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THE SAND FOOTBALL FIELD

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Maintenance of our highly used football fields has become a major headache since few of the fields can provide a satisfactory playing surface throughout the football season. The heavy traffic thins the turf and when the rains come, the game is often played in the mud. The non-turfed soil in the center of the field becomes densely compacted. Knotweed, *Poa annua* and other weeds invade this bare area and further complicate the problems. These problems have led many turf managers, school officials, and coaches to give up and go the route of artificial turf. While artificial turfgrass offers a partial solution, it is expensive and in many cases does not give a completely satisfactory football field.

Now there is a feasible alternative to both artificial turf and the typically unsatisfactory clay or loam soil football fields. The alternative is a sand field. A primary advantage to sand fields is that they are not muddy when wet because they contain little clay and silt. In addition sands will drain rapidly when compacted, can grow an excellent turf sod with proper nutrition and are easy to repair which is ‘essential for the proper execution of football and soccer.

These qualities have been proven by a number of sand fields, which have now been successfully used and maintained for several years.

Type of Sand Used Key to a Sand Field

Sands vary considerably and, typically, there is a great deal of misunderstanding about the different types. Some sands are droughty; some can compact into hard surfaces; and some may lack good stability. This variation is due to the fact that the sand particles can range in size from 0.1 to 2 millimeters (mm), and any individual sand may consist of particle sizes widely distributed through this range.

Economics has pretty well dictated that the depth of any imported sand, top soil, or special mix must be limited due to cost. The soil physics and drainage characteristics of any shallow soil layer further influence selection. These considerations limit the choice of sands to those that have a narrow range of uniform, relatively fine particles. Many such sands are found in natural deposits along the Pacific Coast, although the deposits are not restricted to this area.

A great deal of research has gone into finding out which of the various types of sands and sand mixes work well for golf and bowling greens. This information is also useful for selecting sands to construct suitable football fields. (See suggested references)

Physical Characteristics Needed in a Sand

Both laboratory tests and field experience have shown that the most satisfactory sands are those in which the particles are fairly uniform in size. Ideally, these sands should also have a relatively small percentage of particles small than 0.1 mm or greater than 1 mm. (See table 1.)

TABLE 1 TEXTURAL CLASSIFICATION FOR HIGH TRAFFIC TURFGRASS FIELDS

U.S.D.A. Discipline Name	Particle Size mm	U.S.D.A. Standard Sieve Number	% Range of Suitable Sends
GRAVEL	4.00	5	O-10%
FINE GRAVEL	4.00-2.00	10	
VERY COARSE SAND	2.00-1.00	18	
COARSE SAND	1.00-0.50	35	
MEDIUM SAND	0.50-0.25	60	60% 85-95%
FINE SAND	0.25-0.10	140	
VERY FINE SAND	0.10-0.05	270	
SILT	0.05-0.002	-	2-8%
CLAY	0.002 -		

An excellent sand for high traffic conditions is one that has 60 percent or more of the particles in the medium size range, with a total of 85 to 95 percent of the particles falling between coarse (0.5 mm to 1.0 mm) and fine (0.25 mm to 0.1 mm). If the coarse fractions predominate or equal the medium fractions, the sand tends to be more droughtly and less stable. A sand that is too high in the fine fractions has slower drainage characteristics, and the addition of a small amount of clay and silt could seal the surface pores, thus restricting water infiltration. When a sand has an equal distribution of coarse, medium, and fine particles, the result is a harder surface with reduced drainage characteristics. This is why the key fraction is a sand that has particles in the medium size range (0.25 mm to 0.5mm).

If the particles vary only slightly in size, sands retain a high percentage of uniform pore spaces. When subjected to compaction, these sands do not greatly change in density or pore size. If the sand particles are relatively small, the individual pores are also small, resulting in a sand that has a fairly good water-holding capacity. Move-

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ment of water into and excess water through these sands can be relatively rapid. Therefore, a sand carefully selected for a football field would settle into a stable compacted state, have good drainage characteristics, yet hold sufficient moisture for plant growth. And these physical characteristics would not change under high traffic. Even at the outer limit of the acceptable range this will still produce a mud free playing surface.

No Need to Crown a Sand Football Field

Fields constructed of clays, loams, or artificial turf depend on surface drainage to remove water that cannot move rapidly into the surface and through the soil profile. This is why football fields usually have 12 to 24 inch crowns. A crown is not required and has only become a standard procedure in football field constructlon to help remove excess surface water. However, a sand football field, if well constructed and correctly maintained, accepts (infiltration) and moves water through it profile (hydraulic conductivity) faster than any irrigation system or heavy rain can apply it. This is particularly beneficial when the field is also used for other sports, since crowning may then be undesirable. Surface catch basins at the edges of the field can also be eliminated as a sand field does not rely on surface drainage.

Removal of Excess Water

It is not uncommon for a false water table to develop at the interface of the sand layer and the parent soil base. A false water table can occur even if the right sand is used and is correctly placed 12 to 18 inches deep on the parent soil. This is because few parent soils (clays, clay loams, or loams) can accommodate water at a rate greater than 0.25 inch per hour and, when compacted, infiltration rates often drop to 0.01 to 0.1 inch per hour. Therefore. excess water moving through the surface of a sand field accumulates at the interface between the sand and the parent soil.

Some type of tile drainage system is usually necessary to remove this accumulated water. The only exception may be when rainfall or irrigation is not excessive and the parent soil has relatively good drainage characteristics. (Since the parent soil is not subject to surface compaction, its drainage characteristics should not change.) However, a tile drainage system can be expensive and providing the parent soil is not impervious, the omission of a tile system would be less serious than many of the other compromises commonly made.

Spacing of Tile Lines Can Be Critical

A false water table that develops at the interface of the sand layer and the parent soil is close to the surface of the playing field. The importance of rapidly removing excess water created by a false water table governs the distance between tile lines. The maximum spacing between tiles can be as much as 30 feet although this may be too far apart during prolonged rainy weather. Between tiles the water table will rise above the water table at the tiles for a period of time due to the slower movement of water laterally along the interface. However, if the sand depth of the field is 12 to 18 inches, there is no need to space tiles less than 10 feet apart.

Design of a Tile System

There are several approaches to laying out a tile system. Trenches are usually cut in the parent soil to the depth and width needed to accept the tile, which is surrounded by gravel or a sized rock. It is important that no soil cover the tile line and that no trenches be deeper than necessary. Loose soil trenched from ditches should be removed from the site so as to avoid contaminating the tile system. The lines should have a fall of 1 percent and should empty into a storm drain, drainage ditch, or other facility.

In some instances a 4 to 6 inch blanket of gravel and/or coarse sand between the sand and the parent soil has been used. The added expense of these complete gravel blankets are questionable since field experience has not proved that they improve the drainage characteristics of the surface sand. The cost of 200 to 1,000 cubic yards of gravel or sized rock should be well documented before such an expense is added to a football field installation.

Other Approaches to Design of a Tile System

It would be good to consider using a single trench to install both the irrigation system and the tile lines. These systems are often designed and installed separately when it would be more advantageous to combine them. If correctly engineered, closer spacing of the sprinkler system or wider spacing of the tile system could effect a saving in installation cost. with no loss in efficiency.

Still another approach is to grade the parent soil so that three sloping channels run the length of the field. Excess water draining from the sand would then move laterally through the sand at the interface of the parent soil, flowing down a 2 percent slope to gravel encased tile lines. This type of system reduces the amount of trenching necessary for both the tile and the irrigation systems. Since the maximum depth of the sand in the surface layer governs the internal drainage characteristics of the sand, the total volume of sand used does not need to be increased.

Design of the Irrigation System

It is essential to supply adequate moisture to every part of a sand football field. There is minimal lateral movement and no surface spreading out of water when applied to a sand. For this reason, the rule should be 100 percent overlapping of the sprinkler system, with sprinkler heads space 30 to 60 feet apart. Half heads around the outside edge of the field should be clocked separately since they discharge twice as much water as a full circle head. The system should also be designed so that the critical center of the field can be irrigated separately. Many new football fields are also combined with areas for track and field events. If this is the situation, special controls or spacing of sprinkler heads should be used so that water can be applied where and when needed.

There can be no compromise when it comes to an irrigation system for a sand football field. Precipitation rates can be higher for a sand than for a soil field because infiltration rates usually exceed 2 inches per hour and may go as high as 30 inches per hours but coverage is essential.

Amending the Sand

Many of these uniform, relatively fine sands have been tested on golf greens, park sites, and football fields. No organic or inorganic amendments were used in these tests. However, if frequency of light irrigation during the germination period is difficult to manage, a light surface application of organic matter worked into the surface 2 to 3 inches of sand could be used. The type of sands recommended are not drouthy if properly selected, installed and managed. During periods of high evapotranspiration (0.25 to .30 inches per day) every other day irrigation may be necessary. The added expenses of physical amendments plus their mixing problem and cost can therefore be avoided.

Careful Fertilization Is Essential

Turfgrass nutrition studies have been run on sands collected from various sections of California. In these tests nitrogen, phosphorus, and sulfur were always found to be deficient. Most of these sand deposits were found to contain fragments of primary minerals, such as feldspar and mica, which release other nutrients to the plants. Few of our sand sources were pure quartz.

Single superphosphate (0-20-O) can be used to add a relatively large amount of phosphorus and sulfur to the soil. This material is particularly good because it does not leach rapidly from the sand or injure the plants. A rate of 20 pounds per 1,000 square feet or 800 pounds per acre of single superphosphate supplies about 4 pounds of phosphate P_2O_5) and sulfur (S) per 1,000 square feet to the sand. This is enough to last for several years, particularly if the clipping are returned to the sand.

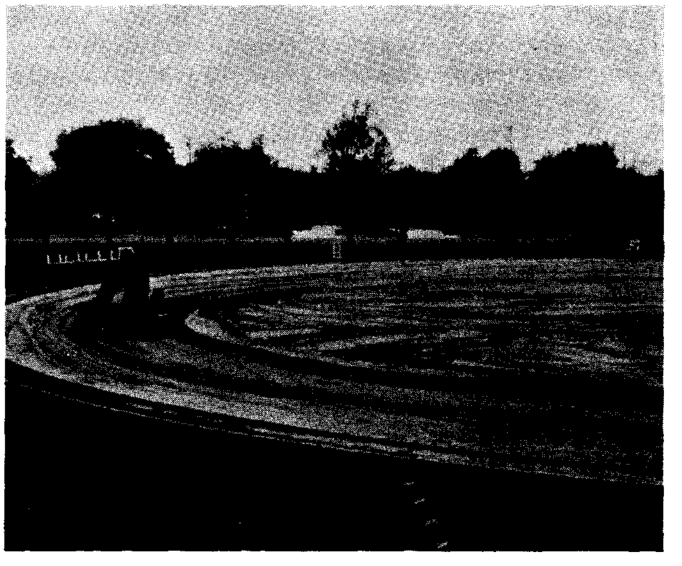
Nitrogen presents a problem because most forms of nitrogen are soluble in water and are soon leached from sands. Water soluble forms of nitrogen include the nitrates, ammoniacals, and ureas, as well as most nitrogen mixes or blends. To be effective, low rates of these types of fertilizers must be applied frequently. It has been found that once the turfgrass is established, an application of 1/2 pound of nitrogen each month or 1 pound of nitrogen every other month produces a very satisfactory, cool-season turfgrass sod. More frequent or higher rates are required during the summer to maintain the warm-season grasses. While a new turf is becoming established, nitrogen levels must be maintained at a high level to ensure proper growth.

Several sources of slow-release nitrogen are available and have also produced a good, healthy sod. These materials can be applied at much higher rates and will supply nitrogen for several months. Urea formaldehyde, IBDU (isobutylidene diurea), and plastic-coated nitrogen fertilizers are slow-release nitrogen sources. These materials can be applied at rates as high as 9 pounds of actual nitrogen per 1,000 square feet without injury to the grass. Applications of 6 to 9 pounds of nitrogen per 1,000 square feet, using urea formaldehyde or IBDU, have sup plied newly seeded grass with adequate nitrogen for at least 4 months. A similar application of plastic coated nitrogen fertilizer provided nitrogen for as long as 11 months.

Potassium should not be overlooked even though many sands did not show a deficiency. Starter application of 5 lbs. of K_2O per 1000 sq. ft. or 200 pounds per acre are recommended. Potassium can be easily leached from some sands so frequent application may be necessary.

Establishment and Management of the Sand Field

Grading the sand football field takes greater care and skill than the typical soil field. If the parent or base soil is firm enough to support loaded trucks, the sand can be partly spread as it is dumped from the truck. If not, the sand can be dumped from the sides and spread with a blade on a small tractor. In either case, considerable work will be required with the blade to move the sand in place and smooth it. Frequent watering will settle the sand and make it more workable. Loaded trucks should not run over unprotected tile and irrigation lines. Most of this traffic can be kept between these lines.



Rough grading of sand completed with road grader. Sand placed 14 inches inside the quarter mile track.

Select seed that grows well in your climatic zone and that can withstand heavy traffic. Spread the seed in two directions to ensure good coverage. Firm the seed into the sand with a ring roller or cultipacker.

The single superphosphate, potassium, and the nitrogen fertilizer can be distributed over the surface of the sand after it has been smoother and settled.

Water frequently enough to keep the surface moist but not saturated. Once the plants germinate, less frequent irrigations are required.

Water and nitrogen management is the key to a successful establishment. Supply what is needed when it is needed. Don't rely on the irrigation controller clock, the calendar or a cookbook recipe for water and nutrition.

The sand football field answers many of the serious problems encountered on high use football and soccer fields. Overuse of a field still removes turf, but, even in the rain, good footing and playability of the field prevail. Overseeding, fertilization, topdressing, mowing, and other management practices can be done at the convenience of the turf manager. There is no need to wait several days to several weeks for the field to dry out enough to practice a sound management program.

SUGGESTED REFERENCES

1. Davis, W. B., J. L. Paul, J. H. Madison. L. Y. George. "A Guide to Evaluating Sands and Amendments Used for High Trafficked Turfgrass," AXT nll3. Agricultnral Extension Service, University of California 1970.
2. Davis, W. B., Sands And Their Place on the Golf Course. California Turfgrass Culture 23(3) : 17-24. 1973.
3. Davis, W. B. "Examples of Real Solutions-The Fine Sand Green," California Turfgrass Culture 23(3) :20-24. 1973.
4. Madison, J. H. "Sand Used in Soil Mixes," California Turfgrass Culture 19(1):2-3. 1969.
5. Gowans, K. D., E. J. Johnson. "Nitrogen Source in Relation to Turfgrass Establishment in Sand." California Turfgrass Culture 23(2):9-12. 1973.

AN ALTERNATIVE METHOD OF GREENS MANAGEMENT
Part II

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We consider that our program to date is a success. These are the results we have seen:

WEEDS

Weeds have almost disappeared from the green though they are abundant around the green, though wind blows in seed, and though *Poa annua* was present and seeding when the program was started, When we have injury that destroys grass, weeds come in at once, but they are soon crowded out. We do not know how much of our bentgrass seed is germinating or whether any of it is becoming established.

DISEASE

In the summer we get *Pythium* on the apron around the experimental area, but it hasn't become serious on the green. Before beginning the program we had *Fusarium* patch in the winter. *Fusarium* patch occurred in shaded areas in proportion to the amount of shade. The first winter after treatments began there was no *Fusarium* patch. In the late fall of the second year we added extra applications of N to produce a cosmetic green for a special open hourse. *Fusarium* patch appeared a month later, again following the patterns of shade. There was some significant reduction of disease in the treatments where a fungicide had been added to the topdressing. At this time we haven't the data to draw conclusions about the effect of frequent topdressing on disease.

INSECTS

Caterpillars are a problem but they are readily controlled with insecticides in the topdressing. Without thatch to burrow in during the day the caterpillars are more vulnerable to birds, and birds can mar the green with their beaks while pecking out caterpillars.

FREQUENCY

The three to four week interval appears appropriate for "Penncross" at Davis during the growing season. Three weeks is adapted to our N program, and to go four weeks we would want to use a longer lasting N source. From November to February growth is slow and there is little growth of stolons so there is no need for topdressing. We continue to fertilize but at less frequent intervals. In different areas of the country it is likely that the program would have to be adjust to make the total application of sand proportionate to the total growth. Also, if more or less N is used, then more or less sand would be needed to just keep the thatch covered. Seaside may require less sand than our "Penncross" bentgrass.

THATCH AND GRADE

When topdressing is properly done, grains of sand just separate the organic residues and no thatch layer forms. Air and water movement continues unimpeded through the sand channels. There is build-up of uniform sand and organic matter without layers.

Change in grade is not a problem. Of 20 applications per year that we schedule, we actually use topdressing only 14 times. Because of lack of stolon growth during winter, we apply only the seed and chemicals. When growth is slow we have cut our application of sand to 1 1/2 feet per 1,000 feet^2 of green. Our build-up is only slightly over 1/2" per year. This is hardly more than the annual build-up of thatch and sand under a usual program in this area. In northern tier states, 6 to 8 applications of sand per year may be sufficient to keep up with stolon growth, and grade changes are even less. Grade changes occur

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regularly and are neither noticed nor commented on. When cutting a cup in a California green that has been down for 30 years, one no longer cuts down to parent material, but I have never heard this change commented on.

FERTILITY

Our program is set down below. It provides a good level of nitrogen without the excess that gives a high cosmetic green color, but invites trouble. Less nitrogen might be desirable on Seaside bentgrass, and less would be wanted in areas of high overcast. The program contains most minerals that would be needed, and it should be reduced to allow for minerals that are supplied by irrigation water and soil. We don't wish to have excess salt in our drainage waters. Some California sands contain sufficient potassium to meet most of the needs; a few have adequate phosphorous. Irrigation water may contain adequate amounts of calcium and magnesium. As we had large amounts of iron in the sand and appreciable iron in the Milorganite, applications of iron chelate in the topdressing were probably unnecessary. We still get a favorable response from foliar applications of iron sulfate, but that is usual. We included zinc as there is evidence of occasional need in California. It is probable that a need could be as well met by use of zinc sulfate as by the more expensive chelate.

Material	per 1000 ft^2	per $100m^2$
Stand-1.Omm to +O.O5mm (-#18 + #200 screen)	3cuft	90 liters
*Nitrogen source to provide N	3/4 lb	350 grams
K_2SO_4	5-6 oz.	150-175g
Dolomitic lime on acid soils	2 oz	75-1OOg
or		
above pH 6.5, gypsum	23 oz	50-75g
plus Epsom salts	1½ oz	45g
Zinc chelate (or mixed minor element chelates)		10-15g
Iron chelate		10-15g
*Phosphorus source to provide P	1-1½ oz	30-40g
Bentgrass seed	½ oz	10-15g

*In In our study the N and P were provided by:

Ammonium sulfate	210g
Ammonium nitrate	500g
Milorganite	220g

Fungicides and insecticides were used from the following list at the rates given for 1000 ft^2:

Thiram	85g
Dexon	110g
Daconi l 2787	56g
Captan W50	85g
Diazinon W50	56g
Sevin 10%	570g

MIXING

Mixing was done in a cement mixer. The sand was damp enough to prevent segragation of -materials. Pesticides were added last with the operator wearing a dust mask and gloves. Once the pesticides are mixed with the sand, there is a problem of safety in handling and disposal of the topdressing material.

SPREADING

The need is to apply a light, even application. One commercial topdressing machine uses a vibratory action. This will spread both damp and wet sand at a low rate, but the damp sand spreads only if the machine is run fast to get intense vibration. This machine also tends to cause segregation. We have had fertilizer rise from the mix and then go on last at a heavy rate that caused burning. We have not yet used the belt type of topdressing machine. One fertilizer spreader, made by Gandy, has a special agitator so it can spread damp sand.

Evenness of application may depend on the moisture level of the topdressing. At some moisture levels with some sands, one may have only to turn on the irrigation to wash the sand down. Under other conditions brooming the sand may be needed to even out the application.

INFILTRATION

When topdressing is started on a soil with low infiltration, infiltration remains low. If infiltration rates are high, they will drop to the rate sustained by the topdressing sand.

WHAT DOES THE SYSTEM OFFER ME?

The system presented here produces a healthy, vigorous turf of excellent golfing quality. Joe Carlson, golf coach at UCD, says: "I get excited when we are going to play Franklin Canyon, or Davis Muni. I know exactly how my ball is going to behave on those greens. I have complete control, and the action of the ball is completely predictable whether I am pitching to the green or putting." These are courses that are using a fine sand topdressing with greater frequency in an effort to go in the direction we are suggesting.

The reason for the excellent control is that there is no thatch layer and the surface is firm and true.

We believe our system of frequent topdressing offers a desirable method for Poa annua control. Crowding the Poa with vigorous bentgrass, burying the seed of Poa, and ceasing to prepare a seed bed provides control that is more desirable than any use of herbicides we know of. Herbicides we have tested are all damaging to bentgrass in some way or another.

Elimination of coring removes an operation that requires an expensive machine, quite a bit of labor, and some upset to the golfer. Verticutting may also be eliminated.

As a uniform soil profile is built up, depth of rooting tends to increase and sudden water stress is less common. Of course, water stress can always occur when a dry breeze rises on a sunny day.

Compaction is no longer a problem. The sand used has good infiltration rates and reasonable aeration characteristics even when densely compacted.

DISADVANTAGES

First, a new method of operation involves change. If you have a good operation that goes like clockwork and there are no serious problems on the greens, there is no reason to change just for the sake of change.

Second, it may be troublesome finding the right sand, learning how to mix it, learning how to spread it, providing storage for it, and otherwise working it into your program.

Third, a firmer green with no thatch may feel strange to the duffers and they may not know how to play it at first. Result-complaints (but also compliments from the golfers).

Fourth, there are no sudden spectacular results from all of the effort you have to put in getting this program started. Within several months the green should firm up. Within a year there should be a noticeable decrease in the amount of *Poa annua*, but it is apt to be two years or more before enough new soil is built up so the benefits of a deeper root system are noticed. If you are looking for spectacular results, you may be disappointed. This is a long-term system of management.

HOW DO I GET STARTED?

Management using a system of frequent topdressing will require making new judgments. One should become familiar with the operation before applying it extensively, and we suggest initial experience on the practice putting green. To be thoroughly fair, the initial test should leave half or at least a third of the practice green under the regular management so both you and the course members can feel the difference underfoot and watch the difference in the way the ball rolls.

The first step is to locate a suitable sand source. Without the right sand, the authors do not recommend the program. One superintendent has solved this problem by using sand from a deposit on his course. He has a local sand company wash it and screen out fines that pass through a #100 screen. He then screens off the +18 material himself and ends up with an excellent sand.

We suggest that the second step is to begin applying the light sand topdressing every 3-4 weeks during the growing season. Finding the techniques and equipment that will permit you to apply in the neighborhood of 1/32 of an inch of sand and not more than 1/16th of an inch. These techniques should allow you to apply either dry or damp sand. If the sand must be dry to go through your equipment, you will have to find storage space to spread out and dry sand, and this is seldom ecnomically practical.

The first application or two of sand should go on with a heavy coring treatment to cultivate the interface and create a transition zone into the present profile. By the time you have 3 or 4 applications of sand down, you should be able to make some initial evaluations of playability. As you get experience and can make an even application at the low rate, you can then add seed and fertilizer to the topdressing.

Once seed and fertilizer is in the sand, the mixture should be used. Seed will probably deteriorate rapidly in storage and there can well be ammonia loss from mixed fertilizer if the sand is at all damp. We have not tested these. Begin using seed in the topdressing at least a month before the season for Poa ***annua*** germination. Then when Poa germinates, bent is already filling in the thin areas. During the next six months you should have some idea of the possibilities for Pou control. After the initial cultivation of the interface you must, of course, not use a coring machine on the test area, and disease and insects should not be allowed to open up bare areas.

You are now essentially in operation and at any time can make a decision, to add pesticides in the topdressing. If your physical plant allows an economical mixing opera. tion, then a single periodic topdressing with all chemicals in the topdressing will give you a simple, economical operation. If mixing involves hauling and shuffling, and moving, and loading and unloading, and storing, and reloading, etc., then it may be more economical to just add a monthly topdressing as one more operation on top of the fertilizing and spraying.

Once a couple of inches of topdressing and thatch mixture has been built up, you can begin to test your experimental area with a little water stress. You may find you can go an added day between irrigations or that you can economize with a light sprinkle on one day, with regular irrigation on the alternate day.

Once in operation you should find a program of light, frequent topdressing 15-20 times a year requires no more effort than the present major campaign which is mounted 2 or 3 times a year and which involves several man crews engaged in the coring, sanding, dragging, vertical mowing, and mower sharpening, and involves you in answering complaints, and in struggling with Pou. A program of frequent, light topdressing seems to us a simple way to have championship greens where a controlled shot is still under control after it hits the green.

REFERENCES CIT'ED

1. Madison, John H., J. L. Paul and W. B. Davis. "An alternative method of greens management." Proceedings of the second international turfgrass conference. Madison Wise. (press).
2. ———, ———, ———, 1974. "Consider a new management program for greens." U.S.G.A. Green Section Record: 12(3), 1974.
3. Bell, R. S. and .J A. DeFrance, 1944. "Influence of fertilizers on the accumulation of roots from closely clipped bentgrasses and on the quality of turf," Soil Science 58:17-24.

UC TURF CORNER

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This "corner" is a new addition California Turfgrass Culture. It will contain summaries of recently reported research results, occasional abstracts of conference presentations, and announcements of new publications relating to turf management. The source of each summary will be given for further reference.

ANNUAL BLUEGRASS CUTTING HEIGHT

Annual bluegrass likes a cutting height of one inch. That's the best cutting height for shoot development of this unwanted grass when grown by itself or with Kentucky bluegress, according to results of Michigan State University research.

Cutting heights of 1/2, 1, 1 1/2, 2 and 2 1//2 inches were used in the study.

Cutting height had a noticeable effect on the tillering and shoot dry weights of individual bluegrass plants grown in a Merion Kentucky bluegrass sod. Shoot dry weight was highest for the annual bluegrass at the l-inch cutting height and lowest at the 1/2-inch cut. More tillering of annual bluegrass plants grown with the Kentucky bluegrass occurred at the l-inch cutting height. Also, there were more annual bluegrass shoots per square inch at the l-inch cut than at the other heights.

These results reflect the influence mowing height can have on plant competition: mow at a height that helps the desired turfgrass species, not one that gives an advantage to an unwanted species such as annual bluegrass.

("Cutting Height Effects on the Competitive Ability of Annual Bluegrass *(Poa annua L.)* " Agronomy Journal, Vol. 65, May-June 1973, by J. E. Bogart and J. B. Beard.)

FUSARIUM BLIGHT

Watch out for Fusarium blight during hot summer months. It has increased in frequency of occurrence, severity and distribution during the past couple of years and today is one of the most damaging diseases of Kentucky bluegrass in California.

The disease occurs primarily as a very severe foot rot and secondarily as a foliage blight in California. The easiest way to check for the disease is to remove healthy tiller and dead leaves and examine the crown or basal area of the dead stems. In advanced stages, the affected crown and some of the root attached directly to the crown appear dark brown or black. The diseased crown is very hard and tough.

Fusarium blight first appears in bluegrass turf as a small, roughly circular area. All plants within the circle usually show the foot-rot stage of the disease. The disease generally shows up as soon as the weather turns hot. It occurs most commonly in areas that have been stressed for moisture and areas exposed for long periods to direct sunlight.

Proper management of Kentucky bluegrass is probably the best and most feasible approach to control of Fusarium blight, according to University of California researchers. They recommend adequate but not excessive fertilization, proper irrigation, mowing at 11/2 to 2% inches, aerifying when needed to prevent localized dry spots, and control of excessive thatch by vertical mowing.

The disease has been partially controlled in the Midwest and in California with bi-monthly applications of the systemic fungicide benomyl at the rate of two ounces of 50% W.P. per 10 gallons of water applied to 1000 square feet of turf. Preliminary information indicates that application of the fungicide should probably begin in late April.

Field observation, according to the UC researchers, suggest that Kentucky bluegrass varieties differ in their resistance to Fusarium blight. Tentative ratings based on these observations are: very susceptible, Park and Campus varieties; moderately susceptible, Common, Windsor, Merion, Baron and Newport varieties; least susceptible, Cougar, Fylking, Nugget, Pennstar, Prato and Victa varieties. Further research is under way to verify these ratings and to find additional sources of resistance,

("Fusarium Blight, A Destructive Disease of Kentucky Bluegrass, and its Control," *California Turfgrass Culture,* Vol. 23, No. I, Winter 1973, By R. M. Endo, R. Baldwin, S. Cockerham, P. F. Colbaugh, A. H. McCain and V. A. Gibeault.)

FLOODING INJURY

Flooding remains a major problem of turfgrass culture across the country since it has been common practice to locate parks, golf courses, and recreational areas in lowland, flood plains adjacent to rivers. The three main types of damage caused by flooding are: (1) soil erosion, (2) soil, salt and debris deposition, and (3) turfgrass injury from submersion.

*Extension Environmental Horticulturist, U.C. Riverside; Extension Communicator, U.C. Riverside, respectively.

Turf may be damaged directly if flood waters remain on it too long. The causes of this injury are complex, involving soil oxygen depletion and buildups of various toxic compounds. Turfgrass injury becomes more likely as depth and duration of submersion, water temperature and light intensity increace. Dr. J. B. Beard of Michigan State University ranks 11 turfgrasses as follows for their submersion tolerance:

Submersion Tolerance	Turfgrass Species
Excellent	Bermudagress Creeping bentgrass
Good	Timothy Rough bluegrass
Medium	Meadow fescue Kentucky bluegrass
Fair	Crested wheatgrass Annual bluegrass Perennial ryegrass
Poor	Red Fescue Chewings fescue

("Flooding Effects and Submergence Tolerance of Turfgrasses," by J. B. Beard, 13th Illinois Turfgrass Conference,No V. 30-Dec. 1, 1972 conducted by Cooperative Extension Service, College of Agriculture, University of Illinois at Urbana-Champaign.)

PEOPLE NEED CONTACT WITH PLANTS

One reason for the flight to the suburbs and the dramatic increase in wilderness recreation use is man's basic desire for contact with vegetation, according to Seymour M. Gold, urban planner at UC Davis. He spoke on the social aspects of plants in our environment at the recent 1974 Southern California Turf and Landscape Institute held in Anaheim. Research by behavioral scientists, he says, indicates that the current popularity of indoor and outdoor gardening is a result of this same frustrated desire as well as an attempt to modify the sterility and ugliness of most cities. Gold notes, "We have too long thought of building parks in cities instead of cities in parks, considered landscape planting as amenities instead of essentials and have weighed the values of plants in terms of economic costs instead of social benefits. Traditionally, we have emphasized the production and maintenance of plants rather than the attitudes of people toward plants and the impact plants can have on people in cities."

He believes use of plants in cities to satisfy human needs could result in several social benefits: (1) less need to escape from cities just to enjoy plants and green landscapes at a time when our society faces the prospect of prolonged fuel rationing or shortages; (2) better use of existing local parks which are often sterile because they lack adequate landscaping; (3) possible reduction of urban crime and violence because of the observed potential of plants to reduce levels of environmental stress; (4) more stable property values and less change in neighborhood populations because of the type and quality of landscape plantings.

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