## Results and Discussion

~~During each year of the study, fall harvesting schedules were found to significantly affect the development of winter hardiness in both Callie and Coastal bermudagrass. Yields during each year (1983, 1984, and 1985), following the application of fall harvesting schedule treatments, were significantly influenced by differences in winter tolerance development resulting from these treatments. Table 2 shows that yields through July each year decreased as monthly harvesting was continued after August during each previous fall. For example, mean yields for both varieties in 1983 through July decreased from 8,272 lb/A under Schedule A where no fall harvesting was done after August 1982, to 7,230, 7,037, and 6,477 lb/A as monthly fall harvesting was continued through September, October, and November, respectively (Schedules B, C, and D). Schedule A which prescribed no harvesting after an August cutting each year provided for the highest amount of winter tolerance development which typically resulted in the highest yield compared to the other treatments. Schedule D which prescribed harvesting monthly from August through November provided the lowest amount of winter tolerance development and the lowest yields. Schedules E and F produced results which were intermediate to those of Schedules A and F in their effects on hardiness and yields. These treatments did not differ from each other and indicate that late fall harvesting tended to be less obstructive to winter hardiness development when harvest frequency is decreased.~~

~~Yields under all harvesting schedule treatments increased with increasing nitrogen fertilizer application. Nitrogen was also found to be important for stand maintenance and weed control, but like fall harvesting schedule, had no significant effects on in vitro digestibility.~~

### Literature Cited

1. ~~Harris, T. S., L. Gordon, and V. L. Jones. 1984. Effects of fall clipping on bermudagrass yields the following year. *In* Forage Research in Texas (1984). Texas Agr. Exp. Sta. Publication CPR-4253.~~

# Effect of Defoliation on Regrowth of Warm-Season Perennial Grasses

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## Summary

Twelve warm-season grasses were evaluated for yield, non-structural carbohydrates, and leaf area. Significant differences in dry matter production were found to exist due to frequency and severity of harvest, the highest yields being with the least frequent, least severe defoliation. Non-structural carbohydrate levels indicate that the plants cannot tolerate continuous heavy frequent defoliation. Productivity of most of the grasses increased as leaf area increased.

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KEYWORDS: Defoliation/leaf area/warm-season grasses/carbohydrates.

## Introduction

The total production of herbage and the persistence of grasses can be markedly reduced when herbage is removed too frequently and intensively by cutting or grazing animals. Winter-killing and lowered vitality with attendant decreased yield result from improper management of the herbage. In addition, in pastures, undesirable species increase in number when there is improper management. Overgrazing in many situations may affect recuperation or productive capacity of grasses.

Although the relation of harvesting practices to the development of grassland is known in a general way from observations, and more definitely for a few species from experimental studies, there is still a definite need for further experimental work. Few studies have been made on growth and regrowth abilities of warm-season perennial grasses. In order to determine the proper management of these grasses, it is important to study the effects of various management practices on the potential regrowth.

## Materials and Methods

Seedlings of twelve warm-season grasses-(Pretoria-90, Loresa, Old World Bluestem, Verde, Klein-75, Kleingrass, Wilma, Morpa, and Renner lovegrass, Nueces and Llano buffelgrass, Bell Rhodesgrass and Alamo switchgrass) were started in peat pots in a green house in late winter. The seedlings were transplanted to the field in April 1985. Test plots consisted of four 50 cm rows, 6 m long.

A split split-plot field design was employed with three replications. Main plots were the 12 warm-season cultivars. Sub-plots consisted of two harvest frequencies (21 and 42 days), and sub-sub-plots were two stubble heights (10 and 30 cm). Measurements included dry matter yield, leaf area, and non-structural carbohydrates.

Every 3 weeks prior to harvest, two plants were hand-clipped at the designated cutting height. The laminae from one group of tillers from the hand-harvested plants were removed from the stem and the leaf area was determined with the use of an optical planimeter. The units were expressed in square centimeters per plant.

Every 6 weeks, plant stubble and the root system of one of the hand-clipped plants were excavated and used to estimate non-structural carbohydrates. Stem base and crown samples were washed, dried, and ground in a Wiley mill with a 2 mm screen. Non-structural carbohydrate determinations were made by the method described by Smith (1969).

The data was subjected to analysis of variance and means were separated using the LSD test. Leaf area and dry matter yield relationships were evaluated by regression analysis.

## Results and Discussion

Forage yields are reported in Table 1. Although dry matter yields were not significantly different due to height of harvest, by the end of the growing season there was a tendency for yields to increase with the 30 cm height. Only Nueces buffelgrass and Alamo switchgrass decreased in dry matter yield when clipped to 30 cm over 10 cm. There was, however, a significant difference in

TABLE 1. DRY MATTER PER PLANT AT TWO CUTTING FREQUENCIES AND TWO CUTTING HEIGHTS

| | Harvest Frequency | | | |
|---|---|---|---|---|
| | 21 days | | 42 days | |
| | Harvest Height | | | |
| Cultivar | 10 cm | 30 cm | 10 cm | 30 cm |
| Pretoria-90 | 71.0 | 95.9 | 218.2 | 230.9 |
| Bell Rhodesgrass | 53.0 | 93.2 | 111.7 | 101.1 |
| Old World bluestem | 47.6 | 70.4 | 65.2 | 102.3 |
| Nueces buffelgrass | 40.6 | 44.8 | 116.1 | 106.2 |
| Wilma lovegrass | 37.7 | 45.3 | 112.7 | 106.6 |
| Llano buffelgrass | 36.8 | 45.4 | 96.4 | 106.3 |
| Verdie kleingrass | 31.5 | 61.1 | 98.4 | 79.9 |
| Klein 75 | 27.1 | 44.3 | 68.5 | 89.4 |
| Morpa lovegrass | 25.9 | 48.1 | 62.4 | 60.9 |
| Renner lovegrass | 21.6 | 45.7 | 52.8 | 54.9 |
| Alamo switchgrass | 19.1 | 33.4 | 96.7 | 77.0 |
| Loresa | 15.5 | 25.2 | 44.5 | 47.2 |
| LSD (.05 level) | 16.1 | 18.9 | 27.4 | 27.8 |

yield due to the cutting frequency. All plants increased in dry matter with time. There was a 113 percent increase in dry matter production when cut every 42 days over those cut every 21 days.

In this study the interaction between interval and height of clipping was not significant in all the species. The more pronounced influence exhibited by the interval of cutting compared to the clipping height suggests that in the management of these pastures the frequency of defoliation would play a more important role than degree of utilization and to that extent the grazing management is simplified.

Changes in the concentration of the non-structural carbohydrate content in basal crown varied between grasses and as the season progressed (Table 2). Non-structural carbohydrates generally declined from summer to fall with the lowest level during late-winter (February 10).

The concentration of non-structural carbohydrates of Pretoria 90 remained at a relatively high level throughout the season compared with the content of the other grasses, particularly Loresa and Renner lovegrass.

The decreases in carbohydrate levels occurred with all defoliation treatments. The least severe defoliation, 42-day frequency, had the highest level of concentration of carbohydrates.

Due to an erect growth habit of all these grasses, all treatments removed a lot of the leaf area. The photosynthetic active tissue remaining on the stubble after each harvest was insufficient to support regrowth, thus, under these clipping regimes regrowth was depended on the carbohydrates reserves.

This study clearly implies that the regrowth of defoliated perennial forage plants are related to food reserves. Frequent and intensive defoliation reduced the carbohydrates reserves and rate of regrowth. Also, the depletion in concentration of non-structural carbohydrates during the dormant season (Winter) indicates that the plants used food reserves as source of energy for plant survival during this critical season.

In all treatments, yield increased linearly as leaf area increased (Table 3). As leaf area increased, more light was absorbed, more $CO_2$ assimilation, hence more productivity. Broughman (1960) presented evidence that indicated productivity is more related to the amount of chlorophyll than to leaf area, but leaf area is easier to determine.

TABLE 3. PREDICTIVE EQUATIONS FROM REGRESSION ANALYSES

| | Leaf area versus Yield |
|---|---|
| Loresa- | $Y=4.40836+0.008976X$ |
| Pretoria-90 | $Y=1.86029+0.022364X$ |
| Verdie kleingrass | $Y=4.46226+0.021904X$ |
| Klein 75 | $Y=4.68067+0.026116X$ |
| Wilma lovegrass | $Y=2.04893+0.078643X$ |
| Nueces buffel | $Y=1.95991+0.026049X$ |
| Llano buffel | $Y=2.84758+0.020299X$ |
| Morpa lovegrass | $Y=2.65262+0.026482X$ |
| Renner lovegrass | $Y=3.94228+0.027219X$ |
| Old bluestem | $Y=8.425904+0.014503X$ |
| Alamo switchgrass | $Y=1.794919+0.024619X$ |
| | Y = Yield (grs/plant) |
| | Y = Leaf Area (cm$^2$) |

TABLE 2. ROOT CARBOHYDRATE LEVELS (%) BY DATES

| | Dates | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 8-5 | | 9-17 | | 11-07 | | 2-10 | |
| | Cutting Frequency, days | | | | | | | |
| | 21 | 42 | 21 | 42 | 21 | 42 | 21 | 42 |
| Pretoria-90 | 8.7 | 8.7 | 10.2 | 10.5 | 9.3 | 11.0 | 6.5 | 7.3 |
| Bell Rhodesgrass | 6.3 | 6.6 | 7.2 | 7.5 | 5.8 | 7.0 | 3.3 | 4.4 |
| Old World bluestem | 6.3 | 6.5 | 7.1 | 7.6 | 6.0 | 6.4 | 4.2 | 4.5 |
| Nueces buffelgrass | 7.4 | 7.3 | 9.0 | 9.0 | 6.3 | 7.6 | 4.1 | 4.4 |
| Wilma lovegrass | 4.6 | 4.9 | 5.3 | 5.4 | 4.1 | 4.7 | 3.3 | 3.8 |
| Llano buffelgrass | 7.5 | 7.4 | 8.8 | 9.2 | 6.9 | 8.0 | 5.0 | 5.6 |
| Verdie kleingrass | 6.7 | 7.1 | 7.4 | 7.6 | 6.5 | 7.1 | 4.4 | 4.8 |
| Kleingrass-75 | 6.7 | 7.3 | 7.5 | 8.1 | 6.1 | 6.7 | 4.6 | 4.6 |
| Morpa lovegrass | 5.0 | 5.3 | 5.3 | 5.5 | 4.5 | 5.3 | 3.2 | 3.5 |
| Renner lovegrass | 4.4 | 4.6 | 5.4 | 6.3 | 4.3 | 4.9 | 3.0 | 3.4 |
| Alamo switchgrass | 5.5 | 5.6 | 6.0 | 6.5 | 4.7 | 4.8 | 2.7 | 3.2 |
| Loresa | 4.9 | 5.3 | 5.5 | 5.5 | 4.0 | 5.2 | 3.1 | 3.8 |

## Literature Cited

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