July 1974

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GOLF COURSE
SUPT.
ASSOCIATION
MICHIGAN

A Patch of Green

Official Publication of the
Michigan & Border Cities Golf Course Superintendents Association

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TIP OF THE MONTH

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L&E CHEMICALS SPECIAL OF THE MONTH

THERE IS A DIFFERENCE IN FERTILIZERS AND SWIFT CHEMICAL I.B.D.U. IS THE DIFFERENCE . . . LET US SHOW YOU HOW I.B.D.U. CAN WORK FOR YOU.

Q. WHAT IS **IBDU** AND HOW IS IT MADE?

A. **IBDU** is the registered trade mark for isobutylidene diurea, a relatively new controlled release nitrogen source. It is manufactured by combining isobutraldehyde and urea to yield the most effective source of water insoluble nitrogen.

IBDU is totally unique. Although it is slow acting, it is 100% available to the turf in a single growing season. Unlike UF sources, **IBDU** is not substantially affected by variations in temperature or bacterial activity, and depends almost entirely upon hydrolysis (water) for its release to the soil.

Q. WHAT IS THE ANALYSIS OF **IBDU**?

A. **IBDU** contains 31% nitrogen. About 90% of the total nitrogen from **IBDU** (27.9%) is slow release or water insoluble nitrogen. **IBDU** itself contains no phosphate or potash, but is available in **Par Ex** fertilizer grades containing phosphate and potash.

Q. WHAT ARE THE PHYSICAL CHARACTERISTICS OF **IBDU**?

A. As can be seen in the picture in this ad, **IBDU** is a white, totally homogenous granule. The picture in this ad shows the two commercially available sizes of **IBDU** (fine and coarse). It is non-caking, uniform in granule size, highly flowable, and will not absorb water during storage — making it ideal for handling and spreading.

Q. WHY IS **IBDU** AVAILABLE IN TWO GRANULE SIZES?

A. The release rate of **IBDU** to the soil is only governed by two factors — soil moisture and granule size. By changing the granule size, the rate of release can be controlled.

Q. WHY IS **IBDU** SLOWLY RELEASED?

A. **IBDU** itself is very slightly soluble in water, being about 1000 times less soluble than urea, a commonly used fast release fertilizer. In addition to its basic insoluble nature, the release rate of **IBDU** is slowed even further by granulation, which decreases the contact surface of **IBDU** with water in the soil.

Q. GENERALLY, HOW LONG WILL **IBDU** LAST?

A. Since the duration of availability of **IBDU** is mainly determined by soil moisture and granule size, its release rate is very predictable.

Depending upon the granule size and soil moisture, **IBDU** will continue release of nitrogen a minimum of 3 months and a maximum of 6-7 months at normal rates of application.

Q. HOW DOES THE GRANULE SIZE AFFECT THE **IBDU** RELEASE RATE?

A. The larger the original **IBDU** granule, the longer it will last and continue supplying nitrogen to the soil.

Q. HOW DOES SOIL MOISTURE AFFECT THE **IBDU** RELEASE RATE?

A. Up to a point, the higher the soil moisture, the faster the release rate of **IBDU**. However, since the release rate of **IBDU** is limited by its solubility, it will only release at a certain maximum rate — no matter how wet the soil becomes from watering or rain fall. This characteristic prevents leaching in high moisture conditions, without changing the rate of release.

Q. DOES SOIL TEMPERATURE AFFECT THE **IBDU** RELEASE RATE?

A. Unlike UF fertilizers, **IBDU** is not substantially affected by variations in soil temperature. There is only a 25% variation in release rate with **IBDU** from 40°F to 80°F.

Q. DOES SOIL pH AFFECT THE **IBDU** RELEASE RATE?

A. Only slightly. Some tests have indicated that **IBDU** will release at a higher rate as the pH of the soil decreases. In other words, pH values ranging from very acid to moderately alkaline (7.5 pH) do not substantially affect the release rate of **IBDU**. However pH values in excess of 9.0 (very alkaline soils) do tend to somewhat inhibit the release rate of **IBDU**.

Q. HOW IS **IBDU** MINERALIZED?

A. **IBDU** cannot be used by the turf until it is first dissolved, and then it is mineralized in the same manner as other sources of nitrogen.

In other words, the release rate of **IBDU** is more dependent upon its granule size and the soil moisture than on the actual mineralization process — since once it is released from the granule, it is almost immediately converted to the available form.

Q. DOES BACTERIAL ACTIVITY AFFECT THE **IBDU** RELEASE RATE?

A. No. Because **IBDU** is released by hydrolysis (water), its rate of release does not depend upon bacterial attack. Typical UF fertilizers depend almost entirely upon the bacterial activity of the soil for their release.

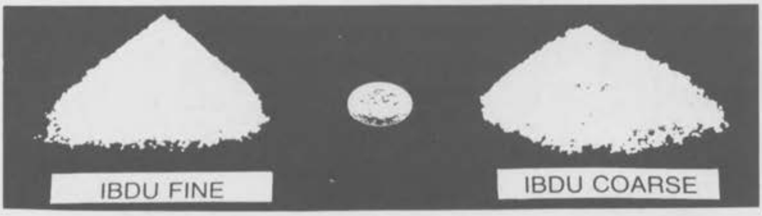
Q. HOW MUCH **IBDU** CAN BE APPLIED SAFELY?

A. The critical quantity of **IBDU** depends, of course, upon the type of turf, but generally it may be applied to most types of turf at rates 3-4 times higher than other conventional slow release fertilizers with no damage.

Tests at UCLA indicated no damage on turf when **IBDU** was mixed into the soil (not top dressed) at as high a rate as 32 lbs. Nitrogen per 1000 sq. ft. Top dressing rates as high as 12-15 lbs. Nitrogen per 1000 sq. ft. may be used with no damage to the turf.

Q. WHAT IS THE KEY ADVANTAGE TO USING **IBDU**?

A. Control. Because the release rate of **IBDU** is so even and predictable, the professional turf manager can literally control the response of turf at will — without considering the interfering conditions such as temperature and weather that alter the response to other slow release products.



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Don Benham, Representative

DIVISION of LAWN EQUIPMENT CORPORATION

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Published monthly by the Michigan and Border Cities Golf Course Superintendents Association

Circulation 1,250

Ted Woehrle, Oakland Hills C.C.
Clem Wolfrom, Detroit Golf Club
Co-Editors

Blakeman Publications
Graphic Arts/Circulation

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How Much Water is Enough?

by **JOHN H. MADISON**
Professor
Department of Environmental Horticulture
University of California at Davis

Presented at
"California Golf Course Superintendents Institute"
1973, University of California at Davis

The title raises the question of how much water is enough. The answer to this question may depend on who is asking it. The person developing a new golf course wants abundant cheap water and the more the better.

The golf course that is paying $4000 a month to the city for water is apt to rephrase the question and ask, "How little water is enough?"

In the irrigated west we manage water. It becomes an important tool. I rate it second only to fertilizer in management importance, and I'm not sure but what it should rate first in many management programs.

At Davis there is a long history of research directed to the question of the economics of water and of crops and of how much is enough. One of the outstanding figures in the irrigation story is Frank Veihmeyer, a Professor Emeritus of Irrigation Science who retired over 15 years ago but is still an active worker in irrigation.

Veihmeyer worked with range and tree crops and from his studies of dry weight yield set forth a principle that water is equally available to the plant for producing yield, from a moist soil at field capacity down to a dry soil at the point where the crops wilt. This principle has been a useful guide over the years to many ranchers, helping them to get optimal yields with minimum amounts of water.

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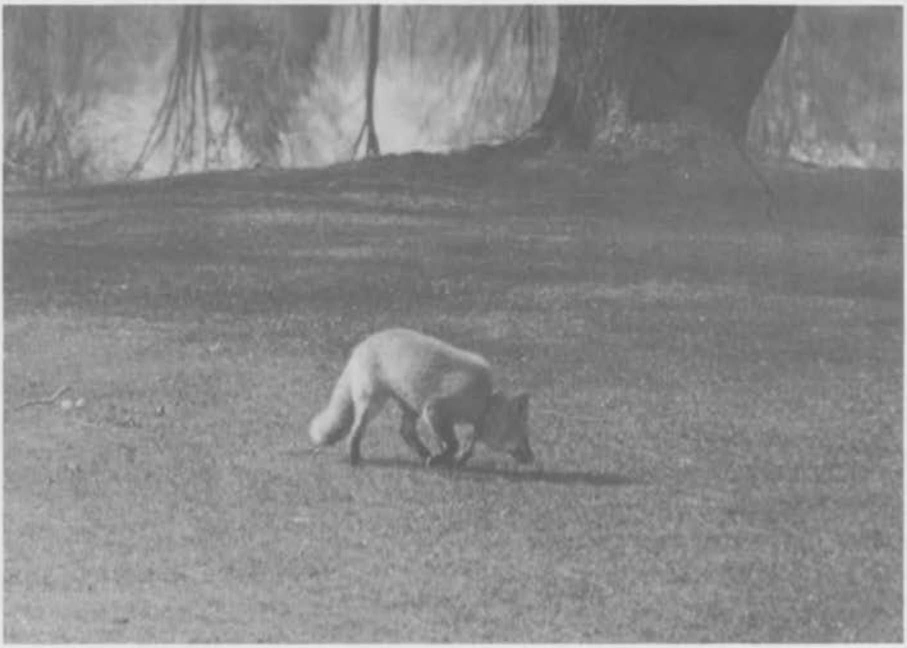
The "Red Fox" of Oakland Hills Country Club . . .



How Much Water Cont.

After WWII, the USGA made many grants to the Universities of the US to get research in turf started again. Recognizing the need for more information about water use and irrigation they placed a grant with Professor Veihmeyer to investigate the amount of water needed to maintain a putting green. Veihmeyer made his study along the lines used with walnuts and similar field crops and concluded that a putting green could be adequately maintained with an irrigation once a month. And you can, in fact, keep seaside bentgrass alive and healthy with only occasional deep irrigation.

There were some missing variables in Veihmeyer's experiment such as high levels of traffic and of nitrogen fertilizer, and I'll come back to these later.

When I came to Davis, Bob Hagan and I had some cooperative work started. In our principal experiment we irrigated bluegrass turf at different intervals. The longest interval between irrigations called for us to irrigate when the grass began to wilt, and in practice this gave us a 20 day interval between irrigations. For the shortest interval we irrigated every other day whether the turf needed it or not. Irrigating once in 20 days we did get deeper roots developed. The turf, however, was not good looking. None of us would be proud to grow it. But oh, was it a joy to irrigate. That Yolo clay loam opened up cracks you could put a pencil in, and we couldn't put water on fast enough to get run off. The water all went right in.

Bob Hagan was asked to talk to the superintendents about our irrigation work on several occasions. We couldn't talk about our work because while it was started we didn't have finished data to talk about. There were some basic irrigation principles however that we could talk about. It was those basic principles that Bob Hagan talked to you about that I am going to use to introduce my discussion today.

The first point is that the soil is

Continued on Next Page

How Much Water Cont.

our reservoir for water. As with any reservoir, the amount of water it contains depends on its depth. For us, the measure of reservoir depth is the depth of the roots - the depth from which the turf can use the water. The amount of available water in this reservoir is subject to additions and depletions. When there is rain, or when we irrigate, there are additions to the reservoir. When there is evaporation from the soil or transpiration from the plant, there are depletions.

Once we have the idea of a reservoir, of additions and of depletions, we can easily see that irrigation management becomes in a sense a simple matter of bookkeeping. And as with bookkeeping where we can use fiscal periods for reporting, we can make time choices in our water bookkeeping. We can take a little out each day, add a little back each night and keep a balance. Alternatively we can take a little out each day, accumulate our withdrawals, and add back a larger amount once a week. The important thing is to keep a balance, and not to allow the reserve to become overdrawn.

The questions to which Hagan and I addressed ourselves were: 1 - Can we develop deeper roots so we can have a bigger reservoir? 2 - Can we go until the reservoir is dry and then refill it?

Now why would we want to do this? Why would we want to wait till the reserve was gone before refilling?

First, there are labor savings. At that time you were all irrigating with quick coupling heads, and the labor savings with a long interval could have been considerable.

Secondly, a long interval between irrigation provides one of the finest methods of weed control. You'll often notice that one of the first results from installation of an automatic irrigation system is an immediate jump in the amount of weeds.

Third, there is less soil compaction. Compaction is greatest on a moist soil, one at field capacity. There is little compactability of a dry soil. Where there is shrinking of a clay the shrinking and swelling action with moisture cycles is important in restoring soil structure and keeping the soil open so you get good water and air circulation.

Fourth, with a longer interval you induce more fibre formation in the grass and get a hard fiberous grass that resists wear and which has other good characteristics.

Fifth, we save water with longer intervals between applications. The water goes into the cracked soil readily and we wet the soil profile with much less runoff. As we irrigate less often there is less lost from evaporation. Another saving is in actual water use by the plant. These savings occur in the following way: Each day a certain amount of sun's energy falls on a turf. This energy is lost, some by being convected away on

Continued on Page 10

Agrico 18-4-10 Works More Efficiently.

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How Much Water Cont.

the wind, some moves down into the soil by conduction, some is reradiated into space, and some is lost as energy used to evaporate water. On a given piece of grass kept continually moist a fairly constant fraction on the solar energy will be lost by evaporation. But if the soil begins to dry and water is less readily available; less water will be evaporated by the plant; leaf temperatures will be relatively higher by a couple of degrees; and so convection and radiation will be more effective, and more heat will be lost by these means.

Sixth, there is a more subtle reason to favor fully rewetting the soil at less frequent intervals. These have to do with the difficulty of managing a daily replacement. If we add back a bit too much each day, we have trafficked areas where the soil becomes compacted, and where with daily irrigation, the water sits on the surface and forms wet spots. Traffic tears up the turf and ruts the soil in these wet areas and they become progressively worse and form an ugly eyesore on the course.

On the other hand if we misjudge and apply a bit too little each day, the top inch or half inch may remain moist but gradually we deplete the soil in the lower part of the root zone and it becomes dry. Once we create this "dry bottom" our grass goes through a period of daily water stress, and the salts in our irrigation water begin to accumulate in the surface layer where they become concentrated by evaporation. This is a regularly occurring problem in irrigated turf. Every year we see areas of turf dying from physiological drought caused by excess salts building up on top of a dry bottom. The problem always results from frequent light irrigations. The persons to whom this happens never believe they have a drought problem until we stick a shovel in the soil and show them.

As I indicated earlier, Hagan and I succeeded in growing deeper roots by stretching the interval between irrigations, but with long intervals we got poor turf. The best period appeared to be the longest interval we could go without causing stress to the grass. The recent work by Endo and his students confirms the need to avoid stress. He is finding that diseases such as *Helminthosporium* and *Fusarium roseum* may not be problems unless the thatch dries out. Then on rewetting there is a heavy release of sugars and nutrients from the thatch. This stimulates pathogenic growth of organisms.

Again, let me note, we used bluegrass in our experiments. Had we used a grass adapted to water stress such as bermudagrass we would have been much more effective in stretching the period between irrigations.

Let me give you again, the data from Vic Younger and the group at Riverside, using bermudagrass irrigated at different levels.

Continued on Page 12

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JIM VINCE has been designing irrigation systems for all types of turf areas for the past 13 years. That covers a lot of valuable experience for you in applying products to make up an irrigation system. Give Jim a call and he will be there. SISCO sales office and warehouse is conveniently located west of I-75 and 12 Mile Road exit (Royal Oak).

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Or you may contact the next golf course supplier who calls on you and give him the information needed for application.

How Much Water Cont.

TABLE I

How irrigation determined	Inches per year used
Standard practice	43"
At 75% of evaporation loss	39"
When tensiometer reads 15cb	38"
When tensiometer reads 40cb	31"
When tensiometer reads 65cb	27"

The high rate used 60% more water than the low, yet all the grass looked equally good.

How much water is enough will depend on the grass, but also on where I am growing the grass. In those lovely lawns in the British Isles, the bentgrass is often under greater water stress than the bermudagrass in the above experiment. But in England we run up against the climatic factor of temperature. With a mean temperature of 55 degrees, temperate season grasses can tolerate and survive a great deal of water stress. In the California Valleys temperatures do exceed 70 degrees and even 80 and 90 degrees. Above 90 degrees the problem may be one of survival instead of water use. Blue and bentgrasses will survive heat stress better with modest nitrogen levels and lots of water. Unfortunately, with frequent irrigation bent becomes a weed in bluegrass, bluegrass a weed in bentgrass and *Poa annua* and crabgrass increase as weeds of both.

In all of this it is possible to set a maximum water use. The maximum is that needed to use up the sun's energy input by using the energy for evaporation. This maximum is between 16-18'' for June and July. (See Table II)

To cut down from this maximum we might consider several factors.

First is the grass. Bermudagrass can use less than the maximum as we saw. In 1955 we ran a series of grasses from April to September without water to test ability to survive drought. Bermuda was not only able to survive but continued to make a slight amount of growth. Zoysia was not as able as bermudagrass to tolerate

Continued on Next Page

How Much Water Cont.

drying but did well on one irrigation every 3 weeks. Tall fescue grass not only tolerated 4 1/2 months of drying but within two weeks of receiving water was growing vigorously and had an excellent appearance. Most cool season grasses had some patches that survived drought but they were largely replaced with weeds. The exception was 'Highland' which had crowns surviving every few inches. These crowns recovered and made a full turf again within a season. We can see the ability of Highland to recover from drought expressed on many golf course fairways where Highland takes over wherever the sprinklers apply insufficient water.

Another consideration in the use of irrigation water is the efficiency of the plant in using water. Grasses are reasonably efficient and their efficiency can be increased by the use of fertilizers. One problem is that efficiency of use and total water use are in opposition. With the use of nitrogen fertilizer, more water is used to make more grass with a higher degree of efficiency.

We use nitrogen to grow more grass to take care of increased traffic and wear, to provide quick recovery from injury, and to grow a dense sod that competes with weeds. If none of these are problems, the least water will be used by a turf low in nitrogen which is making little growth.

When we use nitrogen to provide us with this greater and denser growth, other things happen. We have shorter roots and hence a smaller reservoir. The principle of Veihmeyer no longer applies. His work was done under conditions where nitrogen was limiting. (Figure 1) As we increase nitrogen use our growth is affected more and more easily by water stress (Figure 2).

FIGURE 1

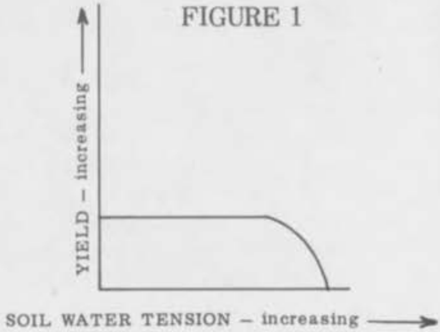
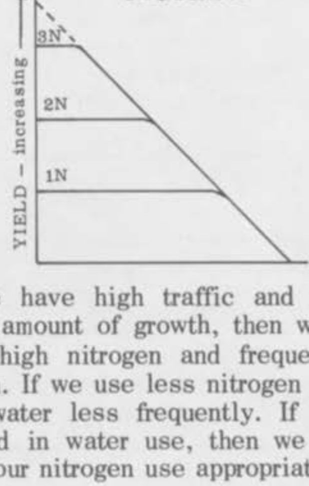


FIGURE 2



If we have high traffic and need a large amount of growth, then we need both high nitrogen and frequent irrigation. If we use less nitrogen we can use water less frequently. If we are limited in water use, then we should limit our nitrogen use appropriately.

Continued on Page 16

How Much Water Cont.

Another factor to consider in economy of water application is the frequency of application. Consider a hypothetical example in which we can use 10'' of water over a 60 day period. We could apply 1/6th inch every day. The effect of this would be an evaporation loss every day, and we would wet a loam soil no more than 1'' deep (Figure 3). The soil would dry out every afternoon. We would probably create a dry bottom and would add all the salts to the top inch of soil.

If we applied the whole 10'' in a single irrigation we would wet the soil to about 5' deep and since we probably don't have roots that deep we probably would lose most of the deep water. Our turf would dry out and we would lose grass during the 60 days. If we made 3 1/2'' applications at 20 day intervals we would wet the soil to about 21'' deep and again, much of it would probably run through the root zone and be lost.

If we were to apply 1'' every 6 days or 2'' every 12 days we would probably survive and make good use of the water. This would wet the soil either 6'' or 12''. At the 6'' level we could probably recover most of the water for plant use, and salts would be spread over a 6'' soil depth.

The subtleties of soil cracking, dry bottoms, wet spots, leaf temperatures, rooting depth when taken all together may tend to add confusion to attempts to answer the question how often should I irrigate. But if you find confusion arising, perhaps it is because the wrong question has been asked. A better question is this: "If water is limited, how do I use it most effectively?" To this question we can answer by laying down guidelines:

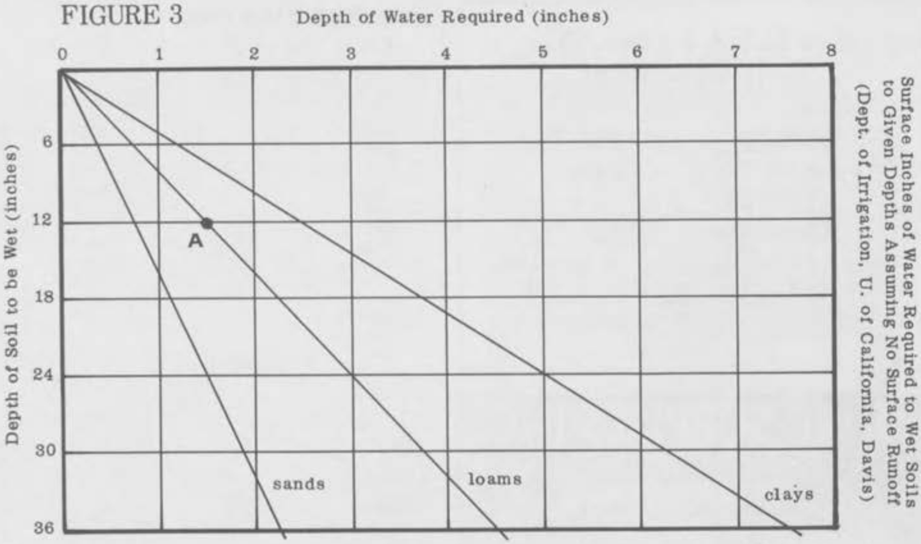
1- Dig down and find where your roots are so that you know the usable size of your soil reservoir.

2- From Figure 3 find out how many inches of water is held in your soil in that depth of reservoir.

3- From Table II note the ET for that time of year and see how long the

Continued on Next Page

FIGURE 3



HOW TO READ CHART: If a 12-inch depth of loam soil is to be wet, run down left-hand scale to 12-inch line, then across chart to diagonal line labeled "Loam" (at point **A**), and then project line vertically up to scale across top of chart. Depth of water required is 1½ inches.

water will last. Inches of water in reservoir/Inches of water used per day equals Days water will last. This is an average and doesn't take account of the hot dry windy day when use soars etc. so the result needs interpretation by that finest of computers, the rational human mind.

4- Cut down your nitrogen levels to the minimum amount you need to get good replacement growth, to make up for wear, caterpillar feeding, etc.

5- Minimize runoff and evaporation losses from applying water too fast, and too often.

6- Minimize percolation losses from applying too much at one time.

7- If there is salt hazard use occasional irrigations that apply enough water to leach salt out of the root zone before it becomes a hazard.

Using such guidelines you should be able to make the best use of limited water. If you have lots of water and no need for care, the best question to ask is still, "How do I use water most effectively?", and the same guidelines apply.

SUMMARY

Grass will survive infrequent deep irrigation but turf quality is poor. Grass will survive frequent irrigation but weediness and compaction become serious. Good management can be based on bookkeeping systems. The soil is a reservoir. The amount held in the reservoir depends on soil and depth of rooting. Water is lost by evaporation and transpiration. It is replaced by rain and irrigation. With deep roots bermudagrass and tall fescue grass will withstand the longest period between irrigations. 'Highland' makes good recovery following drought. Both efficiency of use and amount used will increase with an increased nitrogen fertilization program. For good management the superintendent will ask himself the question, "How can I make most effective use of my water."

Use will be most effective if he avoids losses from evaporation and runoff associated with application too fast and too frequently, and avoids percolation losses from applying too much. Too fast and too frequently also lead to dry high spots, wet hollows, dry bottoms, and excessive compaction.

TABLE II

Data for Davis is used. This will not apply in the fog belt. Elsewhere in California, it may be taken as a general guide. Next Page

TURF SUPPLIES INC.
6900 Pardee Rd., Taylor, Michigan
(313) 291-1200

How Much Water Cont.

From data of Pruitt on water use by turf:

	Average in. Month
January	.937
February	1.94
March	3.01
April	4.84
May	6.08
June	8.35
July	8.36
August	6.46
September	5.04
October	3.35
November	1.67
December	0.91

If we assume that it is worthwhile to save 0.3" of water per week - that is over 400,000 gallons a week on 50 acres, then it is worthwhile to change schedule II times a year, and apply water according to the following schedule:

Dec. 20 – Jan. 20	0.3" per week
Jan. 20 – Feb. 20	0.6" per week
Feb. 20 – Mar. 20	0.9" per week
Mar. 20 – Apr. 5	1.2" per week
Apr. 5 – Apr. 20	1.5" per week
Apr. 20 – May 10	1.8" per week
May 10 – Aug. 15	2.1" per week
Aug. 15 – Sep. 10	1.8" per week
Sep. 10 – Oct. 1	1.5" per week
Oct. 1 – Oct. 17	1.2" per week
Oct. 17 – Nov. 15	0.9" per week
Nov. 15 – Dec. 10	0.6" per week

The above are rather crude data and are only illustrative. They make allowances for evaporation and other losses.

One approach to use might be this: Suppose in mid-summer we apply 0.6" every other night, wetting the soil to about 4" deep. Then beginning Aug. 15, we skip one night a week and make 3 applications in 7 days; beginning Sept. 10, we make 5 applications in 2 weeks, beginning Oct. 1, we make 2 applications per week (7 sunny days); beginning Oct. 17, 3 applications in 2 weeks (i.e. 14 sunny days); beginning Nov. 15, 1 application per week; beginning Dec. 10, 1 application in 2 weeks, and then so on, back in the other direction. Of course, we make due allowance for rain, and pick up or schedule again only when skies are clear and sunny.

The method of keeping the number of irrigations the same, but making them shorter or longer, is not desirable for the obvious reason that short irrigations are also shallow irrigations.

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