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Contents

	Page
The Use of Fertilizers on Putting Greens.....	106
Fertilizing Putting Greens at Wilshire. By Robert S. Greenfield.....	110
Experience with Fertilizers at Plainfield Country Club. By F. J. Roth.....	112
Fertilizing Putting Greens at Oakmont Country Club. By Emil Loeffler...	114
Fertilizing Putting Greens at Brookline. By Howard D. Farrant.....	115
Fertilizing Bermuda Greens for Winter Play. By O. Sproule Baker.....	117

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The Use of Fertilizers on Putting Greens

One of the most important problems in maintaining golf course turf is that of determining the kind and amount of fertilizer to be used on the putting greens. The general appearance of any grass can readily be changed by the application of the right kind of fertilizer. A yellow, unthrifty putting green can within a few days be given a dark green color and a vigorous growth of grass simply by the use of some quickly available fertilizer. On the other hand, the injudicious use of any fertilizer may as quickly ruin turf.

The need for certain fertilizing elements in the growth of plants is too well appreciated to call for elaboration here. Careful fertilizer experiments, checked by countless practical tests under farming conditions, have shown the need for specialized fertilizer formulas for different agricultural crops. It is well known, for instance, that a fertilizer which may be generally desirable for grain crops, such as wheat or rye, may be quite different in character from one necessary in the production of crops harvested for their leaves or stems, such as tobacco and certain forage crops. Therefore in producing turf, where the main object is to get a growth of leaves, the greenkeeper need not expect to get the most favorable results by following some fertilizing program which may have proved valuable in some other kind of agricultural work. The fertilizing elements which are most generally considered essential are nitrogen, phosphorus, and potassium. Nitrogen is the element which is most frequently deficient in putting green soils and thus likely to be needed in largest amounts. Some soils are deficient in phosphorus, and this deficiency may be the limiting factor in producing turf on those soils. Deficiency in phosphorus is much more apt to be apparent in fairways than putting greens. In some cases potassium is deficient; then an application of potash is likely to give striking results. However, on the big majority of courses there is very little evidence of a deficiency in potassium in putting greens. Calcium, an ingredient of lime, although not regarded strictly as a fertilizer, is used frequently for agricultural purposes. To get the best growth of any plant it is desirable to have a favorable balance in the soil of all these fertilizing elements. If one or more is missing, the addition of any of the elements already present in abundance will be of little or no help in improving the crop. Practically every soil has a certain amount of all of these elements in addition to a large number of other elements necessary for plant growth. Also they are usually all present in manures and certain other products derived from animals or plants. To supply any deficiency in his soil, the modern greenkeeper or farmer has a wide choice of highly concentrated or of low-grade fertilizers both natural and artificial, as shown in the April number of the Bulletin.

The ever-growing multitude of fertilizers and fertilizer mixtures, each with its advocates claiming superior qualities as compared with all other mixtures on the market, makes the fertilizing problem increasingly confusing. Undoubtedly a large number of the fertilizers now on the market are suitable for putting green use. It must, however, be borne in mind that any fertilizer which may be most desirable on a green where there is a deficiency of a certain fertilizing element may prove injurious if used in excess on that green. Unfortunately there is no simple rule that can be laid down for ferti-

lizing putting greens. There are, however, certain general principles that can be used as a guide in determining the fertilizing program for the greens on any golf course.

In making plans for the fertilization of most agricultural crops, due consideration is given to the natural seasonal developments, but on golf courses seasonal developments in many respects are ignored, particularly on putting greens. The grasses growing on putting greens are forced into a more or less unnatural condition, and efforts are usually made to bring them into the best of condition for special tournaments, regardless of whether or not it is the particular time when grass naturally would be at its best. Therefore the fertilizing program for putting greens must be modified to some extent to try to bring about the best growth of turf at the time of the most important tournaments. Fertilizers which are quickly available, therefore, have come into much favor for putting green use because they are able to affect the growth of grass within a few days after they are applied. In order that they may produce quick results, however, it is desirable that the regular fertilizing program provide for well-balanced feeding of the grass throughout the entire season and without the excessive use of any one fertilizing element.

In planning a program of fertilizing putting greens it must be remembered that the maintenance of a putting green constitutes a very intensive form of plant production. Few realize the large amount of plant material removed each year in the clippings from the greens. In the days before the grass catcher came into use this material was allowed to return to the soil, but under present conditions it is lost unless it is used in compost. In order to obtain an estimate of the amount and composition of this material, the grass clippings were weighed and analyzed from some of the better-treated putting green plots at the Arlington turf garden in 1930 over the period June 1 to November 1. The results obtained from these observations at Arlington would indicate that the amount of field-dry material removed from 18 greens totaling 90,000 square feet would be about 4 tons, containing approximately the following equivalent amounts of plant foods: nitrogen as obtained in 2,000 pounds of sulphate of ammonia; phosphoric acid as obtained in 200 pounds of 20 per cent superphosphate; and potash as obtained in 400 pounds of 50 per cent muriate of potash. These figures should not be used as a basis for building up a complete fertilizer for putting greens, as various conditions, such as soil, climate, and season, would influence the results; however, they are valuable as indicating the importance of a careful program in using fertilizers. They also show the importance and value of saving the clippings so that the fertility removed may be, in part at least, returned in the form of compost.

The fertilizing program for any putting green must be based on the fundamental principle that a vigorous production of healthy leaves is desired. Fertilizers that are designed chiefly for the production of grain or certain other agricultural crops are therefore not most suitable for putting greens even though sold at an attractive price. It is known that fertilizers containing a good proportion of nitrogen are most likely to stimulate a vigorous growth of leaves. However, too vigorous a growth may produce leaves which may suffer from diseases or other injuries. Therefore, although nitrogen is distinctly desirable as the chief ingredient of putting green fertilizers,

its use can be easily overdone and great damage result. It is important to realize that nitrogen can be supplied to the turf in compost or mushroom soil. Frequently greenkeepers apply large quantities of mushroom soil or compost without realizing that they are thereby adding fertilizers to their turf. When large quantities of these materials are used, it is necessary that a proportionately less amount of the more concentrated nitrogen fertilizers be used. It is not unusual to apply a ton of mushroom soil or compost to a green. Such material usually contains about 1 per cent, or 20 pounds of nitrogen. It takes 100 pounds of sulphate of ammonia, or 333 pounds of 6 per cent cottonseed meal, to carry the same amount of nitrogen to the green. The nitrogen, however, in sulphate of ammonia is more quickly available to the plant than is the nitrogen in cottonseed meal, compost, or mushroom soil. It is well to have part of the nitrogen applied to a green in a form that is quickly available and some that is only slowly available. Experience has shown that if too much nitrogen is stored in the soil in a slowly available form there is apt to be damage to the turf at any time when weather conditions are most suitable for rapid disintegration, which changes the nitrogen from a slowly available to a readily available form and thereby produces an over-fertilization with nitrogen.

As indicated in articles appearing in this number of the Bulletin, contributed by five different greenkeepers located in different parts of the country, there is no standard fertilizing program for putting greens. It is indeed unlikely that a standard fertilizing program will be developed in the future, for the simple reason that different soils and climatic conditions require different fertilizing programs. It will be noted in these discussions by greenkeepers that the favored method of determining the need of putting green grasses for additional food supply from fertilizers, is careful observation of the color and general appearance of the grass. When the grass is being starved, it shows certain general symptoms which may be extremely difficult to describe, but which are, nevertheless, readily recognized by anyone who is a close observer of growing grass. Unfortunately every golf course does not have some one who is a close observer of grass who is able to recognize the symptoms which indicate the various needs of grass. This absence of discriminating observation undoubtedly is responsible for a great wastage of club funds in a number of instances. Frequently clubs will endeavor to improve greens by some expensive rebuilding program, tiling, or other procedure, when the poor turf can be very simply explained on the basis of available plant food. In the latter cases the cheapest and least inconvenient method is to apply the required amount of fertilizer. On the other hand, there are undoubtedly a great many golf courses where the fertilizing program has led to the application of excessive amounts of fertilizer, with the result that putting green problems have arisen calling for large outlays for repair work. In such cases the sensible and by far the least expensive solution is to reduce the budget allowance for fertilizers. The old appeal of Aristotle for moderation, as quoted on the back page of this number of the Bulletin, applies equally as well to the fertilizing of putting greens as to the purpose for which he intended it.

A general recommendation for fertilizing putting greens might be about as follows:

Well-prepared and weed-free compost, or mushroom soil, to which sand has been added, should be applied liberally to the greens at the beginning of the growing season. When compost prepared from a mixture of manure and soil is used, or when mushroom soil is used, the top-dressing will be of considerable fertilizing value.

One of the most important purposes of applying top-dressing is to fill in slight depressions in the turf and thereby improve the putting surface. A sifted soil, preferably sandy loam, may be used for this purpose. If the top-dressing has not been produced by composting the soil with various manures, it may be of comparatively little fertilizing value.

When a top-dressing of natural soil or soil mixed with sand or peat is used, a complete mixed fertilizer should also be used occasionally to provide the nitrogen and mineral elements, such as phosphorus, potassium, calcium, and other elements contained in manure. Although the mineral elements will have to be applied only occasionally it will be necessary to keep up the nitrogen supply; this is best done by making frequent light applications of some soluble nitrogenous fertilizer, such as sulphate of ammonia.

If the fertilizing is not being done by means of top-dressing with compost or mushroom soil, only enough top-dressing should be applied to keep the putting surface true throughout the playing season.

Close cutting, brushing, raking, and even light rolling of putting greens, in many instances, tend to make frequent or heavy top-dressing unnecessary.

An application of one cubic yard of top-dressing at one time is ordinarily sufficient to true the surface of a putting green of 5,000 to 6,000 square feet. Often such a top-dressing in the spring and fall is sufficient on some greens, while on others several top-dressings may have to be made during the season.

Top-dressings during the playing season should be much lighter than the spring and fall top-dressing in order to interfere as little as possible with play.

Top-dressings should be worked in with a mat or some device which will rub the material from the high spots and deposit it in the lower areas.

The amount of top-dressing to apply will depend largely on the needs of the turf from the playing standpoint and to less extent on the needs of the grass for growth. When the putting surface is not true, top-dressing should be applied. Frequent light applications are better for this purpose than infrequent heavy applications.

The cost of application must also be considered on many golf courses, and from the standpoint of cost it is inadvisable to top-dress more frequently than necessary. When large quantities of compost or mushroom soil are used on greens they may in themselves add enough of the fertilizing elements to provide for adequate growth of the grass. Good compost is, however, more costly than it was many years ago, and therefore the use of compost is becoming more and more restricted to the actual need for providing a true putting surface. Commercial fertilizers, on the other hand, have been greatly reduced in cost as compared with compost in recent years, and are therefore coming more and more into general use on golf courses. It is therefore advisable to supplement the compost with sandy loam

(Concluded at bottom of page 113)

Fertilizing Putting Greens at Wilshire

By Robert S. Greenfield

Wilshire Country Club, Los Angeles

Our putting greens, which with a few exceptions are 11 years old, were originally a mixture of fescue, Kentucky bluegrass, and rough-stalked bluegrass (*Poa trivialis*). Four years ago seaside bent was seeded upon the original turf, with the result that now the greens are practically pure bent, except that during the cooler months of the year some plants of the rough-stalked bluegrass are still evident.

Our soil is a black adobe clay 2 to 3 feet deep underlaid by a sub-soil of a mixture of gravel and compact brown clay. Several of the greens were under-drained with tile and crushed rock. This drainage however proved of little value, as the tile was laid too deep and the rock fill was not brought up high enough, thus apparently being inaccessible to the storm water. We believe in good surface drainage for a soil like ours. In building the greens, top soil was not available, and as a rather poor substitute sandy silt from our barranco was used.

We depend mainly on compost top-dressings for fertilizing our greens. We apply $1\frac{1}{2}$ yards to 4,000 square feet. As our greens are large, half a green can be top-dressed at a time, thus allowing a sufficient portion to remain without dressing for the use of the players. The material is applied by hand. We have not found a mechanical spreader that does as good a job as a well-swung shovel. We do find however that a small-sized mechanical spreader is fairly satisfactory for applying concentrated fertilizers.

Although at various times we have used various commercial mixed fertilizers, we prefer those that are not mixed, such as 13 per cent blood meal, cottonseed meal, or fish meal. For the past two years, in addition to compost, we have used an organic mixture consisting of 13 per cent blood meal, cottonseed meal, and sardine meal, with a filler of converted sewage, the complete analysis being $6\frac{1}{2}$ -2-0. We apply this at a rate of about 100 pounds to 4,000 square feet. We are so well pleased with this mixture that we have it made up to our order by a local dealer.

We have no fixed feeding program, except that in the early fall we always apply a compost top-dressing to all our greens and aprons. We feel that the less stimulation given turf at that time, the better. Heavy winter play nevertheless calls for some fertilization; so we compromise with a mild compost, which carries us through the winter in fair shape.

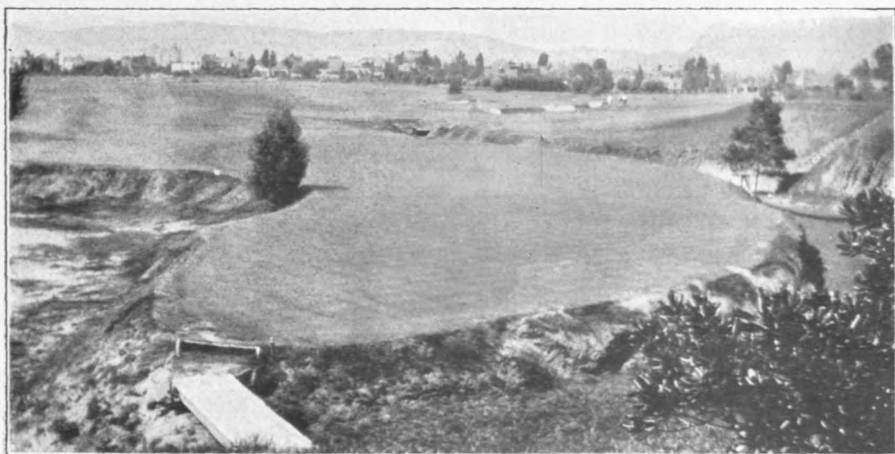
Our greens generally respond to the spring rains without much assistance from us, and show vigor and good color. They are ready for fertilization about May, when we give them a compost top-dressing and an application of the organic mixture to which I have referred.

This is about as near as we get to a fertilization schedule. During the summer there are always some greens needing something extra, which is generally a light dressing of compost. Attacks of brown-patch at times call for a stimulant to assist in the quick recovery of the turf. We use sulphate of ammonia only after the greens have been injured by a severe attack, applying it dry. Usually we check the attack by the use of a commercial mixture of calomel and corrosive sublimate before any real damage is occasioned.

In deciding when our greens need fertilization we depend on signs

of slow recovery from heavy play, signs such as lingering ball gouges or heel scars. We try to avoid feedings that cause a lush growth and heavy clippings. Our heaviest clippings occur during times of spring rain. We have no trouble as regards color during the growing season, but the turf does go off color a little when the cool weather comes.

In January we shall be the host for a big tournament, and in the hope that we may have greens of a good color by that time, we shall add our 6½-2-0 organic fertilizer mixture, as a further stimulant, to the compost top-dressing which we should apply early in November. It may be somewhat wasteful to apply such fertilizers in the hope of keeping good color through the cold weather; but should the weather warm up again it is likely that a better reaction will be obtained than if the compost alone had been used.



The eighteenth putting green of Wilshire Country Club, Los Angeles, Calif.

After a long summer of irrigation we find it necessary to top-dress with sand. We use a sharp silica sand free from lime. The constant threat of invasion from native clover makes it necessary that the use of lime be avoided. We also use a light dressing of charcoal in the late fall; this seems to prevent a nasty state of sweating during dull, muggy days, and also makes the turf firmer.

We have kept a record of all fertilizers applied since the course was built. The record shows that compost has been the main diet, blood meal and cottonseed meal next, and mixed fertilizers last. Our mixed fertilizers have always been low in phosphoric acid, never more than 2 per cent, and very low in potash and lime, simply such as occurs in the cow and horse manure in our compost.

In making our compost we use as light a sandy soil as we can buy. In years past we also used cow and horse manure; but such manures are becoming scarce and expensive in the vicinity of Los Angeles, so that we are now using a good grade of steer manure, which runs about 2 per cent nitrogen. We also use a coarse wash sand from the rock crushers. We have no exact proportions of soil, sand, and manure to use in our compost. We first put down a layer of soil of about 6 inches, then about 1 foot of manure, and then 2 or 3 inches of wash sand. We repeat the operation until the pile is 6 or 7 feet high. We

then cover the sides and top with a 6-inch layer of soil. We leave the pile undisturbed for a year. The pile is built on a concrete floor and covered with a permanent roof. We keep it moist with overhead sprinkler pipes. The second year we turn the pile twice, and the third year it is ripe and ready for use.

Readers will perceive at once that we do not favor any popular short cuts in greenkeeping nor place any dependence on magic brands of fertilizers. Considering the poor character of our soil and the results we have obtained, we believe the course we are pursuing in the use of fertilizers for our putting greens is a logical one. We can not close without giving expression to our appreciation of the unbiased service the Green Section has been to us in connection with our problems and the confidence with which we look forward to its further aid.

Experience With Fertilizers at Plainfield Country Club

By F. J. Roth

Plainfield Country Club, Plainfield, N. J.

The past ten years have witnessed many changes in fertilizing putting greens, and a brief narrative of our own experiences during the period will doubtless reflect the experiences of many other golf clubs. The narrative is of peculiar interest to me, inasmuch as I built the course in 1920 and have accordingly had opportunity to witness the results of different practices under conditions with which I am thoroughly familiar. In the end I feel that we have made some progress, since the results seem to satisfy our club members at an annual expenditure of \$25,500 for our 27-hole course.

Our greens are built on a gravelly clay subsoil. Some are slightly built up and others are on natural contours. We have on an average 6 inches of compost for the top layer. Four of the greens are provided with subdrainage. They were seeded in 1920 with a mixture of 40 per cent German mixed bent, 50 per cent New Zealand red fescue, and 10 per cent redtop. At the present time practically all of the fescue has disappeared except on our No. 1 green, which seems to hold the fescue very well. No reason is apparent for this, as the green was constructed in the same manner as the other greens. It is strange also that with this green we never have any trouble; it requires the least amount of fertilizer to keep it in condition. Annual bluegrass appears in all of our greens in the spring, persisting until the middle of June, when it weakens and is replaced with bent to the extent of 40 to 75 per cent.

In 1921 and 1922 we top-dressed with compost alone, using one yard to a green. In 1923 we began using sulphate of ammonia for the effect it would have in reducing the amount of clover in the turf. In 1924 we discontinued the use of compost, since we found that our compost contained much plantain seed. From that time on we have used nothing but mushroom soil as top-dressing material or as a medium for the distribution of fertilizers, fungicides, or insecticides. During 1925 we top-dressed each green monthly from April until October with $\frac{1}{2}$ yard of mushroom soil into which 10 pounds of sulphate of ammonia had been mixed. In 1926 and 1927 we cut down the amount of sulphate of ammonia used, making two applications of 20 pounds each, one in April and one in October, and during the intervening period of the season used nothing but mushroom soil at the

rate of $\frac{1}{2}$ yard to the green. Beginning in 1928 we used 15 pounds of sulphate of ammonia in April and October in 1 yard of mushroom soil. Between these months we used $\frac{1}{2}$ yard of mushroom soil with 25 pounds of an 8-5-4 fertilizer regularly each month. All told, each green accordingly received for the year 125 pounds of the 8-5-4 fertilizer and 30 pounds of sulphate of ammonia, in addition to the mushroom soil.

In 1929 we changed our program of top-dressing and watched the condition of our greens more closely. In April we applied 10 pounds of sulphate of ammonia with 1 yard of mushroom soil. For the rest of the season we top-dressed only when need seemed to be apparent. In other words, if a green looked "hungry"—and by that I mean very much off color and of stunted growth—we gave it 1 yard of mushroom soil and 25 pounds of the 8-5-4 fertilizer. This practice has done very well with us up to date and it is our plan to continue with it.

My experience seems to indicate that in mushroom soil we have a fertilizer of lasting effect and a resultant steady, uniform growth. We buy our 8-5-4 fertilizer already mixed. The top-dressing is applied by hand, from pails; it is smoothed with a steel mat and lightly watered.

For brown-patch, both small and large, we apply calomel and corrosive sublimate every other Monday during the season when the disease is prevalent, at the rate of 3 ounces to 1,000 square feet. In this way we have escaped all injury from the disease.

In Farmers' Bulletin 1397-F, issued by the United States Department of Agriculture, methods are described for controlling field mice, including the destruction of mouse shelters, treating trees with repellent washes, inclosing trees with mechanical protectors, trapping, and poisoning. Where field mice are destructive to trees or turf their control should be undertaken at regular intervals. Inspections should be made, especially in fall and early spring, for mouse signs, and protective measures taken if necessary. The bulletin may be obtained free from the United States Department of Agriculture.

The Use of Fertilizers on Putting Greens

(Continued from page 109)

for making the putting surface true, and with fertilizers for providing the food necessary for the growth of the grass. For this purpose the greenkeeper has available a large choice of thoroughly tested commercial fertilizers. There has been in the past some prejudice against the use of commercial fertilizers on the part of many who have clung to the preference for so-called natural fertilizers, which were practically the only ones available at the time of our great-grandfathers. The modern farmer and greenkeeper have learned to recognize that plants are not influenced by prejudices and are satisfied to get their food from any source that is available. The important question is the matter of availability, which means, as a rule, whether or not the plant food can become soluble in the soil and thus in condition for the roots to absorb.

Fertilizing Putting Greens at Oakmont Country Club

By Emil Loeffler

Oakmont Country Club, Oakmont, Pa.

Our chief aim in handling our putting greens during the past years at Oakmont (near Pittsburgh, Pa.) has been centered in keeping the foundation and topsoil in the best possible physical condition for the production of good turf. In this way a minimum amount of fertilizer is required, this resulting not only in a saving in expense of upkeep but in keeping the grass in the best condition possible for combating disease and adverse weather conditions. In brief, we fertilize only when it appears that the grass is in need of a little nourishment.

Our putting greens are 27 years old. They were originally seeded with mixed bent and Kentucky bluegrass. For some years after that however the turf was mostly annual bluegrass (*Poa annua*) and Kentucky bluegrass. In recent years the bents have crowded out the bluegrasses to such an extent that at present the turf is about 75 per cent bent. Annual bluegrass is evident only in the spring after the greens have been cut several times and put in playing condition, after which it gradually disappears.



The new sixteenth putting green on the Oakmont course, Oakmont, Pa.

Our subsoil is clay. A 4-inch layer of topsoil produced by top-dressing once or twice a season for the past 15 years has put our greens in very satisfactory condition. Our top-dressing material consists of about 60 per cent well-decomposed compost and 40 per cent sharp river sand. The sand is quite essential, as it produces a soil texture which could not be produced by the use of compost lacking in sand. Sand keeps the soil mellow so that water and air can get down to the roots of the grass and puts the soil in the best possible condition for growth. It also makes it possible to hold a ball on the putting greens under any condition. Compost keeps up the humus content of the topsoil and supplies plant food in a natural way; and this can not be effected by the use of fertilizers alone. Top-dressing also helps to make a true putting surface. At one time we let our grass grow about an inch long in the spring before top-dressing. This resulted in a coarse turf which could not be converted to a turf of suitable fineness until after a month or six weeks. Now we cut and roll our greens several times before applying the top-dressing.

We try never to overfeed our greens. We determine the need of fertilizer by the way the ball acts on the putting green. If the turf loses its nap and the ball is hard to control on a long putt we make an application of fertilizer. During the past season all the feeding we did was to top-dress the greens once and give them two applications of sea-fowl guano at the rate of 40 to 50 pounds to a green.

We believe the most important features in maintaining our putting greens have been good surface drainage, not overfeeding, good top-dressing for providing a good topsoil, and keeping them as free as possible from worms. Drainage we consider exceedingly important. Most of our greens do not need subdrainage; they are either built up and have perfect surface drainage, or are trapped in such manner that the traps serve both as drains and hazards. Our greens never winterkill or become water-logged under any conditions.

Fertilizing Putting Greens at Brookline

By Howard D. Farrant

The Country Club, Brookline, Mass.

Our putting greens are bent grass, 19 having been seeded with mixed bent and 9 having been planted with the Virginia strain of creeping bent stolons. All have considerable annual bluegrass (*Poa annua*). We do not intentionally seed with annual bluegrass for we do not like to have it in our greens, but it seems to thrive all through this section of the country and has come in of its own accord and is especially troublesome in our new greens. The subsoil of our greens is mostly clay. The surface layer is a heavy loam, which is being steadily improved by the sand which we mix into our compost. Three of the greens are drained with a herringbone system of tiling 10 to 12 inches below the surface; all the other greens have only surface drainage.

The greens are not covered during winter, except for the brush which we scatter around the edges of certain ones, mostly on the north and northwest sides of the green. The brush is allowed to remain as late as possible in the spring. It is surprising how beneficial a wind-break of this kind appears to be, as after the snow has gone in early spring the turf that has been thus protected responds as if it had been fertilized.

Our first spring treatment is top-dressing. This is done after the grass has started to grow, care being taken not to apply the top-dressing too soon. The time depends entirely on weather conditions, but it is generally around the last of April or first of May. The top-dressing material is compost which has been prepared the year before and into which sulphate of ammonia has been mixed, in the loam shed, just before the material is applied. One cubic yard of compost is used on a green of average size (about 6,200 square feet). Sufficient sulphate of ammonia is used to give an application of 5 pounds to 1,000 square feet. The material is spread from wheelbarrows, by hand. The spreading is started at the side of the green opposite from the pile of compost left by the truck on the edge of the green. We try to select a good drying day on which to make the application, also a day when the play is light. The top-dressing is then worked into the turf with steel mats, lightly swept with birch brooms, and thoroughly watered.

A second top-dressing is applied after the turf has made some growth, which for us is about the second week in June. The material is compost into which poultry manure has been mixed, in the loam shed, just before use. One and one-half yards of material, containing about 70 pounds of poultry manure, is applied to a green of average size.

During the warm months that follow we have no set rule of procedure. It may be 3 weeks or 7 weeks before another top-dressing is applied. If any of the greens look below standard we try to stimulate their growth to equal the other greens. The vigor of a green is determined more by the color of its turf than the quantity of clippings obtained from it, as the latter depends a good deal on weather conditions. During the warm weather we would rather not use a quick-acting fertilizer unless forced to do so. In such cases a solution of sulphate of ammonia applied with a power sprayer at the rate of 3 pounds to 1,000 square feet gives quick results. However we have known this treatment to fail. When this occurs we have at times obtained good results from an application of Scotch soot, while two of our greens which have occasionally troubled us have been helped by an application of lime. We have no set rule to follow in such cases, except to test the soil and do what seems to be necessary to keep it in a slightly acid condition. During warm weather we have used only compost as a filler for the grass roots. The latter part of September another application of sulphate of ammonia is made. This seems to be all that is required to keep the turf in good condition for the balance of the year, except that we have in late fall applied bone meal, in sand, when the ground is frozen. In general, we try to be on the light side in the application of fertilizers and to force the turf as little as possible in midsummer.

We are obliged to purchase all our loam for compost. We keep a two years' supply on hand, and this permits us to prepare good compost by working into the loam grass clippings, green material from the rough, and leaves which have been kept in piles. This mixture is turned every four or five months or spread out in the open and turned by plow, the latter process being preferable.

While it is of course necessary in caring for putting greens to formulate a fertilization program of some kind, it is not always advisable to follow it to the letter. Of equal importance is a diligent observation of conditions as they develop on the course and the adjusting of one's program to existing conditions. A program that might be successful in one location might be disastrous in another.

Several years ago the United States Department of Agriculture distributed a new variety of sugar cane developed from their investigations at Canal Point, Florida. Agricultural scientists are enthused over the development of this variety, known as C. P. 807, which has shown an increase in yield of nearly a ton of sugar an acre over the best of the competing varieties. Considerable loss from diseases almost wrecked the sugar industry in Louisiana prior to 1926, at which time the United States Department of Agriculture introduced from Japan the P. O. J. variety, which was more resistant to disease. The new C. P. 807 variety was bred at the Department field station at Canal Point, Florida, which was established in 1920 by the Bureau of Plant Industry.

Fertilizing Bermuda Greens for Winter Play

By O. Sproule Baker

Boca Raton Club, Boca Raton, Fla.

Of our 36 Bermuda grass putting greens 28 were built up out of sand, topped with a mixture of marl, muck, and sand in equal proportions. While their natural subdrainage is very good, their topsoil is not of a character that can be expected to produce good turf without careful attention as regards its fertilization. Our muck and marl soils are notably lacking in the various plant food elements required by most plants, but we are having success in supplying these elements through an active organic material, activated sludge, used in conjunction with inorganic fertilizers. Two of the greens were planted with stolons and the remainder with seed. We do not use such grasses as rye grass, redtop, and bluegrass, for our winter greens, neither on our regular courses, our large practice green, nor our 9 pitch-course greens.

The activated sludge is applied to our putting greens at intervals of 6 to 8 weeks, at a rate of 25 to 50 pounds to 1,000 square feet. An ordinary seeder is used for making the application. Sulphate of ammonia is also applied to the greens, at intervals of 2 to 4 weeks, at the rate of 3 to 5 pounds to 1,000 square feet. This is broadcast by hand, in the dry state, when applied alone, and properly watered in; when mixed with activated sludge, the material is applied with the seeder.

In April, near the end of our season, we apply a mixture of 2 pounds of sulphate of potash, 5 pounds of sulphate of manganese, 5 pounds of treble superphosphate, and 40 to 50 pounds of activated sludge, to 1,000 square feet. We believe the use of a complete mixed fertilizer of this kind at the end of the playing season helps the grass build up sufficient reserve strength to resist the drought and insect attacks of summer. We buy no mixed fertilizers but mix our own. In the early fall, at the beginning of the rains, hydrated lime is applied at the rate of 15 to 20 pounds to 1,000 square feet.

The applications are determined by the vigor and color of the turf, time of the year, temperature, moisture, and the requirements of play. Our heaviest play is at the time of the year when the grass is naturally dormant, a condition which of course calls for suitable fertilization in order to prepare the turf for the demands to be put upon it. With the exception of 8 of our greens, which were taken over from the old Cloister Inn Club, we treat the greens all alike, since all have about the same kind of soil and drainage, and none are heavily shaded. The 8 Cloister Inn greens give us some trouble and call for special attention, due to the layer-like nature of their topsoil resulting from their having been formerly top-dressed with layers of unmixed materials, especially black hammock sand.

For top-dressing our greens we use a mixture of equal parts of muck, marl, sharp sand, and German peat moss. No fertilizer is put into this mixture. We apply fertilizer only when needed, and before the top-dressing is applied. Sufficient top-dressing material is prepared at a time to dress all of one 18-hole course, this amount giving us a good start on the top-dressing crew. The material is fed dry through a shredding machine into a sheltered place. It is then passed through a mixer of the impeller type, being thrown up through a revolving screen against a partition in the upper or feed end. Impact

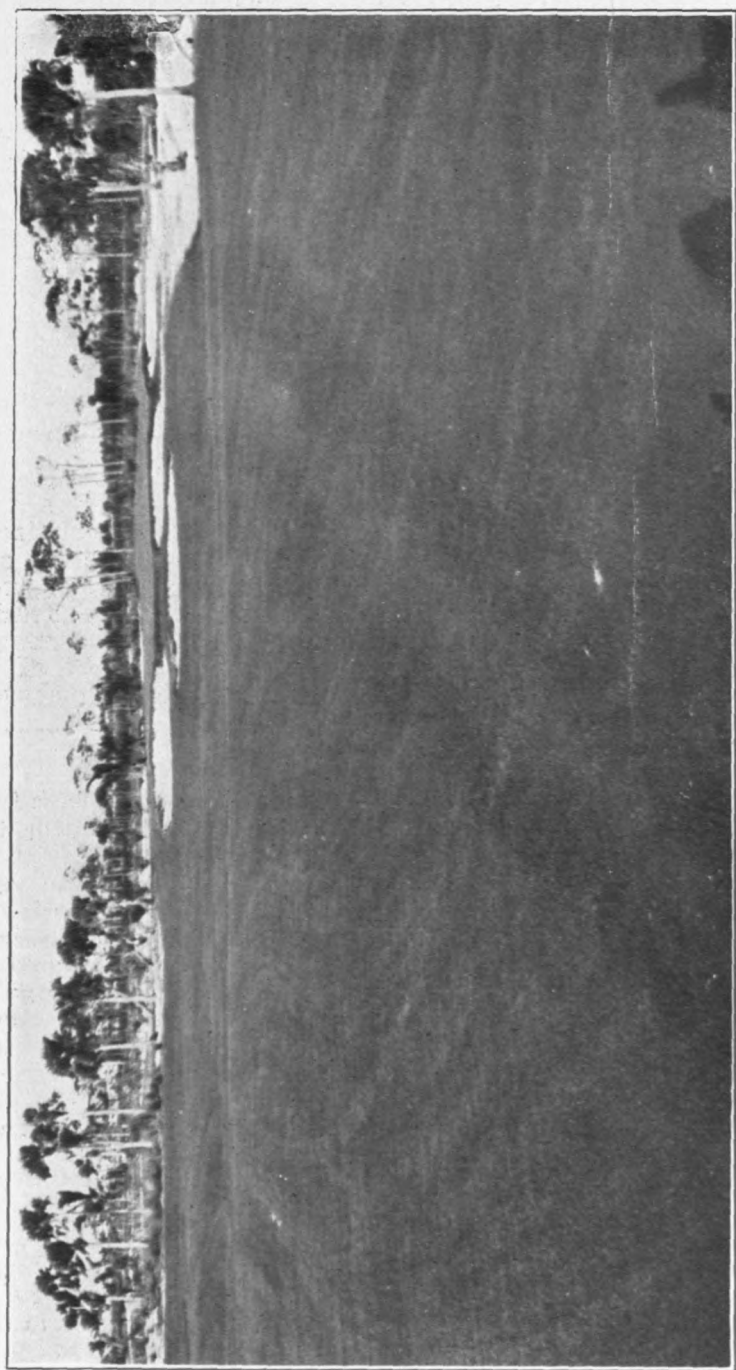
against this partition breaks the material to such an extent that as it feeds down the slope of the screen more of the good material comes through in the first handling than would otherwise be possible. The screening crew loads the finished material into trucks which carry it to the top-dressing crew on the green. It is then applied to the green with top-dressing machines equipped with a steel door mat $2\frac{1}{2}$ feet wide by 3 feet long hung from the axle instead of the ordinary brush attachment. We follow this operation by dragging steel door mats in circles down one-half of the green and back the other half, overlapping in a manner much the same as that practiced in penmanship when a series of O's are run together. The dressing is then watered in to save the cutting edge of the mower.



Working top-dressing into turf by dragging door mats in circles over a putting green on the Boca Raton course

During the playing season we top-dress as required to keep a true putting surface, which is at intervals of 2 to 3 weeks. During the summer, when the courses are not in use, we top-dress only about once in 3 months; this is for the purpose of covering the cuttings, which we never remove, since in this manner they are rotted into humus, but in quantities not so large as to create heat in the process of decomposition. The cuttings thus left on the turf, in combination with the peat moss in the top-dressing material, increase the organic content of the topsoil and hence keep the soil in a more porous condition and assist in the conservation of moisture. A dressing of this kind is a great help to the heat-loving Bermuda grass. The turf will respond to the warmth of the sun more readily when plenty of peat moss has been applied, since the darker substance absorbs heat from the sun more readily than does the white sand.

The airplane menace to wild fowl grows more acute each year. The airman is swifter on the wing than ducks and geese and frequently takes advantage of his fast-flying ability to bag ducks, geese, and other game birds. The regulations under the Federal migratory bird treaty act make it unlawful to hunt migratory game birds from an airplane, and the law provides a fine of not more than \$500 or imprisonment for not more than six months, or both, for violations. Aviators violate this provision every year, however, some in ignorance of the law and some in disregard of it.



Approach of the sixth hole (343 yards) on the South Course of the Boca Raton Club, Boca Raton, Fla.



First of all, we must observe that in all these matters of human action the too little and the too much are alike ruinous, as we can see (to illustrate the spiritual by the natural) in matters of strength and health. Too much and too little exercise alike impair the strength, and too much meat and drink and too little both alike destroy the health, but the fitting amount produces and preserves them.

Aristotle

