

California Turfgrass Culture

VOLUME 28, NO. 4

FALL 1978

PROS AND CONS OF FREQUENT SAND TOPDRESSING

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Excellent putting greens don't just happen. They are the product of a professional turfgrass manager. Each of us has played on greens which, at the time, were near perfect. Some were constructed of pure sand, some of pure clay. Some were solid stands of Penn-cross or Seaside, others pure Poa. Some are aerated frequently, some only once a year. Some are played every day, and others are open less than 6 months a year. Some are used by few players each day, while others commonly support more than 200 golfers daily.

Because of this great variation in use, existing conditions, and micro- and macro-climates, the answer has to be the professional superintendent. This person must be a problem solver and not just a schedule maker and ramrod of a maintenance crew. It is to the professional and to those working toward that goal that I wish to direct my thoughts and information on topdressing as a key management program to excellent putting golf greens. I have no cookbook formula to give anyone that will guarantee success, but better greens are possible if you can put the pieces together.

There is nothing really new about the concept of topdressing. Since the beginning of golf course management, it has been a natural or common practice. Unquestionably, topdressing is necessary to improve the trueness of a putting surface. It also seems to invigorate and improve the growing condition of grass. In part, this may be due to the fertilizer or aeration, or both, which usually accompany topdressing. For many years the standard practice has been to aerate and topdress twice a year. Some courses still follow this practice. Others may aerate six times per year, but few courses have used light, frequent topdressing as a major component of their putting green management programs.

Several factors led us into the study of topdressing as a major management program for achieving high-quality putting surfaces:

1. We learned through previous research and field experience that a medium-fine narrow particle size range of sand made an excellent growing medium.
2. These types of sands were relatively noncompactible.
3. They produced a stable firm surface.
4. They accepted water at relatively high rates.
5. They retained moisture in the root zone as well as did most mixes presently used for golf greens.
6. Their nutritional problems were no more difficult to solve than those of the various soils and mixes commonly used.
7. With the right sand, we had a medium that was easy to apply and to work into the surface of growing grass.
8. Because our putting green grasses produced more organic matter than we needed, it was unnecessary to amend these sands to make a topdressing mix.

One major problem with any new program is how to get it accepted if it is likely to increase labor and material costs. To avoid this problem, we decided to eliminate aerating and verticutting from our basic experiments so that the total time expended on green management would remain about the same. We also decided to premix fungicides, herbicides, fertilizer, and bentgrass seed into our topdressing sand. Our management practices for greens, therefore, would consist of mowing, irrigating, and topdressing.

It worked for us, but, for a practical field

operation, the premix of chemical and fertilizer posed many problems. Added chemicals and fertilizer were not always needed. During periods of very little growth, fertilizer was needed, but added sand was not. Once herbicides and fungicides were added to a sand, the topdressing material had to be handled, stored, or disposed of under EPA regulations.

Our basic experiments were done on our campus experimental green. We also experimented on practice greens using pure sand at different frequencies and amounts in combination with different aerating frequencies. We published the results from these experiments under the title "An Alternative Method of Greens Management" (in two parts, in California Turfpass Culture, Vol. 24, No. 2, Spring, and No. 3, Summer, 1974). Since then, we have continued to field-test the program and work with superintendents to solve their problems in making frequent light topdressing a viable management program.

A key question to be answered in our research was whether frequent topdressing could effectively control accumulation of thatch. Would it not enable us to get away from the problem caused by buried thatch layers that impede water movement and restrict depth of rooting? Would it not create a uniform growing medium and aid in the breakdown of this organic matter? We need a vigorous renewing turf to have a putting surface. On many greens, vigorous turf also produces excess thatch, which gives an untrue surface, increases disease potential, and reduces the fastness of the green. Frequent light topdressing could, therefore, solve many of our problems in maintaining a high-quality putting surface.

Experimentally we proved what we believed to be true, but the real value of any experimental work is its application to the field. Therefore, let us look at a range of field questions and their possible answers:

Q. Will just any sand or topdressing mix give basically the same results?

A. No, for several reasons. Coarse sand particles do not work readily into the surface grass. Golfers do not like to putt on greens that have just been topdressed. Coarse, sharp sands dull mowers and are abrasive to the grass. Sands that are too fine can seal the surface of a green and reduce infiltration.

Q. What type of sands do you recommend?

A. A relatively fine narrow range of particle size. Round sand particles are best. Table 1 gives the particle ranges we presently suggest for construction and topdressing. Table 2 shows several sands now used by some California golf courses.

Q. Are suitable sands readily available?

A. Yes and no. For the past 10 years, we have tested sands from many areas of our state as a service to golf course superintendents. We find them in coastal deposits and dredge them from the San Francisco Bay. Some come from deposits on individual golf courses, and some come from many, varied river deposits. The nearest local sand and gravel company has been of little help. They produce concrete and plaster sands that may be washed but are too coarse. They basically are producing sands with a wide range of particle sizes so that when a little clay (cement) is added they produce an impermeable, dense medium. Some sand companies now produce what we want because we have specified the grade of sand we desire and will no longer buy their standard grades. Most major sand suppliers can screen and wash to a specific grade range if you create the demand, and will not accept second best.

Q. Do you mix any amendments with the sand ?

A. No. Amendments must be uniformly and evenly mixed if they are to measure up to their potential, and this greatly increases the cost of the topdressing medium. Topdressing is difficult to apply when moist. When dry, mixes separate. Typical sand and organic mixes become thin layers of organic matter and sand by the time they are brushed into

the turf surface, and irrigation further separates them. Very fine organic matters can seal the surface, and coarse organic matter does not readily work down into the grass. Most greens already are producing more organic matter than we want, so why should we add more?

Q. How frequently do I need to topdress to achieve the maximum benefits of this type of program ?

A. How fast is your grass growing? It is very likely that 20 applications a year (year-round play) would be too many. Fifteen applications was just about right for our Penn-cross green. At some periods of the year, topdressing every 2 weeks is just right, but you may well go for 8 weeks between some applications.

Q. Can I apply topdressing too frequently?

A. Yes. It is important to maintain some organic cushion. Excessive turf damage can result from ball marks where sand is applied too frequently, too heavily, or both.

Q. How much sand should I apply at each topdressing?

A. Assuming your only objective is topdressing and not quick buildup of a new surface, you should be applying $1/32$ to a maximum of $1/16$ inch.

Q. How do I apply such small amounts?

A. It takes good equipment and a skilled operator. Topdressing machines set at almost closed application settings have done a good job. Some superintendents have found broadcast fertilizer equipment to be the answer.

Q. Can these uniform medium fine sands be applied at the higher rates typically used when aerating and topdressing once or twice a year?

A. No. These finer sands are not as easy to move and push around over the green. If heavy amounts are desired for some reason, it would be best to make several uniform fine applications.

Q. Do you tend to build up the depth of the green much faster than typical aerating and topdressing practices?

A. There is very little difference. At the frequencies that produced our best putting surface, the difference was less than $1/4$ inch per year, when compared to standard practice. On golf courses, we have not seen an observable difference.

Q. Do you recommend limiting aeration and verticutting altogether once you start a topdressing program ?

A. No. The condition of your present green will, in part, govern how fast topdressing can become a major management program. It is best to increase aeration at first to ensure a good transition between your old and new surface. Some courses have found that a double aeration, deep aeration, or both, work best for them. During the first year, some courses have gone from two basic aerations to a maximum of six. Tines of $5/8$ inch are used to start, then only $1/2$ - or $1/4$ -inch tines. Their topdressing might be much heavier at first, but they are soon on the $1/32$ - to $1/16$ - inch application rates. Verticutting may or may not be used, but with present-day equipment many superintendents have found it beneficial.

Q. Once on the program, is aerating completely eliminated?

A. No. But we no longer use aeration as our basic and most effective means of relieving compaction and removing thatch. Once we have a new uniform surface with a depth of 2 to 3 inches, late spring or early summer aeration, or both, may be in order. Even though we do not have a buried thatch layer, we may want to reduce the density or firmness of the surface. Verticutting the plugs on the green will separate the sand from the organic matter. By removing the organic matter and brushing the sand into the green, you will have topdressed without the need for adding extra sand. Some superintendents feel that, of their 12 to 18 topdressings per year, 2 or 3 would be verticutting their aeration plugs.

TABLE 1: SUGGESTED PARTICLE SIZE RANGES FOR SAND USED IN GOLF GREEN CONSTRUCTION AND TOPDRESSING

Sieve opening (mm)	U.S. standard sieve number	U.S.D.A. class	Construction		Topdressing	
			Desired	Accepted	Desired	Accepted
2.38	8	Fine gravel				
2.00	10	gravel				
1.68	12	Very coarse sand				
1.41	14				0-10%	
1.19	16					
1.00	18					
.841	20	Coarse sand				
.707	25					
.595	30		0-1 5%	80-90%		0-1 5%
.500	35	Medium sand*				
.425	40					
.354	45		80-95%		100%	75+%
.297	50					
.250	60					
.210	70	Fine sand				
.177	80					
.149	100					
.125	120					
.105	140					
.088	170	Very fine sand				
.074	200					
.063	230		4-8%	5-10%		0-8%
.053	270					
.044	325					
.037	400	Silt and clay				

NOTE: The proportions proposed are tentative guidelines only. Individual sands should be considered in terms of the infiltration rate when compacted and the moisture release curve. These will be affected by the particle size distribution within the limits proposed. The shape of the sand particles also must be considered, because round sand particles do not compact as readily as sharp sand particles.

- The key fraction is the medium sand. It should be the dominant fraction.

TABLE 2. PARTICLE SIZE DISTRIBUTION OF SOME RECOMMENDED SANDS BEING USED ON NORTHERN CALIFORNIA GOLF COURSES

Source	Fine gravel	Very coarse sand	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay	Center three fractions*
Dillon Beach	0.0	0.3	2.3	68.3	24.6	0.9	0.8	2.8	95.2
Antioch Fill	0.0	0.1	1.0	71.6	21.7	1.2	1.6	2.8	93.3
Guadalupe	0.0	0.0	0.9	76.6	17.9	0.2	0.0	4.4	95.4
Brown Manteca	0.3	4.1	28.5	42.9	22.3	1.4	0.2	0.4	93.7
Santa Cruz 1070	0.0	0.0	11.3	62.5	23.2	1.0	1.5	0.5	97.0
Coloma Sand	0.9	0.3	17.5	52.9	23.0	0.8	1.3	2.0	93.4
Lappis 10	0.0	0.0	19.2	75.3	4.1	0.0	0.7	0.7	98.3

- Note that the center three fractions of each of these sands is greater than 90 percent retained and that the dominant fraction is medium (0.50 mm to 0.25 mm).

Q. If you aerate, aren't you opening up the green for greater Poa annua invasion?

A. Yes and no. It depends on the time of year. We recommend only aeration in the late spring and early summer when Poa annua germination is at a minimum.

Q. How long before a topdressing program will make a major difference in the surface of the green ?

A. This again depends on the condition of your green when you start the program and how soon you are developing a uniform surface. Considerable improvement has been noticed in greens before the end of the first year. More typically, it takes about 18 months.

Q. Will the golfing membership like the new green surface?

A. Maybe yes-maybe no. If your golfers want a true firm green, the answer will be yes. If they expect a poor shot or an improperly played shot to stick on the green, they will be unhappy. Some players will have to take a few golf lessons and learn how the game is played.

Q. Can this program be easily incorporated

into my present management program ?

A. Yes. But it is a poor practice to go into any new program without first testing it out on your practice green. Your sand source is critical. Do you need new storage bins for your sand? Do you need to relocate or add sand storage bins to reduce the time it takes to move sand to your greens? Is your present topdressing equipment in excellent condition, and will it evenly apply the right amount of sand? Does your crew know what is expected from the program and what it must do to make it work?

No doubt, there are many other questions we might ask and answer. In this paper, they should be unnecessary, because this program is not for the nonprofessional superintendent. The true professional can make it work, and results will be quite predictable. Tournament golf every day is possible. Less reliance on fungicides and herbicides is possible. You also may find that height of cut will be increased and frequency of mowing reduced. If the primary function of your putting green is for putting and not just for a lush green carpet appearance, a properly developed topdressing frequency program could be the answer to great golf for your golfers and fewer problems for you.



Turf and Landscape Institute speakers, from left to right: Dr. John R.Hall
Dr. George Hawkes, Mr. Robert Minick, and Dr. James R. Watson. Articles on the
Institute, held in Anaheim, follow.

INSTITUTE SPEAKERS STRESS EFFICIENT ENERGY USE

*Forrest Cress **

The need for efficient use and conservation of energy and practical suggestions on how to meet this challenge were spelled out by three featured speakers close to the "green" industry at the opening general session of the annual Turf and Landscape Institute held recently in Anaheim.

Talks by Dr. George Hawkes, Dr. John R. Hall, and Dr. James R. Watson served to complement that of the fourth special speaker, Bob Minick, district administrator for Representative George E. Brown, Jr., 36th District, California. Minick spoke on the government's role in availability and use of energy.

Dr. Hawkes, environmental quality technical advisor for Chevron Chemical Company, first pointed out that fertilizer manufacture is an energy-intensive process, most of which goes into the fixing of nitrogen into ammonia. He explained the processes involved, including their energy requirements, in producing various forms of nitrogen as well as potash and phosphate.

Synthesizing the ammonia and further processing into the fertilizer used on lawns take the equivalent energy of 1 quart of gasoline, based on an application rate of 1 pound of nitrogen per 1,000 square feet. The inclusion of phosphate and potash, granulation of the product, and other processes add to the energy input.

Turning to natural fertilizers, Dr. Hawkes said that they should be used where feasible, but added that they have their shortcomings with respect to energy efficiency and conservation. "Depending on the source, the length of the haul, and processing, use of these materials can conserve energy, but they can be expensive. It takes about one-fifth to one-quarter as much energy to apply the same

amount of nutrients from manure as from commercial fertilizer, if the haul distance is about 10 miles. But because of bulkiness and low analysis, the differential quickly changes as the haul distance increases."

Although the manufacture of chemical fertilizers and the loading, hauling, and application of natural fertilizers require large energy expenditures, irrigation takes about five times the energy as does the fertilizer applied to turf. "Therefore," Dr. Hawkes said, "we must be efficient in our irrigation practices. The user of fertilizer has a large influence on the efficient use of energy contained in the product. Improper irrigation can leach nitrogen below the root zone. Improper timing and poor application of fertilizer can cause gaseous losses of nitrogen to the atmosphere. The user should keep in mind the 'Fertilizer Bill of Rights'-the right kind, the right amount, the right time, the right place."

Dr. Hall, Virginia Polytechnic Institute and State University turf expert, had much to say from a practical point of view about the concern today over such an abstract item as energy. He also described consequences he foresees for a turf and landscape industry faced with high costs or scarcity of energy. "Energy availability and price directly influence the U.S. gross national product, which influences disposable income in the American family. Disposable income is what feeds the green industry. When energy costs rise, the costs of basics-food, shelter, and clothing-rise, and disposable income decreases. We are competing with enclosed patios, second cars, and campers for that disposable income, and, frankly, our industry is in a tenuous position with the current energy situation being what it is."

Reviewing the world's human population

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explosion, he cited these statistics: a population of 1 billion people in 1830, 2 billion in 1930, 3 billion in 1960, 4 billion in 1975, and 5 billion predicted by 1985. "The impact is impossible to predict," Dr. Hall said, noting the challenge such growth poses for agriculture here and abroad if the world's population is to be fed. Compounding its problem are the petroleum energy crunch and agriculture's need for such energy if food production is to be maintained at its present levels, let alone increased.

"The consequences to the turf and landscape industry resulting from high energy costs or scarcity are many," he said. "They will force us to reduce our energy use, which may mean less fertilization. It may mean less mowing. We will have to substitute grasses and plant materials that consume less energy. Irrigation is an expensive part of turfgrass management. Perhaps we'll have to turn to more drought-tolerant species. Perhaps we'll have to be more concerned about varieties that give quality with low nitrogen fertilization, or maybe we'll have to return to pre-World War II considerations of intercropping legumes in grass for nitrogen fixation."

High energy costs or scarcity will force the industry to invest in new technology. Some will have to convert from gas to cheaper diesel or from gas to electric motors. Some will have to consider use of composted sludge and effluent irrigation.

"In summary," Dr. Hall said, "I would submit to you that turfgrass is, in fact, not a luxury to be relegated to the term I've been using—disposable income. Granted, agriculture's most important task is feeding the world, but the importance of turfgrass and ornamentals in absorbing and in breaking down pollutants, recycling nutrients, binding soils, degrading organic wastes, maintaining a balance of gasses in the air, cooling the environment, fixing solar energy, providing recreational potential for Americans, and providing beautiful landscapes for the health and mental well being of man cannot be over-

looked." In short, he added, they are the functions that clean the air we breathe, help purify the waters we drink, help provide the green earth humans enjoy, and maintain the tenuous balance of nature.

"The challenge is clear," he concluded, "we need to get organized as an industry. We need to be active on a national level in policy-making decisions that influence the green industry. We need to work as associations to increase the popularity of sports and recreations that require turf. We need to provide the very best possible turf quality per dollar and to make Americans aware of the value, the true importance, of turf. It's really not an item that should be relegated to disposable income. Whenever possible, we need to be a part of the solution to a problem and not a part of the problem."

Speaking on equipment design and use to conserve energy, Dr. Watson, vice president of The Toro Company, first touched on some product innovations. One is a solid state controller for turf irrigation: "a controller to control the central controller." Another is a low-cost method of converting to automatic irrigation. Called modulating pressure control (MPC), it was developed especially for golf courses with limited budgets, but also has application for parks, sports fields, cemeteries, other large turf areas, and agriculture.

"The heart of the MPC," Dr. Watson explained, "is a unit called a cyler that reacts to pressure changes in the main line to turn the sprinklers on and off. No electric wiring or control tubing is needed between the central controller and the sprinkler heads, and there are no satellite controllers—an obvious conservation of energy. Probably the main attraction of the MPC system is that it can be installed piecemeal over a period of months or years and financed from savings in operating and labor costs."

A design area yet to be fully exploited, according to Dr. Watson, is the use of lightweight materials. Much progress has been

made with lightweight snow removal equipment and with gears, shrouds, and appendages, but not in other components.

Another approach to energy saving is the development of slow-speed machines—mowing equipment, for example, that cuts just as efficiently with an engine operating at a much slower speed than previously available engines. “Although fuel-consumption savings in the range of 15 to 20 percent are possible with this type of engine,” Dr. Watson said, “I am sorry to say the industry is not doing very much to popularize this approach to energy saving.”

Another recent trend is toward greater use of diesel engines. “It takes fewer barrels of crude oil to provide the fuel for a diesel engine than for a gasoline engine with comparable performance,” Dr. Watson said, “and we are seeing more diesels going into turf maintenance machines, especially the larger units, such as tractors equipped with gang mowers.”

Turning to equipment use to conserve energy, Dr. Watson reviewed the five-point program he offered back in 1975, which is as valid today as it was then:

- Select the most efficient piece of equipment for each job. Generally, reel mowers are more efficient than rotary or flail mowers. Keep in mind that the number of blades in a reel not only affects the quality of cut but also the fuel consumption. A five-bladed reel uses 8 to 12 percent less power and fuel than a six-bladed reel.
 - Use diesel fuel instead of gasoline. It generally costs less than gasoline, and the diesel engine is 20 to 25 percent more efficient than the gasoline engine.
 - Allocate more funds for the purchase of higher capacity, labor-saving equipment.
- Keep equipment clean and properly adjusted so that it will require less power and, therefore, less fuel. Proper adjustment of belts, bearings, chains, and shafts can reduce friction within the machine, allowing for more power for work output. Frequent lubrication of vital parts also reduces friction. Maintain tire pressure of all machines at proper levels to reduce the rolling resistance of the machine. With reel mowers, the bed-knife adjustment is critical. Too tight an adjustment requires extra fuel or power and also causes excessive wear. No part of a machine is as critical as its engine in achieving fuel economy. Keep it properly maintained and tuned well. Also, don't overlook routine maintenance of trucks and autos.
 - Mowing practices also may save fuel. Some examples: plan mowing patterns that minimize transport between locations; use the smallest overlap consistent with the skills of the operators; select the height of cut best suited for each area; where possible, eliminate mowing of steep slopes.

In his concluding remarks, Dr. Watson stressed the importance of associating water with energy savings. “From an energy standpoint,” he said, “we can't use water without expending energy, and we do both very wastefully. We waste water, and we waste the energy it takes to put it where it is needed.

“Water is the most precious, most fragile of our natural resources, and yet in most parts of the world it is taken for granted. We must learn to conserve and to protect our water just as we must learn to conserve the energy used on our turfgrass facilities. Design of equipment to use today's energy sources is only one aspect of the very large task we have ahead of us. We must seek new sources of energy and design our equipment to accommodate their use. Most importantly, we must take advantage of our skills and our technological competence.”

CONSERVATION AND ENERGY EFFICIENCY STRATEGIES

*Forrest Cress **

Conservation and energy efficiency strategies offer the most hope for making energy available to meet America's future needs, and the turf and landscape industry should bear this in mind in all of its future planning. That's the view of Bob Minick, district administrator for Representative George E. Brown, Jr., 36th District, California. Congressman Brown is heavily involved in energy and environmental issues on Capitol Hill.

Minick, a featured speaker at the opening general session of this year's annual Turf and Landscape Institute at Anaheim, spoke on the government's role in availability and use of energy. He called for greater energy conservation by the turf and landscape industry and offered several suggestions.

One important way would be to put more emphasis on drip and underground irrigation systems in future turf and landscape planning, because energy costs related to irrigation are expected to skyrocket.

"The type of turf, trees, shrubbery, and plants you use-the watering, fertilizer, insect and disease control 'care they need-will, in all likelihood," Minick told his large audience, "be subjected to more careful consideration in the future with an eye toward conservation."

He foresees more attention being given to the use of edible decorative plants, shrubs, and trees for landscaping than has been true in the past. "In a crisis, energy use priorities for food-bearing crops are likely to be much higher on the list than decorative planting alone. Besides, many food-bearing plants are just as decorative. Use of citrus trees and date palms to landscape southern California freeways does not seem to be out of place to me. Nectar-bearing foliage almost anywhere

creates a renewable resource in a cash crop-honey." Smiling, he added that the latter suggestion was a self-serving plug. Minick keeps bees.

Turning to insect control, Minick noted that integrated pest management (IPM) in rural agriculture has been receiving more attention recently from the federal government, because it minimizes reliance on chemical pesticides. "An urban IPM program may be possible," he said, "and your industry may well lead the way in such an endeavor."

Biomass, the conversion of certain growing grasses, plants, and trees into liquid fuel, is going to get much attention from the government, according to Minick. Some plants suitable for landscaping, such as eucalyptus and sunflowers, have great potential in biomass conversion.

"In the future," he said, such crops will have value as renewable energy sources. As the price of petrochemically based fuels soars, the arithmetic will become right for such development. The time may come when the clippings and trimmings of our turf and landscape may be of enough value to justify their growth for the energy they provide-this aside from any esthetic consideration." Many trees and plants now considered to be of little value may take on an added importance as the arithmetic changes and conversion methods for turning them into usable energy improve.

"I am suggesting to you that you give added consideration to the utilitarian possibilities of your industry," Minick said. "If push comes to shove, the utilitarian aspects will give weight to the esthetic nature of your work and afford you greater priority if energy use has to be controlled because of limited availability."

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Conservation and energy efficiency strategies are efforts where return, in BTUs not needed, will be far faster than trying to generate new BTUs from undeveloped technologies, Minick maintained. "It is also the approach where the unfavorable impact on the social and environmental structures will be least," he added. "Just as important, it is the one in which the return on energy investment, in the form of conservation energy savings by individual homeowners, tenants, and businessmen, will flow most equitably through society.

"Thus, since it is fair and reasonable, and a credible case can be made for it, conservation and energy-efficient thrusts by the government may be politically more possible, while the development of new energy sources such as nuclear and coal-burning power plants may not be politically possible."

Massive increases in coal production would have tremendous adverse effects on the environment at every stage of the fuel cycle, according to Minick, and would require new capital facilities currently difficult or impossible to obtain. Synthetic fuels from coal, or large-scale oil shale production, he added, again would be environmentally destructive, place huge demands on capital, and preempt scarce water supplies.

Turning to nuclear energy, he noted that nuclear plant design and construction are plagued by huge cost overruns, lengthening delays from several causes, and an increasingly skeptical climate of public opinion about plant safety, waste disposal, and many other problems.

As for the availability and use of more exotic, benign energy technologies, Minick said he believes that the United States is not ready for a massive conversion to a non-nuclear, nonfossil, alternative energy system.

"With hindsight," he concluded, "it can be said that we have made a serious historical mistake in narrowing our energy options to where we find them now. It would be very difficult to justify narrowing them further. In our defense strategy, the public has long accepted the notion that a considerable financial investment is justified simply to preserve a set of options for the future and a flexibility in responding to varied problems. This is done even in the knowledge or hope that many of the options will never be used. Our energy strategy is thought to be as important as our military strategy, for it may turn out that our energy strategy and our military strategy are, in the final analysis, one and the same thing."

UC TURF CORNER

Victor A. Gibeault and Forrest D. Cress*

EFFECTS AND CONTROL OF THATCH IN COMMON KENTUCKY BLUEGRASS

A comprehensive study of various ways to prevent thatch accumulation in common Kentucky bluegrass and of the relationship between thatch accumulation, turf quality, and leaf spot damage was conducted recently by U.S. Department of Agriculture researchers at Beltsville, Maryland.

This study consisted of three sets of treatments: (1) mower clippings removed versus not removed; (2) lime applied as needed to maintain a soil pH 7, lime applied at 4.8 to 7.3 kg/are biannually, and no lime (soil

pH 5.4); (3) sub subplots that were aerified by coring, handraked, verticut, treated with a wetting agent, supplemented with Milorganite, or left untreated.

Thatch accumulation was only significant during the last 3 years of the 8-year study.

Clipping residue left on plots significantly contributed to thatch accumulation when all treatments were averaged and after thatch had built up to approximately 1.25 cm in depth. Residue from clippings didn't increase thatch

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on aerified turf or turf receiving the wetting agent. Maintenance of soil pH of 6.8 and biannual lime applications effectively reduced thatch accumulation over that of untreated soil. Biannual lime applications didn't increase decomposition beyond that of liming as needed to maintain a favorable soil pH. Aerification resulted in the least amount of thatch followed by the verticut and handraked treatments. The wetting agent didn't effectively reduce thatch, and the addition of Milorganite significantly increased thatch production.

The highest quality turf was produced by permitting clippings to remain on the turf, maintaining a favorable soil pH, and aerification. Clippings increased turf quality during temperature and moisture stress periods. Leaf spot damage was reduced by aerification, applying the wetting agent, and removing clippings. No significant difference existed in thatch level among the check, aerified, handraked, verticut, and wetting-agent plots 14 months after the treatments were discontinued.

The USDA researchers who conducted the study had this to say about factors that in-

fluence the rate of thatch buildup:

"The frequency of thatch control practices should be based on regular examinations of the thatch-soil profile to determine the amount of thatch present rather than on a set schedule as in the experiment reported here. Analysis of the thatch-soil profile of certain treatments or combinations of treatments in this experiment showed that applications twice a year were not necessary to maintain an acceptable thatch level. Aerification once a year without lime applications or removal of clippings, or less than once a year with lime and removal of clippings, probably could have prevented excessive thatch development. Vertical mowed and handraked treatments in combination with lime applications, with either clipping treatment, once a year probably could have prevented a thatch problem from developing."

("Effect of Management Practices on Thatch Accumulation, Turf Quality, and Leaf Spot Damage in Common Kentucky Bluegrass," by J. J. Murray and F. V. Juska, *Agronomy Journal*, Vol. 69, No. 3, May-June 1977.)

EFFECT OF NITROGEN FERTILIZATION ON ANNUAL BLUEGRASS IN BENTGRASS

Don't overlook the impact of nitrogen fertilization on the quantity of annual bluegrass (*Poa annua*) in bentgrass turf, cautions a Rutgers University turfgrass expert.

Some of the important considerations to keep in mind, he suggests, are:

- An increase in the use of nitrogen will result in more annual bluegrass.
- To control annual bluegrass encroachment, it's better to apply smaller amounts of nitrogen per single application to bentgrass than to use the amounts commonly applied to other types of turf.
- Nitrogen applications should be stopped or reduced when there is grave risk of serious turf loss from heat, cold, disease, or moisture extremes.

. Nitrogen fertilization should be limited to the amount required to maintain satisfactory turf.

To the extent possible, nitrogen should be applied only during seasons when annual bluegrass encroachment potential is minimal.

Of course, he notes, factors other than annual bluegrass encroachment must be considered in a turfgrass manager's nitrogen fertilization program for bentgrass. Recovery from traffic and enough upright freshly cut leaf blades for good putting are necessities. Also, the turf must be reasonably attractive and free from grass failures.

("Nitrogen Fertilization for Minimal Encouragement of Annual Bluegrass," by R. E. Engel, *Rutgers Turfgrass Proceedings*, 1977, Vol. 8, July 1977.)

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