USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association

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Modifying Putting Greens

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COVER PHOTO: Aeration holes filled with new topdressing material to modify the layering effect.

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When All Else Fails - USE PROVEN GUIDELINES

by **WILLIAM S. BREWER, JR.**, Agronomist,
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CONSIDERING THE exceptional nature of our resources and of the agronomic knowledge available, one might wonder why all putting greens are not perfect. While some puzzling situations exist, along with factors that are either imperfectly or not at all understood, nearly all poor greens can be faulted for inadequate design and construction techniques or materials.

CONSTRUCTION

As a general rule, any green more than 20 years old on a course that has 200 or more rounds daily, particularly during periods of adverse weather, is likely to be a candidate for rebuilding. Two decades ago soil profiles had not yet been engineered to withstand this level of traffic and still maintain sufficient pore space for supporting vigorous turfgrass roots. When these older greens are also overburdened with additional problems, such as shadiness, restricted air movement and non-ideal surface drainage, the very life of large sections of turf can repeatedly be in jeopardy.

What about newer greens? There is no doubt that the performance record has improved. However, it would not be safe to assume that the best available information on design and construction methods has always been used. Indeed, serious problems continue to be built into golf greens, most particularly where a rigid set of specifications has not been contracturally agreed upon and ensured through a schedule of quality control inspections and material analyses.

The United States Golf Association continues to seek improvements in the Green Section specifications for putting green construction, but it does not sanction modifications that have not been rigorously researched. Greens built in accordance with these specifications will, in most instances, cost more initially than greens built using techniques designed to make the work easier or faster. Yet it will take two or more years after they're built to realize the value of the more exacting specifications. It will take time for thorough profile settlement and turf density development to achieve maximum effects upon such vital physical characteristics as water infiltration rate, a rate that will certainly fall to no more than half (and, perhaps only one-fifth) of that determinable in the laboratory.

Nor should designs be approved that fail to resolve future problems that might reasonably be anticipated: traffic constrictions, limited cupping space, inadequate room or contouring for maintenance equipment, surface or subsurface water flow problems, and so forth.

In short, functional criteria for greens do exist, those which common sense will reveal and those which are sufficiently complex that they were developed through painstaking research. Neither sort of functional criteria can be overlooked or subrogated to other kinds of criteria without increasing the risk of ultimate disappointment. (Editor's note: single copies of the Refined Green Section Specifications For Putting Green Construction may be obtained, free of charge, from any of the Green Section regional offices, as may information about obtaining the special soil testing required for formulating and evaluating topmixes and topdressing materials.)

CORRECTIVE MEASURES

Short of rebuilding, what might be done to improve upon the problems inherent with a green not constructed to withstand today's heavy traffic?

First, look toward eliminating or modifying any other possible source of difficulty — tree root invasion, traffic concentrations, uneven irrigation patterns, drainage problems, etc. In many instances too, a hard look should be taken at the possibility of regulating total volume of play, and certainly at the wisdom of permitting play when surface soils are saturated with water. That is, readily identifiable agronomically unfavorable situations cannot be neglected, nor can management dodge responsibility for establishing and enforcing policies which protect the golf course from inadvertent damage done by golfers themselves when they are allowed to play in excessive numbers or during periods when the turf or surface soils are rendered critically sensitive to traffic stress by extremes in climatic conditions.

Second, develop a program to improve the rootzone through aerification and topdressing. A nearly complete transformation can be achieved within a year or two if the program is designed well and carried forth resolutely.

COMMITMENT

It cannot be stressed strongly enough that the attitudinal aspects of a surface improvement program are every bit as important as the technical details. In case after case that could be cited, the golf course superintendent and his club are able to consistently produce an excellent golf course in spite of having to contend with problem situations which are not significantly different from those affecting neighboring courses.

Cut away the many layers of detail that make up the rich texture of any golf course and the men responsible for it, and in the consistently successful operation you will find a steadfast will to succeed. The unavoidable setbacks are not overwhelming. Unanticipated problems are recognized for what they are, as additional factors to be fitted into the overall equation. Problems become debilitating only in proportion to the time spent in commiserating about them. With forward thinking, seeming difficulties can often be turned to advantage; but where that determination does not exist, no amount of expertise can bring about a trend reversal.

The responsibility for performance rests coequally with the superintendent and his boss(es), the individual or group responsible for ensuring support for the golf course maintenance operation as it is developed by the superintendent. Often we encounter resourceful superintendents who are unjustly criticized, men whose demonstrable level of achievement is being held back, not by their own shortcomings so much as by a lack of the necessary tangible resources, administrative policies and moral support of their efforts to provide that degree of golf course excellence desired and deserved by the players. Be clear about this — without an attitude of positive commitment seated firmly and harmoniously at both ends of the management table, the golf course and, in particular, any program set forth for improving putting surfaces is certain to fall short of expectations.

PROGRAM SPECIFICS

Rather than provide a stepwise discussion of a model program for putting surface improvement, the remaining space will be devoted to addressing some questions which are frequently raised. The references supplied at the end can be used to gain access to further literature.

Why maintain that commitment to such a program is of utmost importance? For three reasons:

(1) Additional resources must be allocated. Naturally topdressing and seed need to be pur-

The goal — smooth, healthy, dense and uniformly paced putting surfaces throughout the 18 holes.

The 16th hole at Oakland Hills Country Club, Birmingham, Michigan, a dog-leg as viewed from back of green to tee . . . excellence aesthetically and from the standpoint of play.

chased, and perhaps handling and application equipment as well. There may be other non-soil related problems to rectify. Provisions should be made for the testing of materials, both preliminary to final selection and periodically thereafter as a quality control check. Some redistribution of labor may be needed within the total man-hour requirements. A three-man crew should be able to apply a light dressing (½ cubic yard per 5,000 square feet) and restore nine greens to play in four to five hours, given efficient equipment, freedom from interference and a material which presents no handling problems. To maximize the program's effectiveness, topdressing should be carried out once each growing month, including twice (or more) at a heavier rate in conjunction with aerification for the first years of this program. From operational costs estimated using the above guidelines it will be seen that the most expensive factor can be the unit price of the topdressing material itself. Thus, it will pay to shop around.

(2) The second reason why commitment is vital is because, unlike most greens' maintenance procedures, the aerification — topdressing — seeding program intentionally disrupts the playing surface for a time in order to attain a better surface over time. Moreover, this must be done periodically through the growing season, which necessarily coincides with the active golfing season. Further still, the most disruptive parts of the program — the aerifications — need to be done according to the demands of nature's calendar, not the golfing calendar. Some golfers will, without fail, perceive this as a deliberate attempt to ruin their enjoyment of their game. With them, no amount of explanation or rational argument will prevail. One can only be firm and maintain composure. Others will at times become upset, but they can be won over. All players deserve to be kept informed well in advance, to have the program developed so as to minimize the degree and length of disruptions, and to have the golfing calendar planned around the program so that key tournaments will not conflict with it.

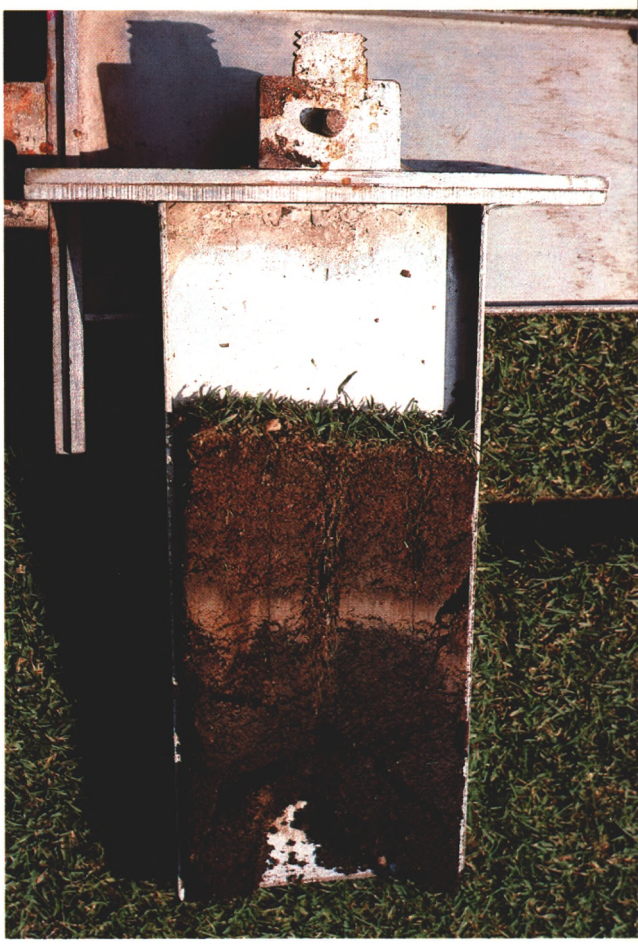
(3) The final reason for dwelling on commitment is that there is no way to guarantee uniformly

uneventful success in this or any other program involving the culture of growing plants. If the will to achieve success in spite of encountered difficulties is weak, the program will hit the skids long before it has been given sufficient time to prove its worth.

What if the greens present no soils-related management problems and are consistently maintained to the golfers' liking? Clearly in this situation one would be ill-advised to radically alter what is already a successful program. Be alert, however, for changing conditions, particularly to increasing traffic pressures. This is not to say that for courses where the greens are already in great shape some type of aerification and topdressing program is not needed. Very likely the prevailing good conditions are due principally to such efforts as they have been adapted to suit the particulars of the situation.

If one is unsure if the existing soils or topdressing is contributing to management difficulties, is there any way to check these materials for performance characteristics relative to some objective standards? And, is it possible for anyone to make a sufficiently accurate judgment about a putting green soil or topdressing on the basis of its appearance and feel? Yes, the soil testing laboratory located at Texas A&M University is equipped to analyze materials for comparison with the ranges currently considered acceptable for construction according to the researched and widely field tested Green Section specifications. For a preliminary inexpensive survey of existing soils, it may suffice to submit aeration core samples for a testing of infiltration rates only. To properly evaluate a topdressing material, however, a complete mechanical analysis and testing of various physical performance characteristics will always be preferred. No one lacking full certifications as a clairvoyant can tell by feel or appearance precisely what this laboratory testing of a material will reveal. It is possible, though, for those familiar with the specifications, when assisted by a simple sieve analysis, to single out those samples widely at variance, so that only the most promising of materials need be sent on for the complete evaluation.

What is the material of choice for topdressing? Remembering that we are discussing those situations in which the surface soils have proven inadequate to support both heavy traffic and vigorous turf growth, the material of choice would most importantly be one which withstands such compacting forces so as to remain well aerated. It will also be: (2) well drained, with a good infiltration rate; (3) capable of modest nutrient and water retention; (4) firm, but not hard, when in place; (5) free from weed or disease contamination; (6) easy to handle; (7) lacking any significant amount of oversized particles, those difficult to work into the turf surface; (8) readily available into the foreseeable future; (9) uniform in composition, both within each load and from load to load; and, (10) relatively inexpensive. In other words, this is a very special sort of material which should only be selected after a thorough investigation that absolutely should include the special laboratory testing mentioned already.



Note clay silt layer through the center of profile, a result of using sod grown on poor soil. The effect is permanent impairment of water movement through the green profile and a soggy, problem green.

The ideal material would conform in every respect to the Green Section specifications and would be ready to apply as delivered. The next best situation would be to so process the delivered materials as to obtain a mixture which conforms. This may involve but a simple screening operation to remove oversized particles, or it may require the more exacting process of blending materials according to a specially prepared laboratory formula.

Finally, there is the so called sand topdressing program which has come into prominence. Here it is worth noting that mixes which conform to Green Section specifications are also technically in the sand textural category. What we are really discussing then is the use of a sand which differs from the specifications in but two measurable criteria: an infiltration rate faster than the maximum suggested and a water (and nutrient) holding capacity

below that recommended. Pending the results of future research, provisional acceptance is being given to such sands with a preference for those slightly "dirty" sands coming closest to also meeting the specifications for infiltration rate and water holding capacity. By sampling widely those sands readily available, one or more can be selected to send on for the complete testing. Owning a set of sand sieves would provide superintendents valuable assistance in the selection process, as well as a means to conduct quick quality control checks on each on-site delivery.

What about layering problems? Where the existing surface material is inadequate, and rebuilding has been rejected as a solution, layering cannot be avoided. Problems associated with layering can be held to a minimum, however, by being particularly careful with irrigation and by diligently carrying through on both the aerifications and the topdressings. The aerifications serve to puncture the barrier layer, the topdressings serve to continually add to the depth of the new rootzone being created.

How does the Stimpmeter fit into the picture? It is simply an instrument with which one aspect of putting green performance can be measured. The green speed and uniformity in speed from green to green may indeed be a factor to consider when determining whether or not to institute a topdressing program. Cutting height influences green speed, and it can often be lowered somewhat without incurring damaging effects but only after the topdressing program has begun and the first several applications made. It is easy to imagine, however, any number of agronomically unwise practices, such as dropping the cutting height too severely or at an inappropriate season, for which the Stimpmeter may be blamed. But it should be obvious that an instrument cannot make a decision, good or bad. It can only furnish some information for consideration in arriving at a decision.

It is here, somewhere in the middle of things, that this discussion should come to an end, so as to emphasize that this is no completely determined area of investigation. There are guidelines for us to follow in striving for putting green improvements, some of which continue to be ignored, but the field remains open for those who would seek to advance our understanding and progress.

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USGA Green Section Specifications for Soil Mixtures Used for Golf Greens

Particle Size Analysis of the Mixture (Size and Distribution of Particles)

Size Fraction	Particle Diameter	Tolerances
gravel	greater than 3mm	0
fine gravel	2-3mm	Max. 3%
very coarse sand	1-2mm	Max. 10% above 1mm
coarse sand	0.5-1mm	Min. 65% between .25 and 1mm
medium sand	0.25-0.5mm	Min. 65% between .25 and 1mm
fine sand	0.10-0.25mm	less than 25% below .25mm
very fine sand	0.05-0.10mm	
silt	0.002-0.05mm	less than 5%
clay	less than 0.002mm	less than 3%

Bulk Density (g/cm^3)

1.25-1.45 ideal
1.20 is minimum
1.60 is maximum

Porosity (% Pore Space when compacted at 40cm of water)

Total 40-55%
Non-capillary minimum 15%

Infiltration Rate (after compaction at 40cm of water)

4-6 inches per hour is ideal
10 inches per hour is recommended maximum
2 inches per hour is minimum for bermudagrass
3 inches per hour is minimum for bentgrass

Water Retention (at a tension of 40cm of water)

12-25% by weight at 40cm

Herbicide Approach for Weeds

by B. J. JOHNSON, Associate Professor of Agronomy,
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ARE HERBICIDE applications necessary to maintain a good quality turf on greens, tees, and fairways? Think back to the time when bermudagrass greens contained more annual bluegrass *(Poa annua)* than either bentgrass or overseeded cool-season grasses, when annual weeds dominated the fairway turf. Fertilization and other management practices definitely influence weed populations, but herbicide usage has proven itself necessary in the overall program for maintaining a quality turf.

Several factors must be considered in choosing a herbicide. First, the chemical must be selected for the specific weed under consideration, not simply because it is a weed killer. Secondly, treatments must be applied at the correct date and rate for effective control, and, third, in some cases repeated treatments are as necessary as choosing the correct herbicide. Having a weed-free turf does not happen by accident; it requires careful selection, planning and execution of all seasonal-herbicide treatments.

WINTER ANNUAL CONTROL

Winter annual weeds are found in most dormant turfgrass areas throughout the southeastern United States. They become evident during the winter and early spring where mild winter temperatures occur. To prevent this undesirable appearance, and also to prevent these weeds from

Figure 1. Spiny stickers on seed pods of spur weed.

delaying spring green-up of the warm-season grasses, the weeds should be eradicated.

The selection of herbicides for postemergence control of different weed species common in the Southeast is shown in Table 1. These results indicate that in most instances, weed species should be identified before selecting a herbicide treatment. A single paraquat treatment completely controlled annual bluegrass and common chickweed *(Stellaria media)*, and 82 and 91 percent of corn speedwell *(Veronica arvensis)* and spur weed *(Soliva sessilis)*, respectively. However, two applications were required for acceptable henbit *(Lamium amplexicaule)* and parsley-piert *(Alchemilla microcorpa)* control. A single 2,4-D + MCPP + dicamba treatment satisfactorily controlled common chickweed and spur weed, but two treatments were needed for acceptable henbit and parsley-piert control. Since corn speedwell was not satisfactorily controlled with 2,4-D + MCPP + dicamba, a different herbicide should be used when this weed is present. Metribuzin was the only herbicide that controlled all six weeds in this study with a single application. It may not be necessary to obtain complete control of all weeds in order for a chemical to be acceptable. However, there are exceptions and spur weed is one that the chemical must control completely because of the many sharp spiny stickers on its seed pods (Figure 1).

SUMMER ANNUAL WEEDS

Crabgrass *(Digitaria sanguinalis)* and goosegrass *(Eleusine indica)* are major weeds that invade bermudagrass and other turfgrass areas during late spring and summer. When weeds are not controlled, they will compete with turfgrass for moisture and nutrients and this usually results in

TABLE 1

Postemergence Herbicide Treatments on Control of Winter Annuals in Dormant Bermudagrass.

Treatments			% Weed Control					
Herbicide	Rate	Application	Annual Bluegrass	Corn Speedwell	Common Chickweed	Henbit	Parsley-piert	Spur Weed
	lb/A	No.	0 to 100 (100 = best)					
2,4-D + dicamba	1+.5	1	0	32	100	75	82	89
		2	0	60	100	98	95	98
2,4-D + MCPP + dicamba	1+.5+.1	1	0	27	96	64	46	88
		2	0	63	100	93	76	100
Bromoxynil	0.5	1	0	14	10	28	88	23
		2	0	47	31	81	100	85
Paraquat	0.5	1	100	82	100	57	61	91
		2	100	100	100	99	98	100
Metribuzin	0.5	1	100	99	100	100	99	91
		2	100	100	100	100	100	100

Treatments were applied at the given rates for each of 1 or 2 applications. First application was generally applied in February and second application 2 weeks later. Data are averages from 3 or more experiments.

low-quality turf. Selected preemergence herbicides applied in early spring will satisfactorily control both of these weeds in bermudagrass turf (Table 2). It is important, however, to apply the treatment prior to the germination of the weed seed. Crabgrass usually germinates after mid-March and goosegrass after mid-April in the Piedmont Region of Georgia, where these studies were conducted. Both weeds will germinate earlier in southern locations and later in northern locations. Bensulide and oxadiazon treatments controlled the highest percentage of crabgrass when applied in mid-March. The control was reduced slightly when treatments were applied in February and greatly reduced when applied in April or May. The poor control from April and May treatments indicated that crabgrass seed had germinated prior to the preemergence treatments. These results indicate that it is better to apply preemergence treatments a little earlier than later for crabgrass control.

Neither DCPA nor benefin applied as a single treatment controlled crabgrass satisfactorily regardless of dates of treatment. In a separate study, crabgrass was controlled satisfactorily when benefin was applied in March followed by a second application in May. DCPA failed to give consistent control from repeated treatments.

Oxadiazon was the only herbicide that controlled goosegrass satisfactorily (Table 2). Although the control was the highest from April

Figure 2. Turf on the right was treated with DCPA for four years compared with untreated turf on the left side. Upper: Tifway. Lower: Tifgreen.

TABLE 2

Dates of Herbicide Treatments on Control of Crabgrass and Goosegrass in Bermudagrass.

Treatments		% Weed Control	
Herbicide	**Date**	**Crabgrass**	**Goosegrass**
		0 to 100 (100 = best)	
DCPA	Feb.	60	15
	Mar.	57	32
	Apr.	33	16
	May	17	10
Bensulide	Feb.	80	10
	Mar.	93	23
	Apr.	71	24
	May	46	5
Benefin	Feb.	60	50
	Mar.	65	39
	Apr.	51	41
	May	37	41
Oxadiazon	Feb.	83	76
	Mar.	90	82
	Apr.	46	93
	May	15	83

Treatments were applied at mid-month and data are averages from 6 experiments for crabgrass and 3 experiments for goosegrass.

treatment, the control was not reduced greatly from earlier or later dates of treatment. Oxadiazon should not be applied to bermudagrass greens, but it can be used around greens, tees and on fairways.

When herbicides are applied annually for summer weed control, the turfgrass tolerance may differ with varieties. After four consecutive years of treatment with DCPA, Tifway bermudagrass was not injured, whereas Tifgreen had moderate injury in the spring (Figure 2). This indicates the need to know the effects of chemicals on the desirable turfgrasses as well as on weeds.

Emerged crabgrass can be readily controlled with repeated MSMA treatments. However, the treatment will not give consistent goosegrass control. Recent tests showed that Metribuzin controlled goosegrass almost completely when applied at 0.5 pound per acre in each of two applications (Table 3). In some years the control was just as good from one application at 0.5 pound per acre rate, or two applications at 0.25 pound per acre per treatment. Results, however, were not consistent from year to year. Preliminary results indicate that two applications of MSMA + metribuzin at 2.0 + 0.12 pound per acre per treatment control goosegrass better than MSMA alone and just as good as metribuzin applied alone at the higher rates. Goosegrass control from the combination treatment is shown in Figure 3. The advantage in using the combination treatment is that there is less bermudagrass injury than when treated with higher metribuzin rates.

Spotted-spurge *(Euphorbia maculata)* is often found in bermudagrass and strongly competes with the grass throughout the summer. In a pre-

Figure 3. MSMA + metribuzin controlled goosegrass in left plot compared with untreated turf on the right.

liminary study it was found that a single treatment of metribuzin (0.5 pound per acre) or 2,4-D + silvex + dicamba (1.0 + 0.5 + 0.1 pounds per acre) resulted in excellent spotted-spurge control (Table 4). None of the other treatments (2,4-D + dicamba, 2,4-D + MCPP + dicamba, or dicamba) satisfactorily controlled the weed with a single application. The 2,4-D + silvex + dicamba treatment severely injured the bermudagrass stand and resulted in 27 percent loss one month after treatment. Metribuzin caused initial yellowing of the turf, but the grass fully recovered within three weeks. This indicates that 2,4-D + silvex + dicamba should not be applied to actively growing bermudagrass because severe injury is surely to result. It is also possible that metribuzin applied at rates lower than 0.5 pound per acre may result in acceptable control; however, it should be remembered that these data are not complete.

These results indicate that it is important to identify weed species before selecting a herbicide for weed control in dormant or actively growing bermudagrass turf. When preemergence treatments are used, choosing correct dates of application are also important to obtain maximum weed control performance from the herbicides used.

Editor's Note: Metribuzin is non-selective, and therefore not recommended for use on cool-season grasses.

TABLE 3

Postemergence Herbicide Treatments on Control of Goosegrass and Crabgrass in Bermudagrass.

Treatments		% Control	
Herbicide	**Rate**	**Goosegrass**	**Crabgrass**
	lb/A	**0 to 100 (100 = best)**	
MSMA	2.0	58	93
Metribuzin	0.25	66	47
	0.5	98	87
MSMA + Metribuzin	2.0+0.12	98	—[a]

Treatments were applied in 2 application rates at one week interval in August. Data are averages from 3 or more experiments.

[a]Crabgrass control would be equal to or higher than MSMA applied at 2.0 lb/A alone.

TABLE 4

Effect of Postemergence Herbicide Treatments on Spotted-Spurge Control in Bermudagrass: A Preliminary Report.

Treatments		
Herbicide	**Rate**	**% Spotted-Spurge Control**
	lb/A	**0 to 100 (100 = best)**
2,4-D + dicamba	1.0+0.3	61
2,4-D + silvex + dicamba	1.0+0.5+0.1	98
2,4-D + MCPP + dicamba	1.0+0.5+0.1	59
Dicamba	1.0	50
Metribuzin	0.5	100

Data are preliminary and represent a single treatment from only one year.

Charles B. White

Charles (Bud) White was appointed Southern Region agronomist in December. He has just completed his Masters thesis at Clemson University in the Department of Horticulture under the direction of Dr. A. Robert Mazur. He has had eight years experience working at golf courses in North Carolina, thereby providing an excellent balance of experience and education in the field of fine turfgrass culture. He is eminently qualified in the science of golf turfgrass maintenance and management.

Effective January 1, 1979, the National Director and Northeastern Region offices will be located at the United States Golf Association headquarters, Golf House, Far Hills, New Jersey 07931. Telephone, (201) 766-7770.

This Poa annua *collar winter-killed in winter 1977-78. The bentgrass green survived the extended period under ice cover with no problem.*

Promoting Recovery from Winter Injury

by JAMES T. SNOW, Northeastern Agronomist, USGA Green Section

"NEVER HAS the winter weather in the East caused so much damage to the fine turfgrasses as this year."

Sound familiar? The winter of 1977-78; right? Or how about the winter of 1976-77? Actually, this quote is taken from the July 1963 USGA *Green Section Record* and describes the winter of 1962-63. It would be safe to say that golf course superintendents can never feel totally at ease about their chances to avoid winter injury.

Despite the best efforts of the superintendent to prepare his course for winter, to remove ice and snow and to make mid-winter snow mold fungicide applications, some courses still are hit by winter injury. Why winter injury strikes one section of the state and not another, one golf course and not the course next door, or one green and not the green 100 yards away probably never will be answered satisfactorily.

Fortunately, more than luck is involved in promoting the fastest possible recovery from winter injury. A number of good techniques have been developed for the introduction of new grasses into injured areas.

SET THE GROUND RULES

Ground rules regarding the nature of the re-establishment program should be set and made known to the entire membership through the Green Committee. The Committee should know what will be done long before damage occurs and about how long it may take to effect full recovery. Of paramount importance, try to ensure that heavily damaged greens will be temporarily closed until

An example of successful use of a winter cover over a green with a history of winter injury problems.

re-establishment is well under way. A little patience on the part of the members early in the spring will definitely pay off in terms of having the turf on the regular green in top shape far more quickly. Injured greens that remain in play recover painfully slowly.

START EARLY

We have found that the fastest and best results are usually obtained when the renovation work is begun as early in the spring as possible. It can be argued that the soil and air are too cold to promote fast germination and growth at this time, but the fact remains that the sooner the area is seeded, the sooner it is back in play. The golfers also like to see that something is being done to resolve the problem as early as possible. A green seeded a month earlier than another may be in play just a week or two sooner, but that is a significant period of time to golfers who are eager to play the regular greens after a long layoff.

PLASTIC MAY HELP

To partially overcome the germination and development problem due to cold soil and air temperatures in early spring, some superintendents have had excellent results by placing sheets of clear plastic over the seeded area. The plastic cover acts as a greenhouse, raising soil and air temperatures and keeping the soil surface moist. It is important to be prepared to remove the cover during warmer mid-day temperatures. Logs, boards and old tires work well to hold the plastic in place, as they must be moved daily to prevent the underlying turf from weakening. Black plastic causes drastic increases in the air temperatures below and should not be used. If reasonable care is taken, the use of clear plastic to promote early germination and growth can save several weeks of recovery time, especially when the spring weather is cooler and cloudier than normal.

SODDING VERSUS SEEDING

Sodding an area has some obvious advantages over seeding, but the situation has to be right to get the best results. Ideally, the new sod should be grown on a soil identical to the soil of which the green is constructed. If the soil accompanying the sod contains more silt and clay than the soil on the green, layering results and drainage becomes a problem. The sod is best taken from a nursery area on the golf course which has been maintained exactly like the regular green. If good sod is not available or the area to be treated is very large, then overseeding is the better choice. Another good reason for seeding is that it may take many months to true the surface after sod has been laid.

SLICE AND SEED

When overseeding is done, the basic prerequisite of providing good soil-seed contact is absolutely necessary. One accepted method is to

deeply verticut and broadcast seed over the area to insure that some of the seed will settle into the grooves. Spiking in several directions prior to broadcasting the seed may also contribute to the success of this operation. Another method is to use the machines which place the seed directly in the grooves in the same operation, thereby saving seed and ensuring good soil-seed contact. In the re-establishment of a green, it is best to go in two directions with this operation. For even better results, spike in several directions and broadcast more seed over the area after the machine has been used. A light topdressing should follow each overseeding.

We have found that chances for success are limited with this technique if the green is to be kept in play after overseeding. The crowns of the young plants are near the surface and the seedlings are crushed before they have a chance to mature. Under these circumstances it would perhaps be best to aerate, topdress and overseed, thereby giving the young seedlings an opportunity to develop in the aeration holes which protect them from traffic.

AERATE — TOPDRESS — OVERSEED

A good alternative to slicing and seeding, and one which many superintendents prefer, is to re-establish an area through aerating, topdressing and overseeding. Aerating relieves soil compaction and provides an excellent microenvironment for seed germination and turf development. As suggested above, this may be the preferred technique if the green must be kept in play during re-establishment. However, this method also will work far better if the green is kept out of play.

First aerate the green and remove or break up the cores. Then topdress at a rate of about two cubic yards per 5,000 square feet, broadcast seed over the area and drag or brush the material into the aeration holes. A seeding rate of about two pounds of bentgrass per 1,000 square feet should be sufficient. Some prefer to apply the seed before the topdressing and still others like to spike in several directions between the aerating and topdressing operations in order to provide more openings in which seedlings can become established.

Slicing and seeding in two directions is often recommended as part of a re-establishment program.

SYRINGE — SYRINGE — SYRINGE

Once the seed has been sown, nothing is more important to the success of the re-establishment program than keeping the seedbed uniformly moist. Allowing any portion of the surface to become dry may severely set back or kill many young seedlings. Syringing once per day is not enough, except perhaps where a mulch is used. Frequent watering is especially critical on a sandy base, and syringing may have to be done several times a day, seven days a week, depending upon the physical characteristics of the seedbed and the environmental conditions. Sometimes a light dusting of peat will help conserve moisture on high sand content greens. Periodic applications of a fungicide should be made to prevent damping-off of the young seedlings.

POST-ESTABLISHMENT CARE

In addition to frequent syringing, a number of other maintenance operations are recommended for best results. A starter fertilizer, high in phosphorus, should be applied at the time of or soon after seeding to promote root growth and seedling development. Syringing frequency can be reduced as the roots of the grass become stronger. Spiking the turf at least once per week is recommended because spiking will open holes in the surface crust through which new plants can develop. If you choose, seed can be put down after spiking at a rate of about ½ pound per 1,000 square feet. If overseeding is done, a light topdressing should follow at a rate of ½ to ¾ cubic yard per 5,000 square feet. Do not bury the seed with a heavy application of topdressing. When seed germinates and develops, it is most important to mow seedlings carefully with a sharp mower.

Finally, keeping traffic away from the newly seeded area is critical to ensure the best results. If a major portion of a green has been injured, it should be closed and a temporary green put into play. If a small, localized area on a green has been damaged, keep golfer traffic away by putting pin placements as far from the area as possible. If it is located in or near a walk-off zone, it will probably be necessary to redirect traffic.

A discussion of turf establishment would not be complete without mention of the weather. If cold, cloudy conditions prevail during much of the spring, as in the Northeast during 1978, recovery from winter injury can be delayed by several weeks or more. However, by following the procedures outlined above, successful results in promoting recovery can be obtained. Above all, remember to start your renovation work as early as possible, keep the seedbed evenly moist through frequent syringing, and keep traffic off the newly established areas as long as possible.

TURF TWISTERS

SAVE THE BARK

Question: How can young trees be protected from damage caused by wildlife during the winter? (New York)

Answer: You may have at least two types of injury: the browsing of deer on twigs or entire small plants and the feeding of mice or rabbits on the bark of trees, perhaps to the extent of girdling them. Keeping the surrounding vegetation down is important in mice control, especially for a 4- to 5-foot radius about the trunk. Mice and rabbits can best be thwarted with a wrap of ¼ inch mesh hardware cloth imbedded several inches into the ground and extending above the expected snow line. Fencing can be used to keep deer and rabbits from an area, or commercially available repellents can be applied.

A LITTLE HEAT

Question: Why is it that constant effort is needed to keep the golf course in top shape and the whole operation running smoothly? (Illinois)

Answer: The Second Law of Thermodynamics deals with this, the tendency of all systems to randomize (the property of entropy). In effect, to maintain order always requires energy expenditure . . . and sometimes a little heat!

WILL REMOVE ICE

Question: When does ice endanger turf on putting greens . . . when should it be removed? (Connecticut)

Answer: Removal operations should begin after 60 days of continuous ice cover on greens composed primarily of *Poa annua*, whereas, 100 days may be allowed to pass before initiating ice removal on predominantly bentgrass greens. Tolerance to ice cover is another strong reason why bentgrass is preferred over *Poa annua* as a putting surface.