Watering in the 20s –

(Continued from Page 11)

60 yards in width by about 60 or 75 feet in length. After experimenting we found it would take about four machines of this kind to handle our course. On every golf course there are certain short holes where the fairway is of no consequence. We have four short holes where it is not practical or necessary to water the fairway. That leaves us 14 holes, and we found that four machines would satisfactorily take care of those 14 holes. We start a machine, and one man tends the four machines. The rig is very light and one man can push it; just roll it up the fairway, right up a hill. He turns on the water and lets his machine stand there and run for 40 or 45 minutes; or if it is a very dry spot he will let it run for an hour while he goes and tends the next machine; and when he has made his rounds he comes back and shuts off the water and moves his machine up to the next area that is dry.

We found that we would have to water the fairways in the daytime at present. We expect to water at night next year. A night crew waters the putting greens 8 hours every night. We found that we would have to increase our pumping capacity a little in order to carry all the fairway sprinklers and the putting green sprinklers at night; but that is a minor matter. We find the mechanics have figured out a method by which we can increase our pumping capacity this spring, so that we will do both the putting green watering and the fairway watering at night.We run 12 rotaries at night on the putting greens. We water 9 putting greens on Monday and 9 on Tuesday, so that every putting green is watered every other night for six nights in the week. We do not water on Sundays unless it is very dry. Those 9 putting green rotaries, together with 3 which we keep running on the tees on the dry places, are all regular night equipment. There are 4 rotaries on each one of those "sea serpents," so that the amount of water which is used by the 4 machines is a little more than you would use in watering 18 greens at night. Each rotary is just a riser with an arm and two outlets, a T-rotary. We figure these 4 machines will water the entire fairway once a week, which will be sufficient. That is what we have done.

One of the practical difficulties that we havc found in building this machine, as a great many of you men who are mechanics would know, was to make it light and at the same time rigid. On the first machine with which we experimented the pipe broke or bent and we had a great deal of trouble, so that we devised a scheme of trussing.

These machines can be built for not to exceed $200 apiece; and we bought the pipe and put in the side line, including the labor, for $1,800. You could equip a course which was already supplied with an adequate water system somewhere from $2,500 to $3,000, including the machines.

1949

USGA JOURNAL

LET'S SAVE WATER

Note on "Ion Exchange Process for Brackish Waters" (World Wide Chemistry), Chemical and Engineering News, Vol. 27, No. 45, Nov. 7, 1949.

"The world is becoming increasingly aware of shortages of a raw material once thought inexhaustible, i.e., freshwater. There are a number of regions, such as Los Angeles, Cal.; Perth, Australia; Johannesburg, South Africa, and Tel Aviv, Israel, where large population densities combined with small annual rainfall give rise to situations where the future economic development is limited by the fresh-water supply." The article describes several possible methods and costs of demineralization of brackish water and states, "although the maximum present-day water cost for very highly valued crops is 30 cents per 1,000 gallons, a more reasonable maximum figure for moderate-scale agricultural uses is 10 cents per 1,000 gallons."

Notes on we're Running Out of Water" by Pat Frank, *This Week Magazine*, p. 5, Nov. 6, 1949.

This article points up the alarming water shortage in a dramatic way. Scientists say that 1957 is the critical date when action will have to be taken if new sources of fresh water are not found.

The article stresses the possibilities of tapping the oceans for fresh water and says that the Department of the Interior has asked Congress for 50 million dollars to find a way to obtain fresh water from the sea. The author says, "Hundreds of thousands of acres of irrigated lands are being kept in production only through serious over - pumping of the existing water supply ..."The water levels of the reservoirs that feed Louisville and Indianapolis have dropped 40 and 50 feet, respectively.

"But the most critical areas are the great, expanding metropolitan districts of the nation where the population is jumping, constantly stepping up the use of water."

(Continued on Page 13)

Watering in the 40s–

(Continued from Page 12)

The article describes methods of purifying salt water, including the possible use of atomic energy, and ends with this thought: "There is no greater gift this country could give the earth than the perfection of techniques for transforming the sea into fresh water. And for our own good, we'd better do it soon!" The growing scarcity of fresh water is not an idle threat; it is real. Two recent references have been abstracted here to indicate the trend of thinking. To cite other references would serve no useful purpose.

During the educational turf conferences of the winters 1948-49 and 1949-50, USGA Green Section personnel stressed repeatedly the need for saving water on turf areas. Since 1945, Green Section research has been directed toward a program of growing the best turf possible with the minimum of artificial irrigation, using every known device such as: (1) Aeration of the soil to improve porosity and absorption and to reduce runoff; (2) More adequate fertilization to produce denser turf, which is the best-known method of saving water; (3) Emphasis on the turf grasses which have low-water requirements and high drought-tolerance. The Green Section expresses its considered opinion that funds for agricultural research may be used justifiably for turf research which is directed toward saving water. It is well known that, even in areas where water shortages are becoming critical, many turf areas regularly are overwatered. Agricultural and industrial interests should welcome the opportunity to support this phase of turf research because the savings in water largely will accrue to the benefit of agriculture and industry. We do not limit our thinking and our planning to golf course turf; we include all turf areas. We subscribe to the policy that the best turf for all purposes is that which is maintained with only sufficient water to keep it alive.

1953

USGA JOURNAL AND TURF MANAGEMENT: FEBRUARY, 1953

KNOW HOW TO WATER

By ROBERT M. HAGAN
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To do a good job of turf irrigation, we must consider the rooting habits of grasses. If given an opportunity, grasses will develop surprisingly extensive root systems. It is commonly thought that the roots under turf are confined largely to the top six inches or certainly to the top foot. What are the rooting capabilities of turf grasses? The rooting depths of 15-months old plantings on a deep clay soil at Davis, Cal., were studied by measuring the extraction of soil moisture. The plots were irrigated deeply and then allowed to go without irrigation until the grasses wilted. When wilting occurred, all of the available soil moisture in the following soil depths had been extracted:

Effective Rooting Depth Grass	(inches)
Chewings fescue	8
Wahee fescue	10
F-74 fescue	10
Highland bent	12
Kentucky bluegrass	30
Merion bluegrass	30-36
K-31 (tall) fescue	36
Bermuda (U-3 and Common)	36+

In all cases considerable moisture extraction took place below the depths indicated.

Some roots were found at the five foot depth under Merion bluegrass and at the six-foot depth under the bermudas. The ability of grasses to root so deeply has not been considered in the preparation of sites for planting or in the irrigation management of turf areas. Of course, rooting depths will be less in shallow soils or where management practices have restricted root development. These data simply indicate the rooting capability of grasses under these conditions at this location. What practical application does this information have in turf irrigation? Such data help to answer the two basic irrigation questions: (1) how much water to apply and (2) how often to irrigate.

How Much Water to Apply

How do we decide how much water to apply? After a rain or an irrigation, a given depth of a well-drained soil will hold a certain amount of water, depending on its texture or particle sizes. This amount is called the field capacity. Any water applied in excess of the soil's field capacity will drain out. The drier the soil is at time of irrigation, the more water is required to wet a given depth. If the soil has been dried until the grass wilts (approximate wilting point). For example, to wet a two-foot depth requires one and one-half inches of water for sands, three inches for loams and five inches for clays.

Some turf is overwatered that is, more water is applied and soaks in than the soil will retain within the root zone of the grass. The surplus water drains down through the soil, carrying away nutrients and often creates soggy subsoil and consequently shallow roots.

Turf is often underwatered. For example, traveling sprinklers, as they are commonly used, usually apply only one third to one-half inch of water. If the soil has been dried out, one-third inch of water will wet only about five inches of a sandy soil, two inches of loam, and one inch of clay.

The superintendent should determine how much water his sprinklers are putting on. This may be done by using coffee cans as rain gauges. Uniformity of application can be checked by placing the cans in a line running out from the sprinkler. Many will be surprised to find how little water they are applying, especially near the fringe of the area hit by the sprinklers.

Where there is no appreciable surface runoff, the correct running time for sprinklers can be estimated if the rate of water application is known.

In many cases it is easier to let the sprinklers run until coffee-can rain gauges contain the depth of water required to wet the soil to the desired depth. If the sprinkling time is recorded, it can be used as a guide for future irrigations.

Remember that shallow rooting may be caused by repeated shallow irrigations or, in some soils, by application of excessive amounts of water. In either case, the shallow-rooted turf thus produced will then demand frequent irrigation to prevent wilting.

How Offen to Irrigate

Our turf irrigation habits are often bad habits from the standpoint of soil characteristics and the needs of the grasses. Irrigation practices are usually set by habit, the calendar or what we are told are the special moisture requirements imposed by the use to which the turf is put. Let us forget, for the moment, these special demands and look at irrigation solely from the viewpoint of soil characteristics and needs of the grass. Consider the soil as a storage reservoir. The storage capacity within the root zone is determined by the rooting depth of the grass and by the difference between the amount of water retained by the soil after irrigation (approximates field capacity) and that remaining when the grass wilts

(Continued on Page 14)