

Soil Moisture Extraction by Irrigated Pasture Mixtures as Influenced by Clipping Frequency¹

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AMONG the more important factors which affect the production of pastures are soil fertility, species, grazing management, and the maintenance of favorable soil moisture conditions within the root zone. The influence of clipping frequency upon yield, botanical composition, and feed quality has been reported by Peterson and Hagan (6). Clipping (or grazing) at frequent intervals was found to greatly reduce the amount of herbage produced per acre. This factor might be expected also to influence root growth and thus the soil depth from which moisture could be extracted by the plant.

Numerous investigators have considered the effect of clipping on root growth in turf and forage crops, but few have investigated its effect on root depth distribution of mature stands under field conditions. Many of the clipping studies are reviewed by Salmon *et al.* (7), Graber *et al.* (4), and Biswell and Weaver (1). There is general agreement among the workers cited that the more frequent and severe the clipping treatment, the lower is the production of shoots, rhizomes, and roots. Similar conclusions have been reached in more recent work by Harrison and Hodgson (5), Carter and Law (2), and Wagner (10) from greenhouse investigations using young plants in containers and by Comstock and Law (3) from a field study. The latter workers compared root production by pure stands of alfalfa and by alfalfa-wheatgrass mixtures under two clipping schedules. Some plots were cut once per season for hay while others were cut two or three times which allowed recovery periods between clippings of approximately four weeks. The more frequently clipped plots produced a lower dry weight of roots with a higher percentage of roots in the top foot of soil and a lower percentage in the second foot.

An exception to the general conclusion that frequent clipping reduces depth of rooting appears in the report by Salmon *et al.* Alfalfa growing in the field was cut for nine years at four stages of growth which permitted average recovery periods of 31, 35, 40, and 51 days between clippings. The roots were washed out to a depth of 4 feet at the end of the second year. Large, healthy roots were found in all plots, but some dead and decaying roots were found under the most frequently cut treatments. When the roots were excavated at the end of the ninth year, a water table at 18 feet was found to have prevented further downward growth. Roots were seen at this depth in all cases and were assumed, on the basis of their size (1 to 2 mm. in diameter), to have been capable of penetrating further had soil conditions been favorable. No differences related to plot treatment were observed.

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It was the purpose of this investigation to determine the long-term effect of clipping frequency on moisture extraction and depth of rooting under mature stands of typical irrigated pasture mixtures.

MATERIALS AND METHODS

The plots used for the clipping experiment reported by Peterson and Hagan were utilized in this study. Three pasture mixtures were investigated, each containing a mixture of annual and perennial ryegrass, orchardgrass, and alta fescue but differing in the legume component. The legume portions consisted of ladino clover, broadleaf trefoil, and alfalfa each used alone. The plots were established in October, 1948, and for the next three years they were clipped at intervals of two, three, four, and five weeks during the growing seasons. Further details are given in the paper cited.

The almost complete absence of rain throughout the summer months made possible an accurate control of soil moisture conditions by irrigation. Plots were flood irrigated approximately every seven days during the warm part of the summer and less frequently in spring and fall.

The plots were located on a deep alluvial soil of the Yolo series. The texture varies with depth because of stratification. The surface soil and the soil to a depth of 8 feet are quite uniformly a loam or sandy loam. Below 8 feet, a clay stratum retards drainage and restricts the root development of deep-rooted plants such as alfalfa. Slow drainage through the clay layer made it impossible to evaluate accurately root activity in the lower portion of the profile during the first three weeks after irrigation. Aside from this difficulty, the soil was ideally suited to a detailed study of moisture extraction. The apparent (bulk) specific gravity of the soil, as determined using a standard California soil tube, varied little with depth, but in 112 measurements individual values ranged from 1.59 to 1.11. The mean of 1.36 was used for all depths in calculating consumptive use.

The effect of clipping treatments on rooting was studied by periodic soil moisture determinations continued until the plants were badly wilted. The relative activity of roots at any depth can be inferred from the rate of soil moisture extraction. No attempt was made to wash out and weigh the root systems since the weight of roots is not a reliable measure of their ability to supply water to the plant.

Soil moisture records were obtained in the third year during the months of July, August, and the first half of September for each of the mixtures at the four clipping intervals. After the winter, clipping was resumed on March 19, 1951, and terminated approximately two weeks before beginning soil moisture sampling. Three replications of each mixture were studied.

EXPERIMENTAL RESULTS AND DISCUSSION

Influence of Clipping Frequency

Soil-moisture extraction records at various depths for one replication of the ladino clover-grass series clipped at two, four, and five week periods are given in figure 1. The curve for the three-week period is very similar to the others. Although there are the usual minor irregularities in the extraction curves, they are quite smooth particularly in the upper portion of the profile. About 25 days after irrigation, the soil moisture content in the top two feet of soil approximated the average permanent wilting percentage (9.5%) indicating that most of the readily available water in this depth had been removed. Except for the continued slow