spoiled the golfer to the point where he is possessed with always having the ball in play. It started with the touring pro, and now the member is possessed also. The playing trend has swung from accuracy to an emphasis on long ball hitting and never landing in trouble. It's time we started back the other way. I believe the paramount objective of the founders and architects of this wonderful game was not this idea of present day "hairstyling" conditions and excessive grooming factors that are pricing us right out of the game. If they were here now, they would say to us, "Do less grooming—put skill back into the game."

In reading the recent results of the Chicago District Golf Association questionnaire; Item 6, Answers to Question, "Do you feel that green maintenance and capital improvements may require future limitations due to financial pressure and the energy crisis?" the majority answered YES. In answer to the Question, "In what areas would you feel limitations might be first applied?," the majority from our Chicago golf courses answered, "Less golf course grooming."

To conclude, in the December issue of the *Golf Superintendent*, William H. Bengeyfield, the Editor of the USGA GREEN SECTION RECORD, wrote something that impressed me:

> The word grooming is overworked today. Its meaning is muddled and in need of redefinition. A well groomed course doesn't mean that every blade of grass has to be clipped. Rather, it is a course that plays well from each tee to each green. That's the point; it plays well. The course is well groomed—for golf.

Role of Soil Tests in Turf Management

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Certain rules are important and should be followed if results of soil sampling, laboratory analysis and interpretation of these results are to prove meaningful to your turfgrasses.

Samples must be correctly taken. They must be representative of the turf use function as well as the soil classification. Soil samples must be taken at an exact and constant depth.

Thoughts are changing regarding the frequency of sampling for maintenance turf. Recent sampling and testing evidence points to yearly sampling of the same turf use function area. Any established golf course, regardless of the number of holes or acreage need but sample one fairway, one tee and one putting green each year to keep abreast of nutrient trends on the entire area. Sampled areas should be typically average (neither the best or the worst) and the same function area should be sampled again the following, and each subsequent year. Also, sample any area where turfgrass injury or general unthriftiness has occurred, provided the true cause of the injury, such as disease, insect damage, etc. is not already known.

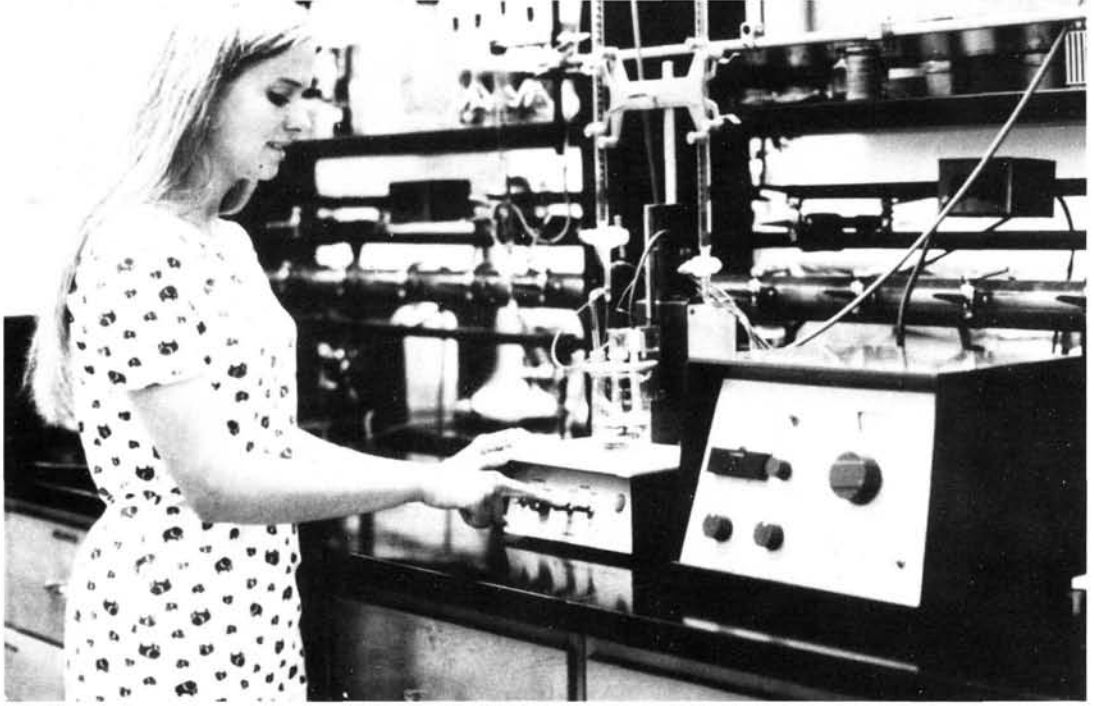
New areas to be planted should be sampled separately. In this case a deep plowshare composite sample should be taken for analysis.

Maintenance samples should be taken at the same season of the year. At least two and preferably four weeks delay in sampling should follow any fertilizer application. Thus, most finished golf courses are looking at three samples yearly with possibly one or two extra some years for that new USGA specifications green, a trouble spot, or that once-in-a-decade check on the unfertilized rough. Taking smaller numbers of samples over prior practices will save money. As to those who have never sampled, even this small amount will cost money. However, if even one worthwhile recommendation results the savings can be appreciable. As an example, under low pH or highly acidic conditions, nitrogen applications lose effectiveness. Adjusting acid soils toward the neutral point can result in a 20 per cent saving on nitrogen and make other elements more available.

Some day we hope to reach standardization of techniques among laboratories testing soils for turfgrass use. Until then it is impossible to compare one laboratory's results with another. Although much is being made in scientific circles about the merits of various extractants, cation exchange, calcium-magnesium ratios, etc., these factors pale in significance with proper sampling and proper interpretation of the results. This is because turf is a permanent and seldom harvested crop.

In the past we have said the soil test results should be interpreted by a turfgrass agronomist. Undoubtedly this was a step in the right direction as against having the tomato, corn or buckwheat scientist attempt to diagnose results for a completely unfamiliar crop. Now it is time to make further qualifications on expertise. The advisor must be aware that some turf areas are harvested continuously, whereas others never have nor ever will experience a crop removal. Further, he must understand that the ratio of N-P-K in the clippings should have absolutely no bearing on the N-P-K ratio in the fertilizer! These are strong but long overdue words.

Admittedly this will cut down appreciably on



Determining pH and lime requirements in laboratory.

those I feel are competent to give advice. Anything we do that can lead us away from the policy racket or "numbers game" in fertilizers is certain to save money. Once this comes to pass, the turfgrass grower should be fully as capable as the trained agronomist to formulate fertilizer programs based in part on soil test results. The practical value of soil tests properly interpreted are excellent to determine pH or soil reaction and levels of calcium and magnesium. They are fair to good for phosphate and potassium, and worthless as far as nitrogen is concerned. They can also be quite helpful in determining salinity problems, but they aren't very helpful on minor and secondary elements. Maladies from the presence or absence of these minor elements most often show in imbalances in the grass tissue rather than the soil.

So much for the known. Now to the reasons why the value of soil testing is in dispute, or perhaps I should say disrepute. Most of us know that test results have been used to sell fertilizer, or, a soil testing service. It is probably not so well known that our university system must also share some blame. We still run into instances of our experiment stations recommending 10-10-10 at 10 pounds per 1,000 square feet, irrespective of the test results or functional use of the area.

I sometimes think some of us have failed to appreciate the obvious. The soil supplies the needed elements, and it needs but little supplemental assistance where a crop is never harvested. A constant reminder of this is to look at that deep rough that hasn't been fertilized in many years, if ever. The grass there must be self-sustaining without man's help. It is self-supporting because it is self-fertilizing. The reason: CLIPPINGS ARE NEVER REMOVED. I repeat, whether or not clippings are removed should be the largest factor of all in determining fertilizer practice.

Other than nitrogen, our industry has failed to give proper consideration to the source of the nutrient. It is important. I am responsible for switching the turfgrass grower from muriate to sulfate of potash. I say this not to gain credit. Unfortunately the reverse is true. Had I let this "sleeping dog lie" most mixed fertilizers sold to the trade would still contain the less expensive muriate or potassium chloride, and at a savings to you.

Despite this, my intentions were good. In resurrecting the "salt index" of fertilizers, I found some nutrient sources had a much greater tendency to cause wilt, burn and desiccation when compared to others. This classic work was published by Rader, White and Whittaker in Soil Science Proceedings 55, in 1943. Among many interesting things it shows 60 per cent muriate of potash has an index of 116 compared to sulfate of potash at 46. Thus, muriate has twice the tendency to burn grass. In fact, muriate on a pound for pound basis was the saltiest of all the materials tested. It was sometime later that we found sulfate of potash often was poorly granulated with poor water solubility when compared to muriate.

I still advocate the use of potassium sulfate under conditions of dire need as shown by the soil test whenever temperatures are 80 degrees Fahrenheit or higher, or increasingly where we suspect the lack of sulfur could be limiting growth. We must, however, ask ourselves why we should apply any potash source in hot weather when good management tells us the potassium applications are best made during cool growing weather when materials with high salt indexes seldom cause trouble. This is the time to ap-

Often the grass plant will send signals; soil testing is needed.

ply muriate at a saving on both the water and fertilizer bill.

Please do not confuse cool with cold, non-growing weather. Potassium can only help a grass's winter hardiness when it is inside the root-leaf system. Those who apply potassium or mixtures containing this element on dormant turf are foolhardy to say the least. They are begging for trouble should the weather stay dry and open after the water system is turned off. Cool weather is also the time to apply water soluble, fast release chemical nitrogen, if needed, and for the very same "high salt index" reasons.

The other unfortunate result of our romance with potassium is that formulators now offer mixtures containing almost as much potash as nitrogen. Even though increasingly it is the expensive sulfate of potash in the mix, the burn tendency is still there, and it offsets to a great degree the safety of the slow release expensive nitrogen in the product.

N-P-K fertilizer mixes make little sense for use on established turf. They were designed originally for use before planting in the same way mixtures are advocated for farm crops—to bring the seed from planting to fruition. Again, unfortunately, the ratios available to the turf planter are poor. In establishment we need something like a 3-12-6, or similar. This can safely be applied at 40 to 50 pounds per 1,000 square feet, or in enough bulk to adequately cover the area in depth. At the same time it will supply a goodly quantity of phosphorus and potash as well as some water soluble nitrogen, and without hurting the seeds or seedlings. The high analysis mixtures are designed for banded row planting of farm crops, not turf. Despite this, the fertilizer formulator wants to sell you the high analysis mixture. Why? Because he makes more money on the mixture as compared to selling you source materials. He will continue to do this as long as you, the user, are willing to accept a mixture and those in an advisory capacity advocate their use.

I sometimes feel the worst thing that has ever happened to turf is the researchers' performance measurement of grass based on weight of clippings and their nutrient content. It really isn't. It just seems this way because many growers and experiment stations have interpreted these results to apply to all turfgrass areas whether or not a crop of clippings is actually being harvested. How else can one explain the N-P-K ratio of fertilizer mixtures applied to fairways where a crop is never harvested?

Any mixture is bound to look good if it contains nitrogen. In fact, if nitrogen is eliminated, the mixture would not sell. Our question is: "Can we any longer sanction the use of unneeded elements just because the mixture contains nitrogen?" I think not. To do so blows the whole concept of trying to grow turf more economically.

Where soil tests show a need for extra phosphorus or potash, the source materials should be used and applied separately from nitrogen. But let's make certain the need is really there, and that it is

not the nutrient ratio in healthy clippings that you or the testing laboratory are looking at. All too many of us have been rebuilding the auto with new tires and spark plugs when all it needed was a little gas to make it run.

Even on putting greens, and, increasingly teeing areas, because clippings are harvested, the source materials make sense over using mixtures. They are less costly and they provide complete flexibility in application.

I'm sure most of us are familiar with the source materials. I mentioned the two major potassium sources. With phosphate it is becoming increasingly difficult to get the older and much better 20 per cent super, so you may have to settle for the treble or 45 per cent variety. This brings up another interesting point. Most of us have been led to believe the higher the analysis, the better the value. " 'Taint so!" As the phosphate percent doubles in concentrated superphosphate, sulfur is lost. When urea replaces ammonium sulfate as a nitrogen source, the same thing happens. If in doubt just ask the grass—your grass—the high analysis question. It may take a while to get the answer on our heavier soils in industrial areas, but almost no time at all in Florida and the Pacific Northwest.

In most areas you have a choice between dolomite or calcite lime. It makes little economic sense to use the more expensive dolomite if magnesium levels are adequate. We sometimes find that using the coarser grind can also save a buck.

There are a raft of cold water-soluble, fast-release chemical nitrogen sources. Ammonium sulfate, ammonium nitrate, calcium nitrate and urea are the major ones used on turf. The more slowly available nitrogen sources include ureaforms, I.B.D.U., coated ureas and the natural organics like leather tankages, seed meals and activated sludges. A good economic case can be made for both fast and slow release forms. In fact, many turfgrass managers use a combination of water soluble and slowly available sources each year. This makes good sense when used separately and not when mixed together.

For example, a cool-season grass needs it, and if weather conditions are such that only a water soluble source can be expected to perform, it makes little sense to apply a slowly available material at the same time. Conversely, warm to hot weather applications of water soluble nitrogen as a fertilizer, and not as a colorant, make no sense at all. They cause too many problems with moisture stress and over-succulence then.

Finally, we say only recommendations that have been field proven should be followed. This is done by making test applications. You should do the same. Ask your grass what it thinks about the soil test recommendations. It doesn't take that much time or that much money to put out a few test plots. Just remember, in so far as possible, keep the elements separate. You don't want to confuse a sulfur response with a potash application, or have nitrogen mask the need for phosphorus.

The field test concept may be the best way of all to save money, or, at the very least, to make sure the money budgeted for fertilizer is being properly spent.

ABOUT THE AUTHOR: Few turfgrass agronomists have traveled more extensively throughout the western world than Charles G. Wilson. None have been more closely associated with chemical soil testing techniques and analysis. A graduate of the University of Maryland, Mr. Wilson served with the USGA Green Section for a number of years and now as Director of Agronomy and Marketing for the Milwaukee Sewerage Commission.