# Effects of Cutting and Fertilizing on the Growth of Grass

By C. M. Harrison

Questions arise in golf course maintenance as to what sort of response grass plants will make upon being cut at different heights. Will they produce the same or different amounts of top growth? Do the different grasses respond alike to any one treatment with respect to top and root growth? What effect will cutting have upon the weight and length of root systems? How will the treatments affect the plants in their ability to produce new rootstocks (underground runners) or new stolons (surface runners)? What effect will fertilizers have upon the grasses cut at different heights? To answer some of these questions a preliminary experiment was started in the greenhouse at the University of Chicago in the spring of 1929.

Three common grasses were selected for study, namely, Kentucky bluegrass (*Poa pratensis*), red fescue (*Festuca rubra*), and colonial bent (*Agrostis tenuis*). These grasses differ somewhat in habit of growth. Kentucky bluegrass grows upright and produces few leaves at the base of the plant. It spreads by means of rootstocks. It continues this upright growth even under close cutting, with the result that practically all of its green leaf parts are removed when the plant is cut close.

Red fescue, on the other hand, tillers or branches at the base of the plant, and under close cutting and favorable climatic conditions many fine, short leaves are produced close enough to the ground to permit the leaf parts to continue their function of aiding in nourishing the plant. Colonial bent also produces many leaves close to the ground.

These three grasses were grown separately in flats of soil in the greenhouse and were cut to three different heights,—¼ inch, 1½ inches, and 3 inches. Additional flats of each grass were cut to ¼ inch and fertilized twice with sulphate of ammonia. The first application was at the rate of 2 pounds to 1,000 square feet and the second at 7 pounds to 1,000 square feet. The grasses were cut sixteen times between April 15 and July 5. The grass roots were then washed from the soil. The roots were distinctly matted in the grass cut to the higher levels, but in that cut close they were not sufficient in quantity to hold the soil wall. The tops were cut from the roots and the roots dried and weighed. The results are shown in table No. 1 and illustration No. 1.

TABLE 1.—DRY WEIGHT OF GRASS ROOTS, IN GRAMS, TO A SQUARE FOOT OF SURFACE AREA AT DIFFERENT HEIGHTS OF CUTTING

| | *Short cut ¼ inch* | *Short cut ¼ inch. Sulphate of ammonia added.* | *Medium cut 1½ inches* | *Long cut 3 inches* |
|---|---|---|---|---|
| Red fescue | 1.4 | 1.0 | 8.6 | 13.7 |
| Bluegrass | 1.6 | 1.3 | 7.5 | 11.7 |
| Colonial bent | 2.1 | killed | 5.0 | 7.7 |

From the table it is seen that the root system of the bent grass which was cut short weighed much more than the root system of either of the two other grasses receiving the same cutting treatment. The increase in weight of roots with increase in height of cut was marked.

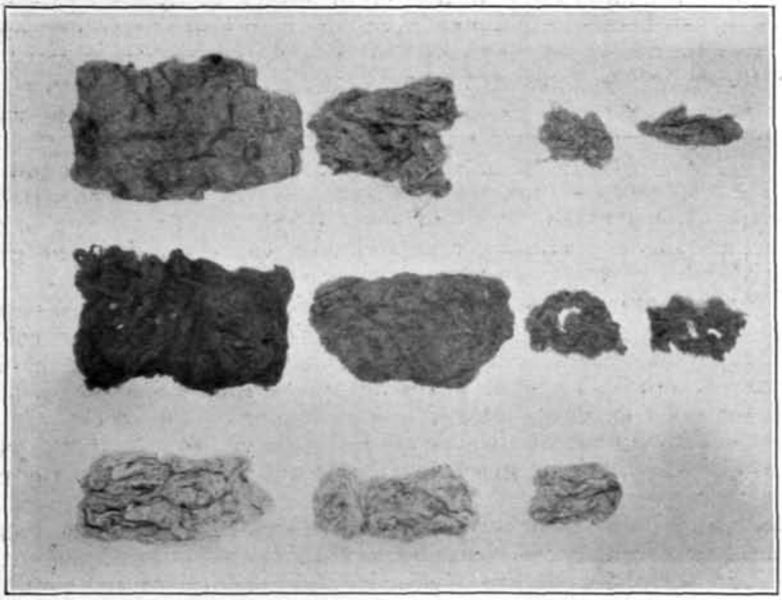

**Illustration 1.—Bulk of roots produced by 3 different grasses when cut to 3 different heights and when nitrogen fertilizer in the form of sulphate of ammonia is added to the short-cut grass. Weights of the roots are given in table No. 1. In the upper row (reading left to right) are Kentucky bluegrass roots from turf cut long, cut medium, cut short, and cut short and fertilized with nitrogen. In the middle row are fescue roots, treated the same as the bluegrass. In the lower row are colonial bent roots, also treated the same; roots from the colonial bent turf that was cut short and fertilized are missing, as the grass was killed**

The short-cut bent which was fertilized showed a peculiar response to a light shading. All of the grass flats were shaded about the first of June to cut down the heat and light intensity. Before this shading, the fertilized short-cut bent was a beautiful dark green while that unfertilized but cut short was a yellowish green. No later than three days after the shading, the unfertilized grass turned a dark green color and that which was fertilized took on a water-soaked, scalded appearance. These latter plants soon died, and after microscopical examination of the material their death could not be attributed to fungous troubles. The bent in the medium and long cutting heights was not affected to a noticeable degree and neither were any of the cutting heights of the other two grasses. It appeared that the shading, which had followed a heavy application of a nitrogen fertilizer, cut down the rate of carbohydrate (starch and sugar) manufacture by the tops of the plants, by cutting down on the amount of light. This manufacture of starches and sugars takes place only in sunlight and in the green parts of plants. By cutting down on the amount of light, the rate of manufacture of foods by the tops was not sufficient to balance the added nitrogen, and as a result the nitrogen became toxic to growth, which was not the case before the plants were shaded.

In order to supplement this preliminary study another experiment was begun in the fall of 1929. Only Kentucky bluegrass and red fescue were used and they were sown in flats of soil on September 25.

TABLE 2.—DRY WEIGHT OF ROOTS, IN GRAMS, OF 3 SQUARE FEET OF KENTUCKY BLUEGRASS AND RED FESCUE TURF UNDER 3 DIFFERENT HEIGHTS OF CUTTING WITHOUT FERTILIZER AND 3 DIFFERENT HEIGHTS OF CUTTING WITH 4 DIFFERENT FERTILIZER TREATMENTS

| | Bluegrass | | | Fescue | | |
|---|---|---|---|---|---|---|
| *Fertilizer treatment* | *Cut ½ inch* | *Cut 1½ inches* | *Cut 3 inches* | *Cut ½ inch* | *Cut 1½ inches* | *Cut 3 inches* |
| Checks (not fertilized) | 7.9 | 23.6 | 36.5 | 14.8 | 25.2 | 43.3 |
| Nitrogen alone (sulphate of ammonia) | 11.5 | 22.2 | 28.3 | 18.2 | 26.3 | 33.1 |
| Nitrogen and phosphorus (ammonium phosphate) | 8.9 | 21.0 | 28.6 | 14.9 | 22.5 | 29.1 |
| Nitrogen and potassium (potassium nitrate and sulphate of ammonia) | 11.1 | 23.8 | 24.0 | 16.2 | 21.1 | 29.3 |
| Nitrogen, phosphorus, and potassium (potassium phosphate and sulphate of ammonia) | 7.3 | 23.5 | 27.9 | 16.6 | 20.6 | 33.2 |

TABLE 3.—COMPARISON OF ROOTSTOCK PRODUCTION OF KENTUCKY BLUEGRASS WHEN CUT AT 3 DIFFERENT HEIGHTS, FERTILIZED WITH A COMPLETE FERTILIZER, AND NOT FERTILIZED. THE COMPLETE FERTILIZER USED CONSISTED OF POTASSIUM PHOSPHATE AND SULPHATE OF AMMONIA

| | *Total dry weight of rootstocks of Kentucky bluegrass in milligrams per flat* | |
|---|---|---|
| | *Fertilized* | *Not fertilized* |
| Cut 3 inches | 726 | 594 |
| Cut 1½ inches | 400 | 225 |
| Cut ½ inch | 18 | 8 |

Cutting was started on November 7 and continued each week thereafter until April 21, the heights of cut being ½ inch, 1½ inches, and 3 inches. The clippings were removed from the flats. Some of the flats of grass in each cutting height were fertilized with nitrogen alone, some with nitrogen and phosphorus, some with nitrogen and potassium, and some with nitrogen, phosphorus, and potassium. Three flats of grass were used for each treatment and three set aside as checks in each cutting height. The fertilizers were added once a month in January, February, and March. The roots were washed from the soil beginning April 21; the dry weights of the roots are shown in table No. 2. It is apparent from the table that the difference in cutting heights made considerable difference in the amount of roots produced. The mineral fertilizers were evidently not as effective as top growth in the production of roots, since there was far greater variation in the weight of roots between the flats with different heights of cutting than there was between the flats receiving different fertilizers. In the case of the grass cut at 3 inches the weight of the roots of the fertilized flats was in each case less than the weight of the roots of the unfertilized flat.

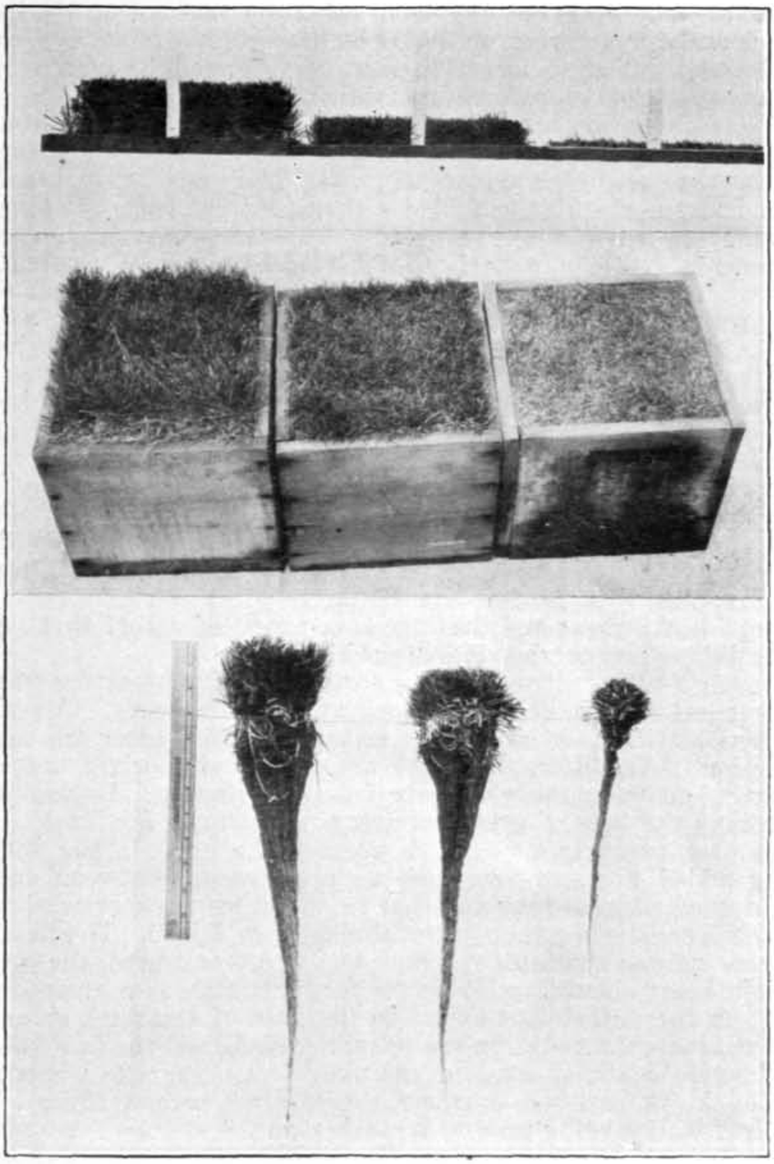

Illustration 2.—Mass and length of roots produced by Kentucky bluegrass grown in 3 flats each of which was cut to a different height. All of the flats received 3 applications of a complete fertilizer. Above are shown the various heights of cuts; in the middle the character of turf produced; at the bottom the mass and length of roots. The rules in the illustration are 6 inches long

The best top growth appeared to be in the flats which received the complete fertilizer. The grass from these flats was photographed and is shown in illustrations No. 2 and No. 3.

The rootstocks were carefully picked out of the three fertilized bluegrass flats, as well as three check flats. The oven-dry weights of the rootstocks are shown in table No. 3. Many more rootstocks were produced by the grass cut at 3 inches than by that cut at 1½ inches and decidedly more were produced by the grass cut at 1½ inches than by that cut at ½ inch. In fact, very few of the plants which were cut short had any visible rootstocks.

It was observed that the shorter cutting of the fescue brought about much more tillering or branching of the plants at the crown than was the case in the longer-cut grass. The grass cut to a medium height had much stiffer leaf blades than that cut long, the long-cut plants having a tendency to lop over. This was probably due to the difference in the length of the leaf blades between the two cutting heights. The plants which were cut short tillered more than those cut to a medium height, but the leaf blades were not nearly as stiff as those cut to a medium height. The grass cut to a medium height would hold up a golf ball while neither that cut short nor that cut long would do so. None of the three cutting treatments resulted in a thinning of the fescue turf. The grass in the unfertilized check flats could be told from that in the fertilized flats by the difference in color. The grass receiving no nitrogen was yellowish in color while that receiving fertilizer was dark green. There was also a difference in the length and thickness of top growth, in favor of the fertilized grass. The bluegrass turf, on the other hand, thinned when cut short; that with the medium cutting height produced a good turf with stiff leaf blades; and that cut long produced a turf that lopped over as did the fescue when it was cut high.

The effect of the nitrogen in the fertilizer on the bluegrass was not apparent until after the second application in February. All of the bluegrass had been a dark green color, until soon after the second application of fertilizer, when the weather became bright and clear as contrasted with the cloudy period preceding it. During these sunny days the flats of grass receiving no nitrogen fertilizer turned from a dark green to a yellowish green. The grass in the flats receiving added nitrogen remained a dark green. Between cutting periods, the grass cut long and that receiving nitrogen grew approximately 3 inches, while that in the checks grew 1 inch. The medium-cut grass showed the same response but to a less degree, the growth in height being about 2 inches in the fertilized flats as compared with ¾ inch in the unfertilized ones. In the flats of grass cut short and fertilized, each plant sent up one spindling blade and the turf thinned badly due to death of some of the plants. On the other hand, the grass in the unfertilized short-cut flats did not become thin, several short leaf blades being present on each plant.

It was noted that the shorter the cutting, the smaller the newly-produced parts became. The roots were shorter and finer and the new leaves were narrower and shorter. The new leaf growth corresponded in height to the size of the plant; that is, the new growth produced by the short-cut plants was much less than that of those cut long.

No attempt was made, in conducting these experiments, to study the effect of different soils on the growth of grass, nor the effect of varying temperature or supply of water. Any or all of these factors may materially alter the effects produced by cutting. Some evidence has been disclosed in the experiments, however, to indicate that seasonal differences of light and temperature may have a relation to

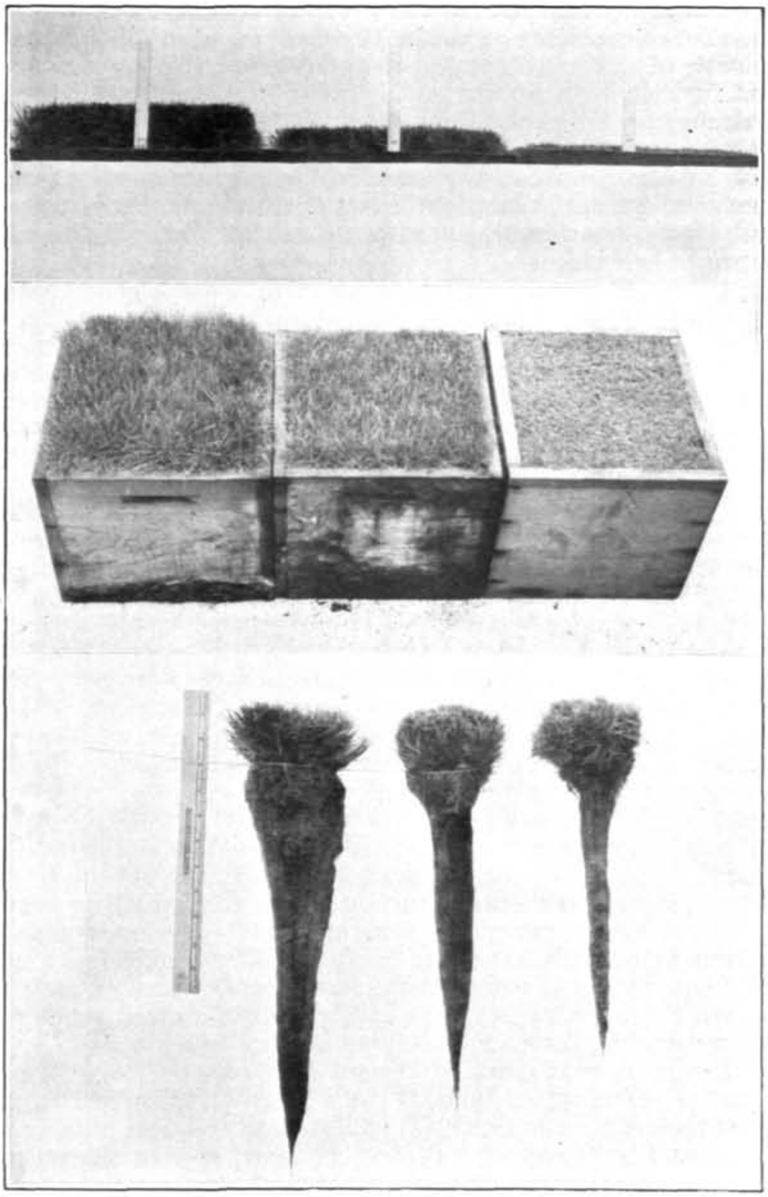

Illustration 3.—Mass and length of roots produced by red fescue grown in 3 flats each of which was cut to a different height. All of the flats received 3 applications of a complete fertilizer. In the top row are shown the various heights of cut; in the middle the character of turf produced; at the bottom the mass and length of roots. The rules in the illustration are 6 inches long. The greater amount of root system of red fescue (when cut short) as compared with Kentucky bluegrass is observable in a comparison with illustration No. 2

the effect of height of cutting upon both bluegrass and fescue. Present results suggest that fescue does not tiller abundantly during the summer months when cut short, and that bluegrass, on the contrary, is more adversely affected by the growing conditions of the winter season. These problems as to the effect of seasonal differences upon the growth of different grasses are of considerable importance and warrant further investigation.

Summing up the general observations, it appears that fertilizing with nitrogen produced increased top growth in all cases except in the case of the short-cut bluegrass. When grown under favorable seasonal conditions, the fescue which was cut short tillered more than that cut long. The fescue cut at a medium height had the stiffest, most upright leaf blades.

The killing of the plants in the short-cut flats was not due to a cutting off of the buds but to the removal of food-manufacturing parts of the plant to a point beyond which the plant could not maintain itself. The green leaf parts of a plant, in common with other green parts of the plant, serve as a factory—as it were—in which carbohydrates (starches and sugars) are manufactured, under the action of sunlight, from the carbon dioxide of the air and water. This food-manufacturing process is known in plant physiology as photosynthesis. The carbon dioxide enters the leaves of the plant through small openings in the leaf known as stomata. The substance which gives the green color to plants, called chlorophyll, aids in this food-manufacturing process, which takes place only in the light. The organic food (starches and sugars) manufactured by the green parts of the plant is as important an element in the nourishment of the plant itself as are the mineral substances absorbed from the soil by its roots. It is thus evident that the removal of the leaves of a plant can not be carried on beyond a certain limit without weakening the plant and thus decreasing its resistance to drought, disease, heat, cold, or the competition of neighboring plants such as white clover, dandelion, crab grass, knotweed, and plantain which, by their prostrate habit of growth, can escape severe cutting. Kentucky bluegrass, with its upright habit of growth, is thus particularly susceptible to injury from close cutting. Bluegrass turf in the rough, which is generally left uncut for longer periods of time and cut higher, is usually relatively free from such troubles. Because of the difference in the height of cut, the grass plants in the rough retain more of their green leaves than those on the fairways and, as a result, often remain thick and green after the fairways have become dry and sparse.

The foregoing data show in general that root growth will not respond to fertilizer applications if the ability of the plant to manufacture carbohydrates is hindered by close and frequent cutting. The mowers should be raised on the fairways where the cutting treatment is proving dangerous, and cutting should be discontinued in the fall as early as possible in order that the plants may manufacture and store food for use during the season of short and frequent clipping.

It would seem probable, therefore, that if the fairways could be cut in such a manner that a greater amount of leaf surface could be left uncut than is true with the usual short-cutting treatment, they too would remain in better condition in so far as the growth of the grass is concerned. This result might be brought about by lengthening the intervals between cuttings or by cutting more frequently with the mower raised. The first method would probably prove troublesome because of the height to which the grass would grow during the intervals between cuttings. It would also be undesirable during the summer months when the recovery from short cutting of grass which has grown long, is very slow. The second method might prove usable, since it would provide a suitable playing surface and yet prevent serious injury to the grass because of too close clipping. Using the latter method some leaves would always remain, whereas with the first method there would be times immediately after cutting when nothing but stubble would be left. This stubble recovers very slowly when soil and weather conditions are unfavorable.

## Change in the Scientific Name for Colonial Bent

A classification of the common bent grasses was given in the Bulletin for March, 1930. In this classification the name used for colonial bent was *Agrostis capillaris*. The policy of the Bulletin is to use the botanical classification and scientific names recommended by A. S. Hitchcock, botanist of the United States Department of Agriculture. Since making his recommendations for the names used in that number of the 1930 Bulletin, Doctor Hitchcock has had an opportunity to make a more detailed study of some of the earliest recorded specimens of bent grasses in European hebariums. As a result of this study he has decided to discontinue the use of the name *Agrostis capillaris* for this grass and to use the name *Agrostis tenuis*. There are several technical reasons for this change but they are not likely to be of particular interest to most of our readers. The Bulletin will hereafter use *Agrostis tenuis* as the scientific name of the species of grass commonly known as colonial bent. It is hoped that this name will be generally used in the seed catalogues in order to avoid confusion. It is suggested that our readers who keep files of the Bulletin refer to pages 47 and 49 of the Bulletin for March, 1930, and where the word is used there cross out *capillaris* and insert *tenuis*.

**Accelerating the melting of snow.**—At times it happens that a greenkeeper would welcome the melting of the blanket of snow that lingers on his putting greens in the spring in order that the turf may dry the more quickly and permit the starting of desirable spring work. The same problem has been encountered by the Forest Service of the United States Department of Agriculture at their nurseries at various locations in the United States, and a simple method has been developed for hastening the melting of the snow. In some years it happens that sites chosen for reforestation by planting are ready for seedlings from the forest nursery while the nursery is still buried in snow. By the time the snow in the nursery has melted and the trees are ready for transplanting the soil in the planting sites may be too dry. The problem in such a case is to melt the snow and advance the working season in the nursery. To melt the snow, fine black soil is broadcast on the snow over the compartments of the nursery from which planting stock is to be removed first. This soil, because it is black, absorbs considerable heat which would otherwise be reflected from the snow, if uncovered, on account of its whiteness. The operation hastens the melting of the snow and enables the workers to get out the planting stock as much as two weeks earlier in some instances.