

CALIFORNIA'S GOLF COURSE BOOM

William B. Davis

*Extension Turf & Landscape Horticulturist
University of California, Davis*

During the past decade, California has become a leading state in food and fiber production, ornamental production, park development, and population-to mention a few areas. So, it is not surprising that California should also be a leader in its total number of golf courses and total acreage devoted to this recreational activity.

Since 1960, we have been opening new courses at the rate of three every month. Few people comprehend the magnitude of this growth in California. And if you were to talk to golfers in some of our metropolitan areas, you would be led to believe we have a golf course deficiency because many golf courses book starting times 3 weeks in advance, particularly during summer months.

In 1964, the University of California* made a major survey of California golf courses. Much was learned, but no attempt was made to look at the growth rate of golf courses in the state. During 1967, because many questions arose about golf courses in California, the University of California Agricultural Extension Service contacted every course that would be in play by January 1968. We found that California had 665 golf courses actually in play, and more than 50 golf courses under construction or on the drawing boards to be completed by 1970. When we consider in 1955 there were only 234 golf courses in play, it gives us some idea of how fast golf courses have developed in California. (Figure 1) These figures give those concerned with turf management, maintenance, and use of golf courses some insight into why some serious problems have developed.

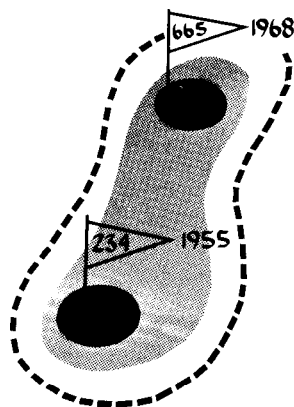


Figure 1

What type of golf courses are we building in California, and just how are these 665 courses divided into playing units? Nearly 60 percent of the courses are regulation or near regulation 18-hole golf courses. They range from 5,000 to 7,000 yards with pars between 65 and 72. Approximately 22 percent of our courses are regulation 9s with pars from 32 to 36. In recent years, the regulation 9 has become less popular and these courses have decreased in number. While regulation 18s continue to be the most popular course constructed in California, there has also been a considerable increase in our par-3 courses. Since 1964, we have been constructing special par-3s—that is, 18 holes but each hole a par-3 instead of the conventional 9-hole par-3. Rather than develop a special category for these types of courses, they are included in this study as par-3 courses, irrespective of whether they are 9 holes or 18 holes. In California, approximately 18 percent of the golf courses fall in this class. (Figure 2)

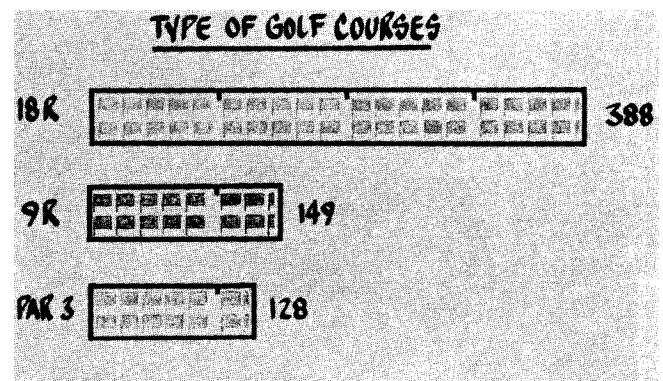


Figure 2

Before 1950, the largest percentage of golf courses were private country clubs, but this picture is changing rapidly in California. Even though the number of country clubs has steadily increased to 208, the percentage increase has been far less than that of municipal and public courses.

The majority of golf courses in California are now public or semi-public. The city or county golf courses have increased to 123. Perhaps the biggest increase in

*See California Turfgrass Culture "California's 50,000 Acre Golf Course", Vol. 16, No. 1.

public golf courses has been the semi-public golf course-that is, the course that is usually developed in connection with a land development enterprise or built strictly by a private corporation. Play on these courses is open to the public on a fee basis. For lack of a better term, we also call these public courses, and they presently number 309. Perhaps the most stable golf course development has been the military courses, of which there are 25. These military courses are generally not open to the public, but are a part of the total recreation program on major military installations in our state. (Figure 3)

TYPE OF OWNERSHIP-MANAGEMENT

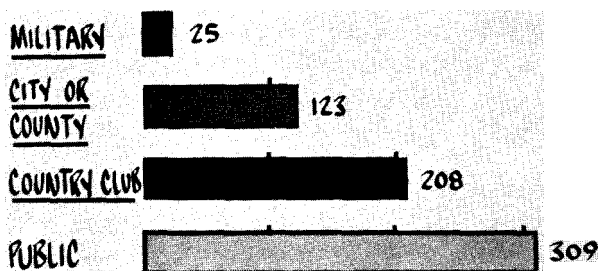


Figure 3

We developed accurate average data on various types of courses from our 1964 survey including information on over 50 percent of the golf courses in California. These average figures give us a rather accurate evaluation of the land area involved in each major type of course and the maintenance cost of golf courses. However, because of rising labor costs, our 1964 figures had to be readjusted. In 1968, we checked with major golf courses and found that their total maintenance budget had increased approximately 15 percent during the last 4 years.

Our 1964 figures showed that an average 18-hole golf course is located on a site of 142 acres, of which 101 acres are mowed and irrigated. (Figure 4) Since we have 388 18-hole golf courses in California, the total acreage devoted to 18-hole golf courses is 55,096, 39,188 acres being intensively maintained. Nine-hole golf courses are half the size of regulation 18's and these 149 courses occupy 10,393 acres, of which we intensively maintain 6,765 acres. Par-3 golf courses usually are located on a 17-acre site, with about 14 acres being mowed and irrigated. Although this acreage might be considered a little low-because of the increase of 18-hole par-3s-it still represents a conservative figure and accounts for another 2,190 acres of golf course site and 1,844 acres of intensively managed land area. In total, these figures show that California's 665 golf courses occupy 67,679 acres, of which 47,797 are intensively maintained. Few crops produced in California require the amount of irrigation, fertilization, and continuous harvesting that is

required to produce an acceptable recreational area for the game of golf. (Figure 5)

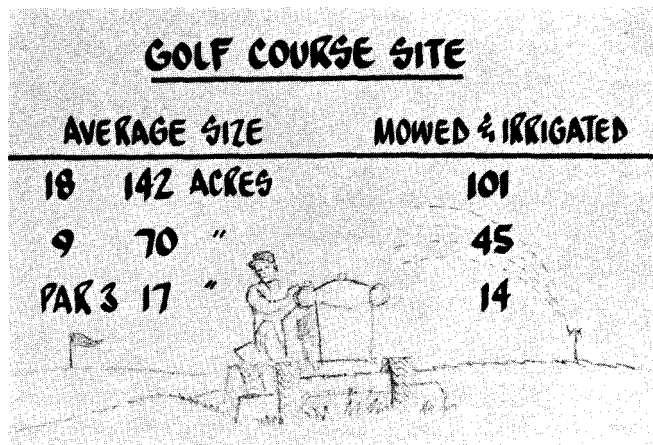


Figure 4

One of the biggest problems facing golf course management is the annual costs of maintenance. These costs do not include major capital improvements, such as the rebuilding of greens, major modification of irrigation systems, development of cart paths, etc. Nor does it include any of the costs associated with the management and maintenance of the club house, pro shop, etc. If we consider only costs to maintain the landscaped area, we find that 1&hole golf courses cost a total of \$34,726,000, regulation 9-hole courses \$4,664,500, and par 3s, \$3,648,000. This amounts to a total expenditure of \$43,008,500. This is big business even in California. And while this sum does not represent the entire cost of landscape management and development of the 665 golf courses, it does show the day-today cost of maintaining greens, tees, fairways, and other landscape areas directly associated with a good game of golf. (Figure 6)

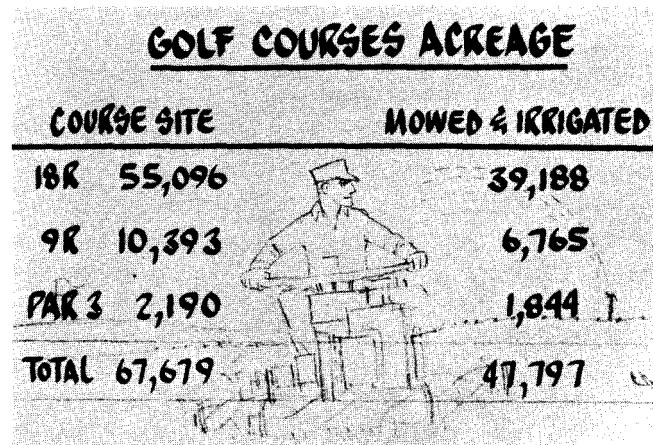


Figure 5

In order to maintain these 665 golf courses, 4,869 persons are employed, solely in landscape management. (Figure 7) Wages of supervisory and maintenance personnel account for 65 to 70 percent of the annual maintenance cost. It cost approximately

\$80,000 annually to maintain an 18-hole golf course, with costs ranging between \$50,000 and \$175,000 per course.

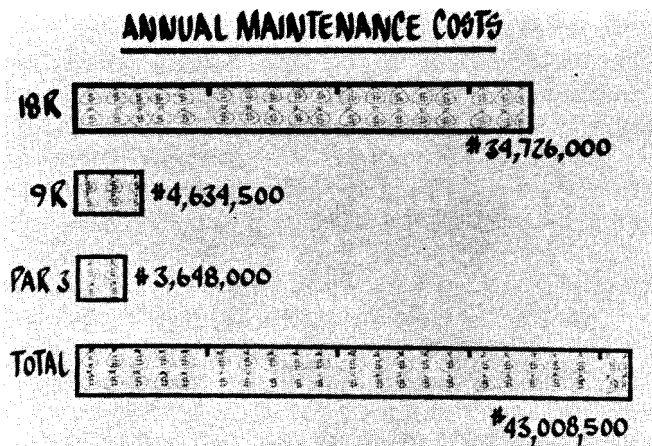


Figure 6

Any regulation 18-hole golf course management that has a maintenance budget of \$80,000 or less should determine why they can get by at this average figure. Water costs alone for an 18-hole course range from \$1,000 to over \$40,000 per year. Minimum labor wages range from a \$1.50 to \$4.50 per hour. Irrigation systems vary from completely inadequate to adequate, and the labor costs for applying irrigation vary 6-fold depending on the type of system. Each course is individual and, therefore, must be evaluated individually. When considering changes in the overall maintenance program or in the redevelopment of any segment of the golf course, good detailed cost figures are a must. The cost should also be properly evaluated with the degree of maintenance. All too often a decision is made to increase fairways mowing to twice a week, with little thought being given to revision of the maintenance budget.

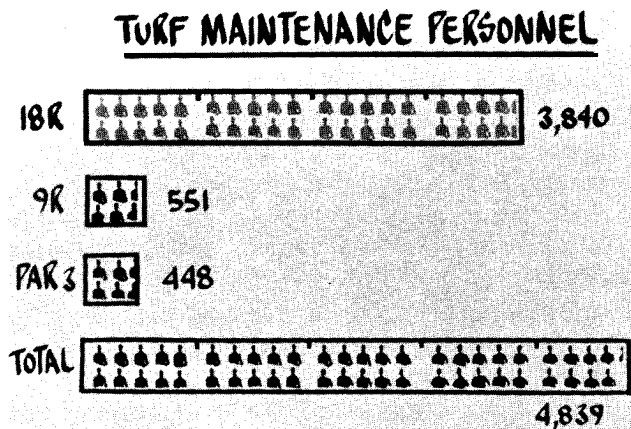


Figure 7

We have looked at costs, size, number of employees, and type of courses, but now let us take a closer look at the phenomenal growth rate. The growth curve for golf course development in California since 1890 shows a gradual increase for 1

course to 35 courses in 1920. Between 1920 and 1930, some 90 courses were built during the prosperity years after World War I. From 1930 to 1940, only 27 courses were built reflecting the depression years of the early and mid 30's. Many of the courses built during that period were municipal courses, and their construction was justified on the basis of giving needed employment rather than to fill a demand for more recreation area. From 1940 to 1950, only 31 courses were built, because of World War II and the start of the Korean conflict. From 1950 to 1960, we built 199 golf courses. Population was exploding and times were good for the majority. No longer was the game of golf restricted to a few-it became a recreational outlet for the masses. From 1960 to 1968, we built 283 golf courses, and the number is rising. (Figures 8 and 9)

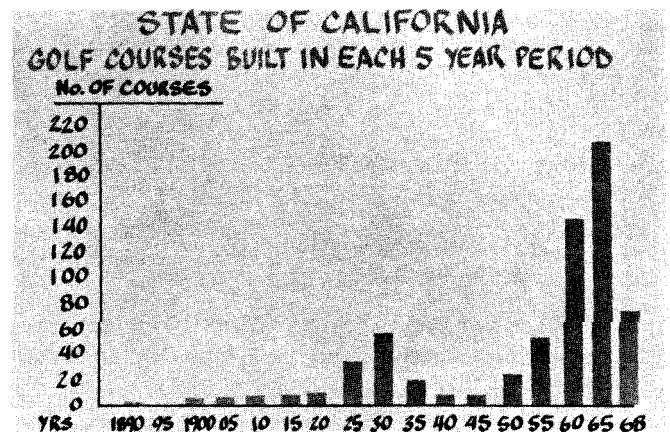
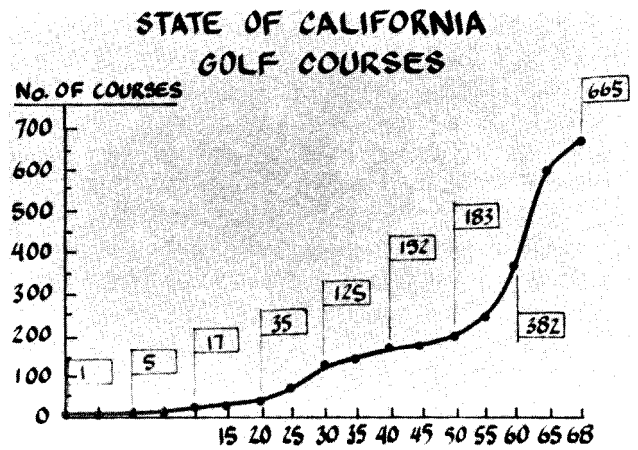


Figure 9

With 665 golf courses occupying some 67,000 acres, and costing over \$43,000,000 annually to maintain, courses in California have become big business. Conservatively, most agree that we will have well over 700 golf courses by 1970. At that time, we should reach a leveling off point.

This leveling off period is needed to train expert turf managers and maintenance personnel. We also need more basic, as well as adaptive, turfgrass research to cope with the complex problems we, the golfing public, have created by our high use and demand for perfection of our golf courses.

SYSTEMIC CONTROL OF BLUEGRASS RUST

T. G. Byrne and A. H. McCain

University of California
Agricultural Extension Service

The common rust disease of Kentucky bluegrass (*Poa pratensis* L.) in California is stripe rust caused by *Puccinia striiformis* West f. sp. *poae*. Some varieties of bluegrass, such as Merion, are particularly susceptible to attack by this fungus. A severely infected turf appears orange to brown in color. It exhibits loss of vigor and is aesthetically undesirable.

The experimental fungicide oxathiin (Plantvax; 2,3-dihydro-5-carboxanilido-6-methyl-1, 4-oxathiin4, 4-dioxide), which is produced by Uniroyal, has given excellent control of rusts and smuts of grasses and other plants. In view of this, an experimental plot was established at the University of California Gill Tract at Berkeley, California to evaluate the effectiveness of oxathiin as a control for bluegrass rust.

Six varieties of Kentucky bluegrass (Merion, Prado, Winsor, Park, Newport, Fylking) with varying degrees of rust infection were sprayed with oxathiin at the rate of 1-1/3 oz. (75%) in 7 gallons of water per 1000 square feet on November 16, 1967. A similar application was made November 28, 1967. The treated turf was observed to be free of rust on December 13, 1967 and January 26, 1968. In contrast, untreated turf within the test area was severely infected with rust on December 13, and moderately infected on January 26. No phytotoxicity was observed in any of the varieties.

Oxathiin also controls *Rhizoctonia* sp. When registered, this systemic chemical should prove to be a very useful turfgrass fungicide.

RENOVATION OF OLD BERMUDAGRASS TURF WITH CALCIUM CYANAMIDE

Victor B. Youngner
University of California, Riverside

Areas of poor quality weedy bermudagrass turf may be found in many parks, golf courses and other types of turf. Often these areas are not improved because they are thought to require complete renovation and reseeding at too great a cost. However, studies over the years have shown that it is possible to renovate such turfs at relatively low cost applying for the most part well known principles and techniques. Vast improvement may be possible in a single year.

The deterioration of these turfs usually may be attributed to one or more of the following conditions: 1) compacted soil with poor aeration and water infiltration, 2) low fertility, especially nitrogen, 3) excessive shade and tree-root competition, 4) poor irrigation practices. Weed invasion is usually a secondary problem resulting to a great extent from the conditions cited above. Therefore, they must be

corrected prior to or simultaneously with applications of herbicides to achieve a dense vigorous turf which will resist new weed invasion.

The corrective measures should be familiar to any experienced turf manager. The first step, of course, must be to correct any serious deficiencies in the irrigation system. Good turf cannot be grown in arid regions unless adequate water is provided. The second step is to imitate a program of thorough aerification which may be as frequent as once per week at the beginning in badly compacted soil. The frequency of aerification may be extended as the condition is remedied. If shade is heavy from trees low branches must be pruned and the trees thinned to permit increased light penetration. Root pruning is often necessary to remove shallow tree roots and reduce competition with the turf.

After these measures have been started it is time to consider fertilization and weed control. Field tests have shown a way in which these two rather costly practices may be combined utilizing a single material, calcium cyanamide, if there is a base of bermudagrass throughout the area.

Calcium cyanamide has been used in turf culture for many years for preplant weed control. Control of many weeds is excellent, but common bermudagrass generally survives to rapidly take over the new turf. As used for this purpose calcium cyanamide is applied at approximately 50 lbs. per 1,000 sq. ft. of area and mixed into the top inch of prepared seedbed. The soil must be kept moist during the three to five week activity period. Decomposition is favored by warm temperatures and moisture.

Commercial calcium cyanamide is a block product containing approximately 21% nitrogen plus calcium and free carbon. The herbicidal properties result from several decomposition products but perhaps primarily from hydrogen cyanamide produced early in the decomposition. A final breakdown product is nitrate nitrogen so the material serves as both a herbicide and a nitrogen fertilizer.

These characteristics of calcium cyanamide and the relative tolerance of bermudagrass to it are utilized in the renovation program. Two methods of treatment have been developed; a dormant season single application or a growing season treatment of several smaller applications.

Greatest success has been achieved with the dormant season method. An application of 30 to 50 lbs. of calcium cyanamide per 1,000 sq. ft. is applied to the dormant bermudagrass in late winter about three weeks prior to the time of expected green-up. This is watered into the turf and normal watering is given thereafter.

All growing weeds and cool season grasses are completely burned within two days after treatment. New spring growth may be delayed as much as two to three weeks, however, growth is rapid once it begins. Both the 30 lb. rate and the 50 lb. rate have been

successfully used. The 50 lb. rate causes burn of all living bermudagrass growth above the ground and delays recovery at least a week longer than the 30 lb. rate. However, control of weed seeds and deep rooted perennial weeds is better. Both rates have given nearly complete control of crabgrass for at least one season. By mid-summer a dense nearly weed-free bermudagrass turf is obtained with no additional applications of fertilizer. The higher rate may provide a full summers nitrogen needs.

While all field tests were made using these two rates, a 40 lb. rate may be best. This would be a compromise between the greater safety of the lower rate and the superior weed control of the higher.

The growing season treatment method differs only in that a lower rate (about 15 lbs. per 1,000 sq. ft.) is used on the green turf and is repeated at about 6-week intervals until the desired improvement is obtained. Some turf burning results and weed control is not obtained as quickly. However, because weed control and fertilization is obtained with a single, relatively low cost material it is still a method worthy of consideration.

In conclusion several points must be emphasized. Calcium cyanamide renovation of this type is recommended for bermudagrass turf only. There is no evidence indicating that it will work on bluegrasses and fescues. These turfs may be too severely injured. The 50 lb. rate can be used on dormant bermuda only. Severe injury will result if used after the turf has begun to grow. Turf must be kept moist after the application even though it appears completely brown. There must be some bermudagrass distributed throughout the area otherwise only bare ground will result from the treatments.

As with most chemical treatments, results may be affected by soil, weather and other local environmental conditions. Therefore, the wise turf manager will try treatments on a small scale first. He can then determine the applicability to his needs and if any modifications may be required.

DEPTH OF ROOTING OF BERMUDAGRASS

O. R. Lunt
University of California
Los Angeles

A trench cut into two-year-old sod of Tifdwarf bermudagrass in May provided an opportunity to directly observe the depth of rooting. When the sides of the trench were sprayed with a very fine water mist, soil was removed gently and the fine, fibrous root system was clearly displayed. The heaviest mat of roots occurred in the surface six inches, however, fine roots were distributed densely and approximately uniformly to a depth of about five feet. Density of roots then gradually diminished to a much lower level at six feet. The deepest roots were found at about seven feet. There was an appreciable showing

of roots at six and one-half feet. It was judged that the density was such that soil water would be effectively utilized to a depth of five feet and probably about six feet.

Previous irrigation management in the area had been relatively infrequent-approximately once in about 10 days in hot, dry weather. The depth of rooting suggest irrigation intervals might have been much longer if the entire rooting depth were wetted at an irrigation.

These observations, while showing a genetic potentiality of Tifdwarf bermudagrass, cannot be projected in management recommendations for Tifdwarf turf without confirming studies. They are consistent, however, with similar observations that have been made on other bermudagrass strains.

WINTER TURF MAINTENANCE

Victor B. Youngner
University of California, Riverside

In California and other regions of mild winter climate turf maintenance is an all year task. Many cultural practices not only can but indeed must be carried out during the winter season. Although leaf growth may be slow on many turf species during this season, pronounced changes may be occurring in other less visible plant structures; tiller buds, roots and rhizomes. Therefore, the type of care given during this season will determine to a great extent the quality of turf in the following spring and summer.

Winter fertilization is important for all cool season and warm season grasses. Adequate levels of phosphorus, potash and especially nitrogen throughout the winter will help produce a dense vigorous turf. Much root growth occurs during the time when little top growth may be observed. The root system developed during the winter and early spring must carry cool season grasses through the following summer when few new roots are formed and many roots or root tips may die.

Bermuda and other warm season grasses should be provided nitrogen fertilizer as long as the turf retains some green. These nitrogen applications will prolong the period of good color and may keep the turf green throughout the winter in many areas.

Rates of one-half to one pound of actual nitrogen per 1,000 sq. ft. per month will be satisfactory for both warm and cool season grasses. Best results will be obtained generally from a nitrate source of nitrogen but urea and ammonia forms are nearly as good under most conditions.

Where winter rains are insufficient to meet the water needs winter irrigation may be nearly as critical as that of summer. Effects of poor water management may go unnoticed for long periods because of slow grass growth and reduced evapotranspiration rates. Thus, much damage may result unknown to the turf manager.

This danger arises from either excess or insufficient water. If watering is performed on a schedule without careful consideration of changes in temperature and humidity, a saturated condition may develop producing severe root damage and restricted tillering. On the other hand, turf often may be underwatered as stress symptoms may not show readily under the cool temperatures and higher humidity of winter. Frequent observations of soil moisture with a soil tube or other device, therefore, is necessary for good winter irrigation.

Most turfs will benefit from thorough fall and winter aerifications. An exception, of course, is made for greens and other turfs where *Poa annua* is a problem (see California Turfgrass Culture, January 1968 and July 1968). Cool season grasses may be aerified frequently throughout fall, winter and spring. Warm season grasses should not be aerified when the turf is dormant.

If cool season grasses have become dably thinned during the summer months, reseeding should be done in fall or early winter to provide a long season for establishment. Generally all that is necessary is to rake or in other ways scratch the surface of the turf, broadcast one to two pounds of seed per 1,000 sq. ft., and top dress lightly. This must be done well in advance of any preemergence weed control so that new seedlings will not be injured by the chemical.

Several troublesome warm season weeds may be most easily controlled by late winter applications of preemergence herbicides. For crabgrass control these chemicals must be applied by late January or early February in Southern California. In cooler areas further north or at higher elevations treatments may be delayed two to four weeks. As these chemicals have little or no postemergence effect, applications must be made before seeds germinate.

A number of excellent preemergence herbicides for crabgrass control are available today. These chemicals are formulated and packaged under various brand names. Five chemicals known to be good in California are the following:

Bensulide Be tas anand Presan
Siduron Tupersan
DCPA Dacthal
Benefin – Balan
Diphenamid – Enide, Dymid

Each of these materials have certain advantages and disadvantages which must be considered in selection. Bensulide has a fairly high degree of safety on most grasses and dichondra, but has been reported to cause some root injury under, as yet, poorly defined conditions. It gives moderately good control of crabgrass and some other species. DCPA gives excellent control of crabgrass and many other annual grass species but may cause injury to bentgrass and dichondra. Siduron does not control crabgrass as well as DCPA but can be used safely on young cool season

turf. It may be used at the time of seeding of bluegrass and fescues if necessary without significantly reducing the stand of turf under most conditions. Siduron should not be used on bermuda or other warm season grasses as they may be severely injured.

Benefin is a relatively low cost material effective against crabgrass and other annual grasses. It is not safe for bentgrass putting greens and dichondra and should not be used on young poorly rooted turf. Diphenamid is to be used on dichondra turf only as it will severely injure most grasses. It is an excellent material for dichondra.

All of these materials must be used at the rates recommended by the manufacturers. Directions on the label should be read carefully as rates and application methods for many herbicides may differ for different grasses, soils or weather conditions.

PESTICIDE INFORMATION AND SAFETY MANUAL

This valuable manual, issued by the University of California in July 1968, should be on the bookshelf of everyone who uses pesticides frequently. It contains much technical information on the toxicity of herbicides, insecticides, fungicides and other chemicals used in pest control. It also presents directions and advice on safe handling and storage of pesticides. Some of the more important federal and state laws and regulations pertaining to pesticides are discussed. Poisoning symptoms and first aid treatment are summarized.

The manual may be purchased for \$2.50 from Agricultural Extension Service, University of California, 2200 University Avenue, Berkeley, California, 94720.

THE CORRECT SAND FOR PUTTING GREENS*

Charles G. Wilson

Head Agronomist

Milwaukee Sewerage Commission

Surprisingly enough, there is considerable agreement among turfgrass soil scientists on the subject of correct sand particle size to be used in construction and topdressing of putting greens. Unfortunately, we have sometimes lowered our standards in the mistaken belief that the customer would not pay the cost of using the correct materials. This is a mistake needing correction!

The right gradation and size of sand particles can be justified by the builder and golf superintendent, as well as those who pay the bills.

The first step is to refuse any sand that is retained above a 10 mesh Tyler standard screen. Materials passing through the 10 mesh size are 1.410 mm or .0555 inch or smaller. As the Tyler mesh size drops (10, 8, 6, etc.) the particles get larger. Coarse clinkers (those above 10 mesh) should be eliminated, or tolerated if present in only fractional percentage amounts. The reason is simple. Once the green is turfed it is virtually impossible to work anything larger than .065 inches (10 mesh) into the turf fiber when the putting green is top-dressed.

Suppose, for example, your course has purchased a "concrete grade" of sand under the mistaken belief that it is cheaper because it cost less per ton or per cubic yard. Dr. Donald V. Waddington at Penn State University has found that sand grades are quite variable in particle size, so let us also suppose 50 percent of this sand is retained above a 10 mesh screen, a not uncommon occurrence. You mix this carefully in proper proportions with soil and humus to match the USGA soil specifications used in construction. You even compost the mixture to be sure the particles won't separate in the act of topdressing. You have a physical soil analysis made just to be sure it's the proper mix. The tests show the 7 parts sand, 2 parts peat and 1 part soil by volume in the mixture to be excellent in terms of infiltration and percolation after compaction.

Then the greens are topdressed. Your labor crew is a good one. They work carefully and diligently to brush, board and drap mat the topdressing into the turf. In fact, they spend many extra hours in this attempt. But lo and behold, almost all of the coarse sand fraction is eventually carried to the green collar where it must be picked up and hauled away to create

even more work.

The small percent of coarse clinkers that remain on the green and on top of the grass does not escape notice. The golfers are angry, and the mechanic is paid overtime for keeping the dull mowers sharpened by extra grinding and lapping in bedknife and reel. And what of the poor grass after the dust (literally) has settled? Instead of the 7-2-1 mix originally specified and intended in this example, the grass has received a 4-2-1 ration that makes an excellent substitute for concrete.

Assuming all the peat and all the soil applied can be worked into the grass, look at what this act of removal does to our original mixture of a "by volume" percentage basis. The 70 percent of sand in the original 7-2-1 mixture (100 percent) drops to 57 percent contact on the green after three parts of the coarse sand is hauled away. The peat increases from 20 percent to 28.5 percent, and the soil content jumps from 10 percent to 14.5 percent.

"Hardly the original mixture," you say. And you are correct! Even the act of aerating and core removal prior to top-dressing won't solve the problem, because there is still two inches of turfed area between each hole that refuses to accept the coarse sand particle.

So, why not buy an acceptable sand in the first place? Penn State recommends a minimum of 80 percent in the 14-65 mesh size (1.190-0.208 mm, 0.0469-0.0082 inches). Dr. Raymond Kuntze, of Michigan State, who did the original work on the USGA specifications at Texas A & M, favored a gradation of 0.25 mm to 1.0 mm in size. This comes very close to Penn State's suggestion. Most turfgrass soil scientists also would prefer a round sand to a sharp, angular sand where a choice is available, and in this discussion on sand we are referring only to true silicas and not some substitute such as crushed limestone or slag.

Seldom will you find such a sand available without special screening. One sample we analyzed from Ottawa, Ill., is as near perfect in 'run of the pit,' as we have seen. It is ideally suited for bunkers as well as construction and topdressing. The mesh size was as

*Reprinted from USGA Green Section Record

follows:

Mesh	m m	Inches	Percentage Retained
10	1.651	.065	0.30
16	.991	.039	11.24
28	.590	.0232	58.91
48	.295	.016	26.62
100	.147	.0058	2.60
Pan	- -	- -	0.33

We would hold out for nothing coarser than the above 10 mesh in screen size, and only then in a fraction of 1 percent as being acceptable. We would approve as much as 20 percent falling below the 48 mesh size, but retained on a 65 mesh screen.

Such a sand screened to specifications, essentially passing through a 10 or 12 mesh and being retained on a 65 mesh screen will obviously cost more per ton than common concrete or mortar sand. Yet, one ton of this sand is equivalent to two tons of the sand used in our horrible example, since none is wasted in top-dressing.

It is appreciated that most of the savings in freight

and bulk handling will be realized after and not during construction. Although, even during construction the finer grade of sand specified should go farther because there are more particles per unit of measure now that the coarse clinkers have been removed.

And just think of the fringe benefits. Less labor down time involved in top-dressing, happier golfers; and by no means last, protection in perpetuity of the putting green soil profile you so laboriously and expensively put together in the first place.

Thus, one should provide a physical soil laboratory, with the competence to carry out the tests described in the USGA Green Section Specifications, with decent sand in the first place. The same can be said for humus and soil, which is another subject and too lengthy to include here.

Follow the USGA Green Section specifications on mixing and construction exactly as written.

And finally, each club should require an Act of Congress before anyone is permitted to tamper with or alter the soil mixture decided upon, no matter how well-meaning he may be.

CALIFORNIA TURFGRASS CULTURE
 Department of Agronomy, University of California
 Riverside, California 92502
 Editor, Dr. Victor B. Youngner

CALIFORNIA TURFGRASS CULTURE is sponsored by the Federated Turfgrass Council of California and is financed by the regional councils and other turfgrass organizations of the state. The Federated Council consists of officers and directors of the regional councils. Subscription to this publication is through membership in one of the councils listed below.

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