

JULY 1971

USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association

Fall Overseeding Lies Just Ahead





USGA GREEN SECTION RECORD

A Publication on Turf Management by the United States Golf Association

© 1971 by United States Golf Association. Permission to reproduce articles or material in the USGA GREEN SECTION RECORD is granted to publishers of newspapers and periodicals (unless specifically noted otherwise), provided credit is given the USGA and copyright protection is afforded. To reprint material in other media, written permission must be obtained from the USGA. In any case, neither articles nor other material may be copied or used for any advertising, promotion or commercial purposes.

VOL. 9, NO. 4

JULY, 1971

Overseeding, 1971, to Transition, 1972	by Holman M. Griffin	1
Zoysia — A Turf for Transition Zone Fairways	by Lee Record	5
Ground Pearl Damage to Tifgreen: A Research Report	by George P. Wene	7
Books on Golf Course Turf Management	by William H. Bengeyfield	11
Turf Tips — Some Usable Ideas for Situations Someday		12
Turf Twisters		Back Cover

Published six times a year in January, March, May, July, September and November by the UNITED STATES GOLF ASSOCIATION, 40 EAST 38th ST., NEW YORK, N.Y. 10016. Subscription: \$2 a year. Single copies: 35c. Subscriptions and address changes should be sent to the above address. Articles, photographs, and correspondence relevant to published material should be addressed to: United States Golf Association Green Section, P.O. Box 567, Garden Grove, Calif. 92642. Second class postage paid at New York, N.Y. and other locations. Office of Publication: 40 East 38th Street, New York, N.Y. 10016.

Editor: William H. Bengeyfield

Managing Editor: Robert Sommers

Art Editor: Miss Janet Seagle

Green Section Committee Chairman: Henry H. Russell, P.O. Box 697, Miami, Fla. 33157

Green Section Agronomists and Offices

EASTERN REGION

P.O. Box 1237

Highland Park, N. J. 08904

Alexander M. Radko, Director, Eastern Region
and National Research Director

William G. Buchanan, Eastern Agronomist

Stanley J. Zontek, Eastern Agronomist
(201) 572-0440

SOUTHERN REGION

P.O. Box 4213

Campus Station, Athens, Ga. 30601

James B. Moncrief, Director, Southern Region
(404) LI 8-2741

MID-CONTINENT REGION

P.O. Box 592, Crystal Lake, Ill. 60014

F. Lee Record, Director, Mid-Continent Region

Carl Schwartzkopf, Mid-Continent Agronomist
(815) 459-3731

MID-ATLANTIC REGION

P.O. Box 5563

Barricks Road Station, Charlottesville, Va. 22903

Holman M. Griffin, Mid-Atlantic Director
(703) 295-4823

WESTERN REGION

P.O. Box 567

Garden Grove, Calif. 92642

William H. Bengeyfield, Director, Western Region
and Publications Editor
(714) 638-0962



Seed must be evenly distributed. Dragging after seeding helps accomplish this and helps establish good seed-soil contact.

Overseeding, 1971, to Transition, 1972

by HOLMAN M. GRIFFIN

Director, USGA Green Section Mid-Atlantic Region, Charlottesville, Virginia

July and August—months of continual “alert” and “combat” for the Northern golf course superintendent—are the months of planning and preparation for his Southern counterpart. Fall overseeding lies just ahead for the Southern superintendent, and the quality of next winter’s golfing turf depends largely on how successful the overseeding program goes this fall. Overseeding warm season grasses for winter color has been practiced since the early 1900s, but it is still a much-discussed topic which lends itself to very few certainties.

Extensive studies by O. J. Noer, C. Wilson, and J. Latham in the early 1960s yielded much useful information and particularly advanced the use of *Poa trivialis*. Other studies have been conducted at various experiment stations,

but results vary from year to year and no panacea has evolved for our overseeding problems.

One of the many unsolved problems is the exact time to establish the winter grass. It occurs to a serious student of this operation that perhaps soil temperatures may be used to ascertain the appropriate date much as they are for field crops. A new seedling is largely influenced by temperatures in the microclimate and may grow rapidly while temperatures one inch above or below are adverse. By the time the plant parts grow beyond the microclimate, the chances are the air temperature will have changed considerably. The optimum seeding date would therefore seem to be more related to soil temperature than air temperatures.

Damping off a problem? New overseedings are always in danger of disease because of the susceptibility of these tender shoots and because temperature and humidity are ideal for disease about the time of planting. Since we can't control the climate, appropriate fungicides must be used to control the disease. Captan has proven to be effective against many turf diseases and has the advantages of being economical as well as gentle on the new seedlings. Certainly there are other fungicides as effective or possibly more effective than Captan, and most superintendents will recognize the need for specific fungicides to combat specific diseases. The important thing is simply to recognize the need for and the value of a good preventive fungicide program.

Which Grass Is Best?

Each year prior to overseeding there is a great deal of discussion about which grasses to use. The mixtures used are almost as numerous as the golf courses that overseed because there are unlimited combinations possible. Each turf species or variety has its own characteristic color, texture, resistance to disease, plus other special attributes or deficiencies. Varieties are used singly or in combination to give the performance and special effect desired.

The ryegrasses have long been the king in the field of overseeding, and new varieties promise to keep them in this position for a long time. These grasses give fast germination because of seed size and have good color and density according to the rate seeded. New varieties such as Manhattan, Pelo, NK 100, and some varieties from Pennsylvania State University now under test, are darker green, more heat tolerant, more disease resistant, finer textured and seem to go through the transition period better.

Creeping red fescues are desirable in mixtures because they add stiffness of blade to the putting surface, which is a characteristic that adds speed and trueness to the green. These are narrow-bladed grasses and are slower to establish than rye but they seem to make for an easier transition from overseeding to bermuda in the spring.

The bents are expensive and rather weak in the fall, but they produce good quality greens in the spring. These grasses are more heat tolerant, especially Pennncross, and if you are planning to hold your winter greens a little longer or you have a special tournament in April or early May, you should give strong consideration to some bent in the mixture. Bents can be discouraged to give a good transition but are aggressive in early spring and the transition is dependent on management.

Because of the heat tolerance and aggressiveness of bents, more and more courses are making the transition to year-around bent. This is relatively simple to accomplish, but well drained greens are essential and the farther south you go, the more important it is to have both good internal and surface drainage. It follows also that the further south you are and the warmer the winter climate, the more bent required for a successful overseeding.

The bluegrasses with the exception of *Poa trivialis* have generally proven rather poor for overseeding purposes. The seed is slow to develop by comparison, the blade is rather coarse, transition is often poor and the seed is more expensive than other grasses which produce the same or better results. On the other hand *Poa trivialis*, ranks next to the ryegrasses as the backbone of the overseeding program in the South. This is a fine-to medium-bladed grass which masks *Poa annua* and offers a better-than-average transition. The primary problem with *Poa trivialis* is contamination of the seed with weeds and only triple-cleaned seed should be used.

Possibly some of the newer strains of bluegrass will prove worthy of consideration, but as of this year, only *Poa trivialis* measures up. Because of seed crop failure, *Poa trivialis* was scarce in the late fall of 1970 and availability may not be good for the fall of 1971. If this is the case, everyone should be extra careful about reading the seed tags to see when the crop was harvested and beware of outdated seed which may provide greatly reduced viability. The best alternative would be to select other varieties which have shown up favorably in testing.

Planting Techniques for Greens

Selecting the overseeding grasses is important, but it constitutes only a minor part of successful winter greens. More important are good planting techniques and proper subsequent maintenance. Almost any of the grasses mentioned will provide acceptable greens, but even the best grasses are only as good as the management they receive.

Planting is a crucial step in bringing about good winter greens. The planting date varies with location and seasonal variations in weather, but everyone is shooting for a date that coincides with the onset of cooler temperatures. This condition is more favorable for the grasses being planted than for bermuda. If the weather remains hot after planting, renewed bermuda growth and disease often destroy the overseeding and replanting becomes necessary.

There are several ways to go about planting

winter greens, and here again almost everyone has his own special technique. To start with we will list only the major points to be considered:

1. Get the seed in contact with the soil,
2. Strive for even distribution of all seeds planted,
3. Protect seedlings against disease,
4. Insure adequate nutrients and moisture, and
5. Mow properly.

Getting the seed into contact with the soil is usually accomplished by vertical mowing to remove thatch and excess bermuda growth. Topdressing is also used before seeding or after seeding or both. Vertical mowing and/or spiking after seeding is a third measure to further insure good seed-soil contact. Any one of these methods or any combination may be used successfully. Aeration, however, should be discontinued for five to six weeks before overseeding to avoid tufts of grass coming out of the aeration holes.

Even distribution of the seed is usually accomplished by sowing different size seed separately in as many different directions as practicable (two directions minimum). Small seed in lighter quantities may need a carrier such as sand or organic fertilizer. Skillfully operated, a knapsack or other broadcast type spreader is faster and insures good distribution, but the seed is more likely to be displaced by wind. If the drop type spreader is used to reduce the wind factor, then a splash board is necessary to prevent seed rows.

We have already covered the necessity of a good preventive fungicide program, so don't be caught short trying to save a few dollars by leaving your new grass unprotected with before and after seeding treatments of fungicide. Your investment in seed alone may run well over \$20.00 per thousand square feet, so why risk failure trying to save your club a couple of hundred dollars or less on an investment of perhaps \$3,000.

Adequate nutrients, especially phosphorus, should be applied prior to seeding and then as required to keep it growing rapidly. Slow release materials have some definite advantages on young seedlings, but all fertilizers should be used carefully during the establishment period. If you have made adequate preparation for a fertile seed bed before planting, the nutrients in the soil and the food stored in the seed should carry you at least two weeks from the time of germination.

Moisture is critical at planting time, and it makes no difference how wet the soil is underneath if the surface is dry. The first tiny root the seed puts out must have moisture at all times or the new plant will die in a matter of minutes. The quantity of water applied each

time increases as the roots develop, but the soil should always be moist in the entire rootzone. Heavy watering just after seeding will only wash the seed into pockets or off the fairway, so be gentle.

Last of all, I wonder how many tons of seed have been pulled up by a dull mower? The first few mowings should simply have the effect of rolling or firming up the seedbed. The mower should be set at half an inch or higher to just nip off the tops of the higher shoots. And the mower should be sharp. The height of mowing is then gradually reduced to the desired level as the seed becomes better established.

Temporary Greens?

With all this done the new seed should be well on the way, but you should also take some extra precautions, such as providing temporary greens for a few days after seeding so the tender shoots won't be walked off the greens. If the overseeded greens must be played immediately, move the cups frequently and keep them on the front so that traffic is minimized on the major portion of the green. Now you can take a short coffee break before you begin to worry about getting rid of all the seed you have just planted so the bermuda will come back in the spring.

During the next few months, most superintendents may be found anxiously watching the daily weather forecast for ice, sleet, snow, or rain or cutting out little plugs of turf to see how the dormant bermuda likes it. You have heard the saying that "green is good and brown is bad." When it comes to dormant bermuda stolons and rhizomes, a light milky brown is pleasing to the eye, but black means the funeral services are in progress.

The Spring Transition

If Nature is kind, spring will come as a gradual warming period and the transition from overseeding to bermuda will be gentle, gradual and relatively undetected by the golfer. Bermuda breaks dormancy at about 50°F and will continue to gain strength as the temperature increases to around 100°F. A few days of 60°, followed by a couple of 80° days, then a drop to 20° will cause some trouble unless we get back into the 70s pretty fast. These false starts followed by long periods of warm days and cold nights cause more trouble than much of the severe mid-winter cold.

When warm weather finally arrives for the summer, the golf course superintendent takes on a whole new set of problems. Now the aim is to discourage the overseeding and bring out the

bermuda. Too much discouragement will cause a rough transition with the cool season grasses going out before the bermuda is ready to take over. If the overseeding is pampered and allowed to remain too long, bermuda is retarded and may not come back at all. The process must be gauged according to the weather and the progress of the bermuda.

Early season vertical mowing lightly to thin out the cool season turf will get more light to the bermuda and help warm the soil. Spiking also helps to put air into the soil surface and speeds soil warming. Later on, aeration will introduce still more air into the soil and encourage the warm season turf.

Putting stress on the cool season grasses by a reduction of watering frequency and eliminating the use of more water than is required to just keep the turf alive will slow down the overseeding without affecting the bermuda.

Apply only enough fertilizer to keep a satisfactory cover on the greens and avoid stimulating top growth in the overseeding. Light doses of quickly available nitrogen as needed only to maintain some color and density are helpful. Quite often a gradual, almost imperceptible transition can be made, but a rather rapid transition is possible if it is required for a tournament or other special event. Once you are sure the bermuda base is strong and healthy and pushing to come through the overseeding, enough fertilizer can be applied to complete the changeover more rapidly. Since the cool season grass is tottering on the brink and bermuda is in an active growth stage, larger amounts of quickly available nitrogen of up to one pound per 1,000 square feet will stimulate rapid bermuda growth and virtually eliminate the overseeding. Just be careful not to apply so much fertilizer and withhold water to the point of damaging bermuda.

Closer mowing will also help to thin out the competition from winter grass and a combination of many or all of the practices reviewed may be helpful. A delicate touch is required for an easy transition, and each spring is different.

It is a sad state of affairs when you have to start thinning out a nearly perfect putting surface, but if properly done, the putting surface will be acceptable through the transition and nearly perfect again early in the summer.

Planting Techniques for Tees and Fairways

Overseeding tees and fairways is another matter. Tees may or may not be too complicated, depending on the maintenance standard of the individual course. Fairways require the least attention of all. Except in the very popular resort areas, we are only trying to give some winter color to fairways, and the lighter the seeding rate with which we can accomplish this, the better. Tees are intermediate between fairways and greens, but approximately the same general rules of overseeding apply to all areas.

Where possible, fairways are left unseeded, but concentrated traffic requires a protective winter cover on tees and greens. Bermuda fairways which have not been overseeded and are not subject to heavy traffic will come out in the spring two or three weeks earlier and in much better condition.

Instead of overseeding, dyes have been tried on greens, tees and fairways but have met with limited success. Dyes last only so long as the dormant cushion on which they are sprayed. Where traffic is heavy and concentrated (such as on tees and greens), thin turf covers soon develop, mud holes may result, and the dormant bermuda is often completely destroyed. With dyes, the playing conditions can only get worse because without a live surface, they will never be any better than they were when the bermuda went dormant. Don't rule out dyes altogether (especially for fairways), but recognize their limitations. Don't expect dyes to do anything but add color.

Hopefully, we will gain more knowledge about overseeding each year, and, better still, find a turf which needs no overseeding in the South. Until then, just be thankful for each success and try to learn from each failure.

THE CHANGING SCENE

G. Duane Orullian, Western Agronomist of the Green Section since 1968, has accepted a position as Director of Golf for the City of Pocatello, Idaho. He will be in charge of golf operations for the City's 36-hole course. During his three years with the Green Section, Mr. Orullian visited USGA Member Clubs in the

Eastern, Mid-Continent and Western Regions.

Carl Schwartzkopf joined the Mid-Continent office region as an agronomist in June. Schwartzkopf is a graduate of Michigan State University and will work with Lee Record in the Midwest and assist in Western Region visits as well.

Zoysia—A Turf for Transition Zone Fairways

by LEE RECORD, Mid-Continent Director USGA, Green Section

When Jonathan Swift wrote, "Whoever could make. . .two blades of grass to grow upon a spot of ground where only one grew before would deserve better of mankind," he must have been thinking of the golf course superintendents of a transition zone; especially those superintendents who work in the mid-continent on a line between Cincinnati, Louisville, St. Louis, Kansas City and Wichita. It is in this transition zone that the survival of fairway grasses make a superintendent and his club.

A brief history tells us combinations of bluegrass, fescue, rye and bentgrass had been the standard turfgrasses for this area. The combination of bluegrass and fescue was by far the most superior mixture of grass to work with until fairway watering came along. Mis-management of water and the demand for a short height of cut of these grasses limited their longevity.

Today, new improved bluegrass strains, such as Pennstar, Sodco, Prato, Windsor, Fylking and Warren's A-20 may enlighten the bluegrass picture in the future; only time will tell.

Bentgrass had had little success until the last few years when Louis Miller, of the Louisville Country Club, began showing his membership they could have excellent bentgrass fairways. Lou's programs of water management and feeding practices, and the development of a very strong fungicide program, have given his membership the bentgrasses they wanted.

U-3 bermuda was introduced a dozen years ago and it seemed to have the desirable qualities. However, after six or eight years, U-3

began dying. Fairways that had been solid bermuda are now sparse. What happened? Insufficient aeration during the summer? Excessive thatch buildup? Height of cut? Drainage? Marginal potash levels? Winterkill? Whatever the cause, bermudagrass, whether it be native, U-3, or hulled, is being used very conservatively.

Zoysia, on the other hand, is becoming the number one turf, although it is not new to the transition zone. In the early 1950's, Ernie Schneider began introducing zoysia into his fairways while he was superintendent of Evansville Country Club in Evansville, Ind. Today, the present superintendent, Edward Boyd, reports acres of zoysia throughout the course.

Why has it taken so long for zoysia to catch on? The principle reason was one of introduction. Zoysia is a very slow growing turf that can only be planted vegetatively into established fairways by sprigging, plugging, strip-sodding, or solid sodding; on a clean area, hydro-stolonizing can be done. Zoysia cannot be introduced by seed in the transition zone as it can be in the South.

Meyer Zoysia has been the most promising zoysia to work with in the transition zone. Midwest Zoysia, released by Purdue University, has not shown the promise it was selected for in this region. Midwest, although darker in color than Meyer, has longer internodes and spreads twice as fast as the Meyer strain. However, it has too wide a leaf surface to stand up under golfing requirements for fairways. Meyer is a slow grower, but it has the following assets:

Figure 1. Hydro-stolonizing Method.



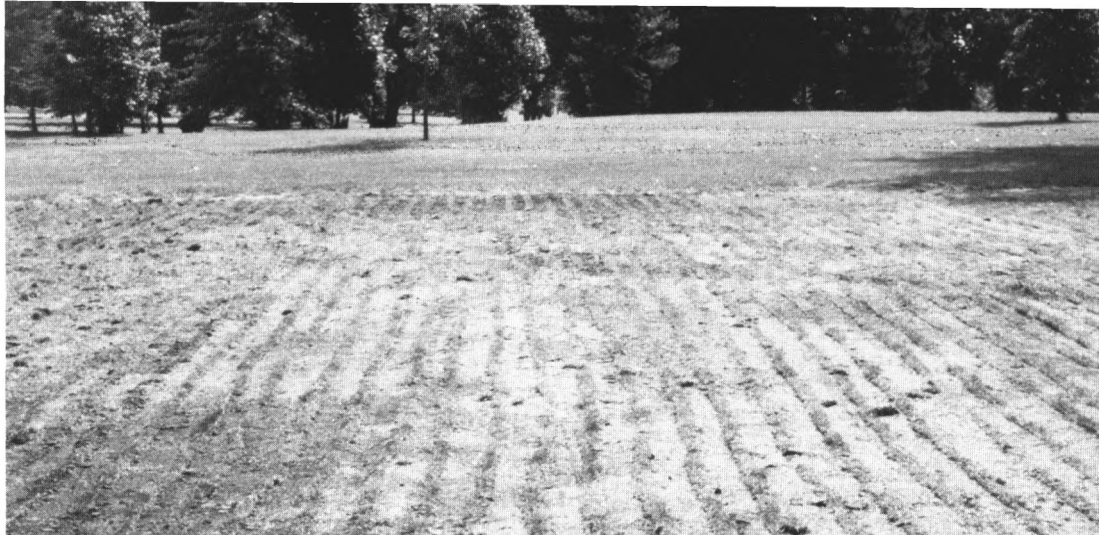


Figure 2. Strip sodding at four-inch intervals.

1. It resists crabgrass and other summer weeds.
2. It thrives during the heat of summer.
3. It grows on almost any kind of soil.
4. It is very drought tolerant and needs less irrigation than most turfgrasses.
5. It is easy to mow when cut regularly.
6. It needs mowing less often than most turfgrasses.
7. It can be mowed at heights from one-half inch to one inch without loss of vigor and beauty.
8. It produces a firm, resilient cushion of turf.
9. It is very resistant to wear.
10. It has good texture and color during the growing season.

Meyer, as well as any other zoysia, has its disadvantages too. For instance, it loses its green color in late fall after the first few killing frosts. It does, however, green up much faster in the spring than any other warm season grass. Dormant zoysia will let winter weeds invade, but this is not a serious problem with a good herbicide program. Zoysia is more shade tolerant than bermudagrass, but it will become weak in shaded areas. For this reason, a bluegrass-zoysia combination has worked very successfully at many courses. Bluegrass is overseeded in the fall along tree line fairways where sunlight is limited.

Strip-sodding and plugging have been the two primary methods of introducing zoysia into fairways. Solid sodding has been carried out extensively on many collars, but is not advocated for complete fairway areas due to the economics involved. The hydro-stolonizing method (Figure 1) was carried out at two golf courses in the St. Louis area during 1970. One course has been very successful with this program; plowing up six acres of fairways and

hydro-stolonizing five bushels of stolons per 1,000 square feet. Hydro-stolonizing fairways is new in this area, and anyone wishing to venture into this program is a pioneer.

Strip-sodding at 4-inch intervals (Figure 2) has been very successful in the Kansas City area. Paul Beer at the Indian Hills Country Club, Prairie Village, Kans., has been strip-sodding fairways for years. His endeavors have been very rewarding, not only for himself, but also for his membership. Complete coverage has occurred within 18 months with this type of sodding.

Plugging by hand or by mechanical means may have been done by more superintendents than any other method. Tom Sams, of the Audubon Country Club, Louisville, Ky., plugged 15 fairways during 1970 at an approximate cost of \$50,000. Peter Hitch, of the Meadowbrook Country Club, Ballwin, Mo., and Carl Beer, have been planting fairways to zoysia by plugging for the past several years with great success. All these superintendents have been using Meyer Zoysia.

It is true that the zoysia program is a slow program. The fact remains, though, that zoysia is the most winter hardy turf of the warm season grasses and has survived the long, cold winters of the transition zone. Disease has not been a problem and insect activity to date has been minimal. Thatch is not of concern, nor should it become so; there is available mechanical equipment to take care of this problem.

Meyer Zoysia makes an excellent fairway turf, or it wouldn't have been suggested and encouraged in the very difficult transition zone of the United States. Not many years ago, yarrow was seeded in fairways in the St. Louis area for turf cover. Yarrow, a weed, couldn't do the job. Zoysia can; try it and see!

Ground Pearl Damage to Tifgreen:



Ground Pearls shown in enlarged picture.

A Research Report

by GEORGE P. WENE, Urban Entomologist, University of Arizona

The ground pearl, *Margarodes miridonalis* Morr., is a subterranean scale insect which feeds on the roots of bermudagrass. It is a serious problem on lawns and golf greens throughout the southern United States, especially those planted to Tifgreen bermudagrass.

This scale was first described in 1927, nine years after specimens had been collected at Fort Myers, Fla., and in Georgia (Morrison, 1927). No mention was made of the scale's host, or whether its feeding was injurious. However, since nine years had elapsed between the original collection and the published description, one can assume that it originally was more of a collector's curiosity than an economic pest. Ground pearls are now causing extensive damage to centipede grass lawns in Georgia (Tippins and Bashear, 1968). In California, ground pearls were causing injury to grapes in 1954 and were also reported on irrigated bermudagrass pastures and other areas where bermudagrass was growing (Barnes, et al., 1955).

Ground pearls were first observed in Arizona during 1949 at Glendale, where they destroyed

two small areas of a bermudagrass lawn. This early damage was overcome by adequate fertilization and watering. A survey conducted in 1954 showed that ground pearls were injuring lawns and golf courses in the Phoenix area (Werner, 1955). In 1958, Tifgreen was introduced in Phoenix, and because of its desirable qualities for both lawns and golf greens, its use was greatly expanded in the succeeding years. Shortly after the introduction of Tifgreen, ground pearls were found in injurious numbers. Damaging infestations appeared to spread along with the expanding use of Tifgreen, which isn't surprising since most of the common bermudagrass turf had noninjurious infestations.

In 1968, ground pearls were found infesting sorghum near Phoenix. In 1970, this insect was found infesting grape roots in the Chandler Heights area.

What is a Ground Pearl?

A ground pearl is the immature stage of an insect which develops to an adult inside a pearl-like shell. This shell is hard and protects

the developing insect from predatory insects, diseases and prolonged periods of drought and excessive moisture. Because of the pearl-like covering, the immature insect is able to survive when grass is dormant.

Actually, very little is known about the life history of this insect. After the ground pearl has reached maturity and is about 1/8 inch in size, the adult leaves the ground-pearl shell. Only female adults have been reported (Morrison, 1927). The adult female is called a crawler because it has a small head, short legs and no wings. The crawler is slightly larger than the ground pearl from which it emerged, and it can only crawl short distances. Each crawler lays about 100 eggs which hatch into nymphs (Almand and Thomas, no date). These nymphs have legs, no wings, and are so small that it is impossible to see them unless they are placed under a microscope.

Shortly after hatching, the nymphs crawl a short distance, and with their mouth parts, attach themselves to bermudagrass roots. Immediately after attachment the nymphs lose their legs and develop pearl-like coverings. During this change, their mouth parts develop into tubes used for sucking plant juices. Newly formed pearls are difficult to see, but, as the immature insects inside the pearl-like shells grow, their shells also increase in size. The immature insects or nymphs slowly grow to adulthood within a year inside their shells. When nymphal maturity is reached, the adults emerge as crawlers from the ground pearl around June 1.

These crawlers are slightly larger than mature ground pearls. Their legs are short, and when they were placed on filter papers in petri dishes they moved very slowly, about an inch or so in a 24-hour period. This apparent lack of

movement is supported by population studies which showed very few ground pearls six inches away from half-dead Tifgreen spots known to be infested for at least three years.

Injury

Excessive ground pearl populations usually kill Tifgreen in irregular areas ranging from six inches to three feet in diameter. Such areas will be bare when the turf commences growth in the spring. In early July when temperatures are 100°F. or over, and especially when the turf is stressed for water, previously healthy looking turf may be killed by ground pearls in areas ranging from 6 to 12 inches in diameter. Ground pearls can be found in these areas during the mid-summer, the fall and the succeeding spring. If the area has been destroyed for over a year, ground pearls will be absent in the dead areas but present in large numbers on live grass roots in a 3- to 4-inch border surrounding the dead area. Within a year or so, the border area will be killed.

The damage by ground pearls to Tifgreen turf often is overlooked because common bermudagrass can tolerate ground pearl activity. Common bermuda will migrate in and develop a healthy-looking turf in spots of Tifgreen that have been weakened or killed by ground pearls.

Ecological Studies

During the last two years in Arizona, it has been observed that ground pearls developed to their maximum size during April and May. Shortly before June 1, crawlers (adults) start emerging from mature pearls. Soil samples showed that the highest populations of crawlers were on June 15. A few were observed on July 1. On June 1 only mature ground pearls were observed, whereas on June 15 only immature ground pearls were found. These ground pearls grew in size so that by fall, 25 per cent were

ABOUT THE AUTHOR

The late George P. Wene was raised on a farm in northeastern Ohio. He received his A.B. degree from Park College in 1934 and his M.S. degree from Ohio State University in 1939. He then worked for the Virginia Agricultural Experiment Station on tobacco insect control, completing his Ph.D. work at Cornell University in 1946. He was employed as a vegetable entomologist for the Texas Agricultural Experiment Station until 1957 when he moved to Arizona to do cotton insect research. In 1967 the Arizona Agricultural Experiment Station transferred him to a newly created position as an urban entomologist. In this position, Dr. Wene did research on the control of turf,

ornamental and household insects.

Dr. Wene died in a dust-caused multiple-vehicle collision near Casa Grande, Ariz., on May 12. He was returning home from research work on certain grasses in the Phoenix area.

At the time of his death, Dr. Wene was serving his second term as a member of the Arizona Pesticide Control Board. He was Southwestern regional member of the Executive Committee of the American Entomological Society, and in 1968 received a special award from Arizona Aerial Applicators Association for his contributions to Arizona agriculture. As a research scientist, Dr. Wene published extensively and the above article is his most recent contribution to the science of turfgrass culture.

approximately 1/16 inch in size and the other 75 per cent slightly larger. In spring, these ground pearls grew to their maximum size of 1/8 inch.

The life cycle of this insect is only one year. This is shown by the lack of mature ground pearls on June 15 and the presence of crawlers and immature ground pearls instead.

Grass becomes dormant in October and remains so until early March. Large ground pearls were collected on November 5 and placed in dry soil. A number of these larger pearls were opened on April 20 and eight of them had live crawlers (adults) in them. This shows that large ground pearls can survive for prolonged periods without being attached to grass roots.

Studies conducted in the greenhouse indicate that ground pearls spread a distance of only about four inches per generation, or per year, since there is only one generation annually. This explains why injury to Tifgreen spreads so slowly in the field.

Populations in yards and golf greens were determined by taking half-inch soil cores to a depth of six inches. In spots where the Tifgreen recently had been killed, the population averaged 31 ground pearls per sample. Although as many as 150 were found in some of the samples, samples taken three inches away from the dead area averaged only 20 and none were found 12 inches away.

The vertical distribution of ground pearls is

influenced by available moisture and soil type. On most golf greens, water is applied often and in small amounts. In a sandy soil on one Phoenix golf course, the majority of the root development was in the top two inches of the soil. The highest concentration of ground pearls was in the second inch of soil, similar to the root concentration. Below this two-inch soil level, the root concentration declined as did the ground pearl population. A few ground pearls were found as deep as nine inches in sandy soil, but this was in an area which received sufficient water thereby promoting root development.

Clay soils have a greater water holding capacity than sandy soils. As a result, bermudagrass roots were numerous to a depth of four inches. The ground pearl population was well distributed throughout the top three inches of soil. However, a few ground pearls were found at a depth of nine inches.

Ground pearl population records were taken from a golf course maintained on an adobe soil. The greens had from 1 to 1.5 inches of sand above an impermeable adobe layer. The Tifgreen roots were found only in the sandy layer, as were the ground pearls. Therefore, vertical distribution of ground pearl populations is determined to a large extent by the factors influencing root distribution in the soil.

Surveys show that populations of 25 ground pearls per 0.5 inch core sample (taken to a depth of 4 inches) killed Tifgreen. Populations of 25 or more per core sample caused no injury

Table 1.
Summary of 1969 and 1970 ground pearl control experiments
conducted in Encanto Park, Phoenix

Insecticide granules	Year	Applications		No. ground pearls in 25 0.5 x 4 in. soil cores	
		No.	Lbs./1000 sq. ft.	Before	After
Aldicarb, 10%	1970	4	2.3	859	11
Bay 68138, 15% ^a	1970	1	4.6	626	216
		4	1.6	857	39
		4	2.3	30	401
Diazinon, 14%	1969	4	4.6	711	311
	1970	4	4.6	711	311
Di-Syston, 10%	1969	1	6.9	266	57
		4	2.3	245	55
		4	4.6	87	43
Di-Syston, 15%	1970	1	1.6	515	27
		4	6.9	621	67
		4	2.3	405	148
Phorate, 10%	1970	4	2.3	667	259
		4	2.3	667	259
		4	2.3	667	259
Untreated	1969			882	701
				11	110
				415	188
	1970			11	110
				415	188

^aEthyl 4 — (methylthio-tolyl isosoprophylphosphoramidate)

to common bermudagrass.

Control Experiments

In the laboratory, crawlers were immersed in various concentrations of insecticides. Such organic phosphates as diazinon, Dursban, Azodrin, and Gardona proved highly toxic to the adult crawlers. Chlordane had no effect on the crawlers. Although toxic to crawlers, the organic phosphate had no effect on large pearls when they were immersed in various concentrations.

Controlled experiments were conducted in 1969 on the temporary greens at Encanto Golf Course, Phoenix. The greens were approximately 1,000 square feet in area. Each green was divided into two areas. The treatments used are shown in Table 1. Due to the limited number of plots, it was impossible to replicate, but this was partially overcome by repeating the treatments in 1970. Previous work shows that the crawler stage was the most vulnerable, and treatments were started before they appeared. The first treatment was applied on May 15. Those plots receiving multiple applications were treated at two-week intervals after the first application. Immediately after treatment the plots were irrigated. Population data was taken before the first treatment and again in October.

The data in Table 1 show that systemic insecticides can reduce ground pearl population greatly. Aldicarb proved to be the best, but this was one year's data and should be repeated. Di-Syston reduced populations significantly in both years. Phorate and Bay 68138 effectively reduced populations. Diazinon at a high rate of application also reduced the population. Four applications of 1.6 pounds each of Di-Syston (15% granules) per 1,000 square feet appeared to be slightly more effective than one large treatment (4.6 pounds) at the beginning of the season.

The population in the untreated plot remained constant throughout 1969. In 1970 two untreated plots were observed. The first had been treated in 1969 with Di-Syston. The data show that there was no carryover effect since the population doubled. The second untreated plot had been severely injured by ground pearls and very little grass survived.

The data indicate that ground pearl populations can be reduced greatly by applying 10% granule formulations of Aldicarb, Di-Syston, Phorate and Bay 68138 applied at the rate of 2.3 pounds per 1,000 square feet. Four applications should be made at 14-day intervals, the first being applied 14 days before the adult crawlers emerge.

SUPER SAM

by Paprocki



Books on Golf Course Turf Management

by WILLIAM H. BENGEYFIELD, Publications Editor, USGA Green Section

"Books," Bacon once wrote, "are the shrine where the Saint is, or is believed to be."

There is always a direct proportion: as man's knowledge on any subject increases, the number of authors and published volumes on the subject also invariably increases. Within the last year and a half, for example, at least four new books on turfgrass management have appeared, and more are on the way. As a professional turfgrass manager, you will be interested in these volumes as well as the major published contributions of the past. They are reviewed here with some candor. But please remember, placing something in print does not necessarily make it infallible. That applies to the books we review and this article itself.

Turf For Golf Courses by C. V. Piper and R. A. Oakley has become, for all practical purposes, a collector's item today. Published in 1917 by the MacMillan Company and written by two staff members of the United States Department of Agriculture, it is truly an original; the first of its kind. Although 54 years old, many of its passages are timeless.

The book is no longer available through normal channels. Probably a used bookstore and a lot of luck offers the best chance for obtaining a copy. Perhaps rare book dealers could be of assistance.

Turf Management by H. Burton Musser first appeared in 1950 and was revised in 1962. Many consider it the "Bible" of all turf management books. It is well illustrated, authoritative, and a practical guide to the subject. In addition to an editorial board of Messrs. O. J. Noer, Fred Grau, Herb Graffis and others, Professor Musser also called upon the knowledge and experience of golf course superintendents Marshall E. Farnham, T. M. Baumgartner, Ray Gerber, W. H. Glover and E. W. Van Gorder in preparing his text.

The book is a publication of the USGA Green Section and printed by McGraw-Hill. Available from Golf House, 40 East 38th Street, New York, N.Y. 10016 or your local book store. Price is \$10.95.

Building Golf Holes For Good Turf Management was edited by Dr. M. H. Ferguson and developed by the USGA Green Section staff in 1968. It is a particularly valuable publication for anyone considering building a new golf course or renovating and revamping an old one. Practical information on golf course site

selection to construction of greens, tees, fairways, bunkers, roughs, lakes, trees and irrigation is included within its 55 pages. References for further reading on each subject are also listed.

Copies are available from Golf House, 40 East 38th Street, New York, N.Y. 10016, and a charge of \$1 is made per copy.

Proceedings Of The First International Turfgrass Research Conference — 1969 is indeed a future "collector's item." Research papers from throughout the world are reproduced in English and cover a wonderfully broad spectrum of turfgrass science. Over 100 scientists attended the Conference and each paper is reproduced in the 610 pages. The range is wide.

There is only a limited (200 copies) supply of this publication in the United States. Write to Dr. R.R. Davis, O.A.R.D.C., Ohio State University, Wooster, Ohio. The price is \$8.50.

Turfgrass Science, edited by A. A. Hanson and F. V. Juska, was published in the fall of 1969. Some 38 authors, mostly university and research oriented, have contributed to the 28 chapters. Necessarily technical in some areas and only moderately illustrated, it serves as an excellent reference source for the serious-minded turfgrass manager.

It is a publication of The American Society of Agronomy and may be purchased from the Society, 677 South Segoe Road, Madison, Wisconsin, 53711. The price is \$12.50.

Principles of Turfgrass Culture and Practical Turfgrass Management by John Madison are two new books that have been published simultaneously and some may consider them as one. The author has obviously devoted tremendous time and energy to their preparation. The volumes are well illustrated and contain profuse references. He has combined history, restated facts and principles, interpreted old and new research, and added some personal philosophy and theory as well. Practical considerations are not always allowed to get in the way of theory. The author says in the preface, "Many readers will disagree with my viewpoint" — and he is right. But one must admire and respect him for not equivocating.

These books have been published by Van Nostrand Reinhold Company, 450 West 33 Street, New York, N.Y. 10001. The first sells for \$19.95 (420 pages) and the second for \$18.50 (466 pages).

TURF TIPS—

Some for Situations

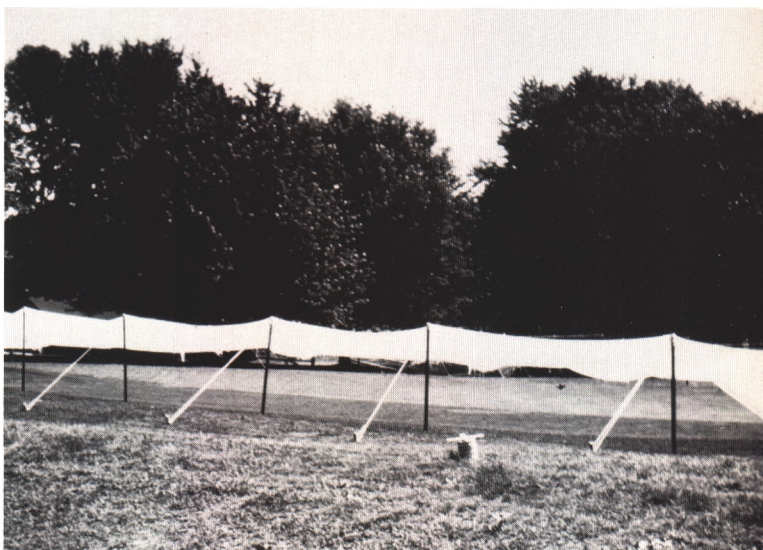
MORE THAN ONE WAY TO COOL A GREEN IN AUGUST

"One early August day, five inches of rain caused heavy flooding of our lower fairways and No. 7 green. They were completely submerged. Approximately 36 hours later the green cleared but the grass was weak and sickly. The temperature was high and conditions were right for wet wilt. The green was in danger!

"After the usual practices of aeration, syringing, and spiking, the green still showed signs of stress. It needed more protection from the blazing sun, and suddenly the practice of shading tobacco came to mind. We placed steel stakes at 10-foot intervals and stretched heavy nylon cord across the green, placing the tobacco netting on the nylon cord, forming a tent over the green. The sides were left open for ventilation.

"We syringed several times daily. The temperature was 15° cooler under the tent, and I have every confidence that the tobacco netting saved the day."

*John Perry, Superintendent
Country Club of
Farmington, Conn.*



NOT A MAN ON THE MOON — ONLY FRIT FLIES ON GOLF BALLS



*The frit fly (*Oscinella frit*) is a small black fly that seems to be attracted to white colors and will light on a golf ball or a handkerchief within seconds after it is placed on a green.*

The insect is about 1/16-inch long and 1/3 as wide. It is present in wild grasses in many states and frequently moves to cultivated grasses, especially greens when droughty conditions develop. Working on the crowns of the grass, it causes turf to have a weak, chlorotic appearance as though suffering from drought or disease.

Diazinon, Sevin or most insecticides effective against sod webworms or chinch bugs will control the frit fly.

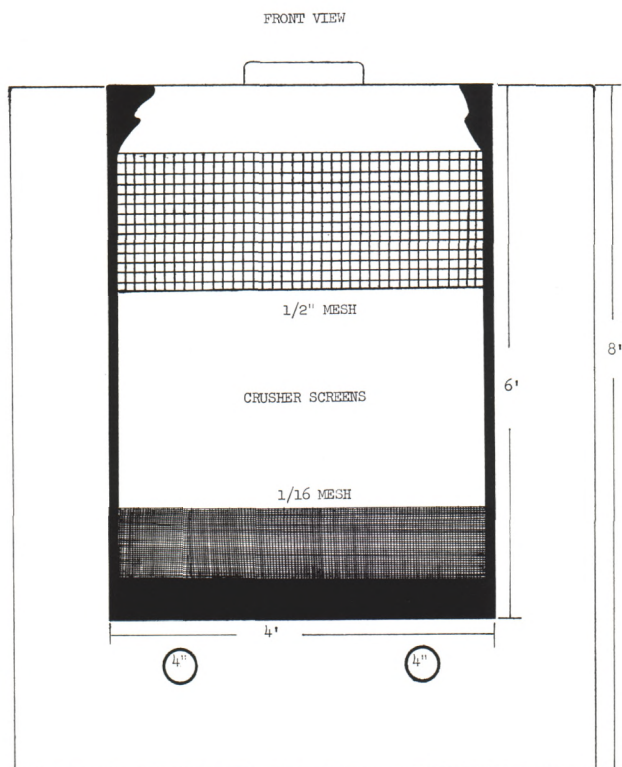
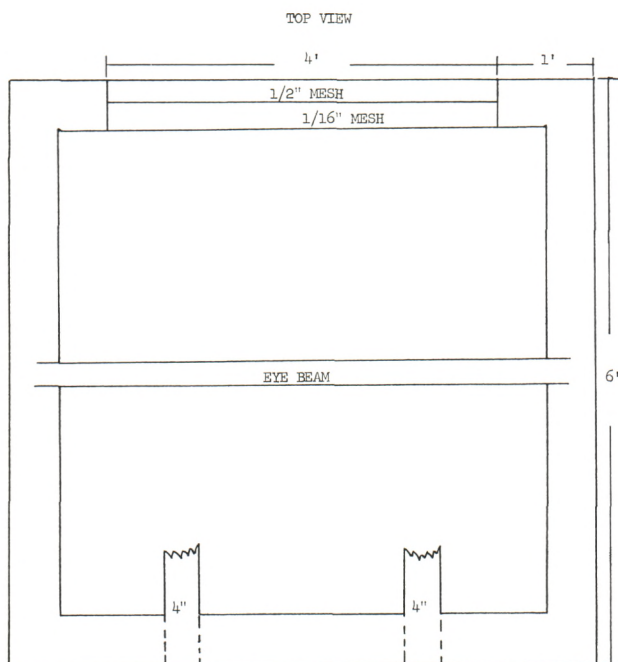
Usable Ideas Someday

FILTER BOX FOR IRRIGATION POND

Superintendent Bob Reighter, Philmont Country Club, Huntingdon Valley, Pa., constructed the filter box shown to keep foreign matter from getting into his pumping station intake lines for his course irrigation system. The idea was given to him by George Ley, Superintendent of the LuLu Temple Country Club nearby. Ley had constructed a similar filter box at his club.

There are two screens. One is placed in front of the other and these screen out leaves, twigs, and other floating debris normally found in ponds. One is a $\frac{1}{2}$ -inch mesh screen which is placed in front (on the pond side), of a $\frac{1}{16}$ -inch mesh screen. They are called crusher screens and are made of steel. They are easily removed as necessary for cleaning.

Two 4-inch intake lines suck the water from the filter box into the pumping station. Each has a foot valve, but no screen is needed over the end of the intake lines because the water remains clear and clean within the filter box.



TURF TWISTERS

CHECK IT OUT

QUESTION: What shall I do with surplus pesticide spray materials? (Pennsylvania)

ANSWER: First, check with your local county agricultural agent as to possible state regulations for pesticide disposal. If there are none, do not simply dump the material into your drain or sewer line. Instead, the following procedures have been suggested: A predetermined pesticide disposal area should be selected. It should be flat or gently sloping away from any potential water supply. The soil must be deep, at least 8 to 10 feet, and at least 100 feet from any water supply. The site should not be used for any purpose other than pesticide disposal. It should be fenced and labeled with warning signs. The site should be convenient for other types of chemical waste disposal, i.e., burying, burning, and liquid waste disposal. On the other hand, it might be just as wise (or wiser) to sit tight, continue to store the material as is, and await a solution or more factual information from authorities. The full story is not in as yet on this subject.

CHECK IT UP

QUESTION: Is water from a swimming pool, containing chlorine, harmful to golf course turf—putting greens in particular? (New York)

ANSWER: We have never found chlorine to be a problem on putting green soils even when directly applied from a swimming pool. Chlorine dissipates quite rapidly and, in fact, will not build up in the soil. At swimming pool rates for purification, chlorine will not harm soils or turf other than a possible minor temporary discoloration of blades. However, other elements or salts (chlorides, sodium, etc.) may present a serious turfgrass problem if they are present in the water and it is used for irrigation. A chemical soil analysis check will provide this information if you are having a soil problem and suspect swimming pool water.

CHECK IT IN

QUESTION: I need a good reference book on herbicides that gives common and chemical names. The chemical names alone are confusing to me. (Tennessee)

ANSWER: One of the best handbooks we know that fits this description is *Herbicide Handbook of the Weed Society of America*. You can purchase it from the Weed Science Society of America, Department of Agronomy, University of Illinois, Urbana, Ill. 61801.