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METHODS OF REESTABLISHING BUFFALO GRASS ON CULTIVATED LAND IN THE GREAT PLAINS

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INTRODUCTION

The value of native buffalo grass for lawns, pastures, athletic fields, golf courses, and general landscaping purposes has long been recognized and largely substantiated by practical and scientific experience. For these purposes no other domestic or imported grass has been found fully adapted to the climatic conditions of the Great Plains area.

Comprehensive resodding experiments with buffalo grass were started at the Fort Hays (Kans.) Branch Station [2] in 1929. Since 1910 lawns have been successfully established by methods similar to those here described. These investigations have not been carried on long enough to warrant the formulation of definite conclusions regarding all of the details involved. However, a progress report of the results obtained to date is considered worth while, in view of the widespread demand for information on the subject of renewing native grasses on

[1] The writer wishes to acknowledge the valuable assistance of H. N. Vinall, Division of Forage Crops and Diseases, and A. L. Hallsted, Division of Dry Land Agriculture, in outlining the experiments reported herein, and of L. C. Aicher, superintendent, Fort Hays (Kans.) Branch Experiment Station, in providing facilities for conducting these investigations.

[2] These experiments were conducted cooperatively by the Kansas Agricultural Experiment Station and the Division of Forage Crops and Diseases, Bureau of Plant Industry, at the Fort Hays Branch Station, Hays, Kans.

land found to be unprofitable or unsatisfactory for the production of cultivated crops.

Most of the native grassland in this region, of which that in buffalo grass constitutes an important part, was placed under cultivation within the last half century (fig. 1). The sloping nature of thousands of acres of this land soon rendered unprofitable the production of cultivated crops. Recognizing the mistake made in plowing under so much of the native grass, many acres were left out of cultivation, hoping that the grass would become reestablished of its own accord.

The time required for buffalo grass to renew its original virgin condition on abandoned farm land was stated by Shantz [3] to range from 20 to 50 years. This is fully substantiated by recent observations of abandoned fields in western Kansas. In very few instances and only under the most favorable conditions has a good turf of buffalo grass been reestablished naturally in less than 20 years. Long after

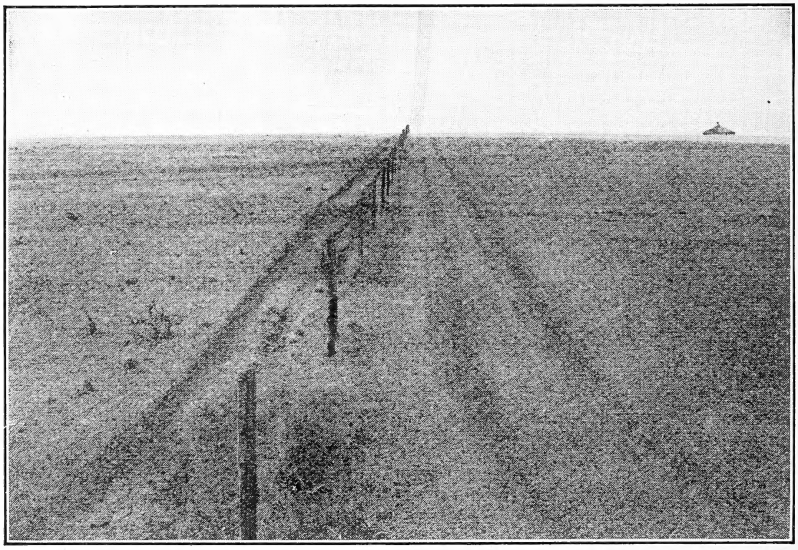

FIGURE 1.—Typical buffalo-grass prairie which has never been plowed. On left of fence is a closely grazed pasture; on the right a golf course where the grass has been clipped frequently.

land is taken out of cultivation the resultant vegetation is largely composed of less desirable annuals and taller grasses, indicating even to the casual observer that the area had once been cultivated (fig. 2).

DESCRIPTION OF BUFFALO GRASS

BOTANICAL CHARACTERISTICS

Buffalo grass (*Buchloë dactyloides* (Nutt.) Engelm.) is a long-lived perennial stoloniferous grass, generally dioecious but occasionally monoecious, with flat, light-green leaves and flaglike inflorescence (fig. 3). The writer has observed and collected many scattered plants showing definite monoecious characters. The staminate-flowered stems grow to a height of 3 to 6 inches, ascending slightly

[3] SHANTZ, H. L. NATURAL VEGETATION AS AN INDICATOR OF THE CAPABILITIES OF LAND FOR CROP PRODUCTION IN THE GREAT PLAINS AREA. U.S.Dept. Agr., Bur. Plant Indus. Bull. 201, 100 pp., illus. 1911.

above the leaves, with spikes well exserted and containing two clusters of spikelets on one side of the rachis. The staminate inflorescence resembles that of blue grama, but the flaglike clusters of spikelets on the side of the rachis are shorter. The seed-bearing stems are ex-

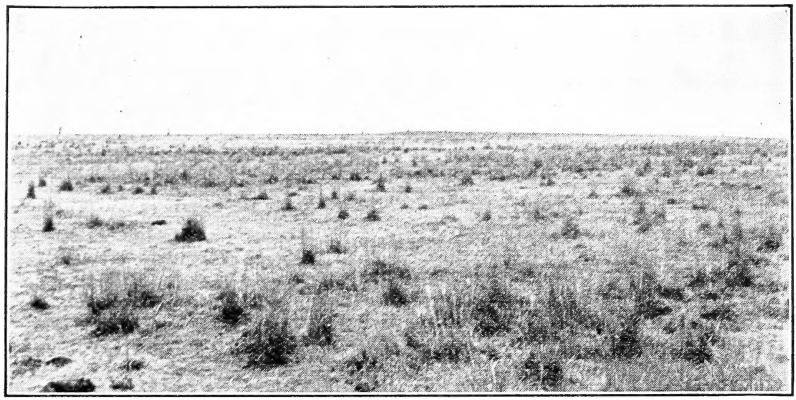

FIGURE 2.—Field on the ranch of William Philip, near Hays, Kans., after being uncultivated for 30 years, showing scarcity of buffalo grass and prevalence of taller grasses and weeds. This field is surrounded by thick stands of native buffalo grass.

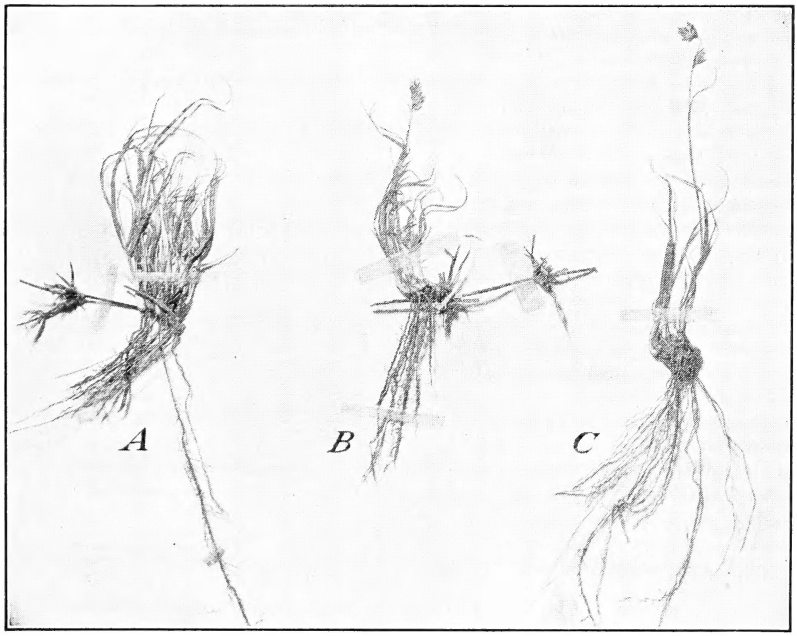

FIGURE 3.—Different types of buffalo-grass plants: *A*, Pistillate; *B*, monoecious plant; *C*, staminate.

ceedingly short, mostly one-half to 1 inch long, usually hidden by the leaves and carrying ovoid spikelets with indurated outer scales. The leaves are erect, one-twelfth of an inch or less wide, and generally 3 to 4 inches long.

Improved strains of buffalo grass that are decidedly more rapid in spread than the average plants have been selected and isolated at this station. Repeated transplanting of this material in comparison with the average sod has proved that the difference in spread is due to inherent characters rather than to chance environmental conditions. Numerous comparisons of staminate and pistillate plants showed no consistent relation between the sex and spreading ability. Certain plants have appeared to be more abundant seed producers than others, indicating the possibility of selecting abundant seed-producing strains.

SPREADING HABIT

The grass spreads almost entirely by surface runners, or stolons, which are equally abundant and vigorous on the staminate or so-called "male" and pistillate or so-called "female" plants. When the end of one of the stolons is raised it appears to have a springlike tension, tending to return to the surface of the ground with more force than that of its weight alone. This interesting characteristic of the stolon structure promotes rooting of the stolons.

SEASONAL DEVELOPMENT

In the latitude of Hays, Kans., buffalo grass becomes dormant shortly before the first killing frost in the fall, remains in that condition all winter, and renews growth late in the spring, seldom before the early part of May. Its maximum growth usually occurs in May and June. During the summer there are usually one or more periods when heat and drought cause a practical cessation of growth. The grass greens up rapidly after a rain following one of these periods and will remain green all summer if rains are timely and well distributed. The leaves lie rather flat on the ground and tend to curl up at the ends as the plants become dormant. The attractive gray-green leaves assume a light-brown color in the fall.

The flowers usually occur in greatest abundance in June, but continue to appear later in the season if conditions are favorable. The seeds begin to mature in July and many remain attached to the plants until dislodged by torrential rains, killed by freezing weather, or eaten by livestock.

ADAPTATION

DISTRIBUTION

Buffalo grass is adapted to a rather wide range of soil and climatic conditions in the Great Plains area, its natural habitat.[4] The grass derives its name from the fact that it represented one of the chief constituents of the native flora upon which vast herds of buffalo grazed in the early days. It seldom occurs in pure stands, even in the central Great Plains where it is best adapted, but usually is associated with other grasses, chiefly blue grama (*Bouteloua gracilis* Lag.). The latter, also one of the so-called "short grasses", is often erroneously referred to as buffalo grass, but is taller, spreads less readily, and does not lend itself so well to vegetative methods of propagation. Blue grama has narrower and more erect leaves and no stolons.

[4] The writer is particularly under obligation to the following men for supplying information as to the distribution of buffalo grass: A. E. Aldous, A. S. Hitchcock, H. L. Shantz, J. T. Sarvis, Herbert C. Hanson, B. F. Kiltz, E. F. Chilcott, V. L. Cory, Alvin Kezer, Matthew Fowlds, O. R. Mathews, J. C. Stephens, L. L. Zook, J. F. Brandon, Owen Nelson, C. P. Wilson, H. E. Morris, A. E. Seamans, Leroy Moomaw, R. S. Towle, A. L. Nelson, Lyle F. Watt, and A. L. Frolik.

Buffalo grass occurs in varying abundance on the nonsandy soils from the central part of western North Dakota and southeastern Montana southward to Texas and New Mexico. Its distribution includes the western two-thirds of South Dakota, a small part of eastern Wyoming, western Nebraska outside of the sand hills and favored bottom lands, eastern Colorado and western Kansas, western Oklahoma and Texas, and eastern New Mexico. It is also found in the mesquite-grass (*Hilaria belangeri* Steud.) area of south-central Texas. Throughout this region of major distribution are many areas in which buffalo grass occurs sparingly or not at all (fig. 4). It is found in greatest abundance on the Plains west of the ninety-ninth degree of longitude in Kansas and east of the 5,000-foot contour line in Colorado.

Scattered areas of buffalo grass, varying in size from small patches to large meadows, occur east of the ninty-ninth meridian, but the principal grasses in this more humid section are the big and little bluestems, though these often give way to buffalo grass on the higher lands or when overgrazed. The ninty-seventh degree of longitude in Nebraska, Kansas, and Oklahoma represents the approximate eastern limit of major occurrence of the grass in overgrazed pastures. It is found east of this line, but usually in isolated colonies.

Buffalo grass is said to be important in Texas on the high plains, the rolling plains, the black-land prairies, Grand Prairie, and in much of the Edwards Plateau, but in this latter area curly mesquite is the dominant turf grass.

The outer limits of distribution of buffalo grass are indicated by reports of its occurrence near Forsyth, Miles City, and Wibaux, Mont.; Williston and Valley City, N.Dak.; Brookings, Huron, and Sioux Falls, S.Dak.; Lyon County, Iowa; Lincoln, Nebr.; Manhattan, Kans.; southeastern Oklahoma; Shreveport and St. Charles, La.; Carlsbad, Magdalena, and Grant, N.Mex.; in parts of Arizona, and above an elevation of 6,000 feet in Colorado. This grass comprises varying proportions of the native vegetation in an area embracing 538,000 square miles of the Great Plains.

Buffalo grass thrives with very little care or attention in the localities where it is most widely distributed. It also grows well and spreads rapidly in the marginal areas when protected from invasion.

CLIMATE

Buffalo grass is adapted to a rainfall range of 12 to 25 inches. It is able to endure the cold winters of the northern Plains except in the extreme north, the hot summers of the southern Plains, and the frequent excessive droughts and high winds characteristic of the entire area. Where the rainfall exceeds 20 inches the taller grasses encroach upon and tend to crowd out the buffalo grass. Dry years under such conditions favor the latter, while wet years witness an increase in the stand and growth of the tall grasses.

SOIL REQUIREMENTS

Buffalo grass is best adapted to the heavier types of well-drained upland soil in this region. It will not thrive on pure sand or on soils containing a high percentage of sand, but grows well on sandy loam soils which contain a fair percentage of clay. It is especially well

adapted to the class of soils regionally referred to as "hard lands", which produce heavy yields of wheat and other crops when the rainfall is sufficient. Buffalo grass also occurs on the heavy gumbo soils

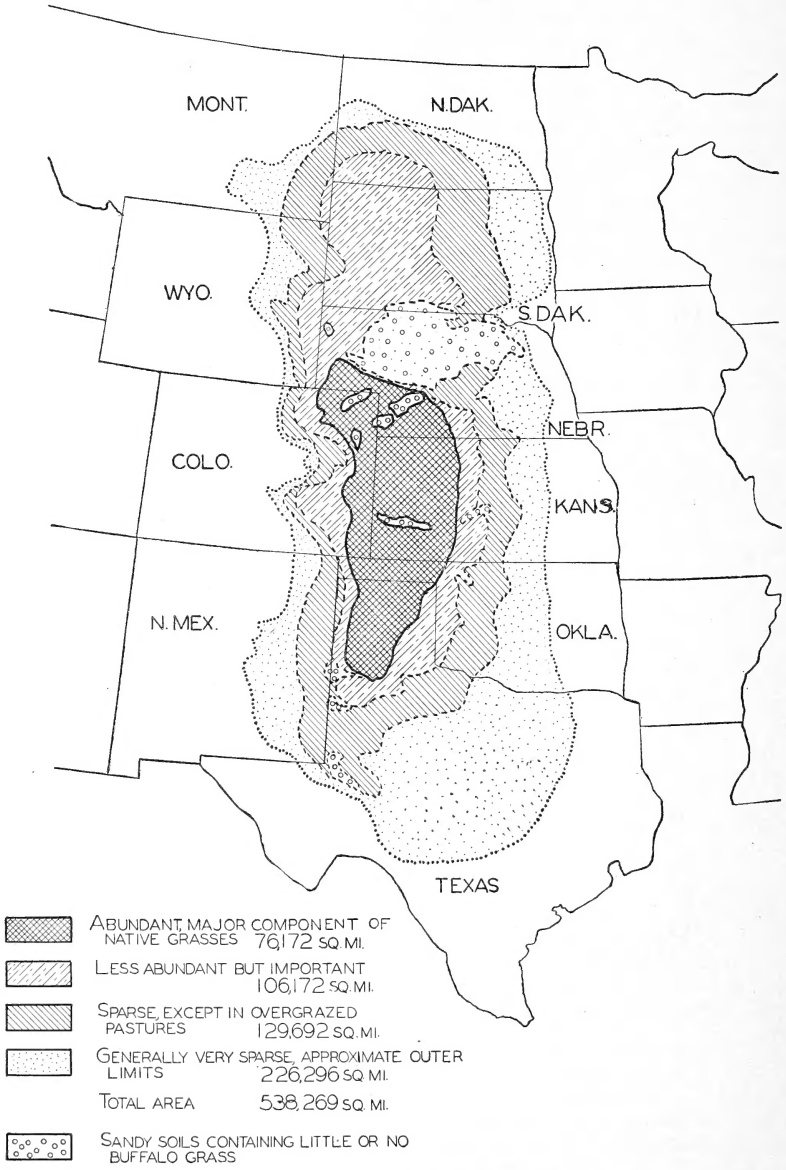

FIGURE 4.—Regional distribution of buffalo grass, showing the sections in which the grass occurs in varying degrees of abundance and the approximate area of each.

of Nebraska and the Dakotas but is rarely present on the sand hills of Nebraska and southwestern Kansas. It is seldom found growing on land in which the subsoil is wet periodically below a depth of 3

feet. The accumulation of moisture below this depth encourages the development of taller grasses.

OUTLINE OF EXPERIMENTS

The experiments conducted at Hays, Kans., for 5 years have included annual transplantings of buffalo-grass sods of various sizes spaced at different distances and broadcastings of small pieces of turf by hand and with a manure spreader. Some resodded areas were clipped and others left unclipped, to determine the effect of such treatments and of shade upon the spread of the grass. After setting out sods in a uniform manner on certain areas, parts of such areas were seeded with sweetclover and the crop allowed to maintain itself by continuous reseeding, to ascertain the effect of the clover upon the spread of the grass and the possibility of obtaining sweetclover pasture while the grass was becoming established.

The effect of light irrigations was determined by applying water to certain station lawns after transplanting with sods. The effect of periodic excesses of moisture was studied by setting out sods in the spillway ends of roadway drainage systems. This also provided an opportunity to study the function of buffalo grass in controlling erosion. Studies of a similar nature were conducted on terraced and unterraced eroded land.

The recently invented Davis erosion-control hole-digging machine was tried in preparing land for transplanting sods on certain areas. Other mechanical contrivances have been given some consideration in an effort to expedite and reduce the expense of resodding operations. Sods have been set out at different times during the year, to determine the optimum transplanting period. Measurements of the actual spread of the grass under different controlled conditions were made whenever possible.

ARTIFICIAL SEEDING

Buffalo grass cannot be reestablished with consistent success by artificial seedings. The seeds usually germinate poorly and are extremely difficult to collect because produced so near the ground.

Occasionally the seeds germinate satisfactorily under natural conditions. In moving a building during the winter of 1930–31 the excavated soil from the new building site was used to fill in and level the ground. It was planned to resod this area, but a volunteer stand of scattering buffalo-grass plants emerged and made artificial transplanting unnecessary. Inspection of these plants showed that they emerged from seed at a uniform depth of 1 inch. Parts of the seed were still adhering to the rootlets when examined. Apparently all the viable seed covered to a proper depth produced plants.

This original stand was rather thin at first, but it spread rapidly, and by the end of the 1933 season had covered practically all intervening spaces. After transplanting only a few sods in the blank spaces this lawn, composed of pure buffalo grass, presented a pleasing uniform appearance at the end of the third season (fig. 5).

The success of this volunteer seeding indicates the importance of continuing investigations in the development of strains bearing viable seed, also of satisfactory seeding and seed-harvesting methods.

TRANSPLANTING RUNNERS

Limited experiments indicate that buffalo grass may be propagated by setting out rooted or unrooted stolons in moist soil. The stolons will take root and grow in much the same manner as strawberry plants under especially favorable moisture conditions. This is a tedious method and will succeed only if the soil is kept moist for some time after the stolons are set out, which is not practical on an extensive scale.

SOLID SPACING OF SODS

Covering an entire area with sods at once is practical only for very small areas or where the chief consideration is immediate results without regard to the costs involved. This is accomplished by leveling or smoothly grading the land, laying the sods on the surface

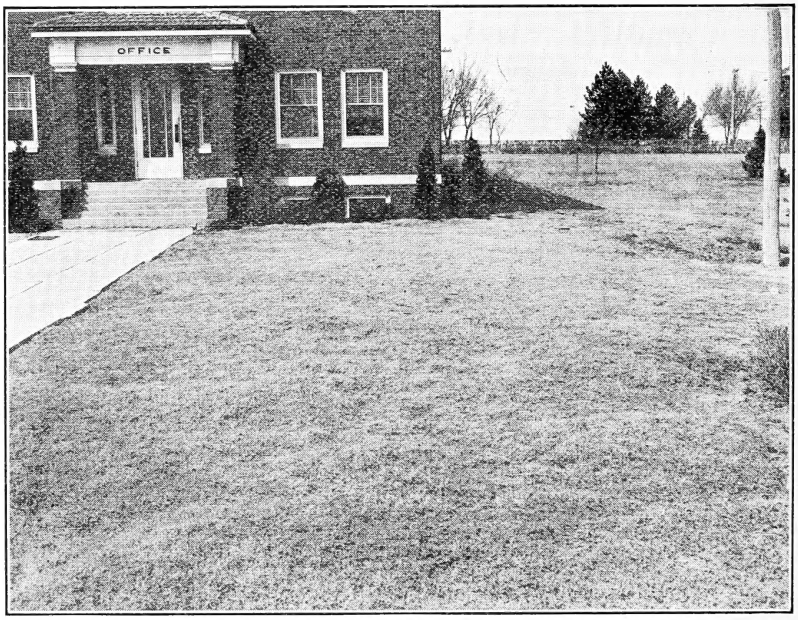

FIGURE 5.—A lawn of pure buffalo grass on the Hays Station photographed in 1933, the third year after being started by natural reseeding in excavated soil containing a large amount of native sod.

of the ground, and snugly fitting them together. Sods used for this purpose should be cut smoothly to a uniform depth of 2 to 4 inches. Although strips of buffalo grass may be successfully cut to a depth of an inch or less, it has been impossible at Hays to roll up and move such strips like a carpet, as is done with other turf grasses in the Eastern States. Unsuccessful attempts have been made at different times to roll up thin strips of buffalo grass under varying moisture conditions. Even when the heavy clay-loam soil at this station was thoroughly wet, the sods could not be rolled up without breaking into numerous pieces and severely injuring the roots. There may be soils in the buffalo-grass region where this could be accomplished, and, if so, the task of sodding would be simplified.

TRANSPLANTING PIECES OF SOD

Lyon and Hitchcock [5] were the first to suggest propagating buffalo grass by cutting the sods into small pieces and pressing them into prepared soil. It was claimed that if these pieces were spaced 2 feet apart each way they would "thicken up fairly well in one season."

J. T. Sarvis transplanted buffalo-grass sod on the experiment stations at Highmore, S.Dak., in 1906; Ardmore, S.Dak., in 1913; and Mandan, N.Dak., in 1918.

Some sodding of lawns at the Fort Hays Branch Station was done prior to 1910, but no satisfactory record of this work is available. In 1912 two cultivated lawns were set to pieces of buffalo-grass sod spaced several feet apart in shallow furrows. Figure 6 shows one of these lawns as it appeared in 1933, 21 years after it was established.

FIGURE 6.—A buffalo-grass lawn set out with sods in 1912, as it appeared in 1933.

These lawns, under trying conditions and dependent only on the natural rainfall for soil moisture, have continued highly satisfactory for many years.

The object of the experiments herein described was to develop effective and economical methods of reestablishing buffalo grass on lawns and cultivated fields. The following discussion of results will indicate the procedure found most satisfactory at the Fort Hays Branch Station.

SOURCE OF SODS

The sods should be obtained from a virgin stand of nearly pure buffalo grass. It is possible to find such areas in most localities

[5] LYON, T. L., and HITCHCOCK, A. S. PASTURE, MEADOW, AND FORAGE CROPS IN NEBRASKA. U.S. Dept. Agr., Bur. Plant Indus. Bull. 59, 64 pp., illus. 1904.

throughout the central Great Plains. Most of these areas contain a small mixture of grama grass, which is not very objectionable. Under natural conditions buffalo grass occurs in mixtures of about equal numbers of staminate and pistillate plants with occasional patches consisting of pure stands of one sex. The exclusive use of pistillate plants for lawn purposes is preferable. A lawn composed of such plants with leaves wholly covering the stems is much more attractive than a lawn containing staminate plants. While the brown spikelets of the latter are not wholly unattractive, they rise above the leaves and detract from the green appearance of the lawn.

CUTTING THE SODS

The best procedure in cutting sod is to use a sod cutter which disturbs the roots less than a plow and makes a smooth clean cut which facilitates the handling and transplanting operations. A satisfactory sod cutter may be constructed with comparative ease and at little expense by bolting a sharpened U-shaped flat steel blade on sled runners or frames similar to those on a walking plow. A series of holes bored in the vertical ends of the blade to which sliders are attached allows for adjusting the depth of the cut. The blade should be shaped so as to cut a strip of sod about 12 inches wide. When the soil is well moistened by heavy rains one team of horses can pull a 12-inch sod cutter with ease. Where it is desired to cut the sods in strips narrower than 12 inches, rolling colters or vertical knives similar to the fins on a crowning plow may be fastened to the U-shaped blade, so that 2 or 3 strips, 4 to 6 inches wide, may be cut with one operation. These strips usually are cut with a sharp spade into the final size desired before loading for transporting. Figure 7 shows a satisfactory hand-made sod cutter that cuts two strips 6 inches wide at one operation.

Cutting the sods in strips alternating with uncut areas allows the buffalo grass to spread and rapidly heal the scars of furrows left by the cutter. At Hays the vacant strips left in the sod in the spring of the year usually are re-covered with grass by the end of the first season. If it is desired to maintain the original smooth surface, the furrows may be filled with fresh soil, taking care to leave no heavy deposit of soil on the adjoining uncut areas. A few years after this is done, it is impossible to see where the sods had been removed. If the sod is obtained from sloping land, it is important to cut the strips on the contour to control erosion. Observance of these precautions will encourage the owners of buffalo-grass grazing land to provide sods to those who otherwise would be unable to resod their cultivated land.

RATE OF TRANSPLANTING

The amount of sod required to transplant an acre depends upon the manner in which the work is done. An acre of cultivated land when transplanted with 4-inch cubes spaced 3 feet apart requires about 2 square rods of original sod or a strip 12 inches wide and 538 feet long. Four and one-half times that amount, or about 9 square rods, are required when the cubes are spaced 2 feet apart and 9 times that amount, or 18 square rods, when the sods are spaced 1 foot apart. Double broadcasting with a common manure spreader requires the

use of sod material equivalent to the amount needed to space 12-inch squares of sod 3 feet apart. By this method one-ninth of an acre of cut sod will cover an acre of cultivated land.

OPTIMUM TRANSPLANTING SEASON

Buffalo grass has been successfully transplanted at Hays every month from March to August, inclusive. The moisture content of the sods at transplanting time and the rainfall conditions afterwards determine the rapidity of spread to a greater extent than the month in which the work is done. The slight differences noted for the dates of transplanting indicate that the best time is in early spring after growth has started and following a heavy rain.

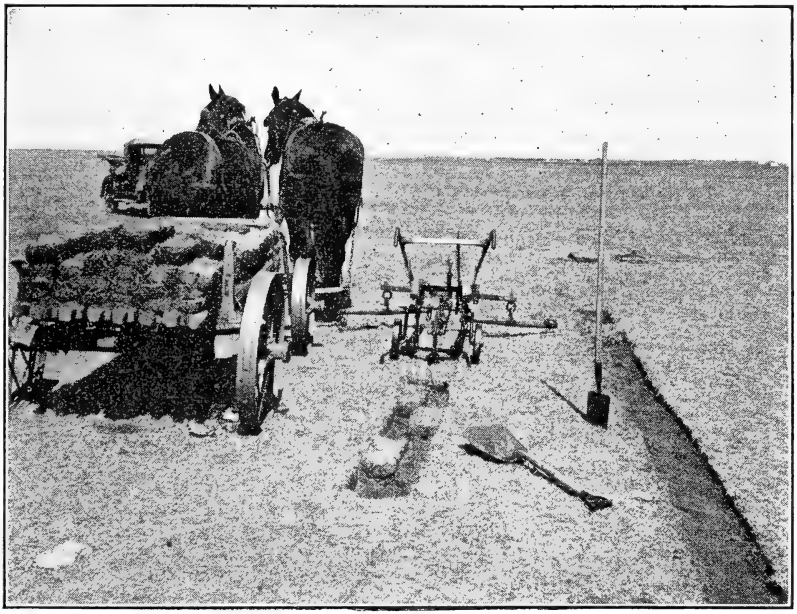

FIGURE 7.—A hand-made sod cutter used at the Hays Station in cutting two strips of sod 6 inches wide at one operation.

The work at Hays usually was conducted when the sods were fairly moist, although some very dry sods have been moved. Dry sods are more inclined to crumble and break in handling, and the drier sods require a longer time for recovery and renewal of growth. In certain instances sods were dug, stacked in the open, allowed to become completely dry, and then carefully transplanted in comparison with freshly dug sods. A thorough soaking of some of the dry sods forced them to start growth as rapidly as the freshly transplanted but nonirrigated sods. Most of the dry nonirrigated sods recovered from the enforced period of dormancy following rain, but they spread much slower at first than those which were transplanted without drying. No attempt has been made to move the sods in midwinter, but doubtless this may be done with fair success if the sods are well saturated with moisture and the ground is not frozen.

DIFFERENT SIZES OF SODS

Twelve sizes, ranging from 2 to 17 inches square and from 2 to 4 inches deep, have been compared in annual transplantings since 1929. A 4-inch cube was the most efficient in spread and the most convenient to handle, except for large-scale transplanting where a 2-inch depth was preferred. Sods larger in surface area than 4 inches square spread faster but not so rapidly in proportion to their original area. The large pieces may be used to advantage if it is found convenient to do so and the source of supply is plentiful. Smaller sods, particularly the 2-inch squares 4 inches deep, spread much more slowly than the 4-inch cubes.

For sods ranging from 2 to 6 inches square, those cut 4 inches deep spread considerably faster than those cut shallower. When larger sods were used the thin sods spread almost as fast as the thick ones.

WIDTH OF SPACING

Experiments in spacing transplanted buffalo-grass sods were started in 1929 and repeated each year thereafter. The results indicate that 4-inch cubes or 6-inch squares 4 inches deep, spaced 1 foot apart in rows 1 foot apart, will spread to cover the intervening spaces in 1 year under local dry-land conditions. Similar sods spaced 3 feet apart required less than 3 years to make a complete cover of grass (figs. 8 and 9). At the end of 5 seasons the sods spaced 6 feet apart had spread to cover practically all of the intervening spaces. Transplanting the sod in solid rows 6 inches wide and 3 feet apart spread much faster but less efficiently, considering the amount of sod used, than individual sods spaced 3 feet apart. The alternate or off-set method of spacing the sods in rows resulted in more efficient spread and faster coverage of the intervening spaces than regular checked spacing.

PRECAUTIONS IN TRANSPLANTING

While buffalo grass may be transplanted with reasonable assurance of becoming established and spreading rapidly, considerable care is necessary when a smooth turf is desired. To accomplish this, the land should be leveled and graded a sufficient time before transplanting, to permit the soil to settle. Embedding the sods level with the surface of the ground either in holes dug by hand or in carefully plowed furrows is important if it is desired to use the area for landscape purposes. If the sods are set too deep, loose soil washes over them and retards the spread of the grass. If the sods are not set deep enough, the soil may erode from around them, leaving the surface unlevel. High winds also contribute to a roughened condition by blowing soil particles from around the sods and depositing dust in the patches of grass. While care in transplanting is helpful in obtaining a final smooth surface, treatment after transplanting may serve to correct a rough surface condition caused by careless transplanting or wind and water erosion.

RESODDING LARGE AREAS

Recognizing that transplanting has been consistently more successful than broadcasting, efforts have been made to devise practical methods by which transplanting may be accomplished at a low acre cost. For extensive areas intended for pasture purposes a smooth

final surface is not so important and costly care in transplanting is therefore not necessary. In fact, less moisture will be lost by run-off

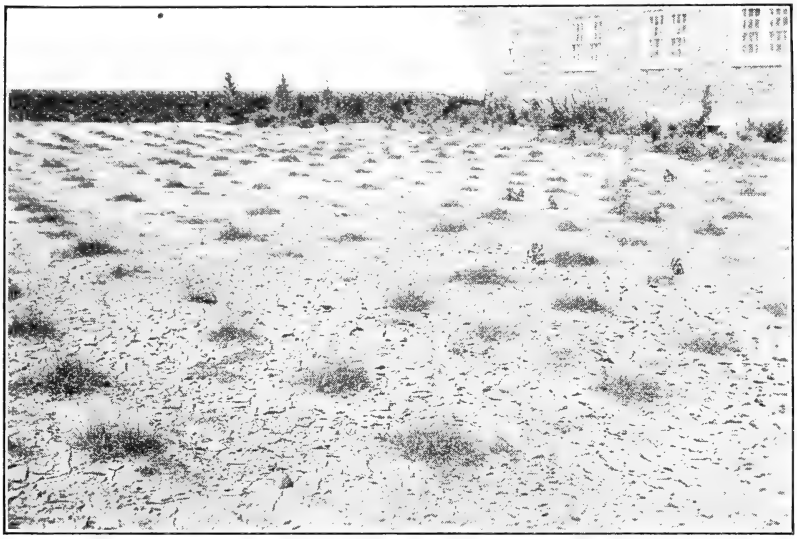

FIGURE 8.—Four-inch cubes of buffalo grass transplanted 3 feet apart, July 21, 1932. Photographed September 15, 1932.

FIGURE 9.—Four-inch cubes of buffalo grass transplanted 3 feet apart, background July 21, 1932, as shown in above illustration; foreground May 10, 1933. Photographed in December 1933.

on pastures having a surface somewhat rough than on those having the finished smoothness of a lawn.

Pieces of sod varying from 2 to 17 inches square and cut to a depth of 1 or 2 inches have been successfully transplanted by merely dropping them on freshly and deeply cultivated land and pressing them level with the surface of the ground with a heavily weighted surface packer. This eliminates the tedious labor involved in digging holes or plowing furrows and setting the sods by hand.

This time-saving method of transplanting, which has been rather well tested and found to be both practical and successful, may be practiced in several ways. One is to cut the sods at a depth of 1 to 2 inches, using a 12-inch sod cutter equipped with rolling colters so as to cut two or three strips 4 to 6 inches wide at one operation. The strips then may be cut rapidly with a sharp spade into sods of convenient lengths of 4 to 12 inches and set in a field that has been prepared by disking or one-waying to a depth of 4 inches.

A 3-man crew can unload the sods in a comparatively short time—1 man to drive the truck or wagon and 2 men to unload the sods. If the sods are thrown to the ground they must be handled with reasonable care, to prevent them from landing grass side down. To eliminate this possibility and save time the sods may be unloaded in sheet-iron chutes fastened to the wagon and dragging on the ground far enough in the rear to prevent the sods from overturning as they slide off the incline. In this manner they are rapidly transferred from the wagon to the surface of the cultivated land into which they are pressed by a heavily weighted packer. If there is difficulty in packing the sods level with the surface, shovel attachments may be fastened to the bottom of the sheet-iron chutes, to provide furrows for the sods.

Unloading also may be facilitated by using a manure spreader with the reel removed and platforms fastened to the sides of the rear end on which the men stand who are unloading. The driver can then operate the apron-moving lever so as to keep a supply of sods constantly available for unloading.

By following a practical resodding method of this sort a farmer can reestablish buffalo-grass pastures on a considerable acreage during his spare time and at a nominal cost. Such work should be started on the higher elevations, so that if it is not completed at once seed washing down from the higher land will assist in resodding the lower areas.

Other means of facilitating the transplanting of large pieces of sods have been tried with varying degrees of success. Tossing the sods in shallow-plowed furrows and harrowing and packing the land afterwards often covers many of the sods beyond recovery or to an extent that retards growth.

The Davis erosion-control hole-digging machine has been used to prepare the land for sodding. This machine makes 10,000 holes per acre, or one every 4 square feet. It is possible to vary the depth of the holes from 1 to 6 inches. After placing a sod in each hole the area is either harrowed or raked by hand. The harrowing buries many of the sods and retards the growth of others but leaves a sufficient number to indicate some merit to the practice. Because of the rough nature of land handled in this manner it is impossible to pack the soil firmly around each sod. Using a hand rake instead of a harrow results in renewal of growth by all sods, but adds materially to the cost.

BROADCASTING SMALL PIECES OF TURF

Broadcasting on recently cultivated land and packing afterwards has been shown by results at this station to be a practical method of reestablishing buffalo grass only with favorable rainfall.

Resodding by various broadcasting methods has been tried since 1929 (fig. 10). In the first trial the sods were cut with a sod cutter in shallow strips about 2 inches deep, chopped into small pieces with a spade, and broadcast by hand. Each piece represented a surface area of approximately 1 square inch. Certain plots were double-disked before broadcasting and others afterwards, all being firmly packed with a corrugated surface packer or roller as the final operation. When well-distributed rains followed, most of the sods renewed growth in excellent condition, with the difference in plots decidedly in favor of disking before broadcasting. About 1 acre of sod was used

FIGURE 10.—Buffalo grass in 1933 on an area broadcast by hand with small pieces of sod in 1929.

to 9 acres of land, and the ultimate spread was the same as that for 4-inch cubes spaced 3 feet apart. The final surface of the grass was smoother on the broadcast than on the transplanted plots.

In 1930 a manure spreader was successfully used in broadcasting the sods. At first they were cut into small pieces, as for broadcasting by hand, loaded on the manure spreader, and scattered. This distributed the sods rather evenly over the freshly cultivated ground, but shook most of the soil off the roots, causing the grass to dry out rapidly. To overcome this difficulty and to eliminate the task of chopping the sods into small pieces, shallow strips as large as could be handled conveniently with a shovel were loaded onto the spreader. The spreader reel broke the sods into small pieces without shaking so much soil off the roots and scattered them rather evenly over the

ground. The manure spreader in full gear was driven over the ground twice, leaving an even covering of small sods on the cultivated soil and the land was firmly packed immediately.

Favorable rains followed immediately and most of the grass renewed growth satisfactorily. The spread was just as fast as that for 4-inch cubes transplanted 3 feet apart, and the final surface was more smooth than that for sods set out by hand.

Successful reestablishment of the grass also resulted from similar methods followed in 1931. However, broadcasting in 1932 and 1933 was followed by dry windy weather which none of the grass survived, indicating that broadcasting is not a safe practice under all conditions.

TREATMENT AFTER TRANSPLANTING OR BROADCASTING

PACKING THE LAND

After the sods are set out or broadcast, the use of a heavily weighted surface packer, preferably a smooth roller, is essential in securing a rapid start of the grass and assuring a smooth surface.

IRRIGATION

It is seldom necessary but may be helpful to apply water sparingly and judiciously. Most of the resodding at this station has been on dry upland soils without the aid of irrigation. Water has been applied to a sufficient number of areas to determine the effects of irrigation. Too much water is decidedly detrimental, as it encourages the competitive development of weeds and less desirable grasses. Where water is available, a few light and timely irrigations will be helpful in starting the grass, hastening the spread and maintaining the green appearance during periods of drought, but it is rarely necessary to keep the grass alive. When set out on low, poorly drained areas the grass soon succumbs to an excess of water and is replaced by the less desirable taller grasses.

CULTIVATION HARMFUL

Buffalo grass spreads almost entirely by surface runners, which should not be disturbed by hoeing or cultivating. The stubble growth of weeds and other grasses should be allowed to occupy the spaces between sods, to control erosion and to permit dust-laden winds to leave an even coating of wind-deposited soil over the entire surface. Erosion of cultivated land around the sods and dust collected and held in the leaves of grass cause the final surface to be rough and unsatisfactory for landscape purposes.

CLIPPING OR PASTURING

At intervals throughout the season clipping or grazing should be practiced, to control other growth and to admit sunlight to the grass. This will not wholly destroy but will reduce competing growth and leave a stubble over the land sufficient to minimize the roughening effects of erosion by wind or water. A mowing machine or a high-cutting lawn mower, cutting at a height of 2 inches, will clip the taller grasses without injuring the prostrate buffalo grass. Repeated clipping with an ordinary lawn mower has actually increased the basal

cover of buffalo grass, but such treatment had an injurious effect on the blue grama.

In 1929 certain plots transplanted with 4-inch cubes of buffalo grass spaced 12 feet apart were kept clipped throughout the season with a mowing machine for comparison with similar plots not clipped or pastured. The unclipped areas soon became covered with a rank growth of weeds and taller grasses. The clipped grass spread three times as far as the unclipped in the same length of time.

SWEETCLOVER AS A COMPANION CROP

When properly grazed, sweetclover may be grown continuously on areas being resodded with buffalo grass, thereby increasing the total pasturage without seriously interfering with the spread of the grass. The sweetclover will not properly reseed itself when severely overgrazed and will retard the spread of the grass by shading if allowed to make a rank growth. Continuous stands of sweetclover have been maintained by natural reseeding on land transplanted with 6-inch squares of sod spaced 12 feet apart in 1929 and 1930. The stands have been perpetuated for 5 years in the first instance and 4 years in the second and are still vigorous at the present time (1934).

One of these areas, seeded to sweetclover in 1929, was pastured moderately throughout the 5-year period. The total spread of the buffalo grass was about one-half that of similar transplanting containing no sweetclover. Other sweetclover areas seeded in 1929 and 1930 were harvested for hay until 1933, when they were grazed intensively. The growth of sweetclover was exceedingly heavy during the first 4 years, which severely retarded the spread of the grass. The latter remained alive, but failed to spread very fast so long as the sweetclover was providing a dense shade and competing heavily for moisture, but when the sweetclover was short and after it was harvested the grass grew satisfactorily. The total spread on the areas containing sweetclover harvested for hay was about one-third of that on similar areas containing no sweetclover. On the areas that were closely grazed in 1933 the buffalo grass appeared to recover from the previous effects of shade and sent out runners as fast as those on the nonsweetclover areas.

GRADING AND TOP DRESSING

The uneven surfaces caused by wind and water erosion or careless transplanting may be leveled by grading and top dressing after the grass has become fully established on lawns, golf courses, or football fields where a smooth surface is desired. The high spots may be scraped off with a sharp road grader and depressions eliminated by periodic applications of a fine layer of soil, being careful not to cover the leaves entirely. While these precautions are helpful in improving the landscape value of buffalo grass, they are not necessary and may be detrimental where it is desired to use the grass for pasture. In the latter case a rough surface may assist in controlling run-off and conserving moisture.

UTILIZATION

Buffalo grass probably has served more useful purposes than any other domestic grass in North America. The sod was used as building

material by the early settlers in the Plains area. Many of these old sod houses dot the landscape in western Kansas, and a few of them are still used as residences.

Virgin stands of this grass have been successfully used for many years for lawns, golf courses, athletic fields, college campuses, and, more recently, for airplane landing fields, erosion control, and roadside improvement. Too many acres of the native prairie were plowed up and placed under cultivation before the value of buffalo grass was fully appreciated.

LAWNS OF BUFFALO GRASS

The lawns of buffalo grass have many distinct advantages in the Great Plains area. Buffalo grass is especially adapted to dry-land conditions, being the only satisfactory lawn grass able to survive extended periods of drought with no irrigation. It requires much less care and attention than other common lawn grasses and therefore makes an ideal farm lawn. Kentucky bluegrass when carefully handled and repeatedly irrigated often fails to survive the dry atmosphere and hot summers of the central and southern Plains, and Bermuda grass is not winter-hardy in the central and northern Plains. V. L. Cory [6] reports that "buffalo grass makes a much better lawn than curly mesquite grass in Texas."

Although buffalo grass may be successfully established and maintained in the Great Plains without the aid of irrigation, where possible it will be found helpful to irrigate immediately after the lawn is set out and during periods of excessive drought thereafter. By judicious applications of irrigation water a buffalo-grass lawn may be kept attractive from the first part of May until killing frost occurs in the fall.

PASTURES

Buffalo grass is a rather low producer, but it is highly nutritious and an exceedingly palatable pasture grass. Its ability to persist where most grasses fail, to withstand severe tramping and heavy grazing, and to recover promptly from the effects of drought contribute to its value as a pasture crop. When moderately grazed during the summer it cures naturally on the ground and provides excellent winter pasturage.

EROSION PREVENTION

Buffalo grass may be used to advantage in controlling run-off and erosion on terraced and unterraced slopes. It takes root and spreads almost as fast on severely eroded land as it does on fertile soil (fig. 11).

According to actual measurements made at this station by the Bureau of Chemistry and Soils, United States Department of Agriculture, the run-off loss from land having a slope of 5 percent amounted to 0.04 percent of the annual rainfall on unclipped buffalo grass, 0.59 percent on close-clipped buffalo grass, 15.06 percent on fallow land, 16.11 percent on kafir land, and 8.84 percent on wheatland as averages of the 4-year period, 1930–33. The average quantities of soil lost by erosion during this period were practically negligible on the buffalo grass, but were 13.64 tons per acre on the fallow land, 13.21 tons on the kafir land, and 2.08 tons on the wheatland.[7]

[6] Range botanist, Texas Range Experiment Station, Sonora, Tex.

[7] These data were furnished by F. G. Ackerman, of the Bureau of Chemistry and Soils, U.S. Department of Agriculture.

ROADSIDE IMPROVEMENT

Buffalo grass may be used effectively along highways for protecting and beautifying the embankments and other well-drained areas between the roadbed and the fence. It will not grow satisfactorily in the bottom of the barrow pit but will thrive on the sides if not disturbed by repeated grading. The sides of the barrow pits should be prepared for transplanting by grading at an angle of 45 degrees or less to reduce erosion while the grass is becoming established.

SUMMARY

Native buffalo grass is the only grass adapted to the Great Plains area that may be successfully used for pastures, athletic fields, golf courses, lawns, and general landscaping purposes. It occurs in varying degrees of abundance from southeastern Montana and south-western North Dakota to south-central Texas and from the foothills of the Rocky Mountains to the ninety-seventh degree of longitude on the Great Plains.

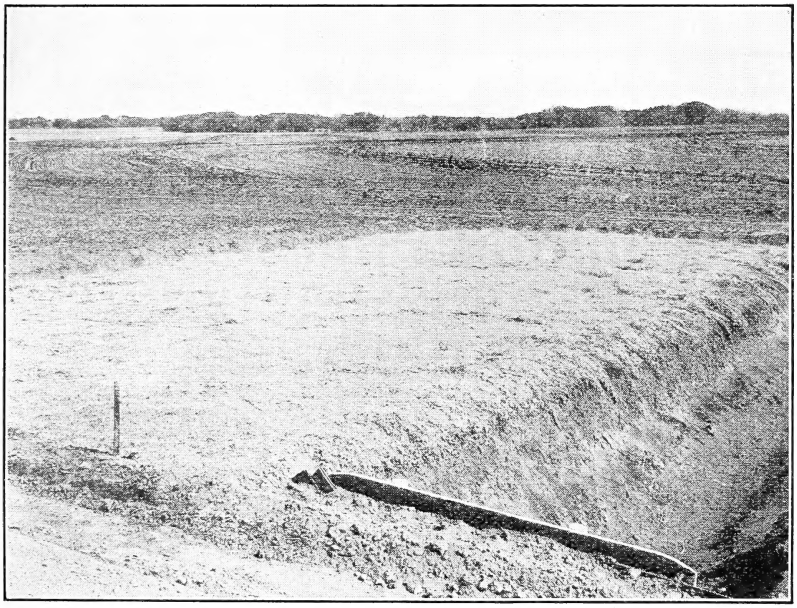

FIGURE 11.—Four-inch cubes of buffalo-grass sod set 3 feet apart on badly eroded land, July 1932. Photographed in December 1933.

From 20 to 50 years are required for buffalo grass to become reestablished naturally on abandoned farm land. It is not practical to establish it by seeding, because seed is difficult and expensive to collect and of low yield and germination.

Buffalo grass may be propagated by setting out the runners or stolons in moist soil, but this method is not successful on strictly dry land. The most practical method where watering is not possible is to set small pieces of sod in well-prepared soil at intervals of 3 to 4 feet. Solid spacing of sods is practical only for very small areas, such as lawns, where the chief consideration is immediate results.

An acre of cultivated land when set out with 4-inch cubes spaced 3 feet apart requires about 2 square rods of sod or a strip 12 inches wide and 538 feet long.

Buffalo grass has been successfully transplanted every month from March to August, inclusive, but the best time appears to be in early spring after growth has started and following a heavy rain. A 4-inch cube is the most convenient size to handle and the most efficient in spread.

Four-inch cubes of sod when spaced 1 foot apart covered all intervening spaces the first season, when spaced 2 feet apart the second season, and when spaced 3 feet apart before the end of the third season. Similar sods spaced 6 feet apart made a total cover at the end of the fifth season.

Extreme care is necessary in grading the land in advance and setting the sods level with the surface of the ground if it is desired to have the final surface smooth and even for landscape purposes.

An effective way of planting large areas is to slide pieces of sod in sheet-iron chutes from wagons to the surface of deeply cultivated land and press them into the ground with a heavily weighted surface packer. Packing the land after the sods are set is essential to success.

Buffalo grass spreads largely by surface runners which should not be disturbed by hoeing or cultivating. Cultivation also encourages erosion.

Clipping at a height of 2 inches or moderate pasturing at intervals throughout the season to control other growth and admit sunlight is beneficial to the spread of buffalo grass.

Sweetclover if properly grazed may be grown continuously on areas being resodded with buffalo grass, thus providing additional pasturage while the grass is becoming established.

The cost of resodding, which consists mostly of labor, may be materially reduced by spacing the sods widely apart and depending upon companion crops to provide pasturage until the land is fully occupied by buffalo grass.

Top dressing with soil after the grass has become established, to level the uneven surfaces caused by wind and water erosion, is advisable on lawns and other areas intended for landscape purposes. The exclusive use of pistillate plants is preferred for lawn purposes.

Buffalo grass may be used to advantage in controlling run-off and erosion on well-drained sloping land, but it will not withstand protracted excesses of water on low land.

Buffalo grass ranks high for grazing purposes. Although it is a rather low producer, it is highly regarded as a nutritious and exceedingly palatable pasture grass, capable of producing excellent summer and cured winter pasturage.

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