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of the

UNITED STATES GOLF ASSOCIATION GREEN SECTION

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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 well. 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.

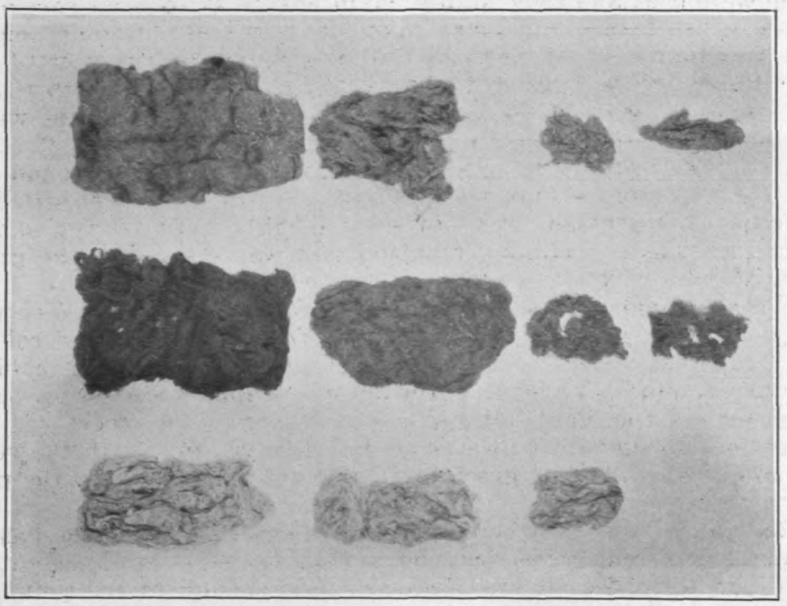


Illustration 1.—Bulk of roots produced by 3 different grasses when cut to 3 different heights and when nitrogen fertilizer in the form of sulphate of ammonia is added to the short-cut grass. Weights of the roots are given in table No. 1. In the upper row (reading left to right) are Kentucky bluegrass 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.

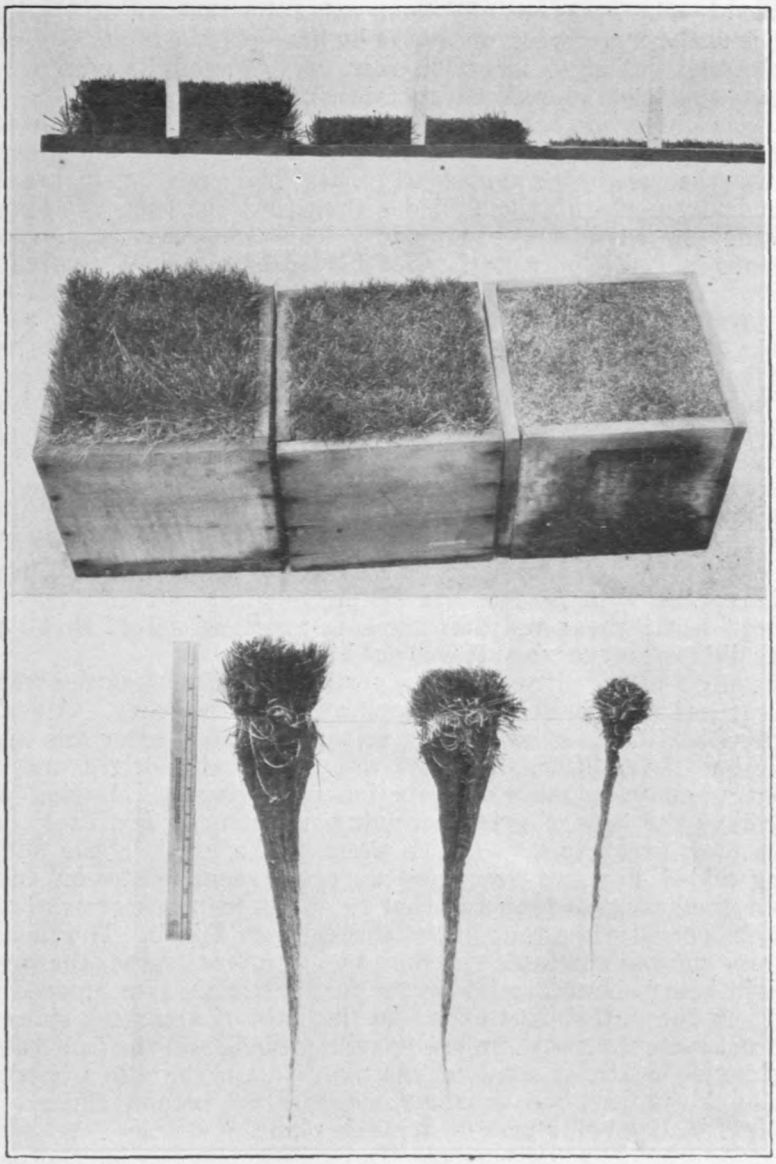


Illustration 2.—Mass and length of roots produced by Kentucky bluegrass grown in 3 flats each of which was cut to a different height. All of the flats received 3 applications of a complete fertilizer. Above are shown the various heights of cuts; in the middle the character of turf produced; at the bottom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

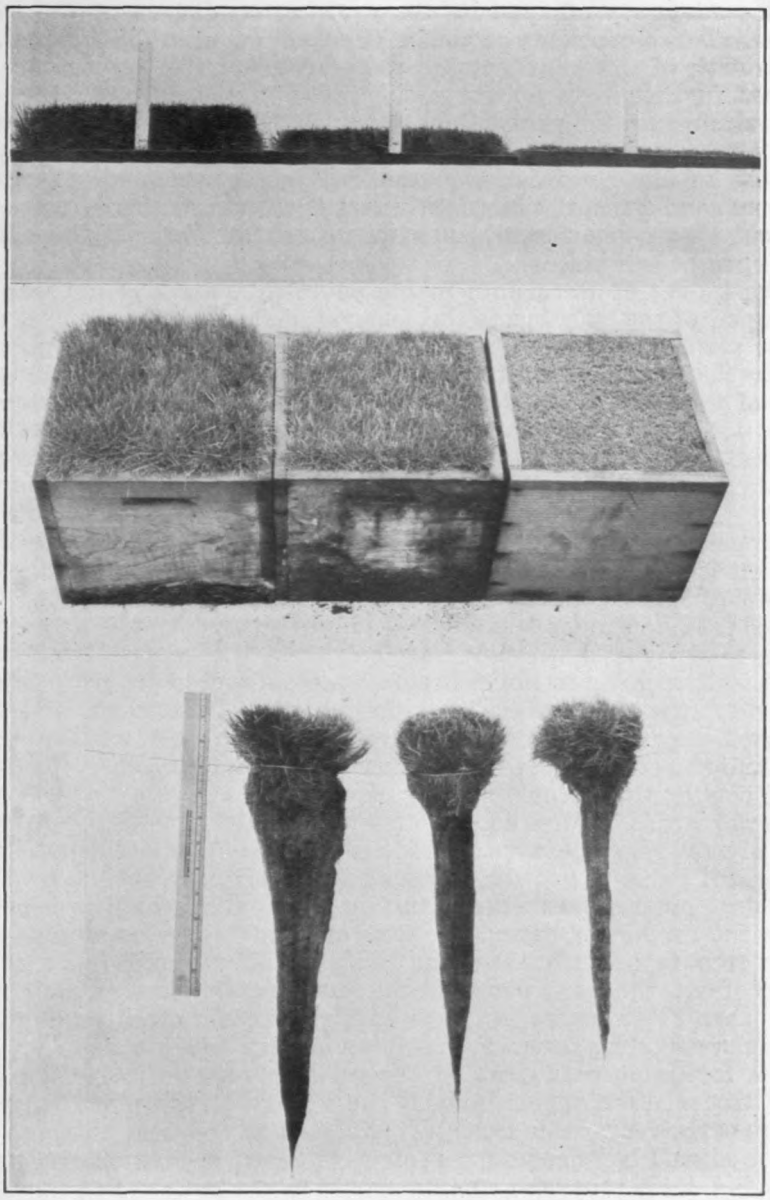


Illustration 3.—Mass and length of roots produced by red fescue grown in 3 flats each of which was cut to a different height. All of the flats received 3 applications of a complete fertilizer. In the top row are shown the various heights of cut; in the middle the character of turf produced; at the bottom 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.

Methods of Applying Chemicals to Turf

By Arnold S. Dahl

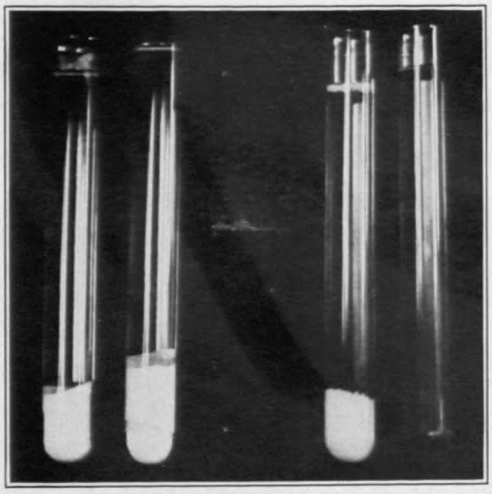
The maintenance of good turf on putting greens requires intensive cultural methods, frequently involving the use of concentrated chemicals as fertilizers, fungicides, or insecticides. The use of this type of material has introduced new problems into greenkeeping practice. Extensive damage to turf has sometimes resulted from the application of concentrated chemicals. When injury occurs as a result of their use the chemicals invariably are criticised, when, as a matter of fact, carelessness or poor judgment in making the application is the real source of the damage. One of the distinct advantages of using concentrated materials is that a small amount will cover a large area. On the other hand it is more difficult to distribute evenly small amounts of material than it is to spread bulky substances.

Concentrated chemical fertilizers and fungicides may be applied more satisfactorily if they are diluted to give much greater bulk. Only rarely should an application be made without any dilution. It is largely a matter of choice whether they are applied in water or in the dry state mixed with soil, sand, or other material. The putting greens on a course should be treated with a fungicide soon after an attack of disease is noticed, as the injury to the turf is greatly reduced by prompt attention. Applications of fertilizers to putting greens should likewise be made rapidly, so as to interfere with play as little as possible. The method to use is that which will give the most even distribution in the shortest time at the least cost. This will vary on different courses according to the individual preference of the greenkeeper.

Many golf clubs in recent years have acquired power sprayers for use in treatment of turf diseases and for applying chemical fertilizers. The cost of such equipment is considered prohibitive on some courses but others prefer to use this method and also use the sprayers for spraying trees and shrubbery on the course and therefore consider the equipment as necessary. It is felt by some greenkeepers that power sprayers reduce the cost of application and the time necessary to treat the greens. Fertilizers or fungicides that go into solution readily are well adapted to use in spray equipment. When applications of a chemical are made to coat the leaves with a film of poison, as is the case in combating many plant insect pests and diseases, a spraying outfit is most effective. This is also true when small amounts, less than ½ ounce to 1,000 square feet, of corrosive sublimate are applied at frequent intervals to check attacks of large brown-patch. The use of insoluble chemicals such as lead arsenate, hydrated lime, and calomel in particular, necessitates sufficient agitation in the tank to keep the material in suspension. In the use of calomel many greenkeepers have found it necessary to add more agitators to keep the material from settling to the bottom of the tank, for any such settling results in uneven distribution.

Some difficulty has been experienced in dissolving corrosive sublimate for spraying. Solution of many chemicals can be hastened by the addition of other chemicals. Corrosive sublimate mixed with one-fourth its weight of common salt or ammonium chloride will readily go into solution and the addition of these materials will not harm the

grass. A small amount of salt increases the solubility of corrosive sublimate many times, so that it is possible to dissolve in a gallon jug enough to treat more than one green. Less than ½ pound of the mercury compound will slowly dissolve in a gallon of water, but a mixture of 4 pounds of the chemical and 1 pound of salt will quickly dissolve in the same amount of water. The latter amount will treat approximately 22,000 square feet of turf, or four moderate-sized greens. During the hot summer weather this amount used at reduced rates will be enough for eight greens. The solution may be prepared in earthenware or glass jugs or in wooden kegs and used whenever an attack of disease occurs. Corrosive sublimate solutions should never be placed in metal containers, because of their corrosive action on metals. Not only would the container be corroded by the chemical but the solution would be weakened and it would be impossible to calculate the amount to use to get the desired control of diseases. The area of each green should be determined and the quantity of the solution to be used should be calculated so that all guessing is eliminated.



Corrosive sublimate can be dissolved rapidly by adding a little table salt to the water. Each of these four tubes contains equal quantities of corrosive sublimate and water in the proportion of four pounds of corrosive sublimate to one gallon of water. The tube on the right in each of the two pairs had common table salt added at the rate of one pound of salt to one gallon of water. The two tubes on the left were photographed immediately after the mixture was prepared; the two tubes on the right were photographed immediately after they had been shaken for three minutes. The tube to which salt had been added and which had been shaken three minutes (that on the extreme right) contains a complete solution. In each of the other three tubes the undissolved material may be seen in the bottom

Barrel sprinklers are often used on golf courses but they are much slower and more cumbersome than power sprayers. It is generally recognized that such equipment is antiquated and that more efficient methods are needed for applying concentrated chemicals. With barrel sprinklers as with power sprayers it is necessary to provide sufficient agitation to keep insoluble materials such as calomel and lead arsenate in suspension. With the use of either method the operator must watch the treatment carefully so that overlapping does not occur since this frequently causes severe burns due to doubling the rate of application.

Many greenkeepers prefer to apply chemicals in the dry state. This method has an advantage over the spray method in that it does not require a large outlay for expensive equipment nor is there heavy equipment to haul over the golf course. Some greenkeepers find that they can treat their greens more quickly by the dry method. When chemicals are applied in the dry state they should, for the best re-

sults, be mixed with comparatively dry, finely-screened topsoil, compost, or sand. An eight-quart bucketful to 1,000 square feet is a fair amount to use, but the quantity will depend on the preference and skill of the man who applies it. Some men can broadcast a small amount uniformly; others prefer a larger amount. In mixing the chemical with soil it is necessary to obtain a uniform mixture and to pulverize all the lumps of the chemical, for if lumps of a concentrated chemical are permitted to lie on turf they are likely to cause severe local burns. An excellent method of mixing chemical with soil is to first mix it with a small quantity of dry, sharp sand; preferably about twice as much sand as chemical should be used. These are then rolled together with a rolling pin, a piece of pipe, or a bottle. In rolling them together the lumps are broken by the grinding action of the sand.

Lumps of chemicals are readily broken by rolling them in a small quantity of fine sand. This is best done on heavy paper or canvas, which can be lifted at the corners to throw the rolled material back into a pile and to expose new lumps of chemicals to the rolling operation. The rolling and piling are repeated until no lumps of chemicals remain in the mixture

The rolling and mixing should be continued until a uniform mixture is obtained as indicated by the absence of streaks. The chemical and sand can also be forced through a very fine screen, but this will not result in as fine a mixture as rolling. The soil to be broadcast is spread out on a tight floor or smooth concrete so that it is in a layer not more than two or three inches deep. The chemical and sand mixture is then scattered over the soil, raked in thoroughly, and shoveled over several times so that it is uniformly mixed. A revolving barrel churn or a small revolving concrete mixer may also be used for mixing the chemical and sand with the soil. The mixture is then ready to be broadcast over the green at the rate of a bucketful to 1,000 square feet, or at any other rate that is preferred for even distribution.

Chemicals may be mixed with soil and stored until needed. Storing in this way for a short time does not affect the efficiency of chemi

cal fertilizers. The storage of mixtures of mercury fungicides will, in part, lessen the danger of chemical burns if an excess is applied, but if such a mixture is allowed to stand from one season to the next it loses some of its effectiveness. Experiments have shown that mercury fungicides mixed with soil and stored for a period of years lose much of their value. Some, however, is retained so that a greenkeeper who has a supply already mixed, left from the previous season, may use it, but, to be effective, it should be applied at higher rates than recommended for the freshly-mixed materials. It is well not to mix more than a month's supply at a time, so that only a minimum will be lost.

A mixture of chemicals and fine sand can be given greater bulk so as to assure more even distribution on greens if it is mixed with screened soil. A pile of soil is spread out flat and the rolled mixture of sand and chemicals is spread evenly over the pile and worked in with a rake. The pile is then turned over several times to make a thorough mixture

Most chemical treatments on turf should be well watered after application so as to wash the material off the leaves. Only those treatments which are purposely left on the leaves, as mentioned earlier, are excepted. Any of the other chemicals used at the recommended rates will severely burn the grass if left on the leaves. This is true of treatments applied dry or with water in sprayers and sprinklers.

Seventeen states have laws relating to the sale of fertilizers. The percentage of plant food which a complete mixed fertilizer sold in those 17 states must contain is as follows: 16 per cent in Alabama, Louisiana, Mississippi, Montana, Ohio, Oklahoma, Wisconsin; 14 per cent in Arkansas, Delaware, Florida, Kentucky, Pennsylvania, Tennessee; 12 per cent in Georgia, North Carolina, West Virginia; 11 per cent in Virginia.

Kinds and Quantities of Turf Seeds Purchased by Golf Courses

The facts and figures here presented are taken from a report recently published by the Bureau of Agricultural Economics, United States Department of Agriculture, based on replies received from 1,189 golf courses in the United States in response to a questionnaire sent by the Bureau to more than 3,800 golf clubs and municipal courses. Of these 3,800 golf courses, 1,733 replied to the questionnaire; 1,189 gave figures indicating the quantity of seed they purchased, intended to purchase, or their average annual purchases; 495 gave no figures but indicated that they usually purchased little or no seed because they had sand greens or else native grass that did not require reseeding or for other reasons; and 49 failed to indicate whether or not they ever purchased seed. Included in the 3,800 courses within the survey were also some courses that were not in operation.

AVERAGE ANNUAL PURCHASES OF TURF SEEDS MADE BY 1,189 GOLF COURSES

	Pounds	
Rye grasses:		
Italian	333,500	
Domestic (mostly Italian, with a small proportion of perennial and other rye grasses)	210,500	
Perennial	14,400	
		558,400
Kentucky bluegrass		213,900
Redtop		161,700
Fescues:		
Chewings'	63,400	
Meadow	16,300	
Sheep's	9,300	
Other fescues	2,500	
		91,500
Bents:		
Mixed	27,500	
Colonial	15,800	
Seaside creeping	15,400	
Velvet	1,833	
Other bents (unclassified)	2,930	
		63,463
Bermuda grass		48,900
Mixtures (commercial)		26,300
Timothy		15,700
White clover		9,900
Carpet grass		3,300
Clovers other than white clover		3,200
Rough-stalked bluegrass		1,900
Miscellaneous		8,187
Total		1,206,350

"No attempt has been made," the Bureau states, "to estimate what percentage these purchases represent of the total purchases made for all golf courses in the United States. It is believed, however, that a

majority of the larger clubs furnished reports in the survey. Many clubs found it very difficult to estimate their annual purchases of the different kinds of seed because the purchases varied so much from year to year, depending largely upon whether new construction work was undertaken or extensive alterations were made on their courses or reseeding was necessary because of droughts, floods, or other reasons."

"Only a very small percentage of the clubs indicated," the report states, "that they intended to purchase or that they usually purchase bent stolons, and these clubs were situated mainly in Illinois, Ohio, Pennsylvania, Virginia, and Indiana. Many clubs, however, grow their own stolons and maintain their own bent turf nursery for use in repairing old greens. The most popular strain of bent stolons was indicated to be the Washington, but many clubs were using the Metropolitan."

Most of the purchases of rye grass seed, the survey showed, were made by clubs in Florida, Georgia, and Mississippi. In those states it is generally sown each fall on Bermuda grass greens for winter play. This explains the greater annual consumption of rye grasses as compared with strictly perennial grasses, such as Kentucky bluegrass, the bents, and redtop.

More Kentucky bluegrass seed was purchased by clubs in Illinois, Ohio, New York, Michigan, and Pennsylvania, than elsewhere.

Purchases of redtop seed were shown to be the largest in Illinois, New York, Ohio, Florida, Michigan, and Pennsylvania.

Purchases of fescue seeds were mainly by clubs in New York, Pennsylvania, Michigan, and Ohio.

More bent seed was purchased by clubs in New York, Pennsylvania, California, New Jersey, and Massachusetts, than elsewhere.

Florida courses buy much more Bermuda grass and carpet grass seed than any other courses. South Carolina, Texas, Virginia, and North Carolina courses trail far behind Florida in Bermuda grass purchases.

The relatively large amount of white clover purchased would seem to indicate that some clubs are buying it to deliberately sow on their courses, even though most greenkeepers, and others interested in golf courses, are willing to spend large sums of money to eradicate this pest on the golf course, and especially on the greens. It is possible that some of the white clover seed purchased is planted as part of seed mixtures in certain locations.

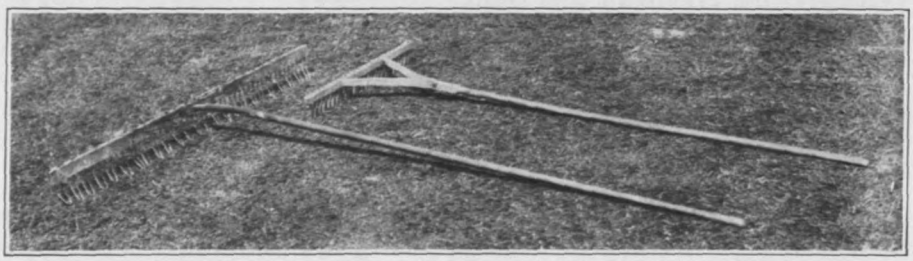
In spite of the fact that fall is generally considered to be the best time to sow grass seeds, the report shows that the heaviest seed purchases were made by clubs in the spring. This does not mean necessarily that they are planting this seed in the spring. Considering that a club needs new seeding and has an item for seed in its budget when this is made up in the spring, the usual plan is apparently to buy the seed then and carry it over until fall. It is possible that many seeds bought in the spring are intended for spring planting, but, due to procrastination, they are not planted until fall. Relatively small quantities are purchased during the months of May, June, and July.

Judicious use of fertilizer will do more to thicken up a thin stand of grass than the best methods of reseeding.

Home-Made Leaf Rake

The removal of leaves and other litter from golf turf is usually a costly procedure. Machines have been developed in recent years designed to speed up this type of work and reduce the labor cost, but on most courses the leaves are still removed by use of the hand rake. The ordinary wooden hand rake, designed primarily for raking small lawns, is the most common implement in use for this work. A good many of the common gardening or lawn tools have been decidedly improved in recent years to meet certain requirements in the maintenance of golf courses, but the lawn rake has seldom been modified.

At the Meadowbrook Country Club, in the Detroit district, there is in use a modified lawn rake which has proved to be much superior to the common rake. This modified rake was designed by William H. Aston, chairman of the green committee of that club. The change was made by merely increasing the width of the rake to 48 inches, the customary width of rake being about 23 inches. In making this rake, Mr. Aston states, a 7/8-inch pine strip 2½ inches wide and 48 inches long is used. Into this holes are bored, not larger than the wire to be used for the teeth, one inch apart on the 2½-inch way of the strip. The teeth are made by bending 12-inch lengths of heavy wire into the form of a staple and inserting them half their length through the holes. The ends of the wire are turned and fastened securely to the wooden strip. The staples are then bent forward as in the ordinary wire rake so they will slide under the leaves. An ordinary rake handle is then attached.



Much time can be saved in raking up leaves and other litter if a wide rake is used

This rake, which covers a much wider area than the ordinary rake, is much more effective in removing a light covering of leaves from a comparatively flat area. There is little increase in its weight over the ordinary rake. Men who use these rakes state that they are no more difficult to handle than rakes of standard size and that with them one can cover a much greater area in a given time. It is a simple device which anyone can easily make from material readily available.

A rake of this kind with teeth on both sides, Mr. Aston points out, would be very desirable, one side to be used for pushing and the other for pulling, simply by turning the rake over as desired. The operator could turn such a rake over and by pushing ahead could walk away with great piles of leaves in a fraction of the time it would take with the ordinary raking motions.

For raking around flower gardens, shrubbery, or similar irregular areas of turf such as are found around lawns, the standard rake is to be preferred, but there seems to be no reason why a much wider rake can not be used to advantage on the larger areas of a golf course.

QUESTIONS AND ANSWERS

All questions sent to the Green Section will be answered in a letter to the writer as promptly as possible. The more interesting of these questions, with concise answers, will appear in this column. If your experience leads you to disagree with any answer here given it is your privilege and duty to write to the Green Section. While most of the answers are of general application, it must be borne in mind that each recommendation is intended specifically for the locality designated at the end of the question.

Bulbous bluegrass as winter turf on Bermuda greens.—We understand that bulbous bluegrass (*Poa bulbosa*) teams admirably with Bermuda grass, one being dormant while the other is verdant, thus giving excellent greens for golf play throughout the year. The Bermuda grass here is killed by frost each year, or if not killed it becomes very thin. Do you think bulbous bluegrass would be satisfactory to use in southern Texas? Would the hot summers hurt it, and would it become dormant in time in the spring for the Bermuda to get a proper start? Would the fact that our winter is late interfere with the growth of the bulbous bluegrass? We have our first killing frost in early December, although the Bermuda begins to get thin about the middle of October when the nights grow cool. Would cool nights and hot days affect the growth of the bulbous bluegrass? How should it be planted? (Texas)

ANSWER.—We have been doing some experimental work with bulbous bluegrass, but chiefly at Washington, D. C., and at Gainesville, Fla. The main benefit of bulbous bluegrass for golf course purposes would be as an alternate with Bermuda grass. We recognize that it would be most convenient if the bulbous bluegrass would come into the greens in the South as soon as the Bermuda grass becomes dormant and if the Bermuda would return in the spring as soon as the bulbous bluegrass becomes dormant. This condition, however, has not developed in any of our experimental work to date. At Washington the Bermuda becomes dormant a month or so before the bulbous bluegrass does much growing, and the Bermuda comes back very patchy in the late spring when the bulbous bluegrass dies. The second winter the bulbous bluegrass comes in patchy, especially if the Bermuda has been vigorous during the preceding summer. We recognize, however, that Washington is too far north for ideal conditions for early Bermuda growth in the spring and for early winter growth of bulbous bluegrass. At Gainesville it was found that the bulbous bluegrass grew well in late fall as soon as the Bermuda grass began to get thin, but that much of it died during the summer. It was thought that the soil was too hot and the bulbs were thus killed during the summer. This experiment was carried on in sand. In our opinion, the rotation of Bermuda grass and bulbous bluegrass would take place more uniformly in Texas than it has at Washington and in Florida, since it is possible that the grass would not die during the summer on the heavier Texas soil. Cool nights do not at all affect the growth of the grass. We also know from our results at Washington that an occasional warm day does not interfere with it; but this might not hold true under Texas conditions, since your days

might become considerably warmer and the air much drier than at Washington. We would advise you to try the grass in a small way. It may be planted from either bulblets or bulbs, both of which may be obtained from seedsmen. We have had much better results from the bulbs than from the bulblets. The bulbs are planted about ½ inch deep and are fertilized and watered the same as grass seed.

Ridding putting greens of clover; sulphate of aluminum.—What information have you as regards the use of sulphate of aluminum for ridding putting greens of clover? (Ohio)

ANSWER.—In some work we have done with sulphate of aluminum we have severely injured grass, and we do not believe it is safe to use it on turf in the control of clover. For the purpose of ridding putting greens of patches of clover the following treatment has proved satisfactory. With the advent of fall and its better growing conditions, clover can be considerably set back by dusting the patches of it with sulphate of ammonia early in the morning when the dew is on the grass. This will severely burn the clover. As soon as the burning of the clover is apparent the green should be watered to prevent the chemical's injuring the roots of grass that may be in or around the clover patches. Much can be done to enable turf grasses to compete with clover by regular fertilizing so as to keep up the nitrogen supply in the soil. Organic fertilizers high in nitrogen should be used in the spring and fall, supplemented during the remainder of the season by occasional light applications of nitrogen in a soluble form, such as sulphate of ammonia. Attention must also be given to preventing the introduction of clover seeds to a green in top-dressing material. Manure usually contains clover seed. Before being used, top-dressing material should be tested for the presence of clover seed, by setting out flats of the material and keeping them under growing conditions to see whether or not clover develops in the flats.

Plantain in bent seed.—We recently had some samples of seed of seaside creeping bent tested by the state seed laboratory and were informed that while the content of weed seeds was low the samples still contained as large a number as several thousand seeds of black-seeded plantain to the pound. We have been told however that this would make very little difference in seeding putting greens, as black-seeded plantain is easily killed. Is this true? (New York)

ANSWER.—If soil conditions and the fertilizing program are satisfactory for the proper development of bent putting green turf, weeds such as the different kinds of plantain are seldom given an opportunity to develop, due to close clipping, and therefore are not ordinarily serious pests. For ordinary use it is therefore improbable that plantain seed contained in the bent seed to which you refer would be objectionable.

Is lead shot falling upon a green from trap-shooting harmful to the turf? (Connecticut)

ANSWER.—The only harm the shot could do would be to your mowers. It would be no more harmful to the turf than coarse sand or gravel. In order to protect your mowers it might be necessary to drag a steel door mat over the green previous to mowing, thus collecting any shot which may be on the surface.

Sixteenth hole (175 yards), Country Club of Buffalo, Buffalo, N. Y.

It is well for a man to respect his own vocation, whatever it is, and to think himself bound to uphold it, and to claim for it the respect it deserves.

Charles Dickens