

CHAPTER II

SOILS FOR TURF GRASSES

THE special soil requirements of the various turf grasses differ considerably, but for the best results they all require a deep, fertile, moisture-holding yet well-drained soil. Such an ideal soil must be a loam, clay loams being better for most turf grasses than are sandy loams. Silt loams are in general intermediate in value. A good garden soil is a close approximation of what is most desirable. If such soil is underlaid by a permeable clayey subsoil to permit deep growth of roots and to provide underground drainage, the best possible soil conditions are present.

Such soil conditions are rarely found on golf courses excepting where they have been constructed on good farming land. In such cases the problem of securing good turf is rarely a matter of difficulty, better drainage being commonly the main thing needed.

Most golf courses are, however, located on land of low agricultural value not only on account of the much smaller initial cost of such land but also to secure the rough or rolling topography so desirable for sporty courses. The soils of such areas near the seacoast or lake shores are very often sandy in texture; elsewhere they are commonly stiff clays, as gravelly soils are avoided for golf purposes whenever possible. It is on such sandy or heavy clay courses that the problem of securing good turf becomes difficult. Unless the plans for the improvement of such a course so that it will grow good turf are based on sound principles, a large amount of time and money can easily be spent and only unsatisfactory results be secured.

The problems on the two types of soil are best considered separately, as the methods of soil improvement to be employed are quite different. Furthermore the particular grass or grass mixture to be used in each case is a matter of prime importance. These statements refer more particularly to the fairways, as on the putting-greens much larger sums of money must be spent with the idea of securing the most nearly perfect greens.

SOILS FOR PUTTING-GREENS

For putting-greens every effort should be made to secure as nearly perfect soil conditions as possible before seeding the green. It is a serious error to seed putting-greens before a satisfactory soil has been established, as this can never be entirely remedied later by any system of top-dressing. Furthermore, it is a notorious fact shown in the history of many clubs that poor putting-greens will be tolerated a long time if their reconstruction involves the use for a period of still poorer temporary greens. As a putting-green is intended to be permanent, its soil foundation should be as nearly ideal as possible.

The texture of an ideal turf soil is a loam, which may vary from a sandy loam to a clayey loam. Where the soil has to be made artificially, it is most likely to be a sandy loam in sandy regions and a clayey loam in clayey regions.

Sandy soils are bettered by the addition of silt or clay, or both, so as to obtain in the surface foot about one-third of these materials. Where clay is used, it should be dry and pulverized, as otherwise a good mixture is not secured. Humus-

forming materials should be added in large quantity, preferably enough to cover the green to a depth of three or four inches. The thorough mixing of these different elements will form a satisfactory sandy loam soil. In some seaside courses the error has been made of attempting to build a green by making a layer of peat eight to twelve inches thick and covering with a few inches of soil, but good results are not to be expected from any such method. Peat remains practically inert unless well mixed with soil. Preferably, it should be composted for a full year before using.

Stiff clay soils are best improved by the admixture of sand and humous materials. Three to four inches of sand may advantageously be incorporated in the top twelve inches, together with a liberal amount of humus-forming materials. Enough of the latter to cover the ground to a depth of four inches is not excessive. When the clay, sand, and humous materials are thoroughly mixed by plowing and cultivating, a very fair substitute for a clay loam is secured.

In some cases it may be cheaper to carry good soil to cover the proposed green to a depth of at least six inches, but good soil for turf is usually

scarce when the prevailing soil is either very clayey or very sandy.

In the North, the clayey loams are best seeded to Creeping Bent and the sandy loams to Red Fescue. Mixtures of these two grasses have in some cases at least given very excellent results, but usually one is better than the other, dependent largely on the difference in soil mentioned.

The depth of the good soil should be at least six inches, but more preferably eight to twelve inches or more. The shallower depths will answer with a good subsoil; the greater depth is highly desirable and sometimes necessary with a poor subsoil.

The subsoil should be permeable to roots and well-drained. If its consistency be too compact for good natural drainage, tiling is demanded. If the subsoil be gravel or coarse sand that will not retain moisture, the surface soil must be deep and preferably a rather clayey loam. No method of irrigation to offset the handicap of very rapid drainage will prove satisfactory.

The fertility of the top soil should be high. The soil should contain a high percentage of vegetable matter, as good turf of any kind requires an abundance of humus. The most desirable fertilizers

are organic in nature, namely, cottonseed-meal, bone-meal, tankage, and the like. Animal manures are always most excellent but should be well rotted and practically free from weed seeds. Lime should rarely be used on putting-greens.

The moisture-holding capacity of the soil should be high. This is best insured by a good content of clay and of vegetable matter.

The drainage should be ample so that the soil never becomes water-logged. Water-logging may be caused either by lack of surface drainage or by absence of subsoil drainage or by deficiency in both. When a green is flanked by a hillside, especial drainage is necessary to take care of the seepage coming out of the hill. In wet seasons this is often very injurious. Surface drainage must always be provided. If any saucer-shaped depression occur in a green, the turf in the hollow, especially if it be Creeping Bent, will turn yellow. In general it may be said that wherever Creeping Bent turns yellow the drainage is defective.

It must be admitted that satisfactory putting-greens have been established where one or more of the above-mentioned factors are lacking. Such cases do not demonstrate that the omitted factor

is of no consequence, but merely that the other conditions are unusually favorable. No hard and fast rules can be laid down that will insure the securing of good turf under any conditions, as the factors involved are numerous and far from being thoroughly understood. So far as our knowledge goes, however, all of the factors emphasized are of prime importance, and it is rare that any one of them can be neglected and good results be achieved. The rare cases where good results are secured by haphazard methods are simply exceptional.

IMPROVING SANDY SOILS ON FAIRWAYS

The growing of satisfactory turf on the fairways of golf courses where the soil is sandy in texture is often difficult, depending mainly on the degree of sandiness of the soil, but partly on the available grasses adapted to the region. Sandy soils may be classified as follows: coarse sands, fine sands; sandy loams, fine sandy loams.

Neither coarse sand nor fine sand will produce a satisfactory growth of turf. In both cases a surface soil must first be secured, which is always an expensive process. This may be done by either of two general methods. (1) By covering with a layer

of good soil. This should be at least three inches deep and preferably of a clayey loam, as much sand will become mixed with it in the process of hauling and leveling. (2) By mixing vegetable matter and clay in the sand to a depth of about six inches. Where the vegetable matter is readily available in the shape of muck or peat, it is cheapest to use this material. Where such humus is not cheaply available and time is not important, a crop of rye, cowpeas, or other plant adapted to sandy soils may be grown and plowed under. Vegetable matter and sand alone are, however, not sufficient, binding material of clay or silt being essential to make a real soil. Clay is not easily mixed with sand unless it be dry and pulverized.

Sandy loams contain about twelve per cent of clay and usually about twice this amount of silt. Such soils will grow good fairway turf if the proper plants be used. In the North the best plants for the purpose are Red Fescue, Rhode Island Bent, and White Clover. The latter is especially important as it does not require nitrogenous fertilizers. Whatever objections may be held against White Clover on putting-greens, they do not apply on fairways. Redtop is also useful. Sheep's

Fescue and Hard Fescue are both well adapted to sandy lands, but should never be used on fairways, as they are strictly bunch grasses. What turf they make gives objectionably cuppy lies for the ball. Red Fescue will thrive equally well and make a true creeping turf. The other fescues are desirable only in the rough, where they are excellent on account of their tough tussocks and deep roots, which enable them to prevent washing and blowing of the soil. Blue-grass is rarely useful on sandy soils.

In the South the available turf plants for sandy soils are Bermuda-grass and Japan Clover for summer, and Italian Rye-grass, Redtop and White Clover for winter. Where Carpet-grass thrives it is an excellent all-the-year grass.

Established turf on sandy fairways can best be maintained by periodic surface dressings of a good clayey loam rich in humus. On courses where peat and clay are available, this soil should be made by composting the peat and the clay in alternate layers of each about four inches deep, with an occasional layer of barnyard manure. This latter furnishes an abundance of bacteria so necessary to bring about the further decomposition of the

peat. A small amount of lime, preferably ground limestone, may be scattered on each layer of peat, and this will intensify the bacterial action. Such compost heaps should be prepared at least a year in advance of their use, and a longer period is preferable.

IMPROVING CLAY SOILS ON FAIRWAYS

The improvement of stiff clayey soils so as to produce satisfactory fair greens is usually less difficult and costly than is the case with poor sandy soils. The important difficulties usually encountered are that the surface soil puddles and bakes easily, and the subsoil is often impervious. The latter is serious only on flat land, and can be corrected by tiling. Stiff clay soils can be made to produce good fairway turf by the use of humus-forming material, either barnyard manure or the plowing under of a green crop. Lime is rarely necessary or advisable unless Blue-grass turf be desired. It is usually desirable to plow such land before seeding so as to incorporate the humus-forming materials added. Furthermore, by proper seeding a much better turf will nearly always be secured than can be hoped for by attempts to im-

prove such grass cover as already exists. Judgment must of course be exercised in this matter, as there is no need of plowing under turf that is fairly good, for this can be bettered simply by top-dressings of manure and by seeding. Steep hillsides should in particular be left undisturbed, as serious damage by washing may occur. It is safer to improve the turf on such slopes by top-dressing methods.

In case sand or sandy soil can be secured cheaply and in abundance, it is an excellent plan to use it to top-dress very clayey fairways. Not only does the sand make a better surface soil for golf purposes, but it helps the grass both by absorbing the rainfall much better and by preventing baking in dry hot weather. The cases are rare, however, where sand occurs in abundance on or near a clay land course.

In the North most turf grasses succeed well on clayey soils. For general purposes a mixture of Redtop, Blue-grass, and White Clover is cheap and satisfactory. If preferred, the White Clover may be omitted, but it is practically certain to appear, whether sown or not.

In the South Bermuda-grass and Japan Clover for summer turf and Italian Rye-grass, Redtop, Blue-grass, and White Clover for winter turf are



PLATE II. — Upper. Sheep are often used on golf courses in Europe to keep the grass short. The same method could well be used in most northern and western States.

Lower. A sample of good muck which makes an excellent top-dressing for turf.

most satisfactory. Such clayey soils in the South are all located in the hilly regions away from the seacoast, and on such soils, at least where the altitude is 1000 feet or more, Redtop, White Clover, and Blue-grass usually live through the summer and begin new growth with the cool weather of fall. Where such winter grasses do not come naturally each season in sufficient abundance to form good turf, they should be supplemented by fall sowing of Italian Rye-grass. This grows rapidly and will make an excellent turf during the winter, but disappears about the time the Bermuda-grass turf becomes good in early summer.

On the better golf courses in the North, the present tendency is to sow only the fine bents and Red Fescue on the fairways, thus producing a turf nearly equal in quality to that on the putting-greens, but which is not clipped so closely. The growing of such turf on the fairways requires a larger expenditure for seed than where Blue-grass and Redtop are used, but provided the soil conditions are satisfactory the cost of the seed is the principal additional expense.

ACID OR SOUR SOILS

An acid soil in the agricultural literature of the day is commonly defined as one on which most farm crops are stimulated by the application of lime. Such soils will usually turn blue litmus paper red when the moist soil is left in contact with the paper for a few minutes. On the basis of this test a large percentage of the area in the eastern half of the United States is acid. When it is desirable to correct soil acidity, it is usually done by applying lime in some form. There are several methods to determine the relative acidity of a soil and by this means ascertain its "lime requirement," that is, the amount of lime necessary to neutralize the soil of one acre to a depth of eight inches. The "lime requirement" of a very acid soil is frequently as high as five tons an acre.

In speaking of "lime requirement," many writers make the tacit assumption that a neutral or slightly alkaline soil is best for cultivated crops, and that acidity is in general harmful. Another way of looking at the problem is that the lime acts directly on the plant as part of its food, and not indirectly as a correction of soil acidity. This is the older view and in accordance with it plants have been

classified as calciphiles or lime-lovers, and calciphobes or lime-haters. Thus Alfalfa, Red Clover, Blue-grass, Bermuda-grass, and many other plants favor a limestone soil, and their growth is helped by this substance. On the other hand, rhododendrons, huckleberries, and other plants will not thrive when there is an appreciable amount of lime in the soil.

So far as the turf grasses are concerned, their relations to lime may be very simply stated. Blue-grass is much benefited by lime while White Clover and Bermuda-grass are considerably improved. Other turf grasses, including Creeping Bent, Rhode Island Bent, Redtop, Red Fescue, Sheep's Fescue, Japan Clover, are almost indifferent to lime, being neither appreciably bettered nor injured on most soils except as the liming stimulates the growth of Blue-grass, White Clover, and various weeds.

At the Rhode Island Experiment Station plots of various turf grasses alone and in mixtures were planted in 1905. On one series the plots were fertilized with chemicals leaving an acid residue, on the other with chemicals leaving an alkaline residue. After ten years the most noticeable result was that the plots treated with alkaline fertilizers were all very weedy, while those treated with acid ferti-

lizers were not weedy. The acid plots of Rhode Island Bent, Red Fescue, and other fescues were still in excellent condition. The grasses on the other acid plots were almost entirely replaced by Rhode Island Bent.

On portions of the plots not clipped, the growth of the grasses in all cases was greater on the alkaline plots than on the acid plots. This larger yield is important agriculturally, but not from a lawn turf standpoint. The closely clipped turf both on the alkaline and acid plots was dense and fine, but on the former was much inferior, due to the prevalence of weeds.

The lesson from this series of plots is backed up by numerous observations elsewhere. It teaches clearly that Rhode Island Bent and Red Fescue are acid soil plants and on such soils will maintain themselves with little difficulty. If, however, lime or other alkaline fertilizers are used, weeds and other grasses will likely invade the turf.

DRAINAGE

Good turf is rarely seen except on well-drained soil. It is true that some turf grasses like Redtop succeed well in moist or wet soil, but under such

conditions several undesirable plants like rushes and sedges always appear. Furthermore, ill-drained land is very objectionable on a golf course because during some seasons at least the ground becomes soggy, and the turf is injured and made uneven by trampling.

On putting-greens especially the drainage should be ample, but on fairways it is also necessary. A common indication of poor drainage is the occurrence of certain characteristic plants such as thyme-leaved speedwell, selaginella, and various sedges in the North and dichondra and kyllingia in the South.

Satisfactory drainage is best secured by the use of drain tiling. On putting-greens which require drainage, four-inch tiles should be placed in lines about six feet apart and at the proper depth to collect the seepage and carry it away. On good permeable loams the tile should be eighteen to twenty-four inches deep; but if the soil is not very permeable they should be placed at a depth which will permit them to collect the seepage. Where a putting-green is flanked by a bank or hill, a line of tiles at the base of the bank or hill to collect the seepage is necessary.

Inadequate drainage on a putting-green composed of Creeping Bent is always promptly indicated by the grass turning yellowish. If a green be so constructed that there are shallow concavities without surface outlet for drainage, the grass in such places is sure to turn yellow. Drainage in these cases may be secured by the use of a "soak-away," that is, a vertical column of sand or other permeable soil to connect with a tile or other subterranean drainage. As a rule, however, a putting-green should be so constructed that there are no hollows unless these have broad surface outlets.

Tiling is also frequently very important on fairways, but as these are rarely watered artificially the tiles need not be so close together.

Subterranean drainage to putting-greens is sometimes secured by the use of a layer of rubble or clinkers in the foundation, one to two feet below the surface of the green. To some extent such a drainage layer reduces the trouble from earthworms, but the disadvantages scarcely compensate for this slight benefit. A drainage layer is expensive to construct in the first place, and sooner or later will become entirely clogged by silt carried in the seepage waters.

While good drainage, either surface or subterranean, is necessary to secure turf, it must be remembered that its only function is to carry off surplus water so that the soil will not become soggy and the plant-roots thus deprived of air. Good drainage alone will not insure good turf, as nearly any piece of sandy or gravelly soil will demonstrate. There must also be fertile soil.