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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.

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, Klein-grass, 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

Cultivar	Harvest Frequency			
	21 days		42 days	
	Harvest Height			
	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 CO₂ 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

1. Broughman, R. W. 1960. The relationship between critical leaf area, total chlorophyll content, and maximum growth rate of some pasture and crop plants. *Ann. Bot.* 24:463-474.
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