



Better Turf for Better Golf

TURF MANAGEMENT

from the USGA Green Section

Plants and Light

By DR. MARVIN H. FERGUSON

Mid-Continent Director, National Research Coordinator, USGA Green Section

The 1962 Yearbook of Agriculture is entitled "After A Hundred Years." It is a review or "a sampler" of progress in the field of agriculture in the 100 years since the establishment of the U. S. Department of Agriculture.

One area in which new knowledge has had a tremendous impact on plant management is that of light influences upon plants. The following paragraphs are quoted from an article written by Dr. Harry A. Borthwick. The article appears in the 1962 Yearbook. Dr. Borthwick is one of the world's outstanding authorities on the effects of light upon plants. Dr. Borthwick and Dr. Sterling Hendricks, a co-worker, have just been announced winners of the Hoblitzelle prize for 1962.

"Two men in the United States Department of Agriculture in 1918 set themselves the task of finding a way to make a certain tobacco plant flower. Most tobacco plants flower without any prompting, but this particular plant was different. It arose as a mutation and had great promise for commercial use if only seed could be produced. But seeds come from flowers, and plants like this one, seen occasionally in previous years, had always been killed by

frost before they could flower. As autumn approached in 1918 and no flowers were evident, the men moved the plant into a greenhouse so it could continue to grow. The plant flowered about Christmastime and produced seed. The immediate problem thus was solved.

"This event attracted little attention at the moment because only a few persons were aware of it and understood its significance. But to W. W. Garner and H. A. Allard, the two men with the problem, the production of those tobacco flowers opened up an entirely new area of plant science. They had discovered the fundamental principle that the relative length of day and night controls flowering. They named the phenomenon photoperiodism. They tested the principle of photoperiodism on several other plants and found it worked on many. Some kinds, the 'short-day' plants, like the tobacco, they learned, flower when days are short and nights are long, but do not flower under other conditions of day-length. Other plants, the 'long-day' ones, such as spinach, flower only when the days are long and nights are short. Still others, 'day-neutral' ones,

have no preference as to daylength.

"When that one tobacco plant flowered in 1918, probably even Garner and Allard did not appreciate the impact their discovery would presently have on agriculture and on scientific understanding of the growth and development of plants. It led to the essential knowledge on which the multimillion-dollar industry of year-round production of blooms of chrysanthemums was founded. It gave the wheat breeder a tool that permitted three times the former rate of progress in producing disease-resistant strains, a tool that was used when strain 15B of stem rust threatened ruination of the country's wheat production. It opened the door to understanding many problems of plant production not outwardly related to flowering. It prepared the way for basic investigations of the response of plants to environment. Research on photoperiodism at an ever-increasing rate is creating a backlog of knowledge useful in new ways to improve further our agricultural efficiency and contribute to our enjoyment of flowering plants.

"The story of the further development of our knowledge of the control of flowering by daylength is the story of how a single bio-chemical reaction of plants to light not only controls flowering but also prepares trees and other plants of temperate climates for the onset of cold weather; causes seeds of some crops and many kinds of weeds to germinate; controls the coloring of apples, tomatoes, and other fruits; and brings about other plant responses. The discovery of photoperiodism was turned immediately to practical use—for example, in the control of time of flowering in commercial production of chrysanthemums. Garner and Allard found chrysanthemums to be short-day plants in their original experiments. Artificial light added to the end of short autumn or winter days to make the days long and the nights short delayed blooming until later, more desirable dates. Conversely, shortening the exposure to light and lengthening the

dark periods artificially in the summer induced early, out-of-season blooming.

"Scientists have wondered, however, why chrysanthemums require an interruption of darkness of as much as 3 or 4 hours while the soybean, another short-day plant, requires only 3 or 4 minutes to prevent flowering. We now have the answer. Chrysanthemums do not require 3 or 4 hours of light. They can be kept from flowering by much less than 3 or 4 hours if the light is divided into short periods and distributed throughout 3 or 4 hours, near the middle of the night. For instance, 18 minutes of continuous light given at midnight does not prevent flowering; but if it is divided into nine 2-minute exposures at 30-minute intervals throughout a 4-hour period in the middle of the night, the total of 18 minutes is as effective as continuous light for 4 hours. Other equally effective lighting schedules have been found, and better ones may be possible.

"This method of cyclic lighting during a part of the night was just being developed when this was written. It has promise of profitable application by the grower because it permits him to use a limited amount of power for lighting a large area. By lighting each of several small areas briefly, in succession, instead of a big area continuously for a long period, he greatly reduces both the demand charge for service and the actual amount of current he uses. Progress in applying light to chrysanthemums since 1925 has come largely as a byproduct of fundamental studies of the action of light on plants in general. One of the first underlying facts scientists discovered about photoperiodism was that red light is more effective than that of any other color when used as a dark-period interruption to control flowering. This discovery has obvious practical importance; it indicates the best kind of lamps to use. Lamps giving light that is rich in the red are more efficient than those giving light that is poor in red.

"A second major discovery was that

the action of red light on flowering is nullified by light having somewhat longer wavelengths in the near infrared, the so-called far red. Thus, after one exposes a soybean to enough red light in the middle of the night to prevent flowering, the capacity to flower is easily restored by an exposure to far red immediately afterward. This discovery was very important, because these red and far-red wavelengths of light also caused peculiar reversals of the ability of certain seeds to germinate. Some kinds of seeds must have light to germinate, and the kind they need is red light. After they receive the red light, however, the seeds can be kept from germinating by promptly giving them far red. Since the same wavelengths of red and far-red light, respectively control both seed germination and flowering in the same reversible way, these two plant processes must be set in action by the same basic light reaction. This is startling, because germination of seeds and flowering are so different in appearance as to seem quite unrelated.

"The occurrence of reversibility in the ability of seeds to germinate and of plants to flower suggested the possibility that such photo-reversibility might also occur in other plant responses. A careful survey revealed that it is, in fact, involved in several other phenomena. It has much to do with the regulation of length of stems and the size of leaves and with pigmentation of fruits and other plant parts. It probably is responsible for many other responses not yet demonstrated. Discovery of the effectiveness of red light and the reversal of its action by far red led to a further step in the knowledge of how light affects plants. Red light obviously causes effects that other visible wavelengths either do not cause or cause far less effectively than red. The energy of light, of course, must be absorbed to induce these effects. Absorption of red in preference to light of other colors requires the presence of an absorbing compound, a

pigment that is blue. We therefore look for such a blue compound in plants. Most plants are green, however; even albino plants are white, not blue. Either there is no blue pigment in certain plant parts, or so little is present that we cannot see it.

"Where do these studies of the light reactions lead? The answer in part comes from looking backward. As recently as 1951 we did not know that the photoperiodic reaction was reversible by light. We knew that a pigment was involved, but we did not know about its change of form in darkness. Extraction of the pigment had not been undertaken at the time. Control of many different kinds of plant response by a single reversible photochemical reaction was not even imagined in 1951. An obvious answer to the question is that we cannot predict where the results of this work will lead in the next few years. We can give assurance, however, that the work will lead to more complete understanding of how plants are influenced by their environment and will enable farmers and gardeners to grow and use plants to better advantage.

"Exactly how results of this kind of work may contribute in the future to more efficient agriculture is also difficult to predict. Looking backward again, we see many practical applications already made and many opportunities not yet realized. Plant breeders use daylength control to make potential parent plants flower at the time desired so they can be hybridized. They grow the progenies on daylengths favorable to flowering and thus shorten the time to maturity and increase the number of generations they can grow in a given time. Physiologists know that plants in different stages of development do not always give the same response to herbicides. Daylength treatments are used therefore to produce plants in vegetative and reproductive states for experimental purposes.

"Still another illustration of the action of light on seeds comes from experiments in burying seeds. Seeds

mixed with moist sand in an unstoppered bottle were buried 3 feet deep in soil. The bottle was inverted so as not to accumulate any standing water and left for 80 years. Some of the seeds promptly germinated when they were dug up. How could they remain viable so long? Why did they not germinate earlier? They were moist, had presumably adequate aeration, and surely must have encountered temperatures favorable to germination many times in the 80 years. Then one wonders why they germinated as soon as they were taken from the soil and placed in a seed germinator. It seems that they did not germinate for 80 years because they were in the dark. In the process of being dug up, they received light and germinated immediately.

“Examples of how light affects plant growth are almost inexhaustible. Those I have given are merely selected illustrations of rather commonplace ways in which light affects our lives through its influence on the plants or plant products that we eat, wear, burn, or

admire. Only enough is told of the direction in which the research is currently leading to indicate its rapid change. An advance in understanding of flowering pointed the way to a new approach to germination of seeds. Progress in extraction and study of the light-absorbing pigment confirmed the conclusions previously reached from physiological studies and provided the basis on which new experiments were designed. In research of this kind there is no new frontier. The ever-advancing old frontier, however, changes so fast that it always seems new and filled with promise.”

The foregoing paragraphs are indicative of the state of our knowledge with respect to light. As golf increases in popularity and we hear more of lighted putting greens and even of whole golf courses, we may well find ourselves faced with a need to manipulate light quality in order to insure the normal growth of turf. This is an area where turf men will be obliged to borrow the knowledge developed by fundamental research efforts.

Questions Frequently Asked

Prepared by Southwestern Office, USGA Green Section

(Questions asked by superintendents during the past season are remembered. Some of these questions along with our explanations of at least one answer to them are printed here so that others, who likely have asked the same either to themselves or to others, may have our thoughts.)

In greens constructed according to USGA Green Section specifications, does all the free moisture drain when the “dumping phenomenon” occurs? Why?

Yes. To answer why, one should recall the incidents leading to the formation of the false water table initially. In general, they are as follows:

(a) The water enters the seedbed from the surface and fills all the micropores; at this point the soil near the surface reaches field capacity.

(b) While the micropores are filled near the surface, many micropores also are filled for short periods of time.

This process continues downward until all the soil is wet down to the sand-gravel interface which is underlying the permeable seedbed.

(c) Surface tension of the water holds the free water against the force of gravity (the only force attracting the water downward).

(d) As water accumulates, a column is formed. When it becomes high enough so that its weight overcomes the ability of surface tension to retain the free water, the interface is then penetrated; and like sheep through a weak fence, each water molecule follows its leader until all the macropores have

emptied. When this occurs, the seedbed is at field capacity—the driest it can become due to downward drainage alone. The remaining moisture will be removed either by transpiration or evaporation.

One superintendent stated he can irrigate until the point just prior to the “dumping phenomenon;” and after applying a small additional amount of water, much more is drained out than that additional amount added. The question then arose, “If he is so good, why does he need the gravel and sand layers?” He could not do this without the gravel and sand layers under a seedbed of given permeability.

Is there any difference between Brownpatch and Rhizoctonia solani Kuhn?

Emphatically, yes. This difference is the same as exists between Dollar Spot and Sclerotinia homoeocarpa, F. T. Bennett; between Gray Snow Mold and Typhula itoana Imai; and between any other disease and its causal organism or agent. In short, one is the name of the disease; and the other is the scientific name of the causal organism.

When should over seeding be done in bentgrass greens which are highly infested with Poa annua?

The purpose for overseeding with additional bentgrass is to increase the relative population of bentgrass to Poa annua. Normally, seeding would be done either in the fall or spring. Seeding during these two seasons should not be discredited or discontinued. However, it is felt that much can be gained from summer overseeding. The procedure followed has been to either power spike in two or three directions to open the turf and permit more seed to contact the soil or to use a verticut with the reel disengaged to accomplish the same effect.

Should a summer aeration be warranted, such an overseeding could be made concurrently. Inasmuch as a very close observation is essential during the summer and especially if the greens are aerified, the possibility of losing seedlings due to drying is reduced greatly.

The rate to seed should be in the range of two or three pounds of seed per 1000 square feet. While this program has helped most of those who have tried it, it does not represent a cure-all for Poa annua. Rather it is possibly another step in management to discourage Poa annua.

Is any benefit derived from winter fertilization of fairway turf?

Virginia tests have demonstrated that winter applications of fertilizer, even on steep roadside slopes, have had little leaching loss. USDA tests have shown that such feeding has an unexpectedly important influence—there is a great deal of winter root growth even though grass tops are frozen stiff.

An experiment at the Lawn Institute in Marysville, Ohio, with the application of high rates of urea to frozen bluegrass sod in the middle of January, resulted in just as attractive a spring

COMING EVENTS

1962

December 4-5-6

Oklahoma Turfgrass Conference
Oklahoma State University
Stillwater, Oklahoma

December 10-11-12

Texas Turfgrass Conference
Texas A & M College
College Station, Texas

1963

January 25

USGA Educational Meeting
Biltmore Hotel
New York City, N. Y.

January 30-31

Virginia Turfgrass Conference
John Marshall Hotel
Richmond, Va.

February 6-15

34th GCSAA International
Turfgrass Conference and Show
El Cortez Hotel
San Diego, California

turf as did equal amounts of fertilizer applied in March. Also, the effects of this mid-winter feeding continued through the summer in the darker green color of the experimental area. At least one beneficial effect was that there was no surge of spring growth that aggravates spring mowing.

What kind of topdressing mixture is best for greens?

Once a topsoil mixture is selected and the greens constructed, every effort should be made to keep the subsequent applications of topsoil as nearly like the original as possible. The best way to go about this is to exercise great care in selecting the original topsoil mixture so that there will be no need for a change later on.

Much of the guesswork can be taken out of the selection of the proper soil mixture with a physical analysis. Such an analysis measures the porosity, permeability, and moisture retention of a soil mixture. These are important characteristics of any soil mixture; and it follows that it would be much better to test these characteristics before the final selection of a soil mixture is made than to select the mixture, incorporate it in a green, and then have it turn out to be undesirable.

If it should become necessary to change the structure of soil under turf, every effort should be made to avoid any type of layering. At least one method which has been successful is the incorporation of amendments into the soil by placing them in the aerifier holes after a thorough aerification. If this method does not work, complete renovation may be the only answer.

Why does young grass in many greens show a nitrogen deficiency even when greater rates of N are applied than normally required?

In most instances when this occurs, raw or readily decomposable organic matter was used in the mixture. For

the most part, organic matter breakdown is dependent upon soil microbes. While their growth responds to temperature changes, they, like the grass, require nutrients for growth; and when an organic material is available, they seem to prosper. Inasmuch as the bodies of the microbes are rich in proteins (which are about 6.25 percent nitrogen), much of the nitrogen in the soil is tied up in their bodies as they grow.

The microbes consume the available substrate (the rough organic in this case) until their population becomes too great for it to support. At that point, death of the older and weaker of the microbes begins to occur until an equilibrium in population is established. It is during the period prior to the establishing of the equilibrium that the deficiency develops; during this time supplemental applications of an inorganic and readily available source of nitrogen are warranted.

While much nitrogen can be tied up in proteins and complex nucleoproteins, later it will become available for turf consumption as those complex compounds are broken down, as described above, and also through chemical decomposition.

The deficiency should not cause alarm but should be expected and its management planned when such sources of

SUBSCRIBERS TO THE USGA GREEN SECTION VISITING SERVICE

EASTERN REGION

Conn. The Farms Country Club, Chesire
Rolling Hills Country Club, Wilton
Maine Inland Winds Golf Course
Loring AFB, Limestone

MID-WESTERN REGION

Ohio Mohawk Golf Club, Tiffin
Colo. Eisenhower Golf Course, USAF Academy
Okla. Rolling Hills Country Club, Tulsa
Texas Lakewood Country Club, Dallas

WESTERN REGION

Calif. Santa Rosa Golf & Country Club
Santa Rosa

organic matter are utilized. It is for this same reason that farmers must fertilize more after a cover crop than when no cover crop was plowed in prior to planting.

When establishing U-3 bermudagrass, why should one use vegetative material when U-3 seed can be purchased?

Even though U-3 bermudagrass produces viable seed which can be and are harvested and sold, those seed do not produce a uniform population when planted. Many of the seed will produce plants so closely similar to U-3 that for all practical purposes one would say they were identical to the U-3 from which the seed came. However, the many other types of seedlings which will develop from the same source of seed will be quite varied in their characteristics.

In "THE LAWN BOOK," U-3 is a strain of common Bermudagrass selected in 1938 from the Savannah Golf Club, Savannah, Georgia. It was tested for several years at Beltsville, Maryland, by the U. S. Golf Association, Green Section, and the USDA and jointly released in 1946-47." He further states, "Although seed produced from U-3 stolons is now on the market, the pure strain of the grass described here as U-3 must be planted vegetatively."

What about mowing when the grass is wet?

There are several drawbacks to mowing when the grass is wet. First of all, there is a good possibility that disease spores will be spread over the turf in this manner. Disease is most active during periods of high humidity and relatively high temperature; so by mowing when the grass leaves are wet, we are most likely to spread disease organisms.

Because wet grass tends to stick to itself and everything around it, it is very difficult to do a good mowing job

under this condition. The clipped grass blades accumulate in sizeable clumps when wet and tend to slow or clog mowers as well as have a detrimental effect on the turf where they fall. These clumps of grass are a fine medium for disease development; and if not broken up can rot, shade, or otherwise kill the grass underneath.

Besides the detrimental effect to the grass, mowing under wet conditions is hard on machinery and makes maintenance somewhat more costly.

Course Care Publicized

"Help take care of your golf courses" is the theme of an educational program being conducted at Griffith Park golf courses through the cooperation of the Griffith Park Men's Club, according to Americ Hadley, supervisor of golf in the Los Angeles City Recreation and Park Department.

Educational stickers are being placed on tee markers at each hole, on the rental golf carts and on the flagsticks at the Griffith Park courses.

These stickers remind players to replace their divots and to keep their golf carts away from tees and greens.

The Griffith Park Men's Club hopes that by putting up the stickers they will persuade each individual golfer to recognize his responsibility for the care of municipal courses.

Plan Your Troubles Away

Emergencies are less shocking if a plan covering eventualities is thought out ahead. In fact, if planned for carefully, most "emergencies" never occur.

If we'll plan "just in case of fire" or "just in case of accident" the action in the emergency situation becomes more orderly and efficient. Then, if we go further to plan against the possibility of fires and/or accidents, you just naturally reduce them.

—*Turfgrass Advisor*