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THE MAKING OF A PUTTING GREEN

OLD WAY OF MAKING PUTTING GREENS.

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UP TO A PERIOD of fifty years ago, the putting green was (as far as grass is concerned) a part of the fair green, merely cropped rather shorter by the sheep—which constituted the only lawn mowers used up to that time.

Putting greens were not especially planted or made. They were merely parts of the fair green selected because of their proper distance from the tees and because the natural conformation of the ground at this point was suited to putting.

It was only after the invention of lawn mowers that the putting green began to be treated materially differently from the fair green. And even today, at the old St. Andrews course in Scotland, many of the putting greens merge almost imperceptibly into the fair green.

Now, however, practically all over the world, when a new golf course is built, the putting greens are made as a separate element of the course, independent of the fair green. They are generally especially graded so as to have carefully designed slopes and convolutions to insure a pleasing variety in the contours of the greens and to demand more skill on the part of the golfer.

Very generally now, also, the putting green is sown with especial care—a finer and more expensive grade of grass being used here than on the fair green.

Up to the time that the writer started his experiments "On the Making of a Putting Green" the best practice consisted in chemically analyzing the soil where the putting green was to be made, and attempting to supply it with the fertilizer and the manure or lime needed to put it in proper condition for growing grass. The soil was then plowed up, the green graded so as to have the proper contour and the grass planted—just as grass has always been planted — carefully sprinkling the seeds over the surface of the ground and either gently raking them into the ground or covering them with a thin sprinkling of dry soil and rolling lightly so as to bring the seeds into close contact with the soil.

It is still almost the universal practice to use a mixture of three or four different kinds of seeds in sowing a

putting green. Almost every large seedsman in the country has his own special putting green mixture—and in many cases these dealers keep the kinds and relative quantities of the seeds used in their mixtures as a profound secret.

Indeed, under the ordinary method of making a putting green, it is good practice to sow a variety of seeds. There are several reasons for this:

First—Because the soil in the different parts of the golf course in which the eighteen greens are situated may (and probably does) vary materially in quality.

Second—Because, even if the soils on all of the greens happened to be of the same quality, some of the greens are sure to be situated where they will get and hold far more water than others and in some places the soil will be packed much more solidly than in others. The depth of the soil will vary and in some places it will be well drained, while in others it may be almost swampy.

In some cases all of these conditions may even exist in different parts of the same green.

Realizing this fact it is desirable to plant a sufficient variety of seeds to be sure that all parts of the green will be covered with grass, whether the soil be dense or open, moisture holding or dry, deep or shallow, lean or well supplied with plant food.

It should be appreciated, of course, that one grass will thrive in a comparatively dry soil while another variety requires a great deal of moisture ; one grass is deep rooting in its nature while the roots of another stay close to the surface of the ground; one grows rapidly and uses a good deal of plant food while another requires next to no food to live on; one grass thrives especially in the early spring and late fall while another has its best growing period in midsummer.

Another reason for sowing a variety of grasses in a green (and this fact is appreciated by very few people) is that some of the grasses are very slow in maturing while others are in their prime during the first year. For example: the very finest of all grasses for making a putting green in a moderately warm climate. Creeping Bent *(Agrostis Stolonifera),* as *ordinarily planted,* requires from three to eight years before it reaches the full stage of development in which it represents almost the ideal putting green grass; and in the meantime some other grass is needed to properly cover the green while the Creeping Bent is in process of development.

Realizing these facts it will be seen that up to this time, those who have made putting greens have been justified in planting several kinds of grass on the same green, even although the disadvantage of having different grasses on the same green must be apparent to everyone.

If the mixed grass seeds came up uniformly as they are sowed all over the green and if the various grasses grew, even approximately, uniformly side by side, then there would be comparatively little disadvantage in planting several kinds of grasses on the same green. In fact, however, they rarely, if ever, germinate uniformly. And soon after the grass is up, owing to different moisture and other conditions in different parts of the greens, some one of the grasses will grow better than the others, so that in a comparatively short time the green begins to have a more or less patchy look—certain areas being occupied almost exclusively by one kind of grass with

patches of other kinds of grass adjoining. One of the grasses will grow faster than the others, while they all vary somewhat in the thickness of their growth and the stiffness of the grass leaves; thus presenting varying resistance to the ball. This renders putting difficult—particularly if the grass is allowed to grow a little long—because then the difference between the resistance of the various patches to the ball is accentuated.

Uniformity in the resistance of the grass to the ball is among the most important conditions needed for good putting.

It is for the purpose of securing this uniformity that the practice of mowing the grass exceedingly short has become very general for tournaments.

The disadvantages resulting from mowing the putting green so very close are so many and so great, particularly in the warm climate of the Middle States of this country, that if a uniform putting surface can be obtained with a longer and more velvety turf the writer feels sure that this type of green, in the end, will prevail.

Perhaps the greatest disadvantage resulting from cutting the putting green close throughout the season in the hot summer climate prevailing throughout the greater part of this country is, that this treatment is so severe on the grass as to require more or less fresh sowing every year.

In order to make the young grass grow on the old green the best practice seems to be to severely rake up the surface of the green in the early spring, add 3-16 to ¼-inch of new, rich specially prepared soil and rub it down with the back of a rake, so as to thoroughly incorporate it with last year's soil, and sow with good seeds. This involves, of course, the presence of old and young grass on the same green. Owing largely to the presence of the young grass, it makes a green of fine quality. This practice, however, is accompanied by serious disadvantages.

The greens are out of use for a period of from three to six weeks during the spring, while the seeds are germinating and the young grass growing strong enough to putt on.

Young grass requires much more careful and more frequent watering than old. In many cases night watering is required.

The annual reseeding of the greens calls for a higher grade of green keeping and workmen. This whole treatment, in fact, calls for an organization on the course which is difficult to get and maintain, and the expense of maintenance of greens of this kind is fully double that of the other type.

HOW THE EXPERIMENTS STARTED

In the year 1904 the writer endeavored to make a small putting green, 50 x 40 feet, in his garden at Chestnut Hill, Philadelphia. In the method of preparing the soil, the selection of the seeds and their sowing and in the subsequent care and treatment of the green he had the advice of the best grass expert in Philadelphia.

A good rich garden soil was used and great pains taken in making the green and yet the resulting grass was a disappointment, if not a complete failure. We (as is the case nine times out of ten) attributed our lack of success to not having the proper manure and fertilizer in the soil and also to our probably not having watered the grass properly.

The next year the green was replanted. Bone meal, cottonseed meal and nitrate of soda were added liberally to the soil and great care was

taken in planting, mowing and watering the grass; and the resulting green was still far from a success and it was not until our experiments had been carried on for several years that we realized that our good rich garden soil (well suited to growing vegetables and flowers) was unsuitable for growing fine grass, because its grain composition did not permit the grass roots to penetrate it as they should and because its moisture holding properties were wrong.

This failure led the writer to start a series of experiments to investigate the conditions required to successfully grow the finer grasses suitable for a putting green.

While the writer must confess that his principal reason for making these experiments was the pleasure which he derived from the investigation, still, as time went on and useful results were attained, there came the secondary object of trying to help the golfers of the country to get better putting greens.

As is frequently the case, what at first started with a few simple experiments opened out finally into quite an extensive investigation covering many elements, the relative importance of which it would have been difficult for anyone to foresee at the start.

Throughout the whole series of experiments leading up to the preparation of this article, the writer has had the constant co-operation of two friends, Robert Bender and Harold Van du Zee. Without their untiring assistance and work the investigation could not have been carried on. In his writing, therefore, the author stands as the representative of all three.

NATURE OF OUR EXPERIMENTS

Our experiments started in a somewhat desultory way of planting grass seeds in different soils.

We soon realized, however, that if the results obtained by us were to be of real use to grass growers outside of the neighborhood of Philadelphia there was little to be gained by experimenting with natural soils.

It is practically impossible to describe a natural soil so that it can be duplicated in another part of the country. Soils which have been in process of formation for thousands of years are, in most cases, so intricate in their grain composition, their organic and inorganic food contents, their moisture-holding properties, and their penetrability by grass roots that it is impossible to so describe them that they can be duplicated.

The words "good sandy loam" and "rich clay soil," for instance, are entirely inadequate to indicate whether a soil is suited to growing grass or not. We, therefore, decided to experiment only with soils artificially made by mixing together elementary materials which can be procured in all parts of the world—thus making the results of our investigation useful to those living outside of our own district.

By elementary materials the writer means such materials, for example, as clay, cow manure, limestone pulverized to a definite fineness, peat moss (a material obtainable throughout this country and Europe)—leaf mold or Humus (in fibrous form and in powdered form)—sand of a definite grain composition, powdered bone, etc. It must be understood, therefore, that all of the soils used in our experiments were built by mixing together elementary materials of this sort and that the soils described by us can be reduplicated almost anywhere.

Our experiments had not proceeded very far before we reached the con-

clusion that a putting green could be constructed of materials of this sort so that a single variety of grass could be made to grow perfectly on all parts of the green, thus securing a degree of uniformity in the resistance of the grass to the ball which was impossible when, under the old system, several kinds of grass are planted on the same green. In other words, we proposed to find out the particular variety of grass which will produce the finest and best surface for a putting green and then develop an artificial soil especially suited to growing this grass. Our object became to suit the soil to the grass not the grass to the soil.

The practice of using the soil as it happens to exist where the putting green is to be located and of adding manure and fertilizer to improve it has been so universal, however, that most grass growers will look upon the cost of transporting from a distance materials for making a putting green as an extravagance and will question whether the members of the club would be willing to pay the cost. The writer is convinced, however, that this objection will not long prevail. The success of a golf course and the pleasure of its members depends more upon the condition of its greens than upon any other single element. And where large sums are spent in purchasing land, building a club house and making roads leading to the club, the money will be forthcoming for making greens which will be perfect within a year rather than to wait for several years while greens are being gradually improved, frequently at great annual expense, by adding properly prepared soil on top of the grass and resowing, so that in the end the green planted on the natural soil costs far more than the artificial green. No one now, for example, looks upon it as an extravagance to bring from a distance the materials necessary to macadamize the road leading to the club or to make a proper cement floor for the cellar of the club house; and yet the materials for making a green cost no more per square yard than those used for making a road or paving a cellar. It is not so many years ago that the average club member would have regarded it an extravagance to bring materials from a distance to make a road leading to the club house.

Even the poorer golf clubs, which perhaps cannot afford to make a full-sized green according to the new method, will surely find it advisable to make the central portion of their greens, where the hole is usually placed, covering a space, say, 20 to 30 feet square, in the best possible way.

There is another fundamental fact which when appreciated causes the necessity for making an artificial soil for the putting green to be most apparent.

The conditions under which young grass will develop quickly differ radically from those under which old grass thrives—so radically in fact that the characteristics of the soil required for young grass are almost directly the opposite to those needed by old grass. It is difficult to make young grass grow successfully in the soil best suited to the same grass when old. Fortunately, however, old grass adapts itself well to the special soil at the surface of the green needed for its rapid development while young.

We shall also point out later that the germination of the seeds according to a new method is a matter almost vital to the success of a putting green. Thus we shall see that a putting green should consist of three radically different kinds of soil:

First—The seed germinating layer extending from 3-16 to ½ inch below the surface of the ground according to the kind of grass seed which is being sowed.

Second—The "blanket" layer consisting of a soil especially adapted to the rapid development of young grass and extending from ¼ to 1¾ inches below the germinating layer.

Third—The main body of the soil extending 12 inches below the blanket layer in which the great mass of roots live. And unless the green happens to be located over a porous subsoil we shall need still another layer.

Fourth—The drainage layer consisting of about 3 inches of broken stone or similar material beneath the main body of the green.

There is also a property which does not exist in the ordinary green. This characteristic adds greatly to the value of a putting green and yet it complicates the construction of the blanket layer.

The surface of the green should be such that, if possible, a ball which is pitched on it will "bite" in about the same way in either dry or wet weather; *i. e.,* the surface should neither bake hard in dry weather nor should it become soft or muddy in wet weather and it should be of such a nature that the freezing and thawing of winter will not cause it to deform.

When we realize that these are the several requirements for a successful green it is evident that they cannot possibly be met by any natural soil; nor even by modifying any natural soil through the addition of manures, fertilizers, humus or sand of any kind.

The following are the subjects which we have attempted partially to investigate:

1 How to germinate the seeds.
2 The proper number of spears per square inch which should be germinated in order to develop grass quickly.
3 How to develop the young grass plants with greatest rapidity.
4 Kind of soil in which the old roots will thrive best.
5 Kind of grasses best for making greens.
6 Nature and amount of food used in soil.
7 How to water.
8 How to mow grass. How soon and at what height.
9 How to keep out weeds.
10 How to promote rapid deep rooting.
11 Soft but firm surface on which ball will bite right in wet or dry weather.
12 Effect of adding covers of different kinds.
13 How to prevent mildew.
14 Rolling—Reason and kind of.
15 Worms—How to prevent them.
16 The causes for sour soil and remedies.
17 How soil should be packed in placing a green—Loose and tight packing.
18 Best and most economical methods of preparing, mixing and placing the materials used in making a green, including study of best apparatus to use for this purpose.
19 The most favorable time of the year for planting seeds.
10 How to best guard against the ravages of a heavy rainstorm coming soon after green is planted.
21 Kind of food to add to older grasses—When and how to feed it. (See 6.)
22 Worm casts.
23 Depth of soil necessary.

The first seven of these subjects have called for the larger part of our study and attention and of these the investigation of the conditions under which old grass roots thrive best has taken the most time. Chiefly, of course, because it was necessary to wait, in most cases, about nine months for the grass to mature before definite conclusions could be reached. It will be appreciated, of course, that many of these elements are so interdependent that a study of one subject must, of necessity, be closely associated with several others.

One of the first principles governing all scientific investigation, however, is that each experiment shall involve only one single change or innovation. And this simple rule has been closely followed by us, although it has, of course, called for a large number of experiments.

For the first two years, owing to our failure to fully appreciate the problems before us, our experiments were of rather a desultory character. After that time we settled down to the following general methods:

Small plots of the different soils, whose grass growing properties were to be investigated, were placed side by side in beds so that a glance from one plot to another would detect even small differences in the quality of the grass. The grass on these plots was all treated in the best possible way so as to bring it to the greatest state of perfection before the intense heat of the summer began to cause it to deteriorate.

Having perfected our grass, in order to prove which plot was the better, it was necessary to subject all of them to the most severe conditions to which grass is likely to be submitted by nature; and as the grass gradually deteriorated, under this severe treatment, to note those plots which showed the greatest resistance to adverse conditions.

It is only by subjecting two or more plots of grass to severe and unfavorable conditions that it is possible to definitely decide which is the best. If they are well treated they are all alike.

The two most severe conditions to which grass is subjected by nature are a combination of great heat with drought or great heat with an excess of moisture. The climate of Philadelphia, owing to its intense summer heat is, therefore, especially favorable for making grass experiments. It would be difficult in fact, if not impossible, in a cool summer climate to successfully conduct grass experiments, because in a cool climate the excessive heat is lacking which is needed to emphasize the differences produced by the different soils in the strength of the grass and in its ability to resist adverse conditions. Briefly, then, our general plan was first to bring the grass on each plot to the highest state of perfection and then reverse the process and injure the grass through heat, drought, etc., and note those plots which lasted best under unfavorable conditions.

Between the fifteenth of September and the first of November of each year from one hundred to four hundred and fifty small plots of soil were prepared and sowed with grass seed. For several years past we have adopted 2 x 2 feet as the standard size of a plot.

Each of these plots contained only one element, affecting the growth of the grass, which we wished to investigate. They were all sowed with Red Fescue *(Festuca Rubra)* seed because, while among dwarf grasses red fescue is one of the most virile and finest in a cold climate, yet in a hot

climate (like that of Philadelphia) it is almost impossible to make this variety of grass live through the summer months if sowed in any ordinary soil; and a grass of this sort (difficult to grow) is needed to emphasize the differences in the soils under investigation.

Our experiments for several years were made in duplicate ; one group of plots containing the various soils to be tested being placed in one part of our grass garden while a second group of exactly similar plots was located at some distance from the first.

These plots were watered, mowed, rolled and cared for in the best possible way all through the fall and spring, so as to have the grass on them all in perfect condition when the hot summer weather started. After perfecting them in this way then began the test to prove which soil was best. With the beginning of hot weather, generally some time between the first of June and the first of July, one of these two groups or plots was covered with glass sash placed about 4 or 5 feet above the ground so as to completely keep the rain off—without shielding them from the sun. The grass was thus treated to complete drought conditions throughout the hot months of July and August—all water, either artificial or rain, being excluded from it. The duplicate plots, situated in the other part of the garden, were on the other hand, treated to swamp conditions. Beginning about the middle of May they were systematically watered far more heavily throughout the season than they ever could be through any natural rainfall. From the time the seeds were planted until the following fall accurate records were kept of all important facts connected with the growth and decline of the grass, such as—

The date of planting and minute details of method of planting.

Date when spears of grass first appeared above surface of ground.

Date when grass was all up.

Dates when grass was watered and method of watering.

Date of first mowing, height of grass when first mowed and height of knives of grass mower above the ground.

Dates when grass is mowed throughout the season and height of knives of mower above ground.

Number of spears of grass which are germinated per square inch.

Number of grass plants per square inch surviving after lapse of one, two or three months.

Depth of heavy root growth and also depth of deepest root growth at several periods during the year.

If any foods are added to the grass plots, dates and amounts of food.

The relative quality of the various plots is examined and recorded at several periods during the growing season and especially accurate observation are made and recorded as to the relative condition of the various plots after the process has begun of injuring them through drought and through over-watering in the hot summer months.

Fairly accurate records of the condition of the plots can be kept by rating them on the scale of 100.

Galling perfect grass 100.

Grass that is half brown, 50.

Grass that is three-quarters brown, 25, etc.

It is interesting to note that red fescue grass (one of the most difficult grasses to grow in a hot climate) when planted in the fall and given during the following summer complete drought conditions by being kept

under glass in the hot sun without any water from July 1 to September 1, when planted on the best soil developed by us, came out 85% perfect.

About the first of September a careful study is made of all of the plots to analyze the causes for their failure or their success. Certain of the soils will be found to have done especially well under drought conditions and certain others under swamp conditions; while the causes for failure or success under drought and swamp conditions are carefully analyzed.

Those plots, however, which are of especial interest and receive the most careful study and analysis are the few that have done the best both under drought and swamp conditions. The particular properties in these soils which have enabled them to withstand both of the adverse conditions are noted and studied; and the new lines for investigation for the following year are generally clearly indicated from this study.

It is, however, not always easy to correctly interpret the lesson taught by these plots; and in one case our failure to interpret the cause for success of certain plots led us to practically lose a year in our experiments. Fortunately we hit upon the true cause of their success later and during the following year made greater progress than ever before. Each year we suffered more or less from the same trouble. It requires a very considerable time to study and correctly interpret the results of one year of experimenting and the time between the first of September and to the tenth to the fifteenth of October (practically the latest period for planting grass in the fall) is too short to properly study the results of one year's work and plan the nature of the experiments for the following year and then procure and prepare the materials needed for new soils and get them planted. We were almost invariably too late in finishing our fall planting.

(To be continued)