The Effect of Cutting Treatments on the Carotene Content of Alfalfa in the Yakima Valley

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Several factors have been shown to influence the carotene content of grasses and legumes. Those factors of greatest importance are the stage of growth of the herbage and the seasonal effect characterized by a minimum concentration in summer. The study reported here afforded an opportunity to separate the two factors and show the effect of each.

Several workers (10, 5, 7, 4) have reported that the carotene content of pasture grasses is dependent largely upon the growing season and the stage of maturity. Thompson (8) showed that for three strains of alfalfa found in California common, the carotene content decreased at successive stages of growth as the plants approached maturity. In four species of grasses studied by Bird (2), the carotene decreased to approximately one-half that of the short-grass stage by the time the plants began to bloom. In general, reports show that an increase in yield of dry matter in the advanced stages of maturity is obtained at a sacrifice of the concentration of carotene.

There is a seasonal decrease in carotene content that is independent of the stage of growth. Atkeson, et al. (1) reported that, in spring and early summer, plants were relatively high in carotene, with a decrease occurring during the later summer months. The decrease was attributed to drought and high midsummer temperatures in combination with drought. In four species of grasses studied by Bird (2), when the grasses were cut at the short-grass stage at six intervals throughout the season, the carotene content in pasture grass reached its lowest level in July. After that time, there was an increase in carotene concentration until fall, when values approached those of spring. In a study of weekly variation in carotene content of various herbage during the season, Snyder and Moore (7) found that first cutting alfalfa in Michigan declined from 432 ppm at an immature stage (April 25) to 171 ppm at hay stage on June 20. The second crop declined from 318 ppm at 17 days recovery (July 7) to 132 ppm at hay stage on August 16. The immature third crop decreased from 367 ppm on August 23 to 284 ppm at the three-fourths bloom stage on September 26. It was observed that the carotene content of the herbage was greater at earlier stages of growth, and the content showed a progressive decrease as the plants matured except where affected by factors governing the rate of growth.

This paper presents the results of a study to determine the cutting treatments or combinations of treatments which would produce the greatest yield of carotene.

Materials and Methods

The study was conducted on Ladak alfalfa at the Irrigation Experiment Station, Prosser, Wash. The climatic and soil conditions, design, management, and harvesting methods were previously reported with the results of various treatments (3). The plots were seeded in 1946, and in 1947 subjected to spring-cliping treatments of no clipping or at average heights of 4, 7, and 12 inches in 25 cm intervals between cuttings of 25, 29, 33, 37, and 41 days. The plots were split on September 1, 1947. Each plot was cut on schedule after that date and the uncult. Samples of approximately 100 grams were cut at the time the plots were cut. Preservation for later analysis consisted of autoclaving at 15 pounds pressure for 20 minutes in the air previously removed, sealing in moisture-proof bags, and quick-freezing.

Carotene determinations were made on whole material well chopped and mixed. From 5 to 10 grams of material were extracted by the procedure of Moore and Ely modified by Wall and Kelly (9). Carotene content was evaluated with an Evelyn type colorimeter. The figures are total carotene in micrograms per gram of dry material.

Experimental Results

The standard regression coefficients of treatments and yield of dry matter on carotene concentration are shown in Fig. 1. The diagram is according to the path coefficient scheme (7) to show fully the relationship among the various treatments and the direct effect of each on the concentration of carotene.

Previous fall treatment had no measurable effect on carotene content. The correlation coefficient (r = -0.1229) between previous treatment and carotene content is not significant.

The standard regression coefficient (b) of previous treatment on carotene content is significant.