Yield, Vigor, and Persistence of Sand Lovegrass [*Eragrostis trichodes* (Nutt.) Wood] Following Clipping Treatments

LOWELL E. MOSER AND L.J. PERRY

Abstract

Individual sand lovegrass [*Eragrostis trichodes* (Nutt.) Wood.] plants on a choppy sands range site in Nebraska's Sandhills were clipped with 7 different harvest regimes for 3 years to determine critical defoliation times. After 3 years unclipped plants had the greatest survival rate and plants harvested only once a year on June 10 or July 10 survived better than those with other harvest regimes. Top and root yields, new tiller counts, and total non-structural carbohydrate (TNC) levels were all reduced severely with multiple harvests within one year. Sand lovegrass plants cannot tolerate close defoliation at anytime of the year although a single June defoliation appeared to be less detrimental than August defoliation. Sand lovegrass is difficult to manage when it makes up a small component of a pasture. Sand lovegrass will probably persist and yield best in a rotational grazing program where it is defoliated only once a year and some leaf area remains at the close of the grazing period. Plants are normally short lived so they should be managed to allow seed production periodically. A grazing management program necessary to maintain small amounts of sand lovegrass in a mixture may not be practical.

Sand lovegrass [*Eragrostis trichodes* (Nutt.)Wood.] is a warm-season perennial bunchgrass that is native to sandy soils in the central Great Plains. It is best adapted to north and east-facing slopes and in some instances can be prevalent on sands and choppy sands range sites (Vallentine 1967). Sand lovegrass is very palatable and highly preferred by livestock. Yearling steer gains per acre in Oklahoma were improved with sand lovegrass compared to other grasses (Smith 1947). Adding sand lovegrass to either big bluestem (*Andropogon gerardii* Vitman), switchgrass (*Panicum virgatum* L.) or sideoats grama [*Bouteloua curtipendula* (Michx.) Torr.] at Lincoln, Nebraska increased the average daily gain and beef production per acre although dry matter yield was generally not increased. In several seasons a relatively small amount of sand lovegrass in switchgrass pastures helped maintain animal performance late in the summer (Conard personal communication). Due to its palatability and bunchgrass growth habit it is often overgrazed by cattle. Sand lovegrass is difficult to maintain in stand even with good management and generally acts as a short-lived perennial. Recently, Vogel and Kindler (1980) have shown that a subterranean aphid (*Geoica urticularia* Passerini) reduced yields of sand lovegrass.

Severe clipping treatments reduced yield of range grasses (Owensby et al. 1974, Branson 1956, Stout et al. 1980, Perry and Chapman 1976). Tiller numbers are reduced with intensive clipping even though removal of the shoot apex should remove apical dominance and increase tillering if environmental conditions are favorable. Carbohydrate level is important in tiller initiation and continued development (Jameson 1963). Root production was more adversely affected than top production by severe clipping treatments (Branson 1956, Crider 1955, Biswell and Weaver 1933).

Adequate carbohydrate reserve is important in initial regrowth (White 1973). Close defoliation treatments, especially at critical stages in plant development, often deplete carbohydrate reserves in range grasses to a level that is not replenished readily (Kinsinger 1961, Perry and Chapman 1974, White 1973) and as a result future tiller production, yield, and plant persistence are adversely affected.

A critical time to defoliate grasses was during shoot apex elevation (Branson 1953, Booysen et al. 1963, Pearson 1964, Vogel and Bjugstad 1968). Sand lovegrass begins growth earlier in the spring than most warm-season grasses (Vallentine 1967, Smith 1947) and elevates its shoot apex later than many other warm-season range grasses (Gilbert et al. 1979). Consequently, sand lovegrass should have a long vegetative period where it would be somewhat resistant to grazing. Once tillers of sand lovegrass begin elevation, the process is more rapid than with other grasses (Gilbert et al. 1979).

The experimental objective was to determine if there was a time during the growing season when relative close defoliation was not especially detrimental to vigor and persistence of sand lovegrass.

Materials and Methods

A southeast facing slope with abundant sand lovegrass on a choppy sands range site was selected for the study near Halsey, in Nebraska's sandhills, in an area protected from grazing. The data from the Halsey, Nebr., weather station, which is approximately 6 km from the plots, indicated normal to above normal rainfall for all 3 years of the study. Precipitation averaged 95 mm, 20 mm, and 289 mm above the normal of 528 mm for 1975, 1976, and 1977 respectively. The plants were fairly widely spaced and there was little other vegetation for competition. In March 1975, 7 replications were marked out and 3 sets of individual uniform plants were selected within each replication for the 3-year study. Seven harvesting treatments were imposed on the plants. The harvesting dates were as follows: (A) unclipped; (B) June 10; (C) July 10; (D) August 10; (E) June 10 and July 10; (F) June 10 and August 10; and (G) June 10, July 10, and August 10. At the end of the growing season, around November 1, all plants were clipped again and the unclipped treatment was harvested. Plants were clipped at 5-cm height, which represented a fairly close harvest especially on a southeast facing slope. Tillers were counted at first harvest and the new tillers, which would represent many of those that would be producing the following year, were counted on November 1. In the fall of 1975 1 set of plants were carefully dug to a depth of 18 cm and removed from the site in order to measure root yields and the carbohydrate level. The remaining 2 sets were subjected to the same harvest treatments in 1976 and one set of them was removed in the fall of 1976. In 1977 the last set was subjected to the harvest treatments for the third year and then removed in the fall. Yield and tiller data from 1975 were averaged

The senior author is a professor and the junior author was an associate professor (now deceased), Department of Agronomy, University of Nebraska-Lincoln, Lincoln 68583.

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Table 1. Vigor and survival of sand lovegrass plants with various harvesting treatments at Halsey, Nebr. Values are averages of 7 plants per treatment.

Harvest dates	First harvest date 1976		First harvest date 1977		November 1977	
	% alive	% vigorous[1]	% alive	% vigorous	% alive	% vigorous
Unclipped	86	86	—	—	86	43
June 10	71	71	57	43	57	43
July 10	86	86	86	71	57	29
August 10	71	43	43	43	43	43
June 10, July 10	57	43	43	14	43	0
June 10, August 10	57	0	29	0	29	0
June 10, July 10, August 10	71	0	0	0	0	0

[1]Plants were considered vigorous if they had 5 or more tillers per plant.

across all 3 sets of plants and in 1976 data were averaged over the 2 remaining sets. Total nonstructural carbohydrates (TNC) were measured using a takadiastase enzyme and a copper iodimetric method (Smith 1969). The stem base material was used for TNC analysis (Perry and Moser 1974).

The experiment was designed as a randomized complete block and Duncan's new multiple range test was used to separate treatment means.

Results

After 3 years the unclipped plants had the greatest survival rate although some of the plants were not vigorous (Table 1). Plants with fewer than 5 tillers were not considered vigorous. Plants harvested only once a year, June 10 or July 10, had a greater survival rate than did those under other harvest schedules. When the leaf area was kept clipped closely during the entire growing season by clipping them 3 times, the plants were greatly weakened after 1 year and were all dead by the second year. Plants cut twice a year, even though some were alive, were all low in vigor at the conclusion of the study.

Total seasonal yield the first year was greatest for the unclipped plants which were harvested once at the end of the growing season and was generally higher for plants clipped only once compared to plants clipped 2 or 3 times (Table 2). In the second year (1976) the unclipped plants again were the most productive by a large margin. Plants harvested June 10 yielded more than those harvested twice at June 10 and August 10 or those harvested 3 times. In 1977 yields were low since many plants were dead or of low vigor. The unclipped plants produced significantly ($p<.05$) more than did the plants in other treatments. Plants clipped twice yielded essentially nothing and those clipped 3 times were dead. Root yields from plants harvested to a depth of 18 cm each November showed a marked decline in all treatments during the 3 years of the study (Table 3). At the end of 3 years of treatment the plants clipped July 10, August 10, June 10 and July 10, June 10 and August 10, and those clipped 3 times had very few roots even if they were alive. The lower yields of sand lovegrass could be anticipated by noting the new tillers that were evident in the fall (Table 4). New tillers were initiated in the fall and a small amount of growth occurred before cold weather. In the fall of 1975 unclipped plants, and those clipped only once, generally had more tillers than those plants clipped more than once. Significantly ($p<.05$) more tillers developed in the fall of 1976 on unclipped plants and those clipped once on June 10 than on the other treatments. At the conclusion of the study the same trend was evident except all of the plants were generally less vigorous.

Total nonstructural carbohydrates (TNC) stored in the stem bases in the fall of 1975 were significantly ($p<.05$) higher in the unclipped plants or those clipped only once in June or July except for the June 10 and July 10 clipping treatment (Table 5). By 1976 some plants were dead and others were so small there was not enough to analyze for TNC in many cases. The unclipped plants and those clipped only once on June 10 tended to have the highest TNC level. In 1977 a TNC determination could not be made due to too small samples for most of the treatments.

Table 2. Total seasonal yield (g/plant oven-dry weight) of sand lovegrass, with various harvesting treatments at Halsey, Nebr.

Harvest dates	1975	1976	1977
Unclipped	29.8 a[1]	11.2 a	11.9 a
June 10	12.5 bc	5.5 b	3.1 b
July 10	9.2 bc	3.2 bc	2.2 b
August 10	21.9 ab	1.2 bc	3.2 b
June 10, July 10	5.2 c	2.6 bc	0.3 b
June 10, August 10	11.0 bc	0.2 c	0.1 b
June 10, July 10, August 10	6.5 c	0.1 c	0.0 b

[1]Values within columns followed by the same letter are not significantly different using Duncan's new multiple range test ($p<.05$).

Table 3. Root weight (g/plant oven-dry weight) in the top 18 cm of soil in early November of sand lovegrass with various harvesting treatments at Halsey, Nebr.

Harvest dates	1975	1976	1977
Unclipped	3.4 a[1]	0.9 a	0.6 a
June 10	1.6 ab	0.5 ab	0.3 ab
July 10	1.5 ab	0.2 bc	0.1 b
August 10	2.2 ab	0.0 c	0.0 b
June 10, July 10	0.8 b	0.1 bc	0.0 b
June 10, August 10	2.2 ab	0.0 c	0.0 b
June 10, July 10, August 10	1.2 b	0.0 c	0.0 b

[1]Values within columns followed by the same letter are not significantly different using Duncan's new multiple range test ($p<.05$).

Discussion

Since the experimental site was a south-facing slope the sand lovegrass plants were under more stress than if they had been located in a situation where they did not receive as much direct sun and had more favorable moisture. Consequently the effects of the clipping treatments were accented. There were no years of below-normal rainfall during the course of this study; however, several months in a row of below normal rainfall can be important since sand lovegrass has a widely spreading, shallow root system

Table 4. Number of newly initiated sand lovegrass tillers counted in early November with various harvesting treatments at Halsey, Nebr.

Harvest dates	1975	1976	1977
Unclipped	186 a[1]	122 a	62 a
June 10	121 ab	119 a	33 ab
July 10	124 ab	13 b	10 b
August 10	69 bc	2 b	11 b
June 10, July 10	36 c	22 b	1 b
June 10, August 10	20 c	2 b	1 b
June 10, July 10, August 10	24 c	0 b	0 b

[1]Values within columns followed by the same letter are not significantly different using Duncan's new multiple range test ($p<.05$).

Table 5. Total nonstructural carbohydrate concentration (%) of sand lovegrass stem bases in early November with various harvesting treatments at Halsey, Nebr.

Harvest dates	1975	1976
	%	%
Unclipped	10.0 a[1]	12.8
June 10	10.8 a	11.0
July 10	9.6 a	9.5
August 10	4.6 b	—
June 10, July 10	8.0 a	7.9
June 10, August 10	3.2 b	—
June 10, July 10, August 10	4.1 b	—

[1]Values within columns followed by the same letter are not significantly using Duncan's new multiple range test ($p<.05$).

(Weaver 1968) and the moisture-holding capacity of the choppy sands range site is low (Burzlaff 1962). Even though the rainfall averaged slightly above normal in 1975 and 1976 the plant loss that occurred in 1976 might be partially attributed to the fact that rainfall was 109 mm below normal from August 1975 until July 1976. In 1975 average temperature was generally several degrees below normal, with the exception of May. In 1976 the average summer temperatures were below normal. In 1977 summer temperatures averaged 4 to 5 degrees above normal, but a cool August followed. The winter of 1976-1977 was especially cold through January, which may have further injured the clipped sand lovegrass.

Sand lovegrass was very sensitive to complete defoliation at anytime during the growing season. There was less of a detrimental affect when the plants were harvested only once early in the growing season. Gilbert et al. (1979) reported that sand lovegrass within 3 km of this study site did not begin to elongate until the end of July so the June 10 and July 10 harvests were on unelongated tillers. Gilbert et al. (1979) also reported that based on mid-August harvests about 40% of the leaf dry matter accumulated by June 10 and by July 10 about 70% of the leaf dry matter accumulated. Evidently the leaf area that was regenerated after the early harvest dates, at least to some extent, restored carbohydrate reserves and maintained some of the vigor and generated new tillers (Table 1, 4, and 5).

Sand lovegrass plants are generally short lived and the rapid decline in vigor in clipped plants that occurred was accented since the study was on a south facing slope. Grazing may not be quite as severe if not all the leaf area is removed as done in the experiment where plants were harvested at 5 cm. Matches (1966) indicated that intact tillers in tall fescue (*Festuca arundinacea* Schreb.) can play an important role in maintaining higher levels of carbohydrate reserves. Crider (1955) reported that root growth was stopped on defoliated tillers of weeping lovegrass [*Eragrostis curvula* (Schrad.) Ness.] but not on intact tillers of the same plant. Grazed sand lovegrass plants had considerably fewer tillers than ungrazed plants in an unpublished experiment conducted near the study area.

Sand lovegrass plants should not be closely grazed at any time during the growing season. Defoliation once early in the season (June) appeared to be less detrimental than later in the summer. Possibly there is a decline in the TNC level in late July and early August associated with rapid culm development as has been reported with other grasses (Owensby et al. 1970). Sand lovegrass is not adapted to continuous grazing since it is so palatable and repeated leaf removal is highly detrimental. Apparently severe defoliation, even once during the season, can have a detrimental effect if it occurs for several years, especially in August. In rangelands where good stands exist, sand lovegrass would yield and persist best in a rotational grazing program where it was defoliated only once a year and it should have some leaf area remaining at the close of the grazing period. Sand lovegrass is a short-lived plant even with light defoliation, and seed production should be permitted to allow the possibility of new seedlings to develop. In rangelands where sand lovegrass is present only in small amounts, management should be for the utilization of the other desirable dominant grasses. A management program designed to permit small amounts of sand lovegrass to persist in a mixture probably would not be practical. Including small amounts of sand lovegrass in a seeding mixture may result in sand lovegrass production for only several years and then it will probably disappear.

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