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Thatch-The Turf Manager's Hidden Enemy

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Every turf manager has an idea of what thatch is and the problems it can cause. He also knows how to get rid of it. Surprisingly, however, thatch removal (dethatching) seems to be one of the least understood practices in turf maintenance. A better understanding of the thatch problem might in many cases lead to the realization that several other turf maintenance practices are either unnecessary, in the absence of thatch, and/or ineffective when thatch is present. The following summary of what is known about thatch and its control is provided with the hope that it will be of practical use to turf managers.

What is Thatch?

A commonly accepted definition states: "Thatch is an intermingled organic layer of dead and living roots, stems, stolons, rhizomes and shoots that develops between the soil surface and the zone of green vegetation'.' Generally, if the thatch layer is mixed with soil (native soil and/or topdressed soil), it is called "mat'.

What Factors Cause Thatch Buildup?

Turfgrass Species: Vigorously growing turfgrass species are generally major thatch builders. This may be due to the inherent genetic makeup of the species, as is the case for bermudagrass *(Cynodon spp.),* kikuyugrass (Pennisetum clandestinum), and Kentucky bluegrass *(Poa pratensis).* Or it may be due to a high level of maintenance which causes healthy and vigorous turf growth. Generally, turfgrass species which produce rhizomes [e.g., zoysiagrass *(Zoysia spp.)* and bentgrass *(Agrostis palustris)]* are much faster thatch builders than bunch-type grasses such as perennial ryegrass *(Lolium perenne),* tall fescue *(Festuca arundinacea),* and creeping red fescue *(Festuca rubra).*

Excessive Nitrogen Fertilization: Application of nitrogen at higher than optimum rates (generally 4-6 Ibs. N/1000 ft^2/year in most parts of California) causes vigorous shoot and stem growth, which, in turn, contributes considerably to thatch buildup.

Soil Texture: Microorganism activity is extremely limited in heavy, compacted soils due to lack of oxygen. In this case, organic matter (thatch) decomposition is restricted.

Drainage: Microorganism activity also is greatly reduced under waterlogged soil conditions caused by poor drainage and/or high rate of water application.

Soil pH: At extremely low or high pH's, the activity of microorganisms is restricted, and, as a result, thatch decomposition is retarded.

Pesticide Effects: Although some pesticides may actually decrease thatch buildup (by restricting growth of the turf and thereby reducing organic matter production), most insecticides or other pesticides, when applied at higher than recommended rates, contribute to thatch buildup by killing earthworms. Research has shown that where earthworms are present, they play a major role in reducing thatch through digestion. Some pesticides also eliminate microorganisms, whose role in thatch decomposition was mentioned earlier.

Turf Clippings: Most turf specialists believe that the adverse effects of turf clippings left on lawns after mowing are minimal. Composed primarily of leaves, turf clippings are 85-95% water. Dry leaves decompose quickly, leaving a residue which contains nitrogen and other nutrients beneficial to turf. It should be noted, however, that irregular mowing, which results in greater than normal quantities of clippings, contributes to thatch buildup if clippings are not removed. As

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a rule, no more than 30-40% of the shoot length should be removed at any mowing. This means that if the turf is maintained at a 2-in. height, it should be mowed before it reaches 3 in. If mowing is delayed and clippings are left on the surface, the likelihood of thatch buildup increases and a temporarily unsightly lawn results.

What Problems Can Result ftom Thatch Buildup?

Restricted Water Movement: A thick and concentrated thatch layer can restrict water penetration into the soil considerably. Consisting of organic matter (primarily lignin), the thatch layer becomes hydrophobic, does not wet easily, and acts as a barrier to downward water movement. This phenomenon often causes development of dry spots in lawns.

Holds Excessive Water: Once a thatch layer is wet, it absorbs and holds a large quantity of water. This not only adds to the water movement problem discussed earlier but also contributes to (a) development of a favorable environment for disease-causing organisms, (b) shallow root development, and (c) wet sponginess of turf.

Research results have shown that the incidence of turf diseases such as *Helminthosporium* leaf spot, *Typhula* blight, stripe smut, dollar spot, and brown patch increases under thatchy conditions. Apparently, the damp micro-environment developed in thatch layers is the major contributing factor to this.

A moist, thick layer of thatch also will keep roots from penetrating into the soil in search of water. A shallow-rooted turf is extremely susceptible to all environmental stresses (drought, heat, cold) and maintenance stresses (compaction, mowing, verticutting).

Finally, a wet thatch layer is spongy and slushy, making the turf undesirable for common lawn uses.

Ineffective Fertilization and Pesticide Application: Adsorption of nutrient and pesticide molecules to thatch components, plus lack of water movement, prevent nutrients and soil-applied pesticides from reaching the soil and thus the turfgrass and/or weed roots.

Restriction of Air Penetration: Lack of air in the root zone, one of the major, though seldom talked about, factors in poor plant growth, can also be a problem when thick thatch is present. Lack of air exchange in the root zone affects the adsorption of nutrients by roots (an active process requiring oxygen), and restricts the activity of beneficial microorganisms in the soil. Carbon dioxide buildup, when air exchange is restricted, can activate harmful microorganisms which act as obstacles to good plant nutrition.

Harboring Insects: The activity of certain insects (such as sod webworm, armyworm, cutworm, adult bill bug and chinch bug) is reported to be directly affected by the presence of thatch. The relationship of thatch and sod webworm is widely accepted since this insect is seldom present and/or active in thatch-free lawns. Sod-inhabiting insects, such as grubs, are indirectly affected by thatch, since the activity of insecticides is reduced when thatch is present.

Occurrence of Crown Lift: The turfgrass crown is often raised from the soil's surface when thatch is present. The most important part of the turfgrass plant, the crown, is normally located at or slightly below the soil surface and is the plant portion capable of producing new shoots (tillers), roots, stolons, and rhizomes. Raising this portion of the turf creates the possible danger of crown removal by mowing (scalping), crown damage by traffic, and/or crown damage by environmental stresses (heat, cold, drought, etc.). Low turf density is a common problem in thatchy turf due to this phenomenon.

Development of Turf Chlorosis: Turf chlorosis often develops when thatch is present, especially in stoloniferous turf species, such as bentgrass.

Turf Sponginess: A thatchy turf is spongy, thus undesirable, where a firm surface is required, such as golf greens. Also, "footprints" will appear after walking on a thatchy lawn even if the grass is not under low moisture stress.

Creation of Soil Acidity: Research reveals that thatch tends to lower the pH of the immediate soil media. If sufficient, this change in pH can cause a decrease in microorganism activity, which in turn decreases the rate of thatch decomposition.

Are There Any Advantages Associated with Thatch?

At optimum thickness (1/4 in. to 1/2 in.) a thatch may provide one or more of the following benefits:

Insulation:A thatch layer can act as an insulator providing protection to the turf crowns, roots, rhizomes, and stolons against sudden, drastic temperature changes. Although this is of great value in areas where such changes commonly occur, insulation is not generally necessary in milder temperature zone regions, which includes much of California.

Cushioning Effect:A moderate thatch layer increases turf resiliency and creates a cushion which makes a lawn safer to play on and more pleasant to use. The wear tolerance of turf also is increased.

Mulching: A thatch layer can prevent excessive water evaporation under hot, dry conditions.

Reduced Compaction: Soil compaction is reduced when a thatch layer is present.

How to Control Thatch

Under similar turfgrass maintenance programs, a lawn containing no more than 1/4 in. to 1/2 in. of thatch is healthier, more attractive, of higher quality, and easier and cheaper to maintain than a lawn in which a thicker thatch layer is present. Therefore, it is important to assess the status of a lawn's thatch on an annual basis. Thatch control measures are necessary whenever more than 1/2 in. (noncompressed) of thatch is present. Thatch thickness is measured between the soil surface and the point where green grass appears. Taking several soil cores from a given area and finding an average thatch thickness is recommended. When more than optimum thatch is present, it can be controlled by preventive, biological and mechanical control measures.

Prevention: As mentioned previously, thatch develops when the rate of shoot and root decomposition is slower than the rate of development. Therefore, if steps are taken to equalize the rate of these two processes, thatch development is reduced. Such steps include:

a) Choose turfgrass species which grow less vigorously and/or are not sod producers. (Bermudagrass, bentgrass, and Kentucky bluegrass produce much more thatch than bunch-type grasses such as perennial ryegrass.)

b) Do not apply more than optimum amounts of nitrogen.

c) Avoid excessive irrigation.

d) Remove clippings if irregular mowing is practiced.

Biological Thatch Control: Soil microorganisms and earthworms play an important role in decomposing thatch. Any practice that promotes the activity of these organisms will greatly aid thatch decomposition. Topdressing on a regular basis would bring soil in contact with thatch and promote thatch decomposition. Earthworm activity can be encouraged by proper irrigation, aeration and judicious pesticide application.

As mentioned earlier, thatch tends to lower the pH at and slightly below the soil surface. Periodic application of small amounts of lime will increase pH and create an environment more suitable for both microorganism and earthworm activity, especially where acid soils are prevalent. The optimum pH for these organisms as well as for turfgrass growth is in the range of 6-7.

Although several biological dethatching materials are available, research by University of California Cooperative Extension and others has not demonstrated their effectiveness. These materials usually contain specific microorganisms which are supposed to increase the rate of thatch decomposition. However, the complexity of thatch chemical composition makes the presence of many different types of microorganisms necessary to change the rate of the composition significantly.

Mechanical Thatch Control (Removal): This method is by far the most effective, and, in many cases, is the only way to reduce thatch.

The most appropriate and successful method of mechanical thatch removal employs a vertical mower, also called a dethatcher or renovator. This mower has a series of revolving vertical blades which cut through the thatch and bring it to the surface where it can be removed with a garden rake, a vacuum, or sweeper. The depth to which the vertical blades penetrate is adjustable and should be determined by thatch thickness.

The frequency of dethatching obviously depends on the rate of thatch buildup. A bermudagrass or Kentucky bluegrass lawn will probably require verticutting once a year. Tall fescue and perennial ryegrass lawns generally need not be dethatched. Specialty turf, such as golf and bowling greens, should be verticut lightly several times per year at the discretion of the superintendent. The rule of thumb for home lawns or parks is that dethatching is required when thatch thickness exceeds 1/2 in.

The time of dethatching also is important. Generally, lawns should be dethatched when turf is actively growing and can thus recover quickly from the injury and shock of the verticutting. Dethatching should be avoided at those times of year when weed seeds are most likely to germinate. In most parts of California, the best time for dethatching is mid-to-late spring, with early fall being the second best. This is true for both cool and warm season grasses. Summer and winter months are not recommended for dethatching turfgrasses.

Hot Green

William B. Davis*

From May through August, management of our golf courses can be most critical. The days are long, there is little likelihood of rain, the skies are clear, temperatures are high, evapotranspiration is at its peak, and golfers fill our courses from dawn to dusk. This is no time to lose a green due to heat stress. When midday temperatures consistently exceed 85° F, we must make certain that water loss by our grass does ‘not exceed its ability to take up water or the grass will wilt and die. Typically, most of us will increase the amount and/or frequency of water application and err on the side of too much water in order to ensure that we have enough.

While temperature plays a major role in water loss by the plant, it might be well to look more deeply into the interrelationship which contributes to water stress or “hot green:’ This subject has been of considerable concern to us at Davis because of the pure sand concept of green construction and the sand topdressing frequency program. Over-irrigation causes excessive leaching. (Our green recommendations produce greens with high infiltration rates.) Over-irrigation, coupled with high frequency of application, also produces a shallow root zone which is atypical for a sand green. Because the presence or absence of free water on the surface of a sand

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green cannot be used as an indicator of when to shut down the irrigation system or when to irrigate, sand greens can easily be over-irrigated. On our experimental green at Davis, we are testing various management practices and, in particular, water management. As part of our data, we take temperature measurements in order to better document when and how various management practices reduce or increase problems due to "hot greens:

First, let me clarify how temperatures are recorded. Yesterday, for example, temperatures were reported in the newspaper at a maximum of 85° F and a minimum of 60° F. These were air temperatures recorded at an offical sheltered weather station 41/2 ft. above ground level. Had the thermometers been placed within 4 in. of the turf on a golf green, the air temperatures would have been approximately 10 degrees higher and lower than the officially reported temperatures. If we measured the actual leaf temperatures of the grass blades, they could be another 10 degrees higher and lower than air temperatures just above the turf. Therefore, it would not be uncommon for maximum daytime leaf temperature to reach 105° F and to have a minimum night temperature of 40°F. While official air temperatures give us a clue to potential heat stress, our real concerns are the microclimates , just above the turf surface, the leaf blade, in the thatch, and in th soil of the root zone.

Until recently, it has been difficult to measure surface microclimate temperatures. Can we really get good temperature measurements except for a limited area of a golf green and then only under the conditions of a carefully controlled experiment with special equipment? Many temperature-related experiments with grass plants have been made in growth chambers. They have given us excellent clues, but their controlled environments may be quite different from what we experience in the field. There is a way to measure the microclimate of the green by using infrared. The amount of infrared radiation which is emitted by a target (any object) can be measured without actual contact. This is the same type of radiation you feel when you hold your hand over hot coals in a barbecue pit. There is a fixed relationship between the temperature of an object and the amount of energy it radiates. Therefore, we can accurately determine an object's temperature by measuring the amount of energy it radiates.

One good thing to come out of the Vietnam War, if any, was the development of the infrared pyrometer. The early infrared pyrometer was a large shoulder-held instrument that was used to detect temperature differences which would indicate troop locations. Today, we now have a hand-held Omegascope TM infrared pyrometer which measures temperatures without contact — at distances of two feet to more than 1/10 of a mile. With its built-in computer, we can quickly and very accurately measure the temperature of any object. Point the gun at your green, pull the trigger, and the temperature appears on the back face plate of the gun. You can set it for Fahrenheit or Celsius, stored temperature data, and etc.

Before reviewing some of the temperature recordings we have taken with the Omegascope TM, we should review some of the information already available regarding solar energy, its effect on grass temperatures, and, subsequently, irrigation management. For a real in-depth understanding, I suggest that each superintendent carefully read the references listed at the end of this article.

During the day, solar radiation from the sun (energy) strikes the grass leaves. The leaves reflect, absorb or transmit this energy. Very little of the absorbed energy is used for photosynthesis; most of it heats up the grass leaves. The hotter the leaves become, the faster they radiate heat to the atmosphere, warming the air above the turf. As the turf gets hotter, the heat given off also can be dissipated to the air by convection: on a still day, films of warmed air next to a leaf rise in plumes of heated air. Heat absorbed by the grass blades also is transferred by conduction to the thatch and the soil. With a breeze of 6 m.p.h., the warmer air around the grass plants can be moved away faster and mixed with the cooler air of the atmosphere. But it is transpiration and evaporation of the moisture from the living grass plant and thatch which keep the green from reaching very high temperatures.

Our first opportunity to use the infrared was on a clear October day in 1972 when the air temperature was 78°F. Using the old shoulder-held infrared pyrometer, we recorded the following surface temperatures: 67°F for a Kentucky bluegrass/perennial ryegrass mix mowed at 4 in., and 79°F for the mix mowed at 1 1/2 in.; 83°F for the Penncross bentgrass green mowed at 1/4 in.; 93°F for the pea gravel walk; 120°F for the Astroturf pitching tee. From these temperatures, we can see the importance of transpiration and evaporation in controlling the temperature of the grass. These measurements also illustrate the importance of a higher mowing height. At the higher cut, there is more leaf surface for the same amount of incoming energy.

Raising the height of the cut is one way we could reduce our potential for heat stress, but, due to the way many of our greens were constructed and how they are managed, it is difficult to produce a fast green unless we mow at 1/8 to 5/32 of an inch. Therefore, changing the height of cut is not considered by many to be a practical solution.

If rapid, high transpiration and evaporation are essential for reducing the potential heat stress on golf greens, how do we ensure their peak efficiency?

1. We must have an irrigation system which applies water at the highest degree of uniformity possible.
2. We need a uniform growing medium which readily accepts water and quickly drains out excess water.
3. The growing medium should have potential for a relatively deep root system (4-6 inches for a bentgrass mowed close and frequently).
4. The growing medium should hold sufficient available water in the root zone well in excess of the estimated evapotranspiration (ET) between irrigations.
5. We must manage the thatch buildup so that it functions primarily as a surface cushion for wear

resistance and putting quality, not as a surface rooting medium and/or an impedence to water filtration.

6. Trees and/or other structures should not stop the air flow across the greens.

When constructing new greens, care should be given to slope and aspect of the green. We don't want greens to be highly efficient solar collectors during the warmer months of the year.

Most of us are fairly convinced that syringing the greens daily between 11 a.m. and 3 p.m. during our warmer months is the best insurance to avoid heat stress. Studies done by Beard and others have shown that syringing can moderate the potential midday maximum. In Beard's studies, 0.25 in. of water was applied as a syringing. For many hot days, this amount of water is equal to better than one half of our daily ET. Applying water at midday at this rate would be a questionable practice if greens were adequately irrigated earlier in the day. A green needing this type of midday irrigation could indicate serious problems with the irrigation system and/or a very poor soil-water-root relationship. If we are syringing with more water than needed, we create problems. During periods of potential heat stress, some courses shut down their green irrigation system and only hand-water their greens at midday.

When greens are being syringed, the grass temperature is lowered by the cool water but leaf temperatures quickly return to their same temperatures or higher. When we increase the relative humidity around the grass leaves, their rate of transpiration slows down. If there is a good breeze following syringing, the temperatures can go down because evaporation from the moist leaves and thatch is increased and higher humidity is quickly dissipated. Evaporation of water and production of water vapor at the same temperature uses up about 570 calories (latent heat) for every gram evaporated. Light, frequent syringing is a short-term solution to wilt. Wet wilt occurs when the evapotranspiration rate exceeds the water intake capability of the grass roots. By syringing, we stop or greatly reduce transpiration by maintaining a saturated humidity at the leaf surface. This, in turn, stops any further wilting due to water loss by transpiration. A healthy grass plant can function well at very high leaf temperatures; and most wet wilt is the result of extremely shallow root systems, caused, in part, by management practices, a poor growing medium, or damage by disease, nematodes and/or insects. If the potential for wet wilt isn't present, syringing, particularly at application rates of more than 1/10 in. of water, actually increases a green's potential for wet wilt.

In the long term, we are less likely to have greens which are subject to wet wilt if we improve our water management programs. This includes both our irrigation program and our practice of syringing. Maintaining a soil water level in the upper 50 percent of available water range should determine the optimum frequency. When irrigation frequency is greater than optimum, turfgrass root growth, shoot growth, leaf succulence and chlorophyll content decline, but shoot density can increase.

In the development of the pure sand green concept, one of our primary concerns was to obtain a sand which should require irrigation no more frequently than every other day under normal, warm summer temperatures. Syringing would only be practiced when air temperatures were above 95°F and/or we had drying winds. The standard practice on some golf courses which have pure sand greens is to irrigate every night and to syringe every afternoon from May to October. Under this type of management program, we can cause excessive leaching, shallow root systems, and weaker greens. Much of our present research on our experimental sand green has centered around developing information on management programs best suited to the sand green. With the infrared pyromenter, we can quickly monitor surface temperatures and correlate them with air temperatures and different management practices.

Using our new Omegascope TM infrared pyrometer, we can measure surface temperatures of our experimental green at the Department of Environmental Horticulture. This green is in full sun, facing northeast with a 3 percent slope. Daily, we record information on its maximum/minimum temperatures, evaporation, and total miles per hour wind velocity at a 2-ft. height for each 24-hour period. If you multiply the evaporation by 0.8, you get the average wind velocity.

On May 24, 1982, we had a 97°F maximum, 74°F minimum temperature with north winds averaging 11.2 m.p.h., which gave us an ET of 0.65 in. Our green had been irrigated in the early morning. At 4 p.m., the range of surface temperature readings was 99°F-l05°F, with the average of 27 readings being 103°F. The green was syringed with 0.1 in. of water, and we dropped the surface temperature to a range of 91°F-95°F, with an average of 93°F. The bare soil surface temperature was 132°F and our Astroturf was 153°F. We got an excellent cooling of the green, because the evaporation was high due to the north wind. While the green showed no stress, we were in our fourth consecutive day of north winds and syringing was beneficial.

On June 16, 1982, we had a hot day with very little wind from the southeast. Our maximum temperature was 98°F and the minimum 58°F, with a wind average of 2.8 m.p.h. Our ET was 0.38 in. At 10 a.m., the surface green temperature range was 89°F-97°F, with an average of 93°F. At 10:45 a.m. we irrigated the green, since it had not been irrigated earlier. At 4:30 p.m., the surface temperature range was 106°F-114°F, with an average of 110°F. We then syringed the green, dropping the average temperature to 105°F. While syringing did drop the average temperature' 5°F, we were already past our peak stress period.

The following day, June 17, we had another hot day with a maximum temperature of 96°F, an average wind from the southeast of 4 m.p.h., and an ET of 0.40 in. We decided not to syringe, but measured the surface green temperature at 9:30 a.m., 11:30 a.m., 2 p.m., and 4:30 p.m. The average surface temperatures were 95°F, 103°F, 106°F, and 98°F. At 2 p.m., the surface soil temperature was 146°F, Astroturf 171°F, and the asphalt road 133°F. With a good root system and available water in the root zone, no turf stress occurred.

During the month of June, there were 17 days when the maximum temperatures ranged between 85°F and 74°F, and 4 days when the temperature was above 90°F. This was a cool June, and except for the four days above 90°F, there was no need to syringe.

Syringing is an important management practice for saving poor greens subject to wet wilt and for reducing stress on good greens when extreme temperatures are encountered. When syringing is used as a routine practice on good greens, we are wasting water and labor. We also can be keeping the greens too wet and encouraging shallower roots which, in turn, could lock us into a program of managing high-stress potential greens.

The most interesting temperature study was that of aerification during one of our hot periods in July. While we generally have 10 to 20 days exceeding l00°F, 1982 was a cool summer. We only had one day, July 29, reach 99°F. July 28 was 95°F, so we decided to aerate at 1 p.m. the next day, at which time the maximum temperature reached 99°F. The green was thoroughly irrigated at 11 a.m. and at 1:30 p.m. was aerified with a positive piston aerifier using 1/2-inch hollow core tines. The sand from the cores was topdressed back into the green with a stiff broom as the cores dried. Next, excess organic matter was picked up by mowing with a rotary mower set at a 3/4-in. cutting height. The average surface temperature of the green was 115°F when the job was completed at 4:30 p.m. Then, the green was heavily syringed and for the next three days was irrigated every morning and syringed every afternoon at 2 p.m. At no time did the green show signs of wilt nor did any portion of the green fail to heal rapidly. Certainly we had put it under a severe test. We recommend aerification of sand greens in May, June and July, but never in the afternoon nor during periods of peak temperatures. Our green IS a pure stand of Penncross bentgrass and was only 10 months old at the time of the test.

All greens get hot, but if you are fortunate enough to have well-constructed greens with strong root systems of bentgrass, they are an exciting challenge to manage.

It is a sad commentary that the basic problems of many greens are never solved and that most of our management skills, time, and budgets are spent on band-aid programs or the aspirin treatment in order to survive.

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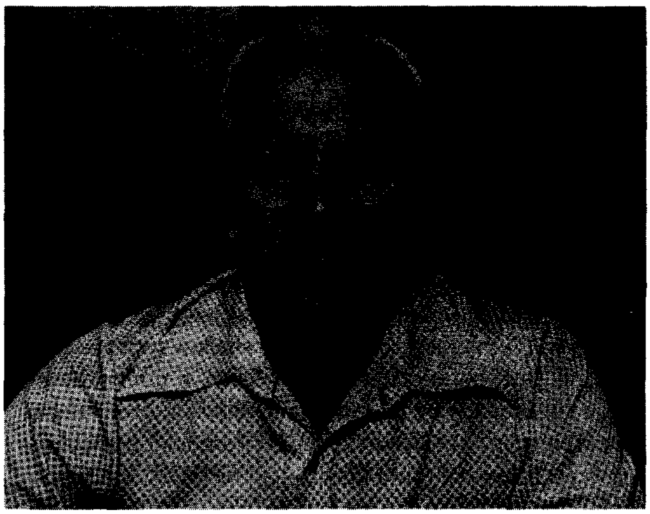
UCR Researcher, Victor B. Youngner, Dies of Heart Attack

California's turfgrass industry has lost a good friend. Dr. Victor B. Youngner, 61, collapsed and died of a heart attack April 18 at his home.

Acknowledged as the prime mover of turfgrass research in California for more than a quarter of a century, Dr. Youngner was an inspiration to all who knew and worked with him throughout his 29 years with the University of California. The breadth of and yields from his career's research are unsurpassed in the field of turfgrass breeding and management. A man who cared about people and their problems, he responded to and met the needs of his students, his coworkers, and this state's turfgrass industry. He will be sorely missed, never forgotten, by all who knew him.

Born and raised on a farm in central Minnesota, Dr. Youngner started then temporarily abandoned his college studies to join the Army Air Corps soon after the outbreak of World War II. Following his discharge from the service at war's end, he returned to the University of Minnesota where he earned his bachelor's degree and a Ph.D. degree in plant breeding and genetics.

After receiving his doctoral degree, Dr. Youngner came to California to work as a plant geneticist for Ferry Morse Seed Co. At that time, this state's turfgrass industry was looking to the floriculture and ornamental horticulture department at UCLA for problem-solving help, but no funds were available



for the research needed. The department's chairman, Dr. Vernon Stoutmeyer, traveled throughout the state to obtain funding from the industry to start a turfgrass research program. In 1955, he chose Dr. Youngner to head this fledgling program. Dr. Stoutmeyer never regretted his choice. He has credited Dr. Youngner with making the University's turfgrass program what it is today.

The first task facing Dr. Youngner was to develop a turfgrass germ plasm pool so that species could be adapted to southern California conditions. From this pool, 10 years later, came the first bermudagrass variety specifically bred for California-Santa Ana. This cultivar marked an important milestone for the state's turfgrass industry-a custom-bred grass strain that met the needs of a regional market and which today is its mainstay. Also, new strains of zoysiagrass that have better year-round color and a soft texture with less thatch also are the products of his work.

Throughout his career, Dr. Youngner was sensitive to the changing demands of this state's turfgrass industry and displayed a remarkable ability to run the gamut of turfgrass research-to do what was needed when it was needed. He is justly credited with having been responsible for major advances in plant identification, weed control, wear resistance, salt tolerance, plus the breeding of new strains and much more. Most recently, Dr. Youngner had been working with the Metropolitan Water District to determine how turfgrass irrigation might be reduced as a water conservation measure during drought conditions. His research achievements brought him the highest national honor in agronomy, election as a Fellow in the American Society of Agronomy.

UC Cooperative Extension specialists and county farm advisors alike credit Dr. Youngner with making Extension's turfgrass program what it is today. Their program reflects his hand, his mind.

Ail of Dr. Youngner's research and that of others relevant to this state's turfgrass industry have been reported over the years in the issues of this publication, which he started in 1955. Throughout its history, California Turfgross Culture has benefited from his guidance. At the time of his death, he still served as a member of its editorial committee.

In addition to his heavy and diverse commitments to research. Dr. Youngner still found time to teach classes during the school year at UCR. He was highly esteemed as a teacher and warmly regarded as a caring man by his students and colleagues.

Dr. Youngner, a professor of agronomy, was a member of the floriculture and ornamental horticulture department at UCLA from 1955 to 1965. Following his transfer to UCR in 1965, he served as active department chairman of the agronomy department there in 1967-1968 and department chairman from 1969-1970.

His survivors include his wife, Violet; two sons, Ben and William, both of Los Angeles; two step-sons, Michael and Thomas Maloney, both of Las Vegas; and seven grandchildren.

A remarkable and inspiring man, Dr. Youngner truly was, in the words of Landscape West & Irrigation News magazine's tribute to him as its Man of the Year for 1981: "...a humanist... a mastermind...a quiet, gentle man...a great teacher and the foremost expert on turfgrass in the Pacific Southwest'.'

UC Turf Corner

Forrest Cress *

UC Turf Corner contains summaries of recently reported research results, abstracts of certain conference presentations, and announcements of new turf management publications. The source of each summary is given for the purpose of further reference.

Oxidation Status, Gas Composition of Wet Turfgrass Thatch and Soil

Results from a comprehensive study by Cornell University scientists of the oxidation status and gas composition of wet turfgrass thatch and soil imply that phytotoxic products of poorly oxidized environments may accumulate in wet thatch on warm sunny days.

The Cornell researchers report that such conditions also may be common in field-grown cores of mature turfgrass which are moved to the greenhouse for study. The relevance of these results to the occurrence of diseases such as Fusarium blight are discussed in the article referenced below.

The oxidation status and gas composition in unsaturated thatch of mature Kentucky bluegrass were measured in the New York study to determine if anaerobiosis occurs under field and greenhouse conditions. Soils under the sods included a Hudson silty clay loam, a Riverhead sandy loam, and an Arkport fine sandy loam.

Redox potentials and concentrations of oxygen, carbon dioxide and ethylene were measured. Conditions of poor oxidation, including redox potential, oxygen and carbon dioxide concentrations, and accumulations of ethylene were measured in thatch on poorly drained soils in the field and in the greenhouse.

Applications of lime and calcium arsenate amplified the extent of poor oxidation in thatch, whereas calcium nitrate improved the oxidation status. Thatch depth and a coring procedure didn't influence thatch oxidation.

Redox potential varied diurnally and was lowest in wet thatches during warm, sunny days when thatch became warmer (by up to 7°C) than the air. Poorly oxidized conditions for periods more than 7 hours were measured in moist but unsaturated thatch in the field. The temperature of thatch appeared to be important in governing the oxidation status. Measurements of redox potential were considered to provide rapid and useful insights into the gaseous composition of wet thatches.

(See "Oxidation Status and Gas Composition of Wet Turfgrass Thatch and Soil:' by D. C. Thompson, R. W. Smiley, and M. Craven Fowler, Agronomy Journal, Vol. 75, No. 4, July-August 1983.)

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WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals In their original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Recommendations are based on the best information currently available, and treatments based on them should not leave residues exceeding the tolerance established for any particular chemical. Confine chemicals to the area being treated. THE GROWER IS LEGALLY RESPONSIBLE for residues on his crops as well as for problems caused by drift from his property to other properties or crops.

Consult your County Agricultural Commissioner for correct methods of disposing of leftover spray material and empty containers. Never bum pesticide containers

PHYTOTOXICITY: Certain chemicals may cause plant injury if used at the wrong stage of plant development or when temperatures are too high. Injury may also result from excessive amounts or the wrong formulation or from mixing incompatible materials. Inert ingredients, such as wetters, spreaders, emulsifiers, diluents, and solvents, can cause plant injury. Since formulations are often changed by manufacturers, it is possible that plant injury may occur, even though no injury was noted in previous seasons.

NOTE: Progress reports give experimental data that should not be considered as recommendations for use. Until the products and the uses given appear on a registered pesticide label or other legal, supplementary direction for use, it is illegal to use the chemicals as described.

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