# The Influence of Intensity and Frequency of Clipping on the Root System of Brownseed Paspalum

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IT IS common knowledge that the frequent removal of a large percentage of the leaf and stem growth of grasses over long periods of time will not only reduce their vitality and production, but may cause the death of such plants. To what extent the root system of the grass plant suffers from various intensities and frequencies of utilization in different environments is only generally understood. Such investigators as Fitts (1925), Weaver (1926), Harrison (1931), and Parker and Sampson (1931), working outside the boundaries of Texas, report that intensive clipping on certain grasses was detrimental to root production. In addition, McCarty and Price (1942) state that root reserves were influenced less by the number of clippings than by the time and degree of clipping on annual range, while Harrison (1931) found that mineral fertilizers did not compensate for a lack of top growth due to clipping in the production of roots.

With these points in mind, a study was introduced on the Encino Experimental Range of the King Ranch, South Texas, in 1948. The objectives were to determine what effect different intensities (heights) and frequencies of clipping might have on the root systems of the "key" range grasses of the area. The grasses included are of the bunch grass type common to the better sites on the sandy soils of the large area within the general region (Fig. 1A). Since these are of the better grasses of the region, they have suffered severely in the past from heavy utilization and especially during years of low rainfall (Fig. 1B). Thus it is apparent that any information on the volume and depth of the root systems in relation to clipping heights and intensities would be of great value in the formulation of proper management practices for such grasses to obtain a sustained forage yield. Since the preliminary trials to obtain such information revealed that time and funds were the limiting factors in testing all the important grass species, brownseed paspalum (*Paspalum plicatulum*) was selected because it was the most abundant among the grasses and equally as palatable.

The study area provides a means whereby data could be obtained under different utilization practices as associated with clipping and grazing on both non-fertilized and fertilized (phosphate) treatments for given periods of time. This particular paper gives the results of the first 18 months of the over-all study.

## Experimental Area

The Encino Experimental Range consists of seven, 640-acre, native pastures. The Nueces soil found on this Range is a gray, loose, fine soil to a depth of about three feet overlying a gray or yellowish noncalcareous friable subsoil. The parent material is a windblown sand beach deposit over Pleistocene clays. The three pastures among the seven selected to obtain root samples from were: Number 1, unfertilized, Number 3, fertilized with

300 pounds 20 per cent superphosphate per acre, and Number 4, fertilized with 300 pounds raw rock phosphate per acre.

The region has a marine climate with comparatively pleasant summers, mild winters and cool springs, with an average growing season of about 290 days. The average annual precipitation reported for a 32-year period is 23.92 inches; however, the area is subjected to long periods of drought and occasional severe tropical storms.

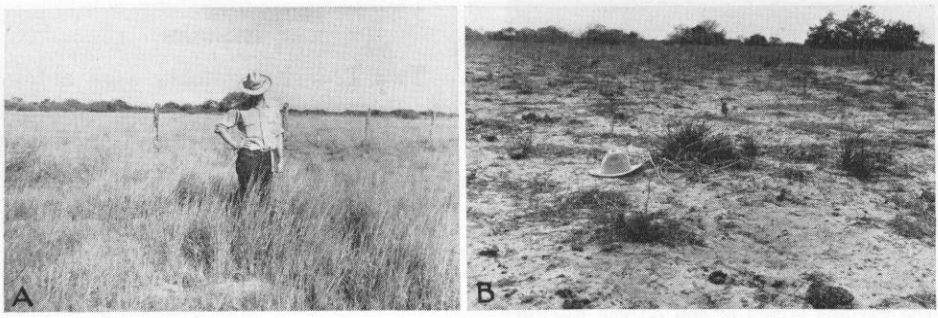


FIGURE 1. Bunch-grass range. *A*. Good condition bunch-grass range on Encino Division of the King Ranch in the Rio Grande Plain of Texas where root studies of brownseed paspalum were carried on. *B*. The effect of severe utilization on the bunch grasses in the same vicinity. Note sandy top soil which is exposed to wind action. Sand drifting is common in the general region where over-utilization has occurred.

Vegetation common to this area is a bunch grass type composed principally of such desirable grasses as brownseed paspalum, seacoast bluestem *Andropogon littoralis*, thin paspalum *Paspalum setaceum*, purple dropseed *Sporobolus purpurascens*, hairy grama *Bouteloua hirsuta*, as well as a number of less desirable grass species.

## EXPERIMENTAL PROCEDURE

Eighteen plants of brownseed paspalum were randomly selected in each of two one-acre enclosures in pastures 1, 3, and 4, as well as four plants outside but adjacent to each enclosure which were subjected to grazing. The enclosures consisted of a replicated experiment on the effects of intensity and frequency of clipping. One plant was taken from each of eighteen strips. Six of these were from check strips. Two strips were cut at a height of 6 inches and at a low frequency of clipping. This low frequency was one-half that of the two strips clipped at high frequency. Likewise, there were two strips at each frequency for the 4 and 2 inch heights of clipping. The brownseed paspalum plants had been clipped according to the above specification over a period of 18 months while the grazed plots outside the enclosures were grazed for a similar period under the grazing rates of 42 cattle per section in pastures 1 and 4 and 63 in pasture 3.

A soil coring machine manufactured by the Utah Research Foundation was used to obtain the root samples (Fig. 2). The boring tube was 4 inches in diameter and 10 feet long. The crown growth of brownseed paspalum was especially well shaped for centering the boring tube. The soil removed by the soil coring machine was sectioned at 12-inch intervals from the surface to the claypan and constituted the sand portion. As much of the claypan as could be obtained was used as the claypan unit, which in

many cases did not exceed 8 inches. When details concerning the entire root system were necessary for any particular grass, the soil block method was employed

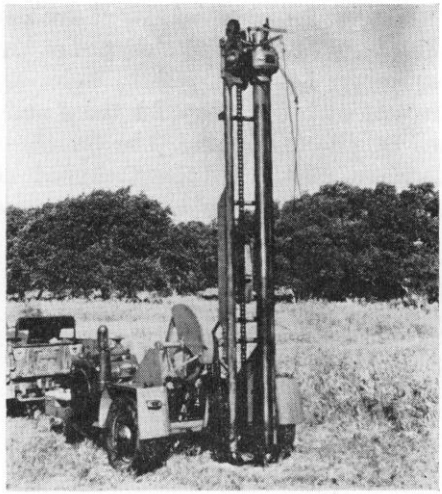

FIGURE 2. Soil coring machine used to study the roots of brownseed paspalum in the various layers of soil on the Encino Experimental Range.

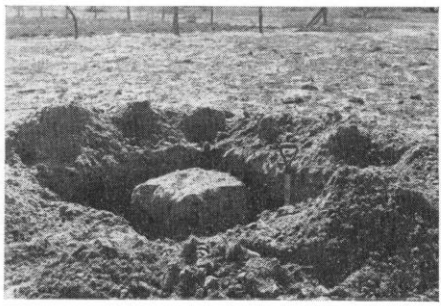

FIGURE 3. Method used to obtain the entire root system for any particular grass plant in the over-all range management study on the Encino Experimental Range of the King Ranch.

(Fig. 3). This was a very expensive and laborious method.

The sandy top soil and roots were separated after drying by the use of a one millimeter soil screen. The roots were also separated from the claypan portion of the soil with the aid of running water and the soil screen. The roots obtained were dried at 45°C. for 24 hours and weighed to the nearest tenth of a gram. Previous data indicated that small samples reached a constant weight at the above temperature and time. Data were obtained on root weights, per unit volume of soil, from each of the 12-inch segments.

All roots present in the soil core were used in this analysis. No separation of live and dead roots was possible. Thus there was a militating effect on the results obtained.

## RESULTS

Two 12-inch segments were obtained of the root systems of 132 brownseed paspalum plants. The mean weights per unit volume soil are listed in Table 1 for each segment.

### *Effect on roots in surface foot of soil*

The mean root weights of the 0–12 inch segment in pastures 1, 3, and 4 reveal a difference between pasture 4 and pastures 1 and 3. This difference may be due to the rock phosphate fertilizer applied to pasture 4, whereas pasture 1 was not fertilized and pasture 3 was fertilized with superphosphate, or it may be due to the location of the enclosures. There is also a possibility that the depth to the claypan may be a factor. However, the difference in depth of claypan between the enclosures in pasture 4 was not as great as between the pastures, even though the depth to the claypan in one enclosure was 24.8 inches while the other was approximately 34 inches. This difference in depth to the claypan was greater than the difference between pastures.

On the basis of statistical analysis, intensity and frequency of clipping did not significantly influence the weight of roots in the surface 12 inches of soil. Neither was the interaction of intensity and frequency significant. However, the sum

of squares associated with one degree of freedom of this interaction for the comparison of the 2-inch plus the 4-inch versus the 6-inch clipping height was significant (P .05). The remaining sum of squares associated with the other degree of freedom was not significant.

on the roots of brownseed paspalum in the surface foot of soil. A comparison of the root weights of the grazed and check plants shows no significant difference in the 0–12 inch segment of the roots. This similarity in root weights would be expected because the two

TABLE 1

*Weight of roots of brownseed paspalum in grams, oven-dry weight, per unit volume of soil in relation to soil depth, grazing, and clipping treatments*

| PASTURE NUMBER | UNCLIPPED | GRAZED | CLIPPING INTENSITY AND FREQUENCY | | | | | | *Average** |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2-inch stubble | | 4-inch stubble | | 6-inch stubble | | |
| | | | *Low* | *High* | *Low* | *High* | *Low* | *High* | |
| *0 to 12 inch soil layer* | | | | | | | | | |
| 1 | 20.2 | 20.7 | 15.3 | 15.0 | 23.3 | 16.7 | 13.2 | 18.3 | 18.5 |
| 3 | 19.9 | 15.7 | 27.3 | 19.2 | 28.6 | 25.0 | 16.7 | 19.0 | 20.7 |
| 4 | 13.5 | 17.7 | 13.4 | 14.5 | 16.3 | 12.3 | 13.3 | 17.4 | 14.8 |
| Average | 17.9 | 18.0 | 18.7 | 16.2 | 22.7 | 18.1 | 14.4 | 18.6 | |
| *12 to 24 inch soil layer* | | | | | | | | | |
| 1 | .95 | .89 | .95 | .84 | .97 | .78 | 1.13 | .82 | .82 |
| 3 | 1.05 | 1.12 | .97 | .93 | .98 | .76 | .95 | .98 | .98 |
| 4 | .78 | .95 | 1.11 | .64 | 1.10 | .76 | .75 | .85 | .85 |
| Average | .92 | .98 | 1.01 | .82 | 1.01 | .77 | .94 | .79 | |
| *Claypan fraction* | | | | | | | | | |
| 1, 3 & 4 | .15 | .08 | .11 | .09 | .10 | .09 | .12 | .11 | .10 |
| *Adjacent sand* | | | | | | | | | |
| 1, 3 & 4 | .05 | .05 | .05 | .05 | .05 | .04 | .06 | .05 | .05 |

* The average is a pasture average and includes all plants in each pasture, however the intermediate values are not shown in the table.

The significant value obtained above was due to a differential response of the roots of brownseed paspalum to frequency of clipping at the 6-inch clipping height as compared with the influence of clipping on the root weights of plants clipped at the 2 and 4-inch heights. Decreased intensity of clipping thus compensates for high frequency of clipping

previous growing seasons were favorable for forage production and the areas surrounding the enclosures were only lightly grazed.

*Effects on roots in soil segment 12–24 inches*

The root weights of the 12–24 inch section of the roots obtained from the plants mowed at different intensities and

frequencies are reported in Table 1. The weight of roots in this section were significantly (P. 05) reduced by the high frequency of clipping as compared with the low frequency of clipping. Effect of intensity of clipping was not significant in the second foot of soil.

The lack of significance for intensity of clipping was due probably to the growth habit of brownseed paspalum. This grass produces a leafy basal growth that enables it to continue photosynthetic activity even after being clipped to a height of 2 inches, thus reducing the demand on the root reserves for the production of new growth.

Frequency of clipping did not influence the weight of roots in the surface 12 inches of soil. The initial response of brownseed paspalum to clipping is thus a decrease in depth of the root systems. This reduction occurred above the claypan which may serve as a water reservoir and as a source of nutrients during periods of drought.

The difference in the root weights between the check plants and the grazed plants was not significant (P .05), which indicates that the intensity of grazing practiced on the areas surrounding the enclosures had little effect on the root system of brownseed paspalum. The claypan formation beneath the sand has a decided influence on the character of the root system. The weight of roots per unit volume of soil in the claypan samples was twice the weight of roots found in the sand immediately above the claypan (Table 1).

The roots in the claypan fraction of the soil show the same response to frequency of clipping as did the roots in the 12 to 24 inch segment of the roots which were in the sandy soil. Under the assumption that the claypan serves as the principal source of nutrients and water during drought periods, it becomes obvious that the shortening of the root systems will result in decreased forage production. The greater weight of roots in the claypan in comparison with the sand fraction above the claypan is a plant response to increased moisture and nutrients.

The claypan intra-faces were characterized by a fine network of roots and by a darker color which was probably due to an accumulation of organic matter. Roots passing through the sand or claypan areas free of fissures did not show such extreme branching. The penetration of the roots may have permitted more water to enter the claypan and the additional organic matter increased the water holding capacity of the soil.

## Summary and Conclusions

Data obtained on the amount of roots of brownseed paspalum in the surface 12 inches of soil did not indicate that intensity or frequency of clipping during an 18-month period influenced the amount of roots in the surface soil. Decreasing the intensity of clipping was shown to compensate for increasing frequency of clipping in the surface soil.

Frequency of clipping had a detrimental influence on the amount of roots in the second foot of soil. Grazing was not detrimental to the root systems of the plants under the conditions of the experiment where over-utilization was not apparent for this period.

The amount of roots in the claypan was twice as great as the amount of roots in the sandy soil just above the claypan in all three pastures. Roots of brownseed paspalum were found to be concentrated on the claypan intra-faces wherever examined. Frequency of clipping appeared to be detrimental to the amount of roots in the claypan soil fraction.

These data which apply to brownseed paspalum may also apply to the other

perennial bunch grasses of the general region. Thus it may be assumed that heavy utilization of the foliage over a comparatively long period of time influences the root development by both quantity and length, and the plants are unable to contact the claypan which is the principal source of needed water supply during the long hot summers and death ultimately results. This may be one of the principal reasons why the perennial grasses of the bunch grass type in the general region have been replaced by the less desirable perennial and annual grasses and forbs with shorter roots.

ACKNOWLEDGMENT

This work was supported in part from Grant-in-aid Funds made available by Swift & Company and was conducted on the Encino Division of the King Ranch.

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