Influence of Maturity on Digestibibility and Nutrient Accumulation of Amclo Clover Foliage

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Highlight: *Cultivars of arrowleaf clover (*Trifolium vesiculosum *Savi.) are becoming important interseeded components of the pasture ecosystem in the humid southeast. This research was conducted to determine the seasonal change in digestibility and mineral composition of "Amclo" arrowleaf clover at various stages of crop development. Three previously unclipped plots of Amclo clover were clipped per week from mid-March until mid-May during 1965 and 1966 to determine the influence of stand maturity on foliar in vitro dry matter digestibility (IVDMD) and nutrient accumulation. Percent IVDMD generally decreased over the 1965 harvest period from 70% to 48%. However, over the same period in 1966 percent IVDMD increased from 48% in mid-March to a maximum of 72% in mid-April and gradually declined to 48% in mid-May. Foliar potassium (K) appeared to be the only element to change over the experimental period. Foliar K content increased until the middle of the vegetative stage of growth. This increase was followed by a gradual decline in foliar K content through the mature stage of crop development.*

Because of high yield and quality and the absence of grazing animal disorders, the arrowleaf clovers (*Trifolium vesiculosum* Savi.) (Fig. 1) are becoming important constituents in forage systems in the southeast.

'Amclo' arrowleaf clover is a high yielding annual legume that readily reseeds in the southeast. At least three accessions have been released (Ahlrich and Byrd, 1966; Beaty et al., 1965; Hoveland, 1967) with differences primarily in length of growing season and date of maturity. Total yields of arrowleaf clover varieties have averaged two to three times those of crimson clover (*Trifolium incarnatum* L.) when cut only once during the flowering stage of development (Knight, 1971). Most annual clovers recover rapidly following clipping or grazing. However regrowth of arrowleaf clovers is slow especially if the harvest occurs after April 15 (Hoveland et al., 1972).

Stanley et al. (1968) showed that, during early stages of crop development, the arrowleaf clover plants are composed primarily of leaves and petioles. Over a 10-week period beginning in mid-March, they determined that Amclo arrowleaf clover growth increased three-fold and the cell wall content increased from approximately 30 to 50%.

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Fig. 1. *A uniform stand of Amclo arrowleaf clover seeded into permanent pasture.*

The purpose of this research was to determine the influence of crop maturity on digestibility and nutrient content of Amclo clover foliage.

Materials and Methods

An area, at Americus, Ga., of established Amclo clover was allowed to reseed during the fall of 1964. In October after the seedlings were established, the area was fertilized with 896 kg/ha of a fertilizer containing 6.16 and 11.6% phosphorus (P) and potassium (K), respectively. Starting on March 22, 1965, and March 16, 1966, duplicate unclipped plots of 0.84 m^2 were clipped at a rate of three per week until May 21. The clover plants were clipped to ground level and dried at 80°C in a forced-draft dryer. After weighing, the dried samples were ground through a 20-mesh screen and stored in a dessicator at room temperature until analyzed. In vitro dry matter digestibility (IVDMD) was determined by methods described by Tilley and Terry (1963). Mineral nutrient content was assayed on forage samples dried in a convection oven at 70°C and digested in a HCl-H_2SO_4-$HClO_4$ mixture (Piper, 1944). P was determined, colorimetrically, in an acid system (Jackson, 1958) and the other cations were determined by atomic absorption spectrophotometry.

Results and Discussion

Forage yields and tissue cell-wall content for these

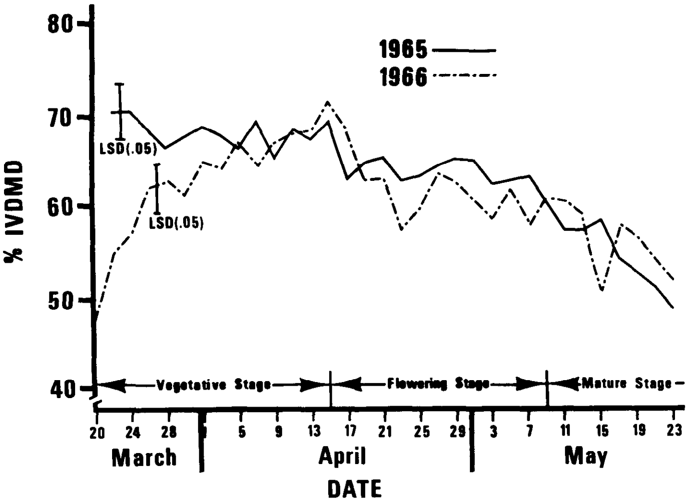

Fig. 2. *Percent in vitro dry matter digestibility (IVDMD) of Amclo clover foliage harvested, periodically, during 1965 and 1966 growing season.*

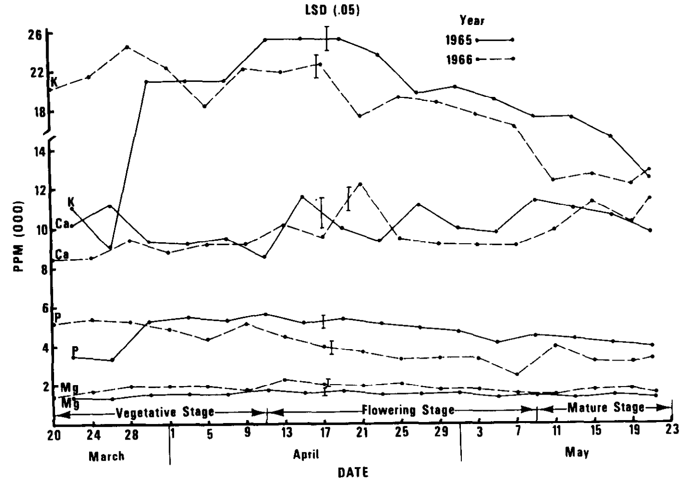

Fig. 3. *Macronutrient content of Amclo clover foliage during the 1965 and 1966 growing season.*

experiments have been reported previously (Stanley et al., 1968) and will be discussed only in relation to other findings. The IVDMD remained fairly constant throughout the vegetative and flowering stages of crop development in 1965 (Fig. 2). However, the IVDMD began to decrease, sharply, at the beginning of the mature stage and dropped to a low of 48% for the May 23, 1965 harvest. The cell-wall content of these samples increased steadily from 29% up to 57% through the three stages of crop development (Stanley et al., 1968). This increase in percent cell-wall content was much greater than the change in IVDMD during the first two stages of crop development.

IVDMD of clover harvested in 1966 (Fig. 2) varied considerably from the 1965 harvest data during the vegetative stage of crop development. In general, IVDMD increased throughout the vegetative stage of development from 48% to a maximum of 72% on April 11, after which it decreased to 50% in samples harvested on May 23, 1966. During the same year maximum yield (7,182 kg/ha) was obtained from plots harvested on May 1, and the cell-wall content remained fairly constant through the first two stages of crop development and increased from 42 to 54% during the mature stage (Stanley et al., 1968).

The major differences between IVDMD, production, and cell-wall data obtained in 1965 and 1966 during the vegetative stage were probably a response to major differences in rainfall patterns for the 2 years. During March and April of both years, the cumulative rainfall was similar. However, in 1965 the March rainfall was distributed evenly through the month and in 1966 most of the rainfall occurred the first 2 days of March and was followed by hot dry weather. In 1966, April rainfall amounted to 49 mm and May rainfall was 153 mm. However, between April 5 and May 13, 1966, only 12 mm of rain were recorded. The drier conditions in March, 1966, caused severe leaf drop and forage harvested was primarily stem. The high stem content is probably responsible for the lower initial digestibility (48%) and the reported higher cell-wall content and lower maximum dry-matter production (Stanley et al., 1968) from plots harvested in 1966, compared to similar data from 1965. Major decreases in IVDMD of forage harvested during the middle of April and May, 1966, are probably due to the lower rainfall and higher temperatures compared to 1965.

Macronutrient content of Amclo clover foliage was similar for both years except K in samples harvested between March 20 and 28 (Fig. 3). In general, magnesium (Mg), P, and calcium (Ca) fluctuated very little over both growing seasons. The minor increase in Ca content throughout crop development, especially during 1966, was probably a result of increasing cell-wall content. Potassium content fluctuated more than other macronutrient elements, reaching a maximum of approximately 25,000 ppm in April, 1965, and 24,900 ppm the last of March, 1966. The K content decreased from 25,000 ppm during the vegetative stage to 12,500 ppm in the mature stage. Hanway and Weber (1971) reported that K content of soybean (*Glycine max* (L.) Merr.) foliage reflected leafiness. They found that fallen leaves and petioles accounted for 20% of the total foliar K content. This would explain the drop in K content from the flowering stage to the mature stage of crop development in our study. However, the lower foliar K content during March 1965, a period of more desirable rainfall distribution, compared to March 1966, a period of severe leaf drop, was probably not a response to leafiness.

Table 1. Seasonal change in micronutrient content (ppm) of Amclo clover foliage at 3 stages of maturity and 16 harvest dates. Reported values are means for two growing seasons.

Morphological stage and harvest date	Elements				
	Zn	Mn	Fe	Cu	Na
Vegetative stage					
March 20-22	29	73	188	5	113
24-26	34	110	155	4	96
28-30	40	101	129	5	137
April 1-3	24	104	187	5	130
5-7	26	97	105	3	86
9-11	35	119	150	6	142
13-15	37	93	137	5	100
Flowering stage					
April 17-19	35	92	104	5	77
21-23	27	84	105	5	99
25-27	23	79	115	3	132
29-1	24	74	88	3	79
May 3-5	22	65	89	4	116
7-9	16	63	94	5	67
Mature stage					
May 11-13	20	70	87	3	58
15-17	21	50	107	3	120
19-21	21	83	130	5	101
LSD	8	27	25	3	33

Data from analyses of the micronutrient content of Amclo clover foliage (Table 1) indicate that the general trend for all elements, except copper (Cu), was a slight decrease from the middle of the vegetative stage to the latter part of the flowering stage or middle of the mature stage. These data varied considerably between harvests within the developmental stages. Foliar-Cu content remained fairly constant for the duration of this study.

Data in this report indicate Amclo clover to be highly digestible throughout most of the growing season. Hoveland et al. (1970) reported higher digestibility percentages for 'Yuchi' arrowleaf clover than included in this report. The difference is probably due to the analytical methods utilized as their data were obtained by the in vivo nylon bag method (Burton et al., 1967). Another advantage of Amclo clover over the other strains of *T. vesiculosum* is that it normally completes a major part of its growth before the onset of severe drought in Georgia (Ahlrich and Byrd, 1966). Data in our study indicate that differences in seasonal rainfall and stage of crop development did influence forage quality. Vaugh and Marten (1971) reported decreased IVDMD with increased moisture stress. They concluded that the reduced digestibility was due to a reduced leaf to stem ratio rather than decreased IVDMD of either type of tissue. Gifford and Jensen (1967) also have shown that soil moisture stress will reduce the yield of Alsike clover (*T. hybridum* L.).

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