Proceedings

of the

Twenty-Eighth Annual Texas Turfgrass Conference

TEXAS A&M UNIVERSITY

and

THE TEXAS TURFGRASS ASSOCIATION

COLLEGE STATION, TEXAS

December 10-11, 1973

ACKNOWLEDGEMENT

The Twenty Eighth Annual Texas Turfgrass Conference was held in the J. Earl Rudder Conference Center on the Texas A&M University Campus, December 9-11, 1973. These Proceedings are compiled from the papers presented at the Conference and are intended to improve the quality of turf in Texas. The program was an overwhelming success because of the dedication and cooperation of the program participants, the Officers and Directors of The Texas Turfgrass Association and most of all, those of you who gave of your time to attend the sessions. As program chairman, I take this opportunity to thank each of you for your contributions to the 1973 Conference and invite you to attend the Turf Field Day and Conference planned for 1974.

A special word of gratitude is owed to Ms. Tammy Kumler for handling the correspondence, registration and proceedings resulting from this Conference.

Respectfully yours,

Richard L. Duble

Richard L. Duble
Program Chairman

TABLE OF CONTENTS

LOOKING AHEAD

James R. Watson
Vice President, Customer Relations
The Toro Company
Minneapolis, Minnesota

Last year I discussed a similar topic with you and some of the points reviewed at that time are as appropriate, if, in fact not more so, today as they were then. One in particular needs to be updated -- the development of managerial skills and talent. For, if possible, this is a more critical need today than it was last year, and in my opinion, will become even more critical in the next few years. But, let me come back to this point later, because I believe that the topic "Looking Ahead" at this time dictates a generalized discussion of the energy situation as it relates to our profession and to the opportunities it will bring to the total turfgrass industry.

There have been some very significant changes within the past few months and that they shall have an impact on our life style is an absolute certainty. However, I see nothing but opportunity and challenge for those of us in this field. And, I am confident that we shall learn to cope with the results that these changes will bring and that we will adjust (and adapt) without undue hardship. Further, I am equally confident that all involved with the turfgrass industry will continue to produce and to provide highly satisfactory recreational and aesthetic turf facilities.

At this time one could wish for that proverbial crystal ball. But without it and without the slightest pretense of having more (or less) information than is generally available on where we are heading, I should like to try and evaluate some of the key factors as they relate to turf facilities and as they may affect our activities for the next few months. For today as we "look ahead" there are more unknowns than at any point of time in our recent history. The unknowns embrace most facets of our lives and are the result of an accumulation of many things -- some technological, some social and some political. The one thing we can be most certain of today is that there shall be changes and alterations in the life style we have enjoyed the past several decades. Whether this shall be for better or for worse will depend entirely on how we as individuals or organizations accept the challenges and hurdles we face. Or, in other words, how effectively we handle or establish, arrange or rearrange the priorities of choice that shall be available and that shall confront us.

The energy situation or "crisis" as it has been labeled is certainly one of the major factors contributing to uncertainty in the near term. And the resolution of near term difficulties may

very well portend and set the pace for the long term. It will have an effect (and I firmly believe, for the most part a beneficial one) on the maintenance and utilization of our turf facilities. But the effect on our general economy will be even larger. Although not to the dire extent some would have us believe. Because I believe strongly that there is a great need for careful analysis of all facts and for calm thoughtful action on the part of everyone I should like to digress and take just a moment to review a couple of editorials I have read recently. The first by Edwin Dale of the New York Times Service stated in part:

> "The evolving events are almost certain to lead to a deluge of denunciations by politicians, headlines in newspapers and pronouncements by industry groups and their economists that will produce more confusion than enlightenment. As an example, the media noted the fact that United Airlines laid off 6 percent of its combined force of pilots and stewardesses, although the article did not talk much about the relatively small figure of 6 percent. They talked about the 1000 people laid off. He quoted one economist as saying It's a good guess that we will see all through 1974 a series of page one and television stories on small layoffs, essentially accurate, that will create a public impression of crisis. Congress will be in a state of total confusion. He concluded that it is a bad time for economists to predict what will happen and stated that the bewilderment of the general public could be an additional and serious element in the course of the economy in 1974. The latest Morgan Guaranty Survey points out the basic implications of the strain on energy supplies is the possibility of a fairly fundamental change in life styles. And if that in fact is what we are headed for, then transitional stress is unavoidable. When people stop spending it in other ways, the net impact on income and employment is very likely to be adverse."

Another editorial from one of our local newspapers sums up another viewpoint of the energy crisis when it asked "Are the energy savers our saviours?" Let me quote:

> "With the energy crisis have come all sorts of people who are excited by the opportunity to take things away from us and to force upon us, permanently, a spartan, frontier lifestyle. Almost gleefully, these people, who include some of our legislators, columnists and other 'know what's best for us' types, advocate permanent bans on big cars, snowmobiles, air conditioning, outboard motors, color TV sets, Christmas tree lighting, and on and on.
>
> Their motivation seems to be more than that of just saving fuel. They seem to be using the energy crisis as an excuse to have us give up luxuries they don't think proper for us to have.

> They, themselves, can afford these things but choose not to have them because, in their minds, these luxuries are representative of a boorish American lifestyle.
>
> Two factors are conveniently overlooked. One, the demands for these luxuries help fuel our economy i.e. create jobs; and, two, the vast majority of Americans want and enjoy these non-essentials.
>
> Obviously, the country is prepared to make sacrifices in the short term or in any national emergency, but, in the long term, most of us want the advantages our technology has given to use -- we like our comfortable cars, our color TV sets and our air conditioning.
>
> It will be much more popular to urge the country to invest in the long term development of our energy alternatives so we might continue to enjoy (even partially) our comforts and luxuries than to ask us to give up forever these things so we might continue to "sneak by" on our present energy resources.

These are only two examples of many that have been written and voiced in the past few months. There shall be many more! And each shall have one or more valid points worth consideration. My plea is simply to ask you, as we look ahead, to carefully study and examine all situations and to act only when all the facts are known. Don't become alarmed and above all don't fuel the flames of uncertainty by responding to, or passing along, idle, unfounded and often distorted rumors. In other words, don't become an alarmist.

Keep abreast of all new developments in the turf and related fields. Be flexible and be prepared to accept the challenge, to interpret what's happening and to convert to those changes that will have the greatest beneficial effect on you and your organization.

In this respect my son told me a story a few days ago about Ezra a farmer from the "big thicket" area who went in to see his local banker about a loan. The banker asked if Ezra were in trouble? No -- just want to borrow some money. Banker agreed as to how this was possible but couldn't really understand why -- they had never loaned money to Ezra's father or grandfather and he was surprised that Ezra needed money. Perhaps should explain that when bank loaned money they charged interest and required "collateral." Ezra said he understood. So, the banker asked how much money he needed -- a $100. Somewhat taken aback the banker said "Well they discounted their interest and that Ezra would get only $92.00 since the interest rate was 8% -- did he need the full $100? No, the $92 was satisfactory, and he produced a certificate for 1000 shares of General Motors stock as collateral. Banker protested that this was much greater than was required. Ezra insisted

that the certificate be accepted and held until he paid off the loan in a year's time. The loan was consummated.

The banker was highly amused at Ezra's naivete and told the story around town. Soon it got back to the local country club and Lucy, Ezra's wife, heard it. She was furious and that night engaged in a little pillow talk and proceeded to tell Ezra how he was the laughing stock of the community. Whereupon Ezra said, "Now Lucy, you just let them laugh. Last year that banker charged me $25.00 to keep that certificate in the bank's vault!"

As we look ahead we must necessarily evaluate and build on the past, we must set objectives and goals for the near and long term and we must develop the plans needed to implement and to ensure accomplishment of those goals. And we must develop alternate plans that can be put into effect when the ifs become actualities. We must become EZRAS!

The turfgrass industry -- all facets of turfgrass -- has a proud record of accomplishment. The achievements of the past quarter century include new warm- and cool-season turfgrasses, new fertilizers, new pesticides -- fungicides, insecticides and herbicides -- new equipment and new cultural techniques. These are some of the material accomplishments. And as we look ahead I see a continuing expansion of these endeavors and accomplishments.

What about the achievements of the individual? In my opinion, the greatest achievement has been in the role played by today's professional turfgrass manager, the certified golf course superintendent and others who direct and guide the activities of the many and varied turf facilities that collectively represent the turfgrass industry today. Yet, I think it is the turfgrass manager who faces the greatest challenge in the near term. He must plan his operational programs, develop alternate plans in event of budget curtailment, carefully weigh all conditions, all situations and all alternatives and then choose the best for his (your) particular operation. The manager must know how much it costs him to grow and to maintain his turfgrass facility at the standard or level desired by his club or his controlling organization. He must know what his expenditures for equipment and supplies produces in terms of lower operating costs. And he must be prepared to defend his budget. In short, he must utilize and improve his managerial skills.

In the days ahead what will be the impact on turfgrass facilities and what may we expect as a result of the "energy crisis?" It is difficult to assess specifically what the full overall impact that loss of adequate, readily available economical sources of oil may be; however, certain generalizations are self evident. For example, delays in <u>delivery</u> but not necessarily shortage of some products -- both whole goods and parts. Perhaps shortages of fertilizer materials, certainly an increase in cost, as well as of most other materials

and supplies. There will be shortages and delays in delivery of petro-chemical products, particularly poly propylene derivatives. In this respect please be patient with your supplier, your distributor and his manufacturer. They will be doing everything possible to meet your needs! We will see tighter budgets and higher prices in general. And on top of this there will be increased usage of most all turf facilities. And for those that do not experience increased usage, a change in their operating format is inevitable. But, this will not necessarily be harmful. In fact, for those few facilities that do experience a decrease in utilization there will be an opportunity to upgrade, repair and improve their facilities. And perhaps preclude the necessity of restricting or limiting the number of visitors to those facilities that already support maximum numbers. For example, visitation to Isle Royale National Park would have to have been restricted in two to three years if the current trend continued. The ecological carrying capacity of this park is only some 25,000 annual visitation days. In 1973 some 20,000 were registered.

Reduced or limited travel will intensify the use of local, readily accessible golf courses and parks. May speed the development and enjoyment of "bowls" -- outdoor bowling -- a highly popular sport in other parts of the world. The resort course may experience more intensive play, because once there the patron will spend all of his time at the facility rather than taking off in his automobile for one or two day sightseeing trips. And the resorts will find a way to get their customers to the facility.

SUMMARY

In summary, and without delving into each area there will be changes in many aspects of our "business." Among the more significant areas I would include:

Energy. The energy crisis will cause a growing number of delays in delivery of materials, supplies, whole goods and parts. Perhaps temporary shortages of some petro-chemical products. It will become increasingly necessary to stock and to inventory critical parts.

There may well be changes in working hours to fit car pools, bus or train schedules. This could have an impact on the number of hours as well as the time of day, or night, that the "customers" will use a given turf facility.

There will be greater emphasis on total cost of equipment operation. This will take into account not just the initial cost but the cost of parts and service, down time, labor and other operating costs; in short, all factors that go into the determination of the cost of the work performed by a given piece of equipment.

Environment. The environmental scene is one of constant change and constant expansion with new restrictions, new laws, new propaganda and pressure efforts along with new technological developments. Every aspect continues to be of utmost importance for anyone concerned with ecological matters. But in the near term this may become secondary to efforts to develop and to utilize fuels efficiently. However, we as custodians of large and important public and private segments of the nations' green swards must continue to strive to set an example of what's good for our communities.

Shorter work week. Already a reality in some industries, and likely to spread to others. Also, there may be a rearrangement of working hours. All of which will lead to more leisure and to greater utilization of "closer to home" facilities. Likewise resort facilities probably will experience more intensive usage by their patrons. Another probability will be the development of outdoor games like "bowls" -- the lawn bowling so popular in other countries.

Metric system. We must move toward an understanding and utilization of this simple system. We are one of the few nations who have not adopted this system. We cannot stand alone and expect to compete internationally, nor can we survive as isolationists, although we may desire to do so.

Cultural practices. The basic studies utilizing sand as a growing medium, initiated at Texas A&M by Marvin Ferguson, Leon Howard, Ray Kunze and continued by others under the leadership of Morris Bloodworth and Dick Duble continues to receive attention. Studies being conducted by Bill Daniel at Purdue and John Madison at University of California at Davis show that sands may well produce the satisfactory growing medium required to support the intensive usage turf facilities are undergoing and will continue to receive.

New cultural techniques that utilize the latest developments and improvements in products must be considered. In fact, programs geared to phase in new materials and equipment at an early date may provide the edge needed to keep the turf facility at the level of maintenance required.

Management. The need for improvement of managerial talent is obvious and will become more critical as the need for control and analysis of all operational procedures increases.

Opportunity. Finally all that has happened in the past few months and all that will happen in the next few months can mean nothing but increased opportunity for all concerned with the turfgrass industry. And as we look ahead we must prepare to accept the challenges available. For the production and maintenance of good turfgrass facilities is a vital and necessary part of our way of life.

GRASS ESTABLISHMENT

Wallace G. Menn, Golf Superintendent
Texas A&M University Golf Course
College Station, Texas

Before talking about the requirements for grass establishment I feel that we should probably divide this discussion into two types of grass establishment. For most of us that do not have bentgrass greens, we are faced with not only establishing a permanent cover of bermudagrass but also with overseeding with a cool-season grass for winter traffic. The first part of my talk will deal with establishment of a permanent cover and I will touch lightly on overseeding later.

In discussing grass establishment, we need to look first at the growth requirements of the grass plant. Probably, the most important requirement is that of moisture. A suitable range in temperature and oxygen are two more requirements of the growing grass plant, however, if the grass is planted in the proper season and if the seedbed has been prepared properly, temperature and oxygen should not present any great problems. Moisture will usually be the critical factor in the initial stages of grass establishment.

The amount of water applied to a newly planted turf area will depend to a large degree on the method of planting and also soil type or texture. For example, plugging will not require as much watering as will sprigging or stolonizing both of which in turn require less irrigation than hydro-mulching where the sprigs are more or less lying on top of the soil with little or no protection against drying out. When establishing turf from seed, the amount of moisture necessary will depend upon whether or not the seed has been worked down into the soil, topdressed lightly or merely broadcast upon the soil surface; the latter of which would require keeping the surface of the soil moist at all times until the seed had germinated and put down a root.

Texture or soil type has always played an important role in determining irrigation frequency; however, with the advent of the near "all-sand" greens it has become critical. We all know how fast sand dries, so it becomes a challenge to keep the top inch or two of your seedbed moist for the first few days after seeding or sprigging. Then we may become so moisture conscious that we might be keeping our seedbed saturated and this can probably be as harmful to the young grass seedling as not having enough moisture. Overwatering results in a shallow-rooted, unhealthy grass plant which is suffering from lack of oxygen. When a soil is saturated most of the air pockets (pore spaces) are filled with water and the plant cannot obtain the required amounts of oxygen necessary for normal

growth, it usually turns yellow and looks somewhat stunted. Of course, over-watering also promotes conditions which are conducive to infestations of grass diseases caused by fungal organisms found in the soil.

Okay, you say all of this is fine, but I still haven't told you what kind of watering schedule that you are supposed to follow in establishing grass at your location. You're right; and, I probably won't. The only guidelines that I can offer are:

1. Keep the surface inch of soil moist from planting time through seed or sprig germination.

2. Gradually decrease the frequency of irrigation while increasing the depth to which you soak the soil at each watering.

This may mean watering 3 to 5 times daily for the first week or 10 days following planting and gradually decreasing the frequency to once per day, then every other day, and so on until you have a plant with a strong healthy root system 6" to 8" deep.

Let's turn aside from watering for a moment and discuss another item that will most certainly enhance a quick establishment of turf. Fertilization is the subject and let's not belittle it for the proper use of fertilizers may mean the difference in getting a complete grass cover in 6 weeks rather than 8 to 10 weeks. When it comes to feeding, I feel that a newly planted grass is much like a new baby, they both require small amounts but more frequently. I am certain that there are several fertilizer programs that will speed establishment; however, I am going to mention one that I have used and found successful in establishing greens.

First, I feel that it is very important to apply a liberal amount (by "liberal", I am talking about a rate in the neighborhood of 2 lbs. of actual Nitrogen, P_2O_5 and K_2O per 1,000 ft.^{2}) of a balanced, complete fertilizer at the time of planting. In the case of seedlings, I would wait to make subsequent applications until the grass plant begins to put our runners. Then, I would begin applying a stricly Nitrogenous fertilizer at a rate of 1/2 lb. of actual N per 1,000 ft^2 per week. Dr. Duble has shown that subsequent applications of phosphorus along with the nitrogen will result in faster establishment in St. Augustinegrass. Perhaps this will affect bermudagrass in a similar manner. Where vegetative planting techniques (sprigging, stolonizing, hydromulching, etc.) have been employed, I would begin the "1/2 lb. of N per week" program with the first sign of sprig germination and carry through establishment. Remember this fertilization program is aimed primarily at greens. Programs designed for tees and fairways will depend largely on soil type. Heavy clay soils would probably

require less frequent applications of fertilizer than would soils of a sandy texture. The reasoning behind this is that when using inorganic nitrogen fertilizers, much of the nitrogen is readily converted to nitrate which, in turn, is easily leached from the root zone of the grass plant.

So much for the fertilization, let's look briefly at mowing and how it may speed up establishment. As a general rule, I would say start mowing as soon as you have something to mow. This will be especially important on teeing areas and in fairways. For the most part, these are areas that have not been sterilized prior to planting and will most likely be giving rise to a healthy stand of weeds and weedy grasses. These volunteer plants compete considerably with your desired grasses for water and nutrients and mowing will certainly lessen this competition.

On greens, perhaps rolling the surface once or twice before mowing will provide a firmer and smoother area on which to mow. Here again I would say mow the new greens just as soon as you have a foundation that will support your mowing equipment. I think that you will find that you can get on the new green early with the old, conventional walking type greens mower. Where stands of bermudagrass are a little bit thin initially, verticutting will probably speed the growth and spread of the grass.

I mentioned earlier that I would touch briefly on overseeding. Of course, I realize that any suggestions that I might lend will be of little value to this year's overseeding program. Assuming that we aren't all out of business next year due to the energy crisis, I would like to offer my experiences with this year's overseeding in hopes that it may help some of you next year.

I am almost like the guy that would rather fight than switch; I mean why change if you've got a good thing going? Well, I did change my overseeding techniques this year because I heard some things that made good sense and boy, am I ever glad that I did. Last year, I went through the old ritual of peeling the bermuda off about the middle of October, then seeding, then dragging, then topdressing and then got ready for the flack from the golfers concerning the condition of the greens.

This year Dr. Duble and Bob Carter brought back tales from a South Texas GCSAA meeting in Houston about some people not tearing their greens up prior to overseeding and about them getting just as good if not better stand of wintergrass. This was latter September or early October and I had just verticut my new greens in two directions to help smooth them. I needed to topdress to fill in some rough spots and overseeding time was slipping away so this is the technique that I used.

First, I mowed my greens at 3/16 inch (which is the height that I had been using); next, I topdressed lightly and dragged it in. I followed this with seeding and settled the seed by watering. The seed was put down on Friday and Saturday afternoon we had a two inch "floater". The following Tuesday we had another hard two inch rain. By this time, I figured most of my seed was floating down the Brazos; however, when the grass started coming up I found that washing or movement of seed had occurred on only one green and not severely on that one. The bermudagrass cover that had been left on the green had held the wintergrass seed in place.

I want to emphasize that the techniques that we employed can only be used successfully on greens where a thatch or mat has not been allowed to accumulate during the year. These practices that I have described lend themselves to a much smoother transition from bermuda to a cool-season grass which in turn results in less complaints from the golfers.

In summary, I would like to again stress the importance of adequate watering during establishment. Remember, at first you need to water frequently but lightly. As the grass begins to take root and grow, the watering should become less frequent but heavier.

Your fertilization program should parallel the irrigation program; light fertilizations, but frequently. The program that has worked for me included a liberal initial application of a balanced complete fertilizer followed by light applications of nitrogen on a weekly basis.

Mowing encourages establishment by reducing competition from unwanted volunteer weeds and by pruning and subsequently inducing the production of new runners or stolons on the desired turfgrass.

WEED CONTROL IN OVERSEEDED GREENS[1]

Palmer Maples, Jr.
Golf Superintendent and Secretary-Treasurer
Golf Superintendent's Association of America
Atlanta, Georgia

Golf in the South is played the year around, and for those golf courses that have bermudagrass on the greens, overseeding with cool-season grasses is necessary because the grass becomes dormant in winter. The best putting surface can be obtained by using selected chemicals to control a number of pests. This article will explain some of the chemicals I have found helpful in my overseeding program, their methods and time of application and reasons for their particular use.

Poa annua has been one of the major problems when overseeding greens. It comes as seed in other grasses, it comes from other parts of the golf course, and even from within the green itself if no control measures are used. The problem is the seedheads and clumpy growth in the spring. Other than mechanical thinning and brushing, little could be done to control the Poa annua because available chemicals which would control Poa annua would also injure the desired overseeding grasses. Pre-emergence chemicals are now available, and if they are properly used, they can give control of Poa in overseeded greens. I have used Bensulide for the past six years. It has given excellent control of Poa in the greens through the winter and spring and it did not bother the desirable grasses.

My first use of Bensulide was on three greens at the Charlotte Country Club in 1966. These greens were very heavily infested with Poa and most difficult to putt in the spring. Smooth, dormant bermudagrass would have been a preferred putting surface and I felt there was nothing to lose by using a chemical to control the Poa annua, even if the desired grasses were also affected. A period of 60 days before overseeding was selected as the time to apply the Bensulide. A liquid material having four pounds of actual chemical per gallon, at a rate of nine ounces of material per 1,000 square feet was applied. This material was put out through a spray Hawk using four to five gallons of water per 1,000 square feet. It was applied during the first week in August. The first week in October is selected as the time to overseed the grass because it gives the seedlings time to grow before the first killing frost.

---

1 Reprinted from "RX for Overseeding Bermuda Greens", USGA Green Section Record, July, 1973, p. 9-12.

The procedure is to aerify the greens the last week of July, topdress, fertilize, and then spray the Bensulide on the topdressing. This forms a seal of pre-emergence chemical that I do not disturb or break with any mechanical operations. The application of this chemical at these rates and over this time span has given me control of Poa annua in the overseeded greens and has not injured or killed any of the desired grasses or interfered with its germination.

Disease also must be controlled by chemicals, not only on overseeded greens but on all greens. A lot of new grass on overseeded greens is often lost to disease because the chemicals were not applied on the green. Applications must be made at the right time to do any good, especially during periods of high humidity.

In preparation for overseeding, I begin spraying the greens with a fungicide in August. An application of capatan at eight ounces per 1,000 square feet is made and an application of daconil, cyrene, or other general fungicide is made. These chemicals will control some of the disease organisms that may be in the bermudagrass but not visible or active at this time of year. Other applications are made in September to rid the green of all disease that could hurt the new seedlings or the bermudagrass as it is slowing growth before going dormant.

Pythium is just as killing and fast spreading on seedlings as on other grasses, and it is a real problem in overseeding. Some treated seeds have been tried but they don't show a vast improvement over treating the seed at time of planting. Pythium control chemicals are kept on hand for immediate use if the disease breaks out after initial germination. I apply these chemicals the first two weeks after planting as a preventive spray, and as needed thereafter. Having used some broad spectrum fungicides in August and September, attention is placed on observing the seedlings as they emerge in conjunction with weather observations. Fungicides must be used on a preventive schedule during the first six weeks after planting. Rain should not interfere with the spray schedule for it is better to spray and have some control than no control at all.

Fertilizer and a combination of chemicals are a great help in establishing overseeded greens. The third week of September, an application of a 1-2-3 ratio fertilizer is made at a rate to supply 1 1/2 to 2 pounds of potash and 1 to 1 1/2 pounds of phosphorous per 1,000 square feet. The small amount of nitrogen will be useful in helping the plants use these other chemicals. A light topdressing of sterilized soil is applied to the greens at this time to give the seed a bed where they can start their new roots.

The continued growth of bermudagrass can be a problem in establishing the overseeded grass. Usually by October the night temperature is cool and the days are shorter so the bermudagrass

does not grow as fast. At times with continued warm weather, bermudagrass does grow and compete with the new seedlings. In looking for a method to slow the bermudagrass, I tried MH-30, (maleic hydrazide) a growth retardant. After the second year, I discarded it due to the lack of desired results. While the chemical would slow the bermudagrass and show some control of Poa seed heads, it did not give repeated, even control. Even spraying the green in two directions did not improve the performance of this chemical.

My next try was PMA. This material used at 3 to 4 ounces per 1,000 square feet worked fine. This amount of PMA would burn the bermudagrass and retard its growth for about 10 days to two weeks, giving the seedlings time to germinate. Another advantage of PMA was in clearing up any disease organisms immediately before seeding. The application of PMA at 3-4 ounces is made on the Friday before the seed is planted the next Monday, or three days before planting.

All seeding is accomplished in one day during the first week of October. It is brushed and matter into the green, and watered that evening and night. This procedure helps wet the seed and get it settled into the grass before topdressing. If the overseeding is topdressed before watering, the topsoil will settle down into the grass and leave the seed floating on top of the grass and not in contact with the soil. When the dew dries the day after watering the seed, topdressing is used at a light rate over the seed, matted in and watering continued.

Three to five days after planting, a broad spectrum fungicide mixed with a pythium control fungicide is applied. Mowing starts in six to seven days at a height of 3/8 inch, and continues at this height for three weeks. This gives the plant time to grow its secondary roots and leaves, and establishes a healthy plant that will withstand the traffic, cold weather, and disease of the coming months.

The use of chemicals is but a part of a planned program that I use in establishing my overseeded greens each fall -- but a most important part. A quick review will show that (1) applications of fungicides in August and September will help rid the green of diseases; (2) after seeding, fungicide applications will help protect the new grass; (3) application of a preemergence chemical 60 days prior to overseeding will control further Poa annua; (4) chemical fertilizers to help establish and support the growth of the grass applied before planting; and (5) the use of a growth retardant to slow the bermudagrass and allow the new seeds to germinate and grow. These procedures have worked for me at my golf course.

BUDGETING FOR GOLF COURSE CONSTRUCTION

Jim Faubion
Vice President, Golf Course Operations
Club Corporation of America
Dallas, Texas

The ultimate success or failure of a country club or golf course facility is often dependent upon developing a realistic construction budget. Knowing in advance the approximate cost of each phase is helpful in financing, cost control, and quality control. Often the cost of "extras" and items "omitted" makes it necessary to skimp in the latter important phases such as plating with top soil, sprinkler system installation, etc.

Each new venture seems to produce an infinite number of variables and challenges. However, careful research and planning by competent and experienced people can be a tremendous aid in developing a workable budget.

During this discussion, I will review cost estimates and will list some of the factors which influence these estimates. Land cost and taxes will not be discussed. They are, however, a definite factor when considering the feasibility of building a golf course.

Some initial considerations:

A. Type golf course

1. Private country club
2. Resort
3. Municipality
4. Real estate
5. Daily fee course

B. Size of golf course

1. Pitch and putt (600 yards-1200 yards)
2. Par 3 (1500 yards-2500 yards)
3. Executive (2500 yards-5000 yards)
4. Short full length (6000 yards-6500 yards)
5. Championship (6600 yards-7200 yards)

C. Terrain

D. Locality

Since it is obviously impossible to list cost estimates which will universally apply to all situations, I have chosen to share with you cost ranges, some influencing factors, and the actual cost incurred on an 18-hole golf course for which my associates and I were contracted as consultants. It is an 18-hole championship golf course of better than average quality and is associated with, but not owned, by a real estate development. It is a corporately-owned, private country club called Hookers Hollow.

In organizing a golf course construction budget, I normally divide the expenses into 20 categories, each of which will be discussed with you in some detail.

1. Golf Course Architect

Among the first and most important considerations in golf course construction is the selection of an architect. He must be experienced and competent. Among his personal qualifications and abilities must be a good understanding of the game of golf, creative thinking, and an abundance of knowledge of engineering and materials as they relate to golf course construction. He should have demonstrated on previous projects his ability to furnish the necessary plans, specifications and supervision to complete the task in an acceptable manner. In my opinion, there is no substitute for a long list of satisfied customers.

Through careful planning and engineering, a golf course architect can not only help create a beautiful and challenging course, but can often save the owner thousands of dollars in the process.

The architectural fees at Hookers Hollow totalled $45,500.

2. Construction Superintendent

Another early and very important consideration is the selection of a construction superintendent, sometimes referred to as an inspector. Although his duties and responsibilities may vary from one project to another, his primary responsibility is to represent the owner's interest. The construction superintendent not only has to be well qualified and experienced in earth moving, but he also needs a basic understanding of agronomy, soil physics, engineering, surveying, and be able to interpret plans and specifications. At Hookers Hollow the construction superintendent was with the project for a total of 12 months at a salary of $18,000.

3. Engineering, Staking, Testing and Evaluation of Site Materials

Accurate staking of all the major features such as greens, tees, turning points, lakes, etc., on a golf course is of utmost importance.

I can site specific examples of greens built on dedicated streets, tees where a swimming pool should have been, a swimming pool where the tee should have been, and one-third of the water reservior in someone's backyard, and others. The most recent was the 18th green which was supposed to end up directly in front of the dining room, but missed it by over 80 feet.

Both horizontal and vertical control is needed since drainage becomes very critical in areas with little relief. It is desirable to establish a half dozen permanent bench marks under these conditions.

In many golf course construction projects, a substantial savings, plus a better quality course can be obtained by careful examination and evaluation of on-site materials. It is often amazing just how much can be learned by spending about two days digging test holes with a back hoe.

According to Robert Muir Graves, a California architect, staking a typical golf course would require approximately 130 points and an expenditure of around $1,600. The cost of staking, engineering, testing, etc., can exceed $20,000 in come situations. However, the normal is much less. These costs amounted to $6,755 at Hookers Hollow.

4. Power Supply

This is an item that should be dealt with early in the planning, budgeting and ordering because of the long lead time and variable costs which are often experienced. At one location our initial request for service was forwarded to the power company in September. Service was requested to commence in December and was received the following June. There were numerous factors which affected this delay and I'm not sure at this time that an earlier request would have yielded quicker service, however, I am certainly grateful we did not choose to wait until November or December to request it.

Getting power to the property is only one consideration and getting it to the various areas on the golf course is another. Often there are savings to be made by the owner taking primary power, purchasing the transformers and running the power to the various locations at his own expense. Charges will vary according to the locality, distances involved, and policies of the power company.

The cost of running power varies from $2.00 to $4.00 per linear foot for overhead service to about $6.00 to $10.00 per linear foot for underground service. It is easy to see the location of the maintenance facility and the irrigation pumps can greatly affect the cost of power service. This cost can vary from 0 to $25,000. At Hookers Hollow the cost was $9,500.

5. Clearing, Thinning and Disposal

When most of us refer to clearing in relation to golf course construction we normally think of tree and brush removal. However, I have been reminded that clearing can often include anything from buildings to a forest to a junkyard and the cost can obviously vary.

Our experiences with clearing have ranged from 0 in California and Arizona to "very heavy" in the Big Thicket area of East Texas. Clearing where burning is not permitted can cost in excess of $1,500 per acre. Disposal itself can be extremely costly and must be considered when budgeting for construction. The cost of clearing usually varies from $200 per acre for light clearing and thinning to $600 per acre for heavy clearing with burning and some burying. At Hookers Hollow we cleared 37 acres of heavy timber at $425 per acre and 42 acres of light clearing and thinning at $250 per acre. Burning was permitted. Total cost was $26,225.

In clearing, as in other phases of golf course construction, the cost per acre will tell only part of the story. The quality of work performed affects that course for years to come. It is a fact that some contractors and dozer operators are more efficient in killing key trees which are supposed to remain than they are at disposing of the undesirables. Therefore, an experienced contractor plus an experienced and conscientious superintendent with a complete set of plans and specifications are essential.

6. Rough Grading, Including Lakes and Drainage

For purposes of this discussion I will define rough grading as "that portion of earth work in which the material is excavated, transported, placed, compacted, and shaped to within plus or minus four inches of final grade".

Rough grading is often among the more expensive phases of golf course construction, and the estimated cost often determines the feasibility of the project. The quality of work performed here forms the base for all future work and mistakes are difficult and costly to correct. Overruns in rough grading sometimes make it necessary to reduce the quality or quantity of materials further down the line, therefore reducing the overall quality of the golf course. Heavy earth moving is an expensive business which should be left in the hands of experienced people. The large caterpillars, scrapers, draglines, etc., which are often associated with heavy earth moving on an 18-hole course, can cost in excess of $3,000 per day. So, it is easy to see that a couple of days work in the wrong direction can be costly.

Some of the factors which affect the cost of rough grading are:

a. Total volume to be moved - 100,000 to 300,000 cubic yards; although, I have heard figures of from almost zero to well over a million cubic yards.

b. Average distance material is to be transported.

c. Type of materials

   1. Swamp
   2. Sandy loam
   3. Rock - contract often includes a "rock clause" since the amount of rock is usually unknown. This is normally worked out on a per yard basis which ranges from $4.00 to $15.00 per yard according to George Cobb, a well known golf course architect.

d. Type of terrain.

e. Specifications.

   1. Strip stockpile plate
   2. Compaction

Again, careful planning on the part of the architect and superintendent will permit the contractor to make the best possible use of on-site materials and also can enable him to work his men and equipment with maximum efficiency.

Recent per yard cost of earth moving has varied from $.18 per cubic yard in Denver with dry, sandy loam to over $2.00 in coastal areas. At Hookers Hollow with rubber tire pulls and moderate distances plus some short push work with D-9's, the cost was $.47 per cubic yard for 180,000 yards or $84,600.

7. Maintenance Superintendent

It is desirable, although not always possible, to bring the golf course superintendent aboard prior to or at least during the fine grading and sprinkler installation. He can often make a substantial contribution to the final shaping of playing areas, introduction of amendments, installation of the sprinkler system, and will be vitally interested in seeing that all these things are being put together correctly since he will be the one who will have to live with it. He is often the logical person to plan and supervise the maintenance area construction, select and order the maintenance equipment as well as the course accessories, and most often is the most qualified person to mature the golf course.

The superintendent will need to select and organize his crew which can usually be phased in during the maturation period. Although there are some good arguments which favor the contractor taking the course through maturation to opening, the decision at Hookers Hollow was to bring the course superintendent aboard during the fine grading, six months prior to opening for play. The cost for this period was $9,000.

8. Finish Grading

Finish grading normally includes green construction, final shaping of tees, greens, fairways and roughs, seedbed preparation, seeding, sprigging and trap construction. Finish grading, especially on the tees and putting surfaces, is an art which simply cannot be left in the hands of the inexperienced. For the most part, small rubber-tired tractors with specialized attachments are used.

Among the factors which affect the cost of this operation are acreage, size and types of tee and green construction, type turf, planting rates, and size and number of traps.

Tees and greens are areas of the golf course which the golfers are sure to visit. Theoretically, on a par 72 course, a golfer will take at least half his strokes on the greens, and their quality will play a large part in forming his opinion of the course. It follows that a large proportion of construction costs will appear here.

Finish grading estimated cost:

a. Greens - from $.50 to $.75 per square foot. Therefore, eighteen 7,000 square foot greens and a 10,000 square foot practice green would cost from $68,000 to $102,000.

b. Tees - 18 tees plus a driving range tee would cost $9,000 to $12,000.

c. Fairways and Driving Range - $200 to $450 per acre.

d. Roughs - $50 to $100 per acre.

e. Sand Traps - $250 to $350 each.

f. Miscellaneous drainage

Finish grading costs at Hookers Hollow were as follows:

1. 138,000 square feet of green surface at $.53 per square foot $73,140

2.	3.1 acres of tees for a total cost of	10,621
3.	65 acres of fairways at $295 per acre	19, 175
4.	40 acres of roughs at $62 per acre	2,480
5.	16 fairway and 47 green traps at $315 each	19,845
6.	Miscellaneous drainage	4,580
	TOTAL	$129,481

9. Lake Sealing

Lakes which require sealing may be plated with clay during grading operations, sealed with bentonite or a similar material or lined with polyethylene, and back filled with a foot or so of sandy material.

The cost varies from under $600 per acre to over $5,000 per acre, depending on the procedure selected. At Hookers Hollow we used a 10 mill polyethylene back-fill at $.12 per square foot on 3.2 acres - cost $16,727.

10. Water Source

The water supply for irrigating the course is among items which are often overlooked or underestimated. Local ordinances many times require permits for drilling. In some cases, the owner is prohibited from drilling wells at all. When irrigation water must be purchased, the cost of meters, pressure reducers, back flow devices, and the cost of the water itself must be considered.

Lakes and rivers sometimes may be used. However, this should be thoroughly researched in the early stages of planning.

Wells can cost from $6,000 to over $50,000 depending upon the depth, local drilling cost, volume required, etc. At Hookers Hollow, a 502 foot deep, 400 gpm well cost $10,200.

11. Irrigation System

With rising labor cost, a shortage of competent labor for night watering, and the increasing desire for better quality turf, we see a trend toward fully automatic irrigation systems. Water being in short supply and at a premium cost in many areas further demonstrates the advisibility of turning to the more efficient automatic systems.

There are various types of automatic equipment available, all of which seem to work reasonably well when properly designed and installed. The cost can vary from around $100,000 for a single row system to over $200,000 for a wall to wall system. George Cobb has just completed a course in West Virginia on which the water system cost over $400,000. According to Mr. Cobb the trenching was extremely difficult because of rocky conditions.

At Hookers Hollow the cost for a fully automatic, wall to wall electric with a 1,450 gpm pumping station, was $184,800.

12. Maintenance Building and Area

As mentioned earlier, the course superintendent should be consulted in planning and, if possible, should supervise the construction of his maintenance building and area.

In planning, consideration should be given as to the general location, traffic flow, proximity to access roads, utilities, type of structure, interior layout, topography, parking, restrooms, chemical storage, fertilizer storage, parts storage, plumbing, heating, ventilation, fuel supply, the superintendent's office, and a few dozen other items.

The building can vary in cost from $5.00 per square foot to $15.00 per square foot and 3,000 to 6,000 square feet in size. Total cost for the building and area normally range from $20,000 to $40,000. At Hookers Hollow the total cost was $28,000.

13. Maintenance Equipment

The cost of equipment on an 18-hole course varies from around $50,000 to $100,000 depending upon acreage, course design, etc. It is difficult to equip an 18-hole golf course with all new equipment for under $50,000 on today's market.

At Hookers Hollow the total cost of maintenance equipment was $76,200.

14. Cart Trails and Access Roads

Cart trails vary in cost as to their length, width, type of construction and local construction costs.

In general, asphalt cart paths with three or four inches of base can cost from $.22 to $.45 per square foot. Therefore, a six foot wide asphalt cart path for a 7,000 yard course with green to tee distances included can cost from $35,000 to $73,000. A rough estimate of 30% of these figures will cover the areas around the greens and the tees.

We normally figure from $.30 to $.50 per square foot for asphalt golf course roads. With these figures, a ten foot wide asphalt road, 600 yards long would range in cost from $5,400 to $9,000. The road at Hookers Hollow measured 525 yards by 10 feet and at $.42 per square foot, the total cost was $6,615. This figure added to the $15,552 for 48,600 square feet of cart paths gave a total expenditure of $22,167 for this budget item.

15. Restrooms, Shelters, Halfway House

These can vary in size, quality and cost to fit the needs of the club. Utilities and discharge of the effluent sewage are factors to consider. Local ordinances should also be checked.

There are a number of prefabricated shelters for sale which vary in cost from $3,000 to $6,000. Landscaping, walks, etc. will be a factor in the total cost.

Two small, combination restrooms/shelters at Hookers Hollow cost a total of $9,215.

16. Landscaping

On most golf courses landscaping is required which is not chargeable to the shelters or maintenance building. Often landscaping and tree planting is included under the same budget item. However, listing them separately will help make certain that proper consideration is given. It is probable that we will see, in the future, a trend toward more low cost landscaping and less turf in some of the out-of-play areas. The general landscaping cost at Hookers Hollow was $5,217 which included materials only. Labor was listed under maturation.

17. Trees

Trees can play an important part in adding beauty and challenge to a golf course. I agree with Desmond Muirhead, who has been quoted as saying "We should not try to make an arboretum out of the golf course". He suggests a $30,000 budget for California courses which, incidentally, is the approximately figure suggested by Ted Robinson, another California architect.

At Hookers Hollow 275 trees, which included both five and fifteen gallon trees, were planted at a cost of $4,434, not including labor. As in landscaping, the maturation labor was used to plant them.

18. Maturation

The cost of maturing (after planting until opening) a golf course according to several golf course architects, is among the most

underestimated expenses in the budget. Maturation can either be a part of the construction contract or it can be the responsibility of the owner, but in either case it should be clearly defined in the specifications.

Time required for adequate growth is the major factor affecting cost. This can vary from as little as two to three months to well over a year, depending upon the planting date, locality, skill and experience of the superintendent, etc. Improper fertilization, and inadequate plans and procedures for erosion control, are common mistakes.

The maturation cost can vary from as little as $15,000 to over $75,000. At Hookers Hollow the course was opened six months after planting at a maturation cost of $54,000.

19. Course Supplies

The supplies (flags, tee markers, benches, signs, etc.) normally cost from $2,500 to $5,000, depending upon the numbers and types. At Hookers Hollow a bench and a ball washer were placed on each tee, and the total for all supplies was $4,500.

20. Contingencies

On a 100 to 200 acre construction project which is as complex as a golf course there are many unknowns going in. It is impossible to think of every conceivable expense. A contingency figure of 10% of expenses, except the golf course architect's fee, is often recommended. At Hookers Hollow this figure was $70,019.

When all costs were totaled at Hookers Hollow the actual construction cost amounted to $815,706. It must be stressed that these figures only apply to this particular club and will not necessarily hold true for any other project. However, it is believed that some of the same factors which influenced these costs will be experienced elsewhere.

SUMMARY

1.	Architects Fees	$ 45,500
2.	Construction Superintendent	18,000
3.	Engineering, Staking, Testing and Evaluation of Site Materials	6,755
4.	Power Supply	9,506
5.	Clearing (trees, brush and buildings)	26,225
6.	Rough grading (including lakes and drainage)	84,600
7.	Maintenance Superintendent (6 months)	9,000
8.	Finish Grading (green, tee, fairway, trap construction and planting)	129,841
9.	Lake Sealing	16,727
10.	Water Source	10,200
11.	Irrigation System (including pumping station)	184,800
12.	Maintenance Building and Area	28,800
13.	Maintenance Equipment	76,200
14.	Cart Trails and Access Roads	22,167
15.	Restrooms, Shelters, Halfway House	9,215
16.	Landscaping	5,217
17.	Trees	4,434
18.	Maturation (6 months)	54,000
19.	Course Supplies (benches, flags, cups, etc.)	4,500
20.	Contingencies (10% of items 2-19)	70,019
	TOTAL	$815,706

GOLF COURSES IN ARGENTINA

James B. Moncrief
Director, Southern Region
USGA Green Section
Athens, Georgia

No fumar, abroche el cinturon, por favor. Fasten your seat belts, we are approaching Buenos Aires. This was good news as we had been on the Aerolineas Argentinas for 12 hours and we were eager to have our feet on the ground again. We had left Miami about 2 a.m., October 31, 1971, with intermediate stops in Lima, Peru and Santiago, Chile before flying over the tall and rough Andes to Buenos Aires.

The flight was very smooth, but the crew was much different as a man was in charge of the stewardesses and the girls were much older than our young American girls.

The immigration facilities were very efficient and we were given the VIP treatment. No doubt this was because I was invited to Argentina by the Asociacion Argentina de Golf to visit member clubs during a two week stay and to take special note of the site of the World Cup Tournament at Olivos Country Club near Buenos Aires. My wife accompanied me and we thoroughly enjoyed the two weeks and learned much about a country we had never visited.

The climate in Buenos Aires is very similar to the southern part of our country along the 34 latitude. The city of Buenos Aires is about 4 1/2 million with a metropolitan area of about 8 1/2 million people. The country was settled by Spain but you can see the influence more in the interior of the country at Cordoba and Rosario.

The language is Spanish and since we did not speak Spanish, we had to have an interpreter at every golf course to converse with the golf course representative and there were numerous questions from each party. We visited seventeen golf courses with many other side trips.

The design of the golf courses was very striking as they were so similar to ours; however, most of them were built 50 to 70 years ago when Europeans went to Argentina as a resort area. Most of the courses were built near railroad tracks as the people would leave town to spend the weekend at the Country Club. Many members have a home in town and one in the country.

Just prior to our arrival, revolutionists had tried to destroy two of the country clubs as they represent capitalism. They were successful in blowing the top out of one club and a large hole in

another one and had completely demolished another earlier. Many of the clubhouses were built on an English style of architecture; however, others have the attractive Spanish style design with adobe walls and tile roof.

We observed bunkers where railroad ties or some sort of piling created a very abrupt wall. One in Mar del Plata had been built 70 years ago and still exists with the wall 6 to 8 feet high. Of all the clubs we observed, The Jockey Club was the largest with 36 holes and was designed about 65 to 70 years ago. It is also very similar to some of our modern designs and to golf courses built in this country 40 to 50 years ago.

An inflation existed that seemed to be more critical than ours. They have not been able to use chemicals and maintain their courses on the same plateau as we do; however, they have more interest now and no doubt are arranging for chemicals to control grassy weeds, such as crabgrass and dallisgrass. They do have turf and their golfers enjoy the game as much as any we have here.

The World Cup (Eisenhower Tournament) will be held at the Olivos Country Club about 20 to 30 miles from Buenos Aires. The basic grass on the greens is bent consisting of Coos or Penncross. Other clubs have common bermuda, Tifgreen, and a selection from Brazil on the greens. The usual fairway grass is common bermudagrass; however, Tifgreen is being increased rapidly and no doubt some fairways will soon be Tifgreen. We observed Tifdwarf being increased in a nursery and only time will tell if it will be satisfactory. Tifway is not in Argentina as yet, but I am sure it will be eventually.

During the time of our visit to the Olivos Country Club, the greens were being aerified with a Ryan Aerifier which the Argentina Golf Association had purchased for its members. In this country, the Ryan costs about $2,000.00, but costs them as much as $5,000.00 to $6,000.00. Since the Association purchased the machine, member clubs will be able to utilize it for thorough aerification which is badly needed, especially since they have not been able to aerify or cultivate in the past except with sod punch aerators.

The equipment from the United States is so expensive that most of their turf equipment is purchased from Europe. At the present time, no equipment for golf courses is being manufactured in Argentina and there is maximum use of equipment since replacement is so difficult.

We observed two greens being constructed according to the Green Section specifications and no doubt others will be in the future. Soil media for the greens is usually a very high clay content, but a sandy soil mixture will be used in the future where water is plentiful.

We saw blades being placed in reels by mechanics and then ground and sharpened or new blades placed on the reels by the maintenance men. This indicated know-how and ingenuity is available which allows them to cope with these difficulties. How would our clubs fare with such strict and detailed mechanics? I feel we could if we had to! I did not see any hydraulic operated fairway units; however, I did see 11 fairway units being operated at one time, but this was limited to a flat open golf course.

Buenos Aires is on the 34 latitude south the equator and our 34 latitude is just north of Atlanta, Georgia. I observed many species of grasses very similar or the same as I see on golf courses in this area. If you check a map, you will find that Argentina extends over 3,000 miles north and south from almost the tropics to tundra. Two weeds observed throughout the golf courses were white clover and Poa annua, but I did not observe goosegrass or crowfoot on the courses visited; however, Poa annua was on practically every course. Other weeds observed during our two week tour were white clover, dallisgrass, carpetweed, and various sedge-like plants. One I recall was a pest called "hog's hair" and belonged to the Juncus. It was a very progressive sort and in some instances, greens were renovated to get rid of it; however, herbicides should eliminate it in bermudagrass greens.

Fertilization of fairways was at a minimum with some receiving probably 1 pound of nitrogen per 1,000 square feet per year consisting of a complete fertilizer or nitrogen alone. The soils near Buenos Aires are naturally fertile and fertilizing is not common as we think in terms of fertilization. Some of the best fairways we observed were at a municipal course near downtown Buenos Aires which was also played more than any course we visited.

We observed some bermudagrass greens in the Rosario area that had symptoms very similar to ours as undecomposed organic material and small round dead areas were in the greens. On examining them with a soil prober, layers of organic material and dead black rhizomes and underground parts of the bermudagrass were prevalent. In the upper south, we consider this a typical Spring Deadspot area. Weeds had grown back into these typical areas. A thorough aerification would be quite helpful to the greens since they had not been aerified. We observed some hand spiking equipment, but it is used only in problem areas where the ground becomes extremely hard and the grass is thinned out or dies.

The interest in golf seems to be on the increase and no doubt the World Amateur Tournament is having its influence. The people we met were very friendly and helpful at all times. It was unfortunate that we could not speak their language; however, we always found someone who could understand some English. We felt very uneducated to be confined to only one language. Would I go again? Indeed I would! I have always wanted to go to South America, but never dreamed that golf would make it a reality. We met many very interesting people and enjoyed the excellent hospitality of the Argentine.

BENTGRASS FOR TEXAS GOLF GREENS

James M. Latham, Jr.
Chief Field Agronomist
Milwaukee Sewerage Commission
Milwaukee, Wisconsin

In the opinion of many people, there are few places in the United States unfit for the growth of bentgrass. A demonstration in Miami has lasted 5 years. Although of shorter length, the Kansas City - St. Louis heat and humidity in the summer are just as intense as found in Texas. The high temperatures in Arizona are equal or higher than those felt in West Texas.

New soil mixtures and construction techniques, better plant protectants and bermudagrass control have enhanced the chances for bentgrass use greatly in the past few years. The rainy 1973 season pointed out the major problems these grasses face in Texas.

Drainage is perhaps the single basic deterrent to good bentgrass development. Water must move through the soil readily to prevent damage from high temperature, rainfall and over-irrigation. The soil porosity needed for rapid internal drainage also allows greater air movement into the soil that makes for better root respiration and gaseous exchange with the atmosphere.

The new high sand content greens that contain little or no silt or clay have greatly eliminated the "pore plugging" seen with earlier soil mixtures. The narrow particle size requirements for sand has done much to avoid blockage of internal drainage due to non-uniform particles. It should be noted that this same specification is a distinct benefit to bermudagrass also.

Water must move off the surface of greens. While not new, surface drainage is better understood and is more easily incorporated into good design.

In hot, humid areas, air drainage is almost as important as water drainage. Courses in heavily wooded country must be designed for air movement across the putting surface. Those older courses that consider conversion to bent must be prepared to cut out brush and some major trees that impair breezes, especially in the direction of prevailing wind during the maximum stress period. Air flow charts show that this must be done downwind as well as upwind in pocketed areas.

Fungicide and insecticide developments in recent years have contributed enormously to stress period maintenance of bentgrass. Pythium control chemicals were especially needed and those now available have proven their worth time and again. The environmentally "safe" insecticides such as Sevin, etc., have shown their effectiveness on a wide range of green-damaging pests.

Bermudagrass control with Tupersan cleared away one of the primary stumbling blocks to bentgrass production. Its selectivity against bermuda as well as crabgrass and goosegrass prevention is perhaps the major breakthrough required in this bermuda country. Many superintendents in the deep South use as much as 13 ounces per 1,000 square feet twice a year.

While this material is apparently safe to use on Penncross, it should be used carefully with Seaside, especially on older greens. It is highly destructive on Washington bent and may also damage other types, so testing is advisable before going all-out.

Irrigation control is a must. While automatic systems can be beneficial, they can be troublesome if not used properly. Too much water is often worse than too little. Water must be applied as irrigation to supply the plant needs and is dependent upon the active root system. Therefore light, frequent irrigation is needed when the root system is shallow.

During heat stress periods, syringing or surface irrigation is needed to cool the plant and prevent wilting. Highly undulating greens may require syringing only on high spots. This means that the water may be applied by hand, or that only a single head on an automatic system should be used. Often the high spots dry out while the lower sections of a green are soupy. Unless there is total individual head control an automatic system could be detrimental.

Water quality is a determining factor in some areas of Texas. To put it simply, Penncross and salt do not go together. Where saline water is a problem, Seaside must be used. Even this variety will not perform where drainage is poor, since capillary action in the soil concentrates salt at the surface. Drainage must be sufficient to leach these salts out of the root zone and into the drainage system and keep them moving.

Incidentally, some of the new bermudagrasses are also fairly sensitive to salt accumulation, so may not be as beneficial as some may think.

Regardless of the money spent for construction and irrigation, management is the key to successful bentgrass management, especially during the summer stress period.

Fertility is a major management factor. Oversupply of nitrogen during stress periods (hot or cold) has probably caused as much damage as misuse of water. Just as the northerners "harden off" turf going into the winter, bentgrass growers here must harden it off going into the summer. This means a gradual reduction of

nitrogen supply in the late spring. Little, if any, nitrogen should be applied during the summer. As the weather "breaks" in the early fall with the advent of cooler nights, a gradual resumption of nitrogen applications can be made.

A golf course superintendent in Phoenix, Arizona, is quite successful in growing bent during their extremely hot summer. He applies 2 lbs. of N per 1,000 square feet per month during October, November and December. During January, February, and March the greens receive 1 lb. per 1,000 square feet per month. The other six months they get no nitrogen most years. Infrequently, a light application is made if he deems it necessary. Should color improvement be necessary, it is accomplished with a light ferrous sulfate spray.

By reducing the nitrogen applications, superintendents have found that it is easier to maintain a satisfactory potash level in soils. Heavy grass growth consumed large quantities of potash, which is removed as the clippings are harvested. With less nitrogen there is less growth and consequently less demand for potash.

The lower nitrogen level and hardening off procedures have several beneficial effects. The bent turf becomes more dense. By being less succulent, there are fewer disease outbreaks and the grass is less attractive to insects. The "hardened" grass also requires fewer syringing operations. It is also more capable of withstanding golfer traffic.

Traffic control helps greatly during the stress period, too. This is done by placing the cups at the legal distance from the edges of the putting surface, not in the center of the green. By thus spreading the wear and tear, the greens can survive during the "no growth" period. This procedure also helps wear off thatch accumulations in the low-use areas.

Some problems have occurred with minor element deficiencies. Foremost are magnesium and iron. Magnesium can be easily kept in the desired range through the use of dolomitic limestone, Sul-Po-Mag or K-Mag, and Epsom salts. Regular soil testing is required to determine this need.

Iron chlorosis is common on high pH greens, and further complicated by high phosphorus levels. Iron can be supplied through the use of some organic fertilizers, chelated iron sources and ferrous sulfate. The latter is cheap, easy to apply, and the results are almost instantaneous. Only 1 to 2 ounces in 5 gallons of water per 1,000 square feet will show results in less than an hour, if an iron deficiency exists.

Shotgun mixtures of minor elements should be avoided. It takes only a small amount of these materials to correct a deficiency and it likewise takes only a small amount to create a toxic excess.

Bentgrass in Texas is already a fact. Losses due to weather in 1973 were the result of weaknesses in design, construction, and, in a few cases, management. All these factors are correctable. Certainly some spoon feeding is necessary for a few weeks in the summer, but overseeding, deadspot, and spring transition problems with bermudas are not childs play. Bentgrass has a definite place on Texas golf courses. It's up to progressive turfgrass managers to recognize the superior putting quality of these grasses and program for this existence.

ATHLETIC FIELD MAINTENANCE

James R. Watson
Vice President, Customer Relations
The Toro Company
Minneapolis, Minnesota

Those charged with care of turf on football and other playing fields are concerned with three major areas. These are: the condition of the grass, the firmness and the uniformity of footing from a playing standpoint. The condition of athletic field turfgrass at any given point in time will reflect past management practices. Good or bad management shows up to a greater extent in the spring of the year than at any other time expect perhaps on colored television.

PLAY From a playing standpoint, good athletic field turfgrass should be tough, wear-resistant and not easily torn by cleats. It should be soft enough to prevent abrasions when players fall, yet firm enough to permit good footing. It should be clipped short enough to prevent hanging of cleats, yet tall enough to ensure healthy plant growth and rapid recovery when torn by shoe cleats. A good healthy and vigorous stand of bermudagrass clipped between 3/4 and 1 1/2 inches in height will meet these qualifications.

Firmness and uniformity of footing are usually present if the condition of the turfgrass is satisfactory. But, with or without good grass, a firm, even and resilient footing is absolutely necessary and should be mandatory on all playing fields. Skinned areas of baseball infields provide these conditions. The same general techniques and procedures used to develop and maintain these areas may be employed to assure footing on football fields. Players will recover from skin abrasions relatively easy -- certainly more easily than from twisted knees and ankles. Dust is a health hazard on playing fields and should be controlled by the use of water on bare and thinly covered areas.

Turf cover, of course, is preferred and every effort to produce good turf cover must be made.

SPECTATOR APPEAL With the advent and expansion of colored telecasting of major sporting events, field color and grooming have taken on new significance. Spectators have come to expect uniformity and compatibility of color. In addition, color is important from an aesthetic standpoint and, right or wrong, apparently is one of the major criteria by which the general public judges the quality of turf.

Mowing to produce a pattern or "ribboning" effect is a rather standard procedure on most major league playing fields. Among the techniques employed to enhance this "grooming" technique would include,

on football fields, mowing each five (5) yard strip in an opposite direction. Another technique that is sometimes used if the grass loses color or goes dormant is to color alternate five-yard strips with a different colorant, a diluted solution of the same colorant or the same colorant to which some white has been added. Both techniques enhance the appearance of the field and have earned well-deserved praise and recognition for the turf managers who have used them.

POOR FIELDS Good turfgrass conditions, firm, uniform footing and a pleasing color, are characteristics of a good football field. Poor fields also are readily recognized under most circumstances. Annual weeds, undesirable grasses and clover often make up the major part of the vegetation. The center of the field often is bare and the soil is bumpy, uneven, usually compacted and poorly aerated. Compacted and poorly aerated soil produces shallow-rooted, tender grasses that are easily torn by cleats during play. Injury to players, particularly around the ankles and knees, are more likely to happen on this type of turf.

Quite often weedy turfgrass indicates mismanagement of water and improper fertilization, in addition to reflecting soil compaction. Mismanagement of water occurs when it is applied at rates incompatible with soil properties -- infiltration rate, percolation rate or storage capacity. Improper fertilization may mean the wrong pH, or too little total fertilizer, an improper balance of the major fertilizer elements -- nitrogen, phosphorus, and potassium -- or a deficiency (or excess) of trace elements. Fertilization is a process of supplementation -- supplementing the soil nutrients in accordance with the requirements of the grass for growth and for the prevailing use conditions. And, no element should be applied in excess of the needs of the plants. This is particularly true of the soluble or inorganic types of nitrogen such as ammonium nitrate, ammonium sulfate and urea. Soluble forms of nitrogen give a plant a quick start, but when supplied in excess, produce tender, succulent growth that increases the chances for player injury and increases susceptibility of the turfgrass to attacks of insects and disease. One exception to this is when the field needs a quick "pick-up" in color or growth at mid-season or following a frost.

GRASSES Bermudagrass is the base grass for athletic fields in Texas and adjoining states. Bermudagrass, in those areas where adapted, provides an excellent athletic field turfgrass. Its one drawback is the fact that it goes off-color with the first frost and will not green up soon enough for early spring baseball play. These disadvantages may be offset by overseeding with cool-season grasses (ryegrass) or by using colorants.

In cool climes where it is adapted Kentucky bluegrass is the base grass for playing fields. Tall fescue (Alta and Kentucky 31) is sometimes used but this grass tends to clump after a few years; hence, is not desirable under most conditions. It should be recommended only for special situations including fields where it is impossible to irrigate -- provide supplemental water during the growing and playing season. If it is used, seed it alone at a rate of 10 to 12 pounds per 1,000 square feet and plan to overseed each spring at a rate of 3 to 5 pounds per 1,000 square feet.

Ryegrass normally is used as a temporary grass. And, it may be used to advantage on areas that tend to become thinned out by concentrated play. Seed ryegrass after each game on these areas. The light-apple green color of the older domestic ryegrasses is not compatible with the dark-green color of many bermudagrasses (or Kentucky bluegrass) and is objectionable from a viewing standpoint. Uniformity of color may be improved by selecting strains like Pelo, NK-100, Manhatten or Pennfine which possess a darker color than domestic ryegrass. In addition they possess superior cutting characteristics and improved vigor. Consideration should always be given to the use of new improved grass selections, especially in the case of new ryegrasses.

Turfgrass Maintenance Program

Good athletic field turfgrass must be cultivated (aerated), fertilized, watered and mowed properly. In addition, programs to control disease, insects and weeds should be developed and used as and when needed. Attention to these fundamentals will ensure the establishment, development and maintenance of tough, wear-resistant turfgrass. Cultivation, fertilization, controlled watering and proper mowing are so closely interrelated that it is difficult to separate their individual effects. Those are the <u>essentials</u> in the production of good athletic turfgrass.

Improvement of Physical Condition

<u>Cultivation (aeration)</u>

Cultivate the field with some type of aerating equipment at least twice lengthwise and once crosswise. Add sufficient weight to ensure penetration to a depth of two to three inches. It may be necessary to sprinkle in order to bring the soil to the proper moisture level for maximum penetration. Soil should be moist, but not soggy. Cultivation alleviates soil compaction, increases water infiltration, and aids the interchange of gases, particularly oxygen and carbon dioxide, between the soil and the atmosphere. Aeration, likewise, permits the movement of phosphorus and potassium into the zone of the root growth, thus aiding in the development of deep root systems.

Football fields that are cultivated in early spring do not necessarily require topdressing to fill in aeration holes. Roots and stems of the grass fill in these holes readily by mid-summer. The need for cultivation of baseball fields will be determined by playing schedules and the rapidity with which the grass is growing. Heavy (clay) type soils will need to be cultivated more frequently than lighter (sand) types.

Topdressing

On fields where topdressing is required, consideration should be given to the type of materials used. A mixture of two parts each of coarse sand and medium sandy loam with one part of a good high grade of organic matter may be considered a good topdressing material. Although, if the soil is heavy, the use of a sandy topdressing material may be preferred.

The best form of static organic matter is raw sedge or cultivated peat. Other types of organic matter that may be used are well-composted leaves, gin trash, sawdust, ground corncobs, straw and any other readily available source of organic refuse. Manure or raw sewage sludge can be used; however, they decompose readily. When decomposing, these materials have an offensive odor that may make them objectionable in many cases. (Proper composting will eliminate this condition). Neither of these should be used later than eight weeks prior to play on the field. Manures may be a potential source of tetanus, so their use as surface dressing should be avoided, unless the material is sterilized.

The organic matter, coarse sand and medium sandy loam, should be thoroughly mixed with a grinder or mixer. After mixing, the material should be screened through a one-quarter inch mesh screen. Sterilization -- chemical or heat -- to kill weed seeds is desirable.

This topdressing mixture should be used to fill and level depressions during and at the close of the playing season. If used as a topping over the entire field, it may have to be applied in the spring. In this case, the field should be topped after cultivation and fertilization.

Fertilization

Fertilizers are applied to supplement the natural nutrient supplies in the soil rather than to constitute the only source of nutrients. In addition, another major function of fertilizer is to balance the soil nutrient supply with the needs of the plant. Fertilization of athletic field turfgrass begins with the determination of the plant food supplies in the soil. Such is accomplished by obtaining a properly interpreted soil test. The soil test will provide a record of the soil reaction (pH) and the level of phosphorus, potash, calcium and magnesium. In addition, most tests will show soluble salts if they are present.

Knowledge of the soil reserves, coupled with the knowledge of the requirements of the turfgrass and the intensity of usage expected, will serve as a basis for development of the fertilization program. Keep in mind that turfgrasses require several times as much nitrogen as phosphorus and potash on a growing season basis. Soil tests usually do not give an accurate evaluation of available nitrogen; rather, growth, vigor and condition of the grass must be used as a guide for nitrogen fertilization.

In general, bermudagrass athletic fields should receive a total of six to eight pounds of nitrogen and two to four pounds of phosphorus and potash annually. Lime, if needed, should be applied in amounts indicated by soil tests. Lime (calcium) is an important plant nutrient and, in addition, renders other elements more available. Lime when pH reaches 6.2. A pH of 6.5 to 7.2 is most desirable for athletic field turfgrasses.

Intensity of use is also a major factor when developing a fertilizer program. More fertilizer (especially nitrogen) is required on heavily used fields.

Timing of fertilizer applications needs to be keyed to growth activity and the necessity of obtaining color for special events. Complete fertilizers should be applied in late summer or early fall before the season starts but not later than four to six weeks before the first killing frost. Organic (slow release) forms of nitrogen are suggested for supplemental feedings. Inorganic (quickly available) sources of nitrogen are suggested for use when the turfgrass needs a quick pick-up in growth or color.

Watering

Controlled watering is one of the most important considerations in the development of good turfgrass. Water must be applied on the basis of turfgrass need (evapotranspiration) and in accordance with soil properties. Judicious use of water, coupled with aeration, proper fertilization and good drainage helps to develop deep rooted turfgrass that is wear-resistant, tough and not easily torn by player cleats. Removal of excess water by means of surface and internal drainage is necessary. Plants growing in water-logged soil cannot function properly because of the reduced amount of oxygen available to the root system.

On new seedlings, the field should be sprinkled lightly each day until the seed germinates and is well established. Thereafter, the amount of water applied should be increased in accordance with the grass need and the frequency of application adjusted to conform with soil characteristics.

Soils differ in their ability to absorb and hold moisture. Water should not be applied in excess of that which a given soil

can take in and hold. If the soil is not wet to the required depth (depth of root zone), wait until the moisture has percolated downward and apply additional water. Recycling with an automatic controller facilitates this procedure.

Consideration should be given to the installation of automatic watering systems on old fields as well as new. The improved quality of the turfgrass along with the savings in labor and water cost, and the control such a system permits, are sufficient justification to warrant installation.

Mowing

A sharp, well-adjusted mower is essential for the cutting of young turf. Mature turfgrass will be maintained in a far more satisfactory condition if the mower is kept properly adjusted and sharp. New seedlings should not be cut until they are approximately two inches in height. Only about one-quarter inch of leaf surface should be removed at any one clipping.

Mature football turf may be maintained at a height of one (1) to one and a half (1-1/2) inches. Sometimes under unusual conditions, two (2) inches.

A few weeks prior to fall play, adjust the height of cut to that preferred by the coach and players. Do not make reductions in one clipping -- reduce the height of cut gradually (one-fourth inch) with successive mowings. Increase frequency of cutting if necessary. Generally, turf that has been properly managed will require mowing at least twice a week in early fall.

Two of the more important grooming techniques for fields relates to the collection of clippings and to the sweeping or bagging of blades, stems and leaves -- plant parts torn up or severed during games. Routine collection of all clippings will add greatly to the appearance of the field and collection and removal of excess clippings is necessary. Routine collection of all clippings will add greatly to the appearance of the field. Collection and removal of plant parts improves appearance and permits easier assessment of game damage.

Vertical mowing to reduce thatch or mat may be required. The spring and summer months -- when the grass is growing most actively -- is the best time for this treatment.

For best results, one mower should be set aside and used exclusively on the field. Always keep mowing equipment properly adjusted, oiled and greased. Rely on service facilities available from the manufacturer to see that equipment performs satisfactorily.

Programs for Disease, Insect and Weed Control

Disease

For the most part, control of disease on athletic fields and playing grounds is not practical. Leafspot is serious during spring months and may cause loss of grass. Chemicals are available to control most turfgrass diseases. And, when needed they should be used. Check with your county agent, turfgrass specialist or local turfgrass distributor and follow the manufacturer's recommendations for use.

Insects

Insects that attack grass may be classified in two groups: (1) surface feeders -- those insects such as sodweb worms, cutworms and army worms that eat the leaves; and (2) sub-surface feeders such as grubs that eat the roots of grass.

Chemicals such as Chlordane, Heptachlor and Dieldrin may be used to control both groups of insects. For surface feeders, apply insecticides in the afternoon, leave the material on over night, then water it in thoroughly the following morning.

For a good general spray, use a mixture of Malathion and Chlordane. This will control most insects. Chlordane provides an excellent control for ants and chiggers.

When spraying insecticides on shrubs and flowers, do not use a sprayer in which 2,4-D or similar materials have been used. These latter materials are difficult to clean out of a sprayer and may damage shrubs and flowers.

Weeds

Chemicals are available for the control of most weeds. All broadleaf weeds and crabgrass may be selectively removed from permanent grasses without damage to the desirable grass. Chemicals should be considered only as tools or aids in a permanent weed control program. Weeds invade turfgrass areas only when the grass is weakened for some reason. The first step in a successful weed control program is to correct the basic cause or reason for the presence of weeds, then use chemicals to eliminate them. Grass may be weakened because of inadequate fertility, poor mowing, poor drainage or damage from disease or insects.

For control of dandelion, plantain, buckhorn and other broadleafed weeds, use 2,4-D as recommended. For control of clover, MCPP or Banvel 4S may be used. A mixture of 2,4-D and one of the latter materials may be used to control knotweed and chickweed.

Early spring when weeds are young and growing actively is the best time to treat them. This is particularly true of knotweed and chickweed. Chemicals for both pre- and post-emergence control of crabgrass are available.

New chemicals are being developed constantly for control of disease, insects and weeds. Keep abreast of their development by attending turfgrass conferences. And, when released keep in touch with your local turfgrass supply house for their availability.

Summary of Recommendations for One Season

1. Cultivate the field twice lengthwise and once crosswise when grass is growing actively.
2. Break up soil plugs, fill, level and grade with topdressing mixture.
3. Apply fertilizer and lime in accordance with recommendations based on properly interpreted soil tests. Use nitrogen to control the rate and level of growth.
4. Seed sprig or sod if necessary to repair damaged areas and to fill in thin spots.
5. After planting top lightly with topdressing mixture. This is to cover seed (or stolons) and should not be done unless the field has been aerated or scarified prior to seeding. Seed contact with soil is necessary for establishment.
6. Roll lightly to press seed in contact with soil and sprinkle slightly.
7. Water as per discussion.
8. Mow as per discussion.
9. Apply additional nitrogen as per discussion.
10. Develop programs for disease, insect and weed control when needed.

ESTABLISHMENT OF ROADSIDE TURF

Wayne G. McCully
Resident Director for Research
Texas Agricultural Experiment Station
and
Range Scientist
Texas Transportation Institute

A right-of-way corridor inserted on a natural landscape is a highly visible feature. Although the travel surface and structures demand considerable engineering attention, a stable roadside is an important feature in the stability and efficient maintenance of the travelway as well as the safety and enjoyment of the traveling public. Establishment and maintenance of a protective cover of vegetation often is referred to as erosion control. While the specifications may vary between urban and rural sections, and among various classes of highway, the following items should be considered:

1. Specify planting materials adapted to the local climatic zone and soil conditions.

2. Provide a favorable environment for seed germination and seedling establishment.

3. Specify early establishment, as soon as slopes and other areas have been formed to line and grade.

4. The vegetative cover establishment on the right-of-way should be compatible with adjacent land use.

Unless the higher cost of sodding can be justified, seeding is the preferred way of establishing a cover for erosion control on roadsides. Generally, native grasses are seeded in the western part of Texas, while bermudagrass is a major component of seeding mixtures used in eastern Texas and along the Gulf Coast. Specialty materials such as bahiagrass, buffelgrass, rhodesgrass and weeping lovegrass often are seeded on specific sites or as accent plantings.

Seed mixtures of native grasses for planting in western Texas consist of green spangletop and several planting materials depending upon the specific location. Other materials include such grasses as sideoats grama, blue grama, yellow bluestem, switchgrass, feathery bluestem, western wheatgrass, plains bristlegrass, buffalograss and others. Seed distributed aggregates 20 to 25 pounds per acre. Hulled bermudagrass is seeded at a rate of 8 pounds per acre. Bermudagrass is relatively easy to establish, but mowing costs could be reduced with a plant material which is more competitive. Bahiagrass excludes most other plants and is often seeded in conjunction with bermudagrass. Bahia is often slow to establish not too tolerant of droughty soils on the faces of many slopes. Buffelgrass is adapted to southwestern Texas. It is easy to establish and quite drought tolerant. Buffel is an excellent material for rural sections, but it is a nuisance in urban sections because of the frequent mowing of the prolific seedhead production.

Cultural treatments optimize the temperature and soil moisture in the microenvironment of the seed and developing seedling. The dense soil materials found on the faces of many cut or filled slopes should be tilled at least 4 to 6 inches deep to facilitate water intake and storage. Our study showed that germination did not change greatly with tillage depth but there was a direct relation between depth of tillage and stand establishment. For example, tilling to a depth of 4 inches gave one-third more established plants and tilling to a depth of 8 inches gave over twice as many established plants as a two-inch tillage. Slopes should not be greater than 1:3 as they are difficult to work mechanically.

A surface mulch greatly enhances the probability of seeding success. A mulch cover dissipates raindrop energy and facilitates entry of water into the soil, suppresses evaporation of moisture from the seed zone, and moderates the extreme temperatures generated on the surface of the bare soil. One and one-half tons per acre of grass hay or two tons of grain straw are most commonly specified as mulching materials. Proper application of a mulch of this type will give a uniform cover with the small clods showing through. Hay or straw mulches usually are tacked in place with asphalt. Mulches which are machine-applied have 0.05 gallons per square yard of emulsified asphalt injected directly into the hay stream. If the mulch is distributed by hand, 3 to 4 times as much asphalt is applied from a distributor. Other mulching materials such as asphalt, wood chips, composted garbage, excelsior and bagasse have been tested as mulching materials. Generally, the best moisture barrier is provided by grass hay, excelsior or bagasse which form a discontinuous layer above the soil surface. Asphalt, wood chips and other materials which are intimate contact with the soil surface are not as efficient as the looser materials, but they slow the loss of moisture from a bare soil.

A starter fertilizer applied with the seed improves plant establishment even though it has no effect upon germination. Three hundred to four hundred pounds per acre of a 16 percent nitrogen fertilizer are commonly specified in plantings for erosion control. Fertilization of areas being renovated may yield better results applied a year or so after seeding to avoid generating excessive weed competition. Also, not all native plants respond to any degree of applied fertilizer.

Scheduling a seeding operation usually is keyed to local farming practices. The beginning date of seeding may be as early as February in southern Texas and becomes successively later as one moves north. The terminal date of seeding is conditioned by reliable precipitation combined with temperature. Earthwork contracts completed off-season for seeding are mulched, and then are tilled and planted during the proper calendar time.

Erosion control usually is accomplished in construction by sub-contracting. Maintenance forces usually do their own seeding. The total cost varies, but approximately 60% is used for mulching, slightly over 30% for seed and fertilizer with the remainder assigned to tillage. Pulvi-mixing (roto-tilling) leaves an excellent seedbed, but discing or scarifying will produce a satisfactory tilth at considerably less cost. Traffic on the area to be planted is discouraged after tillage. Seed and fertilizer often are applied in a water slurry using a hydro-seeder. The water carrier helps cover the seed on impact with the soil surface. The hay or straw mulch usually is applied using a blower.

RECENT ADVANCES IN WEED CONTROL

M. G. Merkle, Professor
Soil and Crop Sciences Department
College Station, Texas

Introduction

There is an old adage which tells us that it is an ill wind that blows nobody good. Shortages of hand labor which occurred in the 1960's were a source of concern to many turf and nursery managers but these same shortages were responsible for a large increase in acceptance of chemical weed control. The current energy shortage may bring a further increase in the use of herbicides because, in a sense, when a herbicide is used, mechanical energy is replaced by chemical energy. Thus, it is important that the turf manager or nurseryman recognize the potential role of herbicides in the various aspects of his program.

Turf Renovation

Sometimes infestations of weeds, insects or diseases may become so severe that it would be more economical to begin with new ground cover than it would be to restore the existing turf to a desirable condition. Under these conditions, a temporary soil sterilant which eliminates weeds, weed seeds, insects, nematodes and diseases is commonly used.

The area to be renovated should be thoroughly tilled with a disk or power tiller so that the soil is loose and free of clods. Since many of the temporary soil sterilants are active as gases, the soil should be warm and moist at the time of application. The area should be covered with plastic or other material to prevent the loss of gas into the atmosphere. The covering should be left for 24 to 72 hours. After removing the covering, desirable plants may usually be seeded within two weeks.

There are several effective chemicals available for turf renovation including methylbromide, ethylene dichloride and chloropicrin. These chemicals are toxic if breathed or allowed to contact the skin or eyes and should always be handled with caution.

Recently, attempts have been made to develop temporary sterilants which are not applied as a gas and consequently do not require the use of a covering. Sodium azide is such a sterilant and application is made with granules. The chemical is often incorporated into the soil with a disk or power tiller. Recent results indicated

that incorporation may be obtained by sprinkler irrigation soon after application. Although the herbicide is applied as a granule, it is supposedly converted into a gas within the soil. The soil should be warm and moist to increase the rate of conversion. Desirable plants should not be planted into the area until bioassays indicate that the chemical is no longer present in toxic concentrations. Lettuce seeds are commonly used as a bioassay and phytotoxic concentrations frequently persist for a month or more.

Contact Herbicides

Since contact herbicides generally have little selectivity among plants and little activity in the soil, they are applied post-emergence for a complete "burn-back" of all existing vegetation. Desirable plants may be transplanted or seeded immediately after spraying. However, any weed seeds in the soil may also germinate and regrowth of perennial weeds is common. Frequently, a pre-emergence herbicide is added to the contact herbicide to prevent the new growth of weeds. Commonly used contact herbicides include herbicidal oils, paraquat, Dow-General, and Phytar (various numbers). For maximum effectiveness the herbicide should be applied on a warm sunny day. Complete coverage of the weeds is essential since there is minimal translocation of these herbicides. Also, protective clothing should be worn when applying certain of these chemicals.

Roundup is a new herbicide which produces the quick "burn-back" characteristic of the contact herbicides but it also translocates to kill the underground reproductive organs of certain perennial grasses. It has been especially effective against johnsongrass but less effective against bermudagrass and nutsedge. As with the other contact herbicides, roundup is not effective against weed seeds.

Selective Post-Emergence Herbicides

Like contact herbicides, post-emergence herbicides are applied after the weeds have germinated and are actively growing. Unlike the contact herbicides, however, selective herbicides control the weeds with minimal injury to the desirable vegetation.

Selectivity may be attained in various ways. For example, most "hormone-like" herbicides such as 2,4-D and Banvel will selectively control broadleaved weeds in grasses. Care should be exercised so that the spray does not contact desirable broadleaved flowers and shrubs.

The organic arsenicals such as DSMA and MSMA selectively control "coarse-leaved" grasses such as Dallisgrass, grassburs, and St. Augustine

grass in "fine-leaved" grasses such as bermudagrass. Atrazine selectively controls seedling broadleaved weeds and grasses in established turf.

New selective post-emergence herbicides such as buctril control broadleaved weeds in turf with less drift hazard than when 2,4-D is used.

Pre-Emergence Herbicides

Frequently it is desirable to spray a herbicide while the turf is dormant and before annual weeds have germinated. When annual grasses such as crabgrass, grassbur and bluegrass are a problem, a pre-emergence application of balan or other dinitroaniline-herbicide provides excellent control. Control of broadleaved weeds is more variable. For best results, these chemicals should be incorporated into the soil. Since a mechanical incorporation is not feasible in established turf, these herbicides are commonly applied as granules and incorporated by watering the lawn immediately after application. The dinitroaniline herbicides should only be used on established turf because they injure seedlings of most desirable grasses. Non-incorporated herbicides such as dacthal will also give effective control of annual grasses. In situations where annual broadleaved weeds and grasses are a problem in established turf, a pre-emergence application of bensulide or atrazine should be considered. These herbicides do not require incorporation and give season-long weed control. Soil residues may be a problem if the turf is to be "over-seeded" with a desirable winter grass. In these situations, a less persistent herbicide such as Furloe or Kerb may be preferred.

New Approaches to Weed Control

Chemicals have provided and will continue to provide the turf manager and nurseryman with an economical and effective means of controlling weeds. This is not to imply that chemicals have no limitations nor that alternate methods of weed control should not be investigated. Because of concern for the environment, the use of herbicides in water and in areas with an abundance of wild flowers is restricted.

Recently, research has been conducted with laser beams to control aquatic vegetation especially water hyacynth. Results have

been promising but economical consideration and availability of equipment make the use of this procedure impractical at this time. Also, the Texas Agricultural Experiment Station in cooperation with Cotton Incorporated and Oceanography International has conducted experiments with microwaves for weed control. Again, initial data look promising but the economical considerations still make the practical application doubtful.

GROWTH RETARDANTS FOR TURF

Robert P. Carter, Research Associate
Soil and Crop Sciences Department
College Station, Texas

In our everyday work almost all of us here are concerned with large areas of turf which undergo very high management levels. If we observe these areas we find they include such areas as lawns, borders along walkways, along shrubs, around trees, median strips, golf courses, schoolgrounds, parks and industrial sites. To maintain these areas and secure high quality, it usually takes a large labor force. As we all know today, the cost of labor is not getting any cheaper. This, combined with our current energy crisis, only increases our management problem. With this in mind we are going to have to search for new methods whereby we can reduce our labor cost and yet maintain the quality we desire.

If we further break down this labor into man hours spent per job, we would probably see that a very large portion of the time is spent in mowing and trimming of the previously mentioned areas. These operations are time-consuming and the equipment used is very expensive. It is easy to see that these two operations alone eat up large portions of the maintenance budget of any turfgrass management program.

Any economical treatment which might reduce the frequency of these operations would certainly allow considerable savings in the maintenance budget. Theoretically, the use of growth retardants sounds like the answer to the problem. Growers have always shown a great deal of interest in the use of growth retardants; especially for use in hard to mow areas such as steep banks, fence rows, along streams and lakes, along walkways, around trees, and around sandtraps on golf courses.

To satisfy this interest, several compounds have been developed and are on the market for use by growers. The first growth retardant, and probably the most common one is maleic hydrazide. Maleic hydrazide is sold under various names some of which are Maintain III, and "Sucker-stuff" or "Sprout Stop". If we take a close look at maleic hydrazide, we find it exhibits these properties:

1. Maleic hydrazide acts by inhibiting cell division in the plant; results in restricted stem and leaf growth and reduced flowering or seedhead formation.

2. When sprayed on, it is absorbed through the leaves and is readily translocated. For this reason, considerable leaf area is necessary for adequate absorption. (Suggestion: mow first, allow three days regrowth and then spray).

3. To insure absorption and prevent chemical loss due to water solubility of product, wait 36 to 48 hours before watering.

4. When applying maleic hydrazide or for that matter any growth retardant, the method of application is very important. Proper spray equipment, properly calibrated, is necessary to insure uniform coverage; otherwise wavy or bumpy patterns may be noticed. (Suggestion: by doubling the amount of water and spraying the area twice in different directions aids in achieving uniformity).

5. Proper calibration and spraying are also necessary due to the tendency of maleic hydrazide to burn if not applied at proper rate. For this reason, split applications are more effective than single applications in reducing the chance of discoloration.

The possibility of discoloration caused by maleic hydrazide may leave it questionable to use on high quality turf. Its primary use would be confined to low quality minimum use turf areas having a fairly low intensity of management such as roadsides, steep slopes, stream banks, and along fence rows and borders where mowing operations are difficult to accomplish.

The effectiveness of maleic hydrazide may vary from 6-14 weeks before wearing off and the warm-season grasses such as bermuda and St. Augustine seem to show less reduction in growth. Also, discoloration is more severe on these species.

Maleic hydrazide is applied in the spring, with spring application being more effective than mid-summer or fall applications of warm-season species. (Reason - catch the grass when it first starts to grow).

Maleic hydrazide does inhibit weed growth the same as grasses but is more effective when used in conjunction with a recommended herbicide. It is compatible with most herbicides and is often mixed with 2,4-D and MCPP.

Chlorflurenol is another growth retardant on the market today. It is sold as Maintain CF-125.

It, too, quite often burns the leaves so many have limited use on high quality turf areas. This initial discoloration is often, however, followed by a darker green color and retarded growth and seedhead production.

Results from tests conducted at Texas A&M University indicate that it only slightly reduces growth on bermuda and St. Augustine. It is also toxic to fish and may have limited use around ponds and lakes.

One of the most promising growth retardants for use on high quality turf is a product developed by the 3M Corporation called "Sustar". This has especially been the case on St. Augustinegrass.

In several studies at Texas A&M, "Sustar" has shown significant growth suppression in St. Augustinegrass. Initial applications of "Sustar" resulted in a slight discoloration but not objectionable discoloration. This was followed by a period of up to eight weeks where the grass took on a darker green color, seedhead production was suppressed, and significant growth suppression was observed.

Proper calibration and application to obtain uniformity is a must, however, to avoid the bumpy or wavy patterns from misapplication.

In summary several points can be made regarding growth retardants:

1. With increased labor cost and our current energy crisis, there is a definite demand for the use of growth retardants in our industry.

2. Several growth retardants have been developed but results obtained from their use vary with method of application, time of year applied, environmental conditions, and products used.

3. Those growth retardants now being used may have limited use on high quality turf areas with the exception being "Sustar" on St. Augustinegrass.

4. More research is needed in the field of development of growth retardants and also in application techniques.

CULTURAL PROBLEMS WITH ORNAMENTAL PLANTS

H. T. Blackhurst, Professor
Soil and Crop Sciences Department
College Station, Texas

We are located in an area where high temperatures are frequently combined with low rainfall. This situation makes for problems in planting and proper maintenance of woody ornamentals.

All our problems do not stem from this weather situation but one very important one, that of soil structure, does relate to it. The final result is low organic matter and tight poorly drained soils which make preplanting as well as post planting care of prime importance.

The poor, light textured, low organic soils result in poor drainage with a resultant low O_2 content. This means a poorly developed root system and spells trouble during drought periods as well as periods of heavy rainfall.

Since many of our plants will be in place for a number of years, care should be exercised in preplanting preparation as well as the planting operation itself.

Since many of our soils are anything but ideal some amendment or adjustment must be made.

The addition of some coarse organic matter to the planting area will help. Sawdust, gin trash, rice hulls, ground bark, cedar chips or any composted organic matter may be used, preferably in the proportion of one third of the material to two thirds soil.

Under many conditions it may be economical to resort to raised beds around the house or for border plantings.

Cinder blocks, concrete or two inch redwood of suitable width may be used.

The bed should be at least eight inches above the surrounding area and can be filled with a good loose sandy soil or mixture of sand, vermiculite and organic matter.

The raised bed is ideal for shrubs or for annuals since it corrects problems resulting from poor drainage or heavy rains and enables us to grow plants not otherwise adapted.

Water can be a problem in many areas of the state, either from irregular rainfall, frequent heavy rains, lack of water for irrigation or high salt content in the available water.

Where drought periods are frequent and irrigation a must there are means of avoiding possible damage from salts.

With salt sensitive plants such as camellias or azaleas the frequency of watering should be held to a bare minimum if high salts are present. Less damage will result from the drying than from salty water.

For most plants the water can be used providing thorough soaking is done each time. This will leach out the old salts and prevent excessive accumulation.

Organic mulches may be used to advantage. The mulch will aid in conserving water, will prevent packing and washing of the soil from heavy rains and quite frequently will add to the attractiveness of the border or individual plant.

In areas of excessively high salts attention should be given to selection of salt tolerant varieties.

Temperature alone may be a serious factor in the health and well being of woody plants or it may be combined with wind and low humidity to multiply the problems.

Hot dry winds are damaging to plants but cold dry winds can be more serious, particularly where soil moisture is limiting.

Frequently little or nothing can be done to alleviate these problems but there are many conditions under which protective measures may be taken.

Maintaining a satisfactory soil moisture level does much to alleviate problems from desiccation during dry northers.

When humidity is low and temperatures high, root absorption may not be able to keep pace with transpiration loss during windy periods. In this condition as well as during cold windbreaks are quite valuable. Where windbreaks as such are not practical, particularly sensitive shrubs or other plants may be located in such manner as to get protection from other larger or more tolerant species or varieties.

As we have seen there are a number of problems involved in planting and maintenance of woody ornamentals in Texas.

However, these problems may be reduced to a minimum through proper attention to preplanting preparation, selection and location of plants on the basis of their tolerance of adverse conditions and with judicious placement in the landscape.

There is no question that we have problems but we can live with them and enjoy many fine plants if we are willing to exert a little effort.

THATCH CONTROL IN BERMUDAGRASS TURF

Richard L. Duble, Associate Professor
Soil and Crop Sciences Department
College Station, Texas

Thatch originates from undecomposed organic residues that accumulate on the soil surface under intensified turf management. Vigorous grass selections, excessive fertilization, frequent watering and extensive use of plant protectants all may add to the problem of organic residue accumulation in turf. Two terms -- mat and thatch -- have been used to describe this layer of organic residues. Mat may be defined as the mass of roots and stems beneath the green vegetation and is associated with sponginess in turf.[1] Thatch may be defined as an accumulation at the soil surface of dead but undecomposed stems and leaves.[1] Both mat and thatch may occur singly or together. For purposes of this discussion, thatch is defined as the accumulation of living and dead undecomposed root, stem and leaf tissue between the soil surface and the green vegetative cover. Thus, it includes both the mat and thatch previously described.

In bermudagrass turf thatch consists of a layer of stems and roots entwined in partially decayed leaf, stem and root tissue between the soil and the green leaves. This thatch layer is characterized as being fibrous in nature and highly resistant to microbial breakdown. As the thatch continues to accumulate, decomposition is further retarded by the increase in lignin content which renders much of the thatch layer inaccessible to microbial breakdown. Physical examination of the thatch layer indicates that it consists primarily of stem, node and sheath tissue in various stages of decay. Grass clippings which consist largely of leaf blade tissue do not significantly contribute to the thatch layer.

Thatch accumulation is a direct result of management practices that produce abundant vegetative growth. High rates of nitrogen fertilization, infrequent mowing and frequent irrigation are factors that contribute to thatch accumulation. Many improved turfgrass cultivars such as Penncross bentgrass and Tifdwarf bermudagrass have a vigorous shoot growth rate that encourages thatch accumulation. The failure to maintain a balance between growth rate and decomposition ultimately results in the accumulation of thatch.

---

[1] Ferguson, Marvin H. 1964. USGA Green Section Record. Vol. 1(5): 10-12.

Decomposition is a function of grass variety, soil microenvironment and management. For example, Penncross bentgrass and Tifdwarf bermudagrass have a greater tendency to develop thatch than Seaside bentgrass or common bermudagrass, respectively. Likewise, environmental factors that favor dense populations of microorganisms encourage the decomposition of thatch. Aerification and topdressing also illustrate management tools that help in the decomposition of thatch. When decomposition and growth rate are out of balance, thatch begins to accumulate.

Excessive thatch accumulation results in a number of maintenance problems and in poor quality turf. Thatch creates problems with mowing, watering and fertilizing; provides a favorable environment for insects and disease organisms; increases winterkill in warm-season grasses; and impairs the trueness of playing surfaces. On the other hand, a limited amount of thatch may reduce or alleviate soil compaction, protect the crowns and nodes against climatic or mechanical injury by imparting resilience to playing surface, reduce weed growth and filter harmful pollutants and residues.

Thatch control involves the application of sound agronomic principles in addition to the use of mechanical tillage and removal. Research at Texas A&M University has demonstrated that different varieties of bermudagrasses and bentgrasses accumulate thatch at different rates. The rate of accumulation is directly related to the growth rate and growth habit of the grass variety. One bermudagrass, Pee Dee, has a very fast growth rate and, as a result, accumulates thatch rapidly. After two growing seasons Pee Dee accumulated a 31 mm layer of thatch; whereas, other varieties accumulated only 16-20 mm of thatch (Table 1). Such grasses require completely different management programs to maintain the same level of playing quality. As a result, consideration should be given to this tendency to accumulate thatch during the selection of grasses for turf areas. For example, golf courses that expect heavy traffic might prefer to plant the more vigorous variety on putting greens and tees because of the recuperative capacity of the grass. On the other hand, golf courses that have limited traffic would not want to plant the most vigorous grasses.

Nitrogen fertilization is the management practice that most influences thatch accumulation since it largely determines growth rate for a particular grass variety. Thatch accumulation may be directly related to the rate of application of nitrogen (Table 2). Measurements made on a Tifgreen bermudagrass putting green fertilized at several rates of nitrogen show a significant increase in thatch for each increase in nitrogen regardless of nitrogen source. Also, the investigation demonstrated that organic and slow-release nitrogen sources produce less thatch than inorganic nitrogen sources such as ammonium sulfate. However, the lowest rate of nitrogen

studied per application was 1 pound per 1000 square feet. If smaller and more frequent applications of inorganic fertilizers were made, then the difference in sources may not be as apparent. Two years of intensive research and many years of observation suggests that turf should be kept "hungry" for nitrogen to maintain a balance between thatch accumulation and decomposition.

The effect of several fungicides and a growth retardant on thatch accumulation in bermudagrass turf was also studied. Applications of each of the materials shown in Table 3 were made to the turf at 2-week intervals. The effects of these materials on thatch accumulation were striking and readily explained by their influence on plant growth and microbial activity. The growth regulator and the fungicide combination (Fore and Thiram OM) retarded the growth of the bermudagrass and thereby reduced thatch accumulation. The fungicide, Fore, applied alone at 2-week intervals at preventative rates resulted in a significant increase in thatch accumulation which could be explained by an inhibition of microbial activity. Tersan SP which is a fungicide specific for Pythium resulted in greater thatch accumulation than the check, but much less than where Fore was used. Apparently Tersan SP had little effect on the microbes important in thatch decomposition. These results suggest that preventative fungicide programs may have a significant effect on thatch accumulation in bermudagrass turf. A similar effect would be expected on bentgrass turf although this has not been established. This area of research will be expanded at Texas A&M University so that the effect of fungicide programs on thatch accumulation can be predicted. Fertilization programs may need to be adjusted to reduce thatch when preventative fungicide programs are essential. Information obtained using three nitrogen rates indicate that where a fungicide is used routinely, lower nitrogen rates should be used to prevent excess thatch accumulation.

Cultural practices including vertical mowing, aerification and topdressing have been recognized as methods of controlling thatch in bermudagrass turf. The effect of the frequency of vertical mowing and aerifying on thatch accumulation was studied on bermudagrass turf at two rates of nitrogen (Figures 1, 2 and 3). Monthly aerification was shown to be as effective as biweekly aerification as far as thatch accumulation was concerned (Figure 1). Biweekly aerification also resulted in lower turf quality ratings and would have been unacceptable in terms of putting performance. Perhaps aerification at less frequent intervals would have been satisfactory, but this was not determined. Vertical mowing alone and in combination with aerification reduced thatch accumulation significantly (Figures 2 and 3). Biweekly vertical mowing produced superior turf and reduced thatch accumulation significantly compared to less frequent vertical mowings. Apparently, weekly

vertical mowing would reduce thatch and improve putting quality even more than biweekly operations. As shown in the fertilization study, high nitrogen rates resulted in greater thatch accumulation regardless of the frequency of aerification and vertical mowing.

The information gained in this investigation indicates that thatch accumulation is influenced by all of our management practices as well as by the grass variety. Thatch control must be a result of a complete management program, and not just the result of a single operation.

Table 1. Thatch accumulation in bermudagrass varieties after two growing seasons.

BERMUDAGRASS SELECTION	THATCH (mm)
TIFDWARF	26
TIFGREEN	25
PEE DEE	31
TEXTURF 1F	20
CHAMPIONS	25
289917	16
289918	18

Table 2. Thatch accumulation in a Tifgreen bermudagrass putting green as affected by nitrogen sources and rates.

N-SOURCE	RATE[1]	THATCH (mm)
MILORGANITE	4	6.0
	6	6.1
	12	7.1
UREAFORM	4	5.2
	6	6.6
	12	7.1
AMMONIUM SULFATE	4	6.7
	6	6.9
	12	7.7

[1] POUNDS N/1000 ft^2 / 12 WEEK PERIOD

Table 3. Thatch accumulation in a Tifgreen bermudagrass putting green as affected by fungicides and a growth retardant applied at 2-week intervals.

FUNGICIDE OR GROWTH RETARDANT	THATCH (mm)
FORE	8.0
TERSAN SP	6.9
CHECK	6.3
THIRAM OM-FORE	5.7
SUSTAR	4.9

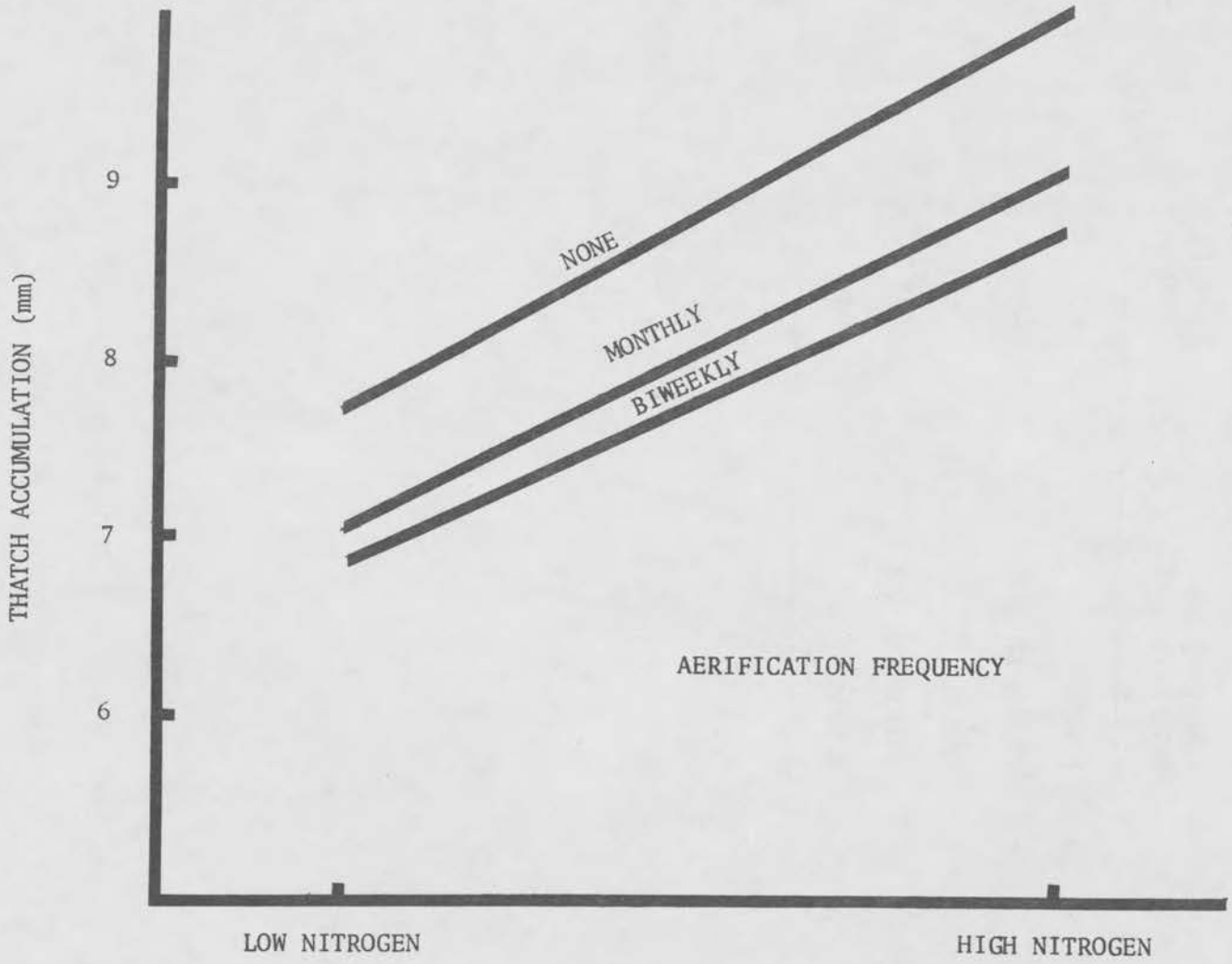

Figure 1. Thatch accumulation in a Tifdwarf bermudagrass putting green as influenced by nitrogen rate and aerification.

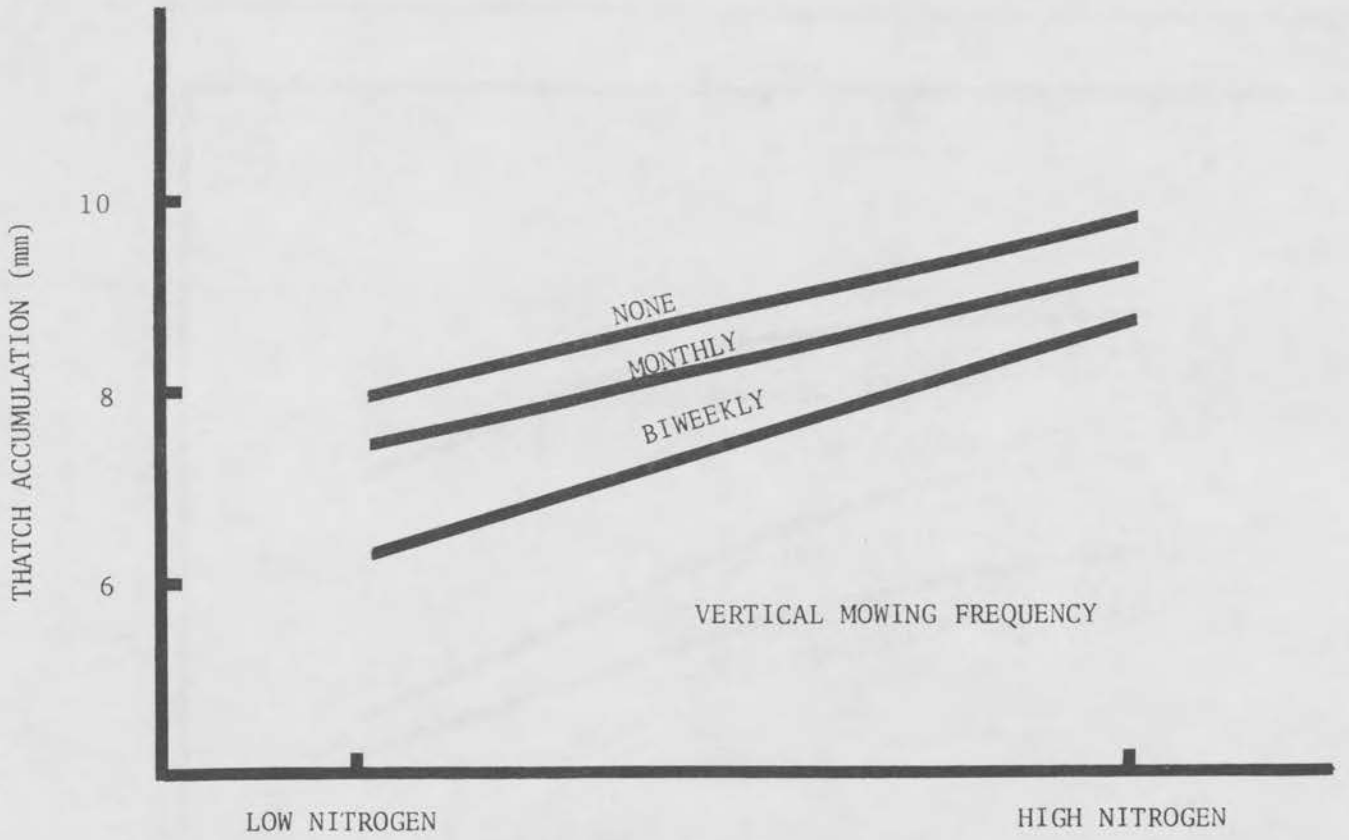

Figure 2. Effect of vertical mowing and nitrogen rate on thatch accumulation in a Tifdwarf putting green.

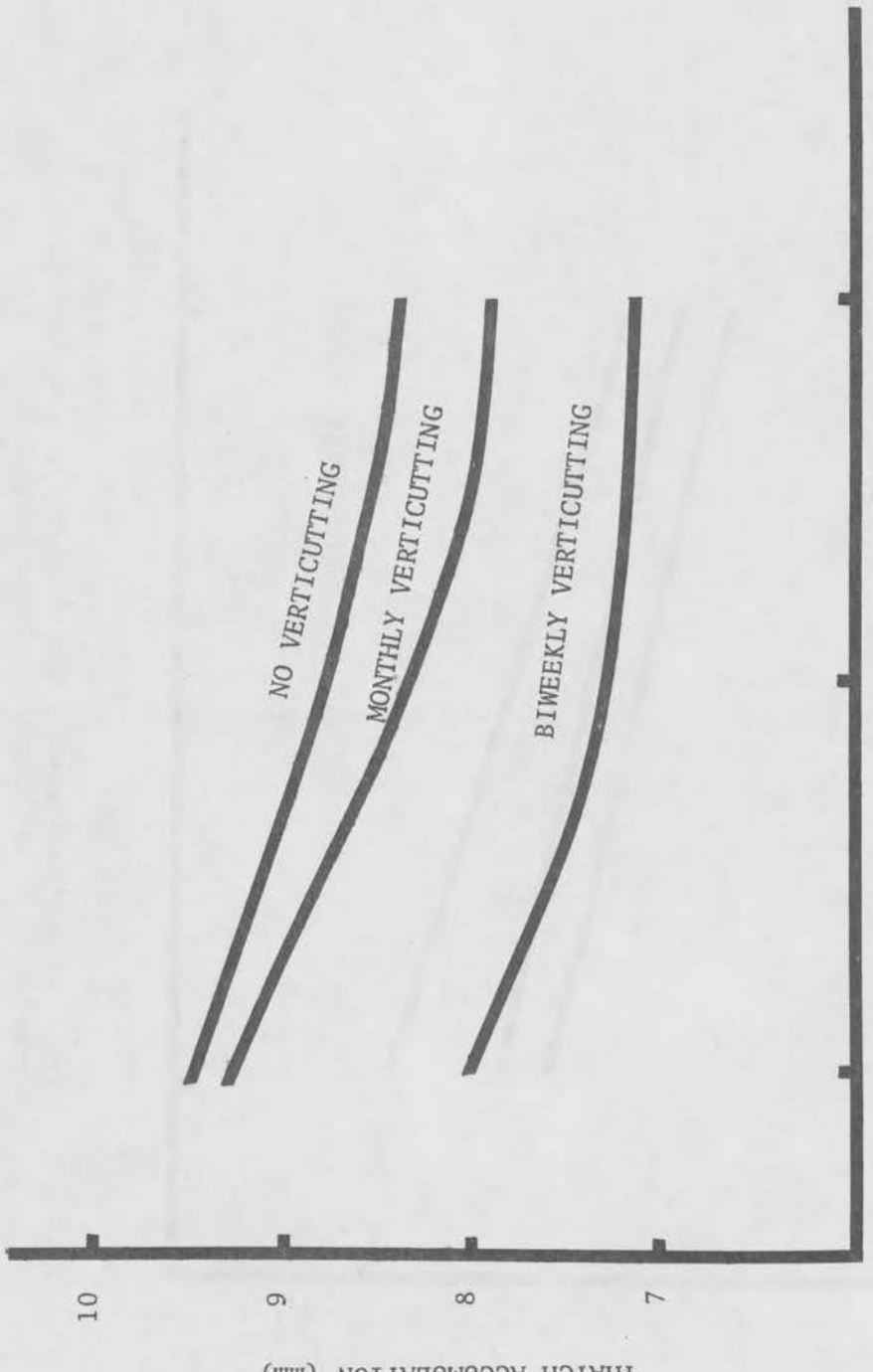

Figure 3. Effect of vertical mowing and aerification on thatch accumulation in a Tifdwarf putting green.

A NEW ST. AUGUSTINEGRASS

Robert W. Toler, Associate Professor
Department of Plant Sciences
College Station, Texas

ABSTRACT

A new variety of St. Augustinegrass was recently developed jointly by the Texas and Florida Agricultural Experiment Stations. The new variety called Floratam is resistant to St. Augustine Decline (SAD) caused by the St. Augustine Decline strain of Panicum Mosaic Virus. Flortam was also tested in separate investigations in Florida and Texas and found to be resistant to chinch injury by the southern lawn chinch bug (Blissus insularis). This variety was released to certified growers in Texas and Florida in 1972 and made available to home owners in 1973. Foundation sod is available through the Texas Agricultural Experiment Station Foundation Seed Service, College Station, Texas.

Lawn and turfgrass production is a major enterprise in Texas. It is estimated that 41% of the home lawns in the state are in bermudas, 56% in St. Augustinegrass and 3% in other grasses. In the Gulf Coast area of the state 96% of the lawns are in St. Augustinegrass (2).

St. Augustinegrasses are versatile and more salt tolerant than most warm-season grasses. They thrive well in full sun or moderate shade and have low maintenance requirements in comparison with most other turfgrasses.

A disease of St. Augustinegrass was observed in South Texas by homeowners and lawn service operators in 1966. Symptoms of the disease were chlorosis and mottling of the leaf blades. As the disease became progressively more severe internodes were shortened and stolon growth was retarded. The causal agent was found to be a mechanically transmissable virus and the disease was named St. Augustine Decline (SAD). The virus causing SAD was found to be mechanically transmitted to Proso (Panicum), Pearl (Pennisetum) and Foxtail (Setaria) millets as well as crabgrass (Digitaria) and St. Augustinegrass (Stenotaphrum). Attempts to transmit the virus through soil and insect transmission with leafhoppers, and chinch bugs were not successful (4). Under natural infestation lawnmowers were shown to transmit the virus from infected to healthy plants. Purification and electron microscopy revealed the virus to be a polyhedral particle and serological tests demonstrated the virus was related to Panicum Mosaic Virus.

The causal virus was named the St. Augustine Strain of Panicum Mosaic Virus (3). St. Augustine Decline has caused extensive damage to Common St. Augustinegrass which is the only cultivar commercially grown in Texas. The disease has been identified in 64 Texas counties in 1973 and also found in Louisiana and Mexico (1).

Control of St. Augustine Decline was sought through the mechanism of host resistance. Inoculation procedures were developed for greenhouse screening of St. Augustine varieties accessions and breeding material. Greenhouse screenings were begun in 1968 (5).

The first diseased field trial in 1969 revealed that some accessions, even though resistant to mechanical infection in the greenhouse, become diseased in the field in diseased test site situations. Accessions showing resistance to infection were test planted in Common St. Augustine turf heavily diseased with St. Augustine Decline at Ft. Worth, San Antonio, Corpus Christi and Kingsville in 1970 and at Houston and Bryan in 1971. In the field trials transplanted susceptible Common became infected and St. Augustine Decline disease developed in this cultivar in 30 to 180 days. Other strains or accessions became infected, and disease developed at one or more locations in the State over a 2-year period; however, Roselawn strains and Floratam remained symptomless. The test material was assayed for SAD virus development by inoculation onto susceptible Common St. Augustine and Proso millet, the clinical indicator host. Floratam has exhibited resistance to St. Augustine Decline under greenhouse testing since 1968 and in the field after 24 consecutive months, 1970-72.

Resistance to infection and disease development as exhibited by Floratam is genetic. This type of resistance may break down due to specific stresses such as: changes in vectors or infection mechanisms or changes in the virus due to mutation for virulence. Pressures from diseases, and their distribution and spread, are enhanced in one-plant-variety communities. The Gulf Coast of Texas is an example of this condition where the Common cultivar of St. Augustine is the only commercially grown variety in the ecosystem. The genetic base of commercial varieties of Stenotaphrum secundatum should be broadened with general adaptation particularly since they are vegetatively propagated. New varieties are desirable to reduce crop vulnerability. Special purpose St. Augustine cultivars will continue to be in demand.

Floratam, like Common St. Augustine, is not resistant to Brown Patch or Rust. Carbamate-type protectants may be employed in reducing Rust and Brown Patch diseases. Floratam has tolerance equal to or slightly better than that of Common to the fungus diseases Gray Leaf Spot and Downy Mildew.

One of the most important problems facing St. Augustinegrass is the southern lawn chinch bug (Blissus insularis Barber). Although chemical control measures are available for this insect, these provide only temporary relief and add to the maintenance requirements of the grass. The development of chinch bug tolerant or resistant varieties of St. Augustinegrass offered the most promising method of control. Dr. Richard L. Duble, of the Soil and Crop Sciences Department at Texas A&M, evaluated Floratam and all other available varieties of St. Augustinegrass for chinch bug resistance in Texas. In his investigations St. Augustinegrass varieties were inoculated with 50 chinch bugs per square foot of turf, and the insects were restricted to the grass by nylon netting. Within 6 weeks Common St. Augustinegrass and other varieties began to show visual symptoms of chinch bug damage. Within 3 months all the grasses except Floratam and one experimental selection were killed or severely damaged by the insects. Very few insects survived on Floratam, indicating that the grass was toxic to them or that they could not reproduce when restricted to the grass. Research from Florida produced the same conclusion -- that "Floratam was resistant to the southern lawn chinch bug" (6).

Floratam is a moderately coarse-textured, fast-growing, dark green grass which was selected at Gainesville, Florida, from FA-23. It is a deep-rooted, stoloniferous St. Augustinegrass that compares favorably in growth with Roselawn and Common. The culms are branching, highly compressed, and the flowering shoots are 30 to 45 centimeters (12 to 18 inches) tall. Stolons are large, purplish red with internodes averaging 3 inches in length. Blades are wide, averaging 8.59 millimeters (0.34 inch) in width and 9.56 centimeters (3.8 inches) in length. Leaf color is a deeper green than that of Roselawn or Common under uniform fertilization.

Floratam, tested as accession number FA110, covers rapidly. When sprigged in rows 12 inches apart on 12-inch centers, in 1 year Floratam covered 93 percent of the planting area in Florida. In Texas, Common and Floratam St. Augustinegrass will cover in one season where planted on 1-foot centers under optimum culture. It has good vigor and rapid growth and competes favorably with weeds. Clipping yields are comparative with those of Common and Roselawn. In controlled greenhouse clipping trials, yields reported in grams oven dry weight over a 6-week period show Floratam yields compared favorably with those of Common and Roselawn. The average clipping yield was Common 0.59, Roselawn 0.56 and Floratam 0.52 grams oven dry weight.

Good tolerance to atrazine and simazine herbicides was demonstrated by Floratam. Both of these herbicides may be used at the recommended rates shown on the labels. Floratam is slightly less cold tolerant and is not recommended for areas where Common St. Augustine normally winterkills. Research is continuing on the development and testing of St. Augustinegrass accessions for improved adaptation, disease, and insect resistance, aesthetic value and cold tolerance.

Literature Cited

1. Holcome, G. E., K. S. Derrick, R. B. Carver, and R. W. Toler. 1972. St. Augustine Decline found in Louisiana. Plant Dis. Reptr. 56:69-70.

2. Holt, Ethan C., W. Wayne Allen, and Marvin H. Ferguson. 1964. Turfgrass maintenance costs in Texas. Texas Agric. Exp. Sta. Bull. 1027:5-19.

3. Lee, T. A., Jr., and R. W. Toler. 1973. Purification and characterization of the virus causing St. Augustine Decline. Phytopathology (Abstr.) 63:444.

4. McCoy, Norman L., R. W. Toler, and Jose Amador. 1969. St. Augustine Decline (SAD). A virus disease of St. Augustinegrass. Plant Dis. Reptr. 53:955-958.

5. McCoy, N. L., R. W. Toler, and R. H. Leisy. 1971. Selecting propagules of St. Augustinegrass for possible sources of resistance to the virus causing St. Augustine Decline. Proc. 3rd Ann. Texas Conf. on Insect, Plant Disease, Weed and Brush Control. 3:65-71.

6. Toler, R. W., and R. L. Duble. 1973. 'Floratam' a new disease-resistant St. Augustinegrass. Texas Agric. Exp. Sta. L-1146, 5p.

THE TEXAS TURF EXTENSION PROGRAM

Albert C. Novosad
Pasture Specialist
Texas Agricultural Extension Service
The Texas A&M University System

Since 1915, the Texas Agricultural Extension Service has had statutory responsibility for conducting state-wide educational programs in agriculture, home economics and related subjects. Turfgrass production, use and management falls within this responsibility.

Prior to a discussion of Extension turf program activities, permit me to give some brief background information concerning the Texas Agricultural Extension Service. This should provide: 1) a better understanding of the Extension Service, its responsibilities and methods of operation and 2) information on how programs in which you have a particular interest may be assisted and strengthened.

Enabling legislation for creation of the Cooperative Extension Service nationally was enacted by the U. S. Congress in the Smith-Lever Act of 1914. The Texas Legislature acted in 1915 and created the Texas Agricultural Extension Service. Supporting funds are received from the Federal, state and county levels of government. The Cooperative Extension Service of Texas is the educational arm of the USDA and the Texas A&M University Land Grant System. A close partner in this sytem is the Texas Agricultural Experiment Station, which provides a research base for Extension recommendations.

The Extension Service conducts informal educational programs based on the felt needs of local citizens. Annual and long-term programs are planned and implemented by local leaders through broad-interest based county program building committees and special-interest sub-committees. A turf or turf and ornamental committee would be an example of a special-interest sub-committee. These programs are coordinated by local county Extension agents who have available for special assistance, Extension subject-matter specialists. Other resource people are also called upon, and provide assistance with the local programs.

The Extension specialists' turf assistance to the county program is provided through an interdisciplinary approach and involves specialists from many specialized fields, such as agronomy, entomology, plant pathology and several others. During the past year, more than 56 specialists were involved in some turf educational activities. Many of these work out of district headquarters locations throughout the state.

Among activities conducted in support of county turf programs have been shortcourses, clinics, meetings, demonstrations, tours and mass media efforts, such as radio and TV programs and news articles.

A partial summary of Extension turf activities for 1972 on a state-wide basis is as follows:

EXTENSION TURF ACTIVITIES
1972

Meetings, shortcourses and clinics held	430
Attendance	25,580
Demonstrations conducted	183
Radio programs	2,224
Television programs	233
News articles	2,222
Number of responses to individual requests for assistance	326,406

Extension activities in the area of turf are to be strengthened. A full-time specialist position has been created and is now open. A qualified person is being sought to fill this position and will have responsibility for coordinating and directing the overall Extension turf program on a state-wide basis. He will work closely with all segments of the turf industry in his efforts to provide the best possible turf educational programs.

It is hoped that you as individuals will continue to support turf educational activities not only on a state-wide basis, such as through the Texas Turfgrass Association, but also on a local basis through appropriate county Extension committees. If you are not active in an organized county program, I would urge you to contact your local county Extension agent and convey to him your interest and needs, and hopefully become an active participant in local turf educational efforts.

INSTALLATION OF IRRIGATION SYSTEMS

Palmer Maples, Jr.
Golf Superintendent and Secretary-Treasurer
Golf Superintendent's Association of America
Atlanta, Georgia

In this modern day of golf course maintenance, one item that is being considered more and more as a necessary part of equipment is the automatic irrigation system. It is a means of supplying one of those essentials necessary for growing good turf, water, and doing it in a way that is best for the grass, considering the kind of grass, and all other climatic factors. I say a piece of equipment because it must be regarded in this respect if it is to function as designed. Maintenance must be performed on a scheduled program and at regular intervals. And so I charge the superintendent to know this piece of equipment, and know it well. I cannot understand the man that does not want to get involved with the installation of an automatic irrigation system nor has any interest in how it works. Today this is a regular part of being a golf course superintendent.

I would like to share some of the thoughts that went into the system that was installed at The Standard Club in 1971. It works! It worked from the first time any controls were operated, it has worked when lightening has hit several trees on the course these past two summers, and I expect it to be working 10 years from now. I had a semi-automatic system in Charlotte for six years and this gave me an advantage as to what I wanted and more so what I did not want. This is what I would like to share with you, not a lot of talk on ditching or equipment, for I am sure all of you have seen many pictures on these subjects, but thought as to why certain things were done a specific way. In some measure I would hope these may be of some help to you as you might get involved with irrigation on your own course.

1. Locate Master Controller in Office and have Field Controllers.

2. Divide course into first and second nines, if possible.

3. Have all of fairway in one zone or on one clock.

4. Have separate start times for Greens, Tees, Fairways, at least.

5. Avoid solvent weild joints.

6. Provide manual by-pass at greens.

7. Provide quick coupler outlets in fairways, at tees and greens.

8. Schedule watering cycles going away from Club House on first holes.

9. Start with the Master Controller if it is a change over job from manual.

10. Know what you want, get involved, and know your equipment.

PERSONNEL MOTIVATION

James A. Wiley
Training Coordinator, Personnel Department
Texas A&M University
College Station, Texas

Before we can approach the topic of Motivation, I believe we need to isolate the problem and define some terms. First, what is Motivation? Webster's Seventh New Collegiate Dictionary says - "To provide a motive." It (the Dictionary) then says "Motive: Something (as a need or desire) that causes a person to act. Motive implies an emotion or desire operating on the will and causing it to act." A foreman in our Physical Plant, who was a member of a group with which I discussed this subject recently, very adequately defined motivation in fewer words. He said, "Motivation Means Wanting To Get With It!"

I hope we will accept that "Motivation" involves a self-willed condition on the part of the "Motivated" individual who I call the "Motivation Target." Let's now examine the factors or elements, or whatever you want to call the variables which exist in a motivation situation. First, there is the "motivating agent," or the supervisor who must do the motivating. Second, there is the "motivation target," in our case the employee. Third, there is the environment or the set of conditions, physical or otherwise, which surround and permeate the space and time in which the motivation must take place.

Let's look at the "motivating agent" - the supervisor. What is a supervisor, what does he do and how does he do it? He (or she) is a PERSON, one of a group of persons who have primary responsibility for accomplishing the goals or objectives of the organization. Supervisors get things done THROUGH THE EFFORTS OF OTHER PEOPLE. Some of you may say, "But I get in there and do things myself." I'm sure that you do; but, if you can and do accomplish the organization's goals through your own efforts alone, you aren't a supervisor, you are a worker and your motivating is a self-directed effort.

Now let us look at the "motivation target" - the employee. He or she is also a PERSON. As such, he or she has feelings, needs, aspirations, and problems just as does the supervisor. Thus motivation is a situation involving people - the supervisor and the employee. Motivation is a HUMAN RELATIONS situation.

The third consideration is the environment. Here we will think of the job, i.e. type of work, service or product, working conditions, hazards, facilities, equipment and materials, and how the job is regarded i.e. prestige. These things describe the environment in which motivation is attempted.

With these thoughts in mind then, how does the supervisor go about getting the worker to "Want To Get With It?"

A supervisor needs the DESIRE to motivate, the KNOWLEDGE of what personal needs are currently the highest priority in the employee's inventory of personal needs, and the MEANS to deal with those needs. I believe these three - DESIRE, KNOWLEDGE, and MEANS - should be placed in the order stated. Without DESIRE, KNOWLEDGE will not be sought nor used. Without DESIRE and KNOWLEDGE, MEANS or resources, will not be and cannot be used effectively to produce motivation.

How does the supervisor go about getting DESIRE to motivate the people who work with him (or for him, if you insist)? I am sure the answer will be something like "My job is to produce X product or Y service, at the lowest price consistant with acceptable quality. I accomplish this by guiding the efforts of my work force." That work force is people. People effort is the least predictable and most difficult resource to apply of all the elements that go into a product or service. In many situations, probably in most, people are also the most costly. At a meeting of the College and University Personnel Association in 1971, Dr. LeMaitre, Chancellor, of the University of Texas System, stated that "people costs - salaries and other costs associated with people - make up over 70% of the UT System operating costs."

In today's world of spiraling production costs, perhaps a look at your "people costs" will promote a desire to maximize the "want to get with it" in as many of your employees as you can.

Now, let's look at the question of KNOWLEDGE of the employee's personal needs and how this knowledge can be used to help develop the "want to get with it" attitude or to motivate. Behavorial researchers have reported results of many studies intended to show what the personal needs are and also many to show which of these are most effective in establishing motivation. These have become more frequent and more specific each year. Due to time limitations and also to my personal preference, I will refer to only two authorities today. Abraham H. Maslow published "Motivation and Personality" in 1954 with a revised second edition in 1970.[1] Frederick Herzberg wrote "Work and the Nature of Man" which was published in 1966.[2] These two books are almost invariably referred to in discussions of employee motivation. I use them for this reason and more importantly because my own very unscientific observations over 30 years of trying to "get things done through the efforts of others," give rise to the same general conclusions expressed by Maslow and Herzberg in these two books.

With apology to the author for greatly oversimplifying his theory, Maslow says, in general, that human needs can be categorized as follows on the next page:

Physiological - the survival needs such as food, water, light, shelter.

Safety and Security - those things which contribute to physical, economic and mental well-being.

Social or Affiliation - people want to be liked, accepted, and to belong.

Ego or Self Esteem - include the desire to know and understand, to be self-confident, to have status in one's own eyes and the eyes of others, to receive deserved recognition, to know that one's efforts are appreciated and to have the respect of others.

Self Actualization - the urge to be and to do all that one is capable of.

He also found that these needs exist in the order listed or as he terms it the "Hierarchy of Human Needs." Further, Maslow believes that the higher order needs do not come into effect until those of lower orders have been largely filled. In other words, appeals to the Ego or Self Esteem needs will not have any effect on a person who is still struggling at the survival level. Maslow and other workers have found that when a particular level of need is reasonably satisfied, additional fulfillment of that level has little motivational effect and any such effect observed is of short duration.

I must point out that Maslow was considering the needs of people as individuals, he was not dealing specifically with people as workers or employees. However, James J. Cribbin in his book "Effective Managerial Leadership"[3] summarizes some "Management guidelines" from Maslow's work as follows:

Needs are driving forces.

Opportunities for employees to satisfy their needs are effective motivational devices.

A satisfied need is <u>not</u> a motivator; adding material benefits when a person is reasonably affluent will not have any lasting effect.

On the other hand, appealing to a higher level need will be useless when a lower level need is not reasonably accomodated.

The needs overlap and interact. Man is multi motivated and as one level approaches satisfaction the higher level comes into play.

The lower level needs are the most demanding; however, when the higher level comes into range, satisfaction of these higher level needs have a more enduring and pronounced motivating effect.

Just briefly I will now summarize what Frederick Herzberg reports. I'm aware that the treatment is far too brief and general. Herzberg and others using his methodology worked more specifically with the factors which are believed to motivate workers. In very general terms they agreed that the opportunities to fulfill driving human needs are the factors which cause workers to put forth effort. They do not, however, agree that all these fulfillment opportunities are true "motivators" in the sense that we have defined motivation as a "willingness" or "want to get with it" attitude. Rather these researchers believe that fulfillment of the lower level needs is necessary to attract and keep an acceptable work force. Also to keep the individuals in a state of psychological health which will permit appeals to the higher level needs which are the true motivations. Herzberg called these lower level fulfillments "hygiene" factors, meaning that they are necessary for psychological health. More recently he and others have used the term "maintenance factors" or "satisfiers" and stated these to be:

Company policies and effectiveness of administration (as seen through the employee's eyes).

Effectiveness of supervision (again from the employer's view).

Adequacy of salary.

Job security.

Personal relationships at the work place.

Working conditions.

These men and women see the motivators as:

Achievement - as the worker sees it.

Recognition - of peers and of the organization.

The work itself - let's face it, some jobs will probably never be motivators. I'm not sure how far dishwashing or hole digging as full-time work can be developed.

Responsibility.

Advancement - the dishwasher or hole digger needs to be able to see something else on the horizon.

Potential for growth.

Some people say, I think correctly, that meeting the individual's requirements in the "satisfiers" gets him to come to work with sufficient regularity and in a frame of mind that MAY give you a chance to motivate him.

Let me hasten to point out that some employees probably cannot be motivated beyond the point of reasonably regular work attendance and doing enough to keep the job. In some of these people, the highest level need which has developed is among the "satisfiers"; others find their higher level satisfactions in family, church, community or other organizations. The latter work to be able to pursue their interests in these other areas.

Now it looks relatively simple to take either Maslow's "Hierarchy of Needs" or Herzberg's listing of satisfiers and motivators and say we'll just determine which represents the appropriate "need" to try to give attention among our particular group of employees. Well, unfortunately it isn't that easy for a number of reasons. First, except that the physiological or survivor needs, are probably highest priority for everyone, the exact order in which the needs exist for any one person will vary with age, length of working experience, relative affluence and many other factors. Also, the priority each person places on fulfilling the various needs varies with the individual. In short, the "environment" which I tried to describe early in these remarks has a very marked influence on the priority any individual places on his needs at any given time. From the evidence I have seen in the work of behavorial researchers and from my own observations I conclude that determining what need fulfillment opportunity will motivate in any particular case is very much an individual determination which requires considerable effort, thought, and study by a supervisor. I believe that real motivation is almost a "one-on-one" proposition between the supervisor and each individual employee.

This leads me further to believe that real motivation must be accomplished by each worker's immediate supervisor. The company president, vice presidents and other company officers can only motivate the people who report directly to them. The company management can provide MEANS to permit individual first line supervisors to motivate workers. These means will include facilities, funds, organization, policies and administration which will reasonably accomodate the "satisfiers." Means must also include training of supervisors so that they will recognize their role as motivating agents and have some knowledge as to how to go about motivating. A third essential

in the means is authority for the supervisor to make changes in work assignments and to take action which will recognize good work on the part of an employee. Supervisors also need the authority to offer achievement and growth opportunities to their workers. Supervisors must learn to use their authority as a motivator not as a whip. Very early in my experience as a supervisor, my own higher supervisor told me something that has remained in my mind quite vividly - he said, "when you want to move a rope, you have to pull it, you can't push it."

I'm sure that some, perhaps many of you are saying - "this business of motivation is all well and good, but it is too expensive. Creating a suitable environment by reasonably meeting the satisfiers is too costly, training and developing supervisors is more so. Then if I give supervisors the authority you mentioned, they'll make expensive errors. It will just cost more than I will realize in improved production." If you make this decision based on sound cost analysis, I'll agree. If your operation can produce at your accepted level of profit, either in dollars or in services at an accepted cost, without motivated employees or if your employees or the work they do cannot be improved by a "want to get with it" attitude, then motivation is not for you. Just be sure that the cost analysis is sound and considers all the facts, not just assumptions or opinions.

In conclusion, if DESIRE and KNOWLEDGE show a need for MEANS, the three combined will produce results. Finally, if a worker can be motivated it will only happen when he believes that you consider him to be an individual person, with individual problems, aspirations, and needs.

---

1 Abraham H. Maslow, Motivation and Personality, (New York: Harper and Row, 1954).

2 Frederick Herzberg, Work and the Nature of Man, (Cleveland: The World Publishing Company, 1966).

3 James J. Cribbin, Effective Managerial Leadership, (American Management Association, Inc., 1972).

WOODY ORNAMENTALS FOR TEXAS LANDSCAPES

Dwight S. Hall
Area Landscape Horticulturist
Texas Agricultural Extension Service
Overton, Texas

Good landscape design includes selecting plants for function or to satisfy a definite landscape need and to add attractiveness in the landscape.

Plant selections for public areas often do not function well due to a lack of knowledge of the plants selected. Often plants in parks, on golf courses, and recreational areas demand too much maintenance thus eventually become neglected therefore cannot fulfill the function for which they were intended.

There are numerous ornamental plants from which to select, yet when one begins to select in accord with intended function and growing requirements, the choice becomes less.

The following plant list is commonly used plants for recreational areas. They are selected due to general low maintenance and attractiveness. One must always keep in mind that there are few perfect plants, thus the following are those with the fewer difficulties.

The listings are by no means complete and must be selected in accord with local growing conditions -- soils, weather, availability, etc.

Ground Covers

English Ivy - (Hedera helix and varieties)
Liriope - (Liriope muscari)
Japanese Purple Honeysuckle - (Lonicera japonica chinensis)
Monkey Grass - (Ophiopogon japonicum)
Potentillia verna
Santolina
Asian Jasmine - (Trachelospermum asiaticum)
Vinca - (Variegated and green)
Dwarf and Spreading Junipers - (Juniperus varieties)
Daylilies - (Hemerocallis)

Dwarf Shrubs

Dwarf Yaupon - (Ilex vomitoria nana)
Dwarf Bamboo - (Bambusa sasa pygmaea)
Dwarf Purple Barberry - (Berberis)
Cotoneaster horizontalis
Holly Fern - (Crytomium falcatum)
Dwarf Junipers - (Juniperus varieties)
Dwarf Nandina - (Nandina domestica nana)
Dwarf Pyracantha
Indian Hawthorne - (Raphiolepis indica)
Fatsia - (Fatsia japonica)
Dwarf Yucca - (Yucca filamentosa)
Dwarf Chinese Holly - (Ilex cornuta "rotunda")
Dwarf Burford Holly - (Ilex cornuta rotunda burfordii)
Santolina - (S. chamaecyparissus and S. virens)

Larger Shrubs

Abelia - (Abelia grandiflora)
Althea - (Hibiscus syriacus)
Barberry - (Berberis thunbergi)
Cherry Laurel - (Prunus caroliana)
Cleyera japonica
Elaeagnus - (E. angustifolia and E. pungeas)
Japanese Yew - (Podocarpus macrophylla)
Junipers - (Juniperus varieties)
Primrose Jasmine - (Jasminum primulinum)
Ligustrum - (Ligustrum japonicum)
Nandina - (Nandina domestica)
Oleander - (Nerium oleander)
Photinia - (P. glabra and P. serrulata)
Pineapple Guava - (Feijoa sellowiana)
Pyracantha varieties
Texas Sage - Senisa (Leucophyllum frutescens)
Viburnum varieties
Mahonia - (M. bealei and M. trifoliolata)
Pampus Grass - (Cortaderia selloana)
Banana - (Musa)
Yucca - (Yucca aloifolia and others)

Vines

English Ivy - (Hedera helix)
Coralvine - Queen's Wreath (Antigonon leptopus)
Trumpetcreeper - (Campsis radicans)
Cats-claw - (Doxantha unguis-cati)
Fig Vine - (Ficus pumila)

Carolina Yellow Jessamine - (Gelsemium sempervirens)
Lady Banksia Rose - (Rosa banksiae)
Asian Jasmine - (Trachelospermum asiasticum)
Wisteria
Fatshedra - (Fatshedra lizei)
Evergreen Smilax - (Smilax lanceolata)
Virginia Creeper - (Parthenocissus quinquefolia)

Small Trees

Texas Persimmon - (Diospyros texana)
Loquat - Japanese Plum - (Eriobotrya japonica)
Cassine Holly - (Ilex cassine)
Possumhaw - Deciduous Holly (Ilex decidua)
American Holly - (Ilex opaca)
Yaupon Holly - (Ilex vomitoria)
Crape Myrtle - (Lagerstroemia indica)
Cherry Laurel - (Prunus caroliana)
Red Bud - (Cercis canadenis)
Chinese Tallow - (Sapium sebiferum)
Crabapple - (Malus varieties)
Ornamental Bradford Pear - (Pyrus calleryana "Bradford")
Fruitless Mulberry - (Morus alba "fruitless")
River Birch - (Betula nigra)
Tree Junipers - (Juniperus varieties)

PROPAGATION OF ANNUAL PLANTS

William D. Adams
County Extension Horticulturist
Houston, Texas

The propagation of annuals is a big business. It is estimated that the wholesale value of bedding plants is currently 60 million dollars per year. As specialists in turf or landscape maintenance, most of you probably have no intention of becoming self-sufficient in your bedding plant needs. Depending on the number of plants you use it might easily cost you more to produce your own.

On the other hand, you've probably seen new species and varieties you would like to grow but which just were not available. Possibly because of the scarcity of seed. The 'Sunkiss' F_1 Hybrid Portulaca or rose moss is primarily handled by one company. As a result, it's not readily available as a transplant. Many new hybrids such as the marigold 'Happy Face' are expensive. Last year fifty seeds of this variety sold for 75 cents. This also limits availability of transplants. The same can be said for 'Peter Pan' zinnias - fifteen seeds for 85 cents. Both of these are excellent varieties that are easy to grow. You should be able to get at least 90 percent of the seeds of these plants to the transplant stage with a minimum of care.

Maybe you have an old favorite annual that Grandma used to grow which is currently unavailable. Gloriosa daisy is just such a plant. It might be the extra touch that sparks favorable comments about the beauty of this year's plantings. Another neglected plant is Stokesia or Stoke's Aster.

For winter plantings, flowering kale might be a welcome change in place of pansies or violas.

Before attempting to grow any of these plants you'll want to consider how difficult they are to grow. This will depend on size of seed; petunias and begonias have tiny seeds and, of course, tiny seedlings. Pelleted seed may help in some cases with seed size but only a limited number of varieties are available in this form. In addition, susceptability to insect and disease pests, temperature, water and light requirements are important considerations.

If a number of these factors combine to make culture difficult you'll probably save money by purchasing plants from a professional bedding plant grower. Snapdragons, periwinkles, seedling coleus and sultanas are others in addition to petunias and fibrous-rooted begonias that are difficult to handle.

Once you've decided what to grow, you'll have to decide what to grow it in. There are almost as many choices in containers as there are varieties of annuals. You can use plastic community type containers, individual pots, paks, peat pots, plant bands, wafers and one of my favorites is a styrofoam "hot cup" with holes poked into the side at the base of the cup. For a few plants this latter choice is ideal and relatively inexpensive.

Your next concern will probably be with planting media. If you mix your own media stay with soil-less mixes such as 1 bushel each of vermiculite and shredded peat moss to which is added 1 1/4 cups of ground dolomitic limestone, 1/2 cup of 20 percent superphosphate and 1/2 cup of 12-24-12 fertilizer. You may want to substitute or supplement with controlled release fertilizers. Be sure to wet this mixture as it is being blended. Most commercially prepared potting soil mixes should also be adequate.

Usually seeds are germinated in a special media such as vermiculite or sphagnum moss. Both of these materials are sterile and well aerated, thus there is less chance for disease organisms to ruin your efforts. Be sure to keep the plants labeled.

Annuals to start in the spring (Jan. - Apr.) include: ageratum, allyssum, cockscomb, cosmos, balsam, impatiens (sultana), rose moss (portulaca), salvia, marigold, wishbone flower (torenia), verbena and zinnia.

For the fall season (Aug. - Dec.) try: snapdragon, calendula, cornflower, coreopsis, pinks, gaillardia, sweetpea, allyssum, evening primrose, shirley poppy, pansy verbena, stokesia, flowering cabbage and flowering kale.

Seed left over can be stored for one to approximately five years if given the proper conditions. Place dry seed in an airtight container such as an old pill bottle and store in the refrigerator at 40° - 50° F.

Try to fill containers as full as possible to exclude oxygen. This lack of oxygen will prolong seed viability by slowing down respiration.

When sowing seed, crease the lip of the seed packet and gently tap the packet allowing the seed to gradually drop into the planting media. For very fine seed, sand run through a 30 gauge screen is sometimes added to facilitate even distribution. Most small seeds should not be covered or covered only slightly. Some petunia varieties, for instance, require light to germinate.

After seeds have been planted, water either with a fine mist or from the bottom by placing the container in a pan of water.

After being thoroughly wetted and drained, cover with glass, plastic or put the entire container in a plastic bag. A heating cable to provide 70° F bottom heat will speed germination of most seeds. As soon as the seeds have germinated remove the covering.

When seedlings have developed the first set of true leaves it's time to transplant them to flats or individual pots such as the "hot cup". Use a pencil, finger or similar tool to make a hole in dampened potting soil. Gently lift seedlings by scooping under them and handling only by the leaves. If you damage the edge of a leaf you're still in business. On the other hand, if you damage the stem you've wasted your time. If seedlings have been started in a pot you may want to carefully tap the entire soil ball out of the pot.

Firm the soil against the roots by a lever action of the dibble in the soil. Water the plants carefully and thoroughly. Lift any plants that become covered with soil.

Growing plants in containers -- even easy ones like zinnias -- has some advantages. If the seed is expensive you should get a better percentage of seedlings to live and you can grow extras to fill in those vacant spots in the bed where a plant dies.

With the larger seeds you may want to start them in individual containers, thus, saving one transplanting. If the seed isn't too expensive sow several seed per container and thin out all but one.

Especially for annuals to be used in the spring, you'll need a greenhouse, hot frame or cold frame. A few transplants can be grown in a window or under wide spectrum flourescent lights, but it's not a very practical technique. For germination, a temperature of 70° F is adequate for most plants. After transplanting, night temperatures of 60° F are maintained for 4-5 weeks and then the plants are conditioned at 45° - 50° F for another 3-5 weeks. Day temperatures should be 10° - 15° higher. Another factor involved in conditioning or hardening is a reduction in watering. This hardening is necessary to toughen the plants before setting them outdoors.

Fertilization will be necessary if good transplants are to be expected. A recent technique with good potential is the use of controlled release fertilizers which are mixed with the potting soil. Another technique is to use a dilute fertilizer at each watering -- 200 ppm of N P K. An easy way to figure ppm is as follows: multiply 75 times the percentage of the element you are interested in. Let's assume we are using a 20-20-20 fertilizer and want 200 ppm of N as well as the other elements. Thus, 75 x .20 equals 15.00 which represents the ppm if 1 ounce of the fertilizer

is added to 100 gallons of water. Set up a ration problem thus:

$$\frac{1 \text{ oz.}}{15.00 \text{ ppm}} \qquad \frac{X \text{ oz.}}{200 \text{ ppm}} \qquad 15X = 200$$

$$15.0 \quad \overline{200.00} \qquad = \qquad 150 \quad \overline{2000.00}$$

13.33 oz.

150

500

450

500 ...

13.33 oz. of 20-20-20 per
100 gal. = 200 ppm

When setting transplants, plant them at the same level as they grew in the container. If peat pots were used tear off the rim, otherwise it will act as a wick causing the soil around the seedling to be dryer. Be sure to water as soon as possible after planting.

If you decide to plant directly in the soil, incorporate 2-4 inches of organic matter (pine bark, peat moss, etc.), 50-100 pounds of gypsum and 50 pounds of 20 percent superphosphate per 1000 square feet into the top 8 inches of soil. Of course, this same preparation is good for transplants as well. Sow the seeds and cover lightly. Deep planting in tight soil is a common reason for the failure of seeds to germinate. Use of a lightweight material such as vermiculite to cover the seed can help alleviate this problem.

Use a gentle mist to water the seeds and be sure they aren't allowed to dry out. If seedlings come up too thick be sure to thin them, otherwise they will be stunted. Once seedlings begin to grow, sidedress with nitrogen -- about 1 pound actual N per 1000 square feet. Four pounds of ammonium sulfate (21% N) will do the job.

I hope I've given you a good idea of how to propagate annuals. If you still have questions about what to grow, the test gardens here on the Texas A&M campus offer an excellent opportunity to see how varieties perform under Texas growing conditions.

REFERENCES

1. Anonymous. 1972. The Ball Red Book. 12th Edition. George J. Ball, Inc. 502 p.

2. _____. 1962. How to Grow and Use Annuals. Lane Book Company, Menlo Park, California. 80 p.

3. Crocket, James Underwood. 1971. Annuals. The Time-Life Encyclopedia of Gardening. Time-Life Books, New York. 176 p.

4. Dewerth, A. F. 1970. The Propagation of Ornamental Plants. Texas Agricultural Experiment Station, Texas A&M University. No. B-1093. 33 p.

5. Mastalerz, John W. ed. 1966. Bedding Plants - A Manual on the Culture, Insects, Diseases, Economics and Breeding of Bedding Plants. Pennsylvania Flower Growers. 121 p.

THE TEXAS TURFGRASS ASSOCIATION
WHERE TO FROM HERE

William E. McLaughlin
Chief, Landscape Services
The University of Texas System
Austin, Texas

Yesterday - Today - Tomorrow! Dead or Alive! The decision is ours!

Yesterday a fledgling Association began its work in promoting and educating the professionals in the turfgrass industry. As I see the Texas Turfgrass Association today we stand at the position of performance on a ten meter diving platform. But before we take our full gainer into the future let us look back over our shoulders for a moment. This Association has made some exceptional strides in the past twenty eight years. We have developed a Scholarship Program that has become a blueprint for other professional organizations. Through this program we support and supplement the future of four young prospective professionals each year. Through this we improve our image to the first order.

For this you and I, as the Association, may pat ourselves on the back.

This past year you and I revised and updated the Constitution and By-Laws. In so doing we provided an instrument by which our organization can more effectively and efficiently function. No organization is capable of operation without a blueprint for procedure and program.

For this you and I, as the Association, may pat ourselves on the back.

Our profession has always needed a close source for professional guidance and information. Texans in general have shared this need. Other fields of endeavor have been supported by Extension Specialists for some time. Experts, of the highest degree, to assist the given profession in many faceted concerns. Last year, following the untiring efforts of many, a position of Turfgrass Extension Specialist was created at Texas A&M. Through this specialist the turf profession will become better informed through a ready source for reference. In addition, the lay persons of the state will be better informed about Turfgrass management. The aesthetic quality of life in our Texas will be greatly improved through their efforts. Texas A&M is presently actively seeking a top talent person to handle this large and important task.

For this you and I, as the Association, may pat ourselves on the back.

For the past twenty-eight years the Texas Turfgrass Association has been growing and improving. And all this growth has been accomplished upon the backs of many persons on a part-time basis. To travel the distance we have, with people sharing their free moments seems to me quite admirable. Our Field Days and Annual Conference Programs hold Class A reputations.

For this you and I, as the Association, may pat ourselves on the back.

In a like manner, we enjoy a Newsletter, better known as Turf News of Texas. This function has been performed in our behalf by a part-time Editor. I doubt there are many organizations working as we do that have a finer publication.

For this you and I, as the Association, may pat ourselves on the back.

Today we find ourselves in the midst of a crisis of any sort you care to imagine. We failed years ago, even yesterday, to articulate with the future. Now in our grotesque nightmare we find confusion and apathy among our people. We scoffed at the environmentalists years ago. We accused them of hollering "wolf". Now in the midst of shortages and complex crisis we blame the environmentalists for causing the fuel shortages of this nation. It is curious that John Connally is blaming the Arabs! It is strange to me to note the apathy of the people of this country on many matters. I have noted in my travels around this state that those persons, long hair - short hair, old - young, rich - poor, seem to have no concern going 35 mph through a 20 mph school zone nor to do 70 mph when asked to do 55 mph to conserve energy. And as these people speed by me I often ask myself -- Can these people all be environmentalists?

When nature is out of balance Mother Nature steps in and corrects the matter. Too many of one kind of animal and she eliminates all but the strong and concerned. So maybe we have used all her patience in our quest for greed. Is it now our time for her wrath? The shortages we now know are only the beginning. The pain we know now is only minor. Power, fuel, air pollutants, water pollutants -- how will these affect the turfgrass industry?

So now we have reached the time to take our full gainer from the diving platform into Tomorrow. Mankind has often solved one horror only to create another. This was well reflected recently when Congress moved rapidly to pass legislation to construct the Alaskan Oil Pipeline. Prior to the energy crisis there had been little support for this project and its possible dangers to the vast wilderness through which it would pass.

The newly approved pipeline will provide 2,000,000 barrels of oil a day. However, the lines will be placed over and through areas where frequent earth shifts and quakes occur. If the line should be ruptured or cracked it is estimated that 64,000 barrels of oil would spill into our native wilderness per hour. How do we reclaim these areas? Solve a crisis to create a crisis!

We are an industry, you and I, and will be more so Tomorrow! I would prefer to think of us as an "industry together". The word "together" does not mean that the officers and directors of this Association want mere followers. It should be participators. For my own reasons I define a participator as "an individual or firm that will truly contribute to the industry as a whole, even though a particular action may not be to the personal pleasure or advancement of the individual or firm involved". We are indeed an industry together though we may be widely diversified. Our common bond is the turf plant!

So where to from here?

My loud and resounding response is research -- research -- research!! This is not just another cry of wolf! If we are to avoid the complex crisis of the turfgrass industry of tomorrow we must have research.

Where you say? I shall mention but a few and those that are the most obvious.

IRRIGATION

If our environmental crisis continues we may expect water to join the list of short supply items. I need not say how this will affect the turf industry. We must have research on new types of irrigation techniques and equipment. We who use the products cannot test our suppliers goods. We are not in that business. The research must be done by a public agency with published results. The new irrigation techniques and equipment must provide maximum efficiency with regard to job done and water used.

I challenge the irrigation and equipment dealers and manufacturers to provide funds to this Association to establish a research program of a comprehensive nature. This area must be researched! You who find livelihood in this field need to make the decision. Tomorrow! Dead or Alive! The decision is yours!

TURFGRASS SPECIES

The pollutants of air and water have already started their adverse effects on many living organisms. There are trees in Houston, Texas that have dead growth from about twenty feet above the ground up. This from the air pollutants. How long will it be

before this reaches the ground and our turf plant? It will not be folly to believe that changes in our turf will be attributed to these pollutants. We need research in new species of turf to meet these new challenges of the future. Grasses that can be tolerant to the pollutants. Grasses that can survive on less water and less fertilizer. These new grasses must be more resistant to insects and disease.

I challenge the turfgrass producers to provide funds to this Association to establish research funds for research of a comprehensive nature in this critical area. For this is your future livelihood and you must decide. Tomorrow! Dead or Alive! The decision is yours!

FERTILIZERS-HERBICIDES-INSECTICIDES-GROWTH RETARDANTS-AND SOIL ADDITIVES

The Texas Water Quality Board has issued strict guidelines on what can be used in the land in water shed areas. I am sure there are few of us who are not in one water shed area or another. They have advised the University of Texas System recently that only certain types of fertilizers and chemicals may be used on certain of our properties. To complicate this we now find the materials approved in short supply.

Soil additives will certainly play greater roles in turf culture in the future. Again we users cannot test or experiment with new techniques and products. We need some agent to do this for us with reported results.

I challenge the chemical and soil amendment manufacturers and dealers to provide funds to this Association to establish a comprehensive research program in this area. For if you are to have a product to sell you alone can decide. Tomorrow! Dead or Alive! The decision is yours!

Research and testing is no new game. We simply have dropped its priority down the list in our rush for profits and little concern for the future. We move now or our industry may well join the ranks of the unemployed from equipment operator to superintendent.

TURF ASSOCIATION

We have for too long functioned as a part-time organization. The times dictate we move ahead. To do this we must be a full-time Association. Our work is outlined for us. We have an Extension Specialist, new Constitution and By-Laws, Scholarship Program, Newsletter and a potential extensive research program. I am confident the commercial world will come forward on the research needs. These all take full-time management.

The Officers and Directors owe a great deal to the Association for the priviledge of representing you. If your Regional Directors served you this year and provided you a field day -- thank them. If they did nothing you have the total right and obligation to ask them why not. If an officer or board member gave less than three hours each week to the work of the Association he cheated himself, you, the profession, and Texas. If you assisted your Officers and Board this past year you are a true professional. If not, how sad for you! How sad for our profession! How sad for us all!

Recently I read an article authored by Vice Admiral Hyman G. Rickover. He is a caustic critic on subjects from bureaucracy to ethics. I have excerpted some of his comments below. "Mans work begins with his job, or profession. Having a vocation is always somewhat of a miracle, like falling in love ... But having a vocation means more than just punching a clock. One must guard against banality, ineptitude, incompetence, and mediocrity. The unwillingness to act and to accept responsibility is a symptom of America's growing self-satisfaction with the status quo ...

For the person who strives to excel, to shoulder responsibility and to speak out, there is an enemy wherever he turns. This enemy is a man who has a total willingness to delegate his worries about the world to officialdom. He assumes that only the people in authority are in a position to know and act. He believes that if vital information essential to the making of public decisions is withheld, it can only be for a good reason ... The enemy is any man whose only concern about the world is that it stay in one piece during his own lifetime ... Nothing to him is less important than the shape of things to come or the needs of the next generation."

I ask which shall we be -- the person trying to excel or the enemy. To this end I challenge the Officers and Board to establish a full-time Association, to pursue the Research Program and to represent you in the highest order. I challenge you to be a participator and not a follower. Tomorrow! Dead or Alive! The decision is yours!

Earlier this fall, I had the pleasure to sit upon the same platform with Dr. Jack Williams, President of Texas A&M University. He shared a small story with me I feel appropriate to this topic. I shall take this opportunity to share it with you.

"We have run across some absolutely irrefutable statistics that show exactly why you are tired. And brother, its no wonder you're tired either! There are not as many people actually working as you may have thought, at least not according to this survey recently completed.

The population of this country is 200 million, 84 million over 60 years of age, which leaves 116 million to do the work. People under 20 years of age total 75 million, which leaves 41 million to do the work.

Then there are 22 million who are employed by the government, and that leaves 19 million to do the work. Four million are in the armed forces, which leaves 15 million to do the work. Deduct 14,800,000, the number in state and city offices, and that leaves 200,000 to do the work. There are 188,000 in hospitals, institutions, etc., so that leaves 12,000 to do the work.

Now it may interest you to know that there are 11,998 people in jail, so that leaves just two people to carry the load. That's you and me!"

We have discussed Yesterday, taken an overview of Today, and challenged Tomorrow! The only people left to do the task ahead is you and I. So we ask ourselves -- Tomorrow! Dead or Alive! The decision is ours!

POND AND LAKE MANAGEMENT

by

Wallace G. Klussmann*

Many of you have the opportunity to manage a pond in the park, on the golf course or within the recreation area that you are operating or managing. Such bodies of water can be an asset or a liability--depending upon how it looks and what it produces. Everybody seems to like water and any amount of it in a pond, lake or stream tends to appreciate property values and to be aesthetically pleasing. However, pretty, well-landscaped ponds that produce good fishing don't just happen. They are the result of proper planning and continuous, and I must emphasize continuous, management.

In the time we have here today, we want to briefly discuss the steps that might contribute to a more aesthetically pleasing pond that produces a better fish crop. As we emphasized a minute ago, continuous management is going to be the key. Keeping the pond as you want it will involve handling problems such as undesirable aquatic weeds, undesirable fish and poor fishing success. As we begin, it is important to mention that the natural cycle for a pond is for it to fill with weeds and silt and to eventually evolve to dry land. Thus, to keep a clean, clear pond free of weeds and vegetation and free of siltation, we must stop or reduce the natural processes of nature to maintain the pond in a static condition. Pond management, then, is a continuous job. It is not something that you can do one day of the year and have a pretty,

*Project Leader, Extension Fisheries, Wildlife and Sea Grant Programs, The Texas Agricultural Extension Service, Texas A&M University.

productive pond the remainder of the year. When dealing with nature, there are very few things that are always true and I learned long ago when talking about the actions of fish or plants to use such terms as "usually", "most of the time", etc. But, there is at least one truism about ponds and if we say nothing else today that proves to be correct I think this one will. That is, when you manage a pond so as to solve one problem there will always be another problem to take its place.

Where does lake and pond management begin? Certainly, it begins with the design of the pond. With respect to fishing and general aesthetics of the pond, two items must be considered in design. First and foremost is the elimination of shallow water. By shallow water we mean water not less than 3 or 4 feet deep. Shallow water provides protection for small fish and encourages undesirable plant growth. Small fish should be exposed to predation. Sloping the shoreline around the entire body of water possibly on a 3:1 or 4:1 slope certainly costs more money in the construction stage but yields benefits for the life of the pond. The second important construction consideration relative to management is the incorporation of some kind of drainage apparatus. The kind of apparatus is not important. What is important is the ability to manipulate water levels within the pond or to drain the pond completely if necessary. Almost all of the management practices mentioned during the remainder of this discussion can be effectively carried out with a drain pipe--that is if you can spare the water or can refill the pond. For example, if algae and certain weeds are problems or if there are to many small sunfish in the pond, the pond can be partially drained in the fall of the year exposing the aquatic

weeds to sunlight and concentrating the fish in a small area to increase predation. In the spring, the pond can be filled, providing new space for fish growth and clean weedless water for fishing, boating or swimming.

Once we get the ideal pond built the next question is what kind of fish should be stocked. A simple, but often good suggestion, is to stock the kind of fish you like to catch. You may want a sunfish pond for fishing by youth, you may want a bass pond or you may want to try a combination of certain species. There are, of course, some limits to this suggestion. For example, we are not able to manage small ponds (one acre or less) to produce continuous good bass fishing. In other words, we are saying that if you want bass fishing you need a clear pond that is at least an acre. However, we can use ponds of any size with turbid or clear water for the production of catfish and sunfish. Larger ponds, of course, can also be advisably stocked with combinations of catfish, bass and sunfish. It is important to point out that the combination of bass and bluegills, long used in Texas as a general stocking recommendation, was researched and recommended to produce a bluegill fishery not a bass fishery. Often we have used it backwards in Texas with the end result being a frustrated pond owner or fisherman, with small, stunted bluegills dominating the fish catch. Catfish, both blue and channel catfish, are perhaps the easiest native species to manage in small ponds. The catfish is an omnivorous feeder. Thus, we can feed him out of the bag and do a good job producing both food and recreation in muddy or clear ponds of just about any size. We can do this to some extent with sunfish ("perch" such as bluegill) that will

accept prepared feeds. We cannot feed wild populations of bass successfully. Some of the best bass fishing I have experienced in small ponds has resulted from a stocking of bass with a combination of fathead minnows or red shiners ("red-horse"). In these situations, the minnows served as a forage fish and were stocked a year before the bass. These species of forage fish do not get too large to be taken by bass and normally do not over-populate a pond. Also, it might be worth mentioning that in some instances fishermen were extremely satisfied with a management plan that involved returning large bass to the pond. In other words, it was a reversal of the typical limit law. If someone wanted fish for food, he was encouraged to take the 1 or 1½ pound bass, but if he caught that trophy bass he could keep it long enough to take his picture to prove he had caught it but was then encouraged to return it to the pond so that he could catch it again on the next trip. We really have no research to document these statements. However, it is apparently working in a few ponds in the state at the present time.

Catfish are easy to manage because we can stock the number we want and generally control spawning. If we don't provide spawning containers and water is fairly clear, normally there will be little spawning activity. However, they may dig a hole under a log or in the bottom and spawn. If there are no other fish in the pond, the small catfish will probably survive. If there are bass or any kind of sunfish in the pond, the eggs or small catfish will be eaten. This is the reason that many people think that catfish won't spawn in ponds. But in reality, there are very few ponds in Texas that don't have species of

predator fish and, consequently, regardless of how many catfish actually spawn there is little reason to expect survival of the fry.

With respect to stocking combinations, it is important to mention that if bass and catfish are stocked in the same pond, it is important to stock the catfish first, usually in the fall of the year, then the bass the following spring. This allows the catfish time to grow before stocking a predator. If done the other way, most of the catfish will be eaten by bass.

Following the sequence of events in management, the next question after you have decided on the kinds of fish to be stocked is how many fish should be stocked and what can I do to have them grow fast. It is important to know what the level of intended management is in suggesting the number of fish to be stocked. A pond which is not fertilized where production is dependent upon natural fertility, an annual production of perhaps 50-150 pounds of fish per surface acre per year can be expected. This means that we would not want to stock more than 150-200 fish of catfish or bass or combinations thereof or more than 400-500 sunfish. In other words, keep the total production in mind. Divide the number of pounds of fish to be produced by the number of fish stocked and you will have some idea of how big they are going to be within one or two growing seasons without reproduction. Add in reproduction and you reduce the expected size even further. So, don't overstock. However, if you are going to fertilize the pond, we can expect a doubling of production to perhaps 150-300 pounds of fish per acre per year and we can then increase stocking rates accordingly. If catfish alone are used, we can continue to increase stocking rates

if we desire to feed them. Stocking rates up to perhaps 500 or 700 catfish per surface acre can be used when the fish are fed biweekly with prepared feeds.

We just mentioned that you could double fish production with fertilization. This leads to questions of how much, what kind and when. Of course, regular commercial inorganic fertilizer such as you use on the soil in your area is also used in ponds. We do know that a high nitrogen, high phosphorus fertilizer is preferable. Normally, we suggest something like 16-20-4 or 20-20-5. Fertilization does not feed the fish directly but increases the first link in the fish food chain (phytoplankton),which in turn provides increases throughout the entire food web. Unfortunately, we cannot test water and give you a specific suggestion on analysis and amount as can be done with soil, mainly because the nutrients are tied up quickly. A test of pond water today from a pond that was fertilized yesterday might show that most of the nutrients have, in a fact, disappeared from solution.

As to how much fertilizer to apply, normally we suggest an initial application of 100 pounds per surface acre in the spring of the year about April 1. Successive applications of 50 pounds per surface acre can be made at approximately 30 days until approximately 200 pounds of fertilizer has been used per surface acre. The fertilization program should cease in mid-summer since over-fertility and hot water can often cause a fish kill in ponds.

Application of the fertilizer is not difficult. In fact, it is one of the few jobs where a lazy method is a good method. The usual procedure is simply to load the fertilizer in the boat and row or motor

the boat around the lake in a water area that would be 3 to 5 feet deep while pouring a "row of fertilizer" into the water. It is not necessary to go to the effort of distributing the fertilizer evenly over the pond. Once you have made the initial application, it is important to watch the pond. If the water turns a green color where a shiny object would disappear at perhaps 18 to 20 inches, we assume that fertility in the pond is adequate. If the water begins to clear to allow a shiny object to be seen at greater depths, it is time to add more fertilizer. A little experience is going to be important here. It is also important to thoroughly carry out the planned fertilization program. Fertilization will normally help clear a pond of any turbidity that may exist. A weed problem can be encouraged by a "half-way" fertilization program. For example, the pond owner may follow fertilization recommendations about half-way, ending up with a clear pond that was fairly fertile. The next thing he observed was a very rapid growth of undesirable submersed aquatic weeds. This is one of the instances where you can solve one problem and provide the opportunity for another to develop. Therefore, it is important that we continue to fertilize to maintain the plankton bloom to inhibit sunlight from penetrating to great depths in the pond.

Weed control is perhaps our greatest problem in pond management, but we cannot adequately cover plant identification and control suggestions in the time we have this afternoon. We can make suggestions that might help you deal with the problem in years to come. Generally, we have chemicals that can control most kinds of aquatic weed problems if we know the identity of the weed involved and if we know something about

water quality. It is important to mention that the optimum time for chemical control of most weeds is during late spring or early summer--May is probably the best month for carrying out any chemical control of aquatic weeds. However, during May the problem won't be as evident as it will be later in the summer and you won't have as many complaints at that time of the year. But, if you wait till July or August or September when you get the complaints, it is too late to do anything unless you want to take a chance on a fish kill as a result of oxygen depletion. If you had the problem last year and you didn't do anything about it, you can be certain it will be as bad or worse this year during the summer or fall. May I suggest that you work through your local county agent who can often help you with identification and control suggestions. If they need further help, of course, hopefully we can provide the backstopping for them. Don't forget that we can use that drain pipe in the fall when fishing pressure is low to effectively control most of the plants growing around the margin or in the shallow water of a lake and actually improve fishing at the same time.

Undesirable fish and over-population of fish are other problems that we face. Solutions to these problems are not easy. Probably the best solution is to drain the pond and start over. However, chemicals are available that can selectively control certain species or eliminate the entire population. Production in a pond in which the fish have simply been eliminated from the water is not nearly as productive upon restocking as one that has been drained, allowing the bottom to dry and aerate for a period of time. In other words, we just can't duplicate the natural productivity of a "new" pond.

Muddy or turbid water is also a problem in many parts of Texas. We do not have a good recipe for solution of this problem. One approach is to increase organic matter. Some success has been achieved in the long term with using one or two tons of hay per surface acre. In your line of work, available grass clippings should certainly be effective in increasing organic matter and in turn decreasing turbidity. I would not put grass clippings in a pond that is already clear. Water quality problems would soon result. Gypsum and alum are chemicals that can be used alone or in combination with the increased organic matter to help clear ponds. The amount to use will vary from region to region and from pond to pond. Our general pond management bulletin is available at the county agents offices and gives guidelines as to beginning amounts.

Controlling pond seepage is a problem that is not easy to handle. Avoiding building the pond in areas with permeable soils is the best solution. But, once the pond is there, sometimes it is necessary to do something about seepage. Treatment to prevent seepage in sandy, permeable soils will cost as much as it does to build the pond. In other words, it is going to double the cost of the facility. I have personally not been successful with any method of introducing a chemical through the water once the pond is built and filled. In my experience, the best success has been with a treatment of a pound or two of bentonite per square foot of soil. The bentonite should be disked into the soil and rolled or packed if possible, giving an impervious layer approximately 6 inches thick when finished. New products for sealing ponds are on the market and in some cases other things might be cheaper and just as effective.

I want to re-emphasize the point mentioned briefly earlier that probably our best management technique is that of simply draining the pond, eliminating the population and restocking every four or five years. In other words, an ideal system where fish production was to be important and where you have clients who like to catch fish, a plan involving two or three ponds in which you could rotate fishing, draining and restocking over 3- to 5-year cycles can provide optimum fishing in one of the three ponds at any time. In such a plan, you have one pond that would be between year one and year three after stocking. It is during this time period that almost any pond with an expanding, growing fish population will provide good fishing success. Thus, if you have the opportunity you may want to consider this type of management program rather than trying to manage all ponds to produce fishing at all times. In other words, keep one lake at peak condition with the others in various stages of re-development.

The Texas Agricultural Extension Service of the Texas A&M University System has a competent staff who are willing and able to assist with pond problems and we would encourage you to contact your local county agent when problems arise.