ference would be distributed over a 6-month period, and since diurnal changes in radii may be many times greater, the error may be considered negligible. If iron screws are used—the only objection is the necessity of frequently oiling them to prevent rust—the error is even less because of a lower coefficient of expansion. Error due to the varying temperature of the dial gauge may be ignored if the instrument is carried in the coat pocket in winter.

A second problem is that presented by the possibility of warping of the two pieces of wood used in making the platform. The writer has used well-seasoned ¾″ hard maple, treated with oil, for this purpose. To determine the amount of error to be expected from this source three iron pegs were welded into a thick iron plate in such a manner that before and after trips into the field readings could be made in the laboratory on the metal apparatus. The results showed that changes in the instrument are extremely small even over long periods. Another check, which all investigators using this instrument should employ, consisted of putting out an extra set of three screws on one tree in the field, then sinking a fourth short screw into the trunk at the spot where the spindle strikes. The short screw should penetrate the tree to approximately the same depth as the three longer ones. Readings made on this set should remain constant, but if not a correction factor for each day can be ascertained, and this will correct for all instrumental error whether due to warpage or to thermal expansion of metals.

Two variations in the construction of the platform have been tried by the writer, and both are successful. Figure 1 shows a platform ($2\frac{1}{8} \times 3\frac{1}{4}$ inches) faced with a plate of stainless steel and surrounded in part by a fence made of the same material, the purpose of the latter being to enable the operator to return the platform to exactly the same position at each measurement. A template is used when installing the screws to space them uniformly in relation to the size and shape of the platform. In an earlier model, three "finishing" nails were driven into the tree instead of using screws, and a piece of plywood pierced by suitably spaced holes was bolted to the face of the maple platform. The holes in the plywood acted as guides so that the platform could be returned to the same place against the nail heads. Before bolting on the plywood piece, bits of stainless steel safety razor blades were glued to the maple surface to provide points of contact essentially free from wear. Screws have the advantage over nails in that they can be reset to compensate for the growth of the tree, which may be necessary within a few months in some individuals.

A final problem was that of wear caused by the spindle repeatedly striking against the same area of bark. This has been easily solved by cutting galvanized sheet iron into 1 cm squares and fastening one of these at each point of contact on the bark surface, using stick shellac melted with an alcohol lamp. It is highly desirable to pare back the surface of rough or thick bark to prepare a firm surface to which the metal plate may be fixed, but the trimming must not be so severe as to stimulate extra periderm activity. Because of the effects produced by direct insolation on the metal plate as well as upon the screws, the writer prefers to locate the dendrometers on the north sides of trees and to take advantage of any other possible shade as well. There seems to be no objection to this practice, for differences in behavior which have been found in different parts of the same cambium layer have had no constant correlation with shaded or insolated sides of tree trunks.

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SURVIVAL OF BUFFALO GRASS FOLLOWING SUBMERSION IN PLAYAS [1]

The topography of much of the Southern High Plains area is characterized by playas or depressions which are commonly called "dry weather" or "wet weather" lakes, depending upon the season. A typical playa of approximately 125 acres on the Amarillo Conservation Experiment Station forms the principal lake covered in these studies (Templin and Shearin, '29; Parker and Whitfield, '41).

During the latter part of October, 1941, practically every playa within a radius of 150 miles of Amarillo, Texas filled to nearly an "all time high" water mark. Measurements on the lake at the Amarillo Conservation Experiment Station showed water to an average depth of 59.1

[1] Contribution from the Soil Conservation Service, Amarillo Conservation Experiment Station, Amarillo, Texas, in cooperation with the Texas Agricultural Experiment Station.

inches after the October rains. Two and eight-tenths inches of water were lost by runoff over the watershed from a total rainfall of 7.86 inches for the 10-day period, October 21 to October 30. This heavy runoff occurred on a soil that was saturated from the second wettest growing season in 49 years at Amarillo, Texas and the wettest season on record at some locations on the Plains. The total precipitation for October, 1941, was 9.14 inches against the 49-year average of 1.53 inches.

At the end of the favorable growing season prior to October, 1941, most of the playas in the Southern High Plains were covered with vegetation. The season had been favorable for the establishment of buffalo grass seedlings and many seedling plants had spread 18 inches in the dry lake beds. The condition of the vegetation on most playa areas at the end of the 1941 growing season before the playas filled with water can be summarized as follows:

1. Shallow playas completely covered with buffalo grass, *Buchloe dactyloides* (Nutt.) Engelm., or western wheatgrass, *Agropyron smithii* Rydb., or a mixture of both; playas in cultivated fields had more western wheatgrass cover while those in pastures were mainly covered with buffalo grass.

2. Deeper lakes that had not completely filled with water during the spring of 1941 had solid stands of buffalo and western wheatgrass on the edges and into the beds as far as 500 feet from the margin, in many cases.

3. The central low flats in the deeper lake areas were covered with scattered buffalo grass and western wheatgrass plants interspersed with a heavy cover of weeds.

When the playas filled with water after 8 years of drought on the Plains, it was assumed that the submersion would kill the grass covering these areas. However, observations made at the beginning of the growing season in April, 1942 after 6 months' submersion and continued until the end of the growing season in October, after 12 months' submersion, showed buffalo grass plants continuing to resume growth as the water receded. Many plants began to grow while still covered with as much as ½–1 inch of water, with new leaves 1–1½ inch in length emerging above the water level before the water receded below the soil surface (fig. 1). At the end of the 1942 growing season, most of the playas had water remaining in the deeper portions which covered buffalo grass to such a depth that the plants had remained dormant for the complete season. The principal lake included in these studies became dry in January, 1943. Buffalo grass submerged for a period of over 14 months, from October 21, 1941 to January 16, 1943, resumed growth in April, 1943. The longest interval in which buffalo grass remained submerged and then resumed growth was 19 months, from October 21, 1941 to the end of May, 1943. This was in one of the larger, deeper lakes of the area near Amarillo, Texas. Survival of buffalo grass after submersion in water for periods comparable to that recorded on the Amarillo Station has been observed near Dalhart, Dumas, Panhandle, Vega, Hereford, Plainview and Lubbock, Texas, and Clovis, New Mexico.

Density counts made August 24, 1942, on the area submerged from October, 1941 to July, 1942, gave an average of 12.5 per cent density of buffalo grass. This appears as a mat (fig. 2) and is 1½ times heavier than "good" pasture in the general area. No dead buffalo grass plants were found in the 5 areas on which density counts were made in the summer of 1942. Scattered dead plants were noted on some of the lake beds but they would not amount to 1 per cent of the total plants, in any case. The density as recorded was almost entirely due to "old" buffalo grass plants, as 1942 seedlings accounted for only a small percentage of the plant cover. The seedlings were mostly confined to areas covered with washed-in silt. There were large numbers of seeds washed to the edges of lakes but most of them remained on the sod areas and were not covered sufficiently to become rooted.

Growth was resumed from the parent plants and from the numerous "sets" developed by the

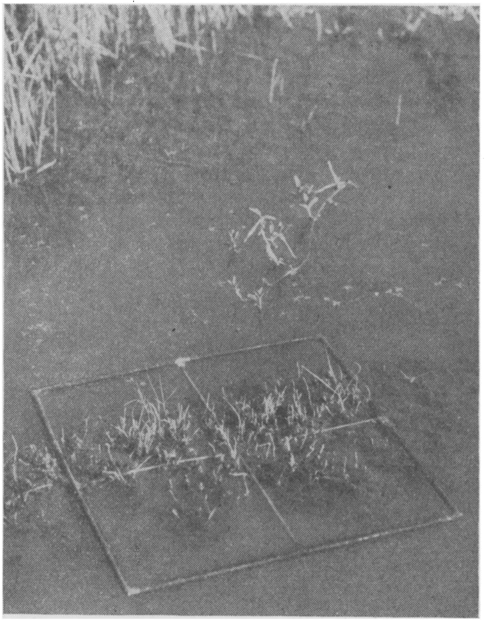

FIG. 1. Buffalo grass plants resuming growth following 10 months of submersion. Plants often start growth when water is ½–1 inch deep.

FIG. 2. A mat-like cover of buffalo grass on September 6, 1942. This area stood under water approximately 9 months, after which the plants resumed growth.

runners or stolons, typical of buffalo grass. Often where the old plants were covered with silt, new growth appeared through the soil cracks typical of such areas when drying out, giving the appearance of seedlings. Examination showed this growth to be from old plants.

Survival of buffalo grass after 6 to 19 months' submersion appears to be unusual in this area. One possible explanation for its survival lies in the season of submersion. Also, the plants were in a very vigorous condition following a favorable growing season. The lakes filled in the last 10 days of October and the first killing frost was recorded on October 30. The plants were green at the time of submersion but just at the stage when they would normally become dormant in this area as the average frost date is November 1. There were no unusual temperature variations from the long-time average during the time of submersion. However, the winter of 1941–42 was considered a very open, mild winter. Buffalo grass usually fails to survive if covered by water for a period of 2–8 weeks during the summer growing season, according to long-time residents of the area. It is well known that buffalo grass established in lake beds has repeatedly died out during past high rainfall cycles, which have left these areas without vegetative cover and subject to wind erosion damage. There have been two intervals during the 3-year study period when buffalo grass was submerged during the summer growing season. The plants were green and vigorous in both instances. One interval was for approximately 30 days in June and July, 1941, and the other, 36 days in July and August, 1943. There was no loss of plants in either instance.

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