Some Water Relations of Turf Plants

By DOCTOR HOWARD B. SPRAGUE, Agronomist

New Jersey Agricultural Experiment Station, New Brunswick

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WATER is one of the most important substances connected with life in this world of ours. The plant uses water in some form at every stage in its life period. Germination cannot proceed without moisture, and the first organs produced by the growing plant are roots for the absorption of water.

Water makes up 50 to 90 per cent of the growing grass plant on fairways, tees, and greens. Even such structural parts of the plant as cell walls, vessels for translocation of food materials, fibers, and tissues for mechanical support, etc., are produced in the plant by combining water with other substances. Approximately 35 to 55 pounds of water is required for every 100 pounds of such tissues formed.

DR. HOWARD B. SPRAGUE

The material which plants use as food, principally the starches and sugars, require 55 to 60 pounds of water for every 100 pounds of food manufactured. The plant's food is actually made in the leaves of the plant, but this process can only take place when the cells and cell walls are kept moist with water. The nitrogen and minerals which the plant must obtain from the soil, and which is frequently added in the form of fertilizer, only enters the roots when dissolved in water. These minerals are transported to the various parts of the plant in a stream of water which extends from the roots, through the stems, to the very surface of the leaves.

The food manufactured in the leaves is carried throughout the plant wherever needed, but only as it is dissolved in water. The combination of sugars, starches and other substances with the nitrogen and minerals to form protoplasm and cell walls for new cells, in roots, leaves and stems, takes place only with an abundant supply of water.

When the plant finally dies, it is decomposed by bacteria and molds which also require moisture for their activities. In nature, the decaying plant is broken down to its elemental components, which are water, carbon dioxide gas, and minerals. At an intermediate stage in this process of decay, humus is produced. When added to the soil, this decayed organic matter greatly modifies its water holding capacity, and other physical properties.

SEASONAL SUPPLY OF WATER

SINCE water plays such a vital part in the life of plants, it is extremely necessary that we consider the problem of providing sufficient moisture for normal growth. We have two principal sources of water on golf courses; one is natural rainfall, and the second is irrigation by some one of several systems. The goal that greenkeepers and others interested in turf management should bear in mind is that natural rainfall must be supplemented by irrigation, *only* to the extent necessary for moderate growth, and never in excess. The critical season of moisture deficiency in the northeastern states usually comes in June, July, and August, because of the relatively low efficiency of the moisture which is applied in this period.

The rate at which water is lost to the air by evaporation largely determines the efficiency of rainfall. The comparative figures for rainfall and evaporation for the 5-year period from 1924-1928, inclusive, are given in Table 1 for 5 locations in the eastern United States. Whenever evaporation is greater than rainfall, artificial watering is required on greens. If evaporation is 1½ to 3 times as great

who may be a bit nervous when performing before a crowd on the first tee, will probably dub the shot, thereby causing congestion. As he goes round his confidence grows.

There are two kinds of two-shot holes: (1) Where the green can be seen from the tee the whole time, with any one of the following contour formations:

a. Level from tee to green.
b. Ground falling away from tee.
c. Continuous rise from tee to green.

In some instances there may be a rise for the green to be built on, which is rather good.

(2) Where the green is blinded from the tee by a rise in ground on which the first shot would land. The tee should then be placed so that when the player, after his first well-played shot arrives at the ball's resting place, he can see the green for an approach shot. Either type of hole is quite all right.

LENGTH OF HOLES SHOULD VARY

THE length of the holes should be as varied as possible, for example, say you have the first hole 420 to 450 yards in length, the second might be 360 to 370 yards, the third hole being a short hole of 160 yards, to be played in an opposite direction, and so on, thus getting some of the holes against the prevailing wind and others with the wind.

Every advantage should be taken of all the natural elements and features of the land. For instance, one might get a very beautiful natural site for a green, entailing very little work, with the exception of creating traps to guard the green. The natural is infinitely more beautiful than the manufactured.

I like to have four short holes in the eighteen with lengths of approximately 140, 160, 190, and 220 yards. On no consideration would I build a *blind short hole*, the first reason being that as short holes are usually spectacular, the possible beauty of the green would be entirely lost, and the second reason being the moral effect on the play.

Take two players starting out to play a blind short hole—the first player gets a good shot, but the fact that his opponent does not see whether the ball goes near the pin or not, gives the opponent confidence. He plays and probably gets as good a

shot as the first player, whereas if the green were in plain view and the opponent could have seen the first player's ball roll beautifully close to the pin, the probability is that he would take extra precaution and care to do as well, and muff the shot.

Now one more point regarding short holes—the selection of locations for these should be over a gully or on a side hill. Sometimes a very fine short hole can be constructed on a side hill if this is at all possible.

Lastly—I like to create at least one three-shot hole in the eighteen of an approximate length of 560 yards.

THE CREATION OF BUNKERS

Now a few comments on the creation of bunkers or traps. I have drawn several types of holes showing the bunkering through the fairways which will speak for themselves.

In the construction of traps through the fairways, first let me say that there should be no hidden traps. The sand should be thrown part way up the back of traps so that they can be clearly seen from where the shot is being played, that is if the hole is being played correctly.

If the traps are on fairly level ground and the banks are up about the level of the ground, they should be well drawn out so that the fairway machine can do the most part of the cutting. All this drawing out of grades means more initial expense, *BUT* it will be found to quite justify itself because it will certainly reduce the cost of maintenance.

CONSTRUCTION OF THE TEES

Now a few remarks with reference to my opinion on the construction of the tees. If the drive is to be an uphill one, the tee should be made lower in the back than the front. Regarding shape—it should not be square in shape. Anything square on a golf course is an eyesore. Rather should it be oval or irregular in shape with the grades pulled well out. When coming off the green and going to the tee, the eye should be attracted by the tee-box rather than the tee itself.

Regarding size—the tee ought to be almost as large as the green, say thirty yards long by twenty yards wide, kept as low as possible and if built on a side hill, the grades to be pulled out as far as pos-

sible. There are two main advantages in creating large size tees, one from the standpoint of play, the other from the standpoint of maintenance cost.

From the playing standpoint, the large tee lends variety to the play in that tee plates can be moved forward when a strong wind is blowing toward the tee where there might be an impossible carry over one of the traps with a small-size tee, or plates can be moved a distance back in the case of a following wind which with a small-size tee would probably make the same trap ridiculously easy.

From the standpoint of maintenance, with the large size tee, by the time the tee plates have been moved all over the expense of the tee, it gives the greenkeeper a chance to repair the divot marks.

A good way of repairing divot marks is the cutting of thin sods from the turf nursery, scraping out the divot marks with a small rounded tool, then tearing off small pieces from the sod and placing them in the marks and stamping down with the foot. This method of repair results in a very quick healing and takes very little time. The soil thus scrapped out of the divot marks can be cleaned up and carried off in a pail.

FAIRWAY CUTTING MACHINES FOR TEES

A VERY big saving in labor is effected by the use of a three-unit fairway machine for cutting the tees. It would take two men all day to cut tees of such large size with hand machines, but with a tractor and a three-unit machine, the same amount of cutting could be done in two hours. I know, because I have done it myself. The machine should be set low and kept for this purpose alone, so that it will not have to be set every time the tees are cut, thereby effecting a saving in time.

Now a comment or two on greens and their construction. The construction of the eighteen greens should be taken in hand with the objective of creating as much variety as possible in beauty of shape, in contour and in elevation.

A green should rise from front to back and care should be taken to see that the surface water will drain off to the front of the green and all edges should be slightly turned up to keep the surface water out of the traps.

Any mounds that may be constructed around the green, or for that matter anywhere on the

course, should be very wide at the base in comparison with the height.

There should be no mounds at the sides and at the entrance to the green. A sliced or a pulled ball rolling over the inside of these mounds deflects toward the middle of the green and turns a bad shot into a perfectly good one, whereas if there are no mounds there, that same ball would very likely find a resting place in the trap where it deserves to be.

If desired, the green in a short hole may be trapped all round and as a rule may be a much more spectacular affair than that in any other type of hole.

SHORT TWO-SHOT HOLE CAN BE TRAPPED

The green on a hole of say 360 yards may be constructed and designed in such a way as to be almost, but not quite, as hard to play as a short one. I would advise leaving a narrow entrance to the green. The back of green could be trapped without it being deemed erroneous as the play would be an iron shot to the green. I would perhaps include two of this kind in a round.

A green on a 400-yard hole should not be trapped at the back and the entrance should be about 16 to 18 yards in width, with traps on the side, guarding the entrance.

A three-shot hole green can be a long and narrow creation with a narrow entrance, and it would not be wrong to trap the back as the approach shot is a mashie or an iron.

DRAINING TRAPS

On trap draining, I would just like to mention briefly a somewhat interesting point which I have illustrated. In my opinion, every trap should boast a drain which takes a course round the entire base of the trap bank, instead of running a straight middle course. This drain would then take care IMMEDIATELY of water seepage through the bank and thereby insure a continuously dry center.

Now in a short discourse on types of construction machinery and construction methods, take for instance a tract of land on which there are trees, stone walls, ledge rock and swamps, the machinery I would prefer to employ on such a tract would be a drag-line or gasoline machine with a forty or fifty-foot boom and bucket capable of digging up a yard of dirt attached to the boom with a cable.

This type of machine reaches out over an area of about eighty feet and if the material can be procured within close range, a green can be constructed in the rough grade, the soil being moved twice, and the cost still be less than if done by any other method. All the labor it requires is that of the operator and a helper for the rough construction.

The finishing can be done in most cases with about six men. Stripping of top soil off the site of the green may be done either with a skimmer boom or a shovel boom. Of course if the top soil is deep, a drag-line may be used. The drag-line can also be employed in the construction of all traps on the fairways, for construction of tees and for burying of stone walls, etc.

For the removal and dumping of stone walls in the vicinity, I prefer to use iron mules on caterpillar treads. These can transport three yards of stone at a time and can be loaded with a small gasolene shovel or a crane. When there are rocks to be blown, a compressor should be used for the drilling.

THE REMOVAL OF TREES

In the removal of trees, I much prefer to use a patented machine put out by a New York firm of years of experience with expert workmen, that is, of course, if there are a number of trees sufficient to warrant the use of it. This machine will pull over a tree of any size and extract the root from the ground in about five minutes, and clear the ground ready for the plough.

Another handy machine is a grader. This is on caterpillar treads, and having a deep blade in front, set at an angle or straight, as required. This machine is good for getting a fine finish to the fairways, and if a small hill is selected for a green site, it can be flattened out with the grader.

On a course which I laid out recently, it was necessary for me to deepen a brook that ran through a swamp. The brook was about four thousand feet in length. I put a gasoline shovel in to dig it out. We had wooden mats for the shovel to sit on. I found however, that the process was to be a slow one, so I decided to blow it out with dynamite, in four hundred foot sections. This worked out very well.

With a crowbar we made four rows of holes two feet apart. In each hole we placed a stick of dyna-

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Building Golf Courses Sensibly

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mite as the hole was made and attached the fuse to one only and then set it off. This was done in a third of the time that a shovel would take and it made a very fine job. In addition, the cost was much less.

On another course I laid out, we filled in eight holes with 18 inches of sand pumped out of a river bed alongside the course. We pumped a very large mound on to each site for the greens and then used the grader, the machine with the blade in front, to flatten out the mound. This operation required only an hour and a half, following which six men shaped up the green and traps in a short space of time. Sand, of course, is so much easier to work with than any other material.

Golf News

Construction activity continues in the Argentine where, on December first, Wendell P. Miller opened the new 36-hole course of the famous Jockey Club designed by Dr. Alister MacKenzie. Construction started in February and the course was seeded in June.

Their winters which come in July and August are mild. A complete Buckner California hoseless water system with 750 outlets and 36 hoseless tees was installed and proved the deciding factor in bringing through the seedings for an opening within ten months of starting work.

After completing the Jockey Club course, Mr. Luther Koontz, engineer in charge for Wendell P. Miller, constructed two private courses, each with three greens and nine tees, several private irrigation systems, six miniature pitch and putt courses, and is now engaged in designing and constructing a new drainage system for the Argentine Golf Club.

This coming spring Mr. Koontz will install a California hoseless system for the Mar del Plata Golf Club. In the meantime, Mr. Koontz continues in charge of the Jockey Club grounds through the first playing season in order to give perfection to all the details, and look after the first year's fertilization.

It is expected that an American greenkeeper will be selected for this post, if the difference in money values can be overcome. Argentine dollars are worth now only thirty cents each in our money but have a high purchasing value in domestic goods and services. An American greenkeeper's salary at the current exchange puts the greenkeeper into the salary class of an Argentine bank vice-president and, of course, the Argentines cannot "see" it.

It is interesting to note that during his stay of three months in the Argentine, Dr. MacKenzie designed seven golf courses. One of these for the local yacht club is to be constructed on land which does not now exist—but is to be constructed when the government dredges a new harbor. This course should prove highly interesting as fifteen holes are reproductions of famous British links land holes, the other three are MacKenzie originations.

Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of THE NATIONAL GREENKEEPER, published monthly at Cleveland, Ohio, for April, 1931.

State of Ohio, County of Cuyahoga, ss.

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared Robt. E. Power, who, having been duly sworn according to law, deposes and says that he is the Editor of the National Greenkeeper and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, (and if a daily paper the circulation), etc., of the aforesaid publication for the date shown in the above captain, required by the act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business managers, are:

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ROBERT E. POWER, Editor.

Sworn to and subscribed before me this 16th day of April, 1931.

A. F. Reymer.

My commission expires Nov. 5, 1931.