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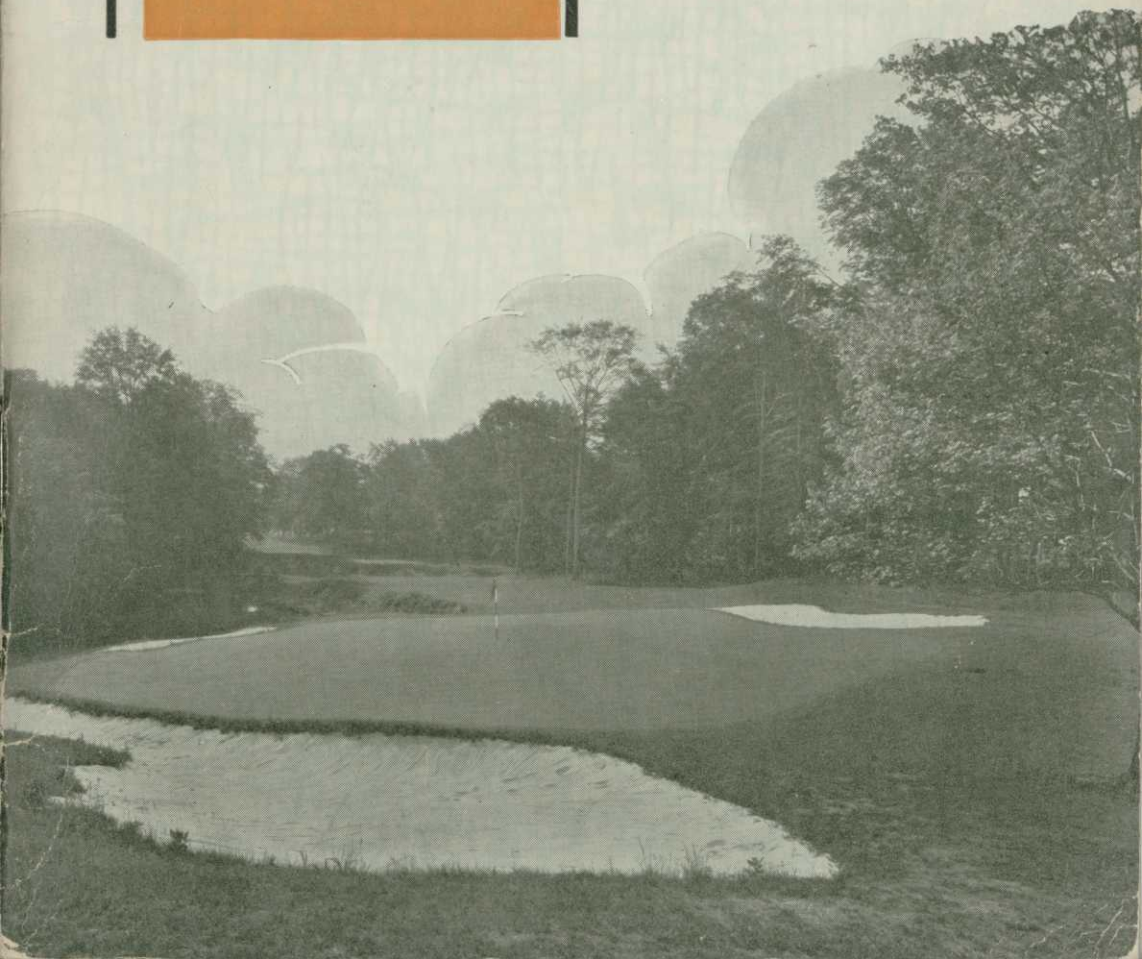
The

PUTTING

GREEN

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The cover illustration is number nine green of the new Country Club of Cleveland course.

Here eighteen greens of Scott's Washington strain of Creeping Bent give superb putting.

Toomey & Flynn, Architects
B. G. Sheldon, Greenkeeper

THE PUTTING GREEN

Its Planting and Care



1931

O. M. SCOTT & SONS COMPANY

MARYSVILLE, OHIO

In publishing this bulletin we acknowledge with appreciation the help obtained from the Green Section of the United States Golf Association, and from a host of progressive greenkeepers.

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BAYSIDE COUNTRY CLUB, Bayside, Long Island, N. Y.—a truck garden being transformed into a marvelous golf course for the Meyer-Cord Realty Corp. Laid out by Dr. Alister Mackenzie, architect; built by the Wendell P. Miller Organization. A complete fairway irrigation system and five tons of Scott's Seed insure good turf.



GRASSES FOR GREENS

THE *Putting Green* has the greatest drawing power of the golf course. It is the *promised land*. Dub and professional alike regard it with the utmost respect. Even the beginner who battles his way desperately over unexplored parts of the course winds up at the green with a feeling of real achievement. And what a thrill he receives when his ball rolls on the carpet-like turf, toward the cup, and then—drops.

Golfers do much talking about smooth, well-grassed fairways, they are likely to appreciate picturesque scenery and layouts that are sporty and testing to their skill, but they actually *rave* about greens. A course is known by the *greens it keeps*.

Our purpose in publishing this bulletin is to impress new clubs with the importance of building their greens well; also to assist the old established club in keeping its putting surfaces in the very pink of condition.

Much is demanded of putting green turf. It must withstand extreme wear, and, at the same time, be composed of grasses which are fine textured and which will give a smooth, even roll to the ball. As such varieties of grass are not common, their selection is one of the most important factors in building a golf course.

In choosing grass for putting greens, geographical location must be considered first. Grasses are usually divided into those suitable for the North and those for the South. The boundary is, roughly, an imaginary line running from Washington, D. C., to Asheville, North Carolina, through Tennessee to St. Louis, thence directly west to include Idaho, north to avoid the interior of California, and south to include the California coast. (See accompanying map.) The line is not exact as in some sections northern grasses will thrive south of the line and vice versa. Mountainous regions of the South represent an exception.

Bent Grasses

In the North, bent grasses have assumed first place for putting greens.

They seem to have the necessary qualities to make good greens turf better than any other variety.

Bent will stand closer mowing than common grasses. While it cannot be considered good cultural practice, some bent greens are cut as close as three-eighths of an inch or even less. Ordinary grasses will not survive this treatment. Because of a dense blade growth, bent is resistant to excessive wear and abuse. It is a vigorous grower and so is quick to heal after injury. Bent produces playable turf in a short time, especially if planted vegetatively by the use of stolons.

A disadvantage of bent is that it is more expensive than other kinds. In addition, it cannot be used successfully unless artificial watering facilities are available. And, it seems more subject to disease.

Kinds of Bent

There are so many different varieties and species of bent that the whole subject seems confusing to the layman. However, the kinds really adapted for use on putting greens are few. They are described briefly as follows:

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Colonial Bent, also called Rhode Island and Browntop. This is a generally non-creeping variety that does not form as matted and compact a sod as true creeping bent. It is less exacting in its demand for moisture than creeping bent and will even thrive on dry, sandy or clay soil. It has a wide range of usefulness.

Velvet Bent. As its name implies Velvet produces a fine stem and leaf growth of velvet-like character. It spreads slowly from overground creeping stems. Pure Velvet Bent seed is almost unknown, as it is usually mixed with other varieties such as South German Mixed Bent. In some instances seed of 50% pure Velvet Bent may be obtained but the cost is almost prohibitive.

South German Mixed Bent. This grass is a mixture of Colonial, Velvet and Creeping Bent with some Redtop. It is largely used for putting greens and a good grade of it produces excellent turf. The turf, however, will be variegated in appearance and texture because of the different kinds of bent in the mixture.

Seaside Bent, also known as Coos County Bent. Seaside is produced chiefly in Oregon and Washington. It is distinctly a creeping grass spreading by trailing and rooting overground stems. Seaside has been commercially available for only a few years, but in that time

has become quite popular. It is being used in increasingly larger amounts each year as its good features are appreciated.

Particularly encouraging have been the results with Seaside in Oklahoma. Other varieties of bent will not survive so far south, but since its introduction into Oklahoma in 1928, Seaside has proven very satisfactory even in the extreme southern parts of the state.

Creeping Bent. Creeping Bent is a widely used expression which has lost its value as referring to any particular kind of bent. Formerly it was used to describe South German Mixed Bent but that was misleading as South German Mixed Bent contains a very small percentage of true Creeping Bent. There is practically no true Creeping Bent seed available except as it may be a part of South German Mixed Bent. Seaside comes nearer to the classification of Creeping Bent than any of the others but it has not been recognized and named as such by the U. S. Department of Agriculture.

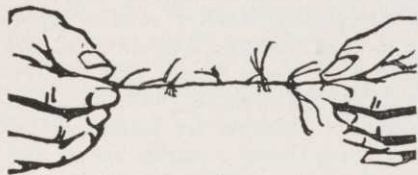
Redtop. While botanically classified as a bent, Redtop cannot be considered with them except as it is often used as an adulterant of the other kinds, particularly of South German Mixed Bent. It is the coarsest and cheapest of the bent species and is primarily a nurse grass for fairway seedings.



The black line represents the approximate boundary of northern and southern putting green grasses.

It is almost impossible to utilize bent south of the line except in mountainous regions where the climate is similar to that of the North.

Creeping Bent Stolons. By accident it was discovered that some of the fine bent varieties could be planted vegetatively. This enabled authorities to select the most desirable strains, and, by nursery propagation keep them absolutely true to type. So far, planting the seed of such grass has not given the desirable turf produced by planting the chopped roots and runners.



A creeping bent stolon.

The vegetatively planted bent was found so successful that in recent years a large percentage of greens have been planted in that way. We early realized the advantages of this method and in 1921 established a large nursery for the propagation of Creeping Bent. A photograph of a small part of the nursery is shown on page 8.

When Creeping Bent is cultivated in a nursery the grass develops long over-ground creeping runners. These are called *stolons*. Stolons are jointed at close intervals, and, in the joints or nodes, as they are sometimes called, are the buds from which new plants develop. (See sketch above.) Whenever the joints come into contact with soil a new plant is formed. Thus a closely knit turf results, as the joints produce a continuous succession of new plants.

Creeping Bent has many different strains and some of them are entirely unsatisfactory for putting greens because they develop a decided grain or they are comparatively coarse. Of the many strains the Washington has emerged as the best, and is now used almost exclusively for the vegetative planting of

greens. There is one other strain which compares with it, that being the Metropolitan. It is quite popular in the East.

For planting greens the nursery turf is taken up and cut into pieces one to two inches long. This chopped grass is then broadcast over the green's surface much like seed and given a light top-dressing of screened soil. Stolons are shipped by express, refrigerated freight, or delivered by truck, because they are perishable. They are sold on the basis of the planting area and not by weight or measure. In other words, Creeping Bent stolons are quoted on the basis of the number of square feet in the greens to be planted.

Other Grasses for Greens

While bent grasses are used mostly on putting greens, other varieties may be planted because of the necessity of using something cheaper, or because bent is not adapted, or because watering facilities are not available. In general, bent grasses are not suitable for use on greens which are not to be watered regularly during dry seasons.

Fescue is a grass adapted for putting greens as it stands fairly close cutting and holds up well under heavy wear. Chewings New Zealand Fescue is the only safe variety of fescue to seed on greens. European Red Fescue, so highly recommended, is often badly mixed with either Hard or Sheep's Fescue. These are coarse and inclined to bunch, and are unsatisfactory on a golf course except in the rough.

Kentucky Bluegrass is somewhat coarse for use as a turf on putting greens. In some cases, where the soil is especially adapted to it, it is possible to keep it fine by frequent cutting, topdressing and fertilizing. As it is not aggressive in the seedling stage, Bluegrass should not be

The Putting Green

planted alone, but seeded with a nurse grass such as redtop.

Redtop is the cheapest grass that can be planted on putting greens. While it is classified as a bent it is considered to be the poor relation of this aristocratic family. Redtop germinates quickly and produces a vigorous seedling which is of fine texture and practically identical to bent the first season. It becomes coarser the second year. On putting greens Redtop will not stand the continued close cutting and so dies out before its coarseness has become objectionable. To have a suitable putting surface with Redtop it is necessary to reseed once or twice each year.

Mixtures. Quite often Redtop is mixed with bent or other seeds for the purpose of economy in planting. It is necessary to use it with bluegrass, as a nurse crop, and advisable to use it with Fescue.

Bent seed mixed with either fescue, bluegrass, or redtop will make a better turf than when the other varieties are seeded alone, for a lesser cost than plant-

ing straight bent seed. Colonial is an excellent variety for planting with fescue, as both thrive under similar conditions of soil and care.

Southern Grasses. The grasses just mentioned are suitable only for the North. South of the imaginary line described above, Bermuda is about the only satisfactory putting green grass. It is creeping in habit and vigorous in growth. Unfortunately, however, it turns brown at the first frost and does not make turf during the winter months. For this reason, redtop, ryegrass, and sometimes Kentucky bluegrass are planted in the late fall to furnish a putting surface during the winter months. These varieties are seeded in with the Bermuda each fall and the same green used both in winter and summer, or separate winter greens are made and seeded. This latter practice is better as the close cutting and trampling of the dormant Bermuda during the winter months is harmful to it. The dual green method is to be advised wherever practicable.



Creeping Bent Stolons as they are grown in the Scott Nursery.



CONSTRUCTION OF GREENS

As mentioned before, putting greens offer special problems because of concentrated play. More than this, the turf is kept cut unnaturally close so that the root system is correspondingly limited in growth. Greens are frequently placed on poorly drained areas or where the soil is poor in order to procure a better golf hole from an architectural point of view. Often these will be on sides of hills where there is danger of surface wash or excessive seepage water.

Design

In designing a green, surface and subsoil drainage are important. The grade should be such that the green will drain and there will be no holes or pockets in which water will stand. Inadequate drainage is often a cause of winter-kill. In the design, mowing and maintenance should be considered. Abrupt depressions and undulations are likely to be scalped by mowers. They are also unfair to the average player. It is difficult to hold moisture in turf on steep grades. A grade of more than three per cent is considered undesirable. In the opinion of some of our finest architects, every green should face the player. He should be able to see the ball roll up to the cup—one of the greatest thrills in golf. Greens should rise from front to back. Often the rear of large greens will be as much as ten feet higher than the front edge.

Size

The size of greens depends upon the type of hole and its location. In general, a small green is one of 3500 square feet while one of 8000 square feet or over is considered quite large. An average green contains 5000 square feet, making a total of approximately 100,000 square feet of

greens area in an eighteen hole course. On public or semi-public courses, where heavy play is expected, it is better to have larger greens, so that wear may be more evenly distributed by frequent changing of the cups.

Grading and Shaping Greens

Saving topsoil is of prime importance. Before the site for any green is leveled or filled in, as the case may be, all topsoil should be removed to one side and not replaced until the subsoil grade is established.

Before the green is shaped and graded its subdrainage should be studied as well as the likelihood of its being subject to surface wash or seepage from higher ground in the immediate vicinity. Surface water from nearby hills may be kept from the greens by grassy hollows and sand traps. Such traps and hollows should conform to the architecture of the hole. If built while the green is graded they will look more natural, particularly if the work is done by horse scoops rather than by hand, as by their use it is possible to more nearly approach nature's gentle undulations and slopes. If a green is located at the foot of, or in the side of a hill, particular attention must be paid to the disposal of seepage water which is almost certain to come from the hill. A line of tile inserted at the back of the green and around it will carry off such excess water. The tile should be laid so that they will be at least as low as the putting green surface.

Drainage

Except in very loose soils, tile drainage is needed for all greens even though they are built up. Bent grasses particularly

The Putting Green

need much water, and the excess which must be applied should find facilities for easy removal. Compact soils need tile drainage. A tight subsoil is likely to become almost impervious to the free rise and fall of soil water. Superfluous water must be carried off so that air, which is necessary for the growth of grass roots, may circulate through the soil and so that capillary water—which is the only type of moisture the grass can make use of—can move through the soil without interference. One feature of tile drainage is that it reduces the danger of winter-killing. By carrying off excess moisture it removes the possibility of injury from the alternate freezing and thawing of soils, which causes heaving. Heaving tends to pull the roots of the plants out of the ground. Another advantage of tile drainage is that it helps to dry the course earlier in the spring and often brings it into playable condition two or three weeks ahead of the usual time.

Tile Installation

Putting greens are usually drained by means of four inch tile laid in herring-

bone fashion, with the main line through the lowest part of the green. The laterals are staggered into the main line. The tile need a fall of at least one inch in twenty feet. In clay soils laterals are placed 2 to 2½ feet deep and about 15 feet apart. In sandy soils the laterals should be from 20 to 25 feet apart.

Backfilling above the tile lines with three-fourths inch crushed stone or gravel to within eight inches of the finished grade is often done to improve drainage conditions. This will insure a quicker disposal of a heavy down-pour of rain. The back-fill should never be close enough to the surface so as to interfere with placing of the hole cup.

It is well to install drainage lines several months before seeding so there will be time for the trenches to settle. Advantage should be taken of this same period to lay the necessary pipe for watering the greens and fairways. A map, made at this time, showing all of the important facts regarding the tile line and watering system, will prove invaluable in later years.



TRAVERSE CITY MICHIGAN COUNTRY CLUB. A fine green of *Chewings Fescue*.



THE PUTTING GREEN SOIL

Economy in golf course construction requires that the *subsoil* of any green will be whatever can be obtained on the property. Therefore clay, silt, sand, peat, and all soil textures in between form the subsoil basis. Not much can be done to them except at great expense. The subsoil condition will be greatly improved by the addition of tile drainage and care in grading so that water will drain from it naturally just as from the surface soil.

Physical Character of the Soil

Regardless of the subsoil, the *topsoil* of all greens should be of about the same physical structure. This topsoil, which should be from four to six inches deep, is the layer in which the root system of the grass works. In it roots get moisture and plant food. It must be of an open, friable structure so that the roots may spread unhampered in any direction, and porous enough to allow for easy absorption and drainage of water. Porous soil also permits circulation of air which is necessary for plant growth.

The ideal topsoil is a sandy loam. Loam consists of sand, silt and clay in certain proportions. Topsoil should contain at least ten per cent organic material and thirty per cent sand, while the balance may be clay or silt.

Preparing the Topsoil

If time permits and expense is not a serious factor, topsoil may be prepared by the acre. Areas of good soil on the property are improved by plowing in manure, sand, green cover crops, or whatever the soil requires to bring it to the composition described above. However, it is less costly to use topsoil stripped from the putting green area and if additional soil is needed to use that which is removed from traps. Sometimes good soil is brought in from the rough.


Good topsoil should never be removed from approaches. Such areas are most important in golf and must have good turf. This cannot be secured on subsoil. It is better to add topsoil to approaches rather than to remove it.

Improving the Topsoil


Heavy soils, or extremely light soils, such as sand, should have from ten to fifty tons of manure disked into the upper few inches of each green. Other materials such as sewage sludge may be substituted but it is necessary to use them in very large quantities to appreciably affect the condition of either a heavy or light soil. The purpose of organic matter is to retain moisture, and, as it decomposes, provide plant food. Also, the particles of organic matter force apart the particles of clay or silt and make the soil more crumbly and open in structure. In sandy soils decaying organic matter helps to bind the sand particles together and provides a medium for the storage of moisture and plant food.

Manure Substitutes

When manure is scarce peat moss or muck may be used as a substitute to assist in improving the physical character of sand, clay and silt. Such material should be limed, manured and aerated by cultivation before use. This is necessary because it often contains toxic matter which is harmful to grass. It is seldom advisable to use peat or muck unless there is a deposit of them on the property or they may be hauled in from a short distance and worked into the soil at a cost of a very few dollars per ton. Most peat materials have practically no value except that of improving the physical character of soils. (Note: We will be glad to test samples of peat or muck and advise regarding their use.)



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Peat, muck, peat moss, manure, or any other organic matter should never be placed in layers, as such layers interfere with the capillary movement of water, hinder natural soil drainage, and are not conducive to perfect root development. Such materials should be intimately and uniformly mixed with the upper four to six inches of topsoil.

Changing Texture

Soils may be improved not only by the use of manures or other organic matter but also by the addition of soil of opposite texture. To break up heavy clay, sharp sand is added. To improve a sandy soil, clay or loam is added.

The presence of thirty per cent clay particles in a soil classifies it as clay whereas a soil is not classified as sand unless it contains eighty per cent sand. Hence small amounts of clay are needed to change sandy soils but large amounts of sand are required to materially change the properties of a heavy clay soil. This is because of the difference in size of the soil particles. As clay is very fine a given bulk of it will have a much greater modifying effect than the same bulk of sand which is much coarser grained.

Other materials that may be used to break up heavy clay are very fine cinders, basic slag and sifted ashes. As with manures, however, they should not be put into a green in layers but thoroughly mixed with the soil.

Applying the Topsoil

Topsoil for greens should be put on after the tile line trenches and the subsoil has thoroughly settled. If possible it should be spread early enough to permit weeds to sprout and be cultivated out before the greens are seeded. Such cultivation also helps to make a fine surface. A heavy soil must not be worked when wet as this will result in puddling

and making a compact mass, rather than the open friable structure so desirable.

In addition to the manure which is worked into topsoil it is advisable to add commercial fertilizers. A complete fertilizer with an analysis of four per cent nitrogen, twelve per cent phosphoric acid and four per cent potash is desirable. About fifteen pounds per 1000 square feet should be worked into the upper inch of soil just prior to the last hand raking. If commercial fertilizers are put in too deep they will do no good during the first two or three years as they will be beyond the reach of the grass roots.

Before greens are seeded, it is well to consider the likelihood of damage by white grubs and earthworms. If there is a chance that they may become a serious pest the greens should be treated with arsenate of lead. This is worked into the surface soil, after the fertilizer, at the rate of five pounds or more per 1000 square feet. There is some evidence to indicate that such poisoned soils may retard the growth of new turf and so the treatment is not advisable unless it seems necessary.

Preparing the Seedbed

In the final preparation of the green for seeding, the area should be worked by hand. At that time all stones of a size that would interfere with the hole cup must be removed to a depth of six inches. The topsoil is hand raked and worked until it is brought to a fine mellow consistency, with the upper inch as fine as sifted ashes. During this preparation, rolling the surface several times will make it even and compact. Rolling also indicates any irregularities that need to be smoothed and trued. The surface should be checked and re-checked to be sure that all parts of the green will drain naturally. A close textured soil must have a grade of at least six inches to fifty feet.



PLANTING GREENS

When to Seed

Regardless of the number of volumes written about fall seeding, many golf courses will be seeded during the spring and summer months, to the later sorrow of the greenkeeper and members. The ideal time to plant greens, whether with seed or stolons, is in early fall between August 20th and September 30th. At that time, unlike conditions in the spring, the soil will be reasonably free from sprouting weeds. There is also a much better chance of getting sufficient rainfall of the kind and amount needed for germinating the seed and supporting a healthy seedling growth. In late spring and throughout the summer there is an insufficient amount of rainfall, while in early spring it usually comes in heavy showers and in such large quantities as to cause considerable washing. The natural moisture supply is most important, regardless of artificial watering facilities. Artificial irrigation will not wholly replace rainfall in the development of turf.

Fall is Best

Fall is the time when nature sows seed and man can profitably follow her example. In addition to less trouble from weeds and drought, weather conditions are such as to encourage root development and not the excessive blade growth which results from spring seeding.

Even though the course is in shape so that the greens may be planted in spring or early summer it is usually the following spring before they are ready for play. They would be playable just as early and at less expense if planting were deferred until August or September of the same year.

Stolons Safe Anytime


Creeping bent stolons are often used because, if water is available, they can

be planted with comparative safety at any time during the growing season. While grass planted from seed in late spring or early summer will be very slow in developing turf, greens have been brought into play in from eight to ten weeks by the use of stolons. But, stolons cannot be successfully started unless water is available in large quantities as they require a great deal of moisture during the first few weeks.


It is not always safe to predict the length of time necessary to get greens into play. In general, greens stolonized in September will be ready in early May of the following year. Those planted with seed will require more time for development and are not likely to be ready until about a month later. When planted at other seasons eight or ten weeks of good growing weather is usually sufficient for stolons and twelve to fourteen weeks for seed.

With Seed

If one of the varieties of bent seed is selected for the greens it should be planted at the rate of four pounds to 1000 square feet. This applies to South German Mixed, Velvet, Colonial, Seaside, Astoria, or any other seeded variety. If it is necessary to reduce the amount of money spent for seed this can be done by seeding one pound of redtop with three pounds of bent. If redtop is used alone four pounds per 1000 square feet is sufficient. Chewings fescue must be seeded at a heavier rate because the seed is much larger and does not go as far. Redtop should be mixed with fescue, to act as a nurse crop, at the rate of one pound of redtop with six pounds of fescue per 1000 square feet. If Kentucky bluegrass is used it also should be mixed with redtop in the same proportion.



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Seed Mixtures

If either bluegrass or fescue is mixed with bent seed the proportion of the mixture is important. Fescue and bluegrass seeds are much larger than bent and so greater quantities of them must be used to avoid an uneven turf. Unless the amount of fescue or bluegrass used is comparatively great (by weight) the results will be an occasional plant of fescue or bluegrass with bent between, giving an irregular putting surface. A good mixture is 75% chewings fescue and 25% bent; or 65% bluegrass and 35% bent.

Sowing

Seed is usually broadcast by hand although a wheelbarrow seeder or like implement sometimes does a better job. As bent seed is so very fine it is advisable to mix it with an equal bulk of sand or fine screened soil to aid in its distribution.

The sowing should be followed by a light raking to cover part of the seed. This must be done carefully to avoid pulling the seed into ridges or rows. After raking, a light rolling will compact the soil around the seed and insure moisture for germination.

Watering

A seeded green is watered immediately after planting if it is desired to hasten germination. It is not absolutely necessary, however, as no harm will come to the seed if it lies in the ground for a few days without moisture. If watering is once started it must be kept up regularly or a hard crust will form on the surface which the seedling will be unable to penetrate. This watering should be sufficient only to keep the germinating layer moist at all times. To do this it may be necessary to water seeded greens at least twice during the day, as, in warm weather, the surface dries rapidly. A spe-

cial type of nozzle, which will deliver the water in a fine spray, will not dislodge the soil.

Planting With Stolons

The soil preparation for planting stolons is the same as for planting seed. The only difference is that it is necessary to prepare in advance sufficient screened soil for covering the stolons. Compost is preferable although a good loam soil is satisfactory. It should be of a sandy nature and not heavy clay nor pure sand. Whatever is used must be screened through a quarter-inch mesh screen. So that there will be no delay in topdressing, sufficient of the screened soil should be placed near each green for use on it. The amount of such topdressing required will be about one cubic yard per 1000 square feet of planting area.

After stolons have been planted it is necessary to water them at once. Therefore, if the lines are not in, or if for some reason watering facilities are not available the planting should be postponed.

For planting greens, the creeping bent turf is taken up from the nursery and run through special chopping machinery to cut it into short lengths. These chopped stolons are then ready for planting. While stolons will retain their vitality for several days it is best to have the planting arrangements ready before they are ordered shipped. The sooner they are put into the ground the faster they will grow. (Illustrations of planting operations will be found on pages 20 and 21.)

Scattering the Stolons

These chopped stolons are broadcast over the greens area. The ground is covered thinly, as shown in the illustration (page 20), the object being to get one live joint on each square inch of surface. After broadcasting, the stolons should be rolled lightly to press them



into the soil and then topdressed immediately with about one-fourth of an inch of the screened soil. This can be put on by hand as illustrated, or by means of special topdressing spreaders. The stolons will not be completely covered and many of them will protrude above the surface. This is advisable as they should not be buried. The area is rolled lightly again and watered at once. A special spray nozzle should be used to avoid washing of the topdressing material and disarranging the stolons.

Watering Stolons

The care in watering newly stolonized greens determines largely the success of the planting. The key to success is to keep the surface soil moist at all times. It is not necessary to saturate the soil but light applications of water should be made at close intervals. During a warm period when the sun is shining it is essential that the greens be watered two or three times per day. This is most important. If the surface soil is allowed to dry out completely during the heat of any single day the grass may be killed completely. This regular watering is necessary for at least two or three weeks or until the grass has become well rooted.

Subsequent Care

Following planting, watering of either seeded or stolonized greens will be the only care necessary for a few weeks. After the grass has developed a height of one and a half to two inches either seed or stolon greens should be mowed. The mower must be sharp so that the tender grass is not bruised or pulled out by the roots. Merely the tips of the blades should be cut off and the clippings allowed to fall. Following this first mowing subsequent cuttings of seeded greens should be made regularly and the mower blades gradually set down to cut at putting green length. After the first few times, it is best to remove the clippings.

Cut Closely

After stolonized greens have been cut three or four times the mower is set at putting green length to keep the grass short. The greens should be lightly topdressed following the first few mowings to encourage the rooting of the new joints and to true-up the surface. After the grass begins to thicken it is well to remove the clippings. In order to encourage an upright growth of creeping bent it is necessary to mow it closely. Therefore, after the third or fourth cutting, this should be done, else there is danger of causing a rank and matted turf.

New greens and established greens, as well, should go into the winter with a comparatively long growth of grass. Therefore, mowing should cease a short time before growth stops. This longer growth will result in: more carbohydrates being stored in the roots, snow being held for protection of the roots, and protection against unseasonable weather causing a too early growth.

Early Topdressing

During the first few months after planting it is necessary to topdress greens frequently. This serves to fill in slight depressions in the surface and to cover the creeping runners of bent. After the grass is fairly well established topdressing should be lightly brushed in around the new plants. In the early stages of growth topdressing may be done as often as once each week, the frequency depending upon how fast the turf thickens and holds the soil after it is spread.

Weeds

During this period some weeds are bound to sprout, and, while they do not offer much of a problem on stolon greens they do on seeded greens. On seeded greens they should be removed just as quickly as it is possible to get on the newly planted area without damag-

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ing it. On stolon greens the spread of the bent combined with close mowing will serve to crowd out most weeds. Usually, the majority of weeds that appear are annuals which are destroyed by mowing. However, if such perennials as dandelions, thistle, buckhorn, plantain and the like develop, they should be pulled out, as no stand of young grass can overcome them.

Other Treatment

Except in unusual cases new greens need not be fertilized until after they have been brought into play (see p. 22).

New greens planted with stolons in late fall should be carefully watched during winter and early spring for signs of frost heaving. As the young grass does not have much of a root system

alternate freezing and thawing may literally lift some of the grass out of the ground. This exposes it to an excessive drying out which may be disastrous, as stolons require moisture, even in winter. If this happens, the greens should be lightly rolled to press the grass back into the ground.

While it may seem that young, tender grass should have some special winter protection, authorities agree that not much can be done. The longer growth of grass recommended will be helpful but that is about all. Straw is often used to cover new greens but there is some question as to the advisability of its use. During a wet winter, the straw will pack and keep much needed air from the grass.



LAKE PLACID CLUB IN THE ADIRONDACKS. Here five private courses owned by the club are well maintained with Scott's Seed.



MAINTENANCE OF GREENS

Mowing

During the playing season greens are mowed almost every day or at least five or six times during the week. Special greens mowers are used, there being a number of excellent makes on the market. The mower must be kept sharp and adjusted at all times and used only by capable workmen. The first thing they should be taught is to mow the greens in absolutely straight lines disregarding undulations and contour. Needless to say, the cuttings should overlap to avoid leaving ridges. After the green is cut the mower should be run around the outer edge to form a frame for the putting green proper. It is well from day to day to change the direction of cut to encourage a more upright growth. As the clippings are always removed, a definite plan for their disposal is required. They may be spread thinly over bare places in the rough where they will add humus to the soil, or put in sacks or piles to be later picked up and carried to the compost pile or bed.

Rolling

In a sense, a putting green is rolled each time it is mowed. But, in addition it is necessary to use a medium weight roller in the spring. This rolling firms the earth that has become heaved by the action of frost and reestablishes the smooth sweep of the undulations. Greens are rolled when all frost is out of the ground and the turf begins to feel firm to the foot. Heavy soil must be rolled with discretion, for if it is the least bit wet it will pack. While sandy and gravelly soils may be rolled without much thought, extreme caution should be exercised in rolling any heavy soil. Rolling should not be expected to iron out bumps and other decided irregularities. These

must be taken care of by topdressing or by stripping off the sod and removing some of the under soil.

Topdressing

Greens of either seeded or stolon grass can only be kept in good condition by regular topdressing. This serves to keep the surface true and free from slight irregularities so annoying to players. At the same time it covers the runners and roots and provides a surface of new soil for a thicker growth of grass. The thicker the turf, the less trouble there will be from weeds and from drought. By providing a surface mulch, topdressing improves capillary action and conserves the moisture supply. If compost is used for topdressing, it adds valuable organic matter and encourages the propagation of the bacteria which are necessary for the release of plant food materials to the grass.

New greens need to be topdressed every few weeks, while established greens are topdressed four or five times during the playing season. The topdressing application should be light and worked into the turf so that it will not interfere with play. It is better to make a greater number of light applications rather than occasional heavy ones.

Materials for Topdressing

Topdressing materials are of three classes: (1) sand; (2) screened loam soil; (3) screened compost.

The purpose of sanding greens is to lighten heavy clay soils. Only sharp and comparatively coarse sand that will work down into the clay is suitable. Real fine sand tends to form a crust. Sand topdressing adds nothing to the green except a mechanical improvement of the soil condition. Unfortunately, during the past few years the theory has been ad-



The Putting Green



vanced that sand mixed with commercial fertilizers is all that is necessary to maintain putting greens in a healthy condition. This is entirely wrong.

If compost material is not available a good grade of loam may be used. Such loam should preferably be composed of particles of opposite texture to that of the green. If it tends toward a heavy clay a sandy loam is best, while if the soil is sandy, clay is better.

Best of all, however, is compost. It improves the soil both mechanically and chemically.

Distributing Topdressing

The distribution of topdressing is made in several ways depending upon the equipment available. Sometimes it is hauled onto the green in wheelbarrows and scattered over the surface with shovels. It may be dumped in small piles and spread by means of a so-called rake board. Probably the most satisfactory method is to use a mechanical topdressing spreader.

Regardless of the material used, all topdressing should be worked down into the grass roots. Ordinary push brooms or cocoa or flexible steel mats, or even bamboo poles are used. Greens are watered immediately after topdressing.

Sulphate of ammonia and other fertilizers may be mixed with topdressing to save a separate application. Other materials are also mixed with it at times, as for example arsenate of lead for grub control.

Compost

The preparation of a quantity of compost is advisable in the early stages of the development of a golf course. A supply of good compost is necessary to keep putting greens in first class condition and the earlier such a supply is available the

quicker it will be possible to bring the putting greens to perfection.

What Compost Is

Compost is an intimate mixture of humus-forming materials with soil and sand. After mixing, it is allowed to decompose for a period of time so that weed seeds are destroyed and the number of friendly soil bacteria increased. A good compost, containing a liberal quantity of organic matter, is not only favorable for the multiplication of bacteria but also promotes aeration of the soil. A fertile soil is necessary for the heavy crop of grass that a putting green must produce, and topdressing with compost helps to return the fertility removed from the original soil. In addition to its influence on the growth of grass, compost makes the soil more resilient, so greens will hold pitched balls better.

Methods of Making

Compost is made in two ways. The older method involves the construction of a so-called compost pile. The newer method, in contrast to making the compost in a relatively small area, involves spreading the material in shallow layers over a large section of ground, sometimes as much as an acre. Both methods have obvious advantages although the soil bed method is considered more economical because it can be worked by means of machinery, while the pile involves mostly hand labor.

The Compost Pile

The compost pile is built up in layers about six inches deep. First a layer of soil and then a layer of manure. Other organic materials may be used as partial substitutes for manure such as peat, sod, or grass clippings but they should be placed next to manure. As some natural peat and muck deposits are very toxic or poisonous in character they should be



erated and cultivated for a period of time to dispel toxic substances. As it is made, the pile should be wet down after each layer has been put on. The addition of a complete fertilizer to the pile, during its construction, hastens decomposition. One hundred pounds per ton of compost material is sufficient.

In building a compost pile the texture of the topdressing material required should be considered. If the natural putting green soil tends toward a heavy loam or clay, considerable sand should be added. If, on the other hand, the greens are very sandy, it is well to use clay and loam liberally. Usually the material required is a sandy loam. Unless the soil used in making the compost pile is quite sandy, a sharp clean sand such as building sand should be added.

One Year Needed

A compost pile may contain 8 or 10 layers of various materials. Because of decomposition such piles may become very hot and they should therefore be wet down several times. After the pile has been allowed to decompose for a while it is turned. This may become necessary at intervals of one to two months depending upon the weather. After it has been turned once, the heating will be less intense and there is little chance of the organic matter being destroyed by burning. For thorough decomposition and destruction of weed seeds, the pile should be turned after there is no more heating and allowed to stand some time before being used. The minimum time required for making compost in this way is about one year.

Organic materials should represent at least 15% or 20% of the compost bulk. If manure is scarce, it may be replaced up to 50% by peat or other organic material such as rotted straw and leaves. It is usually advisable to mix about 25 lbs.

of lime with every ton of peat before putting it into the pile. The addition of a small amount of lime is beneficial to any compost pile.

Making Compost in Beds

The soil bed method of preparing topsoil and compost has increased in popularity in recent years. Hand labor is reduced to a minimum since the bed is comparatively shallow and covers a large space. Horse and tractor drawn equipment may be used to advantage.

Flat ground on which the soil is fertile and which is out of the line of play should be chosen.

Barnyard manure or a substitute is applied at the rate of 40 to 50 tons per acre. Green manure crops, of course, serve the same purpose and they may wholly replace barnyard manure. In the preparation of the soil bed the area should be plowed and disked. After this the organic matter should be spread and disked, or if it is too bulky, it may be turned under with the plow and followed by a spring tooth cultivator which helps to mix it thoroughly. After the sand and organic material have been mixed with the top 4 or 5 inches of the soil by disk-ing, harrowing or otherwise, the bed is again plowed and disked. From then on such roughage as grass clippings, leaves and old sod may be spread over the surface and disked or plowed under.

Pure sand or clay soils require the addition of a surprisingly large amount of other matter to change them into proper topdressing. If the soil is a stiff silt or clay, sufficient sharp, clean sand should be added to change its texture.

Green Manure Crops

Legumes such as clover, soybeans and peas are commonly chosen for green manure purposes since leguminous plants are able to collect and store up nitrogen

STEPS IN PLANTING



SCATTERING STOLONS. Note the workman in stocking feet to avoid disturbing the seed bed. One live joint should be placed on each square inch of surface.

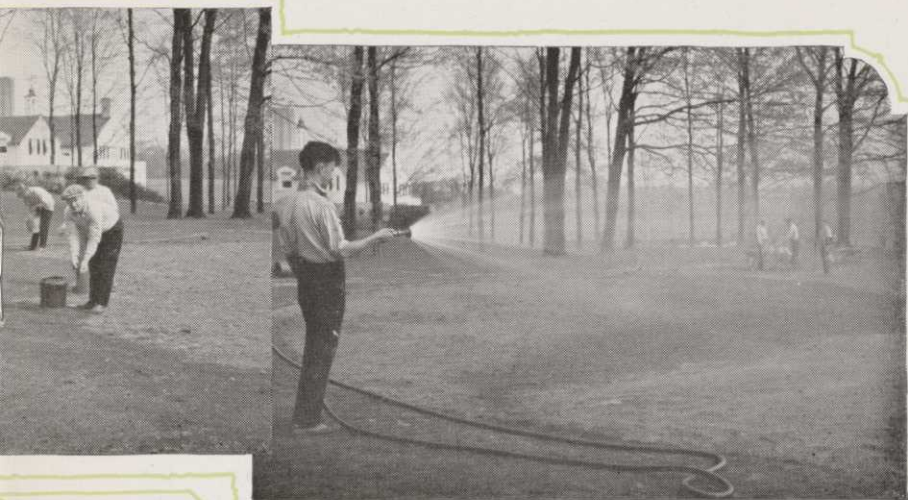


TOPDRESSING. Immediately after scattering stolons should be lightly topdressed with soil. Note that the



FIVE WEEKS LATER. The stolons are beginning to completely cover the surface. At

G CREEPING BENT




ately after scattering, the
y covered with screened
grass is not buried.


WATERING. This is done with a special nozzle which distributes the water as a fine mist. The surface of a newly planted stolon green must be kept continually moist for the first few weeks.



first the growth is thin and patchy but in a few weeks a complete coverage is secured.



The Putting Green



from the air through the medium of certain nodule bacteria which form on their roots. A good system is to plant 30 pounds of vetch with one bushel of rye (per acre) in the fall to be plowed under the following spring. Then soybeans or peas can be seeded at one to two bushels per acre for turning under in late summer.

No matter what green manure crop is used, it should be plowed under when it is green and succulent, because it will decompose much more rapidly than if plowed under when it is ripe and woody in nature. Rye is best plowed under in late April and soybeans during the early part of August.

Many waste materials are high in organic matter and can be used in compost beds. Sewage sludge, often available at a comparatively low cost, is a fine source of organic matter and certain mineral elements which are beneficial to soil beds and compost piles.

Preparing Compost for Spreading

Pebbles and stones are not welcome on putting greens. Therefore compost or any topdressing material should be carefully screened before being applied. Several machines have been developed for the greenkeeper's use in preparing compost. Besides compost mixers and screens, shredders are also available. One of these machines will do a good and quick job of preparing topdressing ready for application to the putting green.

Fertilizing Greens

Putting greens must be regularly fertilized. This is necessary to restore the plant food which has been consumed by the grass. Fertilizer also replaces the food elements which are leached out and drained through the subsoil, and overcomes in part the effect of the unnatural

conditions under which the grass is being maintained.

What Grass Needs

To feed grass properly its needs must be understood. Ten mineral elements are necessary for the growth of plant life. Of these, seven are present in nearly all soils in sufficient quantity to maintain grass. The three usually lacking are: (1) nitrogen, the most important element in turf production; (2) phosphorus; and (3) potassium. The main function of nitrogen is to promote vegetative or leaf growth. That is the all-important thing in growing grass, and it necessarily follows that nitrogen is the most important element in feeding turf. Phosphorus is important in developing root and stem. It gives frame and shape to the plant. Potassium is considered as controlling the living functions of plant life resembling the blood and the vital force of the human body. An ample supply of potassium is said to make grass more resistant to disease.

A fertilizer containing quantities of nitrogen, phosphorus and potassium (usually expressed in the terms, nitrogen, phosphoric acid and potash) is called a complete fertilizer because it supplies the three elements needed.

Sources of Plant Food

These fertilizing elements are derived from many different sources which are roughly grouped in two classes, namely organic and inorganic materials. The organic sources are chiefly vegetable or animal matter with the inorganic sources are either minerals or salts. Examples of organic materials are soybean meal, cotton seed meal and animal manures. Examples of inorganic materials are sulphate of ammonia, nitrate of soda, superphosphate and muriate of potash.

Generally speaking, the inorganic fer-



tilizing materials by themselves supply but one plant food element. For example, sulphate of ammonia furnishes only nitrogen, acid phosphate or superphosphate only phosphorus; and muriate of potash only potassium. In contrast most organic materials have at least traces of all three necessary elements, although these are not always present in the correct proportion for feeding grass. To make a balanced plant food ration, therefore, two or three inorganic materials are mixed together to make a complete fertilizer, or sometimes they are mixed with organic materials to make a complete fertilizer containing both organic and inorganic matter. This latter combination has several advantages, not the least of which is the fact that it gives a fertilizer which provides quick stimulation to the grass as well as a slowly available and lasting supply of plant food. Most inorganic materials are immediately available for the use of grass while the organic materials must first be broken down.

Complete Fertilizers Needed

A few years ago sulphate of ammonia was the only fertilizer used on putting greens. This was due to the fact that, being composed entirely of quickly available nitrogen, it showed an immediate effect in a greener and more vigorous growth. However, after a few years, it appeared that this method of feeding turf was not correct, as it resulted in soft, lush grass, very susceptible to disease and other injury. Another reason for the continued and exclusive use of sulphate of ammonia was the fact that it brought about an acid condition in soils which was thought to be conducive to the growth of bent grass in particular, and discouraging to weeds and clover. But this acid soil theory was never very well substantiated.

Greenkeepers have now come to realize that while sulphate of ammonia has certain advantages it cannot be used to the exclusion of all other fertilizers. Better turf will result if a complete fertilizer is used at least part of the time. As pointed out above, such a fertilizer should contain nitrogen, phosphorus and potassium, commonly known as nitrogen, phosphoric acid and potash.

Nitrogen Most Important

As grass requires for its growth more nitrogen than any of the other elements it follows that this should be supplied in the greater proportion. Because of this, agricultural authorities have adopted as a standard grass fertilizer one containing nitrogen, phosphoric acid and potash in the ratio of 10:6:4. Another formula having the same ratio between the elements can, of course, be substituted providing an amount is used to make up for the difference in the analysis. In other words, it appears that the ideal turf fertilizer is one in which the nitrogen content is equal to the sum of the content of the other two plant food elements, with phosphorus and potash in about a 3:2 ratio.

A Standard Program

Every greenkeeper must in time establish his own fertilizing program which will depend upon the peculiarities of his soil, climate and amount of play. But a general program can be recommended which will be safe and satisfactory under most conditions. The first fertilizing should be done in early spring after growth has well started and the ground is warm. This usually is in late April or early May. At that time an application of a 10-6-4 is desirable, at the rate of 10 pounds per 1000 square feet. At least part of the elements of this fertilizer should be of organic origin. This organic fertilizer will be slowly released as the



MOUNTAIN RIDGE COUNTRY CLUB, famed course of N. Y. Metropolitan district. Scott's South German Mixed Bent was used on greens of the new course seeded in 1929. Donald Ross, architect.



LINVILLE GOLF CLUB, Linville, North Carolina. Here eighteen greens of Scott's Washington Creeping Bent stolons give superb putting. Bent grass does very well at Linville (although south of the usual bent territory) because of the altitude—almost a mile above sea level.



grass needs it, while the inorganic material will provide the necessary immediate stimulation. A later spring application of the same analysis should follow in a month or six weeks, when seven or eight pounds per 1000 square feet is sufficient.

In an ordinary season no more fertilizer will be required until fall. However, if weather conditions are unfavorable or, for some other reason, the grass is not as vigorous as it should be, it can be stimulated by the use of sulphate of ammonia applied at the rate of three to five pounds per 1000 square feet. In some seasons several applications during the summer may be needed. After an attack of brown patch or other disease grass often needs to be revived.

In early September the greens should be given another feeding of a complete fertilizer at the same rate as the spring application. Here again the fertilizer should be made up of at least one-half organic materials. If a different analysis is used the rate should be varied so that the same amount of actual plant food is applied.

Applying Fertilizers

Any fertilizing treatment may be made in connection with the topdressing program. In fact, the ideal way is to mix the fertilizer with topdressing, as any possibility of burning the grass will be avoided.

Sulphate of ammonia may be mixed with compost or screened soil, diluted in water, or applied in the dry form, although this latter method is not safe unless the workman is skillful in getting it on evenly. If sulphate is put on in any way other than in solution the turf should be dry so that none of it will stick to the leaves and cause burning.

As sulphate of ammonia is readily

water soluble it can be applied in solution with spraying or sprinkling equipment. The amount of water to use will depend upon how it is to be applied. The normal ratio is 1 pound to 10 gallons of water.


Other water soluble fertilizers such as nitrate of soda, urea, ammophos, may be applied in the same way as sulphate. Complete or organic fertilizers may be mixed with soil or topdressing, or put on dry and watered in.

Acid Soils and Lime

Whether a soil is acid, neutral or alkaline need not greatly concern anyone building a golf course. However, there has been so much written and said about acid soil in connection with weed control during the past 10 years that a few words of explanation may not be out of place.

In what may be later known as the "acid soil" era in golf course maintenance it was commonly believed that the development of strong acidity resulted in more effective weed control. Soil was made acid by the excessive use of ammonium sulphate and other acid reacting fertilizers. Recent tests and experiments have served to cast considerable doubt upon this acid theory. The present method is to make soils as favorable as possible for grass. Weed growth is reduced and grass growth improved by proper fertilization and maintenance though the soil reaction may be either neutral, slightly acid or slightly alkaline.

During this era, lime was absolutely forbidden. It was thought that it encouraged weeds, and clover as well, which is particularly undesirable in putting greens. This theory too, has been disproved. In fact, there are conditions in which lime will decrease the amount of clover present.



The Putting Green

Lime Sometimes Needed

An example of such a condition is where sulphate has been used exclusively in fertilizing greens for a long time so that the acidity in the soil becomes so great that there is no base on which the nitrogen in the soil can react to become available to the grass. As a result, the grass becomes weakened because of nitrogen starvation, while the clover increases as it can thrive without soil nitrogen. In a case of this kind, a single application of lime may improve the green tremendously in a short time, in a better growth of grass with less clover.

A limited amount of lime would probably improve the greens on many courses, particularly where the overuse of ammonium sulphate has brought about an extremely acid soil. There is a close relationship between the degree of acidity in the soil and its susceptibility to brown patch and to injury from drought and heavy play. If a soil test shows the need of lime it should be applied, but sparingly. The maximum application is 50 pounds of finely ground limestone per 1000 square feet.

Watering

The method of watering greens and the kind and amount of water used are important factors in turf maintenance. The most laborious but, in general, the most satisfactory method of watering is to do it by hand. To save labor special whirling sprinklers are often used. The objection to them is that wind deflects the water and as a result some sections are saturated and overwatered whereas others are underwatered. The common tendency in watering greens with sprinklers is to put on entirely too much, as it is very easy to let the sprinkler operate for a longer period than necessary. More sick turf results from overwatering than from underwatering.

Still another method of applying water is by the use of the newer automatic systems which have been developed. One such system provides for the installation of small sprinkler heads distributed through the green which automatically pop-up when the water is turned on and recede when it is shut off.

When to Water

Ordinarily, greens are watered at night or in the early morning. Either time has certain advantages, although most authorities are inclined to feel that the early morning watering is preferable, particularly if the water used is pumped direct from deep, cold wells. When cold water must be used it is better to put it on in the morning when the greens are cool and more nearly the temperature of the water. Insofar as disease control is concerned, early morning watering is preferable also. Grass is not damaged as much by fungi if it goes into the night in a dry stage as they will not develop as rapidly if the grass is dry. While moisture is not the direct cause of brown patch, it does provide a medium in which the fungus can spread.

Amount of Water

A good greenkeeper soon learns the approximate amount of water which each of his greens requires. The use of too much water will retard the development of the root system of the plant, while too little will result in wilting and browning. It has been found that, in general, the smaller the supply of water during leaf growth, the smaller will be the individual leaves but the greater the thickness of the cell walls. Therefore, grass developed with a relatively small supply of water will be much better able to withstand the wear given putting greens. Such turf will suffer far less during periods of drought. In watering it is well to moisten the soil to a considerable depth



so the roots will penetrate deeply. Occasional watering to a depth of 4 to 5 inches is better than daily light sprinklings which penetrate only 1 or 2 inches.

Good soils need less water than poor soils because they will retain a greater amount of moisture and, at the same time, make more of it available to the grass roots. In the same way, a well drained soil requires less water because in such soil the root system will be more extensive and the grass can therefore obtain moisture from a greater depth. Good drainage also carries off the superfluous water which interferes with the necessary capillary movement of moisture in the soil.

Poling Greens

One of the most important early morning treatments of greens is to pole them by means of 20 to 25 foot bamboo poles. These are whipped across the greens early each morning to break up any mycelium or cob-webby growth of brown patch, and to remove worm casts and clean the greens ready for watering and mowing.

Renovating Creeping Bent

As creeping bent is naturally a vigorous grower there is some tendency for it to develop a matted growth, particularly if it is over-fertilized. A spongy, uneven putting surface results.

To overcome such a condition the dense intertwining growth of stems and runners must be removed. To do this sharp tined rakes are employed to pull up the grass which is then removed by close mowing. This operation should be repeated until the matted grass is thinned out. Greens will look badly after such treatment but they can be restored quickly by topdressing and the applica-

tion of a small amount of quickly available nitrogen.

The tendency of creeping bent to mat can be controlled by judicious fertilizing and proper methods of mowing and topdressing. An occasional brushing and raking will insure an upright growth and enable the mower to cut the runners which develop. Special greens rakes and cultivating disks can be purchased to use in maintaining an upright growth and in aerating the turf.


Special Problems of the South

The southern greenkeeper will follow the same general plan of maintenance as the northern greenkeeper. During the summer months his Bermuda greens need topdressing regularly, with occasional applications of fertilizer. If Bermuda develops a matted growth it should be treated the same as creeping bent.


To provide winter turf in the south it is necessary to seed greens, as Bermuda becomes dormant after the first frost. Ryegrass, redtop and occasionally bluegrass are used. If separate winter greens are not available, the Bermuda grass is scalped by close mowing and the greens seeded after a light topdressing. Winter grasses are seeded heavily at 6 to 8 pounds per 1000 square feet. Light applications of a complete fertilizer will keep winter greens in good condition.

The Turf Nursery

As soon as possible after planting greens a turf nursery is usually started with seed or stolons of the same kind and strain as that on the greens. A suitable nursery comprises several thousand square feet and is planted in the same way as the greens. It should be kept carefully mowed and topdressed so that the turf can be used to patch sections of the greens which have been injured in



The Putting Green



some way, or to supply plugs for use where weed patches have been removed.

Changing Hole Cups

A regular duty of greenkeepers is to see that the hole cups are changed frequently to different parts of the green. For this purpose special hole cutters are used to cut the new hole. Then by means of a cup lifter the cup is removed and placed in the new position. The plug from the new position is carefully placed into the old hole and topdressing used to firm it and true the surface. Immediate watering will encourage quicker rooting. The hole rim should be set about $\frac{3}{4}$ of an inch below the surface.

Weed Control

Many weeds are certain to appear in newly planted greens. Most of them are annuals which may be easily controlled, as they are killed by close mowing. Others offer a more serious problem and must be handled in a different way.

Dandelions, plantain, oxeye daisy and buckhorn are some of the deep rooted perennials most often encountered on putting greens. Probably the most satisfactory control method is to cut them out roots and all. In doing this the greens should be marked off in strips two or three feet wide and men or boys employed to remove the weeds in a systematic manner.

These same weeds may be killed by the use of sulphuric acid. The objection to it is that it destroys grass and clothing, and burns the skin, and so must be handled very carefully. A wide mouth glass bottle is a good container and should be set in a box around which is packed some light material which will absorb the acid if it happens to be accidentally dropped. A small amount of the acid is injected into the root of each weed by the use of a sharpened hardwood stick.

Chickweed, speedwell and creeping thyme are creeping and spreading weeds which are best removed from the green by cutting out the infested turf with a special tool made for that purpose, and substituting good turf. Sometimes such pests are cross cut with a sharp knife or other instrument and dry sulphate of ammonia applied. This will burn and keep down the growth for a while but one treatment will not kill it completely. Another method is to water the weed patch and sprinkle on it a small amount of dry sulphate by means of a common salt shaker. After the weeds have been thoroughly burned the area should be well watered to wash the sulphate into the ground and prevent any permanent damage to the grass.

Crab grass is an annual weed but it cannot be controlled by mowing because of its ability to reseed regardless of how closely it is kept cut. It smothers the grass around it and at the first frost turns brown and looks unsightly. The only satisfactory control method so far devised is to pull it while young. Crab grass develops in hot weather during late June or early July. It should be removed as soon as it appears, and before the seed heads develop. Topsoil which has not been thoroughly composted is a common source of crab grass.

Clover

On putting greens clover is a weed. It must, therefore, be treated as such and efforts made to keep it out or remove it. Contrary to former opinion, clover does not appear in a green because of a sweet or alkaline soil. It is more apt to be the direct result of nitrogen starvation.

To understand nitrogen starvation in greens it must be remembered that clover is a legume. Therefore it has the power to take nitrogen from the air for its growth. Grass is not a legume and



so it must depend entirely upon the soil supply of nitrogen. If this is lacking clover can yet thrive whereas grass can not, and as the grass becomes weaker and offers less resistance the clover will become more vigorous and appear in the green in increasing quantities.

Nitrogen Needed

To overcome such a condition regular applications of a fertilizer high in nitrogen should be made. Ammonium sulphate may be used for this purpose occasionally, but it should not be depended upon to carry the entire plant feeding program, as it is not a complete fertilizer and supplies only nitrogen. It was formerly used exclusively on greens having considerable clover in them because it was thought that the acid reaction of sulphate of ammonia was discouraging to clover. There is now sufficient evidence to refute this assumption.

Where clover appears in concentrated small patches it may be burned out by the use of ammonium sulphate as described for chickweed. If the clover is first bruised so the juice comes out of the stems the sulphate will penetrate and burn more quickly. Sometimes such patches of clover are plugged out and new plugs put in from the turf nursery.

Poa Annuua

Some greenkeepers swear by Poa Annuua and others swear at it.

The stems of this annual variety of bluegrass grow so close to the ground that they develop and mature even when putting greens are cut as close as $\frac{3}{8}$ of an inch. Poa Annuua is constantly reseeding itself except in periods of very hot weather. It really makes a very fair putting green turf except for the fact that in hot weather there is a cessation of seeding and a dormancy in the growth of blades. It goes back on the greenkeeper just at the period of the year when he

really needs it most. Once started Poa Annuua cannot be completely eliminated. There is some evidence to indicate that the regular use of arsenate of lead may check Poa Annuua but this theory has not been sufficiently established to make a positive statement justifiable.

Moss

The presence of moss in a green should be taken as a warning that something serious is wrong. It never appears unless drainage is very faulty or soil fertility is low. In the former case it may be the result of seepage water which is saturating the green from surrounding higher areas. Correcting such a fault will usually eliminate the moss. In case moss is the result of low fertility it can be overcome by regular applications of compost topdressings and a complete fertilizer. Some authorities are inclined to feel that a deficiency of potash is favorable to moss, and the fertilizer selected may well contain a liberal percentage of this element.

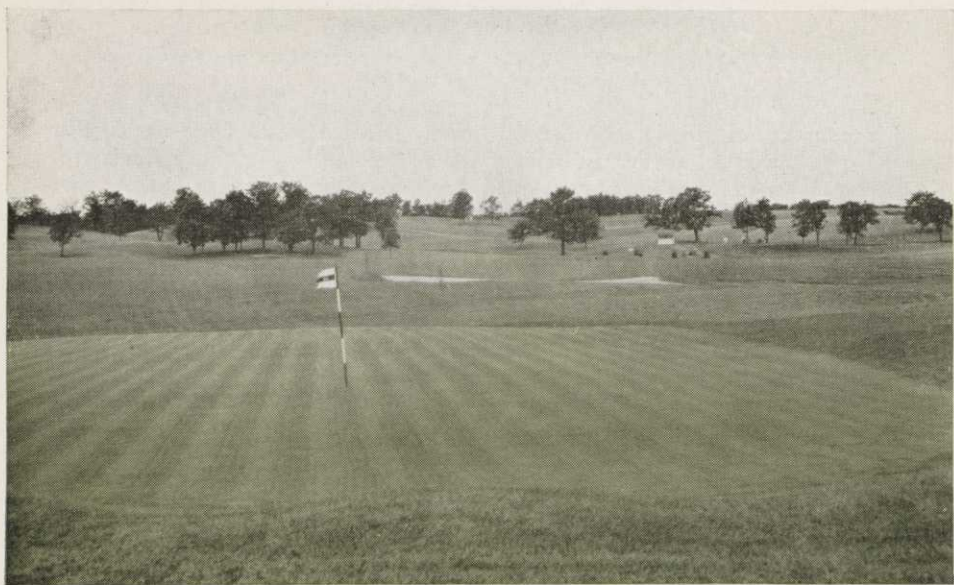
Clean Seed

Aside from being blown across the fields and being carried by birds, weed seeds get into the soil of the golf course in one of two ways:

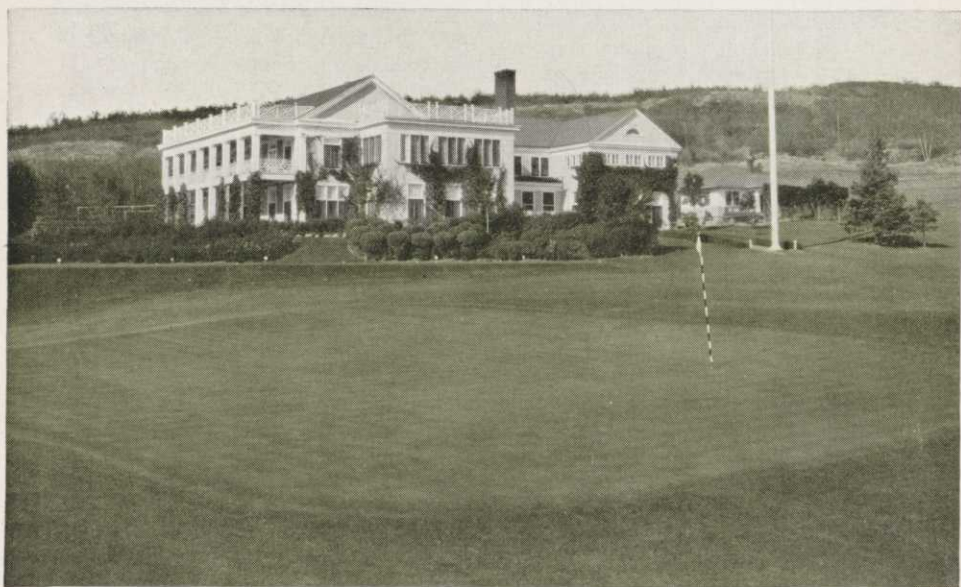
First: They may be spread on the soil in manure, or in topdressing.

Second: They may be sown with impure grass seed.

To avoid weeds pure seed must be sown. If weedy seed is used seedling grass plants may be overcome by the weeds sown with the seed together with those already in the ground. A farmer can practice rotation of crops and cultivation as a means of keeping down weeds. This is impossible on the golf course, so it is more important than on the farm that pure seeds of strong vitality be sown. To sow pure seed should be the established custom of every golf club.



NUMBER 14 GREEN OF KELLER PARK, St. Paul—*Scene of the 1931 Public Links Tournament.*
Planted in 1928 with Scott's Coos Seaside Bent.



NORTHLANDS COUNTRY CLUB, Duluth, Minnesota. *Originally sowed with Scott's Seed and maintained with it ever since.*

TURF DISEASES AND CONTROL

Fungus Diseases

Putting green grasses are maintained under extremely unnatural conditions and are often attacked by diseases. Close cutting, along with heavy wear and forcing of the grass with fertilizer during the entire growing season makes them more susceptible to disease than ordinary turf.

The most common turf disease is brown patch. Because of this seemingly all inclusive name, any turf which turns brown is generally considered to be suffering from an attack of brown patch. As a matter of fact, many other things affect grass in practically the same way. Some of them are improper fertilization, damage by insects, excessive use of certain chemicals, accumulated poison in the soil, etc.

Brown Patch

Brown patch is caused by a specific fungus growth which penetrates and kills grass leaves. The fungus absorbs food from the inner cells of the grass and causes them to gradually break down and the leaf to shrivel up and turn brown.

Brown patch fungi are present in the soil everywhere but they do not become active except under certain favorable conditions. Hot, muggy weather is ordinarily associated with brown patch, and, as its effect is usually noticed in the morning it has been thought that it attacks grass only at night. This is not the case as brown patch may become active any time during either day or night. The first evidence of an attack is the mycelium, a cob-webby growth which is usually apparent in the early morning. A little later the affected grass will have a scalded, darkened appearance and as the sun reaches it and the dew disappears,

the blades will begin to shrivel and finally become brown and dead looking. In the case of the so-called large brown patch the affected areas will be roughly circular in outline and as much as a foot in diameter. In contrast, small brown patch affects areas about the size of a silver dollar.


Large Brown Patch

Large brown patch does not injure all of the blades, so that a scattering of green remains throughout the patches. Usually the blades only are attacked and not the stems, buds or roots. It is possible to restore the turf by stimulating a rapid growth after the disease has been checked. If the disease is not checked by a change in weather or by the use of some fungicide, a smoky ring of blackened grass is noticeable around the margin of the sod on each succeeding day. This represents the extension of the attack. Later this grass turns brown.


Small Brown Patch

Small brown patch usually attacks areas limited to the size of a silver dollar. There will be a number of these spots scattered throughout the green giving it a moth-eaten appearance. Small brown patch destroys the grass completely as it attacks the roots as well as the blades. The grass has a more bleached appearance than after an attack of large brown patch.

While large brown patch is more likely to occur during hot, muggy weather this is not the case with small patch. It may appear almost any time during the growing season, but, on the whole with possibly less damage because its development is slower and can be checked. However, the injury is often severe in these small areas.



The Putting Green



Avoiding Brown Patch

Temperature and humidity influence the development of the brown patch fungus. Also, soil conditions, methods of watering, fertilizing and general treatment of turf may be such as to either encourage or discourage it. Heavy night watering seems to encourage brown patch development as does excessive watering during hot weather. In the same way the continued and excessive use of highly nitrogenous fertilizers is apt to increase the appearance of brown patch. Those fertilizers which quickly release large amounts of nitrogen produce a soft lush growth of grass which becomes an easy victim of disease. Extreme soil acidity also is favorable to the development of the fungus. In such cases applications of lime to greens has proven of benefit in reducing the attacks.

Checking

If the brown patch fungus has developed so that injury to turf is apparent it is necessary to take immediate steps to check it. Should the disease be observed in the early stage when the grass still has the cob-webby growth on it there is a chance of controlling it by poling. Syringing the green to wash the mycelium is helpful but not as effective.

The control of brown patch is an argument in favor of daily poling of greens the first thing each morning. It may serve to completely check an attack just getting started. At the same time, whoever poles the greens will be able to advise the greenkeeper of a serious attack which requires the use of more drastic control measures. An early treatment reduces damage.

Fungicides

If the disease has advanced to such a stage that poling is not sufficient to check it, a fungicide must be applied.

Special treatments now in use depend upon mercury in organic or inorganic form. Several effective commercial fungicides are on the market. One of them is a combination of corrosive sublimate (bichloride of mercury) and calomel, an excellent combination as the former gives immediate action while the latter is more slow acting and gives longer protection. Other compounds may be secured but their value and price should be compared on the basis of mercury content. This is the expensive ingredient and also the effective one.

As there is great danger of burning turf with these fungicides, the instructions of the manufacturer should be carefully followed in applying them. The combination of corrosive sublimate and calomel is used at the rate of 2 or 3 ounces per 1000 square feet of area. To apply such a small amount, it must be mixed with water or with screened soil.

All Grasses Susceptible

Practically all of the finer turf grasses are susceptible to brown patch, although bent seems more so than others. Fescue, bluegrass, redtop, and also many weeds are attacked. Some strains of bent grass have shown a greater resistance to brown patch than others. The Washington strain has proved particularly superior.

The person or persons responsible for golf course greens should be prepared for an attack of brown patch. The remedy should be on hand and instructions for its use given to the men, so that it can be applied on short notice. In an emergency, corrosive sublimate and calomel may be purchased at any good drug store and the combination described above made by mixing 2 ounces of calomel with 1 ounce of corrosive sublimate. They should be mixed very thoroughly and applied at the rate of 3 ounces per 1000 square feet of area.



Applying Fungicides

Brown patch remedies may be put on by sprinkling, using approximately 50 gallons of water to 1000 square feet, or by mixing them with enough sand, soil or finely screened compost to give sufficient bulk for even distribution. When applied by sprinkling it must be remembered that the mercury materials are insoluble in water. They also have an unusual weight and will therefore settle to the bottom of the sprinkling tank, giving uneven distribution unless enough mechanical agitation is maintained to keep the material in suspension.

The dry method of application is therefore the best and has the advantage that it is easier and quicker. It eliminates the necessity of hauling heavy sprinkling equipment over the course and no time is lost in mixing and refilling tanks. This is an important consideration when a severe attack is experienced on all the greens and quick action is imperative.

Two or three buckets of the dry filler thoroughly mixed with the fungicide is generally enough to use in treating one green. By mixing the materials the night before using there is less danger from burning as the chemical reaction between the material and moisture takes place before application to the green. Whether the dry method or the wet method is employed, treatment should be followed by sprinkling with water to wash the fungicide into the soil, although it is well to delay this a little to give the materials a chance to check the fungus.

Some greenkeepers use fungicides regularly during the brown patch season to act as preventives. They make applications at about $\frac{1}{3}$ the usual rate, with the dry filler method. The greens are not watered afterwards so as to keep the fungicide on the grass blades as long as possible. This system is probably a good

one but the treatment must be made carefully to avoid burning.

Pythium

One of the newer diseases affecting bent grass is called pythium. It develops during weather favorable for large brown patch and usually attacks areas of about the same size. However, the grass turns a redder shade of brown and every blade within the injured area is usually killed. So far no effective treatment has been found.

Ring Patch

Ring brown patch has many characteristics of large brown patch but is apparently caused by a separate fungus. Like pythium it differs from the other diseases. As the name indicates it appears in rings which, in some respects, resemble fairy rings. Such rings may be several inches wide. In its early stages the white jelly growth of the fungus is plainly visible just at the surface of the soil. Here again no effective treatment is known.

Scald

One turf injury, similar to brown patch but yet quite different, is scald. This term covers a wide variety of diseases and is somewhat misleading, as it infers, more or less, injury by water heated beyond the point endurable by plants. This, however, is not necessarily the cause as frequently scald is brought on by something entirely different.

Identification

Scald usually appears in irregular and indefinitely outlined discolored patches. As contrasted to the definitely defined outer boundaries of brown patch, scald is usually worse near the center and gradually less severe towards the outer edges. At first the grass may have a purplish or bluish tinge, with the leaves rolled and

The Putting Green

shriveled as though suffering from lack of water, resembling grass clippings in first stages of wilting. After this the development of the injury is often rapid and the grass eventually turns brown, sometimes leaving the ground entirely bare.

As with other turf injury of this nature the development of scald usually begins during periods of excessive heat but the attack may continue even during a spell of cooler weather. Fungi are sometimes associated with scald but it has not been definitely established that these are in any way directly responsible for it.

Causes

One of the probable causes of scald is excessive use of fertilizers. Too much organic fertilizer may cause an oversupply of nitrogen which will in turn result in tender turf. In the same way the overuse of ammonium sulfate may weaken grass especially if the soil is made extremely acid.

Another indirect cause of scald is poor physical soil conditions, such as poor drainage. Injury is sure to follow if water settles in areas where its escape is slow. Probably the main damage is caused by lack of air.

Remedy

As scald is comparatively new there has been little opportunity for studying each type of injury designated as such. However, it seems safe to say that the best remedy is to find the cause and correct it. If soil conditions are unfavorable they must be corrected as no other treatment will suffice.

To avoid scald a careful fertilizing program should be followed. Highly concentrated nitrogen fertilizers should be used sparingly in hot weather. Grass should not be fed unless it shows a definite need for it.

If soils are extremely acid an application or two of finely ground limestone may help to overcome scald. Lime is best applied in spring or fall although it may be put on any time. If ground limestone is used it should be at the rate of 50 pounds per 1000 square feet.

In some instances fungicides such as used for brown patch have been successful in controlling scald.

Algae

Algae, a growth which affects poorly drained surfaces, forms as a greenish scum that mats into a sheet when dry which smothers and kills out the grass underneath. Its appearance indicates bad drainage or excessive watering. Correcting such conditions will usually result in the disappearance of the algae.

Fairy Rings

Fairy rings grow in a complete circle of mushroom like plants. They usually start from spores present in manure which has not been thoroughly composted. There is only one cure and that is to cut out the affected turf to a depth of several inches and at least 6 inches on each side of the growth.

Snow Mold

Snow mold is a disease which affects grass in cold weather somewhat as does brown patch in warm weather. It is caused by an entirely different fungus. Its development is brought about by low temperature coupled with excessive moisture caused by melting snow, heavy fogs or rain. The infection is usually carried about by means of water and, as a result, a green washed by surface water may be badly damaged.

Identifying

The damage of snow mold can be distinguished from other winter-killing as the affected spots are usually covered

with an aerial growth or mycelium, which, when exposed to the sun, takes on a pinkish color, so that the whole patch has a pinkish cast. At this time the cob-webby growth is so abundant that the grass leaves are matted and form a thick layer. Some patches may appear a dirty gray. These are easily distinguished from areas where the grasses have been killed by some other cause, as the latter are light brown in color.

The so-called snow mold area includes the northern states and Canada, extending as a rule as far south as Cleveland and Detroit although the disease has been observed at Columbus. Of the turf grasses, fescue seems highly susceptible, while creeping bent and bluegrass are less so.

Treatment

So far, the best remedy found to check snow mold is corrosive sublimate. In the sections where damage from snow mold is expected, the greens should be treated before the ground freezes, with 2 to 4 ounces per 1000 square feet. The same treatment suffices if snow mold develops during the winter, at which time the corrosive sublimate can be mixed with dry sand or screened soil. It is not necessary to water it in. Treatment after

an attack has started will not check the fungus completely but will usually reduce the amount of damage.

Winterkill

Freezing and thawing inflict many injuries upon fine turf the most common one being breaking of the root system by heaving. There may also be smothering of the plants under melting snow and ice on low areas lacking surface drainage. This is the more serious of the two injuries. It is distinctly the result of faulty construction and the only way to permanently control it is to see that all areas of the green have surface drainage.

If properly installed, tile drainage removes excess water, but the water cannot reach the tile if the ground over the tile is frozen. Poor surface drainage with pockets out of which water cannot flow offers plenty of opportunity for destruction by winterkill.

Rolling in early spring will often restore turf satisfactorily by firming the detached roots into close contact with the underlying soil. On putting greens particularly, an early topdressing is also beneficial. Other areas damaged by winterkill must be reseeded or sodded to insure solid turf.



INSECT AND ANIMAL PESTS

Grubs

In certain sections the common beetle, often called June bug and May beetle, and the Japanese beetle, indirectly cause considerable damage to turf. They prefer to lay their eggs in moist, sod covered soil. Putting greens are therefore particularly favored. From the eggs larvae of the beetles are hatched. These so-called grubs live in the ground for a varying length of time during which they feed on the roots of grass. Often a colony of them will destroy sod in large patches by completely severing the roots so that the grass cannot get plant food and moisture.

Grub-Proofing Turf

In sections where grubs have been known to do considerable damage new greens should be grub-proofed before seeding. This is done by mixing arsenate of lead in the top half inch of surface soil after all grading, smoothing and contouring of the green has been completed. The usual rate is 5 pounds per 1000 square feet of area, although this amount must be increased if it is desired to control earthworms at the same time. A heavier application, as much as 15 or 20 pounds per 1000 square feet, is needed for earthworm control. In applying the lead arsenate it is best to mix it with enough moist sand or screened soil to prevent blowing of the fluffy powder and to insure an even spread.

In cases of an infestation of grubs on an established green the arsenate is applied at the rate of 5 to 10 pounds per 1000 square feet. It should be put on when the grass is dry to permit working it down to the surface soil without any of it sticking to the blades. Using a bushel of screened soil to 5 pounds of the arsenate will provide sufficient bulk

for an even distribution over 1000 square feet. In some cases arsenate of lead is put on with regular applications of top-dressing. If this is done it is not necessary to use as much as 5 pounds to 1000 square feet, but, instead, the same amount may be mixed in about a cubic yard of topdressing and applied to 3000 square feet of area. Annual treatments of 5 to 10 pounds should give complete grub control.

Earthworms

While the lowly earthworm may have an important function in the processes of nature, golfers are inclined to frown upon its operations in putting greens. The castings which are thrown up appear as mountains when in line of ball and cup.

Earthworms are controlled by the use of an irritant such as corrosive sublimate and Mowrah meal, or are poisoned by means of arsenate of lead.

Corrosive Sublimate. Two or not to exceed three ounces of corrosive sublimate dissolved in 50 gallons of water is sufficient for 1000 square feet. After the solution is applied it should be followed with at least twice the quantity of water to wash it thoroughly into the soil. If it is desired to apply the corrosive sublimate dry, it should be mixed at the rate of two to three ounces to two cubic feet of dry sand and the mixture scattered evenly over 1000 square feet. Liberal watering should follow. When corrosive sublimate is applied in this way and at the rate suggested, especially if water is used freely afterward, no injury to the turf results. In very hot, dry times, applications as suggested may cause a slight burning of the turf; but treatments at such times are seldom necessary as earthworms are not then in action. Any effect

of burning, from the suggested rates, however, will not be lasting or serious.

Mowrah Meal. The use of unadulterated fresh Mowrah meal is considered safe and effective. It should be applied at the rate of 15 pounds to 1000 square feet of putting surface and well watered in. Fresh Mowrah meal should always be used as it deteriorates rapidly, especially when stored in a damp place.

Lead Arsenate. In some cases arsenate of lead has given complete control of earthworms. However, it does not seem effective on all soils and must be applied in larger quantities than necessary for destroying grubs. On established greens the arsenate should be applied at the rate of 10 or 15 pounds per 1000 square feet, any time during the growing season. Established turf may be injured if the arsenate is applied carelessly. It should be mixed with moist screened sand or soil, so that it can be evenly distributed, applied when the grass blades are dry, and watered in after application. To insure constant and effective control against earthworms and grubs some greenkeepers mix arsenate of lead with each topdressing at the rate of about 5 pounds per 1000 square feet.

Ants

Ants share with earthworms the honor of trying the golfer's temper by defacing the putting green surface. Ants are about the most difficult insects to control. Methods of eradication are many but the one most used is to gas the hills with carbon bisulphide. A few drops should be put into each hill and the holes closed with a little wet earth pressed down with the foot to keep the gas inside the burrow. Carbon bisulphide must be handled very carefully as it is inflammable and it also burns turf badly. Calcium cyanide may be used instead of carbon bisulphide.

Paris green mixed in equal proportions with brown sugar will often destroy a colony, as the ants will carry the poison to their nests and feed it to the young. A similar remedy suggested is that of dropping a pinch of powdered sugar and borax, well mixed, into the entrance of each nest.

Moles

The main damage caused by moles is the lifting of turf and cutting off roots in their runs. On putting greens they are best controlled by trapping with special mole traps of which there are several good makes available. Carbon bisulphide also is used. A wad of cotton should be saturated with it and inserted into the end opening of the burrows after all other openings are closed. Bisulphide is very inflammable and workmen should not be allowed to smoke while using it.

Crawfish

As crawfish live only in very wet soils the logical remedy is good drainage. Carbon bisulphide is also effective with this pest. It is applied directly into the burrows by means of a long nozzled oil can. Five or six drops are inserted in the burrow, which is immediately closed.

It has been reported also that crawfish may be destroyed by dropping a piece of calcium carbide into the tunnel. The carbide unites with the water at the bottom of the hole to make a gas which kills the crawfish.

Skunks

Skunks will seldom do damage around golf courses except where grubs are present. Their work should therefore be a warning to the greenkeeper that he must get after the grubs which do more damage than skunks.

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Those responsible for golf courses quite surely will be confronted from time to time by situations which this book nor any other will solve. In such cases, we shall be glad, through correspondence, to cooperate with the club in the solution of its special problem.

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