THE FEEDING VALUE OF TWO SUCCESSIVE CUTTINGS OF ALFALFA HAY HARVESTED AT DIFFERENT STAGES OF MATURITY

by

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INTRODUCTION

The dairy cow, because of her rumen,is capable of economically utilizing fibrous plants as a source of nutrients. The problem of obtaining maximum production economically from the feeding of the dairy cow has stimulated efforts toward greater understanding of roughage utilization. Alfalfa, Medicago sativa, was introduced into the United States by the Spanish in the 1850's and is one of the important herbages utilized in the ration of the dairy cow.

The decision as to when to harvest the alfalfa plant involves management problems, climatic conditions, and plant differences in order to obtain maximum yield of high quality feed. The casual observer can see changes in the physical appearance of the plant as it advances in maturity. If maximum results are to be obtained factors such as yield, palatability and changes in chemical composition of the plant must be considered to determine the best time for harvesting of the plant.

This study was initiated to obtain information on the effects of harvesting successive cuttings of alfalfa hay at different stages of maturity on milk production by dairy cows.

REVIEW OF LITERATURE

One of the problems of roughage evaluation is the definition of quality as related to hay. Smith (1957) recognized this difficulty when he proposed that " --the problem of determining quality of roughages has as many facets as there are men who have proposed definitions." The usual criteria for evaluation have been the U. S. hay grades based on plant species, color, leafiness and proportion foreign matter. These are questionable as measures of feeding quality, according to Smith.

Many comparisons of the nutritive value of alfalfa hay cut at different stages of maturity have not included milk production as a criterion. As early as 1897, Widstoe listed three criteria for determining the time of cutting hay: (1) composition of the hay, (2) digestibility of the forage and (3) the production per acre of each nutrient. Bohstedt (1944) suggested leafiness as a factor affecting quality of a forage. Huffman (1939) stated that the value of roughage for dairy cattle depended upon the amount of dry matter consumed, the chemical composition of the roughage and the coefficient of digestibility of the dry matter. Widstoe (1897) recognized that there was a decrease in percentage of crude protein and an increase in crude fiber as the alfalfa plant matures. In the spring when alfalfa was 6.5 inches tall, the crude protein and crude fiber were 28.0 percent and 12.3 percent on the dry basis, respectively. These values changed to 10.7 percent and 42.3 percent, respectively, when the crop was harvested at the late bloom stage of maturity.

Foster and Merrill (1899) studied alfalfa at three different stages of maturity. These workers found that when the alfalfa plant was cut early, at the first appearance of a few scattered blooms, it could be rated at 100 for livestock feeding. The medium maturity or full bloom stage was then rated at 85 and, on the basis of these two ratings, a third rating of 75 was assigned to late cut alfalfa harvested when one-half of the blossoms had fallen.

Composition

One of the effects of harvesting alfalfa at different stages of maturity is difference in chemical composition, according to Huffman (1939). Cottrell (1902) reported crude protein percentages of 18.5, 17.2 and 14.4 for alfalfa harvested at one-tenth bloom, one-half bloom and full bloom stages of maturity, respectively. Extensive experimentation by Salmon _et al_. (1925) at the Kansas station over a period of six years indicated that stand, yield, chemical composition and feeding value of alfalfa hay were materially affected by varying the time of cutting. The four stages of growth studied were bud, one-tenth bloom, full bloom and the seed stage. These workers concluded that at least the first crop of alfalfa should be cut at or near the one-tenth bloom stage of maturity. They concluded that successive cuttings should be harvested at the one-fourth to the one-half bloom stage.

The relationship of maturity to the nutritive value of the first, second and third cuttings of irrigated alfalfa hay was studied by Sotola (1927). No marked difference was found between the one-fourth and one-half bloom stages. The three-fourths bloom alfalfa plant contained appreciably less crude protein than did either the one-fourth or the one-half bloom forage. A low of 29.53 percent crude fiber was found for the first crop harvested at the one-fourth bloom stage as compared to 40.23 percent crude fiber for the third cutting harvested at three-fourths bloom. Sotola (1927) observed one instance in 1923 when the third cutting contained only 8.86 percent crude protein. This low level of crude protein was attributed to growth occurring late in the season during cool weather.

Kiesselbach and Anderson (1926) listed the crude protein and crude fiber contents for the following six stages of maturity: pre-bloom, 21.98 and 25.13 percent; initial bloom, 20.03 and 25.75 percent; one-tenth bloom, 19.24 and 27.09 percent; one-half bloom, 18.84 and 28.12 percent; full bloom, 18.13 and 30.82 percent; and seed stage, 14.06 and 36.61 percent, respectively. The crude protein percentage decreased from 21.98 for the pre-bloom to 14.06 for the seed stage of maturity while the crude fiber percentage increased over the same range of maturity from 25.13 to 36.61. Green (1934), in studying both first and second cutting alfalfas, obtained results similar to those cited by Kiesselbach and Anderson. The second cutting alfalfa contained 19.84 percent crude protein and 28.49 percent crude fiber while the alfalfa cut at full bloom contained 13.19 percent crude protein and 34.01 percent crude fiber. The crude protein of the first-cutting alfalfa varied from 22.43 percent for the bud stage down to 16.87 percent for hay harvested at full bloom.

Crude protein contents that tend to confirm the findings of Kiesselbach and Anderson, and Green were reported by Pollock and Hosterman (1939). The crude protein for alfalfa cut at bud stage was 19.78 percent while that for the full bloom hay was 17.63 percent. Huffman (1939) concluded that most investigations indicate that the greatest yield of dry matter and crude protein is obtained when alfalfa is cut in the one-tenth to one-half bloom stage of maturity.

Loosli _et al_. (1950) compared alfalfa cut at the first appearance of blossoms with alfalfa harvested when some seed pods had formed. The crude protein for the early cut hay was 17.6 percent while that for the late cut hay was 14.0 percent. Loosli _et al_. found only slight differences in the crude fiber content of the hays. Both of these hays graded U.S. No. 1.

Dawson _et al_. (1940) cited work in which alfalfa hay harvested at initial bloom, half-bloom and full bloom contained 18.22 percent, 17.7 percent and 16.1 percent crude protein, respectively. Plummer (1953) analyzed 15 grasses and legumes and found that the protein content of both was highest at early stages of maturity and decreased as the plant matured. The crude fiber, lowest in young early cut plants, increased at a fairly uniform rate as the plant matured.

Yield

Cottrell (1902) reported that the yield of alfalfa decreased with advancing maturity when the hay was harvested at initial bloom, full bloom and at the stage when one-half of the blossoms had fallen. Yields of 5.35, 4.90 and 4.55 tons per acre were obtained for the early, medium, and late crops, respectively. As was pointed out earlier, Cottrell observed a subsequent decrease in crude protein with advanced stages of maturity. Delayed harvest resulted in less hay of a lower protein content.

In contrast to the results obtained by Cottrell (1902), increased yields were reported by Ten Eyck (1908) and Bean (1922) when the hay crop was allowed to mature to near the full bloom stage. Russell and Morrison (1923) concluded that alfalfa should be cut as near the full bloom stage as possible without getting the hay too coarse. They obtained average yields of 2.5, 3.2 and 4.0 tons per acre for bud stage, one-tenth bloom and full bloom crops, respectively.

Salmon _et al_.(1925) found variations in the yields of alfalfa when harvested at different stages of maturity in Kansas. The average seasonal yields of alfalfa harvested at the bud, one-tenth bloom, full bloom and the seed stages was 3.24, 3.41, 3.51 and 2.93 tons per acre, respectively. Sotola (1927) reported yields of 5.83, 6.71 and 6.86 tons per acre for alfalfa harvested at 25, 50 and 75 percent bloom, respectively. The crude protein yield per acre was 1,000 pounds for the 25 percent bloom, 1,106 pounds for the 50 percent bloom and 867 pounds for the 75 percent bloom stage of maturity. The crude fiber yield per acre was 1,776 pounds for the early cut hay, 2,287 pounds for the medium maturity and 2,155 pounds for the late cut alfalfa.

Green (1934) reported an increase in the yield of crude protein up to the one-tenth bloom stage followed by a subsequent decrease at more advanced maturity. The alfalfa harvested at the bud stage contained 812 pounds of crude protein per acre; the one-tenth bloom, 1,228 pounds; the one-half bloom, 1,191 pounds; and the full bloom stage, 1,182 pounds. Dawson et al. (1940) reported results in which alfalfa harvested at initial bloom, one-half bloom and full bloom yielded 8,938, 8,888 and 6,940 pounds of dry matter per acre for the respective cuttings. Total digestible nutrient production per acre for the initial, one-half and full bloom stages of maturity averaged 4,660, 4,413 and 3,269 pounds, respectively, over a three-year period.

Woodman et al. (1934) harvested alfalfa at prebud, bud stage and flower stage. The hay harvested at bud stage and pre-bud stage yielded 84.4 percent and 52.5 percent, respectively, as much dry matter per acre as did the flower stage of maturity.

Leaf-Stem Ratio

One of the most striking changes in the alfalfa plant with advancing maturity is the change in the leaf-stem ratio. Foster and Merrill (1899) reported the ratio of leaves to stems for early, medium and late cuttings of 42 to 58, 40 to 60 and 33 to 67, respectively. The percentages of leaves, according to Pollock and Hostermen (1939), for the different stages of maturity were: bud stage, 53.4; one-tenth bloom, 51.1; full bloom, 48.8 and seed stage, 41.6

Woodward *et al.* (1939 P. 960) cited data (Table 1) collected on alfalfa varieties Howe Hill and Willingham showing the changes in the analysis of leaves and stems with advancing maturity.

Table 1. Protein and fiber content (dry matter basis).

	Howe Hill				Willingham			
	Leaf		Stem		Leaf		Stem	
	Crude protein %	Crude fiber %	Crude protein %	Crude fiber %	Crude protein %	Crude fiber %	Crude protein %	Crude fiber %
Prebud	30.13	12.99	16.67	30.77	32.98	12.47	19.46	30.94
Bud	27.45	12.33	12.48	42.46	28.38	13.19	13.57	42.88
Early flower	23.48	13.39	9.44	44.36	24.57	13.94	11.03	46.48

It can be seen from these data that, in every case studied, the leaves contained appreciably greater percentages of crude protein than did the stems. Conversely, it may be seen that the percent of crude fiber found in the stems is at least twice as great as that in the leaves. Bohstedt (1944) indicated that normally the leaves make up 50 percent of the weight of the alfalfa plant and contain 70 percent of the crude protein, 90 percent of the carotene and are 40 percent more digestible than the stems. Tretsven (1944) stated that the leaves contain approximately three times as much protein as the stems of the alfalfa plant and are richer in soluble carbohydrates (largely starches and sugars), fats and minerals. According to Tretsven, four-fifths of the vitamin A activity may be found in the leaves of the alfalfa plant. He concluded that when alfalfa hay is cut in early bloom 35 to 45 percent of the plant will be leaves as compared with 20 to 30 percent when it is cut in late bloom.

Keyes and Smith (1955), discussing the various losses incurred in hay making, said that dry matter losses due to leaf shattering vary from 3 to 35 percent, with losses ranging from 15 to 20 percent under favorable conditions.

Kiesselbach and Anderson (1931) found a correlation coefficient of 0.86 between relative leafiness and the protein content of hay.

Digestibility

McCullough (1953) stated that forage dry matter digestibility may be the most important single measure of forage quality so long as a limiting factor such as dry matter intake does not exist. Work reviewed by Huffman (1939), listed in Table 2, shows the decreasing coefficients of digestibility of protein and crude fiber that occur with the advancing maturity.

Table 2. Content, digestibility and percent digestibility of crude protein and crude fiber of alfalfa hay.

Stage maturity	Protein Content %	Protein Coef. of digestibility %	Dig. protein %	Fiber Content %	Fiber Coef. of digestibility %	Dig. crude fiber %
Pre-bud	25.3	84	21.3	22.1	63.7	14.1
In bud	20.4	76	15.5	23.9	46.3	11.1
In flower	17.2	74	13.0	29.7	42.6	12.6
Average alfalfa	14.2	74	10.5	29.5	50.8	14.9

Dawson *et al*. (1940) reported coefficients of dry matter digestibility for initial bloom, one-half bloom, and full bloom of 63.4, 61.2 and 57.5 percent, respectively. There was not a significant difference between the digestible crude protein of the early and medium cut hays, but the late cut alfalfa was 2.3 percent less digestible than that of the initial bloom. The digestibility of the crude fiber was 47.7, 41.4 and 38.3 percent for initial bloom, one-half bloom and full bloom, respectively.

Crampton and Jackson (1944) found that the digestibility of mixed pasture herbage measured by steers and sheep appeared to follow the leaf/stem ratio of the herbage quite closely. A steady decline in the digestibility of pasture herbage dry matter from values of approximately 75 percent for early spring grass to 60 percent, six weeks later, was noted. Synge (1952) stated that the soluble carbohydrate content fluctuated greatly with the season. He concluded that these changes in soluble carbohydrate content may be responsible for some of the differences that are said to exist between the value of spring and autumn grasses.

Reid (1955) studied the total digestible nutrient content of more than 70 forage samples cut between May 18 and July 8. The cows obtained more energy per pound of dry matter from early-cut forage than from late-cut forage. Reid found that the total digestible nutrient content of forage could be calculated if the cutting date was known. Stallcup (1956) used fistulated steers to study the influence of lignification of forage on digestibility. The data obtained by Stallcup indicated that the lignin content of hays is important because it influences the digestibility of the forage and because lignin retards passage of the nutrients. He reasoned that more ingesta remained in the rumen twelve hours after feeding with the high lignin hay than of the low lignin hay, thus reducing the physical capacity of the animal for eating roughage at the next feeding.

According to Huffman (1939), the digestibility of fiber appears to be inversely proportional to its content of lignocellulose. McCullough (1953) reported that lignin occurs in plants chiefly as lignocellulose. He cited work by Crampton which showed the effect of lignin on the digestibility of dry matter. As the proportion of lignin increased the coefficients of digestibility of the dry matter decreased.

Woodman et al. (1934) stated that "In the young plant, the cell walls are extremely thin and tender and are composed almost entirely of pure cellulose. The latter is digested in the ruminant tract to almost the same extent as is the carbohydrate fraction." The digestion coefficients of the crude fiber and carbohydrates were 84 and 87 percent, respectively, in early growth pasture herbage. According to Woodman and associates, as the plant matures the cell walls become thickened and toughened due to their becoming surrounded by, and intimately admixed with, the much more carbonaceous and woody form of fiber known as lignocellulose. The latter is "entirely" indigestible. They contended that the process of lignification is accompanied by a gradual diminution of the digestibility of the crude fiber of the plant. Whereas the crude fiber in grass at early stages of maturity was found to be 84 percent digestible, that contained at the hay stage of maturity was digested to the extent of only 52 percent, as shown in Table 3. Becsuse protein, fats and carbohydrates contained in the cell walls may not become accessible to the digestive ferments of the alimentary tract, Woodman concluded that the digestibility of fiber is inversely proportional to its content of lignocellulose.

Table 3. Digestion coefficients of grass and hay (Woodman et al. 1934)

	Young leafy stage %	Grass at hay stage of maturity %
Fiber	84.2	57.4
Carbohydrate	87.4	53.0
Protein	85.4	50.0
Oil	60.0	30.0

Palatability and Consumption

The rate of consumption of any roughage is one of the factors influencing its value for feeding. The food capacity or appetite of an animal is measured by the total amount of dry matter actually consumed when the animal is offered as much as it cares to eat, according to Murry (1926). Huffman (1939) distinguished between palatability and appetite by saying that palatability is but one factor responsible for a large food intake. According to Huffman, a hay considered highly palatable may not be appetizing. The reverse may be true when a hay or forage considered less palatable is consumed in large quantities when the animal is forced to eat the forage. Huffman cited an instance in which a silage mixture of 20 parts of sweet clover and one part of corn was not relished by cows although, when forced to eat it, one cow consumed up to 94 pounds of the 40 percent dry matter silage per day.

Davies (1925) cited three factors that influence palatability: (1) stage of growth, (2) the relation of leaf to stem and (3) harshness to touch. Davies found that sheep were decidedly discriminatory in grazing, selecting the young and succulent leaves of clover plants. Work at the Arizona station (1934) indicated that alfalfa harvested at bud stage was consumed in larger amounts than that harvested at the one-third bloom stage of maturity.

Dawson *et al.* (1940) reported average daily consumption rates of 40.6, 41.0 and 40.9 pounds for alfalfa harvested at initial bloom, one-half bloom and full bloom, respectively. Trimberger _et al_. (1955), found that the average daily dry matter intake was greater with the early harvested hay and silage than with more mature forage. Alfalfa hay harvested at pre-bloom, one-tenth bloom and full bloom was consumed at rates of 11.8, 9.9 and 8.0 pounds daily per 1,000 pounds of body weight when fed in conjunction with silage, according to Blosser _et al_. (1957).

Blaxter (1950) reported that the amount of feed consumed, as measured in terms of dry matter intake, increased with increasing concentration of the ration. Blaxter pointed out that a cow does not regulate its appetite according to its energy requirements. Hoflund and Clark (1948) observed that the appetite for alfalfa hay was directly affected by the rate of cellulose digestion. These workers reasoned that this retardation of cellulose digestion necessitated a longer sojourn of the food in the rumen which in turn decreased appetite.

Stalloup (1956) found that cattle will not eat so much of a mature high-lignin hay or pasture, as they will if the herbage is young. This is often attributed to the animal's dislike for feed. Stalloup suggested that young hay may require 24 hours for passage through the digestive tract while the mature hay may require 36 hours, which would readily explain the reduced consumption.

Milk Production

Early feeding experiments of alfalfa hay harvested at different stages of maturity did not utilize dairy cattle to measure efficiency. Much of the early work measured the feeding value by comparing weight gains in beef cattle. Cottrell (1902) reported weight gains with beef cattle of 706, 562 and 490 pounds per acre for respective harvests at initial bloom, full bloom and at the time one-half of the blossoms had fallen. Salmon _et al_. (1925) found that the average amount of bud stage alfalfa hay required to produce 100 pounds of gain on beef animals was 1,628 pounds, one-tenth bloom, 2,086 pounds; full bloom, 2,163 pounds; and seed stage, 3,918 pounds.

According to Hoglund (1955), studies at Michigan State University show that the cost of feed for producing 100 pounds of milk could be reduced as much as 25 percent on the average Michigan dairy farm. This saving could be accomplished by improving the quality of the roughage and feeding more of this quality roughage and less concentrates. Dawson _et al_. (1940) showed that for each pound of milk produced 1.34 pounds of initial bloom alfalfa, 1.57 pounds of one-half bloom alfalfa, or 1.69 pounds of full bloom alfalfa were required. For each pound of butterfat produced 36.8 pounds of initial bloom, 44.5 pounds of one-half bloom and 45.4 pounds of full bloom hay were required. Four percent fat corrected milk production per acre from initial bloom alfalfa was 6,330 pounds; from one-half bloom, 5,254 pounds; and from full bloom, 3,974 pounds.

Loosli et al. (1950) studied the value of harvesting alfalfa hay at the appearance of the first blossoms and past full bloom. The daily production of fat corrected milk for cows fed the early cut hay was 34.2 pounds while that for the late cut hay was 32.2 pounds. A grain mixture was fed at the rate of one pound for each five pounds of 4 percent fat corrected milk.

Huffman et al. (1952) obtained results that indicated increased milk production when part of the total digestible nutrients furnished by a mature hay was replaced on the basis of total digestible nutrient content by immature hay. Results of a similar nature were observed when corn replaced on the basis of total digestible nutrient content a part of the mature hay being fed. No marked increase in the milk production was observed when corn replaced a part of the immature hay on an equal total digestible nutrient basis.

Logan (1954) ensiled alfalfa cut at bud stage and full bloom. His results indicated that significantly greater milk production was realized from the early cut hay. These differences were not appreciably influenced by varying the protein content of the concentrate from 8.5 percent to 11.2 percent crude protein. The differences in production were directly associated with the total digestible nutrient content of the ration. Trimberger et al. (1955) obtained greater milk production from early-cut clover timothy forage, whether sun-cured, barn dried or ensiled, than they did from the hay and silage harvested at a more mature stage.

Huffman et al. (1956) studied the grain-equivalent value of pre-bud alfalfa hay as compared to hay harvested at 3/4 bloom. It is pointed out that the early cut hay graded U.S. No. 1 extra green and extra leafy while the later cut hay was rained on in the field and graded U.S. No. 2 on leaf and color. Grain feeding was increased six pounds per cow when the feed was changed from the immature hay to the mature hay and, conversely, it was decreased six pounds when the change was from the mature to the immature forage. The average daily amount of 4 percent fat corrected milk produced on the pre-bud and three-quarter bloom alfalfa was 34.2 and 29.0 pounds, respectively.

Work with irrigated hay in Washington by Blosser et al. (1957) involved alfalfa harvested at the pre-bud, one-tenth bloom and full bloom stages of maturity. The daily four percent fat corrected production was 35.3 pounds for the early cut hay, 35.2 pounds for the medium cut hay and 32.8 pounds for the hay cut at full bloom. Blosser and associates fed silage at the rate of three pounds per 100 pounds of body weight and a grain mixture at the rate of one pound for each three pounds of four percent fat corrected milk.

EXPERIMENTAL PROCEDURE

Two successive cuttings of alfalfa hay, each harvested at three different stages of maturity were obtained during 1956 from stands on the Kansas State College farm. The first cutting was harvested at bud-stage, one-half bloom and full bloom. The second crop was harvested at bud-stage, one-fourth bloom and full bloom. The data pertinent to the separate batches of hay are presented in Table 4.

Table 4. Field number, dates for cutting, and bailing and rainfall for respective batches of hay.

Cutting	Stage	Field	Cutting date	Bailing date	Rainfall in.
First	Bud	4	5/17/56	5/19/56	None
First	Bud	4	5/18/56	5/21/56	None
First	½ bloom	16	5/26/56	5/29/56	.04
First	Full bloom	12	6/ 7/56	6/ 9/56	.59
First	Full bloom	12	6/ 9/56	No record	None
Second	Bud	16	6/17/56	6/17/56	None
Second	¼ bloom	12	6/25/56	6/26, 27/56	.03
Second	Full bloom	4	6/29, 30/56	6/29, 30/56	None

The alfalfa was field baled and stored in the dairy barn. Reliable yield data were not obtainable because of the extreme variability within fields due to drought conditions prevailing during the 1956 growing season.

Two samples from each of the hays were obtained for chemical analysis. The samples were analyzed for Kjeldahl nitrogen, ether extract, crude fiber, ash and moisture by the Department of Chemistry, Kansas State College.

The experiment was divided into two parts. Part one was set up to compare the relative palatability of the six batches of alfalfa hay. Part two was a comparison of the several hays with regard to their effects on appetite (as measured by hay consumption), body weight gains and milk production.

Part one was designed to measure the palatability of each hay in relation to every other hay in the experiment. Two dry Jersey cows were used in this phase. At the beginning of the experiment cow 378B was 186 days pregnant and 392B was 134 days pregnant. They were selected from the college dairy herd on the basis of their similarity in breed, stage of gestation and body weight. Information concerning the two cows is given in Table 8.

The cows were placed in separate box stalls and bedded with shavings. A three compartment manger was placed in each box stall to allow each cow access to all of three hays that were placed in each manger. The cows were fed good quality alfalfa hay for a 13-day preliminary period. Two feedings daily of from 12 to 14 pounds each of the six hays allowed each cow opportunity for her fill on any one of the three hays placed in her manger at each feeding. The hay assignment to the mangers is presented in Table 9.

Two feedings and the weighbacks of refusals were recorded daily for each of the six experimental hays. Salt and water were provided ad libitum. No concentrate was fed to these cows during the experiment.

The six experimental hays were assigned to feeding sequences. These sequences were randomly assigned to compartments in the mangers and the cows were randomly assigned to three-compartment mangers. The resulting feeding schedules were randomly assigned to the eighteen days of the experiment.

Part two was designed to measure the effects of stage of maturity in alfalfa on milk production, hay consumption and body weight change. Only five of the hays were used because there was an insufficient amount of first-cutting bud-stage hay to complete the trial.

The incomplete block switch-back design, as outlined by Lucas (1956), was used. The design was as follows with the numbers representing treatments; the columns, cows; and the rows, experimental periods:

Block I	Block II
1 2 3 4 5	1 2 3 4 5
2 3 4 5 1	3 4 5 1 2
1 2 3 4 5	1 2 3 4 5

The five hays were assigned at random to the treatments. Each block was replicated once to give sequence one and two for each of blocks I and II. Five cows were used in each block. The assignment of cows to treatments within the blocks was random. Information on the cows used in the switchback trial along with the block assignment is given in Table 8.

The cows for each of the blocks were selected from the same breed. Cows near the same age and at similar stages in their lactation were chosen for each of the blocks. It was necessary to assign Jersey cow number 350B to two blocks because of the shortage of individuals of the same breed. The rest of the animals were used for only one treatment sequence.

Each treatment sequence required 63 days -- 21 days for each treatment, of which the first 14 days were preliminary and the last seven days constituted the data collection period. The cows in a single block were started on experiment at the same time.

The concentrate mixture was fed according to milk production. The ingredients of the concentrate mixture were as follows: 400 pounds ground corn, 200 pounds ground oats, 100 pounds soybean oil meal, seven pounds salt and seven pounds of steamed-bone meal. The rate of feeding for the experimental period was based on the amount of 4 percent fat corrected milk produced during the first seven days of the first preliminary period for each block. The cows were fed at the rate of 0.4 pound concentrate for each pound of 4 percent fat corrected milk above 16 pounds for Holsteins, 14 pounds for Ayrshires and 10 pounds for Jerseys.

One-half of the grain and hay allotment was fed in the morning feeding and the remainder was fed in the afternoon feeding. The hay was offered in amounts sufficient to allow from ten to fifteen percent refusal each day.

The cows were weighed on two successive days each week and again on the third day if the first two weights varied more than 20 pounds. The average of the two closest weights was used for analysis.

The milk produced was weighed at each milking, and samples were taken for butterfat tests from two successive milkings within each experimental period.

RESULTS

Chemical Analyses

The chemical analyses of the hays are listed in Table 5. The crude protein increased slightly with advanced maturity for the first cutting while it decreased with advancing maturity in the second crop. The crude fiber increased from the bud stage to the one-half-bloom for the first crop but it decreased from the one-half bloom to the full bloom stage in the same crop. The percent of crude fiber for the second crop increased with advancing maturity.

In both the first and second cuttings the ether extract content increased with advancing maturity. Ash in both crops decreased with advancing maturity.

Table 5. Chemical analysis of hays and concentrate mixture used on the dry matter basis.

Cutting	Stage	Crude protein %	Crude fiber %	Ether extract %	Ash %	Nitrogen-free extract %
First	Bud	17.9	28.7	1.7	10.4	41.3
First	½ bloom	18.3	29.8	1.7	10.3	39.9
First	Full bloom	19.2	26.4	2.1	8.9	43.4
Second	Bud	26.1	25.6	1.6	10.8	35.1
Second	¼ bloom	19.5	27.6	1.6	9.8	41.3
Second	Full bloom	17.4	29.9	2.2	9.2	41.1
Concentrate mixture		18.4	5.1	3.6	4.8	68.0

Palatability

The individual results of the palatability feeding trial are presented in Table 9 and are summarized in Table 6. Analysis of variance (Snedecor, 1956) of these results indicated that although the variation among batches of hay was highly significant, neither the variation between cuttings nor among stages was statistically significant. The variation between cows was not significant.

Significantly greater amounts of the first cutting hay harvested at the bud stage were eaten than any of the other hays with exception of the one-fourth bloom hay from the second crop. The second cutting harvested at full-bloom was eaten in significantly less amounts than any of the other hays.

Table 6. Average hay consumption based on 12-hour feeding intervals.

Crop	Bud lb.	Medium lb.	Full bloom lb.	Average for crop lb.
	Stage of Maturity			
First	7.0	4.4	4.3	5.3
Second	4.7	4.8	1.9	3.8
Average for stage	5.9	4.6	3.1	4.5

Switchback Trial

Data relating to milk production, hay consumption and body weight were collected from the switchback trial and analyzed. The data for individual cows are presented in Tables 10, 11, 12 and 13, and means for the various treatments are listed in Table 7.

Table 7. The effect of stage of maturity of alfalfa on hay consumption, milk production and body weight change.

	Stage of Maturity				
	First cut		Second cut		
	½ bloom lb.	full bloom lb.	bud lb.	½ bloom lb.	full bloom lb.
Hay consumption per cow	25.5	28.9	24.5	27.4	27.6
Per 1,000 lb.wt.	24.7	27.4	25.9	27.5	27.5
4% FCM production	29.1	29.8	27.7	29.3	28.9
Body weight change	0.4	0.2	-0.4	1.4	0.5

The hay consumption per cow varied significantly among hays. The cows ate most of the first cutting alfalfa harvested at full bloom. The second cutting bud stage hay was eaten in smallest amounts.

Hay consumption per 1,000 pounds of body weight was not significantly different among the five treatments. Neither milk production nor body weight change varied significantly among treatments.

DISCUSSION

Chemical Analyses

The crude protein content of the first cutting alfalfa hay increased with advance in maturity while the crude fiber content decreased. This trend is not in accord with the results of Foster and Merrill (1899), Cottrell (1902), Salmon et al. (1925), Sotola (1927), and Kiesselbach and Anderson (1926), who found the reverse relationship. This seeming discrepancy may have been caused by several nights with low temperatures from April 17 to 24, which caused severe damage to the alfalfa leaves but did not kill the stems. At the time of cutting, the previously damaged leaves were brown and dead. These shattered off when the alfalfa was mowed. The early-cut alfalfa had much less additional growth at the time of cutting than did the late-cut alfalfa. As a consequence, the later-cut alfalfa had proportionately more leaves than the early-cut forage.

The analysis of the second cutting hays conformed to the pattern normally found.

Palatability

The relative palatability of a forage crop is measured by offering several samples of the forage to cows at the same time by use of the cafeteria system. The most palatable hay on this basis was that from the first crop harvested at the bud stage of maturity. It was more palatable than the full bloom hay from the first crop or any one of the three stages of maturity from the second crop. These findings are in agreement with results obtained by Willard (1933) and Foster and Merrill (1899). Willard (1933) reported that the second cutting of irrigated alfalfa was less palatable than the first cutting at the same stage of maturity. Some results reported as palatability in the literature do not conform to the definition given above, but would be more accurately considered measures of appetite.

That the bud-stage second-cutting hay was not more palatable than the later stages of maturity may be attributed to mow damage of the bud stage hay after storage. Because of forecast inclement weather it was decided to store this hay while the moisture content was high. This resulted in considerable mow damage as evidenced by loss of the green color and some mold that was scattered through the entire lot of hay.

Hay Consumption

The consumption of the hays varied significantly among batches. The hay eaten in greatest amounts was the first crop harvested at full bloom. Findings by Headley (1942), Trimberger *et al*. (1955), and Blosser *et al*. (1957) showed decreased hay consumption with advancing maturity. Their results showed the greatest consumption of the hays harvested at the earliest stages of maturity. The findings in this experiment are attributed to the changes in chemical composition discussed earlier. As was pointed out previously, the full bloom hay from the first cutting contained more crude protein and less crude fiber than the less mature hay from the first cutting.

The hay eaten at the lowest level was that harvested at the bud stage of maturity from the second crop. As was discussed in connection with palatability, this hay was stored while still somewhat green.

Hay Consumption per 1,000 Pounds of Body Weight

The insignificance of the differences in hay consumption on the body weight basis shows that body weight was a factor in the amount of hay consumed by the cows. There was considerable spread in body weight since cows of the Holstein, Ayrshire and Jersey breeds were used. The means reported in Table 7 show the same general trend in regard to intake of the different hays on the body weight basis as was true on the per cow level but with smaller mean differences.

Milk Production

The average daily level of four percent fat corrected milk produced by the cows receiving the five separate hays differed insignificantly. The milk production means on the individual treatments varied from 27.7 pounds of four percent fat corrected milk for the second crop of hay harvested at bud stage of maturity to 29.8 pounds of four percent fat corrected milk for the first cutting full bloom. Four of the means were closely grouped with the total separation being only 0.9 pounds, while the mean for the second cutting bud stage was somewhat smaller.

The fact that these means are not significantly different does not agree, in general, with results reported by Dawson et al. (1940), Loosli et al. (1950), Logan (1954), Huffman et al. (1956) and Blosser et al. (1957). These workers reported the largest milk production on the younger hays when compared to hays of more advanced stages of maturity.

It is possible that the conditions of this experiment were not sufficiently critical to measure nutritional differences which may have existed among the batches of hay. Experimental procedures used to assay the relative value of hay for milk production have varied widely. Dawson et al. (1940) obtained results from 365-day lactations with the cows receiving an all-hay diet. Loosli et al. (1950) reported a difference of 1.1 pounds of four percent fat corrected milk in favor of the early harvested hay. Blosser et al. (1957) reported feeding silage at the rate of three pounds to each 100 pounds of body weight.

Blosser fed grain at approximately the same level as was fed in this experiment. The mature hay used by Huffman (1956) was rain-damaged, while the alfalfa harvested at the immature stage was stored without weather damage.

Body Weight

Body weight increased for all treatments except second-crop bud-stage hay. In general, the weights varied in the same direction of hay consumption and milk production even though their differences among treatments were insignificant. Observation of the array of body weight changes within the blocks suggest erratic variations within the treatments. The non-significance of the variation among the treatments is attributable to this variation.

SUMMARY

A study was made of the effects of stage of maturity and cutting of alfalfa hay on its feeding value for dairy cows.

The first cutting of the 1956 crop was harvested at the bud stage, one-half bloom, and full bloom stage of maturity and the second crop was harvested at the bud stage, one-fourth bloom and full bloom stage of maturity.

Chemical analysis of the forage gave crude protein and crude fiber percentages for the first crop at bud stage of 17.9 and 28.7; one-half bloom 18.3 and 29.3; and full bloom, 19.2

and 27.4, respectively. The increases in crude protein and decrease in crude fiber were believed to be the result of a late freeze which caused the loss of most of the leaves before the bud stage was cut. Regrowth of leaves after the bud stage was removed, was believed to have been the cause for the increase in crude protein and decrease in crude fiber. For the second crop the percent of crude protein and crude fiber were bud stage 26.2 and 25.6; one-fourth bloom 19.5 and 27.6; and full bloom 17.4 and 29.9, respectively.

The variations in palatability among the six hays studied were significant. The bud stage of maturity from the first crop was the most palatable while the full bloom hay of the second cutting was the least palatable. The variations between the two cuttings and between cows were nonsignificant.

Results from feeding five different hays in an incomplete block switch-back trial using a total of 19 cows in four blocks, were studied in regard to hay consumption, milk production, and body weight. Each of the four blocks was run for 63 days which included three 21-day periods.

Hay consumption per cow varied significantly among hays. Hay consumed in largest amounts was harvested at full bloom from the first cutting, while that consumed in smallest amounts was harvested at bud stage from the first cutting. Hay consumption on the basis of body weight did not vary significantly.

Neither milk production nor body weight-changes varied significantly among treatments, among cows or between cuttings.

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APPENDIX

Table 8. Descriptive data concerning cows used.

Block	Cow	Breed	Date of birth	Date calved	Days in milk	Date bred	Date assigned to expt.
Palatability	378B	Jersey	5/18/1951	Dry		4/20/56	10/23/56
	392B	Jersey	8/16/1952	Dry		6/11/56	10/23/56
I	134B	Holstein	6/14/52	8/ 6/56	82	12/17/56	10/27/56
	138B	Holstein	9/ 7/52	8/20/56	68	11/21/56	10/27/56
	167B	Holstein	2/25/54	7/23/56	96	open	10/27/56
	168B	Holstein	5/ 8/54	8/28/56	61	11/17/56	10/27/56
	169B	Holstein	5/ 9/54	8/23/56	66	12/20/56	10/27/56
II	311C	Jersey	1/19/54	9/10/56	68	1/ 9/57	11/17/56
	317C	Jersey	5/ 4/54	9/26/56	52	12/ 4/56	11/17/56
	318C	Jersey	6/ 1/54	9/ 7/56	71	12/26/56	11/17/56
	345B	Jersey	3/24/49	8/22/56	88	1/ 7/57	11/17/56
	350B	Jersey	3/ 3/49	5/ 5/56	196	open	11/17/56
III	315B	Ayrshire	6/ 4/51	9/16/56	72	12/30/56	11/27/56
	231B	Ayrshire	7/ 6/52	10/27/56	31	1/31/56	11/27/56
	238B	Ayrshire	9/22/52	10/17/56	71	open	11/27/56
	245B	Ayrshire	3/24/53	10/23/56	66	1/ 4/57	11/27/56
	257B	Ayrshire	4/13/54	10/13/56	75	1/ 3/57	11/27/56
IV	304C	Jersey	4/23/53	12/20/56	35	2/27/56	1/24/57
	309C	Jersey	12/12/53	11/ 1/56	84	1/15/57	1/24/57
	350B	Jersey	11/ 3/49	5/5/56	264	open	1/24/57
	394A	Jersey	7/ 2/45	12/14/56	71	open	1/24/57
	397B	Jersey	12/ 2/52	10/13/56	103	12/30/57	1/24/57

Table 9. Palatability trial -- hay consumption, manger assignment.

Day		First cutting						Second cutting					
		Bud		½ bloom		full bloom		Bud		¼ bloom		full bloom	
		lb.	manger	lb.	manger	lb.	manger	lb.	manger	lb.	manger	lb.	manger
November													
5	P.M.	5.6	5[1]	8.4	6	0.4	1	4.7	3	7.7	2	1.6	4
6	A.M.	5.0	5	8.2	6	0.3	1	4.3	3	6.7	2	1.6	4
	P.M.	6.2	4	4.5	5	7.2	3	1.6	2	3.4	1	1.6	6
7	A.M.	6.9	4	5.0	5	7.6	3	3.3	2	4.1	1	1.2	6
	P.M.	9.9	6	4.0	4	7.1	2	2.4	1	3.7	3	2.7	5
8	A.M.	5.4	6	6.0	4	8.4	2	4.6	1	4.1	3	1.6	5
	P.M.	4.8	6	4.4	2	4.4	3	9.0	4	1.7	5	6.8	1
9	A.M.	6.4	6	8.2	2	1.2	3	5.5	4	0.8	5	2.9	1
	P.M.	4.3	5	5.8	3	2.9	1	1.6	6	6.3	4	2.4	2
10	A.M.	3.6	5	8.5	3	5.3	1	4.6	6	4.0	4	1.2	2
	P.M.	4.7	4	7.0	1	6.1	2	5.4	5	3.5	6	-0.2	3
11	A.M.	2.8	4	8.0	1	7.7	2	5.8	5	4.3	6	0.7	3
	P.M.	6.7	4	3.3	1	5.4	6	5.4	2	2.9	3	0.4	5
12	A.M.	9.2	4	3.0	1	4.8	6	7.2	2	7.8	3	1.4	5
	P.M.	6.2	5	3.9	2	3.9	4	2.0	3	4.9	1	0.1	6
13	A.M.	7.5	5	2.1	2	4.8	4	4.1	3	9.1	1	2.8	6
	P.M.	8.2	6	4.1	3	3.1	5	2.4	1	4.9	2	-0.2	4
14	A.M.	7.6	6	7.9	3	5.3	5	4.1	1	5.3	2	0.4	4
	P.M.	9.6	1	1.5	3	4.2	2	6.3	5	7.1	4	0.2	6
15	A.M.	10.0	1	2.1	3	5.2	2	7.0	5	7.2	4	0.4	6
	P.M.	7.8	2	-0.1	1	4.0	3	0.9	6	8.1	5	3.3	4
16	A.M	7.0	2	0.1	2	7.0	3	4.4	6	8.1	5	3.2	4
	P.M.	5.6	3	0.4	3	6.3	1	6.8	4	3.0	6	1.2	5
17	A.M.	9.7	3	0.7	3	7.1	1	8.0	4	6.0	6	1.9	5
	P.M.	7.4	3	0.8	4	3.8	5	6.7	6	1.5	1	1.0	2
18	A.M.	8.2	3	2.9	4	5.0	5	6.5	6	2.1	1	6.7	2
	P.M.	7.5	1	3.8	6	3.2	4	4.5	5	1.0	2	4.2	3
19	A.M.	8.4	1	6.2	6	3.2	4	2.9	5	4.4	2	1.4	3
	P.M.	6.6	2	2.8	5	1.3	6	7.5	4	2.8	3	2.2	1
20	A.M.	7.1	2	5.6	5	3.2	6	7.6	4	8.4	3	4.3	1
	P.M.	7.5	2	3.4	5	2.5	4	4.3	1	2.1	6	0.2	3
21	A.M.	9.6	2	5.3	5	5.1	4	4.9	1	5.4	6	2.9	3
	P.M.	8.8	3	3.5	6	1.9	5	1.7	2	5.2	4	0.1	1
22	A.M.	7.2	3	4.6	6	4.5	5	8.4	2	5.8	4	4.0	1
	P.M.	6.9	1	5.0	4	2.6	6	2.1	3	6.3	5	0.9	2
23	A.M.	7.5	1	9.0	4	0.6	6	1.6	3	3.4	5	1.8	2
Total		253.4		159.9		156.0		170.1		173.1		68.9	

[1] Cow 392B had mangers 1, 2 and 3.
Cow 378B had mangers 4, 5 and 6.

Table 10. Performance data -- Block I

Cow No.	Breed	Period	Dates	Hay Cutting	Hay stage	Hay consumed lb.	Grain lb.	4% F.C.M. lb.	Av. weight lb.	Weight change lb.
134B	Holstein	First	11/10-16/56	2	1/4	39.9	9.2	39.8	1264	21
		Second	12/ 1- 7/56	2	Full	38.4	9.2	42.0	1284	12
		Third	12/22-28/56	2	1/4	40.3	9.2	38.0	1338	10
138B	Holstein	First	11/10-16/56	2	Bud	36.8	8.2	32.1	1421	-3
		Second	12/ 1- 7/56	1	Full	49.1	8.2	33.2	1441	1
		Third	12/22-28/56	2	Bud	36.5	8.2	26.0	1427	-8
167B	Holstein	First	11/10-16/56	1	Full	28.2	5.0	28.3	1040	-20
		Second	12/ 1- 7/56	2	1/4	32.3	5.0	25.9	1062	13
		Third	12/22-28/56	1	Full	37.1	5.0	30.1	1076	34
168B	Holstein	First	11/10-16/56	2	Full	34.6	8.6	37.5	1109	1
		Second	12/ 1- 7/56	1	1/2	37.0	8.6	39.0	1110	-8
		Third	12/22-28/56	2	Full	36.2	8.6	35.5	1114	-5
169B	Holstein	First	11/10-16/56	1	1/2	18.1	6.8	27.1	886	-20
		Second	12/ 1- 7/56	2	Bud	28.2	6.8	30.7	872	3
		Third	12/22-28/56	1	1/2	27.3	6.8	32.3	909	19

Table 11. Performance data -- Block II

Cow No.	Breed	Period	Dates	Hay		Hay consumed	Grain	4% F.C.M.	Av. weight	Weight change
				Cutting	stage	lb.	lb.	lb.	lb.	lb.
311C	Jersey	First	12/2 - 8/56	2	1/4	23.1	9.0	25.5	872	4
		Second	12/23-29/56	2	Full	25.6	9.0	25.3	886	-5
		Third	1/ 13-19/57	2	1/4	27.1	9.0	20.6	924	21
317C	Jersey	First	12/2 - 8/56	1	1/2	12.5	7.0	25.1	661	-31
		Second	12/23-29/56	2	Bud	16.6	7.0	22.2	677	12
		Third	1/13-19/57	1	1/2	17.0	7.0	20.0	693	17
318C	Jersey	First	12/ 2- 8/56	1	Full	21.7	6.0	19.4	810	-2
		Second	12/23-29/56	2	1/4	23.1	6.0	19.8	823	4
		Third	1/13-19/57	1	Full	20.3	6.0	14.4	823	5
345B	Jersey	First	12/ 2- 8/56	2	Full	22.1	10.0	36.6	985	-12
		Second	12/23-29/56	1	1/2	20.1	10.0	34.4	977	3
		Third	1/13-19/57	2	Full	21.8	10.0	30.1	978	1
350B	Jersey	First	12/ 2- 8/56	2	Bud	27.9	11.0	34.2	902	-2
		Second	12/23-29/56	1	Full	30.8	11.0	35.8	908	-8
		Third	1/13-19/57	2	Bud	31.0	11.0	26.9	912	6

Table 12. Performance data -- Block III

Cow No.	Breed	Period	Dates	Hay Cutting	Hay stage	Hay consumed lb.	Grain lb.	4% F.C.M. lb.	Av. weight lb.	Weight change lb.
215B	Ayrshire	First	12/13-19/56	1	1/2	29.1	11.0	40.1	1049	19
		Second	1/ 2- 8/57	1	Full	28.3	11.0	29.4	1054	-2
		Third	1/24-30/57	1	1/2	26.3	11.0	27.3	1076	14
231B	Ayrshire	First	12/13-19/56	2	Bud	23.3	11.0	37.5	1034	-15
		Second	1/ 2- 8/57	2	1/4	24.9	11.0	28.7	1068	5
		Third	1/24-30/57	2	Bud	22.6	11.0	22.8	1072	6
238B	Ayrshire	First	12/13-19/56	1	Full	37.1	9.0	34.5	1107	-7
		Second	1/ 2- 8/57	2	Full	36.4	9.0	33.9	1089	-9
		Third	1/24 -30/57	1	Full	32.8	9.0	26.6	1101	-4
245B	Ayrshire	First	12/13-19/56	2	Full	29.7	5.0	25.5	1122	-14
		Second	1/ 2- 8/57	2	Bud	27.9	5.0	27.5	1080	-42
		Third	1/24-30/57	2	Full	30.7	5.0	22.1	1148	-4
257B	Ayrshire	First	12/13-19/56	2	1/4	26.5	9.0	27.4	908	20
		Second	1/ 2- 8/57	1	1/2	26.9	9.0	23.3	896	-18
		Third	1/24-30/57	2	1/4	28.1	9.0	21.6	908	-3

Table 13. Performance data -- Block IV

Cow No.	Breed	Period	Dates	Hay Cutting	Hay stage	Hay consumed lb.	Grain lb.	4% F.C.M. lb.	Av. weight lb.	Weight change lb.
304C	Jersey	First	2/ 7-13/57	2	1/4	18.1	14.0	34.9	868	5
		Second	2/28- 3/6/57	1	1/2	20.6	14.0	33.1	866	1
		Third	3/21-27/57	2	1/4	23.7	14.0	31.9	903	31
309C	Jersey	First	2/ 7-13/57	2	Full	17.9	10.0	22.3	785	-5
		Second	2/28- 3/6/57	2	Bud	11.1	10.0	21.8	777	-7
		Third	3/21-27/57	2	Full	16.7	10.0	21.7	817	31
350B	Jersey	First	2/ 7-13/57	1	1/2	26.3	7.0	25.2	948	2
		Second	2/28- 3/6/57	1	Full	29.6	7.0	25.1	955	6
		Third	3/21-29/57	1	1/2	24.9	7.0	16.4	959	30
394A	Jersey	First	2/ 7-13/57	2	Bud	18.7	12.5	37.6	940	9
		Second	2/28- 3/6/57	2	1/4	21.5	12.5	45.0	952	30
		Third	3/21-29/57	2	Bud	22.8	12.5	34.1	971	6
397B	Jersey	First	2/ 7-13/57	1	Full	22.7	8.0	24.2	940	0
		Second	2/28- 3/6/57	2	Full	23.4	8.0	22.9	956	-4
		Third	3/21-29/57	1	Full	26.7	8.0	26.0	980	36

THE FEEDING VALUE OF TWO SUCCESSIVE CUTTINGS OF ALFALFA HAY HARVESTED AT DIFFERENT STAGES OF MATURITY

by

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Alfalfa hay is the most important forage crop utilized in the roughage program of the dairy cow of the United States. Maturity of the forage crop when harvested, chemical composition, digestibility, leafiness, rate of voluntary consumption and yield of the forage are factors that contribute to the feeding value of alfalfa hay.

This study was undertaken to determine the effects of harvesting the first and second crop of alfalfa hay at three different stages of maturity on its feeding value for dairy cattle. The alfalfa hay studied was from the 1956 crop harvested at bud stage, one-half bloom, and full-bloom stage of maturity for the first cutting; and bud stage, one-fourth bloom, and full bloom for the second crop.

Yield data were not obtained because of extreme variation between the fields of hay studied, as the result of drought condition.

Chemical analyses of the first crop hay studied gave crude protein and crude fiber percentages for bud stage of 17.9 and 28.7; one-half bloom, 18.3 and 29.8; and full bloom, 19.2 and 26.4, respectively. The erratic changes in crude protein and crude fiber within this cutting were attributed to a loss of leaves due to a late freeze with subsequent regrowth at later stages of maturity. The crude protein and fiber for the second crop bud-stage was 26.1 and 25.6; one-fourth bloom, 19.5 and 27.6; and full bloom, 17.4 and 29.9 percent, respectively.

Relative palatability based on consumption of the six hays by two cows indicated significant differences among the hays. The first cutting harvested at the bud stage was the most palatable hay while the full bloom second cutting hay was the least palatable of the hays.

The sample highest in crude protein and lowest in crude fiber was mow-damaged as the result of being stored with excessive moisture. This hay was less palatable than the comparable stage of maturity from the first cutting and more palatable than the second cutting of hay at full bloom.

An incomplete block switchback design was utilized to study hay consumption, milk production and body weight changes with 19 cows, using all the hays except the bud stage hay from the first cutting.

Hay consumption per cow varied significantly among the five hays. The first cutting hay harvested at full bloom was eaten in largest amounts. The inverse protein and fiber relationship, attributed to the loss of leaves after a late freeze, is believed to have been a predisposing factor in the greater consumption of the mature hay. The hay eaten at the lowest level, bud stage from the second crop, was mow-damaged as the result of having been stored too green.

Hay consumption per 1,000 pounds of body weight and daily milk production followed the same general trend among the five treatments as hay consumption per cow. However, the variations among treatments for both hay consumption per 1,000 pounds of body weight and milk production were insignificant.

The body weight changes were not significantly different among the five treatments.