USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association

MARCH/APRIL 1978

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VOL. 16, No. 2 **MARCH/APRIL 1978**

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L. to R. — Will F. Nicholson, Jr., USGA Green Section Committee Chairman; Dr. Jesse A. DeFrance, Award Recipient; Harry W. Easterly, Jr., USGA President.

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Turfgrasses for Golf and How They Affect You - The Golfer

1978 GREEN SECTION EDUCATION CONFERENCE

Dr. Jesse A. DeFrance, 18th Recipient of USGA Green Section Award

DR. JESSE A. DeFRANCE, of Sarasota, Florida, became the 18th recipient of the annual USGA Green Section Award for distinguished service to golf through work with turfgrass. The Award was presented to Dr. DeFrance by Harry W. Easterly, Jr., of Richmond, Virginia, who was then President of the USGA, and Will F. Nicholson, Jr., of Denver, Colorado, Chairman of the USGA Green Section Committee. The ceremony took place during the 22nd Annual Green Section Conference on Golf Course Management, which was held in San Francisco on January 27.

The entire 15-member USGA Executive Committee attended the presentation ceremony, and Mr. Easterly introduced them all.

As he accepted the Award, Dr. DeFrance recalled his early days of education at Colorado State University, where he played golf on sand greens at the Fort Collins Country Club! He then told of his first meeting with Dr. John Monteith, Jr., at the Green Section's Arlington Turf Gardens; his stopping by to see the late Joe Valentine, Superintendent at the Merion Golf Club in Ardmore, Pennsylvania. Valentine showed him the beautiful patch of bluegrass which later became known as Merion bluegrass; his trip abroad in 1937 to attend the Grassland Conference with Dr. Monteith and Dr. Fred Grau, where they met Dr. Dawson, head of the Research Station sponsored by the British golf clubs.

Dr. DeFrance was born in Golden, Colorado, and received his Bachelor of Science and Master of Science degrees from Colorado State College. He earned his Doctorate from Cornell in 1932 where his thesis was on plant materials. Dr. DeFrance was a botany instructor of Colorado State College in 1925-26 and an instructor in horticulture at Cornell from 1926 to 1935. He served one year, 1935-36, as an associate agronomist with the Soil Conservation Service of the U.S. Department of Agriculture.

Dr. DeFrance went to the University of Rhode Island as Associate Research Professor of Agronomy and Landscape Gardening in September of 1936. He held the position of head of the turf department when he retired in 1960. Dr. DeFrance has written scores of bulletins and articles on turf problems. Some of his ideas were controversial, especially his advocacy of close mowing. He recommended a one-inch height of cut year around. He maintained that close, frequent and regular mowing helped force lateral growth and improved the density of turfgrasses — and some of the dissidents finally agreed with him.

Important contributions:

1. The development of high nitrogen descending fertilizer ratios for turf areas.
2. The cyanamid method of soil sterilization for weed-free seedbeds and for weed-free composts.
3. Proved that phenyl mercury acetate was effective in the control of crabgrass.
4. Developed seed mixtures, such as Kingston mixture and URI No. 1 and No. 2 lawn seed mixtures.
5. In 1934 he wrote his first bulletin on "Lawns — Their Construction and Maintenance."
6. In 1935 he wrote the article on "Lawns" in the revised edition of Liberty Hyde Bailey's "Hortus."

Dr. DeFrance was a true pioneer in the development of fine turf as we know it today, and he is a most worthy recipient of this coveted Award.

Grooming is important to enjoyable play.

Requirements for Play – The Professional's View

by RICK RHOADS, Golf Professional, San Francisco Golf Club, San Francisco, California

FIRST, I'D LIKE to mention what a pleasure it is to have an opportunity to speak to such a distinguished group.

I must say that speaking to a group this size is a very exciting experience — especially when you realize that my normal audience is one person somewhere out on the practice tee.

The subject I will be talking about is "The Golf Professional's View of Golf Course Conditioning." I'm going to point out some of the conditions that are required for a golf course to play well. The emphasis will be directed mainly towards tournament play but obviously these same principles can apply to daily play as well.

If you were to ask several golfers how each of them believes a course should be prepared, it is likely that each one would answer differently. This would certainly be the case among professionals, especially if you caught them leaving the 18th green after a particularly bad round. After all, it's much easier on the ego to blame the golf course, the weather, or the spectators, rather than yourself. I have found, though, that at more rational times a good many of the pros have certain feelings in common.

Only by competition on a difficult golf course can the best player be determined. I believe, therefore, in one over-riding rule: a golf course should be set up so that a skillful performance is rewarded and a poor effort is penalized. In order to do this, a number of factors must be considered.

DESIGN IS IMPORTANT

The first of these is design. To have a true championship, you must begin with a good golf course. The organizations which run major championships — the USGA, the PGA Tour and the PGA itself — are very careful in selecting their courses. They

will not choose a course which needs extensive remodeling. You begin, therefore, by taking a golf course as the architect designed it. Perhaps it needs a little tightening. This can be done very easily by narrowing fairways through proper use of rough. Members probably will resent any change from the normal, but in time most of them will enjoy the challenge. American golf courses belong to two principal schools of architecture. The majority of our courses are based on the concept that there is a prime position for each shot and any straying from it is likely to be penalized. In other words, you play from point A to point B to point C, and the area for each shot is restricted to some degree. Pine Valley, in New Jersey, is a fine example of this type of course. However, there is a limiting factor here. I have played in only one event that caused an uproar among the professionals. The design of four holes was questionable. One was a par 3 that demanded a perfectly played 2-iron to the green, or else you were in water right, left, long, or short. If you missed the green, you had nearly the same shot over again. I believe the eighth hole at Pebble Beach would be an example of a better design philosophy. You have water short and right, and bunkers and rough, long or left. Particularly on long, difficult holes, the penalty should be more severe on one side than the other. The better players should be able to control their misses to a specific side and thus incur a lesser penalty.

The other school is a small one. This school gives you considerable freedom on the way to the green, but once you arrive in that area, you find the green and the hole protected to the extreme. There are examples of this design at Augusta National where there is ample room off the tee, but conditions become very severe on and around the putting green.

TURFGRASS CONDITIONING IS CRUCIAL

The second factor is producing championship turf. I do not have the expertise to do this, but I can tell you some of the desired results.

1. The teeing ground. The grass on the tee should be short, ideally about ½ inch for both bermuda and non-bermudagrass. Most short holes will be played with irons, and players don't want grass between the clubhead and the ball. Tees should be firm and level. Superintendents must be careful not to topdress tees with too much sand before a tournament, otherwise the footing will be poor.

2. Fairways. The importance of close-cropped fairways cannot be overemphasized. The possibility of fluffy lies should be avoided. Players detest them, and with good reason. Where fairway grass is long, there is no way to eliminate the possibility of fliers and a player can't show his true skill. A proper watering program is an important factor in assuring good fairway lies. Too much water can be a real problem.

3. Greens. Firm greens, a little dry, offer the best test for both approach shots and putts. An approach shot should stay on the green only because of the skill with which the player has struck it — not because the greens are soft. The great tendency is to overwater in order to keep greens soft and green. This is usually bad for the long-term health of the green. Sound water management and topdressing programs can generally help produce excellent greens. There is a famous old quotation — "You play golf on turf, not on color."

The rough should impose some penalty and its presence should be foreboding enough to make a player want to avoid it.

4. Rough. First, the rough should be severe enough to demand a well-played shot to recover from it. Second, it should reward the player who is skilled enough to stay out of it. Third, some penalty should be extracted in making the recovery shot. To illustrate the first point, look back to the 72nd hole of the 1976 U.S. Open at the Atlanta Athletic Club. Jerry Pate drove to the right. Fortunately for him his ball was sitting up pretty high in the bermudagrass rough. Normally the shot would have called for a 4-iron, but Pate believed he could reach the hole with a 5-iron because of a flier lie. His decision was more difficult because of a water hazard just short of the green. He gambled and used the 5-iron — the combination of his knowledge and skill paid off. He hit a perfect shot and was rewarded with a birdie and the Open Championship.

There are specifications for mowing heights which are sent to all tournament sponsors for the purpose of fairness, continuity and also for providing a good test. They are based on material used by the USGA which has been developed over the years. These specifications are summarized below.

5. Bunkers. A timetable is of utmost importance when it comes to bunkers. Sand too often is dumped into bunkers just before a tournament in a crash effort for preparation. The result is needlessly unfair lies. Fresh sand must be put in bunkers at least three months before a competition is played. Time is necessary for the sand to become well settled. If there is inadequate rain to pack it, then it must be watered artificially. Suitable sand includes what is known as plaster sand, mason's sand, or brick sand. The sand must be able to pass through a ⅛-inch sieve opening and must have had the silt and very fine sand particles removed by washing. This will help to resist packing. Sand particles which are round in shape tend to shift under a player's feet whereas sand with angular particles is more stable. Sand in the face of bunkers must be shallow enough and firm enough to prevent a ball from becoming lost in it. The sand on the Monterey Peninsula golf courses is generally accepted as being especially good. It offers a definite penalty, but it will reward the exceptional bunker player. Players should not be able to putt from greenside bunkers. To prevent this, the lips should be about three or four inches high on the bunker edges nearest the greens. There should be no lip on sides or rear of bunkers, otherwise balls might settle against them and become unplayable. Also, bunker rakes should not leave deep furrows.

6. Practice area. Practice areas are important to tournament players. They should be maintained similarly to comparable areas on the course. Practice areas should be mowed at the same height as fairways. Practice putting greens should be cut and kept in the same manner as the greens on the course. Cups should be changed daily. Also, there should be an area from which players may chip to the practice green.

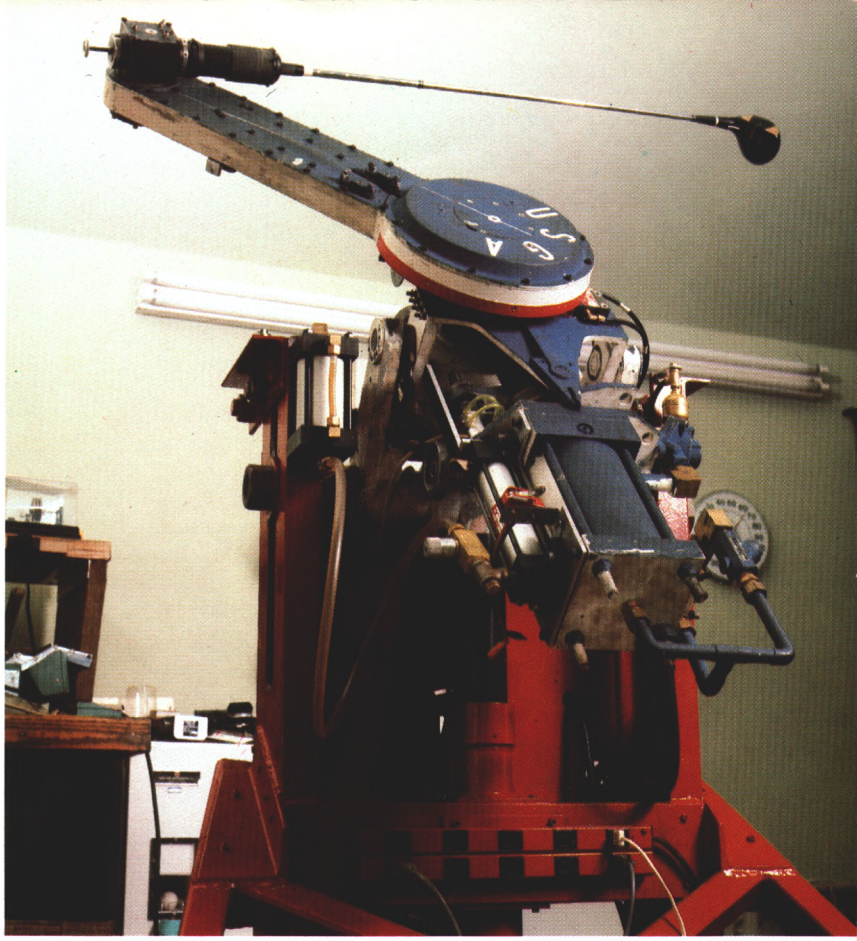
TOURNAMENT PLAYERS LOOK FOR CONTINUITY

The third area of concern in preparing golf courses for competition is to achieve some continuity in conditioning. Much time is spent by the sponsoring organization, club officials, golf architects, the professional and the superintendent to determine the proper conditions for play — what tees to use — how the fairways are to be outlined — and how to treat the area around the putting green. Each hole must be studied individually — each shot must be studied individually. Care must be taken not to favor the hooker or the fader. Also, you want to require each player to use each of his clubs.

The PGA Tour has these same objectives in mind. However, by the very nature of the Tour, achieving consistency and uniformity is extremely difficult. The Tour begins in January and runs most of the year. Tournaments are played over different kinds of terrain, on various kinds of turf, in various climates, and in all sorts of weather. The USGA Green Section offers a great deal of help in this regard. Tournament contracts call for the tournament sponsor to obtain competent outside agronomic advice, such as the Green Section provides. The Green Section agronomists deal with hundreds of superintendents and are trained in turfgrass science and management. When you're getting ready for a championship, they are able to communicate to you not only their knowledge, but the practical experience of hundreds of superintendents.

	HEIGHT		WIDTH
Fairway Areas:	**Non-Bermuda**	**Bermuda**	
Fairway	½ to ¾ in.	½ in.	30 to 40 yds.
Collar off fairway	2 in.	1½ in.	4 to 6 ft. a) don't want severe ridge b) minor penalty if just miss fairway
Rough — primary	4 to 5 in.	2½ in.	
Putting Green Areas:			
Putting Green	3/16 in.	3/16 in.	
Collar off green	½ to ¾ in.	½ in.	30 to 36 in.
Light rough off collar	2 in.	1½ in.	2 to 6 ft.
Rough — primary	4 to 5 in.	2½ in.	

"Iron Byron" Sets Distance Standards



USGA's mechanical golfer "Iron Byron."

by FRANK W. THOMAS, Technical Director, USGA

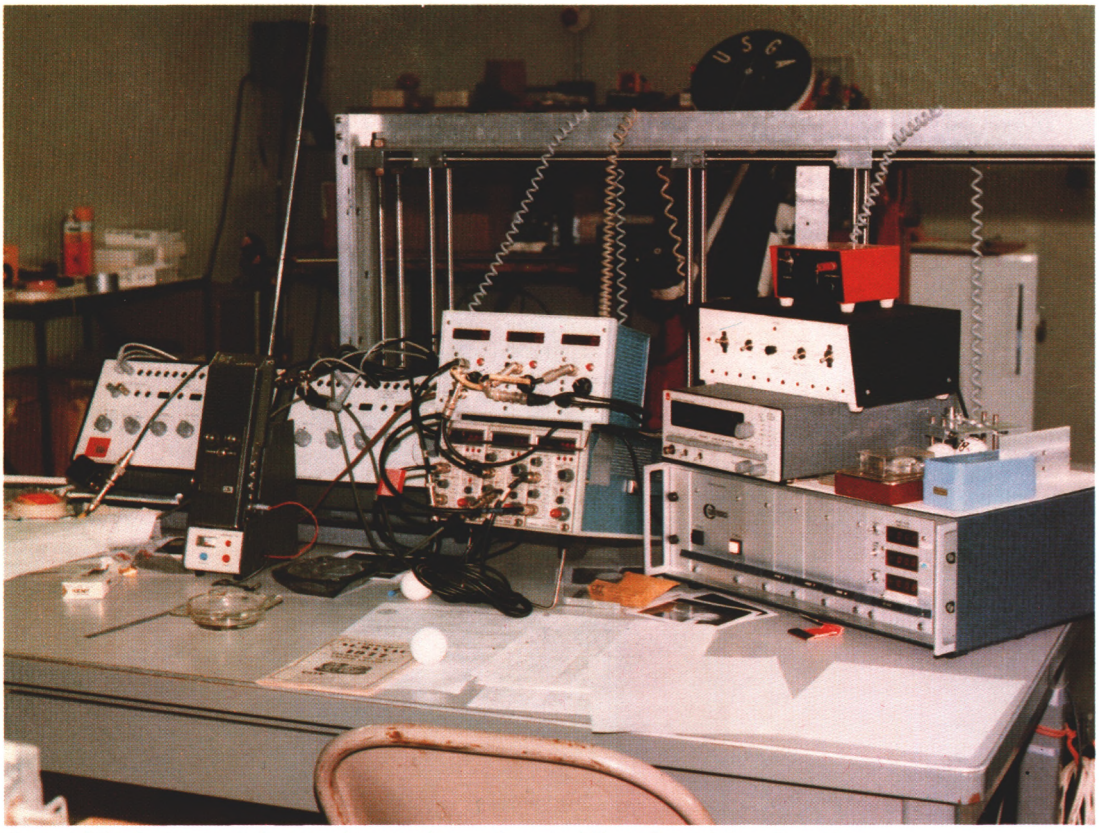
THE USGA IS the governing body of golf in the United States. Our generation is holding this responsibility in trust, so to speak, as generations before us, and, we suppose, as generations after us will do. The game, hopefully, will continue to be enjoyed for many years to come. However, the manner in which we handle this entrusted guardianship determines the destiny of the game and consequently the future pleasure of millions of people. By some estimates we have as many as 11 million golfers in the United States today and approximately 19 million in the world. With only moderate increases in participation during the next eight generations as an example, more than 150 million people will be affected by the action we take during our guardianship. A sobering thought! Perhaps this places our responsibility in perspective. Our mistakes will be corrected by future guardians. Some insignificant action taken now, however, could be the catalyst to a non-reversible reaction. With this in mind and the responsibility well defined, we see the obvious need for cooperation of everyone who is concerned about, enjoys or makes his living from golf.

It was in 1744 that the first 13 Rules of Golf were written, indicating the necessity to control the game for enjoyment and for fair play. The golfer's degree of skill would be his only advantage.

It soon became very evident that the type of equipment being used improved scoring and in most cases substituted for skill. For this, rules were drawn up to regulate equipment. These regulations developed into Rule 2 and Appendix II and III in the Rules of Golf.

More activity, both in research and in testing, is associated with Rule 2 than any other Rule. The USGA is spending more than $200,000 annually to monitor Rule 2 and develop new standards. This is necessary to keep up with technology and dramatic innovations in equipment. Innovations in equipment should never be stifled, however, because golf is not a stagnant game and never should be. Stagnation is sure to harm the game, but the acceptance of innovations must be controlled and limited to those which will add to, as opposed to take from, the game.

To this end, and as it relates to golf balls, the Rules require that a golf ball be no more than 1.62



Some of the instrumentation used to monitor and control "Iron Byron's" performance.

ounces in weight and no less than 1.68 inches in diameter and shall not exceed an initial velocity of 250 feet per second with a tolerance of two per cent when tested on USGA equipment. Neither shall a ball travel more than 280 yards with a tolerance of four per cent in carry and roll when tested under specified conditions using USGA equipment at the USGA test site. This is the Overall Distance Standard.

To monitor this standard and make the actual test is an extremely complex operation.

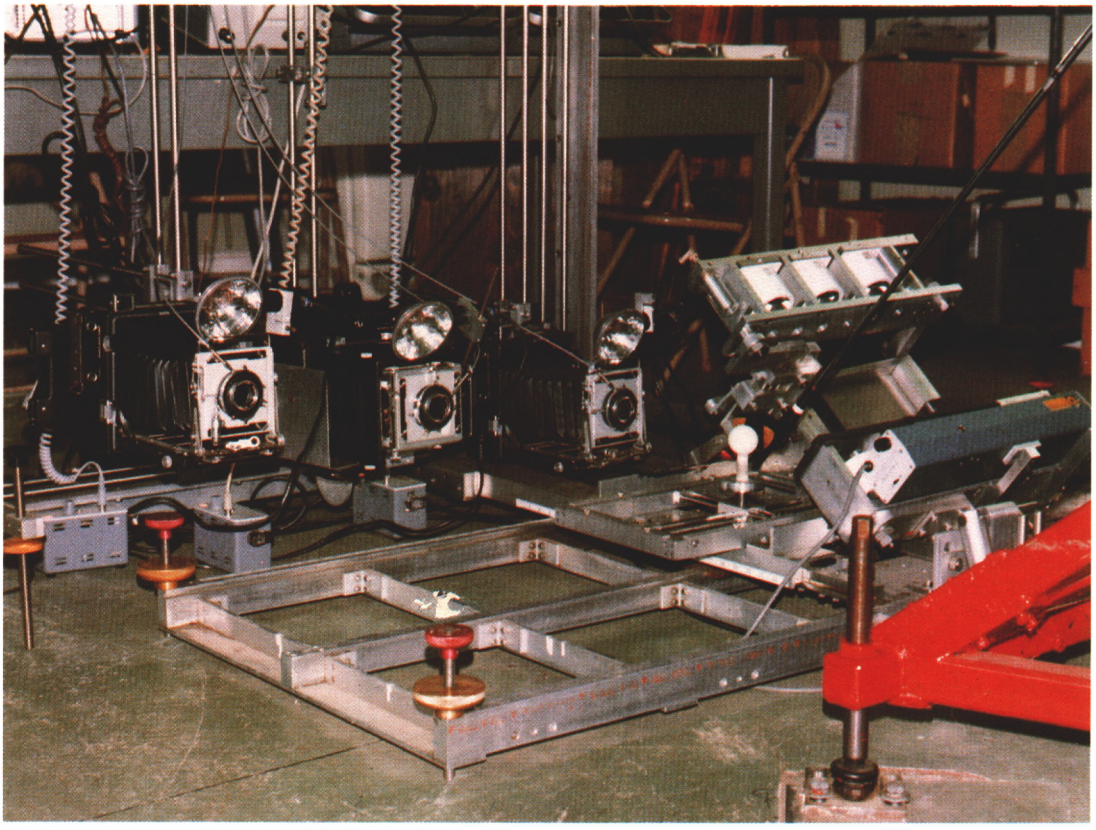
First we must launch the ball as a golfer normally would to obtain a drive of approximately 275 yards. To do this consistently requires the use of a mechanical man, "Iron Byron," a machine that is capable of driving a ball 350 yards dead straight, or, just as easily, hooking or slicing without showing any emotion (something I am trying to learn to do).

In maintaining a set of standard conditions we must first control clubhead velocity and limit it to 160 feet per second, or approximately 109 miles per hour. This is equivalent to the head speed of a reasonably long-hitting professional golfer. To monitor this we have developed a laser beam measuring device which is capable of measuring every two inches of the last 12 inches prior to impact. The measurements are accurate to within ± 1 millionth of a second.

Obviously the way the ball flies depends on how the clubface is presented to the ball. Therefore, such things as dynamic loft angle, spin loft and clubhead direction are also accurately measured.

The collision at impact is dramatic, however, lasting only about 450 millionths of a second and the clubhead and ball remain in contact for approximately three-quarters of an inch. There are two major phases to impact — compressive phase and recovery phase. During the compressive phase the ball is flattened to nearly two-thirds of its original diameter. It does not leave the tee and the front of the ball does not move; in fact it has not yet begun to react. Thereafter the clubhead and the ball move together for a little more than one-quarter of an inch while the ball is kicking off the clubface. It is considered that during the recovery phase is the time when the forces are reacting to create the spin of the ball. The ball does not slide or roll up the clubface (by our usual definition of the word roll).

The ball will leave the clubface at approximately 235 feet per second, or 160 miles per hour, spinning at a rate of approximately 3,300 revolu-



System used to measure clubhead velocity, face presentation at impact, clubhead direction, ball velocity, ballspin, launch angles, duration of impact, etc.

tions per minute. The force required to do this is in excess of 1,700 pounds.

The ball speed, spin, and launch angle are all measured. This ball then flies through its normal trajectory. The peak angle of the trajectory is measured and also how far left or right it may have strayed in reaching this peak. A counter indicates how long it remains in flight, and during this flight period the wind velocity is measured in the three directions, including vertically.

The point of impact with the ground is marked, along with the spot where it stops rolling. This provides the data as to distance of carry, distance of roll and distance from the intended center line.

Temperature of the ball affects its performance characteristics and is therefore controlled by keeping the balls to be tested at 75 degrees Fahrenheit and using them not more than 30 seconds after they are removed from the incubator. The barometric pressure, temperature and humidity are also recorded.

A number of samples of each brand of ball tested are randomly mixed with calibration balls and at the conclusion of the test all data is analyzed and compared to the Standard. The analysis will show that no two types of balls perform in the same manner. In some cases, where the final resting place may be the same, the path they took to get there may be dramatically different.

The spot where the ball stops rolling depends on a number of variables, such as approach velocities, angles, etc. Once the ball makes contact with the grass, we then find a number of other conditions which must be controlled. To obtain the effect of resiliency on the impact, the moisture content of the soil must be measured. A turf tester is also used. This launches the ball approximately 25 yards with a little backspin. The bounce and roll are measured to establish whether or not appropriate test conditions prevail. If not, water can be applied and/or cutting height reduced. We therefore have several immediate steps which can be taken to control conditions. However, annual programs are also important and will have long-range effects.

Various other standards need monitoring and new ones are being developed, some potentially as complex as the Overall Distance Standard. This is, however, the price we have to pay to keep up with the advances being made in technology. The USGA has only one goal in mind and that is to protect the game and so fulfill our commitment as the governing body.

Management Makes a Difference

by **RICHARD H. EICHNER,** Golf Course Superintendent,
Lakeside Golf Club of Hollywood, California

MOTIVATION OF EMPLOYEES is one of the more important facets of personnel management to golf course superintendents. This can be a problem because of low pay levels, although psychologists claim that salary ranks fourth on the list of motivational priorities. It would seem incumbent upon us then to take advantage of those other factors.

Appreciation of effort and results is among the most powerful motivators, more important than pay.

The old saw about a pat on the back is often far more important than we realize.

The ability to cause employees to develop pride in their work is valuable because it leads to development of the employees' self-esteem. In order for that employee to be able to develop pride in his work, though, he must obviously be capable of accomplishing something worthwhile. This is where management is important. How do we make it easy for him to accomplish something he can be proud of?

First he must have skills suited to jobs he'll be given. If he does not have those skills when he comes to the job, then we will have to teach him. This sounds simple here, but it is often overlooked when a new employee's progress and potential are being evaluated.

That is only the beginning.

Now that our employee has the necessary skills to do a proper job, how do we know he'll do it?

Positive direction is necessary so that even a highly motivated individual will do the job he's assigned. In the simplest terms this involves putting our ideas into his head. Positive directions are much more easily accepted than negative ones. A list of do's is seen as a request. A list of don't do's seems an admonishment before the fact. Clear and positive directions are necessary for our highly motivated and well-trained employee to do his day's work. As he progresses he accomplishes the work according to the quality standards which his experience has led him to expect and which are personally satisfactory to him. There is always, however, that nagging question of, "How am I doing?" which can only truly be answered by his supervisor. The pride we hope he will take in his work can only be fully realized by him and made use of by you when there is follow up, correction where necessary and praise when instructions are properly carried out.

Competition, in addition to pride of accomplishment, can be effectively used to stimulate employees. In fact friendly competition can be a marvelous means of establishing and nurturing pride among employees in the place where they work. Golf is such an obvious and readily available means of providing this competition that it may be overlooked.

What are the results of actively encouraging golf play and competition among the members of your crew?

First it gives an opportunity to those whose job assignments may restrict them to a small portion of the course to be exposed to the entire operation and perhaps draw comparisons between their own responsibilities and the responsibilities of some others. Golf provides a basis for boosting employee morale. There is also the advantage of having the crew members assume, for a time, the golfers' point of view. What better means is there for an employee to appreciate the member's dissatisfaction at not finding a towel at a ballwasher than by sharing the same experience? Golf can go a long ways toward breaking down barriers.

Cooperation between neighboring courses in the exchange of playing privileges for employees is a logical and desirable extension of the encouragement of golf play at one's own course. In some areas of the country, quasi golf leagues have been organized among teams made up of golf course employees. The effect on employee morale has been very positive. Clubs that fail to encourage their employees to play golf are missing out on one of the best means of rewarding, motivating and educating their staff. It is a fringe benefit which really costs the club nothing, is highly esteemed by many employees and may make the difference between keeping and losing a good man.

The problems and costs of keeping a large crew have not gone unnoticed by equipment manufacturers. Several pieces of high production equipment have become available over the past 10 years. This equipment has been aimed at minimizing the labor input required to accomplish certain essential operations. We'll look at a few of these, and then, since management makes a difference, we will dissect one aspect of the management, one part of the golf course — greens mowing — and look at some of the choices that must be made by the turf manager.

One of the first labor-saving devices to become available to the golf course superintendent was the riding triplex greens mower, quite a remarkable machine in terms of labor-saving potential. Or is it? There is no question that it will mow as much grass as five men with walking

mowers, but it's not quite that simple. The quality of the mowed surface in many opinions is not equal to that produced by the walk-behind equipment. Where the choice is between either the triplex or not mowing, because of labor budget limitations or crowded course conditions, then this equipment has a place. Where the objective is quite simply the best possible putting surface, the triplex shouldn't be used. The triplex does produce the best finish possible at reasonable cost on tees, and it has become very popular where tees are maintained at mowing heights of ½ inch or less. The availability of vertical mowing heads for the triplex machines has made possible light, frequent vertical mowing of putting greens. Therein is one of the real strengths and advantages of the triplex equipment. In my own case, the triplex vertical mower reduced the time involved in this operation from three days to three hours! Now we vertical mow far more often than we used to, to the advantage of our players.

The power sand trap rake has also contributed importantly to the reduction of the numbers of man-hours which must be alloted for course maintenance. This reduction will become more pronounced as more bunkers are designed or modified to allow more complete raking by machine. Many older courses today find the purchase of one of these machines impractical because of the small amount of their total bunker area which lends itself to machine raking. As costs rise the requirement for hand raking represents a larger and larger liability in the labor budget. Any club contemplating greens and bunker rebuilding would be short-sighted indeed not to give full consideration to bunker construction methods and contours which lend themselves to machine raking.

The hydraulic powered reel fairway mower is relatively new. It has a number of advantages over the ground driven types of fairway and rough mowers which have been standard equipment for many years. Since the hydraulically powered mower reels can be turned at a rate independent of the mowers' ground speed a very smooth finish is possible. Because the reels can be turned at high speeds regardless of ground traction it is possible to mow under wet, heavy growth conditions which would clog and immobilize conventional gang mowers. All equipment manufacturers who build gang mowers now have their own versions of a hydraulically powered fairway mower either available or under development. Within the next few years we will, I am sure, see widespread use of these machines as more manufacturers enter the market and the equipment becomes accepted.

Since we are talking about mowing equipment, let's, for a moment, look at mowing as it affects putting greens as a management practice. Bear in mind that we are going to look at some, not all, of the variables we can change and some, not all, of the effects these variables tend to produce.

We'll begin with mowing height and consider also, mowing frequency, the type of equipment, the condition of the equipment and what sort of accessories are fitted to the mower. Mowing height affects the speed of the putting surface; the more closely the greens are mowed, the faster they putt. Any golfer can tell you that. The trueness or smoothness of the surface is also affected. Most golfers can tell you that as well. The effects the golfer is not aware of, however, are manifold, and generally are disadvantageous to the grass plants which make up the putting surface. They include increased density but smaller weaker plants; increased succulence of leaf tissue, which is more disease- and wilt-susceptible; decreased root growth, requiring more frequent irrigations; and less able to withstand and recover from stress and mechanical damage.

The effects of more frequent mowing tend also to further increase those weaknesses just caused by close mowing. You can begin to see, then, that there is a very direct relationship between the quality and fragility of the putting surface, with those more closely and frequently mowed less able and less likely to withstand the rigors of adverse conditions.

We must make some decisions as well with regard to the type of equipment we will use for greens mowing. Basically, this is a decision be-

National Golf Day

Did you know that since the beginning of National Golf Day, over $400,000 has been contributed toward turfgrass research and scholarships? This amount, divided between the Golf Course Superintendents Association of America and the USGA Green Section Research and Education Fund, Inc., has helped finance many turfgrass projects of benefit to golf; it also provided assistance to needy students early in their careers as golf course superintendents. Support from the National Golf Fund, which administers the funds, has made a decided impact on golf turfgrass management. National Golf Day deserves your support. It is a fun day, a chance to compete on your own course against the scores of PGA and USGA Champions. Ask your club professional for details.

tween the riding triplex and the walk-behind mower. With the triplex we gain high production and economy of labor, but what else? Probably slower greens, grainier surfaces, more mechanical damage around the collars and more rapid thatch accumulation. There is no question, however, that when the mowing must be done at minimum cost, the triplex greensmower is the answer. Our management of the condition of the mowing equipment will also have a telling effect on the turf quality. It is not possible to have too sharp a greensmower. Dull mower blades produce slower, less true surfaces than sharp blades set at the same height of cut. They impose greater mowing shock which predisposes the plants to disease and encourages thatch and grain as well. In the case of *Poa annua* surfaces, dull mowers will leave larger numbers of seedheads. The amount of grain and the number of seedheads are also affected by how often brushes are used and the height at which combs, if used, are set.

Changes resulting from mowing procedures often produce incidious rather than dramatic effects. One can fail to become aware of problems until it is too late unless mowing practices are reviewed frequently. In sports, winning teams place strong emphasis on basics. The turf manager should do the same.

Public or membership relations in the case of the golf course superintendent involve, primarily, maintaining among the membership an awareness of what is involved in maintaining the golf course. I don't think we could argue that the membership at any club wants a good golf course. Most of them, I think, are willing to make occasional sacrifices in course playability in order to achieve a good golf course or a long-term improvement. None of them likes surprises. Good communications is therefore a most important area of public relations for the golf course superintendent.

I think most club members accept the need for greens aeration, for example. Problems arise when the aerating operation causes the member an inconvenience which, because of a lack of communications, he didn't have the option of avoiding. A surprise. There are many means by which these surprises may be avoided. If your club has a master calendar, include your heavy and disruptive maintenance operations on it so that the tournament committee knows when to expect them. If your club mails a social calendar along with its bills, have your aeration dates publicized with the other club events. The editor of your club newspaper or bulletins would probably be delighted to have you contribute a regular column, even if only a few paragraphs. If your club doesn't publish a bulletin, an open letter to the membership can be included, at almost no cost, with a regular mailing. The means available will vary, but the goal, universal and simply stated, is to promote a favorable membership reaction to those infrequent but inevitable interruptions of normal play that are necessary to long-term course welfare.

The increasingly loud voice of the environmentalists should be of some assistance here, in producing a greater awareness of, and reverence for, living things. It should become an easier task to convince memberships that, as a living organism, the golf course is worthy of more consideration than an inanimate object and that grass does not grow by itself. Perhaps increased awareness on the part of the membership will eventually produce understanding rather than complaints when the course is closed temporarily because of frost or excessive rainfall. The golfer must be made aware that there are limits to the abuse which the turf will tolerate. Eventually quality suffers or becomes unattainable.

On the subject of grooming, I submit that United States courses tend to be overgroomed to a fault. Many superintendents — and others — believe that we have developed higher standards than we can continue to afford. The excessive fertilization and irrigation practices which have become so popular at first rate clubs lead to soft, lush turf that looks great but may not play so well or be a very responsible move on the part of management. American golfers have had a long-term love affair with color, often at the sacrifice of playability, which has resulted in many of us maintaining parks which, coincidentally, contain eighteen greens and tees. The golfer has come to expect eighteen greens which receive shots equally, every day; eighteen roughs of equal density, all bunkers to play identically.

Weekly telecasts of professional tournaments are not the least of the villains responsible for this state of affairs. Viewers see courses manicured to perfection for one tournament. They don't know of the immense difficulty and cost involved in duplicating these conditions on a daily basis. This television exposure has also altered the American attitude toward the game to the point the term "rub of the green" scarcely exists in the American golfers' vocabulary. The golf course is becoming increasingly a more contrived and less natural arena. Observation almost any week would lead a television viewer to conclude that mastery of the "free drop" was as important to success on the professional tour as the development of a good putting stroke.

Our golf courses are overwatered, overfertilized and overgroomed. We have become deluded into believing that emerald green turf is vital to good golf when, in fact, a less well nurtured turf will often provide a superior playing surface of greater durability at a lower cost.

The ability of courses to continue to provide excellent playing conditions with no more than starvation rations of irrigation water has been evidenced on Western courses over the past two years. Our tendencies have been towards management practices which have been more productive of beautiful surroundings than good golf. It is time, I believe, especially in view of rising costs and a greater concern for conservation of energy, to put our golf courses on more healthful diets and redirect our craft to the production of fine playing conditions with the least cultural manipulation. Green is good but good golf is better.

The ABCs of Management

Mixing soils for green construction is a project that requires more than a hoe and shovel.

by Carl H. Schwartzkopf, Director, North Central Region, USGA Green Section

EARLY IN LIFE we studied journalism and learned the five Ws of a news story — who, what, where, when and why.

Just as journalism has five **W**s, management has five **M**s: **M**oney, **M**anpower, **M**achinery, **M**ethods and **M**aterials.

In dealing with the **M**oney aspects of problems, one must consider several factors: Where is it coming from? Can the project be completed within the current budget or will special assessments be needed? Will it be necessary to reassign priorities? Should the project be treated as a capital expenditure? Might it even be possible to receive sufficient funds by donation?

The second **M** is **M**anpower. To completely explore the **M**anpower requirements for a project, it is important not to overlook such questions as: Can the project be handled by the present crew? Would it be better to hire additional or temporary personnel? Is there reason for seeking contract labor or volunteers?

Question yourself very closely about **M**achinery as well. What, if any, specialized equipment is needed? Do you have it? If not, can it be rented, leased, borrowed, bought (new or used), or even made or adapted from something you have?

All five **M**s, including **M**ethods and **M**aterials, must be considered in plans for any project, such as building a green, a rain shelter, or planting flowers at the entrance to a club.

When building a green, it is first necessary to decide which **M**ethod will be used. Will it be according to the USGA specifications? Perhaps a Purr-Wick system? Has someone decided to use native soil that has merely been mounded and contoured, or native soil that has been somewhat amended with sand, peat, or other materials? **M**ethod and design will determine what **M**aterials

Spreading a prepared topmix for a green rebuilt to USGA Green Section specifications.

are necessary — how much drain tile, pea gravel, sand, peat and soil will be needed.

How will the new green be financed? Where will the **M**anpower come from to construct it? What **M**achinery will you need? Bulldozers, earth-movers, front end loaders, trenching **M**achines, soil mixing **M**achines?

These same five **M**s apply in the construction of a rain shelter. What **M**ethod will be used: a foundation type of building, a pole building, or others? What **M**aterials: concrete, cement block, 2 x 4s and other lumber? What will be used for the roof: asbestos shingles, cedar shingles, or a light-weight asphalt **M**aterial? Can shelters be financed within the operating budget? Will a special assessment be needed, or will it be necessary to delay or eliminate another project so that enough **M**oney is available? What will be the source of **M**anpower? Is the present crew capable of doing the carpentry work, or will it be necessary to hire a contractor? Could the work be done by some skilled members who would volunteer for a weekend project? What special **M**achinery might be needed, such as power saws or cement mixers for the foundation?

Yet another example of how the five **M**s of management apply is in the planting of flowers around the entrance to the clubhouse. Would the **M**oney be difficult to obtain? Is it possible that the ladies of the club may contribute? When the normal crew is busy with routine golf course maintenance and other projects, the **M**anpower may be unavailable. However, the women may enjoy planting the flowers themselves. Whatever **M**achinery is needed for the project is usually on hand, such as trowels and spades, although it may be necessary to borrow or rent a garden tractor or rototiller to prepare a suitable planting bed. What **M**ethod will be used? Will the approach be formal? Symmetrical? What **M**aterials will be needed? Naturally flowers, but how many and what kinds and colors? What about soil amendments, such as peat, fertilizer, additional irrigation and a mulch to minimize the need for weed control in the future? How will follow-up care be handled?

By consistently applying the five **M**s of management, most problems will be anticipated, your golf course maintenance will be organized, your business coordinated, and your industry will meet more frequently with success.

Management Makes a Difference — The Budget

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

NOTHING HAS more effect on golf course turf, from a playability standpoint, than the club budget. There is no question that a larger budget gives a golf course superintendent many more options with his maintenance program than a superintendent who works with more limited resources.

The following options directly affect turfgrass quality:

(a) A schedule of frequent mowing of greens, tees, fairways and roughs.

(b) Preventive disease and insect control programs.

(c) Extensive grooming of sand bunkers, around trees, on hillsides, around ponds and streams, in out-of-play areas.

(d) A schedule of frequent aerating, topdressing, verticutting and spiking of greens and tees.

(e) Extensive annual renovation or overseeding of fairways, including *Poa annua* control.

(f) Wall-to-wall automatic irrigation system.

(g) An extensive network of drainage systems.

(h) Annual expenditures for major course improvements, including cart path construction, sand bunker renovation and tee enlargement.

(i) A large labor force and a plentiful supply of quality equipment.

These generally have a positive influence on turfgrass appearance and quality. Clubs financially able to develop these programs fully should be in a position to assure themselves consistently fine playing conditions. There is, however, much more to a good maintenance program than having all the things money can buy.

Last summer, for example, I visited a golf course in New England. I toured the course with

Why maintain areas out of play? Weeping love grass not only provides a picturesque scene but requires no maintenance.

the superintendent and several members of the Green Committee, and along the way we discussed their maintenance programs. Their greens were in excellent condition; they had good speed, they were uniform, and they had a high percentage of permanent grasses. The tees were all adequately large, level and had a dense turf cover. The fairways were somewhat off-color in a few areas, but they provided a consistently good playing surface. Their management programs were well-conceived and were working well. Near the end of the day, the superintendent casually mentioned the size of his maintenance budget. I was surprised; it was about half what I would have guessed. As we talked more about his maintenance schedule, the reasons for my mistake became clear. Through a program of carefully setting priorities and developing a list of long-range goals, this club has been able to get the most from its maintenance budget.

The greens are first on their priority list, and they are given royal treatment — aeration, monthly topdressing, weekly spiking or light verticutting, daily mowing and a practical fertilization and irrigation schedule. The tees come next. They are given whatever is necessary to keep them in good playing condition, including periodic aerating, spiking and overseeding. The fairways are third. They are mowed five times a week, sprayed for insects and disease (but, on a curative basis only), aerated each year and, when necessary, are overseeded in the weak areas.

To maintain this schedule with a limited budget, the club plans carefully where each dollar should go. Occasionally it has had to make sacrifices in some areas. For example, it makes maximum use of mechanization by employing a small but well-trained crew and maintains a limited but up-to-date equipment inventory. By narrowing fairways and allowing roughs to exist for 50 to 75 yards between tee and fairway, the total area that requires intense fairway management has been reduced by almost 40 per cent. Roughs are usually mowed once a week, and out-of-play areas are mowed only once a year.

This program concentrates its resources on maintaining quality turf on the greens, tees and fairways, the most important play areas on the course. Through careful management this club uses some of the most progressive and rigorous maintenance programs found on any course, while saving money by doing without many of the extras found at more wealthy clubs.

These organizational principles are not unique to this club, but they can and they should be used by every golf course, regardless of budget size. Success begins with a thorough understanding and proper application of the principles of turfgrass science and management. This, together with a knowledge of golf and of what the club membership is willing to spend, forms the basis for developing a budget which takes best advantage of every maintenance dollar. Money plays an important role in providing the finest quality turfgrasses for golf, but management certainly does make a difference.

It is important to concentrate on maintaining the playing areas, all else is secondary. Shinnecock Hills Golf Club during the 1977 Walker Cup Match.

The Search for Better Grasses

Breeding turfgrasses for drought tolerance and low nitrogen requirement is high on the researcher's priority list.

by DR. VICTOR B. YOUNGNER, Professor of Agronomy,
Department of Plant Sciences, University of California

PRIOR TO 1950 few well-supported breeding programs directed specifically toward improvement of turfgrasses existed either in the United States or, for that matter, in the world. Since then the number of public and private turfgrass breeding programs has increased greatly. The result is that we have many new cultivars. Only a few of these have been of sufficient merit to remain in use year after year. The potential for further improvement, however, is greater than ever because of both an expanding knowledge of genetics and the development of new breeding techniques. Behind every introduction of a new cultivar may be found the efforts of many scientists who have provided the basic genetic and cytologic information, collected new germ plasm sources and devised better breeding methods.

Nevertheless, the plant breeder works within the rather well-defined limits of the germ plasm available in a species and in its close relatives, the gene pool. The continuing effort to identify, collect and preserve new germ plasm sources is therefore of highest importance. Plant breeders are concerned because much valuable germ plasm is lost forever when wild plants are destroyed through agricultural expansion, urbanization and recreational activities.

In simple terms, plant breeding consists of the selection of plants with specific desirable genes, which are then recombined through hybridization. This is often followed by inbreeding and further selection until a pure line with the desirable traits is obtained. Induction of mutations by radiation or chemicals has had limited success; in general, if genes for a desired trait do not exist in nature, not much can be done about it.

Many new turfgrass cultivars have resulted from simple selection of desirable types from segregating populations or from old, established turfgrass areas. In the case of selections from established areas, highly successful genotypes may have survived selection pressures of a specific environment, and they could be well adapted to some similar environments, but not adapt to some others. The plant breeder uses many variations of the basic techniques, as are determined by the plant material and by the specific breeding objectives.

Genetic engineering, which might be called gene transfer in the test tube, has attracted atten-

tion recently because it may make it possible for completely unrelated species to exchange desirable characteristics. Although the basic research is now being done, practical breeding by this method is a prospect for the distant future.

TURFGRASS BREEDING OBJECTIVES

Many broad breeding objectives are more or less common to most programs, no matter what methods or techniques are used, because all turf of any species or for any specific use must meet certain requirements.

Pest tolerance or resistance. Diseases, insects, nematodes and weeds limit the usefulness and increase the maintenance costs of all turf. Improved tolerance to a number of turfgrass diseases is appearing now in some recently released cultivars. We are just beginning to make progress in this area, however. The need is greatest in the creeping bentgrasses for putting greens and the Kentucky bluegrasses, colonial bentgrasses and fine-leaved fescues for fairways. Breeding for disease tolerance is especially difficult and precarious because the breeder is working with two organisms: the fungus disease organism and the host turfgrass. Resistance may be lost through mutation or genetic segregation in either organism.

Progress in insect resistance breeding has been limited. Few sources of germ plasm for resistance to the common turfgrass insects have been identified. We need to learn much more about the nature of insect resistance in plants in general and in grasses in particular. If we knew what characteristics would make a grass plant less desirable as food to an insect, we could begin a serious search for resistant germ plasm.

To minimize weed problems, a turfgrass must have the vigor and density to resist invasion. A grass that is dormant or is weak in growth at a time when a serious weed pest is in its phase of rapid establishment and growth is highly vulnerable. We have a number of turfgrasses today that are good weed competitors, but, unfortunately, excessive thatch often goes along with their high vigor and density. Mechanical dethatching which opens up the turf is frequently required, providing an opportunity for weed invasion. Breeders are now looking for strains which are not high thatch producers but are still sufficiently vigorous and dense to minimize weed problems.

Wear resistance. Any turf used for recreation should be able to withstand the kind and degree of traffic characteristics of that use. Traffic wear may be a scuffing, tearing, twisting or pounding action which damages leaf, stem and root tissue. Nearly 20 years ago we built the first accelerated-wear machine for turf studies. Since then other turf researchers have made machines. Studies with these machines had shown pronounced differences among species and among the cultivars of a species in resistance to the different types of wear. The plant characteristics providing wear resistance are

Zoysia is one of our most winter hardy and drought tolerant warm season grasses. It deserves a prominent place in the breeding program for southern and transition zone golf courses.

not well understood, but the amount and location of fibers are important. As we learn more about these characteristics we will be better able to include wearability as a breeding objective.

Rapid recovery rate. When turfgrasses are injured, ability to recover quickly is important. Tee and fairway grasses must heal over divots in a short time. This means that they should be either rhizomatous or stoloniferous — preferably, both. In bermudagrass country we are fortunate to have several species and cultivars which are excellent in this respect during the summer. Where play is year around, however, these grasses are inadequate during the cool seasons.

In our bermudagrass- and zoysia-breeding programs, better growth during the cool season has been a selection criterion of long standing. We are also attempting to develop zoysiagrasses with a more rapid rate of stolon and rhizome growth.

Tall fescue has had a limited use on the golf course, but if finer textured rhizomatous strains could be developed, this species might become a good fairway grass. At the University of California we have a tall fescue breeding program with these characteristics as primary objectives. Although they have few disease or insect problems, present tall fescue cultivars are too coarse and bunchy for golf course use.

Tolerance of close mowing. Frequent and rather close mowing differentiates a turf from a meadow. In recent years the trend has been to closer mowing on golf course turfs — greens, tees and fairways. This trend has eliminated many cultivars from fairways, especially among the Kentucky bluegrasses and fine fescues.

Tolerance of close mowing is primarily a function of growth habit. If the grass is prostrate with many leaves at the crown of the plant, more leaf surface will remain after close mowing than on plants that grow upright. This larger amount of leaf surface will permit prostrate strains to continue to produce carbohydrates at a sufficiently high rate to maintain good vigor and growth.

Drought resistance. Water shortages and droughts occur in one place or another every year. Our recent experience with these problems has emphasized the importance of using grasses that have a high level of drought resistance and maintaining them to realize their full drought potential.

Drought resistance may be of several types, all of which may not be valuable in turfgrasses. The ability to extract water efficiently from the soil is of great value and can be selected for in a turfgrass breeding program. This ability is the result of root development — the number, depth and extent of branching of the root system.

Some species, notably bermuda, zoysia, red fescue and tall fescue are inherently drought tolerant and should be used wherever other considerations permit. Breeding to improve these grasses in other respects while retaining their drought tolerance will extend their usefulness. At the University of California, for example, efforts are underway to develop zoysiagrasses with less thatch, more rapid establishment, better growth in cool weather and other characteristics which will increase their usefulness on golf courses and other turf areas.

Low nitrogen requirement. Because supplies of natural gas and other energy sources are becoming tighter and their costs higher, nitrogen fertilizer costs will continue to increase and occasional shortages may occur. Significant savings may be realized if grasses with lower nitrogen requirements can be substituted for any high nitrogen consuming varieties now in use.

Tall fescue, red fescue, centipedegrass, zoysiagrass and carpetgrass are species which will make turfs of acceptable quality at relatively low nitrogen levels. Kentucky bluegrass, bermudagrass, and creeping bentgrass need much higher levels. The development of high quality cultivars with reduced nitrogen requirements should be a primary goal of turfgrass breeders.

This goal may be approached in either of two ways. First, there is evidence that germ plasm for lower nitrogen requirements can be found in bermudagrasses and Kentucky bluegrasses. It should be possible, although difficult, to introduce this characteristic into otherwise desirable geno-

Improved Kentucky bluegrass varieties may one day replace bentgrasses for fairways, especially as water use becomes more critical.

types. The second approach, which may be easier to achieve, is to improve the quality and usefulness of those species that already have low nitrogen requirements. As with drought resistance, this is one of the basic concepts in our tall fescue and zoysia breeding programs.

High quality playing surface. This goal needs little explanation. Any golfer knows that unless a cultivar provides an acceptable playing surface it is of little value no matter how good it may be in other respects. Breeders should be familiar with the features of a good green, tee or fairway and should search for the grass characteristics most useful in producing these qualities.

Climatic adaptation. From the seed, sod or stolon producer's viewpoint, a cultivar with adaptation to a wide range of climates has obvious advantages. However, the user may prefer to have one with excellent adaptation to his specific climate. Certainly the latter may often be the easier to achieve.

Climatic adaptation of a turfgrass is primarily possession of characteristics which permit it to grow, or at least to survive, under the temperature extremes of a given climate. It is also the ability to produce a good turf under prevailing temperature conditions. Reproduction, i.e., flowering and fruiting, is not a concern; in fact, it is undesirable where the grass is used as turf.

Selection of strains or clones that have survived for many years in a particular environment have produced some cultivars well adapted to that or similar climates. The introduction of selections from around the world has provided germ plasm for wider climatic adaptation of many grasses.

Salinity tolerance. Irrigation water of relatively poor quality must be used in many parts of the West. An increasing number of golf courses are using sewage effluent water for part or all of their irrigation needs. Salt levels of these waters may run 900 ppm, or much more. Salts from these waters may accumulate in the soil until they become toxic. Our studies have shown that turfgrasses vary greatly in salt tolerance and that it is possible to select more salt tolerant types. Salt tolerance is a selection criterion in most of our breeding work.

Smog tolerance. Air pollution is a fact of most urban environments and may well continue to be for years to come. Leaf injury of turfgrasses from high levels of ozone, sulfur dioxide, PAN (peroxyacetylnitrate) and other pollutants has been known for many years. When this injury occurs it discolors and weakens the turf. Of greater importance, re-

Breeding for resistance to insects is high on the list of needs for golf course grasses. Chinch bugs wiped out all but a few clones of grasses on this lawn.

Even weeds have great genetic diversity.

sults of some of our recent research showed that grasses may suffer severe reduction in growth at air pollution levels below those which cause leaf injury symptoms. These levels would be those which might prevail for long periods in many urban areas.

Our research and that of others have shown that species and cultivars within species differ in their susceptibility to smog. Breeding for smog resistance, therefore, is possible and may be a desirable goal in many programs. Smog tolerance was one of the selection criteria in the bermudagrass breeding work that led to the Santa Ana cultivar released in 1966.

Tolerance of agricultural chemicals. Herbicides, fungicides, insecticides and other agricultural chemicals are standard turfgrass maintenance tools. A cultivar that is too readily injured by widely used chemicals will not be a satisfactory addition to our list of turfgrasses. It is a common observation that existing cultivars differ widely in tolerance to various chemicals. Screening for tolerance to such widely used chemicals as the phenoxy compounds is a worthwhile part of new cultivar evaluations.

This discussion of breeding goals is not meant to be exhaustive, but only to describe briefly some objectives I consider important. Other turfgrass breeders undoubtedly could add some which they consider to be equally valuable.

THE POTENTIAL IN OTHER GRASSES

Up to this point our discussion has dealt only with those species widely used for turf. Although there may be few if any other species equal to these as turf formers, we should still look at the potential value of many others. Some of these may be considered weeds or poor quality turfs at the present. However, they may often have one or more characteristics that are highly desirable in a turf.

If these grasses are of sufficiently close relationship to the fine turfgrasses to cross with them, they may be used as sources of germ plasm in interspecific or even intergeneric hybridization programs. Some examples of these are the relatives of bermudagrass *(Cynodon)*, bluegrass *(Poa)* and fescue *(Festuca)*

Tifway, Tifgreen and Santa Ana bermudagrasses are hybrids between two *Cynodon* spp. Crosses have been made between *Festuca* and *Lolium* (ryegrass) species, but no hybrids of turf value are as yet available. Kentucky bluegrass *(Poa pratensis)* and Canada bluegrass *(Poa compressa)* have been successfully hybridized. This cross may eventually introduce valuable new genes into Kentucky bluegrass.

In some cases we might consider breeding programs to improve some weedy grasses to make them more acceptable as turf. Annual bluegrass, for example, although unwanted, is a major constituent of putting greens across the country. It is a highly variable species with an extreme range in growth habit and other characteristics. In the past we have conducted selection studies which have indicated that some excellent putting green types may be easily obtained. Although we found no disease tolerance in our selections, we believe that it may be quite possible to find such strains. More work needs to be done.

In the West we have been waging a losing battle against kikuyugrass for years. We have been unable to find a satisfactory control for it on golf courses and other landscaped areas. Still it is not all bad. When properly maintained it makes fairly good fairway turf. It is tolerant of drought, insects, diseases, salinity and smog. It grows well under low nitrogen levels, withstands heavy use and heals rapidly. Its worst faults are its aggressive invasion of greens and other areas, a rapid thatch buildup, fast growth which requires frequent mowing, and a fairly coarse texture. Although it lacks the genetic diversity of annual bluegrass, our studies have shown that considerable variation does exist in our material and more can be found in other parts of the world. We plan to begin some very cautious breeding studies on it soon.

Without going into excessive detail, this describes the search for better grasses for turf which we follow at the University of California. Similar programs are underway throughout the country, but I should point out that improvements do not come overnight. Breeding and selection work reap benefits as a result of the consistently applied efforts of many people over extended periods of time. It takes as well your continuing support, the assistance and backing of everyone interested in turf to make things happen.

It is important for each course to have its greens putt uniformly, at a speed its membership is comfortable with.

How Fast Are Your Greens? -- An Update

by ALEXANDER M. RADKO, National Director, USGA Green Section

THE SEPTEMBER, 1977, issue of the *Green Section Record* contained an article on the Stimpmeter, the USGA's new device to measure speed of greens. Over a two-year period, ending in 1977, the eight USGA Green Section Staff agronomists tested more than 1,500 greens in 36 states. Data from these tests confirms that the speed tables for regular membership play and for tournament play should remain as they were indicated in the original article; however, more testing is required before the speed chart for tournament play can be finally determined. For the time being the present chart must serve as a guide for tournaments.

The way putting greens are managed has enormous influence on their speed and consistency. Until the Stimpmeter was developed, however, superintendents could not measure to what degree and for how long management practices influence putting speed. With the Stimpmeter the superintendent can obtain a numerical reading which can be compared with the speed charts and used as a guide for adjusting management practices to obtain the speed his membership wants. The following are among the most obvious and important possible studies:

(1) The influence of fertilizer applications, nitrogen sources, rates and timing on green speed.

(2) The effect of grain on speed and direction.

(3) Differences in speed using single units vs. triplex mowers, free floating vs. fixed cutting units, in frequency and direction of cut.

(4) The effect of double vs. single cutting.

(5) The effects of aeration, spiking, vertical mowing — before and after.

(6) The effects of dew and surface moisture, wet vs. dry greens.

(7) Differences between grass cultivars prominently used for putting greens — stolonized vs. seeded greens, bentgrasses vs. bermudagrasses, etc.

(8) The effect of weeds such as *Poa annua*, clover, crabgrass, chickweed, etc., on speed. Speed differences when *Poa annua* is in seed vs. when not in seed.

Preliminary tests also indicate some interesting but not-so-obvious variables:

(1) There is a definite change in the speed of greens when measured in the morning; after cutting, and in the afternoon on the more liberally fertilized greens. Greens fed sparingly show less change.

(2) The bench-setting of a mower does not insure that the greens are being cut at that height. The thickness of the bedknife greatly influences putting green cutting heights. Free floating units require a setting different from rigid mowing units.

(3) The frequency of cut has a decided effect on green speed. Double-cutting on successive days increases the speed of greens.

(4) Heavy topdressing of greens with a soil mixture slows the green until the material is worked well into the turf. Heavy, infrequent topdressings cause speeds to oscillate whereas light, frequent topdressings improve speed and consistency.

Used properly the Stimpmeter will be an invaluable asset to putting green management programs. Its strength is its simplicity! A speed reading takes just a few minutes. It is possible, therefore, to monitor the speed of greens on a frequent schedule, measure differences and devise ways to promote uniformity through a greater part, or all of the playing season.

Stimpmeters and an operating manual are available to every golf club wanting one, as follows:

(1) One will be mailed in care of the golf course superintendent to each club subscribing to the USGA's Turf Advisory Service in 1978 as part of the annual fee.

(2)*USGA Member and non-Member Clubs and Courses will be entitled to purchase one Stimpmeter at a cost of $15. It too will be mailed in care of the superintendent.

(3)*Members of the Regional Association Liaison Committee may purchase one Stimpmeter at $15.

*Order your Stimpmeter directly from the United States Golf Association, Golf House, Far Hills, N.J. 07931.

Studies are needed to determine how various management programs affect speed of greens.

Water Management Affects Playability A Panel Discussion

Moderator: **Stanley J. Zontek,** Northeastern Director, USGA Green Section.

Panelists: **John E. Rhodenbaugh,** M.D., Radiologist; Executive Committee of Northern California Golf Association; Member and former Green Committee Chairman of Castlewood Country Club, Pleasantown, California.

John A. Zoller, Golf Facilities Manager, Pebble Beach Corporation, Pebble Beach, California; USGA Green Section Committeeman.

Edward C. Horton, Golf Course Superintendent, Winged Foot Golf Club, Mamaroneck, New York; President of Metropolitan Golf Course Superintendents Association, and Co-Editor of *Tee to Green.*

William S. Brewer, Jr., Northeast Regional Agronomist, USGA Green Section.

Moderator: Gentlemen, let us discuss some of the qualities of a good golf green and fairway, and how these might be affected by water management.

Rhodenbaugh: I represent both the club committeeman and the fellow who sometimes complains to the superintendent, that "nasty" club member who wants the golf course very green and lush. In discussing course playability I am sure we all realize that greens command priority attention. Clifford Wagoner, golf course superintendent at the Del Rio Country Club, in Modesto, California, taught me that the superintendent can do a great deal to change a golf course, but he has to know what conditions the golfers want. There must be communication. The greens should, of course, hold for well-played shots, but they can't be so lush that they show footprints as I walk on them, even though many players incorrectly (I feel) favor wet greens. I don't think it requires too much water to provide proper conditions, but it will demand that the golfer learns to hit good approach shots.

Zoller: Overwatering began with the development of the automatic irrigation system. I think there is a message for us in this. I also believe that the holding qualities of a green is a subject which has been beaten to death. I am much more concerned about the condition of the fairways. If I were able to select my ideal fairway lie, it would be firm and tight, allowing the clubhead to take a good grip on the ball. This matter of fairway lie is, I believe, important to any discussion of the holding qualities of a green. You simply cannot have a firm, good golf green and a soft, lush fairway to hit from, because you cannot impart the needed spin on the ball for it to hold. Firm, tight greens require firm, tight fairway lies.

Horton: We should not overlook that water is a tool we can use to make different golf courses play uniformly. For instance, assuming that both John and I are watering properly, a man who normally plays one of John's courses can come East to play one of ours, and his handicap will be valid because the interaction of golf ball and playing surface will be much the same at both courses. These fine points of turf conditioning are directly influenced by watering; the amount of thatch, the firmness of the turf surface, the free and true roll of a golf ball, the turf resiliency and, as John was saying, fairway lies which afford clean clubhead-to-ball contact. Excessive water really is one of our biggest bugaboos.

Brewer: I believe that uniformity as a putting surface is the most important quality of a green, not its qualities as a landing area. That is secondary and is, moreover, influenced primarily by the design of the green, the materials it is constructed with and the skill of the golfer. We should discourage using water to modify the characteristics of a green as a landing area. Surfaces that are often overly wet are ripe for weed encroachment, disease, and deep ball pocks from a barrage of golf balls. Greens routinely kept firm and dry will show fewer problems. And those outbreaks and consequent disruptions which do occur will be less debilitating and will mend more quickly.

Zontek: I would like to find out from Ted and John how they manage their irrigation programs to achieve the exceptional playing conditions at Winged Foot and Pebble Beach.

Small volume pop-up sprinklers around greens take care of collar and bank water needs.

Horton: Certainly for me, and I think this would be true for most superintendents, the decision of whether or not to irrigate is the single most difficult decision I must make day-to-day. It is a very difficult decision. Do I water? I know that if I water I can go home, the decision having been made. But it is not quite that easy. We must gauge how much water individual areas should require. Often we must begin the irrigation cycle long before it is really needed, just to insure that all areas will receive coverage in time, some of them perhaps long after the ideal moment has passed.

Zoller: We maintained our golf courses last year under a strict water rationing edict. To give you some idea of the situation, for one of our courses we were allotted 56,000 gallons of water daily, on the others 70,000 gallons. Normally we would use from 150,000 to 200,000 gallons daily for each course, an amount which would not generally be considered extravagant. The rationing forced a very careful day-to-day management of irrigation. What was left after providing for the greens and tees, almost exclusively by hand watering, amounted to only 25 to 30 minutes of irrigation per *week* for the fairways. This we had to use to the absolute best of our ability. Surprisingly, in looking back at the experience, I truly feel that we did not suffer greatly, or perhaps I should have said that the turf responded well. At any rate, the main thing we did each evening after dinner was to check each fairway controller. This might have resulted in as few as one or two changes in programming on each nine holes, and the changes may only have amounted to a couple of minutes more or less in each instance, but this enabled us to pull through. In the end we learned that we can get by with a great deal less water than we normally would use.

Horton: Let me pick up on this a little further. In 1946 Jim Watson began his graduate work under the late Professor Musser at Penn State. His Ph.D. thesis, summarizing four years of investigation into turfgrass irrigation, said, in effect, to water as it is needed and only so fast as the soil will absorb it. During the course of our discussions, John and I both realized that we have been coming back to these recommendations from Dr. Watson. We are using hand watering in particular far more than we might have been ready to admit. And we are routinely dealing with many small areas individually as opposed to somewhat casually flipping on the entire automatic irrigation system which will throw water everywhere. I also find myself doing more daytime watering than I really want to do, both because I will be on the scene to handle any problems that might develop, and because I can find better, more reliable men to work in the early morning and daylight hours than I can find for night watering.

At Winged Foot our general program is to withhold irrigation in the spring until the grass shows visual signs of stress, allowing the ground which had become water saturated over the winter to drain, and then to dry down quite thoroughly between irrigations. During these cooler days of spring and early summer the grass can tolerate moderate stress and will even become better conditioned to face the more severe weather to come, provided we restrain ourselves from either nursing or forcing it along. Once we have begun our irrigation program in earnest, however, the strategy changes and we attempt to keep the soil near field

capacity throughout the effective rooting depth, without of course permitting any extended periods of saturation to occur. As I mentioned before, this is a tough dance to perform and is surely even harder to choreograph for someone else beyond those rather vague guidelines calling for greater amounts of water infrequently applied in spring and fall, with lighter and more frequent summer irrigations to keep both plant and soil continually within the optimal moisture range.

Rhodenbaugh: I understand what you're saying, but let me explain what I believe the golfing public is after. In addition to that uniformity from one green to another that we spoke of before, the members are looking for that middle condition somewhere between a wet and lush green, and a dry and hard yellow. I have to believe that it is possible to have a relatively dry and firm golf course.

Brewer: You are definitely on the right track, provided you are willing to tolerate a sprinkling of yellow-brown areas. Soils and terrain are not uniform everywhere over an expanse as large as a golf course. As a result it is simply not possible to grow turf that is completely uniform. You have to go overboard in one direction or the other with your irrigation program. If you are overly generous in an effort to keep the high and dry spots green (cosmetic irrigation), then you will have lower areas overly wet and lush. If, on the other hand, your aim is to provide optimal conditions for the majority of the course, you will by design, underirrigate those high and dry spots and these will show up as scattered areas of yellow-brown, areas which apparently offend the aesthetic sensibilities of a great many golfers and even some superintendents. What we have is an image problem. The British have, perhaps unwittingly, accused American golf courses of this for years.

Zontek: Bill, I think you've led us into a most important area of discussion. Why does overirrigation take place? What pressures are imposed on the superintendent that can lead to wet golf courses?

Rhodenbaugh: Well, I was surprised to learn during our discussions that a wet golf course can sometimes be attributed to turfgrass managers taking the easy way out. That was a new one to me. I was told that there is a powerful temptation for the superintendent with an automatic irrigation system to habitually push the start button so that he can go home feeling confident that, although the course may be wet, it will survive and be green and therefore the members will be happy. I hear a ring of truth in this scenario, but I should like to hear more.

Horton: Although we may not be saying exactly the same thing, Doctor, I must repeat my own feeling that the easiest course of action is to overirrigate — the hardest is to irrigate properly.

What are the pressures that I feel when it comes to applying water? Three pressures stand

Ball marks with increased play is becoming a more serious problem. Firm greens offer no real ball mark problem. Wet greens contribute to many problems aside from scarred turf.

out in my mind: the color of my own turf, the degree of firmness of my greens, and the color of the course next door or down the road. Whether or not the heat pressure comes from a minority of golfers, indeed whether or not it is even real, we as superintendents are always sensitive about these matters. We are conscious of the responsibility placed upon our shoulders, and this is part of what makes proper irrigation so difficult.

There is also what I call the snowball effect, by which we can inadvertently turn the screws down tighter on ourselves. This can happen innocently enough by starting the irrigation season a bit early or too forcefully, perhaps in the effort to get the grass growing after a long, bleak and dreary winter. By doing this we of course may actually weaken the permanent grasses and encourage an increase in *Poa annua.* Now we are faced with managing a larger proportion of this failure-prone grass, which generally has to be watered more, once we have committed ourselves to the maintenance of it. Over-watering suddenly has become a way of life and each year the *Poa annua* continues its takeover. After a few years there is no simple or inexpensive alternative. We are now growing *Poa annua* turf. If we want any grass at all for the playing season, we must continue with this insiduous spiral in which it is all too easy to become trapped.

Zontek: We have been talking at length about over-watering. What are your thoughts on having enough water available to irrigate your golf courses?

Fairways maintained on the dry side provide firm lies for most of the playing season.

Brewer: There is in the January *Green Section Record* an excellent short piece written by Ted Woehrle in which he relates an imaginative solution to this problem of making more effective usage of available water, a solution which may well be feasible for many clubs. What they did was to design a system for recycling substantial volumes of water from the club's air conditioning system for use in irrigating the golf course, water which had previously been discarded. This idea of recycling is just coming into prominence.

Rhodenbaugh: We are beginning to become involved with two very under-utilized classes of water. If you are not from California, you may not have heard the term "gray water." This refers to shower water, rinse water, etc. This type of water has been recycled for homeowners and is certainly going to play a role in irrigation for recreational areas, including golf courses. We also are working with effluent water. Seven holes of my golf course are now irrigated with effluent. This and other means for improved water utilization, including increased storage facility development, may insure continued availability of adequate amounts of water for golf course irrigation. We in California do not have a choice. The rest of the country may still be able to pursue the course of luxury consumption of water, but we cannot.

Horton: At Winged Foot we didn't run out of water this year, but we did come perilously close. We were purchasing additional water from a local water company which permitted us to draw a limited amount for only four hours a night from a four-inch open discharge pipe. With 36 golf holes and 280 acres to irrigate, this was not much water and we honestly could not have gone another day or two without rain. This also happened to us in the East in 1966. Adequate water is definitely a problem with which every golf course must deal.

Zontek: I think we have to give a little more consideration to the use of effluent water for irrigation. The American Society of Golf Course Architects has addressed itself to this concern by arranging a grant for a research study on effluent water usage on golf courses. The results of this study should be interesting.

Zoller: Yes, indeed. All nine courses on the Monterey Peninsula are cooperating in a project to bring effluent irrigation into full use, perhaps by 1981. This shows how critically we view the water supply problem. Our water costs also have doubled in recent years to 80¢ per 100 cubic feet now, with $1.20 projected in the near future. This degree of price escalation for water may be further down the road for some than for others, but sooner or later we are all going to pay the price no matter what type of sports turf we are maintaining. This cost factor of itself will mandate the search for alternative supplies.

Horton: In a water crisis there is also the question of priority to consider. Some of us have already discovered the low priority given to our golf courses.

Brewer: That may be more true than any of us wants to believe. I recall an incident last July on Long Island where a club was denied access to its own well water for nearly a week.

Rhodenbaugh: The California golfer must learn that green golf courses are a thing of the past. This is the challenge which green committee chairmen and superintendents will have to meet, the challenge of re-educating our golfers. If I might summarize the golfer's point of view, I believe he will accept drier golf courses, but not yellow golf courses. The drier, predominantly green golf courses I see to be a viable goal, and if we do indeed need images to guide us, I must say that for me the epitome of such a nice, dry, green golf course is Del Rio Country Club, so capably maintained by Clifford Wagoner and his crew. Certainly there are others throughout the country I am not familiar with. Perhaps in our crusade to further the objectives of good water management, these courses should be singled out for special recognition.

Poa Annua -- It Won't Go Away!

by DR. ROY L. GOSS, Agronomist, Washington State University, Puyallup, Washington, USGA Green Section Committee

I WONDER HOW MANY of you want to raise *Poa annua* and how many want to get rid of it. After years of experience with *Poa annua*, I believe it is safe to say it will never go away. You can ignore it or tend to it, but the fact of the matter is that it will probably come on stronger until one day during stress, it will leave temporarily. It will come back, but not before a golf course superintendent has been fired and an agronomist and pathologist have been reminded of their low level of breeding and high level of ignorance.

Why can't we prevent *Poa annua* from becoming dormant? We know a lot of the good and bad things about *Poa annua*; it's not the most comfortable thing to live with, but it sure beats having no grass at all. I've never found that *Poa annua* is as good as good-quality bentgrass for greens — only if you have that very fine type that doesn't have seedheads, you have 100 per cent of it and you can keep it. Several golf courses in the Northwest, some of the oldest in the country, after many years of natural selection probably have the finest type of *Poa annua* anywhere. Their greens are beautiful when they are good, and when they are not perfect, well, then they are *Poa annua* greens. *Poa annua* is a grass that has a great range and is adapted all the way to the tropical areas. It is possible that we have several hundred or even several thousand genetic types; over 55 or 60 types have been identified. The really crushing problem is to have many of these types in one putting green and have to manage for them all.

Some golf course superintendents encourage *Poa annua* growth, and they have been able to capitalize on some of the environmental factors which favor its growth.

From a playability standpoint, one of our greatest concerns is when *Poa annua* begins to set seed. It is not unusual for heavy seed production to take place for a period of up to 45 days in the spring. This is considerably more than any bentgrass or other desirable turfgrass. *Poa annua* will set seed all the way down to heights of ⅛ inch, and there is always some seed in the soil. It is certainly

Vehicle traffic down the same path encourages Poa annua *to take over. A severe winter causes the* Poa *to die out.*

very prolific and germinates well, although it will not germinate during stress periods. It will only germinate when conditions are proper, when the weather cools and good soil moisture is available. It is a real headache when you are trying to establish new turfgrass areas, especially when you are dealing with Kentucky bluegrasses. Annual bluegrass is already producing seed when the Kentucky bluegrass is in the four-leaf stage.

COMPACTION

Compaction is one of the greatest problems in any kind of turfgrass growth, and over-irrigation and excessive rainfall contribute to the problem significantly. Of course there is little that can be done between October 1 and May 1 when we receive more heavy rainfall in the western part of the country, but over-irrigation can be corrected. Compaction is a serious problem. Roots cannot penetrate the soil, therefore oxygen relationships are poor and rooting will occur only near the surface. Under these circumstances we are inducing proneness to drought. You have to remember also that under these conditions *Poa annua* doesn't become dense enough to stand up to the stress it receives. It certainly won't hold up as well under stress as will Kentucky bluegrass, the fescues, bents, or a heavy stand of ryegrass.

Poor drainage is another particularly critical point. It's one thing to have excessive rainfall, but quite another to allow poor drainage to persist year after year. Sometimes drainage problems can be corrected by constructing open slit trenches with stone filled to the top. Be sure that you don't make these trenches too wide and don't use a coarse gravel that will interfere with mowing. Another approach to providing good drainage is through soil modification. I have seen cases where these surface trench drains were placed three feet apart and it was still mushy and soft between them. In this case we had better look at the soil characteristics and repair the soil under heavy aerating and topdressing programs using stable materials.

When heavy traffic, poor drainage and excessive rainfall or irrigation are put together, we really have a problem. The water stable aggregates are destroyed, it becomes one unidentifiable mass of soil particles, and drainage becomes impossible. Some good studies have shown that a soil compacted in a relatively dry state will take water at perhaps ½ inch an hour, whereas the same soil compacted when wet will permit water infiltration at a rate of about 1/100th of an inch per hour. This is exactly what is facing us in our traffic areas, and I guarantee that the ultimate grass in these cases is *Poa annua.* You can observe this for yourself on any golf course where these conditions persist.

Proper construction of tees and greens would eliminate many of the problems we have been talking about. If tees and greens were built with essentially a good sandy profile and an appropriate drainage system, there would be very little soil compaction in a wet state. Another important management consideration on these turfgrass areas concerns the fate of the organic matter which

Poa annua *is a real problem when new turfgrass areas are becoming established. It is already producing seed before the other grasses are ready to be mowed for the first time.*

we are constantly punching into the surface of these soils. The organic matter will represent the very fine material in the soil profile and will take on the characteristics of silt and clay in a normal soil. Thus it is our responsibility to see that an excessive amount of organic matter (thatch) does not build up on the surface or we will eventually have less internal drainage, even over sand. A regular program of aeration and topdressing will help guard against this problem.

One of the greatest contributing factors to *Poa annua* encroachment and development is the failure to control turfgrass diseases. This doesn't always mean that the superintendent hasn't done his job. Sometimes you just can't treat it. Some superintendents in the North are faced each year with snow mold, and because of snowfall or ice, there is little they can do about it. In the Northwest we have *Fusarium* problems, particularly in the more moist areas. When it rains every day, it is very difficult to apply fungicides in an effective manner. *Fusarium nivale*, sometimes called *Fusarium* patch, often occurs at this time. You can practically chart the invasion of annual bluegrass in the putting green or other turfgrass area by observing outbreaks of *Fusarium. Ophiobolus* patch disease is another real problem in the Northwest and there is no known type of control program for it. The only control we have presently is a nutritional program using sulfur, or more intensive programs using other materials containing sulfur. With regard to *Ophiobolus*, we have identified hundreds of rings in cemeteries, parks, golf course fairways and other areas where *Poa annua* encroached because this disease killed the permanent turfgrasses.

Another superintendent was told that the Green Committee would like 100 per cent green

grass and no brown spots on the golf course. This resulted in over-irrigation and conversion of the fairways from Kentucky bluegrass to bentgrass and *Poa annua*, both of which are extremely susceptible to kill by gray snow mold or *Typhula incarnata*.

The committee and some of the trustees wanted to know what they could do about this. I told them that they could renovate the fairways and replant, but they still insisted on over-irrigation to keep the course green. Though the repercussions of their decision were explained thoroughly, it didn't seem to change their minds. In this case there is just not much you can do.

Aeration and vertical mowing also encourage *Poa annua*. If we use these practices during the time when we can expect heavy germination, there is no doubt that you will increase the *Poa annua* stand. This has been proven many times by researchers across the country. To take best advantage of these programs, do them during the period of time when they are least advantageous to the annual bluegrass.

Another problem is the misuse of maintenance equipment, golf carts and other vehicles during inclement weather. Heavy foot traffic at the inappropriate time can be just as damaging. In one case several greens were badly damaged during the frosty periods in December and January in the Northwest. Though some grass was lost, the superintendent said it served a very good purpose in the end: it really impressed upon the membership that they shouldn't play golf when the course is in that condition. Under these circumstances, ice crystals are formed within the cells. As a result of traffic across the turf, the plant cells are ruptured and the grass plant eventually dies. This opens up new avenues for *Poa annua* to move in. Perhaps the most damaging time is when the surface inch or two has thawed and there is still an ice layer or frozen soil beneath. These surface soils are supersaturated and we are literally wiping out our desirable grasses, to say nothing of the damage we are doing to the putting surface.

Shade, too, promotes annual bluegrass growth. The surest way to encourage a *Poa annua* stand is to give it some shade. I don't believe that there should be a tree that is going to block a lot of light within 60 feet of a putting green. If the trees are closer than this you are robbing greens of some light. Use a light meter to measure the light in sunny and shady areas and see the difference for yourself. We have seen many golf course greens that receive less than threshold levels of light for the growth of bentgrass. In its place we have stands of *Poa annua*; but believe me, they are not good stands. I think golf course architects should pay particular attention to this and Green Committees and golf course superintendents need to develop a healthy respect for this problem.

SUGGESTIONS FOR DEALING WITH POA ANNUA

Some control programs, however, may help you live with the problem of *Poa annua*.

I recommend overseeding. However, the broadcast method of overseeding usually does not lead to a significant improvement in the turfgrass stand, even over a period of many years. You need specialized overseeding equipment for this job, and if it is used correctly, there is hope for some success. If we are going to have more success with overseeding greens, however, I believe that they should be taken out of play for a few weeks after the operation so that the grasses will have an opportunity to germinate and develop. I don't think you can plant bentgrass and mow it at 3/16 inch on the first cut and expect it to survive. That is exactly what we are doing now. Except for those few seeds that germinate in the aerifier holes and as a result are tall enough to withstand the first cut.

Looking at soils very briefly, I think the USGA has done a beautiful job in research and in developing publications that promote proper construction techniques for greens. I also believe that the researchers at the University of California at Davis have done well with their investigations with regard to frequent, light topdressing programs. These techniques might well be worth study by golf courses that have wet, unstable greens. Certainly providing good soil mixtures which provide good drainage is significant to growing desirable turfgrasses.

Just because *Poa annua* moves in on poorly drained sites and those that have been subjected to heavy traffic doesn't mean that this is the best and only condition for it to grow. *Poa annua* does much better under well-drained conditions with good levels of fertility and all the other good practices and conditions that help bentgrasses and bermudagrasses thrive. But let's do a better job of soil mixing. We know a lot more about it now and there is information at your fingertips. There is little or no excuse for doing a sloppy job of construction now.

Let me emphasize again that good disease control is very important. We have some good fungicides, but many more are needed. A couple of new fungicides are doing well for us, and I think they will become available soon. The fungicide by itself is just part of the program. Don't wait for a disease epidemic before you apply the material. If you know the conditions under which diseases attack, taking into account temperature, humidity, day length, etc., then be ready to apply the fungicide.

I should mention vigor in grasses. Dr. Gould and I have been working with about 156 cultivar selections and varieties for six or seven years, a project that has been partially supported by the USGA Green Section. We are selecting for *Fusarium* resistance and for other economic characteristics, such as color. I am one who likes color. I don't believe that color is everything, but if I have two varieties that both show many good characteristics, the one that has good color will get a higher rating every time. The point of our program is to develop vigorous and disease-resistant bentgrasses that provide high quality playing characteristics and compete well against *Poa annua*. Unfortunately, none of these 156 types from

After disease weakens turf, Poa annua *will surely encroach.*

Poland, Russia, Sweden, Norway, Holland, etc., have total *Fusarium* resistance; therefore, it looks as though we will always be dependent upon fungicides and cultural programs to a certain degree.

I would also like to mention pre-emergence control programs, which I have been working on since about 1959. About three years ago one of our staff members took on the responsibility of coordinating all the *Poa annua* work that we have done thus far and suggesting new programs that seem promising. The program that he came up with is looking excellent in the Northwest, although I have to qualify this by saying that it may not work everywhere. It involves using endothal and DSMA. It has been successful in removing annual bluegrass from stands of bentgrass, Kentucky bluegrass and ryegrass.

This is a post-emergent application, and it is essential that we use pre-emergence herbicides in advance of the application of endothal. I believe that our program can be further modified so that we can apply the endothal and then overseed without pre-emergence herbicides. The endothal can be reapplied later, and a pre-emergence herbicide can be used to stop further germination. Our program has been tried by some of the researchers in the East, but they haven't had the success with it that we have. Maybe they need additional testing to find the time of season when the material is most effective. I cannot make a recommendation to you now because it would be contrary to EPA labelling, which suggests a rate that will not control annual bluegrass.

I would say eliminate shade; use a little bit of judgement when planting new trees. I believe in a dynamic tree program around greens and tees. Some years after a tree is planted, plant another one near it. When the original tree gets to a point where it is creating problems, cut it down and let the other one come into its place. This type of continuing program should prevent shade problems.

Another important aspect of *Poa annua* control involves nutritional programs. If you are dealing with *Poa annua*, it certainly does respond very well to high levels of nutrition. Bentgrasses in our area respond to medium to high levels. High rates of nitrogen, especially from urea sources, will stimulate more disease activity than will any other source of nitrogen, so be prepared to go to a better fungicide program. If you want to go with lower nitrogen levels, you are taking a risk that turfgrass density will not be adequate for the best playing conditions. So you have to decide in your own areas how much nitrogen is enough to get the density that you desire. If you can do it on one pound of nitrogen per 1,000 square feet, be my guest! If we can't do it on less than eight or 10 pounds, that's what we will use.

Sulfur is another important nutritional component. We have observed some excellent responses by using up to 3½ pounds of sulfur per 1,000 square feet per year. In addition to significantly reducing *Fusarium* patch disease and eliminating *Ophiobolus* patch disease, we have almost completely eliminated annual bluegrass after five years or so of continued sulfur applications. This program also involves keeping phosphorus and potassium levels adjusted. If high levels of phosphorus are maintained, you are stimulating *Poa annua.* If you want to increase or make your *Poa annua* stands better, use higher levels of phosphorus, moving it up to perhaps ten parts per million as indicated by a soil test. Otherwise, keep the phosphorus level between three and seven parts per million. Even when high rates of sulfur were used, high phosphorus levels encouraged *Poa annua* growth and seedhead production. However, if *Poa annua* is what you are managing, I would recommend that you use no more than 50 pounds of sulfur per acre per year because if you go any higher, the *Poa annua* will be retarded and more problems will be created.

It is probably safe to say that annual bluegrass will never go away any more so than the common cold.

USGA GREEN SECTION RECORD
MARCH/APRIL 1978

TURF TWISTERS

FLOODING

Question: We have a periodic problem with flooding from a small stream which runs through our golf course. As land becomes developed around the area, this problem is getting more severe. Any suggestions? (New Jersey)

Answer: Although you might ask a private consulting engineer for his analysis, an individual landowner can single-handedly accomplish very little beyond insuring that developers comply with any applicable regulations with regard to run-off and sediment control. Your best bet is to apply for U.S. Department of Agriculture assistance. Through your local Soil and Water Conservation District, it may be possible to obtain both technical and financial aid from the Soil Conservation Service for accomplishing community size projects. You might also investigate the possibility of obtaining disaster assistance through local USDA agencies, such as the Soil Conservation Service and the Agricultural Stabilization and Conservation Service.

CLOGGING

Question: We are having a problem of nozzle clogging when using some wettable powders. Our screens are properly sized. What can we try? (New York)

Answer: This can be a problem, particularly when using small volumes of water for a carrier. Aerial applicators have found that certain types of surfactants used as spray additives virtually eliminate clogging difficulties. Ask your local supplier which of these materials he carries will work for you.

AND THE RULES OF GOLF

Question: What would prevent golfers from using the USGA's new Stimpmeter to test greens prior to putting? I foresee a great problem here and if this happens, what can be done about it? (Texas)

Answer: We wish our every opponent would attempt this . . . because no match would ever reach the 11th hole! Rule 35-1f reads as follows: TESTING SURFACE — During the play of a hole, a player shall not test the surface of the putting green by rolling a ball or roughening or scraping the surface.

TEN AND EIGHT . . . NEXT MATCH!