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LANDSCAPING FOR FIRE PROTECTION

*Forrest Cress**

Current and impending water shortages greatly magnify the fire threat posed annually to landscaped property throughout California. University of California research has shown that much can be done horticulturally to minimize this hazard.

The following information and discussion have been taken from the texts of three publications that summarize findings from UC research into landscaping for fire prevention and flood or mud-slide control: "Landscaping to Protect Homes from Wildfires," by V. B. Youngner, California Turfgrass Culture, Vol. 20, No. 4, 1970; Fire Protection in the Bay Area, by W. D. Hamilton and K. D. Gowans, Cooperative Extension in Alameda County, University of California (OPA 25) ; Landscaping for Fire Protection, by R. G. Maire, University of California Division of Agricultural Sciences Leaflet 2401, revised January 1976.

Any plant will burn if there is enough heat and other conditions are right, so keep in mind that the term "fire-resistant" can be misleading when used to describe vegetation.

It can be costly to live safely in California, especially in or adjacent to fire-prone hills. Chaparral control can be a major expense. Hillsides, whether landscaped with native shrubs or with other ornamentals, requires maintenance that usually includes irrigation, since few ornamentals or large trees can survive on our normal rainfall. However, you can select minimum-maintenance plants that have both low fire hazard potential and drought-tolerant characteristics for areas where erosion control is necessary and/or an aesthetic effect is desired.

The fire risk is high in unwatered landscapes except where succulent ground covers and groves of certain cleanly maintained trees grow. However, many native California plants that normally do not create fire hazards and which retain water during periods of drought can be used safely in the unwatered landscape. These include yuccas, cacti, and similar succulent natives.

Remember that the more a plant grows, the more potential fuel it produces and the greater the fire hazard it will pose. A green and vigorously growing plant has a low fire hazard potential. However, if its soil becomes dry, the plant will be able to take up less water and its moisture content will diminish. The lower its moisture content, the higher the likelihood of its burning. This is true for native plants as well as for ornamentals purchased from a nursery. Therefore, one or two irrigations in midsummer may make the difference between having an extremely flammable plant and one which will not burn readily. Hot, dry winds can make shrubs tinder dry in but a few hours-even after an irrigation.

To reduce fire hazard

A high-pressure sprinkler system can greatly increase the fire prevention effectiveness of plantings. Because it takes time for water to move through soil into the roots and up the leaves of plants, keep leaves turgid with an on-going irrigation program.

Keep bare land around all structures, or, as an alternative, plant lawns, succulent ground covers, or other low-growing plants. Select plant species that don't support fire readily. Many California native plants may not be usable because they are susceptible to root rotting if irrigated during the summer. Other plants should be watered regularly, especially during times of low humidity and easterly winds (commonly September through December) .

Remove accumulated dry, dead litter under trees and shrubs. (However, leaving a thin mat of litter will prevent dust from becoming a nuisance and will provide some control of sheet erosion.)

Plant trees and shrubs at least 6 feet away from all buildings for proper air circulation and shading of their walls during summer months. Also, this will make it easier to maintain the buildings, will allow plants to grow in their natural form, and will reduce pest control problems.

Leave a wide space between clumps of trees and shrubs to minimize the possibility of a fire spreading over a large area. Maintain a distinct break between low-growing plants and high-growing plants in order to prevent ground fire from reaching tree tops.

Use low-growing plants in high-hazard areas such as canyons, locales surrounded by forests, and those upwind from buildings.

Plant and maintain "heat shields" or "screens." (Thick, well-watered hedges planted at least 20 feet distant from buildings were effective in protecting them from flames during the 1970 Oakland hills fire.)

Use asphalt shingles or a roof of asphalt and rock for all buildings.

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Plants for irrigated landscapes

Studies following recent major fires have shown that plants on well-watered and well-maintained landscapes did not burn as readily as dry plantings. Tall trees often formed a barrier that prevented flying material from reaching buildings. Irrigated ground covers such as ivy 01 iceplant usually did not carry fire. Sprinkler systems that could be operated at critical periods enhanced the effectiveness of the plant protection.

Many ground covers, shrubs, and trees can be used effectively in irrigated landscaping for fire prevention. However, be cautious in the placement of coniferous evergreens such as Monterey pine and some resinous plants which can create fire hazards unless maintained and controlled properly.

Consider potential soil erosion problems when selecting plants for hillsides that are to be irrigated. How much water can be applied to a particular hillside without creating an erosion problem is a determining factor as to what plants to use on it.

The following ground covers, shrubs, and trees are but a few of the many excellent plants available for landscaping irrigated hillsides for fire protection. Your local nuseryman or farm advisor can help you with others for special locations.

Ground covers and shrubs. Some ground covers and shrubs have natural fire retarding qualities, and, once established, they require little or no irrigation. Here are some for you to consider.

Dwarf Coyote bush *(Baccharis pilularis protratus)*- Deep-rooted and good soil binder plant that needs some supplemental irrigation. Grows to height of 18 inches. Likes full sun. Fowers are not showy.

Algerian ivy *(Hederu canariensis)* — Commonly used ground cover with large, glossy leaves widely spaced on the stem. Once established, grows rapidly and won't carry fire easily if kept clean and well irrigated. Prefers heat and sun but must have water. Plant rooted cuttings on 18- 24-inch squares. Generally available.

Sunrose *(Helianthemum nummularium)* - Grows to 1 foot high and flowers in the spring in several colors. Generally available in flats and gallon cans.

Iceplant (various genera used)-Not as good for soil erosion control as some other plants because of their limited root system. Plant weight also can cause a bank to slip if the grade is too steep. They take full sun and heat well and are drought-tolerant but will stand little traffic. They root easily from pieces taken from established plantings. Must be kept moist on hillsides until root system develops. Some of the best available types for replanting slopes are: Fig marigold; Red spike iceplant; White iceplant; Rose iceplant; Yellow iceplant; Croceum iceplant; Bush type iceplant; Purple iceplant; Trailing iceplant; Redondo creeper. Generally available.

Creeping rosemary *(Rosmarinus officinalis prostrata)* — Gives a quick, drought-resistant cover. Root system is not as deep as for some other species. Produces blue flowers attractive to bees. Generally available.

Carmel creeper *(Ceanothus griseus horizontalis)* --Low growing, drought-resistant, evergreen shrub with thick leathery leaves and bright blue flowers in the spring. Single plant will spread to as wide as 10 feet. Generally available.

Rockrose *(Cistus vellosus)* - A low spreading, evergreen shrub that is drought-resistant and which has attractive purple flowers.

Toyon *(Heteromeles arbutifolia)* - One of the best California natives. Is drought-resistant and bears masses of brilliant red berries that remain for many months. Should be used as a large specimen shrub or tree. Generally available.

Oleander *(Nerium oleader*) -Sturdy, tough, attractive summer-flowering shrub that is very drought-tolerant. Grows to a height of 20 feet and may reach a width of 25 feet. (CAUTION: Although widely grown, note that all parts of this plant are poisonous, even the dried leaves, A child can become severely ill from eating but a few of its leaves. Smoke from burning oleander brush adversely affects some people.

Italian buckthorn *(Rhamnus alaternus)* - Large evergreen shrub or small tree with dark green leaves. Bears deep blue berries in the fall and is extremely drought-tolerant. Limited supply available.

Lemonade berry *(Rhus integrifolia*)-A native shrub that is very drought-tolerant, once established. Limited supply available.

Trees

Carob *(Cerutonia siliqua)* -Commonly used in landscapes, parks, and along streets in Southern California. Is pest free and tolerant of alkaline soil and drought. Generally available.

Eucalyptus spp.-Many species are drought-resistant and especially adapted to California climate. Produces much litter and should be kept well pruned and away from structures. Generally available in many shapes, sizes, and flower color.

California pepper *(Schinus molle)* -Very drought-tolerant. Must be pruned well. Produces some litter. Generally available.

Brazilian pepper *(Schinus terebinthifolia)* -Grows 15 to 30 feet high and requires little care except occasional pruning to maintain its shape. Must be irrigated, and is not hardy where temperatures drop below 20 degrees Fahrenheit. Generally available.

California laurel *(Uinbellularia culifornica)* — California native recommended for erosion control. Limited supply.

Fan palms *(Washingtonia spp.)* -Upright palms that are drought-resistant and well adapted in milder areas. Must remove old fronds to eliminate the fire hazard.

Generally available. (Many other palms would be adaptable and usable. Check with your nurseryman.)

Other trees to consider include Deodar cedar *(Cedrus deodara),* Atlantic cedar *(Cedrus atlantica),* Western incense cedar *(Libocedrus decurrens)* , Coast live oak *(Quercus agrifolia)* , Coast redwood *(Sequoia sempervirens)* , California buckeye *(Aesculus californica)* and Big leaf maple *(Acer macrophyllum).*

Unwatered landscapes

Your choice of plants for unwatered landscape areas is especially important. Avoid use of native chaparral plants when possible, because unwatered chaparral becomes highly flammable under drought conditions. Succulents such as yuccas, Agave spp., cacti, and Aloe spp. are excellent background and specimen plants. For lower-growing decorative and ground. covers, a wide choice of succulents is available.

You can give your landscaping variety and accent by planting drought-resistant trees that also show some fire retarding characteristics. California pepper *(Schinus molle),* Carob *(Ceratonia siliqua),* and California laurel *(Umbellularia californica)* are good choices. Palms, especially *Washingtonia spp.,* also are useful if kept well trimmed to remove old fronds before they become a fire hazard.

You can keep some native shrubs in the dry landscape if they are well isolated by low-growing grasses and ground covers that aren't likely to support wild fires. Toyon *(Heteromeles arbutifolia),* elderberry *(Sambucus glauca),* and *Ceanothus spp.* are especially attractive drought-tolerant natives. Several other drought-tolerant shrubs that can be used are listed in Table 1. This listing isn't intended to be an exhaustive list. Many others can be selected from the publications mentioned at the end of this article.

TABLE 1. Drought tolerant shrubs for the dry landscape

Common name	Scientific name
Oleander	Nerium oleander
Rockrose	Cistus villosus & C. ladaniferous
Italian Buckthorn	Rhamnus alaternus
Lemonade Berry	Rhus integrifolia
Yerba Santa	Erodictyon trichocalyx
Fremontia	Fremontia californica
Manzanita	Arctostaphylos spp.
Sugar bush	Rhus ovata

Most of these shrubs have no fire-resistant or slow-burning characteristics. Their usefulness for fire retardation lies in keeping them well separated from each other are carefully pruned of dead branches. Grasses and ground covers of low fuel potential or with slow-burning characteristics may be used between them.

By careful planning, you can prevent your unwatered landscape from becoming a fire hazard, althought it will not provide the safety of a watered landscape. Your most important step is to minimize the fire hazard. Separate the flammable native shrubs. Of those that you keep, prune and remove their old growth that would spread fire easily.

State law requires complete brush clearance within a minimum of 30 feet around all structures. If extra hazardous conditions exist, state law and some city and county fire codes require that brush and other flammable vegetation must be removed or maintained at a height of 18 inches or less for an additional 70 feet. A few specimen shrubs may be permitted by law or code to remain. If landowners fail to comply, the work may be done by county crews, and the cost is added to tax bills. Ask your fire department for local regulations as to how far to keep brush and grass from your buildings.

Landscaping burned areas

Emergency erosion control. Prevention of soil erosion is paramount when establishing cover on burned or cleared areas. For sloping land, materials that impede surface impact of rain droplets and slow down runoff can be a very effective emergency erosion control measure. Among the materials available for this purpose are jute matting, and straw mulch.

Heavy woven jute matting can be rolled over a slope and stapled to the ground. When properly installed, it stays in place and won't be lifted by flowing water, wind, or growing vegetation. The l-inch openings between strands serve as water "check dams." Regular planting procedures can be followed before laying the jute, since it won't interfere with growth of cover vegetation. Eventually, the matting decomposes after the grasses or other vegetation planted have become well established.

A thick cover of straw can be applied instead of jute matting. The straw must be punched into the soil surface at frequent intervals or covered with chicken wire to keep it from being blown away. The straw will hold surface soil and moisture for germinating seeds planted before the mulching.

Erosion control with grasses. When replanting burned areas, a minimum-hazard plant cover that will prevent erosion is of prime importance. Grass can meet this need. If the soil is dry when grass seed is planted, the seed won't germinate until moistened by rain or irrigation. Light irrigation might be necessary to establish a good stand once it does germinate. Watercourses should be thickly planted because heavy runoff during rains will flatten grasses and run over their tops, preventing serious erosion. However, grass covers won't prevent whole hillsides from slipping during unusually heavy rains.

The best fast-starting temporary grasses are annual ryegrass *(Lolium multiflorum),* soft chess *(Bromus mollis),* and common barley *(Hordium vulgare).* Bur clover *(Medicago hispida)* is a good legume to combine with these grasses. Other grasses and legumes can be used but don't appear to offer any additional advantages.

Soft chess reseeds itself and grows 6 to 12 inches high, depending on available moisture. It will survive on natural rainfall, once established. Plant it at the rate of 10 pounds per acre.

Barlev will reseed itself unless seed heads are cut off. It germinates readily and provides a fast cover if irrigated. Plant it at the rate of 30 to 40 pounds per acre.

Annual ryegrass is most commonly planted in burned areas. Some of the seed will be perennial ryegrass, which will carrv over in subsequent years and be hard to get rid of unde; irrigated conditions. Plant 20 to 40 pounds per acre of annual ryegrass for areas normally associated with residential, commercial, and park landscaping (1/2 to 1 pound per 1000 square feet).

For a lasting cover and for areas larger than those normally associated with residential landscaping, perennial grasses and legumes can be used. Keep in mind that they won't realize their full potential for soil erosion control until the second or third year after seeding. However, they have a deeper root system than annual grasses; and, once established, provide greater soil stability. Perennials also remain green throughout much of the summer, thereby reducing fire hazard early in the fire season. Periodic removal of litter accumulating in the perennials may be necessary. Consult your farm advisor, local fire or forestry officials, or California Division of Forestry for specific recommendations in your areas.

Some of the perennial grasses and legumes to consider include: Perennial ryegrass *(Lolium perenne),* Smilo *(Oryzopsis miliacea),* Hardinggrass *(Phalaris tuberosa),* Birdsfoot trefoil *(Lotus corniculutus)* , narrowleaf birdsfoot trefoil (Lotus *tenuis),* Tall fescue *(Festucu urundinuceu),* and wheatgrasses (Agropyron spp.)

Consult your farm advisor, local fire or forestry officials, or California Division of Forestry for specific recommendations in your area.

Hillsides frequently are accessible for irrigation but too steep for easy use of mowers and other equipment. Studies have shown that the grasses and ground covers listed in Table 2 can be grown on such areas with regular but not frequent irrigation and with only two or three mowings annually at the most.

TABLE 2. Grasses and ground covers for irrigated slopes

Species and Varieties	Comments
Zoysia spp. and hybrids	Slow growing and short but slow and difficult to establish. Mowing rarely required.
Cynodan spp. and hybrids (Tifway, Tifgreen, Santa Ana, Tifdwarf)	If not fertilized or irrigated too frequently will require an occasional mowing or renovation only.
Festuca rubra, red fescue Festuca ovina, sheep fescue	Fine leaved fescues make fairly low cover and have good color if not over-watered.
Poa pratensis, Kentucky bluegrass, (Merion, Fylking, Newport and others)	May require mowing every 4-8 weeks.
Lotus tenuis, Narrow leafed birdsfoot trefoil	Does not need mowing but cutting back old growth once a year recommended.
Phyla nodiflora, Lippia	Needs no mowing, drought tolerant, attracts bees.

These plants will remain short and produce a low, dense, meadow-like effect. They should not be cut back closer than 3 inches from the ground, and such cutting should only be done when growth becomes too thick or too tall. Clippings should be removed. Their adaptation to local climates must be determined before planting them.

Controlling brush regrowth

Brush remaining after a fire can be controlled so that a native or wild plant cover is established without creating a dangerous fire hazard, but it requires considerable work and persistent maintenance.

Native chaparral can recover quickly from the undamaged crown. Seeds of native plants will germinate following winter rains or irrigation. Sometimes, the heat of a fire causes seeds to germinate.

If you decide to let native brush remain following a fire, select shrubs to grow in clumps or as individual specimens 25 to 30 feet apart. Chemical brush killers can be used to eliminate undesirable regrowth. Large brush plants and unwanted regrowth should be cut and removed by hand. Prevent regrowth of these cut stems by painting their stumps with brushkiller chemicals or later by spraying the tender growth.

(CAUTION: When using brushkiller chemical sprays, carefully follow the directions on their labels. Be extremely careful to avoid drift to ornamental plantings. Spray only when there is little or no wind. Keep a separate sprayer for these chemicals. Never use a sprayer that has contained brushkiller to apply an insecticide. It is impossible to remover all brushkiller from a sprayer. If used to apply an insecticide, the sprayer's brushkiller residue can seriously damage landscape plants.)

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EVALUATION OF BIOLOGICAL THATCH DECOMPOSING MATERIALS

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Recently, several biological dethatching materials became commercially available for thatch control use. The materials contain a dry medium that has been inoculated with specific fungi. Upon reaching a favorable soil environment, the microorganisms increase and feed on the dead plant material. The objective of the research presented here was to evaluate the performance of the dethatching materials Biodethatch® and Thatch Away® on golf greens in the east San Francisco Bay Area.

The two experimental locations were the San Leandro Marina Golf Course (five greens tested) San Leandro, California, and Orinda Country Club (one green tested) Orinda, California. All greens consisted of a mixture of creeping bentgrass and annual bluegrass. Each location had a significant thatch layer at the initiation of the study.

The treatments, Biodethatch® and Thatch Away® at one pound per 1000 sq. ft. (and an untreated check) were randomly applied by hand to each test green and replicated four times in 10 ft. x 10 ft. plots. Three greens were aerified prior to application of the materials and three greens were not aerified. All plots were irrigated immediately after application of the test materials and normal maintenance for each course was provided thereafter.

Green profile samples were obtained using a Noer profiler, and thatch thickness was measured in centimeters

Figure 1

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TABLE 1. Thatch thickness, in cm, at treatment time and at two dates following treatment on six golf greens.

	Greens not Aerated				Greens Aerated		
Green A	*5/11/76**	**12/l/76**	**4/12/77**	**Green D**	**5/11/76***	**12/16/76**	**4/12/17**
Biodethatch®	7.6	3.2	7.0	Biodethatch®	4.0	4.0	4.2
Thatch Away®	6.8	3.1	6.5	Thatch Away®	4.1	4.1	4.3
Check	6.5	3.3	7.1	Check	4.0	3.9	3.9
Significance	N.S.**	N.S.	N.S.	Significance	N.S.	N.S.	N.S.
Green B	*4/22/76**	**12/17/76**	**4/12/77**	**Green E**	**5/11/76***	**12/l/76**	**4/12/17**
Biodethatch®	7.5	6.0	8.0	Biodethatch®	5.6	3.7	7.6
Thatch Away®	7.3	6.3	8.4	Thatch Away®	4.8	3.8	8.3
Check	7.1	4.9	5.9	Check	1.5	3.8	6.9
Significance	N.S.	N.S.	N.S.	Significance	N.S.	N.S.	N.S.
Green C	*4/22/76**	**12/16/76**	**4/12/77**	**Green F**	**5/17/76***	**12/l/76**	**4/12/77**
Biodethatch®	5.8	4.3	7.2	Biodethatch®	4.0	3.7	1.7
Thatch Away®	6.5	3.9	7.4	Thatch Away®	4.3	3.9	1.8
Check	6.2	3.8	7.0	Check	4.3	3.9	1.7
Significance	N.S.	N.S.	N.S.	Significance	N.S.	N.S.	N.S.

Treatment date-initial thatch thickness
***N.S.=Not Significantly different at 5% level of probability.**

(see Figues 1, 2 and 3), between two plastic blocks under two kilograms of compression force.

All data reported represents the mean value of two samples per replication and four replications per treatment. All data was statistically analyzed using analysis of variance. Significance at the five percent level of probability is reported.

Results

There were no significant differences between the test materials and the control at any observation date at any location. This shows that the biological dethatching materials were not effective in reducing thatch under the conditions of this study. Also, it can be observed that there were no differences in thatch control within greens that were aerated and those that were not aerated.

One can note the decrease in thatch thickness in all treatments, including the untreated check, on Green F from 12/1/76 to 4/12/77 This decrease is attributed to changes in management practices that were superimposed over this study during the time the trial was in progress. Specifically, the changed practices included more frequent aeration and frequent sand top dressing applications. It will be noted and is stressed that a comparison of the two biological thatch control materials with the untested check indicates no significant differences in thatch level, at any observation date.

Appreciation is extended to Mr. Frank Green, Golf Course Superintendent, San Leandro Marina Golf Course, and Mr. Gurmit Sandhu, Golf Course Superintendent, Orinda Country Club.

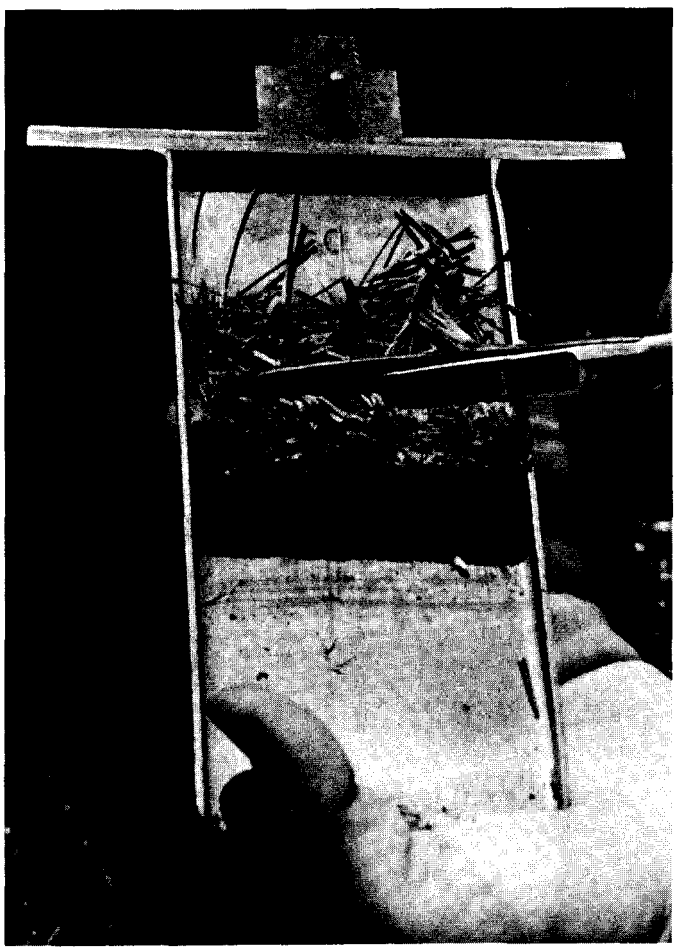

Figure 2

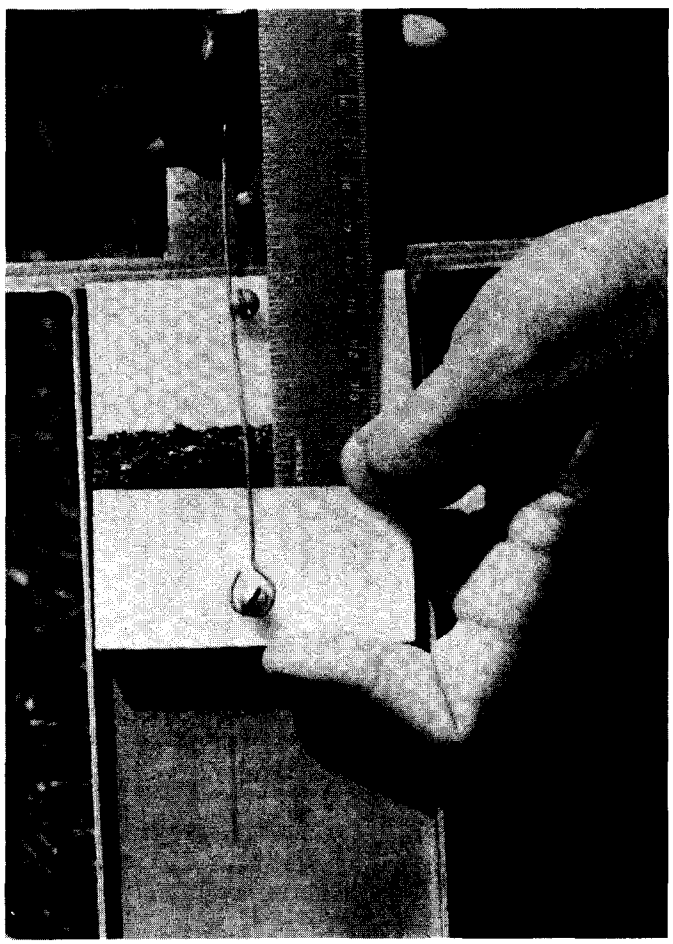

Figure 3

SANDS AND YOUR PUTTING GREEN

*William B. Davis**

Problems of high traffic, year-round play, and the demand for excellent greens led those of us in Extension at the University of California to focus much of our turf research on the use of uniform sands. Right or wrong, we have given up trying to combine sand, soil, and amendments to give a media for high-use putting greens. Even if you get the "right mix" in the lab, someone will do a poor job of mixing it in the field. That is not to say that the "right mix," if correctly managed, is not the way to go on some courses. If the growing media you have works for you, why change? Change for the sake of change is a questionable practice and, on a golf course, it can be disaster.

Regardless of how greens are constructed or topdressed, sands make up 50 to 100 percent of the media. While our work has centered around the 100 percent use of sand for construction and topdressing, we do not use just any sand. We want a sand that has the following physical characteristics.

- When in place on a green, the sand must not change in density due to the compactive forces of traffic.
- The sand must take up water quickly and move it through its pore spaces rapidly.
- When placed at a practical depth of 12 to 16 inches, the surface 3 to 4 inches must hold sufficient moisture for turf growth throughout a 48-hour period.
- During extremes of evapotranspiration, it must not be necessary to irrigate more frequently than every 24 hours.
- When applied as a light topdressing, all sand must move into the turf surface with a light brushing followed by an irrigation.

Sands like these are not commonly found at the nearest sand and gravel company. They are not good plaster or concrete sands. The sands we are recommending have particles in a very narrow range of sizes, and the particles are rounded rather than sharp or angular. Table 1 gives the range of particle sizes we suggest for greens construction and topdressing.

During the past four years, we have been using these finer, uniform sands in a complete "alternative method of greens management." The purpose of this program has been to reduce management, which we have done by topdressing lightly and frequently to maintain the firm, true putting surface most golfers want. We have also experimented with pre-mixing fertilizers, herbicides, insecticides, and fungicides with the topdressing sand. Using this type of topdressing mix, our management program for a green only consists of mowing, irrigating, and topdressing. However, to start using this alternative management program on many existing greens, we have found it necessary to do extensive aerating and verticutting to relieve surface compaction and control thatch accumulation.

Few, if any, superintendents can change their present golf course management program without going through a transition period. The thinking superintendent does not just jump into a new program. He first thoroughly investigates what is known and then slowly adapts what he has learned to the management of his course.

The first key step in our "alternative method of greens management" is to locate a suitable source of sand. Unless you can obtain the right sand, we do not recommend the program.

The second step is to begin applying a light topdressing every 3 to 4 weeks during the turf growing season. Find the techniques and the equipment that will allow you to apply l/32 to l/16 inch of sand at a time. Your first application or two may well include a heavy coring treatment to create a transition mechanism for getting the sand into the present profile of your green. But, once the frequent topdressing program is under way, the Tuesday morning golfer should not be aware that you topdressed on Monday. And, on Tuesday, your putting green mower should be mowing grass-not removing sand and dulling the mower.

Your complete management program may or may not develop into adding fertilizers and chemicals to your topdressing sand, but you might consider doing so. Few, if any, golf course superintendents have gone farther than to just mix fertilizer and some bentgrass with the topdressing. In fact, new Environmental Protection Agency (EPA) regulations have caused some concern about the feasibility of mixing herbicides, insecticides, and fungicides with the sand since specific equipment must be used to apply some chemicals.

A real change to your green does not happen overnight. At the end of the first year, you may have topdressed 8 to 15 times, depending on the growth rate of the grass and the length of the growing season. But, during the second or third year, you may have 2 inches of new surface. By topdressing in the correct amounts at the right time intervals, you will eliminate excess thatch and prevent the build up of alternate layers of buried thatch. You may also find that you can now change your irrigation program and being to manage for bentgrass-not *Poa.*

No management program is any better than the superintendent and his crew, and no program is free of prob lems, which must be overcome or mastered. Typically, when it means making a change, most of us are quick to look for the disadvantages. In contrast, I prefer to look for the challenges. There are several challenges involved in making an "alternate method of greens management" work.

- You must find a consistent, reliable source of the type of sand needed to meet the requirements of the program.
- You must work with your topdressing crew and equip ment to develop the most efficient and accurate method of applying the sand.
- You can experiment with the incorporation of fertilizers in your topdressing mix.
- You must develop other uses for your greens aerating

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equipment (such as on aprons, tees, and even fairways).

- You must stay with the program long enough to resolve any problems- and you must give the program a chance to work for you.

Once in operation, you should find a program of frequent, light topdressing requires no more effort than the present major campaign, which is mounted two or three times a year and requires several crews for coring, sanding, dragging, vertical mowing, and mower sharpening. That major campaign also requires you to answer complaints and continue to struggle with *Poa.*

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.

TABLE 1. Sand Particle Size Distribution

Sieve Opening mm	U.S. Standard Sieve No.	U.S.O.A. Class	Golf Green Construction Desired	Golf Green Construction Accepted	Golf Green Topdressing Desired	Golf Green Topdressing Accepted
2.38	8					
2.00	10	FINE GRAVEL				
1.68	12					
1.41	14	VERY COARSE SAND		0-10%		
1.19	16					
1.00	18					
.841	20					
.707	25	COARSE SAND	0-15%	80-90%		0-15%
.595	30					
.500	35					
.420	40					
.354	45	MEDIUM SAND	80-95%		100%	75+%
.297	50					
.250	60					
.210	70					
.149	100					
.125	120	FINE SAND				
.105	140					
.088	170					
.074	200	VERY FINE SAND	4-8%	5-10%		0-8%
.063	230					
.053	270					
.044	325					
.037	400	SILT & CLAY				

The proportions proposed are tentative guidelines only. Individual sands should be considered in terms of infiltration rate when compacted, and the moisture release curve, These will be affected by the particle size distribution within the limits proposed.

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