THE EFFECT OF DEFOLIATION INTERVAL ON THE YIELD AND SEED PRODUCTION CHARACTERISTICS OF SUBTERRANEAN CLOVER

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ABSTRACT

A two-year study was conducted at Huntsville, Texas on a bermudagrass (*Cynodon dactylon*) pasture overseeded to subterranean clover (*Trifolium subterraneum* cv. Mt. Barker). A 0.25 m^{-2} (2.7 ft^2) quadrat from a 2.25m^{-2} (24.5 ft^2) caged area was hand-clipped to a height of 4 cm (1.5 in) at 7-, 14, and 30-day intervals to determine the effect of clipping frequency on sward and clover dry matter production, seed yield, seed size, germination percentage, and hard seed content. The 7-day clipping interval significantly reduced total seasonal sward dry matter production in 1988 (a dry spring), but not in 1989. Clover dry matter production was also reduced with the 7 day treatment in 1988, but actually increased in 1989. Apparently, the more frequent clipping treatment favored the clover over grasses when precipitation was adequate early in the growing season. Total seed production was lowest for the 30-day clipping treatment in both years. The 7-day clipping treatment produced greater amounds of seed than either of the other two clipping treatments in both 1988 and 1989. Though differences in high temperature germination percentage (lack of hard seededness) were not detected between treatments in either year, 1988 seed had significantly higher germination percentages than 1989 seed.

INTRODUCTION

Subterranean clover (*Trifolium subterraneum* L.) is commonly interseeded into warm season perennial grass pastures throughout the southern U.S. for winter annual forage production. Due to the tolerance of subclover to moderately acid soils (pH 5.5 to 7.0), it is generally considered a suitable forage crop in high rainfall areas. It is adapted to a wide variety of soil types, ranging from a fine sandy loam to clay. Prolific seed production, hard-seededness and the seed burying ability of subclover contribute to its maintenance of a seed reserve, thus sustenance of a stand during adverse as well as favorable environmental conditions. Subclover is now being widely grown where the climate is relatively warm, the winters moist, and the summers dry (Quinlivan, et al., 1973).

Reseeding of this winter annual legume has the potential to provide high-quality grazing during late fall, winter, and spring, without the additional expense of nitrogen fertilizer. The persistence of subclover depends on successful burr burial, hard-seededness, and the number of viable seeds produced. Each of these factors may be influenced by grazing pressure or foliage removal.

Subclover can supposedly be grazed quite heavily without complete destruction of the stand, although under certain defoliation treatments the stand might be reduced as a result of heavy grazing pressure (Evers, 1988; Smith and Gilbert, 1987). The objectives of this investigation were to determine the effects of defoliation interval of subterranean clover on (i) total seed yield, (ii) seed size, (iii) percent hard-seededness, (iv) total plant dry matter yield, and (v) changes in the botanical composition of the sward.

MATERIALS AND METHODS

A 2.5 acre Alicia bermudagrass pasture was overseeded with Mt. Barker subterranean clover on 25 September 1987 and 1 October 1988 at the rate of 20 lbs acre. The soil type on which the study was conducted is a Falba fine sandy loam (a fine, montmorillonitic, thermic, Typic Albaqualfs). Soil pH on the site ranges from 5.6 to 6.5. Fertilizer and lime were applied according to soil test recommendations. Forage samples for dry matter determination and botanical composition were collected at 7-, 14-, and 30-day intervals by clipping with a pair of rechargeable electric hand clippers. A non-clipped control was used for comparing seed yield and seed characteristics only.

Four replications of each treatment were arranged in completely randomized design. Sixteen cages (4.95 ft length x 4.95 ft width x 30 in height) constructed of concrete reinforcement wire were used and secured with tent stakes at each corner. At their respective clipping dates, a 0.25 m^2 (2.7 ft^2) quadrat from the center of each cage was clipped at a height of 4 cm (1.5 in). All plots were harvested with a pair of Disston electric grass shears. The remaining area of each plot was subsequently mowed to the same height with a rotary power mower (Craftsman Super-Lite Starter) to maintain a uniform height of the plot as if the area were rotationally grazed. Following collection, samples were dried at 43°C (110°F) for 48 hours, then weighed for determination of dry matter yield. Each sample was hand-separated into clover, grass and weed components for determination of changes in sward composition and total dry matter production.

Following maturation of the clover, the top growth and 2.5cm (1 in) of soil was removed from one quadrat in each plot. Seeds were collected using sieving techniques. After separating the burrs and freeing them from adhering soil, they were carefully threshed by hand with corrugated rubber sheeting to extract the seeds. Seed weights and numbers were recorded. According to Ballard (1961), freshly harvested seeds of dormant strains of subterranean clover do not germinate at 22°C (72°F) or higher. In this case, both one-year-old (1988) and freshly harvested (1989) seed were subjected to identical treatments. All seed were maintained in complete darkness both before and during germination tests. Exposure to diffuse daylight or florescent lighting occurred only while extracting seeds from burrs and during examination. Prior to testing, all seeds were maintained at temperatures ranging from 70°F to 85°F. An initial germination procedure was conducted on approximately 25 seeds from each plot (four replicates) in which temperature was maintained at 25°C (78°F) for 7 days. Seeds with visible radicles were then counted as germinated (high temperature germination) and assumed to have no seed dormancy mechanisms present. The remaining (ungerminated) seeds were scarified by rubbing between two pieces of 440 grit emery cloth for 10 seconds and tested for germination percentage under the same conditions described previously. Those germinating during this trial were assumed to have been dormant due to a hard seed coat. Ungerminated seeds during either germination test showing fungal growth were assumed to be non-viable and discarded. All intact seeds remaining after the second germination test were assumed to possess some dormancy

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mechanism other than an impervious seed coat. Prior to conducting analyses of variance, all percentage data were subjected to an arc sine transformation. Following analyses of variance, differences between treatment means were determined by Fisher's LSD test (P<.05).

RESULTS AND DISCUSSION

Figure 1 presents cumulative sward dry matter production for both years at roughly 30 and 60 days following the initial clipping date. The 7-day clipping frequency significantly reduced the total sward dry matter production in both years. However, the 14- and 30-day treatments produced the highest total dry matter yields in 1988 and 1989 respectively. Figure 1 illustrates that frequent grazing or clipping can decrease the total sward dry matter yield, particularly if soil moisture is limited. Such was the case prior to the 4 April, 1988 and the 10 May, 1989 harvests. Less than 1 in of rain was received during the 30 days prior to the 2 May, 1988 harvest while about 4 in of precipitation fell in the preceeding 30 day period. This variation in rainfall had a pronounced effect on dry matter production. Plant available soil moisture was fairly uniform throughout the spring of 1989. The approximately 6 in of rain received during March, April, and May were uniformly distributed.

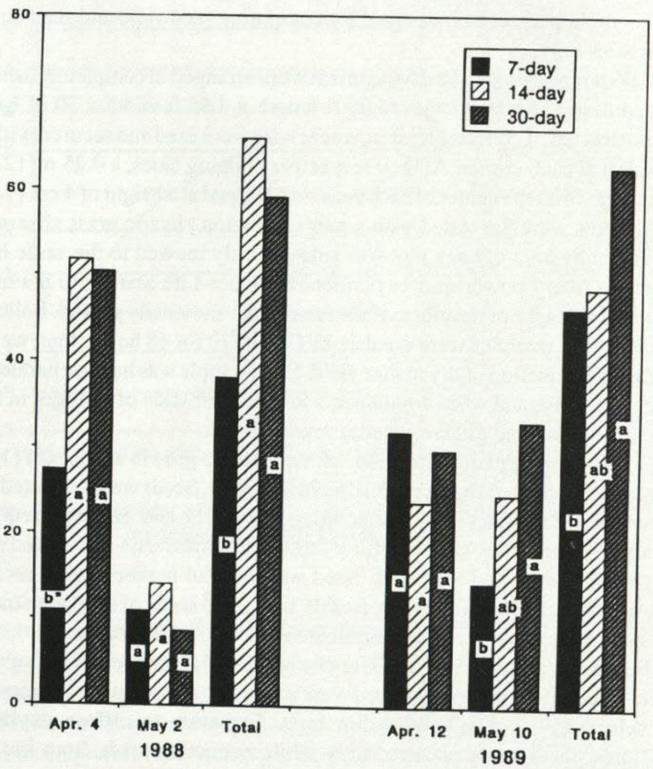

Figure 1. Mean cumulative sward dry matter production as affected by clipping frequencies of 7-, 14-, and 30-day intervals.

*Mean bars within a group containing the same letter are not significantly different at the 5% level according to Fisher's LSD.

The mean percentage of clover and non-clover biomass for both years is presented in Figure 2. In 1988, the clover component of the stand remained relatively high even near clover maturity (2 May). In 1989, all treatments contained considerable non-clover biomass at both the mid-April and May samplings. However, the percentage of non-clover dry matter increased as the time between clippings increased. Apparently, the growth habit of subclover is such that it is favored by the more frequent defoliation compared to the more vertically oriented, taller growing grasses and various dicots.

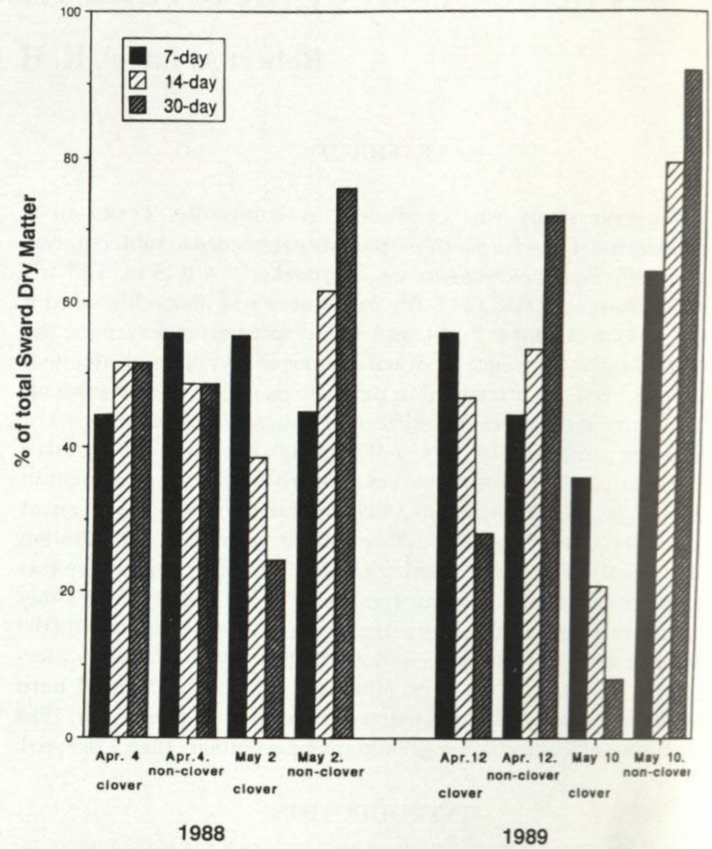

Figure 2. Mean percentage (dry matter basis) of subterranean clover and non-clover (grasses and weeds) as affected by clipping intervals of 7-, 14-, and 30-days.

Tables 1 and 2 indicate seed production was highest in the unclipped plots in 1988 while in 1989 the 7-day treatment produced the greatest seed yield. Clipping frequently had no effect on high temperature germination, percentage of seeds possessing seed coat dormancy or some other dormancy mechanism (tables 1 and 2). There was a difference between years for high temperature germination (table 3). This is in agreement with earlier research which found that subterranean clover has reduced dormancy with the passage of time. Apparently, the loss of dormancy in older seeds is due to some internal, biochemical change and is not related to a reduction in seeds possessing a hard seed coat (table 3).

Table 1. The effect of clipping frequency on seed characteristics of subteranean clover, Huntsville, Texas, 1988.

Clipping Frequency	Seed Production	Seed Weight	High Temp. Germination	Seed Coat Dormancy	Other Dormancy
	no./25m²	mg/seed	------	%	------
7-day	125ab*	5.008a	22a	4a	57a
14-day	119ab	5.303a	33a	12a	48a
30-day	45b	4.400a	23a	5a	46a
unclipped	301a	5.698a	35a	5a	46a

* Means within a column having the same letter are not significantly different(P<0.05).

Table 2. The effect of clipping frequency on seed characteristics of subteranean clover, Huntsville, Texas, 1989.

Clipping Frequency	Seed Production	Seed Weight	High Temp. Germination	Seed Coat Dormancy	Other Dormancy
	no./25m²	mg/seed	--------------------	%	--------------------
7-day	407a*	4.108a	14a	7a	64a
14-day	139ab	3.984a	12a	8a	51a
30-day	84b	4.202a	15a	8a	64a
unclipped	192ab	4.521a	14a	4a	65a

* Means within a column having the same letter are not significantly different(P<0.05).

Table 3. Variation in subterranean clover seed produced in 1988 and 1989, Huntsville, Texas.

Year	Seed Production	Seed Weight	High Temp. Germination	Seed Coat Dormancy	Other Dormancy
	no./25m²	mg/seed	--------------------	%	--------------------
1988	148a*	5.102a	31.4a	14.1a	44.6a
1989	219a	4.204a	20.0b	14.9a	52.2a

* Means within a column having the same letter are not significantly different(P<0.05).

CONCLUSIONS

The 14- or 30-day treatment produced the highest total dry matter yield, while plots clipped at 7-day intervals always had the lowest yields. Obviously, clipping or grazing too frequently can reduce total sward dry matter production. Even under dry conditions, frequent defoliation did not greatly reduce the percentage of clover within the sward. Frequent clipping generally favors subterranean clover over grasses and other weed species, especially when precipitation is adequate (normal).

Subterranean clover swards appear capable of high seed production even when severely defoliated by weekly clippings and when growing under conditions of moisture stress. These results suggest that an intensive grazing system would not impair stand persistence of subclover. The 7-day treatment apparently encouraged greater initiation of floral axes close to the soil surface. Thus the flowers and their resulting seeds were not subject to removal upon clipping treatment. Both greater seed production and a more competitive clover stand may be achieved by allowing or imposing short grazing intervals.

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