南 成歡 蓮庵畜園大 附屬飼草圃場에서 實施하였으며 그 結果를 要約하면 다음과 같다.

1. 5週間隔으로 刈取한 区에서 收穫된 알팔파의 収量은 3週間隔으로 한 것보다 17.4%가 增加하였으며 高刈取区는 低刈取区보다 10.7%가 增加하였다.

2. 葉의 量은 3週間隔刈取区에서 有意的으로 높았으나 葉의 乾物收量은 5週刈取区에서 높았다.

3. 粗蛋白質의 含量은 3週間隔刈取区에서 높았으며 刈取높이의 增加에 따른 含量差는 發生하지 않았다.

4. 磷, 칼슘, 칼슘 및 마그네슘의 含量은 刈取高와는 關係없이 3週間隔区에서 顯著히 높았으나 刈取高 差異에 따른 含量差는 없었다.

### I. Introduction

There have been many experiments to study the effect of frequency of clipping and height of clipping on the yield of alfalfa. Recently, attention has been given to the interrelationship between defoliation frequency and height(KGGRP, 1976). Frequent defoliation keeps plant younger and normally of higher nutritive value, but frequency of clipping is subject to some variation due to utilization systems and environmental factors. McLeod(1978) who had studied the effect of cutting alfalfa at various plant heights found that for maximum production alfalfa would not be defoliated frequently when it is growing vigorously. Alfalfa repeatedly cut when 20cm high had 73% of the yield and 115% of the percentage leaf of alfalfa cut at early flowering, but continuous defoliation at vigorous growth stage caused severe reduction in alfalfa vigor and delayed its recovery growth.

The tendency for livestock to develop bloat when consuming legume rather than grass herbage occurs due to a difference in chemical composition. The deficiency of mineral elements in legumes and grasses is responsible for domestic animal-rearing being uneconomic in certain area of Korea. There are, however, consistent differences between legumes, and grasses, in the percentage contents of some constituents. It is clear that there will be differences to some extent between growth stages, because the herbage contains stem material, the proportion of which generally increases with advancing maturity (Spedding and Diekmahns, 1972).

The following experiment was undertaken to see to what extent variations in the rate of production, crude protein and mineral contents by alfalfa depend upon the frequency and height of clipping.

### II. Materials and Methods

The experiment was carried out at the School

Farm, Yon Am Junior College of Animal husbandry and Horticulture located near Sungwhan, Chungnam-do. The soil at the site was a light loam. Its phosphate status was low, potash high and water retention good. After plowing in August 1977, samples from the top soil were collected to test pH, showing approximately 5.5.

The trial site was prepared by adding lime and was sown in September 1977. A seeding rate of 12kg/ha was sown under simple irrigation. During the growing period, all trial plots were occasionally irrigated when water was needed. The variety used was Du Puits which was purchased from a seed company.

Fused phosphate(20%  $P_2O_5$ ) and muriate of potash (60%  $K_2O$ ) were applied at the rate of 200kg/ha and 150kg/ha, respectively. Boron (as borax) was also applied at the rate of 2.0kg/ha. Half amounts of all fertilizers except boron was applied before sowing. The rests were applied immediately after each harvest.

The treatments in the study consisted of clipping intervals of 3 and 5 weeks and clipping heights of 3 and 5cm arranged in all possible combinations. The total 4 treatments were replicated 3 times in a randomized block design. Plots 1 by 2 meters in size were used in this test. The experiment was continued for a 15 weeks period in order to terminate all clipping treatments on the same date.

All kinds of unsown species were cleaned by hand. Whole plots were mown and 500g per plot sub samples were taken for dry matter determination. Additional sub samples were taken, the leaf stripped from the stem, and each component weighed separately, to determine the percentage green leaf in each treatment. Samples obtained were dried for 24 hours at a temperature of  $90^{\circ}C$ . Dried samples were milled and the powder was used for determination of total-N by means of the semi-micro kjeldahl technique. Crude protein was expressed as total nitrogen  $\times 6.25$ . The content of dry matter and green leaf were given as percentage dry matter in total herbage and leaf content as percentage dry matter in green leaf.

The mineral content of samples from the experiment was determined by conventional procedures following dry ashing. All results of mineral content are given as percentage dry matter of each element in the herbage.

### III. Results

#### 1. Total dry matter yield and dry matter content

Measured alfalfa dry matter(DM) yield is shown in Fig. 1. Because of dry weather condition during the seedling period, the start of the alfalfa growth was markedly delayed and this resulted in an unequal stand of vegetation in spring 1978. As a results an experimental task was started on 21 May, when all the plots were cleanly cut with electric shears.

The differences in the two clipping heights were very apparent under the field condition and the data collected showed the superiority of 5-cm clipping height. When crop was clipped to 3-cm height, the first- and the second-defoliation showed the increment of DM yield, this being perhaps due partly to the trend of bulk production in spring, irrespective of the retarded growth of crop in mid-spring caused by dry conditions, and there was a fairly continuous decline thereafter. It can be seen from Fig. 1 that the maximum yield was obtained from 5-cm clipping height(4,191kgDM/ha) and it increased to 21%, compared to that at 3-cm clipping height(3,469kgDM/ha).

At 5-week clipping intervals, the tendency of decline in yield harvested after the first defoliation was similar to that at 3-week interval, but differences in yield between two clipping heights appeared to be significantly large, due mainly to the lenient increment of yield at the second defoliation by clipping crop to 3-cm height. Regardless of clipping intervals, notable positive differences in yield with 5-cm clipping height occurred in late June, they being 471kg and 722kg, from 3- and 5-week clipping interval, respectively.

In general, severe clipping seriously influenced DM percentage and total DM yield of alfalfa over the trial period. With regard to the influence of

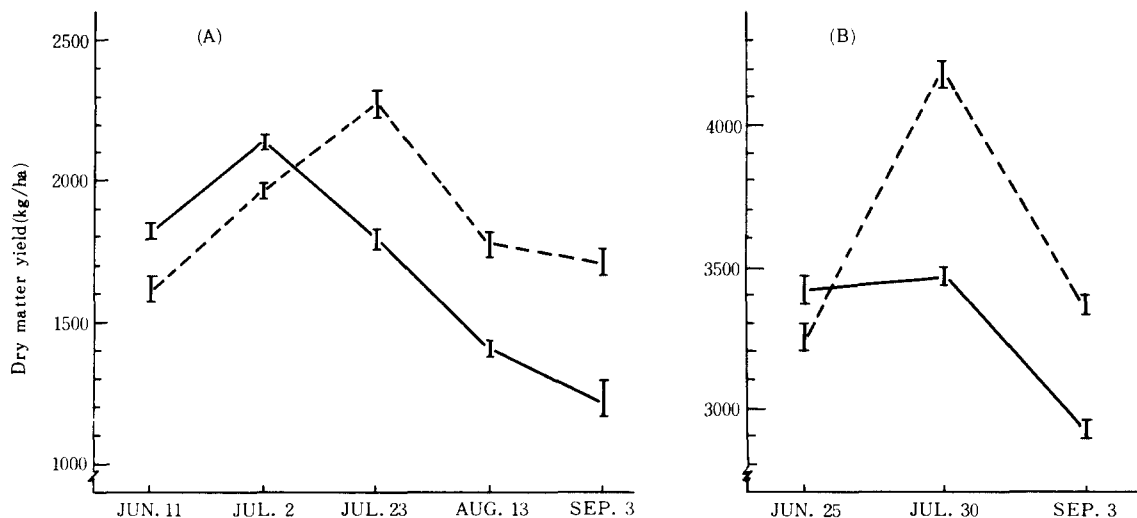


Fig. 1. Dry matter yield of alfalfa from either 3cm or 5cm of clipping height at (A) at 3 weeks and (B) 5 weeks of clipping interval. Vertical lines represent the standard error. ○—○. 3cm height; ○-----○. 5cm height.

clipping frequencies, it can be seen from Table 1, also, that increasing the clipping frequency notably reduced DM percentage and total DM yield, though the case of DM percentage was not statistically significant at 3-week intervals. DM percentage and total DM yield were increased to 7.9% and 10.7%, respectively, as the intervals were extended from 3 to 5 weeks. Although the rate of increase in DM yield by extending the clipping height from 3 to 5 cm was slightly high at 3-week intervals, the highest DM yield obtained from 5-week intervals. This demonstrates that the rate of production of alfalfa was higher throughout the season at 5-week than 3-week interval.

## 2. Content and dry matter yield of green leaf and crude protein

Table 2 shows the content and DM yield of green leaf of alfalfa. Clipping to 3cm increased percentage of green leaf to 4% and 5% at 3- and 5-week intervals, respectively. Comparing the results from clipping interval treatments, mean content value was much lower at 5- than 3-week intervals. This means that a high content of green leaf may be obtained with a shortened clipping interval, together with a short clipping height. However, DM yield of green leaf was obviously high with 5-week clipping interval.

The increase in crude protein by lengthening

Table 1. Dry matter content (% in DM) and total dry matter yield of alfalfa according to clipping intervals and heights over 15 weeks

|                    | 3 - week interval |       |       | 5 - week interval |        |        |
|--------------------|-------------------|-------|-------|-------------------|--------|--------|
|                    | 3 cm              | 5 cm  | Mean  | 3 cm              | 5 cm   | Mean   |
| DM content         | 20.63             | 21.77 | 21.05 | 21.13             | 22.79  | 21.99  |
| DM yield (kg / ha) | 8,401             | 9,357 | 8,879 | 9,786             | 10,833 | 10,310 |

5 % L. S. D. for

clipping interval and height in DM content : 1.24

clipping interval and height in DM yield : 311.9

**Table 2. Green leaf content(% in green leaf DM) and yield and crude protein content(% in DM) of alfalfa according to clipping intervals and heights over 15 weeks**

|                      | 3 - week interval |       |       | 5 - week interval |       |       |
|----------------------|-------------------|-------|-------|-------------------|-------|-------|
|                      | 3 cm              | 5 cm  | Mean  | 3 cm              | 5 cm  | Mean  |
| Leaf content (%)     | 47.06             | 45.20 | 46.13 | 45.12             | 43.00 | 44.06 |
| Leaf yield (kg / ha) | 3,997             | 3,136 | 4,067 | 4,399             | 4,617 | 4,508 |
| Crude protein (%)    | 15.82             | 15.20 | 15.51 | 12.77             | 13.34 | 13.05 |

5 % L. S. D. for  
 clipping interval and height in leaf content : 1.22  
 clipping interval and height in leaf yield : 96.6  
 clipping interval and height in CP content : 2.00

clipping intervals may be attributed to new growth following the increase of green leaf content in alfalfa. It was found that 3-week intervals increased crude protein content to 18.9% of that obtained when crop was clipped at 5-week intervals. Unlike the case of increasing green leaf content at 5-week intervals, compared to 3 week, clipping height had little or no effect upon crude protein content.

### 3. Mineral contents

The changes in mineral content by clipping interval and height in alfalfa are shown in Table 3. Phosphorus and magnesium showed a marked increase with 3-week interval, and this treatment was likely to improve the content of potassium and calcium, though it was of no significance.

In all treatments, clipping height had no effect

upon the content of minerals, with the exception of phosphorus at 5-week interval.

### IV. Discussion

Data were collected over four months to throw light on the problem of results obtained from two systems of clipping regime, height and interval, without companion crops. Some general information on the overall effect of the treatments as affecting DM yield, green leaf percentage, crude protein content and mineral contents which might be a barometer of nutritive value in alfalfa was obtained, and this will be discussed.

Numerous investigations have shown that the alfalfa production suffers if the stand is cut too frequently. Washko and Price(1970) in Pennsylvania

**Table 3. Influence of clipping intervals and heights on phosphorus, potassium, calcium and magnesium content in alfalfa over 15 weeks (on a dry basis)**

|                | 3 - week interval |      |      | 5 - week interval |      |      |
|----------------|-------------------|------|------|-------------------|------|------|
|                | 3 cm              | 5 cm | Mean | 3 cm              | 5 cm | Mean |
| P content (%)  | 0.40              | 0.41 | 0.41 | 0.26              | 0.21 | 0.24 |
| K content (%)  | 3.17              | 2.97 | 3.07 | 3.04              | 2.90 | 2.97 |
| Ca content (%) | 1.20              | 1.28 | 1.24 | 1.16              | 1.18 | 1.17 |
| Mg content (%) | 0.39              | 0.35 | 0.37 | 0.26              | 0.21 | 0.24 |

5 % L. S. D. for

clipping interval and height in P content : 0.031  
 clipping interval and height in K content : 0.204  
 clipping interval and height in Ca content : 0.110  
 clipping interval and height in Mg content : 0.115

showed that alfalfa cut at 25-day intervals gave high yields and good persistency. Similarly at Davis, California, Meyer and Jones(1962) found that annual dry matter yields increased from 11.6 m/t per hectare with 8 cuts at 3-week intervals to 20.9 m/t per hectare with 4 cuts at intervals of 6 weeks. The results of this trial show that for high production alfalfa should not be cut when it is still growing vigorously. Alfalfa clipped at 3-week interval produced only 86.1% as much dry matter as the crop clipped at 5-week interval. According to Leach (1970), the reduced yields could have been due to frequent clipping causing decreased stem growth rate. Langer (1968) also found that plant low in reserves and weakened by frequent cutting during the growing season had fewer carbohydrates for resumption of vegetative growth the following spring. In the present experiment there were consistent yield reductions with frequent defoliations through the growing season (Fig. 1).

Experimental results from Suweon(KGGRP, 1976) showed that marked difference occurred with cutting treatments; the 3-cutting system produced higher yield than the 5-cutting system did, due probably to the better regrowth after defoliation. The results in this present experiment seems to be in line with this.

Keoghan(1967) found that alfalfa seemed to recover well after a period of mismanagement, if a prolonged period of recovery was allowed. These results suggest that an alfalfa management scheduling involving prolonged period of cutting interval should be used for both superior yield and more extended period of utilization of alfalfa. However, maintenance of good performance of alfalfa in mid-summer is rather difficult because of heavy rain expected.

Meanwhile, the tall clipping could compensate the lose of yield caused by the shorten period of clipping, but the yield harvested by 5-cm height when crop was clipped at 3-week interval was slightly lower than that by 3-cm height when crop was clipped at 5-week interval. This indicates that the factor suppressing higher yield of alfalfa would be the clipping interval rather than the clipping height.

Smith(1975) stated that although the height of clipping was not important to the persistence of alfalfa under recommended clipping frequencies, higher yields were obtained with short than tall clipping because new shoots arouse primarily from the elongation of buds close to the soil surface. It is apparent in the present experiment, however, that a short clipping under short period of clipping interval might not allow the rapid recovery of crop after clipping, particularly in mid-summer, resulting in the slow increase of yield. This broadly agreed with the results from many workers(Davies, 1960; Langer, 1968; MAFF, 1969; McLeod, 1978). Work conducted by Janson(1972) showed, also, that first year alfalfa will suffer more than mature crops from frequent defoliation. Thus the one year old stand used in the trial may have suffered from repeated defoliation.

The average DM content of alfalfa obtained was 21.1% and 22.0% at short- and tall clipping regimes, respectively. This tendency of a slight reduction for DM content with decreasing the frequency of clipping was similar to that reported by Shim(1975) who had experimented with perennial ryegrass, of which DM content was 13.6% and 14.2% at 3- and 5-week intervals, respectively. Castle and Watson(1973) have shown that the minimum level, ensuring a margin of safety against production of effluent, was DM content of about 24.7% in the herbage. DM content in alfalfa harvested is below this level. It is suggested, therefore, that to obtain an appropriate DM content in alfalfa for silage making a relatively short period for wilting should be required.

Young, short, leafy alfalfa would be expected to be of higher feed quality than that which is not leafy, and, on the other hand, the leafy alfalfa's markedly lower production would have offset this apparent feed quality advantage. In the present experiment, differences in green leaf percentage did occur: alfalfa clipped at 3-week interval was more leafy than at 5-week interval and, also, 3-cm height had significant effect upon a rise of green leaf percentage. Although no clipping stage which would markedly effect alfalfa quality was included as a treatment, the investigation confirmed that if high quality crops

are desired they can be produced by clipping at shortened interval between clippings, but total yields and/or stand longevity will be affected.

The mineral contents showed an apparent decline with the prolonged clipping interval rather than with the clipping height. Wise et al. (1958) gave 0.30% of phosphorus as the minimum safe dietary allowance of calves. Values attained in alfalfa with 3-week clipping interval in the present experiment was approximately 30% more than the above figure. Otherwise, prolonged interval of clipping failed to supply sufficient amounts of phosphorus to meet the needs of the livestock.

Research data(Dennis et al. 1976) indicate that the potassium requirement of a lactating dairy cow is approximately 0.8% of the dry dietary. In the present experiment, alfalfa contained considerably more potassium than required by dairy cattle. Potassium content decreased with 5-week clipping treatment, but this was still a higher value than the amount needed.

Calcium content was relatively high with 3-week clipping treatment, but comparing with the published requirements for dairy cow(NAS, 1978), the amounts were far below the values required.

Significant differences in magnesium content in alfalfa between the two clipping intervals were found (Table 3) and in comparison with the requirements for dairy cow(NAS, 1978), 0.37% and 0.24% with the 3- and 5-week intervals, respectively, may be sufficient.

## V. Summary

The effect of two levels of clipping interval and two levels of clipping height on total dry matter yield, dry matter content, green leaf content and yield, crude protein content, and mineral contents was examined in Du Puits alfalfa during a 15-week period in the first harvest year in a field experiment.

A clipping system of 5-week interval increased yield to 17.4%, compared to 3-week interval. Further, a tall clipping system increased to 10.7% compared to a short clipping.

Green leaf content and crude protein content

were low at 5-week clipping interval, but dry matter yield of green leaf was significantly increased by lengthening the interval between harvests. There were no significant differences in crude protein content between clipping heights.

Phosphorus, potassium, calcium and magnesium markedly increased with 3-week clipping interval in spite of clipping height regimes. Differences between clipping heights were not significant. The amount of mineral contents in alfalfa tested in this trial was discussed in relation to the problem of the requirement of livestock.

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