
# Proceedings
## Of The
# 39th Northwest Turfgrass Conference

September 23-26, 1985
Rippling River Resort
Welches, Oregon


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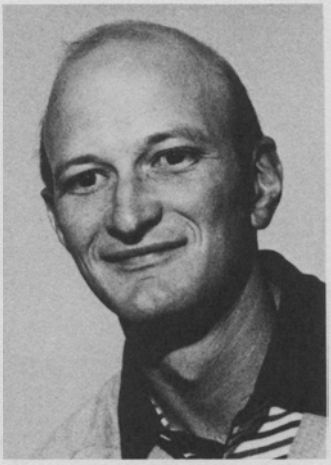
**Welches, Oregon**

# PRESIDENT'S MESSAGE



*Gary Sayre*

Our 1985 turfgrass conference at Rippling River had the highest pre-registration of any that we have had. The material that will be disseminated in this proceedings should be of great assistance to many of you who were in attendance as well as those of you who were not.

This year we have seen some good improvements in our Association and most of all an increase in membership from the areas associated with parks and school districts. We have one loss that I think many of us will feel, and that was Dr. Nus moving to Kansas State University. He accomplished a great deal as our research associate.

I have greatly enjoyed the past 3 years on the board of directors and I would like to thank those who have served with me for their contributions to the Association making it a better one to serve its membership. The supplier participation has helped out the Association financially as well as informatively and I think it has been an area that will continue to show added interest for the whole of the membership as well as helping to raise money for our research programs.

I hope that your new president, Mark Snyder, enjoys his year of leadership on the board of directors as much as I did this past year. Good luck, Mark. I look forward to seeing all of you against next year in Pasco, Washington.

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# MOTIVATION AND MANAGEMENT[1]

Roger J. Thomas[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Jacobsen Division of Textron Inc., Racine, WI.

In reviewing the agenda for this conference, it became apparent that management is an extremely important subject being covered, and in each case where a particular seminar or presentation is being given, people are involved. Some of you are managers now—many of you will be managers later. It will not be easy!

Life used to be simple. In earlier days, managers did not have to do much motivating to get us to work; we needed the job. There were none other available. We worked hard, but were not necessarily happy. People today have a tendency to leave jobs on the slightest provocation, and certainly switching jobs is much more commonplace than in the past.

Napoleon once said, "An army's effectiveness depends on its size, its training, its experiences, and its morale." He also said that morale is worth more than all the other factors combined. Every organization is the same. No matter how capable the people are that you have working for you, when morale sags, so does performance. When the zip seems to go out of a person's work, he or she puts less effort into it and, as a result, we are not getting the top performance needed.

The presentation today is not a psychology lesson, but the placing of some emphasis on the practical things that affect people and their jobs. While good pay is a very important motivating incentive, attitudes of employers also plays an important part. Supervisors must care about the person who is working for them, and not just in terms of how much work they can turn out.

People want to be appreciated. If there is discontent in your organization, then analyze the whole area of attitudes. You can't give employees everything, even though they feel some of their requests are necessities. On the other hand, don't lean on the statement that you can't please everybody all the time, so what's the use! As managers, we must know how the workers feel and we must display a sincere attitude in attempting to supply their wants and needs. Mind you, this is a daily action, however, not portrayed at a "once a month" meeting. It does not mean that we walk around patting everybody on the back and telling them what a great job they are doing. That, too, could be insincere.

Some companies have Monday morning meetings, reviewing the good things that happened the week before. Well, at least they start out the week on a positive note rather than feeling Monday is an awful way to spend 1/7 of their life! We

must rid outselves of workers attitudes that say "T.G.I.F." ("Thank God It's Friday!")

People are motivated in different ways. Many of us recall the story of a certain baseball player who showed up at Yankee Stadium in 1947. He was squat, clumsy, and people around him joked about his gait and just about everything about him. He couldn't throw; he couldn't hit; and he couldn't field, yet there he was, presenting himself to the Yankee management for a position on the Great Yankee Team.

There was a shortage of catchers so this squat, no talent person was placed in that area as a potential catcher. He soon proved that his throwing was wild. He had a strong arm, and that was all. Once, on a throw made to second, he hit the pitcher right in the chest. In his second game, he beaned the second base umpire who was standing ten feet away from the bag! Nothing that he did depicted him as an athlete who could join the pennant winning Yankees. What he did have was the desire and drive to be a major league star, and he worked endlessly to overcome his shortcomings as a catcher. Someone along the line kept encouraging the man and motivated him beyond belief!

He spent hours in the batting cage until he had blisters on his hands. He sat in the dugouts and watched every rival hitter until he knew every weakness they had. He watched every pitcher's throw to determine what ball he was going to pitch. He played on 14 pennant winning teams, and during his career, he had 358 homers, was voted the league's most valuable player three times, and set 18 World Series records. By now you must know the man's name is Yogi Berra. He proved you cannot push a man up the ladder of success; he has to do some of the climbing himself. But, he never gave up.

There are thousands of circumstances where people have overcome tremendous handicaps and have become super stars in athletics, in research, and in business. The will to win isn't really enough unless you have the willingness to prepare and work at it.

Many of us take for granted that a job is *supposed* to be well done. Too often we miss praising the person who consistently does his job well. The system is partially at fault for this because managers are trained to look for errors and correct them. So, we all have a tendency to be more critical than complimentary. Simply stated, criticism doesn't motivate people as much as praise.

People may try hard with criticism because they *have* to; but with praise, they try harder because they *want* to. As a side point, one habit of praise that is most disturbing is the comment that, "You did a good job, but —." Break that habit because you take away the effect of the praise when you take exception to everything that is done. Praise fills the need of being wanted and appreciated. That is why it is an effective tool to get good results.

In many cases the particular task requires a team effort. Why not face the entire team? Set the goals and possibly the members will motivate each other to see that the job is done right. The team may even come up with some great ideas in solving problems. There are few people that cannot be motivated unless, of course, their skills are so limited that they just can't perform the job. Remember, however, that if the employee has the capability and does not fulfill the requirements of the job, then it may be our own failure to motivate that person.

In management, there must be a mutual trust created between people. Sincerity cannot be turned on and off like an irrigation system. Employees become suspicious when the supervisor gets the tag of "Mr. Nice Guy". Insincerity can be spotted easily unless we are great actors. Don't act, but be sincere.

Consider a few examples to spot problems in our organizations.

1. Are we giving proper instructions to the people when we send them out on a job?

2. Are we having them do things to or with equipment without adequate information and training?

3. Have we told them why we are doing the job?

4. Are we telling them how to do the job?

5. Have we, in a simple phrase, told them what will be accomplished by the particular task?

How do we treat salesmen who come into our place of business? Are they treated as peddlers or hucksters? Could we get information that could be used in solving some of our problems? Most sales people collect many ideas from others, some of which could be useful to us. Have we ever given a thought to asking an outsider how he would solve a problem?

With proper motivation, the sales person could bring us all kinds of ideas. Remember not to accept his ideas with a negative attitude, or that "We have tried that". Pick out the good ones and use them. If you thank him for a good idea, you can be certain that he will come back with many more.

In the past busy work was one way to fill the day, but today busy work is an insult to a worker's intelligence. He knows very well we are merely keeping him active on a job that gives no satisfaction. It would be better on a rainy day to have a pre-planned training program on equipment service and handling, but do something constructive. You may be able to vary job assignments and have back-ups for certain tasks.

One simple statement should be sufficient. Hindsight does not solve any problems except to satisfy our own ego or cover up poor instructions. Perfect the instructions and the task will be easier to do.

Sometimes disciplinary action is necessary. Is it given on a one to one basis? Does the action fit the deed? Are we passing along the wrath we have received from our supervisor? Are we placing the blame on others? If *your* supervisor hears you constantly placing the blame on others, he will come up with the conclusion that it is *not always* the workers causing the problems.

As managers, while we have the privilege of hiring, we also have the unpleasant task of letting people go from our payrolls. If an employee receives insincere reasons for his discharge, he can become bitter. He could spread it around that ours is not a good place to work, or may even sabotage some of the equipment. Improper handling in the discharging of people can be very costly to organizations.

We are now in a period of time when maximum performance from each worker will be needed. Budgets may be reduced, new hiring may be limited, and yet, we'll all be expected to accomplish as much or more than we had in the past. We ask that you keep an open mind to the subject of motivation. Use *common sense* in the application of some of the principles discussed today and realize that motivation of employees presents limitless opportunities for improved performance.

In a practical sense, you will receive rewards beyond your imagination and, most of all, you will live the *happy life* among those *with whom* you work. Thank you and good luck.

# TURF WATER USE AND IRRIGATION PRACTICES RESEARCH[1]

Jack D. Butler and David D. Minner[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Professor and Assistant Professor, Colorado State University and Univer sity of Missouri, Fort Collins, CO and Columbia, MO.

An intense turfgrass water research program has been underway at Colorado State University for ten years, and several people have made significant contributions. Investigations have dealt with water requirements, both from quantity and quality standpoints. A significant part of the research has dealt with the influence of various maintenance practices and environmental conditions on turfgrass water use. Other projects have been conducted to determine the water requirements and optimum watering frequency of various grasses and their ability to tolerate drought stress.

Meaningful water research with turf, or any other crop for that matter, is quite difficult to do, even in arid and semi-arid regions. Transferring information gained from water research in such regions to a humid area may be questioned. However, much of the information presented here would seem to have some application west of the Cascades.

When discussing irrigation practices for humid areas in the Northwest it is important to realize that those managing turf have little control over water through much of the year. In most situations, it is not proper to discuss irrigation without a discourse on drainage and other soil conditions that dramatically influence irrigation practices.

## SOIL CONDITIONS AND IRRIGATION

It is quite difficult and expensive to make significant physical improvements on existing soils; golf greens and a few athletic fields are exceptions. Since soil conditions such as infiltration/percolation rates and water-holding capacities play such an important role in irrigation management, it is important that they be considered in research as well as in irrigation systems design and management. More attention has been given to soil conditions when dealing with flood irrigation of deep-rooted field crops grown on uniform soils than to the use of sprinkler irrigation on shallow-rooted turfgrass usually grown on heterogeneous, disturbed soils. However, some positive changes have occurred recently. For instance, many large-acreage turf facilities have had topsoils saved and returned; and the availability of large equipment has made it possible to construct sites with good surface drainage and minimum ponding.

As might be anticipated, the difficulty of working with soil, water, and roots has resulted in little research being done below the soil surface. Now that several universities have or are building facilities for root studies, some much-needed information on roots and water relations may soon become available.

Knowledge of infiltration rates, which may vary from less than 0.1 inch to more than 20.0 inches per hour on the same golf course, can be adequately determined by using a double-ring infiltrometer. This information can then be used to determine irrigation practices such as how much water can be applied in a given amount of time before runoff. Most of our work with infiltration/percolation has been directed toward developing artificial media for golf greens and football fields. A mixture of 80% sand and 20% peat is common. However, our research indicates that this ratio of sand and peat, depending on their quality, can result in infiltration rates ranging from 0.3 inch per hour to more than 15.0 inches per hour.

Water for plant use from different soils can vary greatly. A generalization on soil water availability (Table 1) gives an idea of the amount of water than can be held for future plant use.

There are various ways to determine soil moisture content. Of course, they vary in precision and actual usefulness as a tool for irrigating properly. Among the methods used are those as simple as probing with a screwdriver or using gypsum or nylon moisture blocks to measure electrical flow. Tensiometers may be used to measure soil suction. Also, soil samples can be taken from the field and weighed, then dried and reweighed to determine water content. Although several different ways of measuring soil moisture have been used in turf research, we have found that under our conditions, moisture blocks have generally worked better for turfgrass than tensiometers. Blocks measure soil moisture at much lower levels than tensiometers, and grass in the Rocky Mountain Region can often perform quite well below levels measured by the tensiometers.

The key to using information on water availability, however determined, is dependent upon knowledge of the functional root depth of the turf. Functional depth with the same root system would be greater when plant water demands are low (spring and fall) than when they are high (summer). Figure 1 represents functional root depth during the summer for turfgrasses grown on different soils and under good growing conditions.

Compared to Kentucky bluegrass, the rooting depth of creeping bentgrass and *Poa annua* would be more shallow, and that of tall fescue would be deeper. From Table 1 and Figure 1 it is evident that a sand (average available water of 0.7 inch per foot) able to support a turf with a functional root depth of 2 feet (for 1.4 inches available water) would need frequent watering but more water at one time to replenish water in the root zone than a clay (average available water of 1.9 inches per

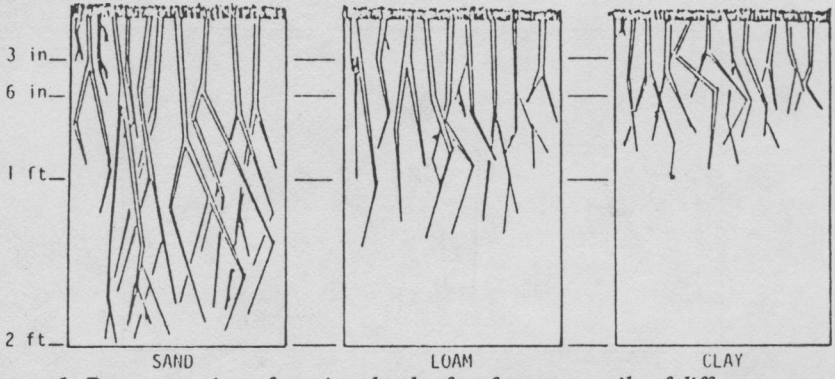


*Figure 1. Representation of rooting depth of turfgrass on soils of different texture.*

foot) supporting turf with a functional root depth of about 6 inches (1.0 inch available water).

Some of the field research findings and observations that a turfgrass professional might find interesting are:

—Functional rooting of Kentucky bluegrass sod placed on a sandy soil reached a depth of 6 inches in about 6 weeks, whereas sod placed on a clay soil did not have significant functional rooting below the harvested sod layer.

—Rooting depth was influenced by water saturation of the soil during the winter months.

—Water use by turfgrass was essentially the same from a sand and a heavy soil.

—Under severe water stress, grass grown on sand did not recover as well as that grown on good topsoil.

## ENVIRONMENTAL CONDITIONS AND MEASURING WATER USE

Throughout the rest of this discussion, the term "evapotranspiration" (ET) will be used. ET is used to describe water loss from a plant and soil surface. "E" relates to water loss from non-plant evaporation, while "T" stands for water loss from plant transpiration. In a dense stand of turf, essentially all water loss is from transpiration. Several factors, such as relative humidity, solar radiation, day length, air temperature, and wind velocity influenced ET. Figure 2 shows the amounts of ET for Kentucky bluegrass for July and August of 1982. This grass was supplied with water to support maximum transpiration. There were several late July days of mostly cloudy weather where the total amount of ET was between 0.05 and 0.10 inch per day; whereas, only a few days earlier, ET was 0.30 to 0.35 inch per day. There are times with high solar radiation and strong winds when

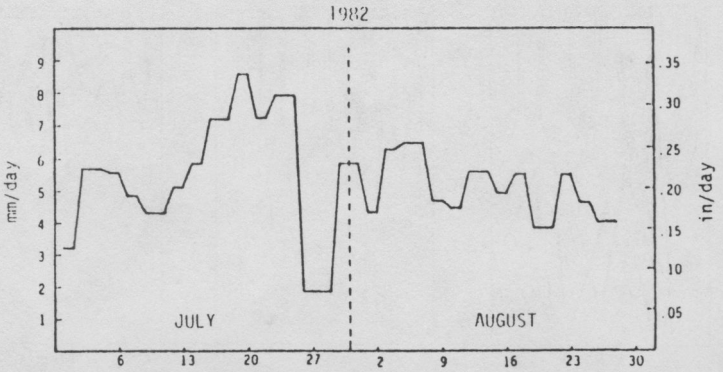


*Figure 2. Maximum measured ET of Kentucky bluegrass at Fort Collins, Colorado.*

Kentucky bluegrass may show drought injury even when soils are moist. Various factors have been used to develop equations to calculate ET. One equation, the Jensen-Haise, uses air temperature and solar radiation to prevent ET. It has been compared to actual lysimeter measurements of ET at Colorado State University. Although the calculated and actual ET varied slightly, they were in the same range. Calculated ET allows for a practical means of keeping track of soil moisture depletion. Through an educational ET program, the Denver Water Department has been able to realize significant water savings; thus, in times of critical water shortages, turf can be maintained with a minimum of water waste. Table 2 shows calculated weather and ET data for Spokane and Portland. Information in this table gives an idea of supplemental water requirements for an average year.

A brief discussion about the use of weighing (bucket) lysimeters is in order (Figure 3). After working with deep, heavy, and difficult-to-weigh bucket lysimeters, a shift was made to those that were shallower and could be handled by one person. With weighing lysimeters, water is added for grass use periodically from 1 to 14 days. In the research at Colorado State University, additions of water have ranged from maximum (100%) to 10% ET. Weighing lysimeters permit a uniform and accurate study of environmental, cultural, and species influence on water use. Weighing lysimeters work quite well where rain is a rarity; however, for the occasional rain or irrigation of surrounding turf, the lysimeters can be covered with metal lids to protect against unwanted water.

The weighing lysimeter method is so simple that it could be set up at one site to serve a rather large area, and this method could be rather easily employed by grounds managers.

In one study, measurement of water used near a driveway in an expanse of lawn and on the south side of a house, indicated that maximum ET was near the driveway. More air movement leads to greater water loss, accounting for the frequent drought stress situations observed along walks and driveways in semi-arid climates.

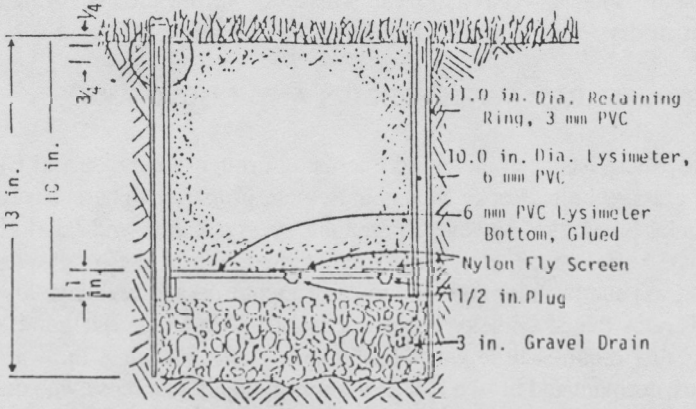


*Figure 3. Schematic diagram of installed lysimeter.*

In more humid regions, runoff onto the turf from impervious surfaces may prevent stresses from developing.

Shade is a very common turf problem in the United States. The problem may be associated with light quantity and quality; also, it may be associated with too much or too little water. Research in Colorado indicated that there is a positive linear relationship of ET to the amount of light received. This then points to the reason why many shady sites, where *Poa annua*, powdery mildew, etc., are problems, must be irrigated differently than those in full sun.

## CULTURAL PRACTICES AND ET RATES

This is an area that deserves much more research. It is now likely that cultural techniques will play a key role in achieving important turf water savings.

In addition to amounts of water required to meet turf needs, frequency of application is an important consideration. Research done in Colorado in 1982 and 1983 revealed generally that more frequent watering using the same amounts of water produced a better quality turf than when water was applied infrequently. With watering done at 2, 4,7, and 14-day intervals, quality declined from the 2- to the 14-day irrigation interval.

Mowing height can materially affect water use and resultant turf quality. Research has shown that although tall-cut grass may use more water than low-cut turf, it is more efficient, probably because of a better root system. Turf mown higher also performs better under stress conditions than low-cut turf.

Fertilization of turf is sometimes avoided since it is felt that it will significantly reduce drought tolerance. Fertilization with nitrogen can increase the amount of water needed to keep a turf. However, nitrogen use up to a point can offset other

turf problems, such as weeds and wear. Therefore, fertilization is normally desirable, even in dry areas of the United States.

## WATER RESEARCH WITH SPECIES AND CULTIVARS

Recently there has been increased interest in drought tolerance and ET rates of different grasses. In the Rocky Mountain Region, primary emphasis has been given to Kentucky bluegrass; however, perennial ryegrass, fine and tall fescue, bermudagrass, buffalograss, etc., have been studied. Warm-season grasses such as bermudagrass and buffalograss tend to be drought tolerant, and have lower maximum ET rates than Kentucky bluegrass (about 20% less). But good Kentucky bluegrass turf requires little water in the spring and fall when the warm-season grasses are dormant and brown. Thus, it seems unlikely that those who desire good year-round quality would replace cool-season grasses with warm-season grasses for a 20% water savings.

Table 3 gives the actual water use of four commonly grown cool-season turfgrasses during three summer months, based upon lysimeter measurements. These ET measurements, although important from an irrigation standpoint, are only part of the picture. Although tall fescue has an ET rate higher than Kentucky bluegrass, it is considered more drought-tolerant in the eastern United States. The deep functional root system of tall fescue is capable of extracting moisture at greater depths: For example, tall fescue may extract two inches of available soil water with a one-foot root system; whereas, Kentucky bluegrass grown under similar conditions would extract a smaller amount of water (perhaps one inch of available water with a 6-inch root system) because of its rather shallow root system. Also, the fact that tall fescue can recover rather quickly from moderate drought stress makes it acceptable for certain turf situations. In cool, semiarid regions where there is little if any water available below the top few irrigated inches, a deep root system would be of little benefit. In fact, in dry areas, tall fescue does not seem to tolerate extended drought nearly as well as Kentucky bluegrass.

Research in 1982 and 1983 at Colorado State University with many cultivars of Kentucky bluegrasses, perennial ryegrasses, and fine fescues has pointed out that drought-tolerance rankings of grasses do not necessarily match research findings. Most drought-tolerance rankings have been derived from field observations under "moderate" water stress in humid climates. It seems that for arid and semiarid locations, a different listing would be appropriate.

In work in Colorado, 55 Kentucky bluegrasses, 34 perennial ryegrasses, and 42 fine fescues were subjected to moderate and severe water stresses during the summer of 1982 and 1983. In an area with 14 inches average precipitation, stress is easily achieved by simply shutting off the water. We did not expect to find that the ryegrasses, which were followed closely in drought tolerance by Kentucky bluegrasses, would remain green well into dry conditions. Most perennial ryegrass

cultivars recovered rapidly once watering was started in September. The fine fescues, which did not do as well as either perennial ryegrass or Kentucky bluegrass, appeared to be heavily thatched; consequently, the thatch may have prevented precipitation from penetrating into and being stored in the soil.

The Kentucky bluegrass cultivars that are shown in the list below recovered well after irrigation was started in September, 1982, following water stress in the summer. None of the fine fescues produced a comparable turf, although they were in good shape before the study began when quality determinations were made.

| | |
|---|---|
| H-7 | America |
| Majestic | Merion |
| Bonnieblue | Vanessa |
| Entensa | ISI-128 |
| Pion | Enoble |
| A-20-6 | |

This synopsis represents only part of the turf water research that has been conducted at Colorado State University. The work presented here was chosen because it would likely be of more interest to turfgrass growers in northwestern U.S. than research on buffalograss, blue grama, fairway wheatgrass or morphological and other laboratory examinations of drought tolerance would be. Extensive work done on poor water quality has not been discussed. Work under way on water requirements to establish turf, water use by various weeds, groundcovers, bentgrass, and *Poa annua* grown under different conditions, has been omitted. In another year or so this information will be made available.

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**Table 1.** Influence of soil texture on water availability.

| Soil texture | Inches of water per foot | | | |
|---|---|---|---|---|
| | Available | Average | Unavailable | Average |
| Sand | 0.4 to 1.0 | (0.7) | 0.2 to 0.8 | (0.5) |
| Sandy loam | 0.9 to 1.3 | (1.1) | 0.9 to 1.4 | (1.2) |
| Loam | 1.3 to 2.0 | (1.7) | 1.4 to 2.0 | (1.7) |
| Silt loam | 2.0 to 2.1 | (2.1) | 2.0 to 2.4 | (2.2) |
| Clay loam | 1.8 to 2.1 | (2.0) | 2.4 to 2.7 | (2.6) |
| Clay | 1.8 to 1.9 | (1.9) | 2.7 to 2.9 | (2.8) |

**Table 2.** Weather and turf water use approximations.

| Month | Average temperature °F | Average precipitation* inch/day | Potential ET inch/day | 100% irrigation inch/day |
|---|---|---|---|---|
| PORTLAND | | | | |
| May | 60 | .06 | .11 | .05 |
| June | 64 | .06 | .14 | .08 |
| July | 69 | .00 | .17 | .17 |
| August | 69 | .03 | .15 | .12 |
| September | 64 | .07 | .11 | .04 |
| October | 57 | .13 | .06 | — |
| SPOKANE | | | | |
| May | 55 | .03 | .11 | .08 |
| June | 62 | .03 | .14 | .11 |
| July | 70 | .00 | .18 | .18 |
| August | 68 | .00 | .15 | .15 |
| September | 60 | .03 | .09 | .06 |
| October | 49 | .03 | .04 | .01 |

* Highly variable.

**Table 3.** Water use at Colorado State University by various grasses during June, July and August, 1983.

| Grass | ET, inches |
|---|---|
| Tall fescue | 23.0 |
| Kentucky bluegrass | 21.3 |
| Perennial ryegrass | 21.2 |
| Fine fescue | 19.7 |

# MEASURING SOIL MOISTURE THE STATE OF THE ART IN TENSIOMETRY[1]

Christopher L. Browne[2]

[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] President, Irrostat, Inc., Corvallis, OR.

Soil moisture measurement in today's world of turfgrass irrigation...Is it relevant?...Is it practical?

Relevant! Yes by all means, because all who control the operation of irrigation systems are involved in the measurement of soil moisture. This is true whether they physically turn valves on and off, or whether they sit at a console and program a system to operate for months at a time. That they are involved in the measurement of soil moisture may not be immediately obvious, so consider the object of irrigation. Apart from syringing for temperature control, irrigation generally represents an attempt to replenish moisture reserves that have been removed from the soil since the previous irrigation. In other words, it continuously requires some estimate of the status of soil moisture at various points in time. It also requires some knowledge or assumption of the relationship between that status and plant performance. Estimates of the prevailing soil moisture conditions can be achieved by intuition, by conscious calculation, or by measurement with instruments.

To my next question... "Is soil moisture measurement practical?" The answer is "not always", but in many situations "yes", and it is becoming more practical with advances in instrumentation and control technology. It is also going to become more economical with the ever-increasing costs associated with inefficient irrigation management. The object of this paper is to review the state of the art in soil moisture measurement instrumentation and, in particular, instruments known as tensiometers. Although my company is developing new forms of tensiometers, for proprietary reasons I shall not be reviewing our own technology at this point. I will, however, provide a few clues to our activities.

## TENSIOMETRY

There are two basic approaches to measuring soil moisture status. One is on an energy basis, the other on a content basis. Tensiometers measure the energy or "tension" with which moisture is retained by soil particles. In other words, they measure the availability of soil moisture, or the work that plants must perform to extract moisture from a given soil. This energy increases as a soil dries, and the availability correspondingly decreases.

Measurements obtained with tensiometers are independent of soil type; thus, the

availability of water from sands or clays registering the same readings would be similar. Clays are generally irrigated at drier readings, however, to insure adequate aeration and because of their greater moisture holding capacity.

Tensiometers are only effective for measuring soil moisture over a limited range. This range, however, is the most critical with respect to plant growth and this is particularly so for turfgrass species. Relationships between turf growth and soil moisture tension levels have received considerable study.

A second approach to determining soil moisture entails the use of probes or porous blocks which measure electrical resistance. Such measurements are related to soil moisture content rather than tension, and moisture content is not necessarily a good indication of moisture availability. For example, a sand at 10% moisture content can be saturated while a clay at the same content would support no growth at all. As such, electrical resistance-type sensors require calibration for the particular soil in which they are used. In contrast to tensiometers, their range of least sensitivity is that which is most critical to plant growth. The remainder of this paper shall be devoted to a discussion of the various types of tensiometers that are currently available.

## TENSIOMETER TYPES

Tensiometers can be categorized into three types as follows:

1. *Hydraulic and Manual.* These are the most common and simple form of tensiometers available. They come in various lengths depending on the intended use and are designed for either permanent or portable use. Both permanently installed and portable instruments are used to indicate to the operator when irrigation is required and, following irrigation, to what depth it was applied.

   Most commercially available hydraulic tensiometers consist basically of a water-filled tube possessing a porous ceramic tip at one end and a sensitive vacuum gauge at the other. When installed or inserted in a soil, the water content of the instrument establishes dynamic equilibrium with soil moisture by the movement of minute amounts of water out of or into the instrument. This occurs through the porous ceramic tip which interfaces with the soil and permits passage of water, but excludes the entry of air under designed limits. The prevailing soil moisture tension is registered on the vacuum gauge.

   Portable instruments with a relatively rapid response time of one minute or less are now available. Rapid response is achieved by the use of modern high-flow ceramics, restriction of the instrument water volume, rapid-adjustment knobs and sensitive but rugged gauges. Such instruments retail for around $175 and come equipped with a coring tool. Although this price may seem high, these instruments can be particularly useful in scheduling

and monitoring the performance of automatic time-based systems.

Permanently installed instruments are used mostly for agricultural irrigation purposes. These retail for around $30-$35 and are generally used in pairs. A primary unit placed in the top third of the root zone is used to indicate the need for irrigation and a secondary unit in the lower third is used to monitor the depth of irrigation.

2. *Hydraulic and Automatic*. Hydraulic tensiometers with automatic electrical switching capabilities are and have been available for many years. These consist of a basic hydraulic tensiometer equipped with a 24-volt electrical switch which, in most cases, attaches directly to a Bourdon-type vacuum gauge with pointer and dial readout. The switching circuit remains open until the gauge reading exceeds a selected moisture level. In this manner tensiometers are used to override pre-programmed time-based automatic irrigation controllers. Dramatic decreases in water use by time-based systems have been consistently recorded following the introduction of this form of soil moisture constraint into the system. Such savings can, in many cases, approach 50%. The average price for an instrument with electrical switching capabilities is around $50. For turf applications, the automatic instruments are installed completely below ground level in gauge boxes similar to valve boxes. The instruments project laterally into the soil for a considerable distance away from the box and are usually installed in pairs.

   Automatic hydraulic tensiometers have suffered drawbacks in the past which have limited their practicality in many situations. Such drawbacks include the use of water-filled gauges which are subject to freezing damage and which also require the initial purchase of a hand vacuum pump for priming. Models with silicon-filled freeze-proof gauges are now available and this can eliminate the need and inconvenience of removing the instruments from their installed positions at the onset of winter.

   Hydraulic tensiometers tend to accumulate air over a period of time as a result of accumulation of dissolved gases. This applies to automatic models also, and a regular maintenance schedule is required to remove gas accumulation so as to maintain instrument sensitivity. The frequency of servicing can be greatly reduced by the manufacturer's choice of ceramic material and the method of ceramic manufacture. The ease and efficiency of gas removal varies significantly between available products. Porous ceramic tips have a potential life of many years. Some manufacturers, however, use materials which quite rapidly lose their hydraulic conductivity. This can only lead to a reduced product life and has been a source of user dissatisfaction in the past.

3. *Solid-State Tensiometers*. The most recent entry to the marketplace are solid-state tensiometers. These are probes or blocks which are constructed of

ceramic or glass-filled material. The pore size of these sensors is tightly controlled during manufacture so that the sensors rapidly drain at a specific moisture tension. This event creates a large change in both electrical and thermal conductivity. Depending on the product, either event is used to activate a built-in electrical switch which permits or overrides the operation of a preprogrammed time-based irrigation controller. These sensors can be used to operate single valves; however, the prices range from $85 to $135 which generally limits their use to an override function for larger time-based systems.

An advantage of solid-state sensors is their negligible servicing requirement. Response time can be slow on the drying phase, but this generally presents no problem. They come factory-calibrated to activate at a predetermined moisture tension.

## INSTALLATION CONSIDERATION

Site selection and the method of installation are probably the most important considerations in the effective use of moisture sensitive devices. The responsibility for providing this information, therefore, lies with the manufacturer. Installation recommendations will vary with plant type, soil type and the method of irrigation application. An advantage with turfgrass is that it is a uniform species with uniform ground cover. It is a fact of life, however, that water application by most irrigation application systems is somewhat less than uniform. To achieve uniformity in turf appearance, therefore, the recommendation should be sensors be located at sites that receive less than the average precipitation. This may introduce a degree of inefficiency, but it recognizes the limitations of system designs. Such installation can still introduce major increases in the operating efficiency of systems and significant reductions in irrigation decision making.

## AND IRROSTAT INC.

Our company is currently developing new forms of automatic hydraulic tensiometers. Contrary to general trends, however, their operation will not rely on electrical power, gauges, or manual servicing. This is achieved through some rather radical changes in concept and instrument design. As such, we expect our products to have competitive advantages in many segments of the irrigation market in which current instrumentation is either inappropriate or relatively expensive. See you in the marketplace soon.

# WHAT WETTING AGENTS CAN AND CANNOT DO FOR YOUR TURF[1]

William J. Johnston[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Assistant Professor, Department of Agronomy and Soils, Washington State University, Pullman, WA.

The field of turfgrass management has seen many products come and go, they were a "flash in the pan" so to speak. Wetting agents may or may not fit into this category of products. However, they have received a considerable amount of attention from the turfgrass community and have caused some controversy. This paper is being presented to update you on the current status of wetting agent and is also an attempt to separate fact from myth regarding wetting agents.

First of all, there are lots of wetting agents. Table 2 lists some of the more commonly used wetting agents in turf.

What are wetting agents? Wetting agents are chemicals that change the physical properties of water. They reduce the surface tension of water. Basically they can be thought of as making water wetter. To illustrate this, if you placed a drop of water on a waxy leaf surface the water droplet would sit on the surface as a somewhat spherical drop. If on the other hand, you added a wetting agent to the water prior to placing a droplet on the leaf, the droplet would spread out on the leaf surface. The drop with the wetting agent added would have a lower contact angle between the leaf surface and the water droplet.

Wetting agents are classified according to their chemistry as anionic, cationic, and nonionic. Anionic wetting agents are negatively charged, general phytotoxic to turf, and highly leached in soil. For these reasons the anionic wetting agents are not generally used in turf. Cationic wetting agents are positively charged and are, therefore, tightly held to the predominantly negatively charged soil particles. This makes these compounds somewhat less effective. The nonionic wetting agents have no charge, are less bound to soil, and are less phytotoxic to turf. The nonionic agents are the most common wetting agents used in turfgrass management.

What can wetting agents do? Table 2 gives a list on some of the claims that have been made regarding wetting agents. Let's look at these claims to see just what role wetting agents might play in your turfgrass program.

*Localized Dry Spots*. The cause of localized dry spots, also termed LDS, has been most frequently attributed to a fungal growth that produces a waxy material that coats soil particles. These coated particles then become very hydrophobic (water

hating). These problems most often are associated with sandy soils or sands in golf course greens. Although LDS is most common on golf courses, it is becoming more apparent that LDS is also associated with other turfgrass areas. Table 3 gives the results of some research conducted at Michigan State University which indicates that wetting agents are quite effective as a treatment for LDS.

*Plant Growth*. Most of the research with wetting agents would indicate that they have little effect on plant growth or are somewhat detrimental. On a positive note, Schmidt indicated from his research at Virginia Polytechnic Institute that sod rooted faster under dry conditions when wetting agents were used. Also, Petrovic's work at Cornell showed that Aqua Gro substantially reduced annual bluegrass *Poa annua* seedhead production without reducing clipping yields on a golf course fairway.

*Infiltration and Percolation*. As has been previously stated, wetting agents can substantially improve drainage in areas with LDS. Drainage is also better on layered soils when wetting agents are used. However, on easily wet soils there is little, if any, effect of wetting agents on drainage. Beard, when discussing wetting agents in his text book "Turfgrass: Science and Culture", cites several references which indicate that wetting agents do not increase infiltration.

*Compaction*. There is no direct evidence in most cases that wetting agents affect compaction. In a University of Maine study (cited by Moore, 1981), it was found that wetting agents reduced soil bulk density and also reduced compaction. Morgan et al., at the University of California at Davis, reported a decrease in compaction in peat-amended soil but they reported no effect of wetting agents on other soil materials. It should be noted that if a site or soil is now compacted, the addition of wetting agents will not cure the problem.

*Thatch*. Wetting agents have been claimed to reduce thatch buildup. There is little, if any, experimental evidence to support this claim. Most studies show that wetting agents, especially prolonged use of wetting agents, generally have no effect on thatch. Some work has shown a thatch buildup. Murry and Juska, in an 8 year study, showed no effect of wetting agents on thatch. Engle and Alderfer's 10 year study showed a slight increase in thatch.

*Dew Removal*. Wetting agents are fairly effective in mitigating the formation of dew. Wetting agents have been reported to reduce dew formation for 3 to 10 days on a bentgrass putting green. The length of effectiveness is probably related to irrigation and rainfall, both of which would tend to remove the wetting agent from the soil profile and thus decrease the period of effectiveness.

*Fertilizer and Pesticide Effectiveness*. Since water is the carrier for most chemicals applied to turfgrass, improved water movement and distribution within the soil profile could improve chemical efficacy. It has been proposed that wetting

agents might improve the uniformity of movement of systemic pesticides into the root zone. More research is needed in this area to verify these claims.

*Water Use Efficiency*. Work at the University Nebraska by Shearman has indicated that in turf where water was not a limiting growth factor, evapotranspiration was reduced as much as 25%. However, this does not necessarily translate over into a 25% reduction in water used by the turfgrass manager. Additional studies by Carroll and Petrovic at Cornell University indicate that a reduction in evapotranspiration due to the application of wetting agents is a result of there being less water available for evapotranspiration due to increased loss of water through drainage. So, it appears that wetting agents will not improve water use efficiency, since water use efficiency is a measure of the amount of water needed to produce a given amount of dry clippings.

## CONCLUSIONS

There are many wetting agents available in the market place and selection of the best one is not always an easy task; therefore, you should gather as much information as possible, especially hard facts, prior to embarking on a program utilizing wetting agents. Remember, wetting agents can be phytotoxic if not properly applied. Also, there is some evidence to indicate that prolonged use may increase thatch. However, wetting agents are one of the cultural practices available to turfgrass managers to improve water movement into and through localized dry spots (LDS) and hydrophobic soils. Wetting agents should be regarded as jut another tool available to the turf manager and not the cureall they are often touted to be. Additional research is needed to fully define the role of wetting agents in turfgrass management.

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**Table 1.** Common wetting agents used in turfgrass management.

| Trade name | Manufacturer | Rate (oz/1000 $ft^3$) |
|---|---|---|
| Aqua Gro | Aquatrols Corp. of America | 4 to 16 |
| Hydro Wet | Kalo Laboratories | 8 to 16 |
| Lesco Wet | Lesco Corporation | 8 to 16 |
| Peneturf* | Four Star Agriculture Service | 0.2 |
| Surf Side | Montco Products Corporation | 16 to 32 |

* Marketed as a soil conditioner.
Data from A. M. Petrovic 1985.

**Table 2.** Claims made for the use of wetting agents.

1. Improve wetting of localized dry spots
2. Affect plant growth
3. Improve infiltration
4. Improve percolation
5. Reduce compaction
6. Reduce thatch
7. Remove dew
8. Increase fertilizer and pesticide effectiveness
9. Increase water use efficiency

**Table 3.** Effect of wetting agents on the visual quality and soil moisture of localized dry spots.

| Wetting agent | Rate oz/1000 $ft^2$ | Quality | % Moisture |
|---|---|---|---|
| Aqua Gro | 8 & 8 | 3.8* | 16 |
| Aqua Gro | 16 | 2.2 | 20 |
| Aqua Gro | 16 & 16 | 3.8 | 16 |
| Aqua Gro | 32 | 2.4 | 19 |
| Aqua Gro | 8 monthly | 2.5 | 18 |
| Check | — | 6.1 | 12 |

* Quality rated 1 = ideal turf.
A. M. Petrovic 1985 from data provided by Rieke and Bay 1977.

# ONE APPROACH TO RENOVATING TURF IN PARKS[1]

Doug Dollarhide[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] City of Corvallis Park Services Manager, Corvallis, OR.

The predominant turf type in the Corvallis parks system ten years ago was a mixture of creeping bentgrass and creeping fescue. The parks were irrigated with quick-coupler systems. By mid-July of each year the turf areas were in a full state of brown-out. Poor maintenance practices and economics had allowed the turf areas to deteriorate.

Conversion projects for existing quick-coupler systems to automatic electric systems began in 1976. Increased irrigation capabilities did not increase turf quality. Unusual accumulations of thatch would not allow the water to penetrate. The wear tolerance of the creeping bentgrass and creeping fescue was low. The combination of poor maintenance in the past and species type gave us a very unattractive and unsuitable turf. Increased maintenance gave us a turf that was still unacceptable. The decision wa made to begin complete renovation of the turf and replant with an improved wear tolerant grass.

The renovation process began in 1980 for Cloverland and Chintimini Parks. Turftype perennial ryegrass and chewings fescue were chosen to meet our needs. The procedure was as follows:

1. Spray existing turf with Roundup.

2. Remove thatch layer.

3. Improve the surface by importing sandy loam to fill minor depressions.

4. Correct irrigation head and valve box levels to new grades.

5. Reseed and fertilize.

6. Irrigate and post signs.

The thatch removal process became more involved than we had envisioned. A Ford 917 flail mower with thatching knives was used and the cut thatch was picked up with a Jacobsen 720 EHL sweeper. After three or four passes over the area only a small amount of thatch had been removed from the two- or three-inch accumulation. The process was repeated several more times reducing the thatch layer

to about one-half the original accumulation. Time was running out. The project had to be completed prior to the fall rains; therefore, we did not completely remove the thatch.

Sandy loam was imported to both parks to cover a total of 11.5 acres. The soil was spread 1/2 to 1-1/2 inches with a special three-point, rear-mount blade/float. Cloverland Park and the east half of Chintimini Park were completed before we were rained out.

Due to a busy maintenance schedule, the west half of Chintimini was not started until the following August. By that time we had to repeat the spray process. A scattered, clumpy volunteer sod had been established during the spring and summer. We felt a need to remove this layer but did not want to lose the loam that was put on the prior fall. It was time to experiment. The experiment revolved around a recently borrowed Lely Rottera tiller. We set the Rottera to a depth of about 1 inch and worked the area one to time times. This process tore up the clumps of thatch and sod measuring approximately 3 x 6 inches. The soil had been completely shattered from the clumps. The experiment continued. We used a side-delivery hay rake to windrow the clumps in preparation for pickup. A three-point PTO rake produces the best results. The windrows were collected with a Jacobsen 720 EHL sweeper. The process was very dusty. Care should be taken to reduce this during the sweeping process. The raking and sweeping process had to be repeated several times due to the volume of the material.

The surface left after the sweeping process was very suitable for a seedbed. A Brillion grass seed drill with a cultivating modification was used to plant 200 lb of seed/acre on this area. The revised process required about 3-1/2 days from start to finish for 3-1/2 acres.

The experiment was a success. We have used it since then with some variations with equal success.

# ETHOFUMESATE - A POTENTIAL TOOL FOR RENOVATING LARGE TURF AREAS[1]

David L. Wienecke and Tom Cook[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Lane Community College, Springfield, OR, and Oregon State University, Corvallis, OR.

Large turf areas are periodically renovated in order to change grass species, improve the grade, add irrigation systems, or repair disruptive construction activities. For all the effort we put into these renovations, it would be nice to get the uniform top quality turf we had in mind when we started. Unfortunately, the result is often a turf containing 25-75% annual bluegrass and a rather thin cover of desirable turf. Few parks or schools have the resources to do anything about the annual bluegrass once it is there.

Even if we had the resources, controlling annual bluegrass in existing turf is not small task. It requires coordinated use of selective postemergent herbicides and preemergent herbicides to get rid of the annual bluegrass and keep it out. To do this requires lots of time and a degree of control over the use of fields most of simply don't have.

Is there another approach that can be used in either preventing or eliminating annual bluegrass in large turf areas? Based on research we have conducted over the past five years at Oregon State University, the answer is yes. Our work has centered on the use of ethofumesate as a selective preemergent or early postemergent herbicide that will kill annual bluegrass as it germinates or after germination up to about the three-leaf stage while allowing tolerant grasses to germinate and develop without ill effect.

The following summarizes some of the things we have learned about the use of ethofumesate during our research.

1. *Species/cultivar tolerance*. Of the grasses we have tested, perennial ryegrass and tall fescue are most tolerant to pre and early postemergent applications. Annual bluegrass, colonial bentgrass and fine fescues are readily controlled by preemergent applications. Roughstalk bluegrass, colonial bentgrass and Kentucky bluegrass are injured but survive early postemergent treatments.

   Not all perennial ryegrasses respond the same way to ethofumesate. Some cultivars are stunted by pre and early postemergent treatments. Among the most tolerant are Palmer, Pennant, Yorktown II, Elka, Diplomat, Barry, Prelude, Premier, Dasher, and Birdie II. Cultivars stunted by ethofumesate

applied preemergently include Blazer, Fiesta, Omega, Derby, Manhattan II, Regal, Barclay, Loretta, Yorktown, and Citation. In all field trials stunting was temporary and affected grasses eventually regained vigor.

2. *Rates*. Single treatments of ethofumesate between 1-1.5 lb a.i./acre are effective in controlling annual bluegrass when applied either pre or early postemergence. We experimented with split treatments but found no advantage over single treatments. Repeat treatments may be effective in controlling annual bluegrass at the 3-4 leaf stage, but we haven't tested at that stage.

3. *Method of seedbed preparation*. Our first efforts at using ethofumesate on no-till sites weren't entirely successful. Generally, we got good annual bluegrass control but poor perennial ryegrass establishment. The last two years have given excellent results in both annual bluegrass control and successful perennial ryegrass establishment. Establishment has been faster on sites that were dethatched and broadcast overseeded than on sites that were direct seeded via a slicer-seeder.

   Nearly perfect annual bluegrass control and perennial ryegrass establishment have been achieved on tilled and graded sites. These tests have been very consistent.

4. *Broadleaf weed control*. Ethofumesate has given excellent control of subclover when applied pre to early postemergence. It doesn't appear to be active on a wide spectrum of other broadleaf weeds though the current label indicates it will control common chickweed, common purslane, and redroot pigweed.

## SUMMARY

Ethofumesate (sold as Prograss 1.5 EC) has proven to be effective in controlling annual bluegrass in new seedings of perennial ryegrass and tall fescue. For best results, apply ethofumesate at 1 to 1-1/2 lb a.i./acre any time after seeding up to the two-leaf stage of the desirable grasses. Since the herbicide is root absorbed, irrigate after application. Do not apply ethofumesate to dry soil since it may be inactivated under such conditions. In addition to annual bluegrass control, you can expect good to excellent control of germinating bentgrass, roughstalk bluegrass and subclover. If applied to mixtures of perennial ryegrass and fine fescues, elimination of the germinating fine fescues can be expected. Ethofumesate is effective in conjunction with most standard techniques used for establishing new turf areas or renovating old ones.

# NECROTIC RING SPOT ON BLUEGRASS TURF[1]

Gary A Chastagner and Ralph S. Byther[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 22-24, 1985.

[2] Associate Plant Pathologist and Extension Plant Pathologist, Western Washington Research and Extension Center (WSU), Puyallup, WA.

For the past several years bluegrass turf in both eastern and western Washington has been plagued by a disease which looks very similar to take-all patch, a disease of bentgrass. However, since bluegrass is generally considered to be resistant to the take-all patch pathogen, *Gaeumannomyces graminis* var. *avenae*, there was some doubt as to what actually was causing the problem on bluegrass. Research at Washington State University's Western Washington Research and Extension Center during the past several years has been directed toward identifying the cause and control of this problem.

The fungus *Leptosphaeria korrae* has been shown to be the causal agent of this bluegrass disease. The fungus also attacks fine leaf fescues. Recent studies in other states have implicated this same fungus as one of several pathogens involved with the disease complex historically known as Fusarium blight (not to be confused with Fusarium patch, which is common to Northwest turf). This fungus also has been described in Australia and California as the cause of spring dead spot on bermudagrass. In 1983, a number of turfgrass pathologists agreed to name this disease necrotic ring spot.

The disease is most commonly seen in our area on 2-5 year old turf established from sod, but it has also been observed on seeded turf. Highly maintained turf, especially turf being overfertilized and overwatered, seems to be more subject to attack. The disease has also been observed on bluegrass turf in Idaho, Oregon and British Columbia.

Affected areas first appear as small spots or patches of dead turf during late spring-early summer or late summer-early fall. These patches can expand to form rings, arcs, and larger patches up to several feet in diameter. Weeds and sometime unaffected grasses invade the center of the rings. During the spring and fall when the fungus is active, the margins of the necrotic areas can have a maroon-brown coloration. The diseased plants can be easily lifted from the soil. Microscopic examination of the surface of lower stems and roots reveals the presence of dark fungal hyphae which are similar in appearance to runner hyphae of *Gaeumannomyces*. Short-necked, black fruiting bodies called pseudothecia are sometimes found on infected crowns and roots. The ascospores produced in these fruiting bodies appear similar to those of *Gaeumannomyces*, and Washington isolates measure 135 (80-188) x 4.5$\mu$ with 7 (5-11) septa.

Little is known at this time concerning the life cycle of this organism. Fruiting bodies of the pathogen are seen infrequently but have been observed with mature ascospores in Washington during the fall. Their importance in disease development is unknown. In both eastern and western Washington, the disease is most active in the spring and early fall. Frequently, the disease is inactive during midsummer and the turf appears to recover, but the same ring spots usually reappear in the fall.

**Disease Management Strategies**

Significant development of plant diseases requires that pathogen, susceptible host, and favorable environmental conditions must be present for a sufficient period of time. Disease will not develop if one or more of these factors are not present. Based on this fact, there are four basic methods which are used to control plant diseases. These are 1) exclusion or preventing the introduction and establishment of a pathogen, 2) altering host susceptibility through the use of resistant varieties or by using mixtures and blends of varieties, 3) modification of environmental factors through cultural practices to favor the growth of the host and not the pathogen, and 4) protecting the host during periods favorable for infection generally through the use of fungicides.

*Exclusion*: Preventing the introduction of a pathogen into an area in which it does not occur is an important method of preventing disease development. Studies in Wisconsin have shown that necrotic ring spot can be present in sod and in some cases symptoms develop on sod prior to lifting. It is not known if sod produced in the Pacific Northwest is already infected or becomes infected after it is installed. The development of this disease on seeded turf suggests that there are other sources of this disease than sod. Research is needed to identify sources of this disease and develop methods to identify infected sod.

*Host Resistance*: The use of turfgrass cultivars that are adapted to a specific area and have resistance to the most important diseases in that area is an important component of any disease management program. Preliminary studies indicate that some cultivars of bluegrass and fine leaf fescue are less susceptible to necrotic ring spot than others. Further work is needed to determine if sufficient levels of resistance to this disease occur within these cultivars to be of practical importance. Perennial ryegrass and tall fescue appear to be resistant. Studies are needed to determine the effectiveness of overseeding programs using ryegrass in minimizing the importance of this disease.

*Cultural Practices*: A sound disease management program to control necrotic ring spot should consist of integrated cultural practices which are unfavorable to the pathogen but favor the growth of the host. There are cultural practices such as site selection and preparation, variety selection, establishment method, fertilization, mowing frequency and height, water management, soil compaction, soil

pH, and thatch accumulation, which are known to affect development of other diseases in turf, but the effect of these cultural factors on the development of necrotic ring spot is unknown at this time. Cultural practices which encourage deep rooting of the turfgrass during periods of new root growth (spring and fall), and which preserve well-developed root systems during unfavorable conditions, probably will be an important part of a necrotic ring spot disease control program.

Although applications of sulfur are helpful in controlling take-all patch of bentgrass, applications of sulfur have been ineffective in controlling necrotic ring spot on bluegrass. However, a balanced fertilizer program including sulfur should not be ignored, since it is beneficial in helping the turf to recover when conditions for disease become unfavorable during the summer.

*Use of Fungicides*: Laboratory screening of fungicides indicated that Rubigan, Banner, and Tersan 1991 had better activity against this fungus than Chipco 26019 and Bayleton.

In 1983, Bayleton, Banner, and Rubigan were field-tested by making monthly applications during May, June and July to turf which had active disease symptoms. These spring and early summer applications of Rubigan and Banner provided good disease control during the late summer and early fall.

In 1984 trials, Rubigan, Banner, Bayleton, Chipco 26019, and Tersan 1991 were field-tested. One application of Rubigan 50W applied at 2 oz per 1000 $ft^2$ on May 24 gave excellent control of disease during the late summer and early fall. Three monthly applications of Banner also gave similar control, but it is not presently registered for use. Interestingly, when these spring and early summer applications have been made to obviously diseased turf, there have not been immediately observable benefits - the benefits are noticed in the fall following the summer turf recovery. In the untreated turf, the rings reappeared, whereas little or no disease was evident in the Rubigan- and Banner-treated plots. Bayleton, Chipco 26019, and Tersan 1991 failed to give adequate protection, even with three monthly applications. In other areas of the country Bayleton has not been effective in controlling necrotic ring spot, but Chipco 26019 and Tersan 1991 have controlled the disease. In these areas, the Chipco and Tersan were applied and then washed into the thatch and soil with water. We did not irrigate these materials into the turf, and this may have affected the levels of control.

Although fungicides are commonly considered a primary means of controlling plant diseases, they should be viewed only as one part of a total disease management program. The development of sound disease management strategies for control of necrotic ring spot will depend upon understanding factors affecting pathogen ecology and disease epidemiology. These are areas where additional research is needed.

# CONSUMERS GUIDE TO LANDSCAPE MAINTENANCE CONTRACTING[1]

Richard Akerman[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Oregon Landscape Maintenance, Tigard, OR.

## LANDSCAPE MAINTENANCE - THE THEORY

Landscape maintenance is the timely coordination of two separate but related functions.

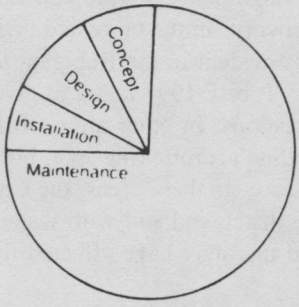
1. A groundskeeping function which requires only modest skills: mowing, edging, trimming, weeding, and debris removal.

2. A horticultural function which requires special skills most often developed by college training: infestation control, disease control, fertilization, and selective pruning.

Timely groundskeeping has an immediate, satisfying, highly visible effect; but without the additional benefit of proper horticultural practices, which provide the less immediate result of extending the life of the landscape and preserving the integrity of the original design, the landscape investment is compromised.

## THE TOTAL LIFE CYCLE COSTS OF A LANDSCAPE

*Landscape maintenance typically represents about 75% of the total life cycle cost of a landscape.*




How many years a landscape survives depends upon the kind and quality of landscape maintenance it receives.

When only the immediate groundskeeping functions are employed the landscape may have a life cycle of as little as 12 or fewer years.

When combined with horticultural functions, which ward off disease and infestation

and assure correct growth patterns through fertilization and selective pruning, a landscape's life cycle can be increased three-fold or more.

The objective of landscape maintenance is to judiciously apply the proper blend of groundskeeping and horticultural services. This will maintain a crisp appearance and maximize the lifetime of a landscape, and will do so at the lowest possible cost.

## IN-HOUSE STAFF VS. OUTSIDE CONTRACTOR

Your decision to perform the maintenance with in-house forces or an independent contractor will depend on the needs of your particular property.

Which alternative best serves your needs? Here's how professionals identify the pros and cons.

## IN-HOUSE STAFF

### Advantages

*Continuity*. Your staff may be more permanent than a contractor if low-bid acceptance requirements result in the periodic change of contractors.

*Control*. Control of maintenance activities is entirely yours, limited only by the size and expertise of your staff.

*Flexibility*. Your staff, unlike a contractor needn't work with rigid specifications or schedules due to its increased time on the property and will be free to attend minor emergencies and special day-to-day requests of management.

*Security*. Your employees are screened by you, resulting in the control over the issuance and return of keys and gate passes.

*Esprit de Corp*. The in-house staff tends to feel pride and a concern for the property, fostering a sensitivity to the needs of the property.

### Disadvantages

*Capitalization*. The outlay of ready cash for the purchase of specialized equipment may be used in more profitable ways.

*Cost Data Control*. The accumulation of cost data from operations usually require a special accounting system unique to the landscape industry.

*Time Limits*. A special amount of your time at intervals that may be inconvenient

or unscheduled will be necessary to manage the work force on the grounds and in the office to comply with Federal and State laws governing employment.

*Inventory*. Tools, supplies, spare equipment, storage space, and a cost effective accounting of them will be necessary.

*Maintenance*. You will assume the responsibility of the repair and maintenance of specialized equipment with high mortality motors and components.

*Employee-Expertise*. In-house personnel tend to remain outside the main stream of the landscape industry's latest practices, procedures and developments.

*Conflicting Duties*. There is a tendency to fulfill other property maintenance needs with the grounds crew. Responding to minor emergencies or special requests may result in the loss of valuable time that is necessary for effective grounds maintenance.

## CONTRACT MAINTENANCE

### Advantages

*Known Fixed Costs*. Contractors offer an amortized fixed cost without seasonal ups and downs.

*Responsibility*. The use of a straight fixed price contract places the entire responsibility of performance on the contractor.

*Reliable Budgeting*. There are no budget shortages or surpluses to content with at the end of the year.

*Personnel Management*. The contractor copes with the myriad of details of employment: workmen's compensation insurance; group insurance; Federal and State quarterly and annual unemployment compensation reports; unemployment claims and hearings; seasonal layoffs; terminations; labor pools; OSHA compliance; unions; training; supervision; retirement; uniforms; hiring; vacation; sick leave; sick pay; bonuses; salary reviews; discipline; overtime decisions. Personnel management is becoming increasingly complex and frustrating. There are stricter hiring and firing procedures imposed by government and union restraints on management prerogatives.

*Personnel Support Facilities*. Among the support facilities necessary to maintain a large work force, a contractor can eliminate certain space allocations: supply room, garages, mechanics, purchasing department, personnel office, and allied trades such as welding and machining.

*Productivity*. Contractor supervisors depend on top efficiency to justify their existence.

*Ability to Respond to Seasonal Emergencies Not Included in the Contract*. The right landscape maintenance contractor will have an available labor pool from which to draw and can respond to unforeseen needs.

*Specialized Services*. The contractor usually offers a wide variety of services, using equipment or materials which an in-house staff may not justify owning: The contractor usually has his own nursery facilities insuring optimum quality, and he has licensed personnel to comply with the changing requirements of the Environmental Protection Act.

### Disadvantages

*Low Bids by Unqualified Contractors*. Unseasoned property managers or those confined to severely restricted budgets may engage a contractor whose bid fails to account for costs to be encountered and lacks the financial credentials to back the contract or who are unable to perform to specifications.

In certain landscape maintenance bidding circles, it is held that once a landscape is bid and its price subsequently known to annual bidders the contract goes for the highest price it ever will.

Competing contractors in subsequent years bid lower and lower prices. Quality, of course, declines and landscape components suffer irreversible damage.

*Failure of the Contractor*. The weaker of the low-bidder style contractors may submit to bankruptcy sometimes leaving a property manager with a deteriorating landscape and no staff to tend it.

## WHEN THE WORK IS CONTRACTED

Contracting for landscape maintenance needn't be difficult if you identify and follow a few simple procedures. First:

### Determine the Level of Maintenance the Property Requires

Beyond the basic level of maintenance that all landscaping requires to protect the investment, a number of maintenance programs exist to meet the unique demands of any property. For example, a warehouse beyond the view of the public may require only the barest maintenance, while the prestigious corporate headquarters may demand a high degree of "showcase" maintenance. After selecting the proper maintenance level:

## Consider the Budget Allocation

Can the budget support the level of maintenance you require? Should expectations exceed what the budget can buy? You must increase the allocation or decrease the expectation.

Once you have satisfied the budget and the level of maintenance, identify each recurring maintenance activity required to support the level of maintenance selected. The greater the level of maintenance, the more activities required. Here is a list of some activities to consider:

*Turf.* Mowing, edging fertilization, soil conditioning, aeration, dethatching, renovation, overseeding, watering, weed and insect infestation control and disease control.

*Woody Ornamentals, Ground Cover Plants, Trees.* Selective pruning, fertilization, soil conditioning, watering, disease control, weed and insect infestation control.

*Miscellaneous.* Parking lot maintenance, leaf removal, seasonal demands, and storm damage.

Specifications serve to qualify activities by setting standards of practice. Units of measure are established: mowing frequency; edging frequency; fertilizer type; fertilizer application rate; and acceptable weed density per square foot per visit. By providing each competing contractor with well-defined specifications, a conformity is created which provides an accurate comparison of like-services in the bidding stage, and a measure of contract performance in the contract period.

Use the following guidelines in your selection of contractors most qualified to perform to your standards:

*Reputation.* How the public, and particularly the business community, perceive the contractor provides an excellent beginning for your investigation.

*References.* Consider his client references. Since quality companies tend to seek out other quality companies with whom to do business, the QUALITY of his clients is generally an indication of the business level at which he feels comfortable.

*Financial Credentials.* A good bank reference or Dun and Bradstreet rating is your assurance of his ability to fund timely payrolls, capitalize the latest equipment, and to perform to the terms of the contract, even in the face of adversity. A good financial condition protects you against materials liens and law suits brought against you for his actions. In a weak financial position, can the contractor stay in business long enough to complete the contract? Will he "cut corners" at your expense?

*Insurance Coverage*. A certification of insurance with at least a $5,000,000 Umbrella is recommended if the contractor is to successfully defend you in a lawsuit brought about because of his activities on your property.

*Personnel*. Landscape contracting is a hybrid industry combining engineering, art, plant sciences, and business management. His staff should include able representatives in the fields of horticulture, agronomy, mechanical maintenance, personnel management, and business management. Workmen should be licensed for chemical pest control.

*Performance*. An on-site inspection of three or more properties similar to yours plus a talk with the managers will indicate how the contractor performs. How well does he respond to problems? How is his follow-up procedure?

*Current Workload*. Insure the contractor does not have conflicting engagements affecting his ability to perform for you.

*Appearance*. An image of you and your property is portrayed in the appearance and performance of his personnel and equipment just as if they were part of your organization.

*Capable of Providing a Variety of Services*. Full service landscape contractors perform a wide variety of services associated with landscaping such as design and construction.

*An Industry Professional*. Note the professional affiliations of the company. Trade groups assist the contractor in comparing performance against other like companies nationally and insure efficiency with "tricks of the trade" and the latest industry developments. His efficiency serves your interest by getting the job done economically and well. Is the contractor an industry professional or does he copy from other local contractors?

*Professionalism*. Do you feel comfortable with the contractor as a professional businessman? Is he sensitive to your needs not insistent upon his ideas?

*Ethics*. The landscape maintenance contractor must maintain a delicate balance between job quality and profit. Remember, he takes your money and carefully distributes it month by month on your behalf, retaining an industry average of 4% for his profit. If he spends too little, job quality suffers and profits increase. If he spends too much, job quality increases and profit suffers. This delicate balance cannot be satisfactorily maintained without high ethics.

Following the qualification procedure should a contractor emerge as a highly desirable candidate with keen competence and a reputation of fair play, you may wish to negotiate the contract.

Because the act of negotiation tends to foster a high spirit of cooperation by breaking the restriction barriers of the arms length relationship, a long term relationship may be fostered to the mutual benefit of both parties.

As the seasoned business person has discovered, the low price does not always reflect the best value. Some contractors may bid a contract at a price beyond their capability to perform hoping to add men, equipment, and expertise as the job progresses. Assuming your contractor qualification process is successful, such troublesome contractors will have been eliminated from the competition.

Analyze any irregular prices with caution. Truly qualified contractors should not deviate in price more than a small percentage. If they do, something is wrong. Specifications may have been misunderstood or an error made in the estimating process. Most qualified contractors begin with an estimate of labor to perform to specification, usually expressed in annual man hours. Some measure the job and estimate the time by a unit of measure, such as lineal foot of edging, a square foot of mowing, etc. Others use an "eyeball" method, relaying on their experience with similar projects to guide them. Both methods, in experiences hands, are reliable estimates of what will become actual costs. The heart of his estimate is his labor estimate. To this, he adds various markups for estimated equipment usage, materials, and overheads.

According to our estimate of costs for efficient contractors with at least $1,000,000 annual landscape maintenance sales in the State of Oregon, here is how your maintenance budget is spent.

| Direct Costs | % |
|---|---|
| Direct labor | 40 |
| Workers compensation | 7 |
| Other direct costs | 7 |
| Total direct costs | 54 |
| Indirect Overhead | 9 |
| Supervisory labor | |
| Unapplied labor | |
| Small tools | |
| Equipment and supplies | |
| Equipment Overhead | 18 |
| Trucks, equipment | |
| Repair, maintenance | |
| Gas, oil, mechanics | |
| Labor | |
| Administrative Overhead | 15% |
| Total Costs | 96% |
| Pretax Net Profit | 4% |

While some contractors may spend more or less in one area than another, the final outcome of the costs appears to yield a pre-tax net profit of approximately 4%.

According to the Associated Landscape Contractors Association's latest Operating Cost Survey Ratio, the industry-average among 126 contractors reporting was a pre-tax net profit of 4.24%. The figure assumes an efficient contractor using industry-recognized practices and procedures. Accordingly, accurate bidding should align the bid prices of competent contractors. A conspicuously low bid should be regarded with suspicion.

## The Contract

A good landscape maintenance contract is comprehensive, addresses all contigencies, and leaves no areas of contention. The contract is legally binding, protects both parties, and outlines specifications by which performance standards may be measured.

Begin the contract with a narrative paragraph defining the precise level of maintenance you have chosen for the property and the positive effects you expect from the maintenance. List, too, what areas of maintenance you do not intend to include in the contract.

Two separate sets of specifications will occupy the contract's main body.

1. *General Specifications* which govern the general administration of the contract: the furnishing of certain labor, materials, and equipment; licenses maintained; taxes paid by whom; bond requirements; insurance limits; contract acceptance; contract termination; contract renewal; contract rights to assignment; contract fee; contract period; employee non-compete restrictions; extra services provision; employer working hours; inclement weather policy; employee holiday schedule; employee uniforms; employee union; employee union restrictions; property boundaries; limits of liability; property breakage; arbitration; inspection policy; guarantees.

2. *Landscape Maintenance Specifications* which you may have already written by activity: Turf - mowing frequency; mowing height; turf clipping disposition; edging frequency, plant beds; weed and insect infestation control; disease control; dethatching policy; watering responsibility; fertilization type; fertilization frequency; replacement policy; aeration policy; overseeding policy; mowing inaccessible to machinery, chemical. Woody ornamentals, ground covers, trees - selective pruning standards for cutting; selective pruning frequency; traffic obstruction policy in the selective pruning process; warning device policy in the selective pruning process; bark damage treatment policy; palm tree frond pruning; palm tree seed pod pruning; weed infestation control, chemical weed infestation control, manual; insect infestation

control; disease control; watering responsibility; fertilization type; fertilization rate; fertilization frequency; replacement policy; spent bloom removal. Irrigation systems - inspection; activation; maintenance; repair/replacement above ground; repair/replacement below ground. Miscellaneous - Parking lot maintenance; debris definition; debris removal/routing; debris removal/season; debris removal/storm damage; soil adjustment; reporting responsibilities; cypress bark mulch/frequency. Extra services - basis of payment; credit terms; discount policy; guarantee policy.

Define terms of maintenance for which the contractor is not responsible, among them: storm damage, freeze damage, drought damage, irrigation deficiencies, consequential damages beyond his control.

### Separate Renovation Contracts

Should the property fail to meet appropriate maintenance standards at the time the contract is scheduled to begin, a second, renovation contract should be let to bring the property up to prescribed conditions. This separate contract serves to eliminate one-time cleanup costs from influencing the pure maintenance contract costs. With a renovation, competing contractors must amortize renovation costs into annual maintenance cost, distorting pure maintenance estimates and permitting varying contractor judgments which your specifications were designed to avoid.

A payment basis of cost-plus-materials reduces his exposure to unanticipated costs and benefits the owner because he pays only for what he receives, and the completion of the renovation provides an excellent time for both owner and contractor to observe first hand and, perhaps for the first time, the property exactly as it is expected to be maintained.

### Enforcing the Contract

This final phase of the administration of the contract can be satisfying with a qualified contractor or a frustrating, tedious, time-consuming process if you have chosen a low-bid contractor either incapable or duty-bound to protect his profit or losses by cutting corners. Your corners: Inspect the property on a regular, weekly or monthly basis with the contractor's agent; record deviations in writing, and follow up on any corrective action you prescribe.

# DEVELOPING STANDARDIZED SPECIFICATIONS FOR CONTRACT CONSTRUCTION WORK[1]

John Hovenkotter[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Portland Parks Department, Portland, OR.

For several years a number of us in the NTA have discussed the potential value of having generalized specifications the membership could share. These generalized specifications could be customized by individual departments to reflect personal preferences and match local needs. The following example illustrates the emotions we hope to avoid by having generalized specifications to use as guidelines.

A Russian Eskimo trapped a lot of seals one winter and sold the furs, making a bundle of money. He traveled to Moscow where he bought a car. Nor, there aren't too many cars in Moscow, but there are "no parking" signs everywhere. Finally, after much driving around, he gets to Red Square, which conveniently is empty and has no signs. He parks the car and starts to walk away when a policeman stops him and says, "Comrade, you cannot park your car here!" "Why not?" asks the Eskimo, "There are no signs." "That's true," replies the policeman, "but this is Red Square, a very special place. Look, Lenin's mausoleum is over there and people are standing in line." "Well, I see that," answers the Eskimo, "but they are over there and the car is over here. It's not in their way." "You still don't understand, Comrade. This is the Red Square, a very special place. Members of the Government, members of the Central Committee, members of the Supreme Soviet, they all pass right by here." "Oh! Thank you for telling me," says the Eskimo. "I'll be sure to lock up the car."

There have been too many times in dealing with a contractor or supplier when we have experience the frustration of the policeman in this story. We know the importance of a project or type of materials, but are in a situation where, though we have dialogue, the understanding of our needs just isn't there.

My goal in offering the specifications listed below is to allow others one view of "how to do it" so they can produce functional specifications without first becoming a lawyer or spending an inordinate amount of time away from other job duties.

Landscaping and fertilizer specifications are presented as we use them. To minimize the length of this paper, other specifications we use are listed by number and may be ordered by contacting me. The costs are: $0.08 per page or $15.50 per complete manual. Send orders for specifications to:

John Hovenkotter
6437 SE Division
Portland, OR 97206
(503) 243-7307

### 7.0.1 Ground Slopes

With turf cover - Maximum - grade 5:1

With shrub cover - Maximum - grade 3:1

### 7.0.2 Turf Grasses

All seed shall be current year's crop and must be certified. All grasses in turf mixtures shall be types generally utilized for turf applications.

### 7.0.2.1 Turf Seed

All turf seed shall be current year's crop and must be certified. It shall be free of *Poa annua*, *Poa trivialis*, and *Holcus lanatus*, and the Oregon State University Seed Testing Lab test report of samples taken from the seed lot to be delivered must be submitted at time of delivery.

1. *High-Usage Area Seed Blend.* Utilize a blend of turftype perennial ryegrass varieties from the following approved list. The blend shall consist of a minimum of two of the approved varieties none of which shall, by weight, be of a lesser percentage than the result derived by dividing 50 by the number of varieties used in the blend.

| | |
|---|---|
| Allstar | Gator |
| Barry | Omega II |
| Belle | Palmer |
| Birdie II | Pennant |
| Blazer | Prelude |
| Citation | Premier |
| Cowboy | Repell |
| Dasher | Tara |
| Elka | |

2. *Non-High Usage Area Seed Blend.* Utilize a mixture of 50% perennial ryegrass blend and 50% fescue. Blends shall consist of a mixture of two (2) or more of the approved perennial ryegrass varieties mixed in accordance with the High-usage area seed specification, and any of the approved fescue varieties.

Improved Hard Fescue Varieties:

Aurora

Biljart

Reliant

Scaldis

Spartan

Valda

### 7.0.2.2 Sod

The use of sod turf is not acceptable.

## FERTILIZERS

Specifications for balanced uniformly sized and blended, professional turf fertilizer packaged in 40 lb minimum to 60 lb maximum bags. *Important!!* Material must be dust free! Particle sizes must be uniform, not smaller than 1/16 inch nor larger than 3/16 inch (approximately 3-5 mm) (minimum 90% passing between No. 6 to No. 10 screen with a maximum of 5% above and maximum of 5% below), formulated so as to allow uniform distribution of 1 lb of N/1000 $ft^2$ with a tractor 3-point PTO mounted Lely spreader.

The ratio of N to $P_2O_5$ to $K_2O$ to be not less than 6-1-3. The mixture must be a minimum of 21% nitrogen of which 50% (10.5% of the blend) must be from slow-release sources.

Acceptable soluble nitrogen sources are urea, ammonium sulfate and ammonium nitrate. Acceptable sources of slow-release nitrogen are sulfur coated urea (from C.I.L. or fine particle size of lakeshore, IBDU (coarse particle size), and urea formaldehyde with a minimum mole ratio of urea to formaldehyde of 1.9 to 1.

The blend must include a complete micronutrient supplement to include but not be limited to minimums of the following: 6.5% sulfur in elemental form, 0.3% copper, 0.4% manganese, 1% zinc, 0.5% magnesium, 0.015% boron, 0.0005% molybdenum, and 2% iron.

The following is a Table of Contents for construction standards. It is available through the Portland Park Bureau:

**02810, Irrigation Systems**

**02811, Irrigation Systems, Underground**

**02812, Irrigation Systems, Above Ground**

Irrigation Design Criteria (12 pages)

Irrigation Standards Index (Specifications & Construction Details) (54)

Irrigation (6)

Irrigation System (9)

Irrigation System, Underground (20)

**02821, Fountains, Drinking**

Standard Pad for Drinking Fountain (4)

**02831, Chain Link Fences and Gates**

Chain Link Fence (4)

Chain Link Fencing (7)

**02860, Playfields and Equipment**

Football and Soccer Fields, Etc. (1)

Baseball Facilities (1)

Baseball Infields (3)

Drainage Design to Handle Intensive Football Field Use (3)

Athletic Fields (Spec. Outline, Construction, and Maintenance) (24)

Construction and Maintenance of Natural Grass Athletic Fields (28)

**02861, Playground Equipment**

Large Swing Set (3)

**02862, Play Structures**

Ballfield Backstop (2)

**02863, Recreational Facilities**

Outdoor Tennis Courts (5)

Recreation Ideas for the Handicapped (1)

**02870, Site and Street Furnishings**

Identification Signs (20)

Bicycle Racks, Approved List (1)

Plaques (2)

**02873, Seating**

Outdoor Benches, Approved List (1980) (2)

**02874, Tables**

Picnic Table, Pedestal Type (2)

Portable Picnic Tables, Approved List (1977) (1)

Fixed Rectangular Picnic Table (1)

Portable Picnic Tables (1)

Picnic Table for the Handicapped (1)

**02875, Trash and Litter Receptors**

Outdoor Litter Receptors & Approved List (1981) (6)

**02900, Landscaping**

Landscaping (8)

Landscaping - Site Work (11)

**02911, Planting Operation**

Fertilizer, Tree and Shrub (1)

Fertilizers (1)

Landscape Contracting - Guide Specs - Planting (12)

Landscape Planting (5)

Planting Design (2)

**02920, Soil Preparation**

Lime, Dolomite (1)

Peat Moss (1)

Soil, Infield (1)

Fill, Select Granular (1)

Soil, Planting, Two-Way Mix (1)

Soil, Planting, Three-Way Mix (1)

Soil, Playfield (1)

Fill, Select Granular (1)

Sterilant, Fill, Permanent (1)

Sterilant, Soil, Short-Term (1)

**02930, Lawns and Grasses**

Fertilizer, General Lawn, 6-2-4 (1)

Fertilizer, Lawn Installation, 10-20-20 (1)

Seed, Clover, White (Dutch) (1)

Seed, Grass, Bent (1)

Seed, Grass, Blue, Kentucky (Merion) (1)

Seed, Grass, Fescue (1)

Seed, Grass, Lawn Mix (1)

Seed, Grass, Playfield Mix (1)

Fertilizer, Soluble, 27-9-18 (1)

Sod (1)

Hydroseeding (5)

Seed, Grass, Rye (1)

**02951.4 Manure and Sawdust**

Mulch, Bark (1)

Sand and Sawdust Mixture (1)

Mulch, Manure, and Sawdust (1)

**02511, Asphaltic Concrete Paving**

Asphaltic Concrete Paving (1)

**02512, Crushed Stone Paving**

Crushed Ledge Rock Path (1)

**02530, Athletic Paving and Surfacing**

Tennis Court (Surfacing) (6)

**11060, Theatre and Stage Equipment**

Theatre Stage (1)

**13120, Pre-Engineered Structures**

Comfort Stations (5)

Restrooms for the Handicapped (1)

# BUILDING GREENS, TEES AND BUNKERS THE CONSTRUCTION PROCESS[1]

Dick Fluter[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Golf Course Superintendent, Oswego Lake Country Club, Lake Oswego, OR.

This talk is intended to aid the person who is considering upgrading, rebuilding, or remodeling an existing golf course. The information puts prime importance on the fastest way to complete the job and put the green, bunker or tee back in play. There have been many fellow golf course superintendents who have contributed to this talk (they are listed in the footnotes).

The success of a remodeling program seems to be tied to the ability of the golf course superintendent to get the job done with the least interference with play—start the season with a whole golf course and complete the season with a whole golf course. This involves doing the construction in the ideal months of July and August and using as much sod as possible for quick turf establishment.

The process begins with a good plan (a master plan for the golf course is ideal because it keeps you on track). At best, remodeling or rebuilding at a golf course, particularly a country club, is controversial. No two golfers can agree on a specific plan. For this and other good reasons, using a reputable golf course architect is an absolute necessity. In the case of a country club, prior to the beginning of any rebuilding project, there should be from three to five meetings with the green committee. A typical meeting schedule might include the following:

1. The committee should establish construction priorities.

2. The committee should meet with the architect to express specific factors to be considered in the project.

3. The committee and architect should review the plans and make further changes.

4. The architect should visit the site at the start of construction to lay out the plans.

At the first indication that remodeling or rebuilding will take place, a turf nursery should be established. For greens and tees the nursery should be grown on the same soil mix that will be used in the future construction. The nursery should be one year old before it is moved (preferably one year and several months). A two-year-old nursery can have too much thatch unless it is managed with light topdressings.

I recommend that for reference you use the book *Turf Management for Golf Courses* by James Beard, which is a publication of the USGA. With the help of this book, the specifications and definitions to which I am referring will be easier to understand. This talk is to give you the approximate time frame involved in each operation without going into extensive detail. The USGA Green Section specifications for golf course construction should be your guideline. Follow them as closely as possible. However, it is not unusual for every project to deviate from these specifications to some degree.

For the sake of this discussion, the time allotted for the respective jobs are based on the following circumstances: a 6000 $ft^2$ green is being rebuilt. No additional soil is needed; however, major recontouring is necessary. There will be three bunkers surrounding the green. The total area involved in the construction measures 200 ft x 200 ft.

**The Steps Involved in the Green Rebuilding Process**

1. Set up a reference point where all instrument readings will be taken. (This area should not be disturbed during construction.)

2. Stake out the greens. Have the architect do this with you. (You must know how to use the transit.)

3. Bring in three pieces of equipment - a dump truck, a tilt angle cat and a loader cat.

4. *Rough Grading*. One man should work with the tilt angle cat operator clearing around the grade stakes and checking grades. The tractor work will usually take 1-1/2 to 2 days depending on the amount of mounding needed around the green. The base of the green will need additional work to leave it smooth. This can be accomplished using two men with rakes and shovels in conjunction with a wheel tractor float combination. This will take an additional day. The contours for drainage are more exaggerated at this time, but, in general, the subgrade slope is as close to duplicating the finished grade as possible.

5. *Soil Mixing*. When the rough grading is completed, prior to construction, a flat area for mixing is chosen or leveled. The sand and the soil amendments are dumped in separate but parallel piles. A loader cat and dump truck are used. The sand and soil are loaded into the dump truck in the same ratio as the recommended soil mix, in an alternating fashion, to create layers. The truck then dumps the load. After 5 dumps the loader cat goes to the dump pile and tosses the pile to continue the mixing. The process continues until all of the soil is mixed. (This usually takes about one day, depending on the loader cat size.)

6. At the same time the soil is being mixed, the subsurface drainage is being installed in the base of the new green. This usually takes 1 to 1-1/2 days using three men. One man is trenching to a depth of 6 inches as two men are clearing the trench and cleaning the spill from the sides. Gravel is laid in the base of the trenches and flexible drainline is placed in the trench and covered with rock to the surface.

7. The drain rock is then hauled onto the site and a 4-inch layer is placed over the entire sub-base. This takes one man to clear and protect the grade stakes and a dump truck and tilt angle cat. This process takes approximately 1/2 day.

8. The irrigation system trenches around the green are being dug at the same time as the gravel in Step 7 is being spread. The irrigation usually takes two days to install. The trenching is done in one day with two men. The installation is done the following day with two men.

9. Following Step 7, the intermediate or transition layer is installed. (Some have used filter cloths in place of the transition layer.) It takes two men 1/2 day.

10. The top mix is then installed on the green. The green is ringed with soil mix where possible. A tilt angle cat is used to move it onto the green. One man is needed to keep the grade stakes clear. This usually takes 1-1/2 days using a loader and dump truck in conjunction with a tilt angle cat moving the soil around.

11. *Final Grading*. You will find that when the soil mix is in place the green surface will be close to grade if you have a good equipment operator. The surface should be further packed using a small power roller. The final grading is done by hand using two men with wide landscape rakes and one man using a band landscape roller. This operation takes about one day with the three men.

12. *Fertilizing*. Apply a complete starter fertilizer and take it lightly into the surface of the green. Roll it again.

13. *Sodding*. Aerify the sod nursery using a greens aerifier one day prior to removing the sod. Set the power sod cutter to cut square pieces (16 x 16 inches is common). Keep the same operator running the sod cutter - uniformity is mandatory.

14. *Sod Laying Operation*. Use plywood to walk on laying it over the new sod you have laid. Use a minimum of seven people - one on the cutter, two men at the site, and two 2-man teams hauling sod and assisting in the sod laying.

lay the sod out further than the edge of the collar around the green. (This sod can be used later for patching.) Sodding takes about one day.

15. *Leveling the Individual Pieces of Sod.* Spend about four hours with three men equipped with ice picks and buckets of soil mix raising and lowering the corners of the newly laid sod.

16. *Topdressing.* Apply a heavy application of topdressing to the new sod. Work it in by first using the back of wide landscape rakes and then use a dragmat. At this time you must still be able to see the turf, but there will be some low areas that will appear to be smothered. Irrigate heavily with the irrigation system for uniformity. This will further work the topdressing in and will keep the surface cool. If the weather is very hot, reduce the amount of topdressing and be sure to keep the surface cool. (Heavy topdressings can cause damage in high heat situations.)

17. Mow with a walking greensmower set at 5/16 inch after five days. Topdress heavily on a weekly basis for the next four weeks. Set mower at 1/4 inch after the second mowing, then mow as often as necessary and lower mowing height accordingly.

18. Cut the bunkers out using a backhoe. Install drainage in the base like you would the sub-base of a green. If you don't have a drainage system to tie into, a sump will be necessary. The average bunker may need a sump that can hold 5 $yd^3$ of drain rock. If the sump is located in the bunker, filter cloth should be used to keep the sand from filling in the sump. This usually takes three men two days per bunker, using one backhoe, a small dump truck and a trencher.

19. Sod the area completely around the green and bunkers concentrating on the areas where there will be heavy traffic. This usually takes from 8,000 to 10,000 $ft^3$ of sod. The remaining area is seeded using the same grass varieties as are in the sod.

20. Fill the bunkers with sand.

21. The green could be open in 4-6 weeks after laying the sod on the putting surface.

The time frame for actual putting green construction is approximately 10-14 working days.

## Tee Construction

There is diversity of opinion when it comes to constructing tees. We have built tees two ways. The first and most expensive way involves following the green specifications mentioned earlier and reducing the amount of topsoil mix to 6 to 8 inches. The second way involves eliminating the gravel layers, still preparing subsurface drainage, but then applying the soil mix over the base. The last three tees we built were done the second way and proved very effective. If I were building a large surfaced tee such as a driving range tee, which would be both long and wide, I would prefer using the first method I mentioned.

## The Construction Process for a 6500 $ft^2$ Tee

1. Layout the tee - staking.

2. *Rough Grading*. One day using a tilt angle cat plus one man checking grades (assuming fill has been dumped in place if necessary).

3. *Mixing Soil*. Same fashion as mentioned for green. One day with loader and dump truck.

4. *Drainage in Sub-base*. One and one-half days with two men.

5. *Irrigation Installation*. One day with two men.

6. *Apply Soil Mix*. One man checking grades plus the loader, dump truck and tilt angle cat for one day.

7. *Final Grade*. Two men with landscape rakes, one man with roller plus a tractor with a float. One day.

8. *Sod or Seed*.

9. *Finishing the Banks of the Tee*. Three men, one day to smooth and seed. (Sod the walk off areas if you sod the surface.)

10. *Install Cart Paths, Signs and Markers*. Asphalt paths installed by separate contractor.

Time frame for actual tee construction, approximately 7-10 working days.

In closing, do not lose sight of the fact that this green or tee is only one-eighteenth of the golf course. It may be an extensive undertaking to you, but not to the golfer. Try not to let the rest of your golf course suffer as a result of this project.

This talk is a result of my work at Oswego Lake Country Club as well as ideas from the following golf course superintendents:

John Anderson, Portland Golf Club

Harvey Junor, Retired, Portland Golf Club

Dick Malpass, Executive Director - OGCSA

Tim Manion, Everett Golf and Country Club

John Monson, Broadmoor Country Club, Seattle

Richard Schwabauer, Waverly Country Club

Richard White, Willamette Valley Country Club

The construction slides were of the 14th Green at Oswego Lake Country Club.

# PLANT NUTRIENTS OTHER THAN N, P AND K[1]

Roy L. Goss and S. E. Brauen[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 22-24, 1985.

[2] Extension Agronomist and Associate Agronomist, Western Washington Research and Extension Center (WSU), Puyallup, WA.

Since carbon, hydrogen and oxygen are supplied by the atmosphere and water, they will not be a part of this discussion. Nitrogen, phosphorus and potassium are considered as the three major plant food elements and have been discussed previously. Calcium, magnesium and sulfur are usually considered as intermediate and secondary elements since they are required in lesser amounts than the major elements but in greater amounts than the micronutrients. Sometimes iron may be considered as a secondary nutrient although it can be classed as a micronutrient as well. Since there are 16 elements required for plants to achieve full maturity and reproduce, this discussion will be concerned with 10 of them.

## BALANCE AND INTENSITY

Most turfgrass managers are aware that there is a specific balance of nutrients that is best for optimum growth of any plant. Nutrients may be in proper balance with each other in the soil but the amount available or present may be inadequate for maximum growth or production of the plant. Therefore, intensity comes into play. As we increase the level of one nutrient, other nutrients can become out of balance and can limit the growth or performance of the plant. Therefore, we must carefully consider both balance and intensity in turfgrass nutritional programs. I am afraid that for golf courses in particular too much emphasis has been placed upon speed of the green and has resulted in starvation of the grass. Not only has this resulted in nutrient imbalances, but also insufficient quantities of nutrients available to keep the plant healthy and vigorous to compete with weeds, mosses, plant diseases and insects.

Let us consider some of these nutrients and their functions and a little of what we know about their balance and intensity.

## MICRONUTRIENTS

Micronutrients or trace elements are required in very small amounts and frequently the margin between deficiency and toxicity is quite narrow especially with such elements as boron and molybdenum. Toxicities or deficiencies of micronutrients can be induced when the pH is rapidly changing up or down, applied irrigation water high in the element, application of fertilizer compounds which form soluble toxic substances, and leached or accumulated spray materials. Guessing

as to what is needed and applying a shotgun mixture is a very dangerous practice.

On the practical side of management, the use of micronutrients places a burden of responsibility on the turfgrass manager. The cost of micronutrient analysis is not cheap. Both tissue and soil micronutrient analyses can be misleading and need a great deal of improvement. Most normally developed soils are usually adequately supplied with micronutrients although deficiencies of one or more are common in most regions. In the turfgrass sciences, the advent of greater usage of sand rooting profiles in putting greens, bowling greens and sportsfields, micronutrient deficiencies are becoming more common and must be carefully considered.

Let us consider some of the micronutrients and a few of the factors that may affect deficiencies.

*Boron.* Factors favoring deficiency include high soil pH, unfavorable calcium:boron relationship, low organic matter, low moisture, and highly leached soils. Boron is extremely important in nitrogen and carbohydrate metabolism and in water relations in the plant.

When high levels of nitrogen are used or phosphate levels are low, more boron will be required. If the level of available boron is low, high levels of potassium application may induce boron deficiency. In general, some soil testing specialists consider that values of 1.3 to 2.0 ppm present high soil levels whereas tissue levels of 9 to 10 ppm are adequate. Visual deficiency symptoms for boron include greenish yellow color, dying prematurely, and abnormal tillering.

*Copper.* Copper deficiencies can be induced by high soil pH, high organic matter content, high concentrations of iron and manganese and highly leached soils. Copper plays an important role in plant growth as an enzyme activator and as a part of certain enzymes which function in respiration. Copper usually does not move from the older parts of the plant to the younger leaves, and this is why lack of copper shows up on younger growth. Copper will leach readily from sandy soils, but is tightly held by soils with high clay content. Soils high in organic matter maintain a tight hold on copper and the availability is decreased. Soils high in organic matter are, therefore, more likely to respond to additions of copper. Turfgrass deficiency symptoms include a withering and graying of the leaf tips, turning backward of the leaves, and dying of tips and newly emerging leaves. In general, high soil levels would register approximately 1.5 to 3 ppm, depending upon methods of extraction, while tissue levels of 17 to 20 ppm would be considered normal.

*Iron.* Iron deficiencies can occur with high soil pH, high soil phosphates, excessive copper, zinc and manganese, excessive soil moisture, and excessive lime. Iron is very essential for the formation of chlorophyll and for photosynthesis. It is also an activating element in several enzyme systems. Lime chlorosis is common in soils with excessive amounts of calcium carbonate (lime). In general, soluble

applications of ferrous sulfate or ferrous ammonium sulfate will restore green color at least temporarily under these conditions. Usually soil levels of 25 to 50 ppm are considered high, depending upon the method of extraction. Tissue levels, however, are much more highly concentrated and can run as high as 280 ppm or higher.

*Manganese.* Deficiency symptoms can be induced by high soil pH, low organic matter content, high soil moisture, and nutrient interaction. Manganese plays a vital role with enzyme systems usually involved in the breakdown of carbohydrates and nitrogen metabolism. Deficiency symptoms on grasses include chlorotic leaves and often characterized by lesions and small brown or gray specks near the base of older leaf blades.

*Zinc.* Conditions favoring deficiency include high pH soils, high phosphate, low organic matter, exposed subsoils, high base exchange capacity and particularly very high organic matter soils such as those described as muck. Zinc is essential for transformation of carbohydrates and regulation of the consumption of sugar in the plant. The availability of zinc at pH values of 6.0 is low, and as the pH increases, the availability of zinc decreases. Therefore, heavy applications of lime can significantly reduce the availability of zinc. Although deficiency symptoms for zinc are not common, older leaves can appear grayish in color while part of the leaf may be gray to bronze-green. Soil test values of 3 to 8 ppm are considered high for zinc while tissue analysis may reveal 40 ppm as being adequate levels.

*Molybdenum.* This is one of the only micronutrients where availability is reduced by decreasing pH value. Values below a pH of 5.5 coupled with low phosphate levels can induce deficiency symptoms. Molybdenum is very important for the reduction of nitrates in the synthesis of protein by all plants and, therefore, nitrogen cannot be properly metabolized in the presence of molybdenum deficiency. Molybdenum deficiency symptoms are not easy to detect in grasses which exhibit generally a pale green color. Soil test values for molybdenum range from 0.2 to 0.4 ppm in the high range, whereas tissue levels may run approximately 5 ppm.

*Chlorine.* Although many physiologists consider chlorine as being an essential element for plant growth and reproduction, deficiency symptoms are rare. Many fertilizer materials contain chlorine and it would be unusual to develop chlorine deficiencies in most of our turfgrasses.

In conclusion, highly leached sandy soils and especially with high pH values could develop micronutrient deficiencies. Rather than to guess or to use the shotgun approach for micronutrient applications, it is much best to conduct soil or tissue tests to determine micronutrient needs. Use caution in tissue tests!

# VARIOUS NITROGEN FERTILIZERS FOR CREEPING BENTGRASS GREENS[1]

Jeff Nus, Stan Brauen, and Roy Goss[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Assistant Professor, Horticulture Department, Kansas State University, Manhattan, KS, Associate Agronomist and Extension Agronomist, Western Washington Research and Extension Center (WSU), Puyallup, WA.

## INTRODUCTION

The use of soilless sand putting greens has gained popular acceptance among golf course managers because they resist compaction, offer good drainage, and possess a high level of soil aeration compared to natural soil greens. Unfortunately, sand offers little capacity for retention of moisture and nutrients. Nitrogen is the nutrient most needed by putting greens and, consequently, most of the typical fertilizer budget is spent for that nutrient. Depending on the release characteristics of the nitrogen source, the method of application, and irrigation practices, nitrogen leaching losses from applied fertilizer can be quite significant, especially on sandy, highly permeable growing mixes such as sand greens.

The choice of nitrogen fertilizers is one of the most important decisions turfgrass managers must make. To make wise decisions, information concerning turf response and nitrogen use efficiencies is needed. This study was initiated to determine the relative effectiveness of various nitrogen fertilizers on Penncross creeping bentgrass grown on a high percentage sand mix for establishment and quality, nitrogen losses by leaching, and nitrogen recovered in the clippings.

## MATERIALS AND METHODS

Construction of a 24-cell lysimeter area for establishment and maintenance of Penncross creeping bentgrass was initiated in December 1983. Each cell was 26.2 $ft^3$ in area and contained a 12-inch depth of an 84% sand, 15% peat, and 1% soil mix. Each cell was underlined with a 6-mil plastic liner which allowed leachate to be collected independently from each cell by the use of 2-inch PVC piping into sunken collection boxes containing plastic buckets.

Penncross creeping bentgrass was seeded at the rate of 1 lb per 1000 $ft^3$ on May 4, 1984. Establishment fertilization was done prior to seeding. Establishment ratings (1-9, 1=no emergence, 9=excellent) were initiated on May 16 and were taken weekly for six weeks. Quality ratings (1-9, 1=dead, 9=excellent) were initiated on October 1 and continued through November. They were resumed in mid-February, 1985 on a weekly basis.

Leachate samples were collected on a weekly basis from each plot beginning in March 1985. Nitrate nitrogen was determined from leachate samples using specific ion electrode analysis. Clippings were taken from each plot at each mowing (3 times a week) and oven dried to determine clipping yield. Dry clippings were ground and analyzed for total nitrogen using micro-Kjeldahl nitrogen analysis techniques (1). Nitrogen yields were calculated from clipping yields and nitrogen contents. Overall fertility program applied to lysimeter plots is shown in Table 1.

## RESULTS AND DISCUSSION

One very important factor needed for judicious selection of a nitrogen fertilizer is cost. Figure 1 shows that there is a wide variation in the cost per pound of nitrogen for the nitrogen sources used in this study. Urea and ammonium nitrate were the most inexpensive, with nitrogen costs ranging from 35-40 cents per pound. Slow release forms, urea formaldehyde (Nitroform) and IBDU, were the most expensive, ranging from 95 cents to $1.10 per pound of nitrogen, respectively.

Figure 2 demonstrates that ammonium sulfate was superior to other nitrogen sources for establishing creeping bentgrass on predominantly sand greens. Ammonium nitrate and urea formaldehyde (UF, Nitroform) ranked the worst. The addition of magnesium chloride (MC) to urea did seem to help in establishment compared to urea alone.

Average quality ratings for the various nitrogen sources are shown in Figure 3. Ammonium sulfate and IBDU gave overall superior quality ratings than other nitrogen sources. Urea formaldehyde (UF, Nitroform) applications resulted in poor turf performance over these cool growing months. Urea formaldehyde depends on microbial breakdown for nitrogen release (2,5). Microbial activity is much reduced under 55-60 °F soil temperatures (4). It seems likely that reduced microbial activity needed for nitrogen release during these cooler growing months was the principle reason for the poor performance of urea formaldehyde (UF, Nitroform) treated plots.

Data from leachate samples was surprising (Figure 4) in light of other research (3). IBDU and urea treated plots resulted in the highest concentrations of nitrate nitrogen recovered in leachates. Ammonium sulfate treated plots resulted in the least amount of nitrate nitrogen in the leachate. We expected urea formaldehyde (UF) treated plots to show very low levels of nitrate nitrogen based on poor turf response, but this was not the case. More data will be needed to resolve this apparent inconsistency.

Nitrogen yields are shown in Figure 5. By determining total nitrogen content of the clippings and the total amount of dry clippings produced from each plot 10 days after application, total amount of nitrogen removed by mowing at that date could be calculated. Ammonium sulfate treated plots resulted in the greatest

proportion of applied nitrogen being removed from clippings. Urea formaldehyde (UF, Nitroform) treated plots resulted in the least amount of applied nitrogen being removed by clippings. The other nitrogen sources were roughly equivalent in the amount of nitrogen removed by clipping 10 days after fertilizer application.

This experiment is only in its initial phase. Much more data needs to be collected and analyzed before firm recommendations can be made. However, we have demonstrated that the lysimeter does work, and that there does appear to be quite a bit of difference in the performance of these nitrogen fertilizers. As more data are collected, it is hoped that this experiment will provide information that will enable turfgrass managers to make wise choices of their nitrogen fertilizers for Pacific Northwest use.

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Table 1. Lysimeter fertility program.

| Nutrient | Application rate (per 1000 $ft^3$) and timing |
|---|---|
| Nitrogen | 1 lb each 3-4 weeks |
| Phosphorus | 3 1-lb applications in May, July, Sept. |
| Potassium | 3 2-lb applications in May, July, Sept. |
| Sulfur | 2 1-lb applications in May and Sept. |
| Calcium and magnesium | 2 dolomite lime applications May and Sept. |
| Micronutrients | Esmigran applications in May and Sept. |

## FIGURE LEGENDS

Figure 1. Cost of nitrogen ($ per pound) from sulfur coated urea (SCU), urea, isobutylidene diurea (IBDU), ammonium sulfate (AS), ammonium nitrate (AN), and urea formaldehyde (Nitroform) when purchased by the ton. Prices courtesy of Turfgo Northwest, Kirkland, WA.

Figure 2. Average establishment ratings (1-9, 1=very poor, 9=excellent) of creeping bentgrass from various nitrogen sources over a 35-day period.

Figure 3. Average quality ratings (1-9, 1=dead, 9=highest quality) for creeping bentgrass from various nitrogen sources for months of October and November, 1984, and March, April, May and June of 1985.

Figure 4. Average nitrate nitrogen detected in leachate samples from creeping bentgrass lysimeters fertilized with various nitrogen sources for the months of March, April, May, and June, 1985.

Figure 5. Average nitrogen yield (grams oven-dry weight) from creeping bentgrass lysimeter plots fertilized by various nitrogen sources for the months of March, April, May and June, 1985 from clippings taken 10 days after application.

1.20
.90
.60
.30
N COST ($ PER LB)
SCU
UREA
IBDU
AS
AN
NITROFORM
N SOURCE

ESTABLISHMENT RATINGS
8
7
6
5
4
SCU
AS
UREA + MC
IBDU
OXAMIDE
UREA
UF
AN
N SOURCE

QUALITY RATINGS
7.0
6.5
6.0
5.5
5.0
AS
IBDU
AN
SCU
UREA
UREA + MC
OXAMIDE
UF
N SOURCE

LEACHATE NITRATE (PPM)
2
4
6
8
10
12
14
16
UREA
UREA + MC
SCU
OXAMIDE
IBDU
AS
AN
UF
N SOURCE

NITROGEN YIELD (G)
1.2
1.0
0.8
0.6
0.4
0.2
UREA
UREA + MC
AN
AS
OXAMIDE
IBDU
SCU
UF
N SOURCE

# RECENT DEVELOPMENTS IN TANK MIXING, AND... "THE GREAT DEBATE"[1]

Mark M. Mahady[2]

[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Western States Zone Research Scientist, ChemLawn Services Corporation, Monterey, CA.

There are many different methods that are available to us for the application of fertilizer and pesticide materials. Drop spreaders, spin spreaders, and handcans, backpacks, boom, and lawn care spray systems have all been used both in the golf course and lawn care industries to apply materials for the improved growth and vigor of turf, trees and shrubs. The debate that surrounds the controversy of whether liquid application of fertilizer and pesticide control materials is superior to dry application or vice versa has at times overshadowed the benefits of having a dual application option. In other words, when choosing a particular product or method of application, which option best suits your agronomic needs, your level of expertise, your pocketbook and your management operations. The bottom line is that we all want the same thing: healthy and aesthetically pleasing turf, trees and shrubs.

The objectives of this presentation are to discuss, (a) the important considerations and misconceptions in the ever constant liquid vs. dry debate, (b) to review the principles of common sense tank mixing, and (c) to review recent developments in tank mixing. However, the most important consideration in terms of a true take-home message would come in the form of the following question: Are there concepts or specific ideas that the lawn care industry is using today which might improve my cultural practices and maybe make my job a little easier?

## LIQUID VS. DRY "THE GREAT DEBATE"

Few topics have ever stirred quite as much controversy in the landscape industry as the recent debate about whether liquid applications of fertilizers and pest control materials are superior to dry applications or vice versa. There seems to be an ample number of supporters on each side with proof positive that their method is superior, however, some of the points being argued are not relevant or are incorrect assumptions.

*Product Availability*: When a new product is presented in the landscape industry, many times there are formulations available only in limited quantities. Some materials can only be formulated to use safely in a liquid or dry application and certain products will dictate the type of application to be used.

*Cost*: The key consideration when looking a product cost is to determine the true price of the active ingredient. Some liquid formulations cost more, particularly when purchasing solutions where the ingredients are combined with a water carrier. Emulsifiable concentrates or water dispersible granules are often produced in higher concentrations, and make the active ingredient more cost efficient. Granular materials may cost more because the active ingredient must be incorporated with a carrier that adds weight to the end product. This is a definite consideration if the material has a low percentage of active ingredient.

In order to calculate the cost of the active ingredient you must know how many pounds of active ingredient there are per ton or per gallon. The cost of the active ingredient per pound is determined by dividing this number into the cost per ton or per gallon. Other factors that will affect actual final cost include freight charges, storage space, tanks, meters, plumbing and pallet charges.

*East of Application*: Liquid applications provide greater flexibility in the landscape and on the golf course because it is possible to combine nitrogen, potassium, phosphorus, iron, pre-emergent herbicides, post-emergent herbicides, surfactants and insecticides at the same time in the same spray tank with excellent results. Dry materials have limitations in terms of the combinations that are cost effective; two or more trips across the site may be necessary in order to get all the necessary materials applied. Granular products can also be difficult to spread over hilly or rough terrain. However, in specific cases drop spreaders can drop materials along very precise lines.

*Burn Potential*: Liquid product formulations normally present more of a problem with burn than granular formulations. Unless a liquid product is soluble in water it must be formulated with some type of solvent which may be phytotoxic to plants. Clays or corn cobs are normally used as carrier agents for granular materials. These carriers produce less potential for possible phytotoxicity. Combining fertilizers and water produces a salt solution. When temperatures increase so do the chances of burn in the field, unless insoluble forms of nitrogen are used. However, improper application methods and rates can also cause dry applications to burn under high temperatures.

*Volatility*: Recent research investigations indicate that many products that volatilize readily in liquid form will also volatilize readily in granular form. One published study indicates almost no difference in volatility between granular and liquid urea applications. However, another study showed liquid urea applications volatilizing significantly less than granular urea applications. It is obvious that considerably more research is needed in this area.

*Efficacy*: Efficacy is the single most important aspect of the liquid vs. dry debate. There are a number of misconceptions that should be cleared up relative to both liquid and dry applications.

A. Liquid fertilizer applications provide only foliar feeding. Recent investigations at the University of California with urea fertilizers indicate that only a small portion of liquid fertilizers are absorbed through the foliage. True foliar fertilization of turf requires frequent application of low rates of nitrogen applied at very low spray volumes.

B. More surge growth is produced with liquid fertilizers than with granular fertilizers. Equal amounts of nitrogen from the same fertilizer source will produce equal amounts of growth.

C. Granular pesticides are not as effective as liquid pesticides. Granular pesticides have been shown to be as effective as liquid pesticides if application coverage is uniform. Particle size of granular pesticide materials is very important, due to the fact that the more uneven the distribution of the active ingredient the poorer the control response. Granular applications of pesticides may actually work better than liquid applications if liquid products are subject to ultraviolet effects and photodecomposition.

The answer to this controversy is "Liquid and Dry" not liquid vs. dry. Each operation must be evaluated relative to the results desired and the obstacles that exist with each of the application methods.

## PRINCIPLES OF COMMON SENSE TANK MIXING

Very often the question is asked, "Which pesticides can be combined and applied safely?" The usual answer is, "Refer to the label" and, "Have you checked the compatibility charts?" Applicators often want to mix pesticides in spray tanks to save labor and application costs. However, some mixtures can cause expensive problems. Plant phytotoxicity, mixing and application complications, and unexpected interactions between chemicals can occur, and are very real concerns.

Before entering the field to mix chemicals there are a number of pesticide regulations that must b considered and followed. Pesticides may be combined when (a) product labels do not prohibit combination, (b) when the target pest is listed on the label, (c) when the commodity is included on each label, (d) when the dilution rate of each is followed, and (e) when the dosage rate for each is not exceeded.

Two types of incompatibilities, physical and chemical, may be observed when mixing different pesticide and fertilizer combinations. Physical imcompatibilities can result in the formation of scumming, lumping and foaming in application equipment. Physical incompatibilities tend to be the most common and are often the most difficult to evaluate. Very often they are caused by incompatibilities between pesticide additives rather than selective active ingredients. An example of a physical incompatibility would be mixing a wettable powder, oil and water. Chemical incompatibilities occur when a chemical reaction in a mixture may increase or

decrease the effectiveness of one or both materials. These results may be additive or synergistic, enhancing the activity of the ingredient, or may actually decrease the activity of the ingredients. For example, combining Roundup with Surflan may reduce the effectiveness of Roundup depending on the growth stage of the target plant and the seasonal period.

An additional aspect of chemical incompatibility that may be separately categorized is physiological incompatibility. In this case plant damage may occur regardless of the compatibility of the materials. This physiological effect on the plant may allow excessive amounts of the cuticle and increasing penetration. Oils frequently act to increase penetration, making many pesticides more effective and, in some cases, phytotoxic. Plant phytotoxicity can also occur due to the action of solvents, wetting agents, and emulsifiers that increase the penetration of individual chemicals. Excessive pressure while spraying may also result in phytotoxicity, in which case the injury is actually a physical injury to the plant itself. Depending on age or the stage of growth, plants may also vary in susceptibility to physiological phytotoxicity. Age of individual leaves and leaf angle also influence the potential of phytotoxicity.

There is a best way to add chemicals to a carrier. First of all, follow label instructions. Keep equipment clean at all times and start with the tank one-quarter full. Start agitation. First, add wettable powders or water dispersible granules; agitate until well dispersed. Add carrier to the tank to 90% of capacity. Add liquid and then emulsifiable concentrates, if necessary, in the tank mix. Continue to agitate and top off the tank with additional carrier.

New materials and formulations are continually being introduced to the lawn care, landscape and golf course industries. If questions still exist concerning the compatibility of certain materials, even after reading material labels, reviewing compatibility charts and consulting with manufacturer representatives, there is a simple test that can be conducted in order to check the in-field compatibility of tank mixtures. This test is called the "Jar Test". The jar test method for determining compatibilities is a simple test using two quart jars. This method helps determine which products, when mixed, neither separate nor form unusable precipitates; however, it does not guarantee that the mixture is safe to use on plants. Plant phytotoxicity tests should always be conducted before large scale use with compatible mixtures. The procedure is as follows:

1. Use 2 clean quart jars with covers. Label on of the jars "with" and the other "without".

2. In a work area lay out the samples you are going to use for the test. The carrier (liquid fertilizer), the herbicides you are going to test, and a small amount of some available compatibility agent.

3. Add equal amounts of liquid fertilizer (approximately 16 oz.) to each jar.

4. To the jar marked "with" add 1/4 teaspoon compatibility agent. Stir.

5. Add 1 level teaspoon of herbicide to both jars. Follow the W-A-L-E sequence. This sequence relates to the addition of Wettable powder, Agitation, Liquids, and Emulsifiable concentrates. First allow the wettable powder to wet and disperse. Then shake gently to mix well.

6. If you are adding additional herbicides, add 1 level teaspoon of a liquid or emulsifiable concentrate to both jars. Shake gently to mix well. Let the mixture sit for 10 minutes.

7. Look the jars over carefully. Large flakes, sludge, or jell deposits found on the bottom of the jar, or oily deposits found on the top of the jar indicate incompatibility. If there is no sign of unusual deposits in the jar marked "without", then go ahead and continue with the work. If there are signs of incompatibility in the jar "without", but things look acceptable in the jar with the additional compatibility agent, use the compatibility agent in the tank mix. If both jars have sludge, oily deposits or unusual products present, then the mixture is not compatible and should not be used. Batches of fertilizer do vary; for this reason, it is best to conduct a jar test every time a new load or batch comes in.

## RECENT DEVELOPMENTS IN TANK MIXING

Recent tank mixing studies and field observations conducted by ChemLawn Research and Development have resulted in significant improvements in the areas of moss control, iron chlorosis in turf, iron chlorosis in trees and pre-emergent tank mix incompatibilities.

Liquid fertilizer products can now be mixed with fertilizer solutions and applied in liquid spray systems for control of moss in turf. Depending on rates and methods of application, control may occur within 12 hours. The addition of iron also produces a significant improvement in turf color.

Liquid iron products can now be mixed with fertilizer solutions and pre-emergent herbicides and applied in liquid spray systems for the control of iron chlorosis in turf. Significant improvement in turf color and vigor is normally noted within 7 days of application.

Liquid micronutrient products can be mixed with fertilizer solutions and applied in liquid spray systems for control of iron chlorosis in a number of tree species. Foliar and soil applications have resulted in significant improvement in leaf size,

leaf color and plant vigor. Such improvement may last for up to 1-1/2 growing seasons.

Beware of the potential of incompatibility between potassium fertilizer salts and commonly used pre-emergent herbicides. The separation of emulsifying agents may result in the potential for turf phytotoxicity.

## CONCLUSIONS

The liquid vs. dry battle will continue. However, the information presented by advocates from each group will continue to stimulate insight into the most efficient method of application as it relates to agronomic need, level of expertise and method of operation.

Proper and successful use of pesticides and fertilizers will ultimately be based on you and me, the operators and the advisors.

Always keep your eyes and ears open for new materials, new methods of applications and new ideas. Life in the landscape business and on the golf course has improved significantly in past years and can only continue to improve with the interest and support of groups such as yours.

# REFINING GOLF COURSE MAINTENANCE PRACTICES HAVE WE GONE TOO FAR?[1]

Larry W. Gilhuly[2]

"When against one's will, one is highly pressured into making a hurried decision, the best answer is always no, because no is more easily changed to yes than yes is changed to no."

Charles E. Nielson

Have you ever been in this situation? Does the request to have the greens 9′ to 9′6″ on a continual basis sound familiar? If so, welcome to golf course maintenance in the 1980's. With the advent of TV, golf played every week on nearly perfect golf courses peaked for the one week of the event. Regular membership players have become more demanding concerning maintenance practices that are sometimes questionable and, many times, detrimental to good growing conditions.

Have we gone too far in our golf course maintenance practices? Actually, there are two answers to this question. Yes, we have gone too far in some areas such as the great desire for "fast" greens on a year-round basis. In other areas we have not gone far enough, such as *Poa annua* control or *Poa annua* breeding and methods to reduce maintenance costs through breeding efforts.

## GREENS

Undoubtedly, the main area of concern and emphasis in the maintenance operations must be on greens. The ultimate goal is to provide the best putting surfaces possible given the soil, turf type, manpower, irrigation system, etc. But, what does the word "best" mean? To some it may mean greens as fast as possible. To others the speed may be secondary to consistency and smoothness. Still others are completely satisfied with slower greens that are smooth and covered with grass. It is in the area of putting green speed where pressure has been, and continues to be, applied.

How many of us have had the comment, "Make the greens as fast as possible." This request is many times made irregardless of the negative effects that occur for actual growing of the grass plant. In some cases, it can be done due to the mild climate and lack of play. For example, Cypress Point Golf Club in the Monterey Peninsula area has a mild climate with only 13,000 rounds of golf a year. Under these conditions they have gone from a speed of 7′4″ to 8′2″ in 1976 to an average speed of 9′6″ to 10′ in 1986. The only problem with this information is that very few, if any, clubs have this small amount of play; yet, those who have played Cypress Point come back to their home club and want the same results.

This is simply not realistic and should not be the goal of the superintendent or club.

## SPEED AND THE USGA STIMPMETER

In 1976, a new tool called the USGA Speedstick (Stimpmeter) was used to determine a standard by which putting green speeds could be judged. In 1976, the average speed of putting greens was 6′6″ across the nation. The slowest greens were found to be approximately 4′11″, while the fastest were approximately 8′6″ in the western United States. It is interesting to go back and review some of the speeds at various clubs in the western United States. For example, in 1976 the average speed at Seattle Golf Club was 7′6″, Broadmoor Golf Club was 6′11″ to 7′6″, Eugene Country Club was in the 7′ to 7′1″ range, while Waverley Golf Club was 6′ to 7′, Pebble Beach 7′6″, Los Angeles Country Club 6′9″ to 7′4″ and Cypress Point Golf Club 7′4″ to 8′2″! By today's standards, many of these greens would be unacceptable. Personally, I feel a speed of 7′6″ to 8′6″ will provide plenty of speed for regular membership play and if more speed is desired, simple double mowing should be adequate.

When one looks at these readings and compares them to greens found today in the West, it is easy to point the finger of blame at the Stimpmeter itself. This is true to some extent; however, the blame can be equally shared by overzealous club members, green committee members, professionals and superintendents alike that have gotten into speed wars with neighboring clubs to have the "fastest greens in town." As a result, we have seen an increase in moss invasion, disease and weeds on putting surfaces that are being mowed lower and lower with less and less nitrogen. It is time that golf courses begin to return to more reasonable speeds and healthier turf.

## METHODS TO INCREASE SPEED WITHOUT LOWERING MOWING HEIGHT

There are basic programs that have been discussed for several years in regard to increased putting green speed without lowering mowing heights. The standard method many superintendents have used recently is a light and frequent topdressing program. A recent study completed at the University of Nebraska by Dr. Robert Shearman indicates that ball roll was significantly greater on turf receiving light and frequent sand topdressing than on those receiving the traditional aerification and topdressing treatment. In addition to this finding, there are other interesting ramifications from the light and frequent topdressing program. Basically, disease increased with the light topdressing program and became less severe when surfactants were used.

While the results of this investigation are not entirely conclusive and long term effects of light topdressing need to be further studied, there is certainly the indication from this study that if the light and frequent topdressing program is used to

increase speed, the superintendent should be aware of increased disease potential and should be prepared to use surfactants to decrease soil surface water content and increase infiltration rates.

Another area where we may have gone too far is in the application of nitrogen fertilizers. While it is not seen as much in the West, back in the eastern United States reports as low as 1 to 1-1/2 lb/1000 $ft^2$ nitrogen/year are resulting in problems on greens. Realistically, a light and frequent application rate during the growing season with a total annual nitrogen application in the 4 to 6 lb range per 1000 $ft^2$, and slightly higher on sand greens, is suggested.

## MEMBERSHIP DESIRES

Realism or fantasy? One of the most difficult situations for a superintendent is to have a membership that desires perfection without providing the equipment or manpower to reach those goals. One of the areas that has come full circle in putting green maintenance has been a return of the walking putting green mower. While a case can certainly be made for the speed of the triplex mower and its necessity on golf courses that have early morning play with a small crew, more and more clubs are turning to the walking green mower for improved playing conditions for its membership. The triplex putting green mower is absolutely necessary in many golf course situations; however, walkers simply provide less compaction, less vertical mowing, and better all-round playing conditions. If the membership desires the very best in putting greens, this is the one area they should be led.

## TEES

In regard to tees, I think we would all agree that close-cropped, firm teeing surfaces are very desirable. Again, it gets back to how much will the membership provide for these results. Basically, tees should be treated as close to greens as possible. Aerification should be done at least two times per year using 5/8-inch tines, cross removed and then topdressed and overseeded. Weeds should be controlled and I completely agree with the idea of seeding divots whenever manpower is available for this operation. Some clubs have gone too far and require divots to be filled on tees and fairways in spite of other needed operations on the golf course. While filling divots is certainly an important program for good teeing surfaces, when there is a manpower shortage, the overseeding of tees should include the membership. Whether it be done with individual buckets of sand/seed placed on the tees (with a good lid) or on individual golf carts, this is one method where the membership can be helpful.

There is one area in tee maintenance that I feel is going too far. There are some courses in southern California and other areas that have begun mowing their tees with walking putting green mowers. While small, hard-to-reach tees can be mowed in this manner, the use of triplex putting green mowers is much preferable to a

walking mower. This is simply too much TLC to be given an area that, while important, does not warrant this amount of extra labor.

## FAIRWAYS

In the hypothetical perfect round of golf, one-quarter of the shots are hit from the teeing surface, one-quarter from the fairways and one-half on the putting green. From a playing standpoint, many feel the fairways are as important as the teeing surfaces in a round of golf. Fortunately, fairways are so much larger than teeing surfaces they have not received the extra maintenance that tees receive. Here again, it depends on what the club wants in regard to fairways. If the club has the money and desires the very best in fairway playing conditions, then fairways can be mowed with triplex mowers, clippings removed and bentgrass can be promoted in the cooler climates. Club membership must understand the amount of extra labor this will involve and provide the extra manpower needed to compensate for the extra labor on fairways. If this is not done, you can expect areas such as lakes, trees, clubhouse area, etc., to get less attention and affect the visual characteristics of the course. Basically, the trade-off is better playing conditions for slightly less visual effect.

In addition to triplex mowing, the use of walking putting green aerifiers has been used by several courses with very good results. When this is combined with topdressing of fairways, the results can be dramatic. However, is this too far to go in the maintenance operation? In the question of aerification and topdressing, I do not feel this is too far for those clubs that can afford it. It is certainly too much to expect from most golf courses.

In regard to triplex putting green mowing and clipping removal, this is out of the question for 95% of the clubs in the United States. Undoubtedly, triplex mowing increases bentgrass, provides much better fairway playing conditions, reduces compaction, and provides a very dramatic visual effect on the course. However, when it begins to affect other areas of the course that require high maintenance (bunkers, areas around greens, tees and surrounds, etc.), then we have simply gone too far in this maintenance practice.

As an alternative to triplex mowing, many clubs are going to the 5-gang concept with equally good results and much faster speed. Personally, I feel the 5-gang unit is the answer between the smaller triplex and heavier 7-gang units of the past. With reduced fairway size and contour mowing, the 5-gang units can be very effectively used to produce the same results as triplex mowers in half the time.

## MOWING HEIGHT AND FREQUENCY

Have we gone too far in our desire for "tight" fairways? If you are a superintendent in Kentucky bluegrass country, many times the answer is yes. However,

I have seen some outstanding Kentucky bluegrass courses in the State of Utah that are consistently mowed at 3/4 inch and produce some of the best playing conditions for fairways I have viewed in the western United States.

The key to their operation, however, is the fairways are mowed at least five times a week. This goes back to the question of what does the membership want and how much are they willing to pay. Mowing Kentucky bluegrass at 3/4 inch five times a week will certainly give extremely playable fairways without problems of *Poa annua* and bentgrass invasion into the turf. To desire lower mowing heights with less frequent mowing is counter productive to proper growing conditions for this turf species. In a case such as this, the superintendent must relay the information to the membership and have complete communication so they understand the side effects of mowing height with this type of turfgrass.

In regard to other cool season grasses, it again depends upon what the membership desires. Basically, a mowing height on fairways of 1/2 to 5/8 inch will provide the best playing conditions for the entire membership. Mowing heights higher than this cut three times per week can many times result in "flyer" lies. This leads to the natural request of members to soften the greens as their downwind three wood, from a 1-inch cut fairway, using a Pinnacle golf ball, with Ping clubs will not hold the green. It is the responsibility of the player to stop the ball, not the responsibility of the putting green! To help the player, the fairways should be kept below 3/4 inch if mowed three times per week.

What about those courses that have gone under 1/2 inch for fairway playing conditions? Provided the membership desires this type of playing condition and the club has adequate irrigation and mowing equipment, there is nothing wrong with this operation. A good example of this are the outstanding fairways being maintained by Mr. Bill Campbell at Sahalee Golf Club in Redmond. Superintendent Campbell is currently maintaining the fairways at 3/8 inch with outstanding definition between the fairway and the 1-1/2 inch rough. While this mowing height may be too short for most country clubs, it appears to have been very well accepted at Sahalee.

## SUMMARY

The golf courses most affected by the new trends in intensive maintenance practices to improve playing conditions are not the high priced country clubs. Those courses that have moderate budgets (or less) with memberships who desire the "country club" look are most affected by these practices. Private clubs with high budgets that use walkers on greens, triplexes on fairways, aerify fairways with walking putting green aerifiers, utilize modern computer-based irrigation systems, purchase and maintain good equipment and have adequate manpower certainly raise the level of maintenance on their courses. It is when members of the "smaller" clubs visit these courses and return to their home course that problems can some-

times occur. On those courses that can afford it, many of the maintenance practices being done today are not too far. On those that can't, these same maintenance practices are completely out of the question. It is up to the superintendent to get this point across, using any means available, that golf courses simply cannot be compared and no golf course is in "perfect" condition every day of the year.

In an excellent article written by Mr. James T. Snow, Director, Northeastern Green Section Region, titled "Who said, The grass is always greener...", he makes two important points. First, no golf course is identical to any other. Second, no golf course will *always* be in excellent condition.

If many of today's players sit down and ponder these statements, fewer problems would result from the inevitable comparisons.

# DEVELOPMENT OF NEW HERBICIDES FOR CONTROLLING BROADLEAF WEEDS: POSTEMERGENT ACTIVITY OF TRICLOPYR FOR BROADLEAF WEED CONTROL IN TURF[1]

Mark M. Mahady[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Western States Zone Research Scientist, Chemlawn Services Corporation, Monterey, CA.

Triclopyr is a pyridine-based systemic herbicide which is effective for control of broadleaf weeds, including several species such as ground ivy, wild violet and *Oxalis corniculata*, which are characteristically resistant to chlorophenoxy herbicides.

Triclopyr is a systemic, selective herbicide that is absorbed via leaves and roots, is readily translocated, and exhibits an auxin type herbicide response. Triclopyr is nonvolatile as an acid, is highly water soluble and is not highly adsorbed by soil particles. It is readily degraded by soil microorganisms and exhibits a half-life of thirty days.

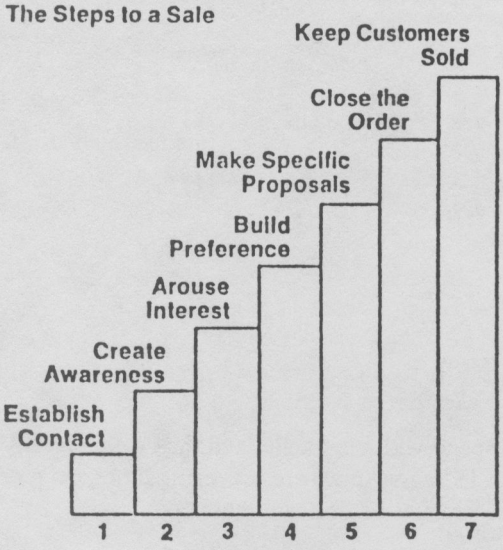
Triclopyr will control many different broadleaf species, but must be tank-mixed with other phenoxy herbicides for broad spectrum weed control. Turfgrasses differ in their tolerance to triclopyr applications. In general, cool season turfgrasses are more tolerant than warm season turfgrasses.

# ADVERTISING AND PROMOTING YOUR BUSINESS[1]

Kathy Copley[2]

[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Editor, Grounds Maintenance Magazine, Overland Park, KS




*The Steps to a Sale*

Why advertise? Because it annoys your competition is not a good enough reason. Better ones are that advertising makes first contacts, opens doors, and presells. Some other good reasons are to find new markets for exiting products or to introduce new services, to build demand for your product, to keep in touch with customers your salesmen can't call on, to pave the way for salesmen's calls, to maintain contact with customers between sales visits, to educate prospects, to raise buyers' standards, and to create a corporate identity.

As your salesmen in print, advertising plays an important part in establishing contact, creating awareness, arousing interest, building preference, and keeping customers sold. Salespeople can most effectively perform steps 5 and 6, making specific proposals and closing the order.

One of the roles of advertising is to generate leads. The majority of all inquires have not been contacted by a sales representative prior to their first inquiry; 6.3% have been contacted prior to their inquiry; 93.7% have not. One-eighth of all inquiries lead to a sale.

The goal of your marketing program is to develop interest in your service in general and your company in particular. In this quote from *Henry IV*, part 1, one character says, "I can call spirits from the vasty deep." A second replies, "Why so can I, and so can any man, but will they come when ye call them?" Your goal is to increase the certainty that they will come when ye call them.

Part of the uncertainty stems from the fact that yours is only one of the messages that your audience is being exposed to. In the 15 years between 1967 and 1982, ad messages increased dramatically.

| | | Presented | | Received |
|---|---|---|---|---|
| Newspaper display ads | Up | 31% | Up | 5% |
| Radio commercials | | 113% | | 53% |
| Magazine ads | | 87% | | 27% |
| TV commercials | | 140% | | 78% |
| Aggregate increases | | 103% | | — |

The time people spend with the media, and thus with advertising, has changed very little in the last 15 years, so we are squeezing more and more units of advertising into the same amount of time and attention.

To get yourself noticed in this plethora of messages, you need a distinct and professional image. The place to start is with a good name. I realize that most of you have a company name, but I stall want to share my favorite name with you: LAWN RANGERS, first in lawn and order.

Once you have the name, you need a good business image. A good place to start is with a well-designed logo. The most successful logos are ones that have: simplicity, instantly relate to your services; adaptability, from business cards to trucks to people; character, looks as good in black and white in a newspaper as they do in color on your direct mail pieces; longevity; printing ease, is it bold enough to reproduce well on paper the quality of newsprint and Yellow Pages. Once the logo is familiar, you could misspell it and few would notice. If you want someone to make the actual logo to go on your equipment, Dice Decal Corp. of Middlebranch, Ohio is one of the companies that can do it for you. It isn't cost-effective to have a decal made for just one truck, but for 10 to 15 decals, the cost is $200 to $300 per vehicle. That sounds expensive, but a truck on the road 8 hours a day in an urban area creates 16 million visual impressions a year.

Marketing is the efficient coordination of a product or service with a promotion,

price and place (channels of distribution). The coordination of the four P's is essential before you can hope to achieve the fifth P - profit. We are assuming throughout this discussion that you have a good product. The idea of this whole session is to talk about promotion. How important is price in the success of your promotion efforts?

Most advertising professionals agree that it is wise to include price in the promotion—so the prospective purchaser knows how much money he needs in his pocket. It keeps him from being embarrassed. Explain an unusually low price; clearance, extra-large shipment. Explain an unusually high price; unusually high quality, long-term guarantee, unique service. Price is a major factor to 40% of the people. It is less important to 40% and low on the list for 20%, who spend the most on their lawns according to the Nursery Marketing Council. If you feature low price as the only reason a customer should buy from you, you had better have the lowest price in town. Otherwise, the customer will just do a little math and go to the guy who is lower, and you will have advertised for your competitor.

You are ready to develop the elements of a marketing plan: company and competitive analysis, market potential, growth goals, action plan, and review. Before we get into the specifics of a marketing plan, let's take a quick look at why they fail. Lack of consistency, effective advertising requires an ongoing commitment, not just when there are extra funds. Spreading too few dollars over too ambitious a program is another reason. Expectation of an immediate profit payback from the marketing investment, marketing has a cumulative effect. Inappropriate marketing plan goals, plans should focus on such things as number of customers, number of first-time orders, repeat orders and other quantifiable goals.

When you analyze your company and your competition, ask yourself some of these questions. Where am I and where do I want to go? Who will my new customers be? What do they want? How many firms in my area provide the same service? Do they appear to be prosperous? Do they have any apparent advantage over me? How many similar firms went out of business last year? How much does my competition charge for its services? How am I better than my competition? What image does my company project? What will motivate the customer to buy from me? The answers to that last question are usually price, professionalism, personal attention, years of experience or education.

It appears to be simple to evaluate the market potential because it consists of very quantifiable information: sufficient population, sufficient per capita income, good economic climate - employment rates, tax rates, building starts, favorable government regulations - local ordinances and zoning regulations. Too bad it isn't that easy. Regardless of these factors, how many potential customers do you have? To answer that question, you have to know what makes someone a potential customer.

The typical customer chooses to use a lawn service for convenience, because of neighborhood peer pressure, or concern about chemical safety. In 52% of the households, the lawn service decision-maker is the woman. The more well-off the household, the more likely it is that the decision will be made by the woman. Eleven percent do their own maintenance in addition to yours; 82% of your customers are probably satisfied with your service.

Where can you find these new customers? Aside from the suburbs, your new customers will be: people buying from others, new arrivals in town, people you failed to sell last year, new home buyers or remodelers, people in areas you haven't worked before, someone else's dissatisfied customer, referrals from present customers, prospects starting new businesses, customers suddenly free of major financial responsibilities like college tuition, wherever you were sure no new customers could possibly exist.

There is no simple method to amass the data about exactly where these people are. You can collect bits and pieces from United States census reports, local census reports, media demographics, the geographic area from which you have drawn your present customers, or driving through town.

The Small Business Administration has several programs that may help you develop this information. SCORE (Service Corps of Retired Executives) and college marketing class projects are two possibilities. The SBA also sponsors advertising seminars. One three-hour program costing $5.00 is called "Advertising for More Profit."

When you formulate your growth goals, you will combine what you have learned about your company's position in the market, your competition and what they are like, how many there are, and your market potential.

Next comes developing the action plan. To do that, you have to evaluate the media habits of your target customers, establish a budget, develop the message, establish frequency, and plan to test the ad program. If all of your competitors have already evaluated the media habits of their target customers, then you should be placing your ads where they are placing their ads. Here are some suggestions: Yellow pages, 70+%; referrals and rebates, 70%; direct mail, 45%; newspapers, 45%; personal solicitations, 25%; door hangers, 25%; door to door solicitation, 19%; radio, 15%; home and garden shows, 15%; television, 10%; billboards, 3%.

Even if you believe that your competitors are in the right media, you will need to decide which radio station, what newspaper, what times of day and days of the week. The radio stations, TV stations and newspapers should be able to tell you a lot about their listeners, viewers and readers. You need to compare that information to the demographics of your typical customer.

A radio station in Kansas City recently released this information about its listeners: 29% are college graduates, 86% own their own home, more than 16,400 own a home computer or intend to purchase one, most are multiple investors and own cars they purchased new, 100,000 go to a "fine dining establishment" at least weekly. More than 42% either do not take a daily metropolitan paper or spend less than 15 minutes reading it. You can expect similar information from your major radio stations.

Now that you know where you want to be, find out the approximate costs involved and project a budget. The average advertising expenditure in the lawn service industry is 4% of gross receipts.

You know where to put the message so your target audience will see or hear it. You know how much you have available and want to spend. Now you have to develop the message. The "Advertising Effectiveness Program" developed by the American Association of Nurserymen suggests these things.

1. Make your ad easily recognizable. Develop a style of type, illustration or artwork and stick to that style.

2. Use a simple layout. The reader will go on to something else if you make it hard for him.

3. Use a dominant element, strong headline, illustration or other feature to get quick attention.

4. Use a prominent benefit headline that answers the question, "What's in it for me?" Many ads have no headline at all, but the Nursery Marketing Council says that five times as many people read the headline as read the rest of the copy.

5. Put the reader in the picture. Perfume and aftershave ads don't sell smell. They sell success and sex appeal. The same is true of automobile advertising; it creates an attitude about the person who is so perceptive as to buy this product.

6. Let white space work for you. Just because you paid for it, you don't have to fill every square inch with ink.

7. Make the copy complete, but don't forget rule 5. Use action words. Give the main message in the first sentence. Keep the sentences short—8-10 words.

8. State the price, 80% of your customers at least want to know the price, even though it may not be the strongest motivating factor.

9. Specify brand-name merchandise, to get the benefit of advertising done by the manufacturer. People recognize names like Ortho and Toro. If you use their products, capitalize on their advertising.

10. Include related services, but the thrust of the ad should be a single product or service.

11. Include name, address and phone number.

12. Urge the reader to act now.

These are elements of a good copy, AIDCA: attract Attention, develop Interest, Describe the product, Convince the reader, get Action.

Who can develop the ad for you? Do you need professional help to develop a clear promotional message, to put it into printed form and place it where your prospective customers will see it? Probably yes. Can you put together an attractive and effective advertising package without professional help? It is harder, but it can be done. If you can't afford an agency, get help from teachers at your local college, in advertising, art, or both. The media you select, especially newspapers and radio, have staffs that can help you.

If you work with an agency, be prepared; you are paying by the hour. Be honest about how much you can spend and your market share. Be open about what you like and don't like that the agency has developed. Listen to the experts you hired and follow their advice. The client should be dominant in what is said; the agency should dominate how best to convey the ideas. Perception Research Service says the average cost of developing a full page black and white ad by a professional advertising agency in 1983 was $3,410 including all costs for text, graphics, layout, photography, retouching, stats and typography. If that is too rich for your blood, remember that many agency people freelance.

How often should your message reach your target audience? More often than you think. In the 19th century, a fellow named Ebbinghaus developed this curve of forgetting. It has been confirmed repeatedly. Within 30 days we forget 90% of what we were told. A Westinghouse study showed that maximum recall needs five repetitions. An ad manager to whom I talked says that a customer needs to hear or see your message three to four times a week. A national marketing communications consultant says that very little is achieved unless the customer is exposed to five messages and that requires more than five ads. The old ad philosophy said three hits which may require a dozen or more ads. Remember that frequency has two roles: extend reach - more individuals have a chance to see or hear it, and increase exposure - because it takes three to five exposures to get action.

The last step in the marketing plan is review - evaluating the effectiveness of

your message and your media choices. Put a code on coupons to test; morning vs. evening, drive time vs. non-prime time, days of the week, one ad vs. another ad in the same paper on the same day, the same media group (newspapers) but a different newspaper on the same day. Make two different offers to test the factors we have just mentioned. Date each coupon so you can evaluate the holding power. How long does it take for people to take action on your ad. Ask people to request information on two different services, "Ask about our renovation program" vs. "Ask about our late fall fertilization program". Keep track of calls and walk-ins mentioning the ad.

Asking new customers how they heard about you can help you test your ads as well as tell you how well you are doing on personal referrals from satisfied customers.

Let's say you evaluate the ad and it isn't producing results. Is it the ad? Is the copy clear? Is it presented well visually? Is the illustration of a size to attract attention? Is it the choice of media? You won't sell much lawn servicing on a hard rock station or through ads in an underground newspaper. Is your message too visual for radio? Have you placed it in the best media? Is it the timing? Do your best prospects only listen to dive-time radio and watch prime-time TV? Are you presenting the ad at a time other than when your customer is ready to buy? Lawn care is not on everyone's lips in November. Is it lack of frequency? You might have a good message at the right time of day in the right media, but you need repeat exposures to generate action. You may be calling the spirits from the vasty deep, but are they coming when you call them?

An effective ad can get stale. Mr. Whipple has been selling Charmin for 18 years, but the campaign is being replaced. John Cameron Swayze sold Timex watches for 22 years. He doesn't represent them now. On the other hand, the Maytag repairman has been lonely for 17 years. The Marlboro man has been riding the range for 20 years. The only changes have been in the cowboy, typeface and layout. If your campaign isn't working, change it gradually if you change it at all; don't sacrifice the identifiable character - illustration, keep a familiar logo, illustration, typeface.

It may be that your ads are doing well, but you are considering cutting back on advertising for financial reasons. *Hardware Retailing* magazine reported that businesses that cut back on their advertising in the mid-70's recession experienced a loss of product awareness and subsequent loss in business after the economy recovered. A better solution is to examine your present program to see if the money you are currently spending is getting you the biggest bang for the buck.

Now we get down to the ads themselves. What do good ads and promotions look like? What information goes into these choices among media and days of the week and times of day? Starting with the yellow pages, which 3/4 of you use. . . Chilton

Research says that over a 12-month period, 112 million people use the yellow pages (81% of adult population), that results in 3.9 billion references a year, 80% of the references result in action: letter, call, visit, and that both sexes use the yellow pages equally—81.5% of the men in the country and 81.8% of the women, also 60-80% of the people who use the yellow pages have the name of a specific firm in mind. Yellow pages give you a chance to make an impression on people who don't know of your service; newcomers, someone else's dissatisfied buyer, comparison shoppers.

The yellow pages communicate best when these items are present.

1. You include complete information. Be as complete as possible; 67% of us assume that if your ad doesn't say you have it or do it, you don't—and 73% of us won't call to find out.

2. Your ad appears under several headings—lawn maintenance, landscape contractor. You don't know how the potential customer will try to find you.

3. Your ad is as large as possible. An ad twice the size of the standard 1/4 page wide ad will draw five times the results at an actual cost per response that will be 60% less. An ad four times the standard will product 15 times the results and the actual cost per response will be 73% less, or 193 times as many responses as the standard ad. In Kansas City, an ad 1/4 page wide and 1/2 inch high is $36.785 a month, or $441.00 a year.

Close to half of you use direct mail. It offers unique selling advantages because it is personal, it doesn't demand an immediate answer (like telemarketing does), it provides more information than TV, etc., people like getting mail (most people like being on mailing lists). Older people respond to direct mail more frequently than young people. Rural people respond more than urban people.

January is the best month of all for direct mail responses across the direct mail industry. Third class mail is growing faster than any other segment of the mail. By 1987, it will make up 30% of all mail, up from 25% in 1980. The usual response to direct mail is 2-5%, and you should get 40% acceptance from that 2%. Response today is less than five years ago.

What should you mail? A piece that you or an agency develops, or literature made available by your suppliers, (eg. Nor-Am, Mobay, PBI/Gordon). Materials from professional organizations like ALCA are all good to mail.

Whatever you mail, begin with a good list without duplications. People don't like to get duplicate materials. Time the mailing for the season of peak decision-making. Reach the target audience up to three times with the same promotion. Reach them over an interval of no more than three weeks. Use an odd-size envelope that

meets postal standards, it will stick out from the rest of the bills in #10 envelopes. There is disagreement over first class vs. third class. I have to agree that few people check how it was mailed, so I would use third class. Convey your message in the fewest possible words. End the piece by urging the recipient to act now. Tell us to lick the sticker, move the token, fill out the postcard. To get people to act now: give a time limit. Deadlines get good results. You can expect 75% of the people who will respond to do so within the first three weeks. Give a bonus for prompt action, offer a guarantee, accept telephone and credit card orders, include a postage-paid order form or return postcard, offer a premium-plant food, free lawn analysis, etc.

Half of you advertise in the newspaper. You use local suburban papers more heavily than you use metropolitan papers. You might make that choice because of cost or because you don't want to generate business in areas of the city that are too far away for you to service. There are other good reasons. Nationally, 31% of the households have an income of $25,000+; 46.6% of suburban households have an income of more than $25,000; their circulation is growing, taking your message to new people. The circulation of daily papers has held steady at 62 million for the last 15 years; weeklies have increased in circulation from 27.9 million in 1970 to 45 million in 1982. For every 100 people who live in the city, 141.5 live in the suburbs, and 34% read their suburban paper on two or more days.

Newspapers are a good vehicle because they offer local coverage, precise timing, lend themselves to promotional tie-ins like coupons and contests, have someone on the staff who can help you put your ad together; they have the tools-types and illustrations to actually create the ad for you, and they can give you a split run: one ad goes to one part of town, another goes to a second part of town on the same day so you can test the ads effectiveness.

Here are some things that will help your ad to be noticed. Morning papers seem to pull better than evening papers. Smaller editions (Monday and Tuesday) seem to pull better than big editions (like Sunday). Food coupon days get high readership, so they are good for you (usually Wednesday or Thursday). The farther forward, the better. The top half of the page pulls better than the bottom half.

Radio is not as popular, presumably because of its cost and because it goes to areas you are not prepared to service. Nonetheless, it is a very effective medium for carrying your message. The higher a person's income, education and managerial responsibilities, the more likely he or she is to listen to radio news.

To make the message work, write a conversational message, human being talking to human being. Get the listener's attention in the first five seconds. Have readers create their own coupons: "Draw one and bring it in."

As a potential recipient of your sales pitch, let me say that I don't like tele-

marketing. Nonetheless, telephone sales are big business. In 1982 telephone selling generated $65 billion in sales, making it number one in total estimated direct response advertising expenditures that year. Direct mail was second.

One-third of you use door hangers or fliers. Your own personnel can put them on doors or you can hire organizations to do it for you. Some of the major suppliers to your industry provide them with or without personalization - Mobay and PBI/Gordon, to name two. The last several years have seen a tremendous growth in coupon services that deliver packets or pages of coupons through the mail or as door hangers. Just as on newspaper coupons, you can vary the coupon to test its effectiveness, Coupon A drew better than Coupon B. You can also evaluate its geographic success, from what part of the city did the coupon bring responses. Discount coupons or coupons that offer something free, like a calendar, are proven to appear to everyone from bank presidents to teenagers.

We have talked about the tremendous number of advertising messages aimed at the same members of the target audience. Your audience and your competition's audience are basically the same; you can give yourself an edge if you bring your message to the audience in a new, less than traditional way. Here are some ideas. Billboards; Gannett Outdoor Group says 62% of all women are exposed to outdoor advertising. Because 50% of the people who decide to use your service are women, that might be a good choice. Signs on landscapes you are installing and later maintaining. A lawn service in Florida routinely places a sign after they have sprayed, not as compliance with a local regulation, but as advertising. A maintenance service in Des Plaines, Illinois leaves boxes of imprinted matchbooks at local banks, service stations and pharmacies. A regional ad in a national magazine like Time or Better Homes and Gardens. The cost is about 1/2 the cost of a direct mail piece. Consumer magazines are a proven audience, they reach an up-scale audience, they are kept long after publication date, you get good color reproduction, the ad assumes some of the magazine's credibility and prestige. A Memphis lawn service works with a local bank. For opening an account of a certain size, the bank gives the person a free chemical lawn treatment rather than a toaster or calculator. Participate in local garden shows at malls and exhibitions. Send Christmas cards and thank you for your business cards. Submit press releases to the local paper on personnel moves, awards won, major contracts won. Write a continuing gardening column for the local paper. Speak at garden clubs, civic organizations, etc. Be a guest on or have your own radio gardening show. Work with the welcome wagon to include information of your service in their packet of information and coupons. Maintain good contacts with realtors and target new home buyers with a special promotion. Create a lawn care hotline on which people call in to ask questions or hear a changing weekly message. A contractor in the Carolinas has an estimate sheet he mails to owners of poorly maintained properties. It tells the owner what he would do and how much it would cost. Keep your name in front of current customers so they don't forget you. Convey your name and professional image on your bills and estimate forms. A lawn service in Michigan offers

a finder's fee to current customers who successfully refer someone. Use educational pieces distributed as door hangers, direct mail, or with the bill. They can become part of the customer's permanent collection of information, and they have your name on it or your business car attached. Do your own, use extension materials, use those developed especially for you by lawn servicing magazine or from commercial companies like PERFCO (85 Quick Road, New Carlisle, OH 45344 (513) 845-3897.

Newsletters to your actual and potential customers can contain company news like awards won, personnel changes, charitable involvements, general lawn and garden care, a calendar of meetings of nearby garden clubs and other organizations interested in landscaping, a return postcard subscription form so a happy recipient can give it to a friend. Commercial companies like Green Pro Cooperative Services (380 S. Franklin Street, Hempstead, NY 11550) (516) 538-6444 NY res., or (800) 645-6464 will personalize a more or less standard newsletter appropriate for your part of the country.

# DEALING WITH CUSTOMERS— ESPECIALLY ONES WITH COMPLAINTS[1]

Kathy Copley[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Editor, Grounds Maintenance Magazine, Overland Park, KS.

You don't have to own a lawn service to have customers. Some other options are: golf course, members and green committee; university, faculty, administration and alumni; hospital, physicians, patients and visitors; industrial sites, owners, employees and their customers. Whatever audience you serve qualifies as your customers. Your job is to give him his money's worth. When he doesn't think he is getting it, you will hear from him. Business goes where it is invited, stays where it is well-treated, and grows where it is cultivated. Whoever your employer, growing your business is your business.

As a businessman, consider the increase in profit if you didn't have to allocate any resources to making good on a customer complaint. As a superintendent, consider the savings in your time if you didn't have to follow up on and satisfy complaints. This makes the first step in handling complaints handling customers so they don't complain. As a businessman, you might be more committed to this process if you knew what it costs to get and keep a customer vs. what it costs to recruit a replacement customer.

Two years ago, the commonly accepted figure to recruit a new customer was $30.00. Today, that cost is fast approaching $80.00. Further, if you could compare complaints to dollars, it costs $20.00 in good PR to overcome $1.00 in bad PR from a dissatisfied customer. Another generally accepted figure is that it costs five to six times as much to get a new customer as it does to keep a current one through a good customer maintenance program.

The industry accepts the average retention rate as being 80-85%. To make these numbers work for you instead of against you, you need to work on a program that avoids customer attrition.

Every business can learn from these lucky 13 tips that appears in *Garden Supply Retailer* magazine.

1. Know your business.

2. Know the customers' business.

3. Anticipate your customers' problems.

4. Solve at least part of the problem.

5. Make promises realistically.

6. Be a team member.

7. Help the customer become a hero.

8. Feed your customers' ideas.

9. Be truthful.

10. Use your time productively.

11. Innovate.

12. Communicate fully and clearly.

13. Serve, and serve willingly.

Doing these things involves your employees actively because your employees are the most important people in your business and your customers are the most important people to your business.

Taking this idea of employee involvement a step further, be aware that every employee is a salesperson. Make employees aware that they are all salespeople. Teach them about your products' uses and advantages. Encourage employees to be customers themselves. Provide incentives for "unofficial" sales people.

Here are some things that people in other industries have done. Georgia Power's monthly newsletter has a column titled "What should I say if my neighbor asks. . .?" Chase Manhattan Bank had a "service with a smile" campaign. "Mystery customers" awarded tickets to entertainment events to employees who served them with a smile. Other companies have employee training programs to help employees learn how to disarm angry customers and how to handle legitimate and perceived complaints.

A customer relations panel discussion last year at the Central Plain Turfgrass Foundation meeting yielded these suggestions on cutting customer attrition. Offer good service at a fair price. Show as much stability as you can, little employee turnover and minimal changes in your office location. Recognize the importance of personable, knowledgeable applicators. They are your link to the customer. Know enough to be able to tell when the complaint is your fault and when it isn't. Sometimes you really did kill the tree. Seek feedback. Perf-A-Lawn in New Carlisle, Ohio sends out "You be the Judge" cards that ask such questions as: how were

your treated when you first called Perf-A-Lawn; has P-A-L lived up to your high standards; how has your lawn looked this year; has our service been prompt and professional; how did you originally hear about P-A-L; what other service would you like P-A-L to offer.

A Philadelphia estate maintenance company has employees ask their customers if everything is satisfactory at least once a week. Instill confidence.

The last suggestion for cutting customer attrition is certainly the most important. Educate your customers to have realistic expectations. The single greatest source of customer dissatisfaction seems to stem from their perception that all they have to do is hire you and pay your bills to have a lawn that looks like the picture on your four-color direct mail pieces. If your advertising program is typical, you use words and pictures that create a kind of implied guarantee that if I pay your $175.00, my lawn will look like the cover of *Better Homes and Gardens*. While you are actively selling us, you do little to dispel the notion that you are selling weed-free and care-free. In truth, lawn care is neither. Lawn care is clearly at least a partnership and more likely a triumvirate—you, me and Mother Nature. In virtually no other business is the businessman so dependent on the client for ultimate success or failure. You can't do anything about nature, so you had better be sure that at least two-thirds of the partnership is working together.

An increasing number of companies are finding ways to create more accurate expectations: newsletters, door hangers, bill inserts; Puget View newsletter, do not water for at least ____ hours; bag grass clippings; here's what we did; here's what you should do; lawn maintenance errors, cutting too high....

If you aren't prepared to develop these materials yourself, you can use extension service materials, pamphlets like those prepared by lawn servicing, newsletters printed commercially and personalized for your company and geographic location, (Green Pro Cooperative Services, 380 S. Franklin Street, Hempstead, NY 11550, 516-538-6444, NY residents, or 800-645-6464), personalized and generic literature from national companies (Perfco, 85 Quick Road, New Carlisle, OH 45344, 1-800-543-0900, or in Ohio 1-513-845-3897).

A second method is offering two or more maintenance programs with names like economy, suburban and estate. Suppose the lawn is really bad and if it weren't for the crabgrass there would be no grass at all. Killing the only green thing he has won't make that customer happy. You might want to put him on the economy program this spring, keep it green with a fertilizer program designed to encourage the desirable species. Next fall, you would work with him to dethatch and otherwise renovate. You know that a bad lawn didn't get that way overnight, and you can't improve it overnight. It may take several years to bring the lawn back. You will be doing your customer a service if you help him know what each of you has to do between here and lush, green, and healthy.

One of the things you are selling, one of the reasons people have you do their landscape work rather than doing it themselves, is that you have the credible, professional answers. When I pay my $175.00 I think I am buying an expert. Aside from performing agronomically appropriate work, you can enhance your image as an expert with things that signify your professionalism, with clean cut, uniformed employees; clean, well-maintained vehicles and equipment; professional business practices such as professionally prepared business stationery, a person rather than a machine to answer the phone, babies crying in the background does little to encourage respect for your skills; a business address rather than a P. O. Box, I like to think I could find you in person if I though I needed to; symbols of professional affiliation; customer education literature that helps me know what you are doing and why, and what I am expected to do.

A 1980 survey of the nursery and garden center industry established these as the reasons customers don't return to a particular garden center: discourteous treatment, 68%; complaints not adjusted, 14%; lower price elsewhere, 9%; convinced by others to change, 5%; moved away, 3%; died, 1%. According to this survey, 87% of the customers were dissatisfied with the human factor, only 13% were dissatisfied with the economic factors. The human factor is present whether you are a garden center or a golf superintendent.

Don't let the fact that you don't have customers in the traditional sense fool you. The people who use your facility have a choice. They can play elsewhere, shop elsewhere, and conduct their business elsewhere.

Mobay Chemical found that 82% of your lawn care customers are satisfied, 10% are not satisfied, and 8% said it is too soon to judge the results of their current service. The dissatisfied customers said things like: he gives advice but we do the work, they didn't get rid of the problems, they always seem to come after the damage is done. A survey of industry complaints ranks them in this order: the service costs too much, lack of weed control, impatience with the service, "I thought it would look better by now!", unrealistic expectations. Golfers can say pretty much the same things about the course. Alumni coming back for homecoming can say, "The campus sure has gone downhill."

To a businessman, the cost of not getting complaints can be higher than the costs of getting them if the customer with a complaint quietly exercises high freedom of choice in the marketplace and changes services; and the fact that you aren't getting many complaints is no assurance that everything is going well.

What is the probability that someone with a complaint will tell you about it? According to *Customer Service Newsletter*, 24 out of 25 dissatisfied customers fail to complain. At least 6 of the 24 have a serious problem in their relations with the company. Instead of telling you, the person with a complaint will tell 11 other people. If you had 5 complaints this week, how many people are actually

dissatisfied—125. How many people are they telling about your poor service or rude employees—1,320. Can any of you afford that? Resolving customer complaints can bring back up to 70% of the complainers and prompt resolution can increase that to 95%.

When you satisfy a customer's complaint, he is likely to become a loyal customer and tell 4 or 5 people about the experience. People who feel they have received no satisfaction tell an average of 10 people about it. I hope you are convinced that you can't afford not to go looking for complaints. You also need to recognize why people don't complain. They have the feeling that no one cares, they don't think you will follow through with your agreement, they don't know who to complain to.

A garden center in the western United States solved the problem of the unresolved complaint by putting this sign on the exit door: "Are you dissatisfied? Ask for Phoebe." There is no one on the staff named Phoebe. When someone asks for her, staff members say, "Phoebe isn't here right now, but I would be happy to help you with your concern." By finding out complaints before the complainer could tell anyone else, they saved money and customers.

If you keep a log of all complaints, service calls and call backs, you can track any patterns that involve particular services, employees, products. A particular lawn care company found that complaints peaked shortly after their college-student crew joined them in the spring. The students were not accustomed to dealing with the public. The solution was a one-day paid seminar on standards of behavior and handling customers.

This is as good a time as any to admit that sometimes the customer is wrong. There is a school of thought that says every customer is worth saving because of the goodwill they can generate, the badwill they can generate, the additional services they may purchase. If you keep records, you can determine when it is no longer profitable to keep a customer happy. When you need independent evidence that nothing you did contributed to the death of the tree or there was no way you could have prevented the Pythium outbreak, try your local Cooperative Extension Service. Their opinion is well respected.

Despite your best efforts, the phone has rung and you find yourself ear to ear with a dissatisfied customer. Your choices are to: ignore it, store the complaint away, react aggressively. How you or your receptionist or your technicians handle the call will have a significant, perhaps the most significant, impact on whether the complaint can be handled satisfactorily. Two out of three complaints will come in by phone, which creates special problems because it is harder to convey concern and humor when you can't see a person's face or read his body language.

To handle dissatisfied customers, make it easy to complain. Do you have a customer service division or a customer service plan? What money and management

resources have you allocated to the resolution of complaints, real or imagined? Do you have a customer hotline or enough regular phone lines that customers won't be greeted by a constantly busy number? If he leaves his problem on a recorder, be sure to get back to him the same day.

Listen to his grievances. The first three minutes can make or break the situation. Don't interrupt, let him tell his whole story before you begin any explanation. Take notes, review them with him to show that you thoroughly understand.

Put yourself in his shoes. The caller is irritated. What he wants as often as not is sympathy. Use nurturing words like, "I can understand your concern." Sympathizing with the problem is not the same as admitting responsibility.

Ask him what he wants you to do to rectify the situation. Sometimes he will expect less than you expected to offer if you are lucky. At least you will know what he expects and whether the solution you intend to propose is likely to satisfy him.

Tell him exactly what you intend to do; the caller wants commitment. Maybe you cannot decide on the spot, so say you will tell your supervisor, or visit the site to evaluate it personally. Give the customer a time limit, 48 hours is common for a return call or a personal visit. Never tell the customer to call someone else. Have that someone call the customer.

Follow up on the complaint. Whether or not you call or visit, plan to follow up with a letter. Ask the customer whether the situation was resolved to his satisfaction. At this point, over-extending yourself is good customer relations.

Remember that the complainer stands for:

Create a climate of interest, where the complainer feels confident he is being heard.

Overcome the urge to argue with the person complaining.

Make sure you ask a lot of questions. If necessary, rephrase the complainer's last statement in question form.

Plainly explain your options, what you can and can't do.

Listen without passing judgment. Don't feel obligated to agree or disagree and don't let them assume you are agreeing or disagreeing.

Assure them you understand the problem.

Ignore the urge to join in. Don't criticize management, be loyal to the people you work for.

Negotiate a workable solution if there is one, but don't do it if you aren't the person with the authority to do so.

Eliminate the urge to find the easy, quick-fix solution.

Resist getting trapped into making a special deal. If you are bending policies, make sure you know why.

*What to do* has just been discussed. *How you do it* is equally important. Establish in the first three minutes that you intend to be helpful. Never point out the customer's errors. It puts him on the defensive and makes it hard to establish rapport. Try to avoid the word "you", which puts the customer on the defensive. Use the customer's name in the conversation; first name for informal effect, last name if you don't know him well. Realize that the customer may not level with you while he is angry. Draw him out to cool him down. Although it is hard, don't let your anxiety show. Use gentle gestures. Pointing your finger at the customer is an aggressive gesture. Folding your arms is an indication of resistance. In the style of Marcus Welby, use a tone of voice that conveys your best bedside manner. Use eye contact. Proper dress and appearance are important in establishing your credentials as an expert. We tend to get less angry at well-groomed people and better-groomed representatives tend to be more believable. Vocabulary contributes to credibility. Use concise, effective words. Don't run down your company. Short term, it may calm him down to say, "It's almost impossible to hire good technicians," but the long-term effect is to destroy confidence in you and your company. Use common sense and assume that the people you are dealing with possess a good deal of it themselves.

Here are some things to keep in mind. Mobay Chemical found that slightly more than half of the lawn-care decisionmakers are women. For this reason, the woman of the house is frequently the one you have to satisfy, even if she begins the call, "My husband told me to tell you..." Although most complainers want to speak to the owner or manager, it is more effective to have a woman complain to a man and for a man to handle complaints from a woman. A maintenance complaint form may make the reporting and handling of complaints easier.

Let's take a look at who is getting those field complaints and how well equipped they are to handle them. The typical applicator, the usual recipient or the complaints is: 22, single, has a high school education or one year of college, loves the outdoors, is an independent worker, is spontaneous and says what he thinks, is playful - likes to play and joke, is active in sports. He is not good on the phone or with paperwork. He may not communicate well. He will ring doorbells because you tell him to, but he hopes the customer won't be home.

As I mentioned, two out of three complaints come in by phone, so how you handle phone calls can significantly contribute to your customer relations success. Have

enough phone lines that every call is answered on the first ring. Answer by giving the company name and extending an invitation to be of help. Have all information on hand, including books, price lists, current advertisements and delivery schedules. Find out what the customer wants, then match your services or products as closely as possible to those needs. Close the conversation by asking the customer how he happened to call you; helpful analyzing your advertising. Ask for the prospect's name and address so you can add him to your mailing list. Let the caller hang up first.

We would all be kidding ourselves if we believed that every complaint can be handled to the customer's satisfaction and yours. Some of those complaints are going to result in cancellations. There are many reasons a customer cancels; moves, changes in financial circumstances, "It looks good and I don't need you any longer."

To be sure you know why customers are leaving, conduct an exit interview. This can be a letter with a dozen or so questions that will help you determine what your service failed to do for the customer. Companies that do this have found that the customer may give you one reason for cancelling when he calls you, but another on the survey. If he says that he is moving, he knows you can't try to change his mind. On a blind survey, he may tell you that the technician who served his yard always kicked the dog. I received a letter when I cancelled my lawn service one year. It stresses that they want a second chance to prove they are dedicated to serving their customers. It included two options to check: resume my program, call me to talk; on one side of a self mailer. The closing emphasizes the tone, looking forward to a new relationship. The cynics way to look at such a letter is—do they have so many cancellations that they need a form letter?

I think the story I am about to tell you is true because the person who told me said it was. A salesman stayed at a particular motel, part of a national chain, and his room had bugs in it. The chain had a very good reputation, so he wrote to the local manager to bring the bug problem to his attention. He received a letter in reply which said such things as; thank you for bringing this to our attention, I assure you this is a problem of which we were completely unaware, our housekeeping staff prides itself on clean rooms and will take whatever steps necessary to see to it that this does not happen to any customers ever again. The tone of concern was tempered by the note from the manager to his secretary that was still attached to the letter: "Send this guy the bug letter."

From my viewpoint, which is more as a customer than as a business person, the problem is frequently one of communications. Communications will be improved if you educate your customers about your service policies, create realistic expectations about what he can and can't expect from his investment and what role he plays in landscape maintenance, support your customers when problems develop, the customer has to know that he can call you, that you will listen to his problem and that you will take action.

For better or worse, every contact you have with a customer is a form of communication. From whether the truck is clean and the technician is in uniform to how the switchboard puts him on hold, you are telling the customer what you think of him, and what you think of yourself.

Remember where we started. Business goes where it is invited, stays where it is well treated, and grows where it is cultivated. Whoever your employer, growing your business is your business.

# SEARCHING FOR THE PERFECT TURF FERTILIZER[1]

Robert J. Grover[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Area Production Supervisor, Oregon Landscape Maintenance, Tigard, OR.

The perfect turf fertilizer will provide uniform, healthy, dark green grass, with the least amount of foliar growth possible. Since fertilizer has been used on turf, "the perfect turf fertilizer" has been searched for. This perfect fertilizer would have the above characteristics as well as others, such as being inexpensive, long-lasting, and easy to apply. The search goes on.

For many years, companies such as O. M. Scott and Chas. H. Lilly have formulated and developed fertilizer mixes to meet the demand for home lawns to golf courses. With hundreds of companies like these, all with their own group of mixes, the question is which one is best. The answer comes from knowing your turf and what it needs.

## KNOW YOUR TURF

The first thing to consider is what kind of turf you have. Fertilizer needs vary for different turfgrasses. A ryegrass lawn will need more nitrogen than a fine fescue lawn (Table 1). Most turf in the Northwest is a mixture of some or all of the cool season grasses plus some weedy grasses. This makes it more difficult to determine actual need.

The next thing to know is what has the turf been fertilized with in the past. Turf that has not been adequately fertilized recently will require more fertilizer initially than turf that has been regularly fertilized. There is a threshold level of turf quality that takes much less fertilizer to maintain than to reach.

Another thing to know is the soil type. Fertilizer reacts and persists differently depending on the soil type (Table 2). Sandy soil has little capacity to hold fertilizer and fertilizer leaches out of the root zone quickly. On the other hand, clay soil has a greater ability to hold nutrients on soil colloids. The result is a greater fertilizer need in sandy soil.

It is also important to know the current soil nutrient level. The only way to do this is through a soil test. Oregon State University, as well as many private companies, do soil tests. The information gained from these tests is very valuable. Fertilizer can be customized to provide what the turf needs.

Evaluating a soil test may look difficult, but it is actually very easy. Table 3 can be used as a guide to evaluating a soil test. Note: Nitrogen is not included in soil tests.

## KNOW YOUR ESSENTIAL NUTRIENTS

There are 16 essential plant nutrients (Table 4). Only some of these are of concern in fertilization. My experience has proven the following to the four most important fertilizer nutrients. They are listed in the order of importance:

1. Nitrogen
2. Potassium
3. Sulfur
4. Iron

Nitrogen is the key nutrient in turf growth. A balance of other nutrients is important, but nitrogen is the most important as it directly affects color, shoot and root growth, density, diseases resistance, heat-, cold-, and drought-tolerance.

Turfgrass requires nitrogen in the largest quantity of all nutrients. Levels may vary but from 3-10 lb of actual nitrogen per 1000 $ft^2$ per year is needed to maintain healthy turf.

Potassium is also needed in large quantities, second only to nitrogen. It does not create any visual growth response but it does aid in rooting, heat and cold tolerance, wear tolerance, and disease resistance. Potassium is often tied up in clays so high levels of potassium can be found in many clay soils. Supplemental potassium is needed since the existing potassium is usually tightly attached to the clay colloids and not readily available to the plant.

Sulfur is an overlooked nutrient. It is considered a secondary element, but its effect on turf can be substantial. Sulfur causes a greening response without growth. Sulfur also aids in the reduction of diseases.

Iron is one of the most exciting nutrients for turfgrass. It is regarded as a micronutrient, but when used at high rates, its response is dramatic. When used with sulfur and low levels of nitrogen, it can create a darker green than possible with any other nutrient. Since it has no visible growth responses, it is valuable when used to keep a lawn dark green without a flush of growth that is associated with nitrogen.

I discovered this response from iron when I used a moss-killing product with

20% iron, 5% sulfur, and 6% nitrogen. This created a darker green than I had ever seen. I have since experimented with iron and found it to keep turf green without the growth surge you get from nitrogen.

Iron has two great drawbacks. It stains concrete orange and turns barkdust black. If left on turf foliage, it turns it black, too. Careful application includes staying away from concrete and fresh bark followed by irrigation to wash it off foliage. Iron can move with irrigation runoff, so care must be used when irrigation runoff crosses any concrete.

Phosphorus is the most over-applied of the major nutrients. Thought phosphorus is important in turf establishment, occasional applications to avoid deficiency are all that is needed in most soils. Consistent use of phosphorus can lead to very high levels. Since it is quickly tied up by the soil, phosphorus does not leach and stays very near the soil surface.

The major problem of consistent use of phosphorus is its relationship with *Poa annua*. It has been shown that high levels of phosphorus benefit *Poa annua*. Consistent use of phosphorus leads to increasing amounts of *Poa annua* in turf. On the other hand, as long as the soil is not deficient in phosphorus, no detrimental effect can be seen.

## KNOW YOUR NUTRIENT SOURCE

There are many sources of nitrogen, but the 5 most commonly used in turf fertilization are urea, ammonium sulfate, urea formaldehyde, IBDU and sulfur-coated urea (Table 5).

Urea and ammonium sulfate are totally soluble sources. Soluble sources provide quick response and are generally much cheaper than slow-release sources. Drawbacks to soluble sources are: short residual, tendency to leach, high burn potential and excess stimulation of growth. Since they will usually last only 4-6 weeks and the initial growth response is quite dramatic, the use of soluble nitrogen can create sporadic and uneven color unless applied frequently. Soluble sources are usually applied at a rate of 1 lb N/1000 $ft^2$.

Ammonium sulfate (21-0-0) is a good soluble source of nitrogen. It includes 24% sulfur which helps to provide a darker green. Drawbacks include a high burn potential, non-uniform particle size and short residual. Overall, it is my favorite soluble nitrogen fertilizer due to the sulfur content.

Urea (46-0-0) is the other common soluble source. Its uniform product size from being prilled makes it spread very easily. Its burn potential is lower than ammonium sulfate, making it safer to use in the fall. Its biggest drawback is its tendency

to dip in color before its spurt of growth stops. I attribute this difference from ammonium sulfate to be from the lack of sulfur in the urea.

Urea formaldehyde, IBDU and sulfur-coated urea are slow-release sources of nitrogen. Slow-release nitrogen sources are becoming more popular because they allow you to fertilize less often and give a more uniform release. Slow-release sources are the best way to maintain a consistent color without pushing a lot of growth. The biggest drawback is that slow-release sources are expensive, up to 8 times as expensive as soluble sources.

This added expense can be justified by the long residual and uniform release. Most slow-release sources will release up to 10 weeks compared to 5 weeks with soluble. The labor savings makes up for the added expense. The other justification is the uniform release. Trying to deal with growth surges can make the mowing operation difficult and the finished product inconsistent.

Sulfur-coated urea (SCU) is an excellent slow-release fertilizer. It gives a good initial response while maintaining a uniform release from 8-10 weeks. SCU is made by coating urea prills with elemental sulfur. As the sulfur coating breaks down, the urea is released. Another benefit of SCU is getting sulfur with the nitrogen. As stated before, sulfur has a good greening response when used with nitrogen.

There are two sources of SCU: CIL, from Canada, and TVA from America. Each formulation process is different and these differences are important. CIL SCU contains variable particle sized urea with a sulfur coating. TVA SCU is uniformed-sized urea coated with elemental sulfur and sealed with a wax and a microbicide. From observation, TVA SCU's release is longer and more uniform. CIL has a quicker initial response and does not last as long. CIL SCU should be applied at a rate of 1-1/2 lb N/1000 $ft^3$, where TVA SCU should be applied at a rate of 1/2-2 lb N/1000 $ft^3$. Urea formaldehyde (UF) comes in two common forms. Blue Chip (38-0-0), which has a urea-to-formaldehyde ratio of 1.3-1, and methylene urea (Scott's 41-0-0), which has a urea-to-formaldehyde ratio of 1.9-1. The difference between the two comes from the urea-formaldehyde ratio. The higher the ratio, the more it acts like a soluble source. Blue Chip is 1/3 soluble and 2/3 slow-release, where methylene urea is 2/3 soluble and 1/3 slow-release.

UF slow-release properties come from long chain molecules that break down slowly with bacterial action. This breakdown requires microorganisms and warm soil temperatures. It is, thus, a poor choice for late fall or winter fertilization as it will not break down until the soil warms up again. Observations also show that a percentage breaks down so slowly that it is virtually unavailable.

At low rates, Blue Chip has little response. To get an acceptable initial response with straight Blue Chip, a rate of 2-3 lb N/1000 $ft^2$ is needed. On the other hand, methylene urea acts very much like soluble sources and will give an acceptable

response at 1 lb N/1000 ft². The drawback is the 1/3 slow release portion is so small at 1 lb N/1000 ft² that it is not enough to do any good.

IBDU (31-0-0) is another good slow-release nitrogen source. IBDU deteriorates by hydrolysis. Therefore, its release depends on water and particle size. There are two grades commonly available. They are fine and coarse. Fine is a powder and coarse is just a little larger. The coarse IBDU has a very uniform long release of up to 10 weeks and is more dependable than UF because all it needs is water to break down. To get a good initial response, IBDU should be applied at a rate of 2-3 lb N/1000 ft². IBDU's biggest drawback comes from its small particle size. It does not mix well with other granular fertilizers and has a tendency to separate out if you are not careful.

## POTASSIUM CARRIERS

The three most common sources of potassium (K) are potassium chloride (muriate of potash, 50% K), potassium sulfate (40% K, 17% S), and potassium magnesium sulfate (K-Mag, 18% K, 18% Mg, 20% S) (Table 6). All three are good potassium sources.

Potassium chloride is the least expensive source of K but it has a high burn potential so caution should be taken when using it in the summer. Potassium sulfate has a lower burn potential, but it is more expensive. It is also a good source of sulfur. K-Mag is a fertilizer not normally used in turf fertilization, but it is one to consider. It not only has 18% K, it also has 18% Mg and 20% S. It is a good source of all three of these important nutrients.

## IRON CARRIERS

The three most common sources of iron (Fe) are all forms of ferrous sulfate, but each one is a little different.

20% Fe is a powder substance and is soluble. It is used a lot for moss control, but it does not do well in mixes because it is dusty and separates out. 30% Fe is a granular substance and is also soluble. It is better in mixes since it will not separate out. Both the 20% and 30% Fe stain concrete, so great care should be used.

40% iron is a granular chelated material. Being chelated, the iron is not as readily available, thus it does not stain concrete like the 20% and 30%. It is not foolproof, but it is much safer around concrete. Being chelated also lessens the response on turf. It does not give the immediate green like the 20% and 30%, but its safety makes it desirable.

## EVALUATING COMMERCIAL MIXES

Evaluating commercial mixes is very important. Comparisons made on just price per pound can be misleading. Cost per pound N and the sources of that nitrogen are very important.

Most commercial mixes boast about having slow release nitrogen. It is true that most do have some slow release nitrogen, but it is usually a small percentage. At the recommended rate, which is usually 1 lb N/1000 $ft^2$, the small portion of slow release is too small to give any long-lasting residual. Unless slow release nitrogen sources are used at high rates, they are not effective.

Table 7 shows the comparison of five popular mixes and two of OLM's custom mixes. Four of these slow release fertilizers are only 25 to 39% slow release. That leaves over half of the nitrogen to come from soluble sources. The recommended rates of these are 1 lb N/1000 $ft^2$. At that rate the slow release portion will have little effect.

The OLM mixes and Parex IBDU include no soluble sources and are 80-90% slow release. It is when slow release sources are used like this, as the major source of nitrogen, that their properties show up. Though higher rates are needed (1.5-2 lb N/1000 $ft^2$) to achieve an acceptable initial response, the long residual response makes up for it.

## CUSTOM MIXING

Custom mixing is the best and most cost effective way to develop a fertilizer program to meet the specific needs of your turf. An example would be to compare Webfoot Turf Treat 15-5-10 to OLM Fall Mix 20-5-10 (Table 7). Both have similar ratios and cost the same per pound of N. The difference is in the percentage of slow release N. Turf Treat has only 25% from slow release while OLM Fall Mix has 80% from slow release. For what you are getting, the OLM Fall Mix is a much better deal.

Another good benefit to custom mixing is that you can change the formula when you want to. From season to season our mix changes. Depending on what our soil tests indicate, we will also make changes to the formula. As you change your mix and experiment with different nutrients and sources, you can customize the mix to fit your specific needs.

## OLM CUSTOM MIXES

I have been custom mixing OLM's fertilizer for two years with great success. Two examples of our custom mixed fertilizer are OLM Summer Mix and OLM Iron Green.

OLM Summer Mix (22-0-8) is our standard mix for the growing season. It is derived from 3/4 SCU and 1/4 IBDU. SCU and IBDU work well together. The SCU has a good initial response while the IBDU helps maintain a longer release. We apply it at 1.5 lb N/1000 $ft^2$. During the summer a response can be seen in one week, and will last 8-10 weeks.

There is no phosphorus since our soil tests show our soils are already high in phosphorus. The potassium comes from potassium chloride because it is a very inexpensive source and it has not caused any burn problems. From the SCU we get 3% sulfur. From 40% iron we get 7.5% iron. 40% iron is used to avoid concrete staining. We previously used the 30% iron because of its superior response, but we were staining all our walks even when we were careful. A trace element package is also included.

OLM Iron Green (6-0-0 + 20% iron) has great potential. It is a high iron-low nitrogen fertilizer that greens up turf with little growth response. We have been using it on some of our large projects with great success. Its greatest drawback is from staining. With 30% iron, it cannot be used anywhere near concrete. Even irrigation runoff from turf treated with Iron Green will stain concrete.

The recommended rate for Iron Green is 6 lb per 1000 $ft^2$. At 6 lb/1000 $ft^2$ you get .36 lb N/1000 $ft^3$ derived from SCU. This is a very low rate for SCU but that is all that is needed. Iron works better with a small amount of nitrogen. At 6 lb/1000 $ft^2$, you get 1.2 lb Fe/1000 $ft^2$, .78 lb from soluble 30% Fe and .42 lb from fritted 40% Fe. We used both the soluble and the chelated to get quick release and hopefully some slow release. No detrimental effects have been noticed from using the rate of1.2 lb/1000 $ft^2$.

If used carefully and in the right place, it can be very beneficial. The ability to keep turf green with minimal growth has much potential in our industry.

## CONCLUSION

The key to developing good turf fertilizer is in knowing the needs of your turf and utilizing the properties of the nutrients and their sources. Custom mixing is a viable alternative to buying commercial fertilizers since it is cost effective and it allows you better control over the nutrients and their sources. The perfect turf fertilizer is the one that is developed to meet the current needs of your turf.

## ACKNOWLEDGEMENTS

I would like to thank Tom Cook for all the help and information he has given me over the years. I would also like to thank Leo Wiedeman of the Webfoot Fertilizer Company whom I have worked with for the past two years developing our custom mixes.

**Table 1.** Approximate nitrogen requirements of cool season turfgrasses.

| Grass | lb N/1000 ft²/year |
|---|---|
| Ryegrass | 6-8 |
| Bentgrass | 5-7 |
| Kentucky bluegrass | 4-6 |
| Fine fescue | 3-5 |
| Tall fescue | 3-5 |

**Table 2.** Effects of soil texture on leaching

| | | |
|---|---|---|
| CLAY | SILT | SAND |
| Little leaching | | Much leaching |

**Table 3.** Evaluating a soil test.

| Element | Low | Adequate | High |
|---|---|---|---|
| Phosphorus - ppm | 0-20 | 20-40 | over 50 |
| Potassium - ppm | 0-250 | 250-350 | over 400 |
| Calcium - meq/100 g | 0-6 | 6-15 | over 18 |
| Magnesium - meq/100 g | 0-1.5 | 1.5-4 | over 5 |
| | Too acid | Adequate | Too alkaline |
| pH | Below 6 | 6-7 | above 7 |

SMP - test for buffering capacity

| | | |
|---|---|---|
| Low | SMP | High |
| High | Buffering Capacity | Low |
| Hard | Ease in pH change | Easy |

**Table 4.** Essential plant nutrients.

| Element | Symbol |
|---|---|
| Organic | |
| Carbon | C |
| Hydrogen | H |
| Oxygen | O |
| Mineral | |
| Macro - primary | |
| Nitrogen | N |
| Phosphorus | P |
| Potassium | K |
| Macro - secondary | |
| Magnesium | Mg |
| Calcium | Ca |
| Sulfur | S |
| Micro | |
| Iron | Fe |
| Manganese | Mn |
| Zinc | Zn |
| Copper | Cu |
| Boron | B |
| Molybdenum | Mo |
| Chloride | Cl |

**Table 5.** Sources of nitrogen

| Carrier | Nitrogen content (%) | Chemical formula | Comments |
|---|---|---|---|
| Ammonium sulfate | 21 (S42) | $(NH_4)_2SO_4$ | Soluble, increases acidity |
| Ammonium nitrate | 33 | NH4NO3 | Absorbs moisture, store carefully |
| Urea | 45 | $(NH_2)_2CO$ | Very soluble, less corrosive than nitrates |
| Urea formaldehyde | 38 | UF | Various size molecules |
| IBDU | 31 | IBDU | One size molecule |

**Table 6.** Sources of potassium.

| Material | Formula | K % | $K_2O$ % | Also has: % |
|---|---|---|---|---|
| Potassium chloride (muriate of potash) | KCl | 50 | 60 | 47 Cl |
| Potassium sulfate | $K_2SO_4$ | 40 | 48 | 17 S |
| Potassium magnesium sulfate (K-Mag) | $K_2SO_4$-$MgSO_4$ | 18 | 22 | 18 Mg O + 20S |

**Table 7.** Comparison of name brand fertilizers

| Fertilizer | Analysis | Nitrogen | Price/lb | Price/lb N |
|---|---|---|---|---|
| Scott's Heavy Duty Fertilizer Plus Iron | 29-3-3 | Methylene urea 25% slow | .59 | 2.02 |
| Lilly Miller Green & Tee | 21-4-8 | SCU Organiform Ammonical 35% slow | .24 | 1.15 |
| Best Turf Gold | 21-3-5 | SCU Amm Phosphate 39% slow | .27 | 1.30 |
| Par-Ex IBDU | 31-0-0 | IBDU 90% slow | .46 | 1.50 |
| Webfoot Turf Treat | 15-5-10 | UF, Ammonical 25% slow | .22 | 1.47 |
| OLM Summer Mix with Iron | 22-0-8 | 3/4 SCU, 1/4 IBDU 80% slow | .32 | 1.45 |
| OLM Fall Mix with Iron | 20-5-10 | 1/2 SCU, 1/2 IBDU 85% slow | .29 | 1.46 |

# STANDARDIZED SPECIFICATIONS FOR FERTILIZERS[1]

Doug Dollarhide[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Corvallis Park Services Manager, Corvallis, OR.

Today I will not give you a simple list of specifications for fertilizer which is contrary to the title "Standardized Specifications for Fertilizers". I will share with you bits and pieces to the puzzle with which we have all struggled to solve. Each time I have let bids for fertilizer, I have refined the specifications. Sometimes I felt we were successful and sometimes not. The question still stands, how do we get the product that we feel is best suited for our situation. We all operate within purchasing controls and regulations.

Specifications are written for bid items to allow the buyer to communicate their needs to the bidders. There are numerous types and grades of fertilizers to accomplish this match. Fertilizer needs for proper plant growth should be determined by soil tests made from soil samples taken from all of your areas. Assemble matrix of the soil test results. Analysis of this matrix will give an average nutrient ratio needed for all areas. Refer to the literature such as the turfgrass fertilizer bulletin for the ratio that is nearest to your needs. If only one or two of your areas are unusual, you may want to consider a custom blend to bring these areas into balance. Your resources such as people, equipment, and dollars should determine the product best suited to your areas. A match must be made between needs and resources.

One of the bits and pieces we will explore today will be particle size. Particle size is an important factor if you are using a broadcast type spreader. If the material has too many fines, all material that passes through a No. 14 sieve could affect the distribution width of the spreader. Fine materials concentrate in narrow bands across your areas. The fine material can also prevent good distribution during wet weather by plugging the spreader openings. Particle sizes larger than 1/4 inch in diameter are undesirable due to the safety hazard while spreading is being done.

How do you determine if the product received met your specifications for particle size? You could send it to a lab for analysis; that may be costly and results not timely. A simple method would be to borrow or purchase a set of soil sieves and a gram scale. We purchased our sieves and scales from Ben Meadows in Eugene, Oregon for approximately $35.00 each for the sieves and $70.00 for the scales. Tests can be made at delivery time to determine specification compliance. The test can be completed in approximately five minutes. In our case, we had a problem with a product. The product actually plugged a Lely 1250 spreader during a light rain. We realize that this is contrary to the advice of our experts, but

many times we cannot schedule dry days to fertilize in Oregon.

We had on hand 50 lb sacks of two products that met our old specification. Product A could be applied during wet weather without causing problems; whereas, product B would plug our broadcast spreader. The particle size of product B was determined to be the culprit. Samples of approximately 3,000 grams of each product were taken from the unopened sacks. These samples were run through the sieves to separate them into different particle sizes. Screen sizes 6, 14, 25, 45 and 60 were used. The results of the tests on Products A and B are as follows:

| FERTILIZER A | Formulation 21-3-5- w/19% S | Sample 3042 gm |
|---|---|---|
| Larger than No. 10 | 2042 gm | 67.1% |
| Passed No. 10 | 818 gm | 26.3% |
| Passed No. 14 | 132 gm | 4.3% |
| No. 25 and smaller | 70 gm | 2.3% |
| FERTILIZER B | Formulation 21-3-5- w/19% S | Sample 3120 gm |
| Larger than No. 10 | 1546 gm | 49.5% |
| Passed No. 10 | 620 gm | 19.6% |
| Passed No. 14 | 918 gm | 29.4% |
| No. 25 and smaller | 48 gm | 1.5% |

From this information we determined that material which would not pass a No. 10 sieve and the material which would pass a No. 10 sieve were acceptable. All material that would pass a No. 14 sieve was undesirable in quantities in excess of 10% of the sample. Therefore, we will be using a particle size specification similar to the following:

"90-95% of material shall not pass a No. 14 sieve and no more than 1% shall be larger than a No. 6 sieve." We also found that screen sizes 10 and 14 were the most important.

Another piece of the puzzle is a cost comparison of nutrients supplied. Information needed is as follows:

1. 43,560 $ft^2$/acre

2. 1 lb actual nutrient/1000 $ft^2$ equals 43.6 lb/acre.

Assume the product is 21-7-14 and it is $500 per ton. Using the above information, we would need to apply 208 lb of 21-7-14 in order to apply 1 lb N/1000 $ft^2$. The cost per acre for 87 lb N-P-K would be $53.00.

It is very difficult to break it down by element due to the varying sources of the elements. Using the percentage of N, P, K, or other nutrients will give you very soft answers.

The next important piece is the match between needs and resources we spoke of earlier. How many applications can we afford to apply with the people and equipment that we have to support this program? Do we make 1, 2, 4, or more applications? If the results of your analysis are 1 or 2 applications, you would need to be looking at an insoluble slow release type of fertilizer. This would reduce the possibility of chemical "burn" on your turf and make fewer applications.

I hope these bits and pieces will be helpful in sorting out the puzzle of writing fertilizer specifications. We want the job to be accomplished as effectively and efficiently as possible.

Good luck in your efforts!!

# ATHLETIC FIELD MAINTENANCE AND EQUIPMENT NEEDS[1]

Roger J. Thomas[2]

[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Jacobsen Division of Textron, Inc., Racine, WI.

When talking about difficult places to grow and keep turf growing, athletic fields rank high in the spectrum. In soccer, the goal zones really get rough treatment, while in football, 15 yards in from either side, the entire field is subject to damage and marching band competition can really compact the soil, especially while standing in one place and marking time.

Athletic fields are made to be used; yes, even abused. Our job is to provide the best turf possible for all events that take place. Recently, we had visitors from European park departments and they marvelled at the American groundskeepers ability to keep turf coming while maximizing the use of our fields.

We visited Milwaukee County Stadium, which is the home of the Milwaukee Brewers Baseball Team. However, the Stadium is also used for professional football teams, rock concerts, tractor pulling contests, Park-It Market, where sellers rent space on the field to sell cars, motor homes, campers, motorcycles, and finally, even a farmer's market in October. Remember, all these events are fitted into a heavy playing schedule of baseball and football with some events leaving only 4 days for recovery.

Harry Gill, the Superintendent of Grounds of Milwaukee County Stadium, simply stated, "We know we have a busy schedule and sometimes we even work round the clock, but that's what our field is all about. It must be used."

Except for cleaning a 50,000 seat stadium, his problems are not unlike most of ours in maintaining athletic fields. The equipment is very much the same as that used on many fields for whatever sports are involved. This presentation will involve personal experience with fields in Racine, Wisconsin as well as the equipment used.

We all have dreams of that perfect field with rich color, but reality tells us we must do the best with what we have in equipment and budget. One of the important jobs is our involvement with overseeding.

The seeder involved in this slide cuts a groove in the turf and then permits the seed to drop through a metering device. It has a metering bar with indentations that measure the amount of seeds that can drop through a chute into the slits made by the thatcher blades.

The object of the slit is to permit the seed to be planted into the soil approximately 1/4 to 1/2 inch in depth. Using this method on several tests made by the universities, a 75% germination can be expected. This field had very little grass on it, so cross-seeding was done at a rate of about 4 lb/1000 $ft^2$. By cross-seeding, better coverage was achieved.

The seeding took place during the early growing season and in our area, best results are generally obtained eight weeks prior to the end of the season. In this area, play is so heavy on the field during July, August, September and October, that one cannot go in and do the type of job needed in fall. Hence, we are forced to spring overseeding. Because of the cool weather, it took about 6 to 8 weeks before a good stand of grass appeared. The field had not been treated, so spraying was a must to eliminate weeds. In a particular case, the spraying had not been done for several years, so the weed growth was heavy.

Large tank sprayers can be rented and/or borrowed from the local golf courses or from some city department.

To encourage the new grasses to grow and not compete with the weeds, fertilizing about 3 to 4 weeks after seeding seems to hold back the competition of the new seedlings. We used a large broadcast spreader and an organic fertilizer.

Of course, all athletic field installations require some type of line marker. I can only recommend buying a quality product as they are used often and for many years.

If the athletic event happens to be marching bands in competition, compaction can take place. If the band activity takes place during July, it is not advisable to use aerator spoons and pull dirt up from the turf; but 4- to 6-inch blades can go down and at least relieve some of the compaction. With watering, the field can be brought back to playable condition for August.

Of course, if the field is used strictly for football and the planting is done in spring, good turf should appear in time. Don't be discouraged if, after the first year, there appears to be little progress being made. Certainly with a good program, some progress will show eventually.

If you have not done so, after the season is over, a good soil analysis should be made to determine whether nutrients have to be added, and what preparation should be made for spring. There have been some successes with dormant seeding on athletic fields. Though limited, it is a head start in the spring when the athletic field is too wet to start the program.

Aeration to pull plugs from the turf is a good beginning for the second year of overseeding. This aeration not only opens up the soil, but brings some soil to the surface for the purpose of covering the seed when the overseeder is used.

If sand topdressing is used, there are larger topdressers on the market today, or drag mats can be used to help fill int he holes with soil to improve drainage as well as develop better root growth. In some cases, soil can be manually distributed around the field and drag mats used to spread soil evenly across the field. There have been new devices on the market for the purpose of getting the sand into the slits but, in most cases, they are very slow and expensive.

Good drainage is extremely important on any athletic field. Trenching can be done with the purpose in mind of draining water through the soil and dispelling it at the sides through established drains. In some cases, fields are so poorly drained that it may be necessary to put drainage pipes across the field at every 5 or 10 yard line. There are many trenching devices on the market but, in this case, it may be well to rent or borrow a ditcher as it is not something that is done often.

Some athletic organizations find it necessary to pre-germinate the seed or plant sod when the heavy use season comes. Others have spread seed during the football season, leaving the cleats to pound it into the turf.

It is interesting to note that football, baseball, and soccer fields are not generally located on the best possible ground that the city may have. In travelling, it is amazing to find a number of athletic fields that were formerly city dumps or swamp areas. These situations add to the problems as there is constant necessities to "even up the turf". If the sand is good, a sod cutter is necessary and fill dirt is required. Since this is the case, a small sod cutter is a very helpful tool in doing work around athletic fields.

To the equipment side, 84-inch triplex mowers are the most commonly used mowers. Depending on the use of the field and the quality of turf, some are using grass catchers.

In many city-owned athletic fields, 3 or 5 gang mowers behind tractors are commonly used. These are transportable units which can be used at many sites. Gang mowing is still the least costly method of maintaining an area.

Since the advent of soccer, larger equipment is generally necessary because some places in the U.S. have two, three, or four soccer fields very close to each others. The simple guideline to use is if you want to cut faster, cut a wider swath. Many cities have been going to 5 or 7 gang transportable units for the purpose of maintaining larger areas. In some installations, self-contained 5 gang units are replacing 3 gang units. The difference in cost per acre of mowing, for labor, is almost double for the 3 gang as contrasted to the 5 gang. Of course, if a number of fields are involved, then a more transportable, self-contained 5 or 7 gang should be considered.

Nearly all athletic fields have special grooming to be done either along the cyclone

fences, around trees surrounding the athletic field, or along the bleacher, etc. Of course, the use of growth retardants in more recent years has assisted in reducing trimming. The use of Roundup or some product similar has eliminated some of the trimming in the "hard to get at" places, so a small hand sprayer can be very useful. In any event, some of the grooming tools that can be of assistance are string trimmers, which have become very popular and should be owned by the particular installation for trimming. In our travels, we see more and more backpack or push type blowers being used, not only to clear wet, slippery grass around the installation, but to blow leaves and paper out of the stands, or below the stands, or putting it into areas where it can be collected.

Most athletic installations have some machines for pick-up or paper and/or grass. Small tractor-drawn sweepers are quite common and save much labor after an event. Some are finger or brush pick-up and others vacuum. Your choice has to be made depending on the surface of the pick-up area.

A few hints to saving turf or maintenance costs on athletic fields:

1. Avoid watering at least a day or two before the activity—firms up the turf.

2. Mow 48 hours before the event to give the turf a chance to recover.

3. Never try to grow grass where it won't grow. Use artificial turf or fine, crush stone at the players benches.

4. Remember the importance of drainage.

5. Try not to cut too close, depending on the grasses you are using, so as not to put too much stress on the turf.

6. Reduce your maintenance *outside* the field by using growth retardants, special grooming tools (string trimmers) or spraying to get rid of turf (around bleachers or cyclone fences).

7. Specialized equipment can sometimes be borrowed or rented to avoid costs for seldom-used machines.

To recommend specific pieces of equipment that should be used is most difficult. We have covered a number of products and there are many of them on the market. Whether the athletic field comes under the responsibility of the city recreation department, the city park department, the school district, the county parks, or is a part of a professional organization, the kinds and the amount of equipment varies as to on-site machines as against multilocation maintenance. A judgment has to be made in the selection of on-site machinery. What is important is the *amount* of use the product will receive, *how much time* is involved in using the product from

a labor standpoint, and how *important is the transport* if multisites are to be maintained. Good analysis of the selection of the equipment that you purchase can give one many years of trouble-free operations, but it is very important to consider the long term return rather than the short term when buying equipment.

Yes, we Americans use our athletic fields as much as we possibly can and, even though it is difficult to maintain athletic fields on which there is high use, it is the very purpose why the field was built. The best thing we can do is provide the finest turf possible within the budgetry we are allowed.

Good luck to all of you involved in keeping turf coming through the seasons.

# SOME FACTORS AFFECTING THE DEVELOPMENT OF FUNGICIDE RESISTANCE[1]

Gary Chastagner[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Associate Plant Pathologist, Western Washington Research and Extension Center (WSU), Puyallup, WA.

Resistance to fungicide is one reason why fungicides sometimes fail to control disease. Instances of resistance and subsequent disease control failure under field conditions have increased since the introduction of newer fungicides with more specific modes of action. There are many factors which affect the development of fungicide resistance. Before briefly discussing these, let's define what is meant by fungicide resistance. Fungicide resistance can be defined as a natural or acquired ability of an organism, in this case a fungus, to tolerate chemicals which it was previously sensitive to.

Resistance is determined by laboratory testing which generally involves growing the fungus on a jello-like medium which contains various concentrations of a fungicide. By comparing the concentrations of fungicide necessary to inhibit germination or growth of different strains of a fungus, we can determine if any of the strains are resistant to the fungicide.

There are three principle factors which affect the development of resistance. These are the chemical nature of the fungicide, characteristics of the pathogen, and the type of disease.

The chemical nature of the a fungicide refers to its chemical makeup, mode of action and persistence. Fungicides can be broken into three major groups based on chemical makeup. These are the inorganic fungicides such as copper, mercury and cadmium, the organic protectants such as Fore, and the organic systemics like Tersan 1991 and most of the newer fungicides.

While there are a few reports of resistance to some of the inorganic and organic protectant fungicides, most instances of resistance and subsequent disease control failure have occurred with the organic systemic fungicides which have been developed since the late 1960's. The major reason this has occurred is that the mode of action of most systemic fungicides is very specific and a fungus only has to overcome or change one process being blocked by the fungicide to become resistant. In most cases, the inorganic or organic protectant fungicides have very general modes of action, that is they inhibit several processes necessary for growth of the fungus, and thus the potential for a fungus to become resistant to these fungicides is much lower.

Some of the mechanisms by which fungi become resistant include a decrease in the permeability of the fungal cell to the fungicide, thus preventing the uptake of sufficient quantities of fungicide to prevent growth. Some fungi are resistant because they have the ability to detoxify the fungicide once it is taken up within the cell, or they may prevent the conversion of the fungicide to an active form. With fungicides which have single or specific modes of action, it is fairly easy for some fungi to circumvent the effect of the fungicide by developing an alternate method of completing the process being blocked by the fungicide.

It is important to realize that a fungus which develops resistance to one fungicide will generally be resistant to other fungicides which have similar modes of action. Thus, *Fusarium nivale* isolates which are resistant to Chipco 26019 will also be resistant to the related fungicide Vorlan. Likewise, fungi resistant to Tersan 1991 will also be resistant to Cleary's 3336, Scott's Proturf Systemic Fungicide, etc. because they are all related.

The last factor associated with the chemical nature of the fungicides which affect the development of resistance is their persistence. Fungicides which persist for long periods of time put more selection pressure on a fungus population than fungicides which persist for relatively short periods of time. This increased selection pressure increases the potential for resistant strains to build up.

There are several characteristics of the pathogen that affect the development of resistance. In many cases, resistant strains of the pathogen are probably already present at very low levels in nature. Since resistance is usually a heritable character that is passed on from one generation to the next, these resistant strains are capable of increasing under certain situations. Changes in the population of resistant strains depends on the selection pressure placed on the population. When a fungicide, particularly one with a single site of action, is repeatedly used to control a disease, the chance of these resistant strains developing and resulting in the loss of control is increased due to the increased selection pressure. Other pathogen characteristics that influence the development of resistance are the potential of the fungus population to survive periods unfavorable for disease development, the reproductive capacity of the pathogen and the potential of the disease to spread.

The last major factor affecting the development of resistance is the disease situation. Resistance is more likely to develop with diseases which require multiple applications of a fungicide during the growing season and for which there are few if any alternative fungicides or nonfungicide methods of control.

## WHAT CAN YOU DO TO PREVENT RESISTANCE?

First, know the potential for resistance. This relates to knowing something about the chemical nature of the fungicide you are using, the characteristics of the pathogen and your disease situation. If you are not able to obtain effective control because

resistance has developed, stop usage of all related fungicides for which resistance has developed.

If resistance has not developed, you should minimize the number of applications of the at risk fungicides by using them only when it is necessary. Make sure you are using as many of the cultural practices which reduce disease development as possible. Tank mixtures or alternating at risk fungicides with nonrelated fungicides are also effective ways to delay or prevent the development of resistant strains. Data from our work on a disease of tulips indicate that alternating the use of an at risk fungicide with an unrelated fungicide was as effective in preventing the development of resistance and subsequent loss of control as making tank mixtures of the same two fungicides. If practical, monitoring the pathogen population to detect increases in the buildup of a resistant strain can be done to avoid the loss of disease control associated with further use of an at risk fungicide.

# CONTROLLING WINTER DISEASES IN TURFGRASSES[1]

R. D. Ensign[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Professor and Agronomist, Department of plant, Soils and Entomological Sciences, University of Idaho, Moscow, ID.

Although this Association has been exposed to much information about winter turf diseases and especially the excellent research in previous years by Drs. C. J. (Chuck) Gould, Roy Goss and others, we still experience significant disease problems. Much progress has been experienced in the past several years, and most is expected as we learn more about the complex world of turfgrass diseases. It has been estimated that $1,500 to $5,000 is expended annually for fungicides to control winter diseases on an average 18-hole Northwest golf course. This figure differs from location to location, year to year, and course to course. In addition to chemical controls, golf course superintendents need to employ many other practices, which will be mentioned later, to control winter diseases. Therefore, turfgrass diseases are costly and control of the diseases will continue to be one of the most important considerations to maintain a healthy growing turf for all athletic fields, golf courses, parks, lawns and other specialized turfgrass areas.

In much of the Northwest, 1984-85 winter was one of the most destructive years for winter diseases, especially east of the Cascade Mountains and throughout the large Intermountain area. Much of the Inland Empire, which includes a 100-150 mile radius from Spokane, Washington, received continuous snow cover from early November extending to late March, 1985. The snow arrived before significant soil freeze which created an excellent environment for several winter diseases.

This paper will present information about winter diseases, especially pink snowmold and grey snowmold. An emphasis is given to the epiphytotics on bentgrasses, especially golf greens, in eastern Washington and northern areas of Idaho at elevations of 2,000 feet or more where severe snowmold conditions existed.

## THE 1984-85 WINTER DISEASE SURVEY

As the 1984-85 winter season progressed, golf course superintendents in the Inland Empire became concerned with potential problems underneath the long-lasting snow cover (early March 1985 meeting of IEGCSA, Clarkston, WA). To assess the situation, a survey form was sent out to all superintendents asking for comments about the severity of snowmold diseases and the kind of control applied before and after snow. Ten (10) responses were returned in April-May 1985. All of the courses in the north Idaho-north Washington and Spokane area reported

moderate to severe snowmold damage. They reported snow cover from 99 to 135 continuous days (av. 113 days) of snow cover. Most of the courses in the Lewiston-Clarkston-Walla Walla area reported none to less than usual snowmold damage and only intermittent snow cover. Many were uncertain if they had pink or grey snowmold. Fifteen (15) different chemicals were used by the golf course superintendents in this survey. Some chemicals were certainly effective, as one respondent using three different chemicals from October to December reported, "Only three spots the size of silver dollars out of 20 greens." Some indicated the early November snow blanket caught them by surprise with only one-half the expected applications, thus unfavorable results. For some, the survey indicated a need for a short-course *early in the fall* to discuss programs, chemicals, application schedules and early disease detection to help prevent possible serious losses of greens.

## WHAT ARE THE IMPORTANT CHARACTERISTICS OF THE SNOWMOLD FUNGI?

The turfgrass diseases discussed in this paper are pink snowmold or Fusarium patch, caused by *Fusarium nivale* (Fn) Ces. Micronectriella (Shaffn.) Booth once thought to be *Gerlachia* patch but this has reverted to *Fusarium*. The other disease is Typhula snowmold, or gray snowmold, caused by *Typhula incarnata* Lasch ex. Fries.

A brief review (Table 1) of the important characteristics of these pathogens is pertinent to highlight the differences and similarities they have, symptoms in turfgrasses, disease cycles they cause, epidemiology and control measures. Many studies and reports have been made on these pathogens (Couch, 1974; Gould, 1976a; Gould et al., 1979; Smiley, 1983; Chastagner et al., 1980).

The two snowmold diseases of turfgrass are different in growth patterns and upon close examination they can be distinguished. All too frequently only the term "snowmold" is used on labels or advertisements to describe the pathogen. The user of control practices should be aware of the differences. Pink snowmold (Fusarium patch), according to Gould et al. (1979), is observed in the early fall to early spring and, therefore, requires somewhat different control practices than gray mold.

Gray snowmold (Typhula blight) produces sclerotia (round dormant mycelium) which lives over the summer in the turf at soil level or below. In late autumn, when cool and moist, the sclerotia will germinate and infect the snow-covered plants. The sclerotia may also produce sporocarps and basidiospores, which are the sexual stage of the fungi, and these spores will also infect the grass leaves under prolonged snow cover. This process requires snow cover to give diffused light high in ultraviolet spectrum (Smiley, 1983; Beard, 1973). In high direct light intensities, low humidity, warm temperatures or frozen soil, the fungus may not be infectious. Only when the temperature is just above freezing at the soil surface over a long period of snow cover will the fungus be active for an extended period

(Smiley, 1983; Gould, 1976a). *Then the turf manager must anticipate infection of gray snowmold before symptoms appear and apply the appropriate fungicide immediately ahead of snow cover and before the soil freezes.*

## USE OF APPROPRIATE FUNGICIDES

*Kinds of Fungicides*. There is an arsenal of fungicides for use on turfgrass diseases. There are 33 single fungicides or mixtures of fungicides registered for use in the three Northwest states. Most of the chemicals are approved and registered for use in Idaho, Oregon and Washington (Wright, 1985; Chastagner et al., 1982; MacSwan et al., 1984) (Tables 2, 3, 4).

These fungicides are broadly classified as: 2) *contacts or protectants* which are not absorbed by the plants. These include many old chemicals, 1930-40's, such as Thiram, Fore, cadmium compounds, mercury chlorides and others. Usually frequent applications of such chemicals are necessary if grass leaves are subject to frequent rains. 2) *Systemic fungicides* came into use in the 1960's. These chemicals are translocated within the plant tissue from one area to another. Many are absorbed by the roots and translocated to the leaf area where fungus protection is needed. These chemicals are not weathered and can be applied before or after first symptoms are observed because therapeutic action is usually rapid and gives protection from advancing fungi (Brooks and Buckley, 1977).

Some of the chemicals may have a narrow spectrum of activity and the fungi may develop resistance to them. To avoid this, Gould (1976) and Chastagner (1980) recommended that pesticide applicators avoid continuous use of a single fungicide, but alternate two or three different fungicides or mix two different compatible fungicides. Thus, systemic fungicides are now frequently sold with a contact fungicide such as Benomyl plus Fore, Actidione plus Bayleton, etc.

Systemic fungicides are effective and generally less expensive than the older chemicals. Also, systemic fungicides are considered among the safest pesticides in current use (Brooks and Buckley, 1977).

*Effectiveness of Fungicides*. As the fungi *Fusarium* and *Typhula* are different, so are the fungicides used on the fungi. Some fungicides are effective to one fungi and not another. Listed in Tables 2, 3 and 4 are fungicides considered best for *Fusarium* (pink snowmold), those effective to only *Typhula* (gray snowmold) and the group of chemicals effective on both fungi. Thus, where one fungi prevails the fungicide specific for that organism should be used (Gould et al, 1977; Ensign, 1976; 1977; Chastagner, 1980). Where we can expect both fungi to exist in most years, such as eastern Washington and northern Idaho, that fungicide(s) should be used. Fungicides, which are effective over a range of different fungi, i.e. Bayleton (Triadimefon), Chipco 26019 (Iprodione), Bromosan (Thiophanate + Thiram), and others are known as broad spectrum fungicides. Where multi-disease problems

exist, then one or two chemicals should be adequate (Gould, 1976b; Wright 1985 PLIRS; Chastagner et al., 1982).

## APPROPRIATE FUNGICIDE LABELS

*Precautions in Use of Fungicides*. Fungicide applicators must know the specificity of fungicides to control certain fungi, i.e. one fungicide may control one fungus and not another. Also, the applicator must know that the same active ingredient (AI) may be sold by more than one trade name in more than one concentration. *READ THE LABEL.*

1. All pesticides must carry a label from the manufacturer. It is:
   —a license to sell
   —a way to control distribution, storage, sale, use and disposal.
   —information how the buyer must use the product correctly.
   —a source of information on treatment for poisoning.

2. The label tells the applicator many things about the product, such as trade name, ingredients, chemical names, common name, type of pesticide, net contents, name of manufacturer, registration number(s), signal words and symbols of caution, hazards in use, direction in use, storage and disposal, and others. An applicator should read the label before using any chemical and use it accordingly (McDonald, 1983).

3. Applicator's licenses are required for all restricted pesticides. Check your state's requirements.

4. *You, the users, are liable for improper use.*

*Source of Pesticide Information*:

Applying Pesticides Correctly: A Guide for Private and Commercial Applicators. 1974. U.S. Department of Agriculture; U.S. Environmental Protection Agency. Washington, D.C.

Within each Northwest state, contact:

Rod Awe (208) 334-3243
Bureau of Pesticides
Plant Industries Division, Dept. of Agric.
P. O. Box 790
Boise, ID 83701

F. Clarke Brown (509) 575-2746
Pesticide Branch, Dept. of Agric.
2015 S. First St.
Yakima, WA 98901

Tom Harrison (503) 378-3776
Dept. of Agric.
635 Capitol St. NE
Salem, OR 97310

*Breeding for Snowmold Disease Resistance*. Research is needed to develop bentgrass cultivars resistant to plant diseases, especially the snowmold pathogens. With the exception of some bentgrass breeding research in Pennsylvania and Rhode Island, and possibly some in Europe, the author is unaware of any significant *Agrostis* spp. breeding research to develop resistance to snowmold. Gould (1976b) recognized the importance of disease resistant research and stated, "Disease resistance seems to be the best long range solution to our turfgrass disease problems...an on the basis of our research to date, it appears that good strong resistance, rather than immunity from disease, is the most we can hope for."

A start for such a breeding program was initiated at Puyallup in the period 1957-1971 when 160 different bentgrasses, collected worldwide, were evaluated for Fusarium patch. Goss, Gould, et al. noted a general susceptibility to the diseases, although "good resistance" was observed under conditions tested for Boral, Congressional, Dudeck's ARC-1, Emerald, Huffine's MCC-3, Kingstown, Kozelnicky's TG040, Nimisila, Penncross, Rusta and Szego's Z-2000. Later in 1973, 138 bentgrasses were seeded in plots at the Hangman Valley Golf Course near Spokane, Washington to screen for *F. nivale* and *T. incarnata*. After 2-3 years of evaluation, they noted that the stolonized types were most susceptible, but none of the cultivars were highly resistant. In addition to those listed above, some resistance appeared in Bardot, Contrast, Metropolitan, Mommersteeg's AT4, Saat Zucht's ACA-61, Skogley's (AC-5, AP-1, APD 1-1, Hyannisport velvet), Svertge N010, Tendenz, Toronto, Yale Selection, Vaartnou's CHV-T02, HV-T-3 and HV-TC-4. They noted that several cultivars also had good cultural characteristic (Gould, 1976b).

From these Hangman Valley trials, the author selected Mommersteeg AT4, which seemed the most disease tolerant, and made large plot seedings with 10 other standard varieties of bentgrass at Moscow, Idaho. Not until 1984-85 did we have adequate conditions to screen these cultivars for snowmold resistance. Then we observed that after 109 days of continuous snow cover, Mommersteeg AT4 was very resistant with few snowmold symptoms (unpublished data). Other cultivars were 100% infected with both *F. nivale* and *T. incarnata*, especially the latter. Individual plants from MOM-AT4 have been established for further screenings. Plans are being developed to screen the top cultivars from Hangman Valley under

heavy snowmold situations, possibly McCall, where heavy snow cover is assured from November to early May and *Typhula* spp. are common.

It appears, therefore, that there are several sources of germplasm with some tolerance to the snowmolds. Some of this material needs to be incorporated in an organized and systematic breeding program whereby thousands of individual plants would be subjected to *F. nivale* and *T. incarnata* to screen out resistant germplasm which, if discovered, may be incorporated into a synthetic variety.

I agree with Dr. Gould that the most significant advancements in dealing with these turf diseases is breeding for resistance. Although we cannot expect to get resistance to the 18-20 recognized turf diseases, we do have excellent prospects to get more tolerance to the two snowmold organisms with standard varieties. Two or three cultivars with excellent resistance to snow molds, plus an acceptable turfgrass quality, would be a valuable contribution to turf culture in the Northwest.

## IMPORTANT POINTS IN PURCHASING AND USING FUNGICIDES

—Is the fungicide needed in your lawn, turf, and/or golf course?

—What fungus is to be controlled?

—What fungicide is needed?

—Are you licensed to apply selected fungicides?

—What does the label say?

—What is the ingredient?

—What is the trade name?

—What is the percent active ingredient (AI)?

—What rates must you apply?

—When must you apply?

—Did the product work satisfactorily?

—Safety problems?

—Cost?

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### Pink Snowmold

Hyphae give a *pinkish* cast when first exposed to light.

Microscopic examination show hyphae do *not have clamp* connections.

Spores on macroconida are 1 to 3 septate and *crescent* (lunate) in shape. Under favorable conditions will germinate and impact the leaves.

Growth favored by rainy and continuous, cool (32-40°F) periods on unfrozen soils.

Patches on greens are first water-soaked and less than 5cm in diameter, tan to dark brown, mycelium white changing to pink when sporulating. Often green grass in center of patch.

Symptoms may be observed from September to early March.

### Gray Snowmold

Immediately after snow melts the yellowish brown infected grass shows fluffy *grayish to white* mycelium on leaves.

The hyphae *have clamp* connections.

Small, hard, round, amber to reddish-brown and dark brown when mature. *Sclerotia* (like alfalfa seed) form on infected leaves immediately after snow melts.

Growth favored by continuous *deep snow,* high humidity, 33-34°F on unfrozen soil with heavy mulch.

Patches of 5cm - 1m in diameter have scalded appearance like "snow scald," leaves matted with fluffy white to grey-white mycelium, fungus kills grass and leaves become brittle.

Symptoms usually first seen after prolonged snow cover and patches may not heal before midsummer.

**Table 2.** Registered fungicides specific to control pink snow mold/Fusarium patch.[1]

| Trade name | Ingredients | Company | Registered in Idaho, Oregon, Washington 1985 |
|---|---|---|---|
| Caddy | Cadmium chloride (20.1%) | W.A. Cleary Corp. | Yes |
| Duosan* | Thiophanate methyl 15%<br>Mancoreb 60% | Mallinckrodt | WA, OR |
| Fore WD | Mancozeb (80%) | Rohm & Haas | Yes |
| Formec 80 | Mancozeb (80%) | PBI/Gordon | Yes |
| Tersan 1991* | Benomyl 50% | Du Pont | Yes |
| Fungicide V* | Iprodione (1.3%) | O.M. Scotts | WA, OR |
| Fungo 50* | Thiophanate-Methyl 50% | Mallinckrodt | OR |

* = Systemic fungicides others contact non systemic

NOTE: To simplify information, trade names have been used. Neither endorsement of named products is intended nor criticism implied of similar products not mentioned.

[1] Data summarized from Pesticide Label Information Retrieval System (PLIRS), University of Idaho, Washington State University and Oregon State University. 9/16/85.

**Table 3.** Registered fungicides specific to grey or speckled snow mold or Typhula blight, *Typhula incarnata* and *Typhula ishikariensis.*[1]

| Trade name | Ingredients | Company | Registered in Idaho, Oregon, Washington 1985 |
|---|---|---|---|
| Daconil 2787 | Chlorothalonil 75% | SDS Biotech | Yes |
| Fungicide II* | Chloroneb 6.25% | O.M. Scotts | Yes |
| Tersan 75 | Thiram 75% | Du Pont | Yes |
| Spotrete | Thiram 75% | W.A. Cleary | WA, ID |
| Dyrene (50%) | Anilazine 50% | Mobay Chemical Co. | Yes |
| Grandular Turf Fungicide | Thiram 5% Cadmium Chloride 75% | W.A. Cleary | WA, ID |

* = Systemic fungicides others contact non systemic

NOTE: To simplify information, trade names have been used. Neither endorsement of named products is intended nor criticism implied of similar products not mentioned.

[1] Data summarized from Pesticide Label Information Retrieval System (PLIRS), for Idaho, Oregon and Washington 9/16/85.

**Table 4.** Fungicides registered for control of both grey *Typhula* and pink *Fusarium* snow molds.[1]

| Trade name | Ingredients | Company | Registered in Idaho, Oregon, Washington 1985 |
|---|---|---|---|
| Bayleton (25%) | Triadimefon 25% | Mobay | Yes |
| Bromosan* | Thiram 50%, Thiophanate | W.A. Cleary | WA, OR |
| Scotts Broad Spectrum** | Thiram 4.65%, Phenyl-mercuric Acetate .69% | O.M. Scotts | Yes |
| Calo-clor** | Mercurous 60% + Mercuric 30%, Chloride | Mallinckrodt | Yes |
| Calo-gran** | Mercurous 1.8% + Mercuric .9%, Chloride | Mallinckrodt | ID |
| Cad-Trete | Thiram 2.5%, Cadium chloride .38% | W.A. Cleary | WA |
| Chipco 26019* | Iprodione 50% | Rhone-Poulenc | Yes |
| PMAS** | Phenylmercuric Acetate 10% | W.A. Cleary | Yes |
| Terrachlor 75 | PCNB 75% | Uniroyal | Yes |
| Turfcide (10%) | PCNB 10% | Uniroyal | Yes |
| Rubigan 50W* | Fenarimol 50% | Elanco-Eli Lilly | OR, ID |
| Scotts 14-3-3 | PCNB 15.4% | O.M. Scotts | Yes |

* = Systemic fungicides others contact non systemic

** Golf courses only

NOTE: To simplify information, trade names have been used. Neither endorsement of named products is intended nor criticism implied of similar products not mentioned.

[1] Data summarized from Pesticide Label Information Retrieval System (PLIRS), for Idaho, Oregon and Washington 9/16/85.

# AN OVERVIEW OF TURFGRASS RESEARCH AT WWREC[1]

By Stan Brauen[2], Jeffery L. Nus[3] and Roy L. Goss[2]

[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Associate Agronomist and Extension Agronomist, Western Washington Research and Extension Center (WSU), Puyallup, WA.

[3] Assistant Professor, Department of Horticulture, Kansas State University, Manhattan, KS.

Turfgrass research at WWREC encompasses several project areas which include new cultivar evaluations and growth regulator effects on turfgrass stress and persistence, nitrogen efficiency and sand amendment studies, mechanisms of drought stress, nutritional influences on bentgrass/*Poa annua* management and chemical control of annual grasses and broadleaf weeds. Several of these research projects are being covered by co-workers in other papers at this conference.

## NATIONAL TURFGRASS EVALUATIONS

*Perennial Ryegrass*. The perennial ryegrasses have been continually evaluated at Puyallup for 12 years and brief results have been summarized at these conferences several times. Exceptionally good advances have been made in the identification of adapted cultivars of ryegrass since that time. I believe much of the increased use of improved perennial ryegrass cultivars available for home and athletic turf is due to the efforts devoted to this project.

In the current round of evaluations, 47 cultivars and selections have been evaluated for the past three years in full sun at Puyallup and in dense shade at the Everett Golf and Country Club. Monthly ratings were recorded for turf quality and quarterly ratings were recorded for living cover, density, and color, while occasional ratings were recorded for *Poa annua* invasion and disease reaction.

In the shade trial during the first year following establishment, Pennant, Elka, Manhattan II, Palmer, Gator, Blazer, Diplomat, Yorktown II, Derby and Prelude were the most vigorous cultivars. Linn, Citation, Pennfine, Regal, Premier and Dasher were distinctly less vigorous.

In the second year following establishment, the best performing cultivars in shade which were not significantly different from each other in turf quality were Birdie II, Repell, Gator, Palmer, Citation II, Manhattan II, Blazer and Prelude. Some cultivars, such as Pennant and Elka, did not perform as well as in the first year, while the turf quality of Linn, Regal, Delray, Pennfine and Dasher remained significantly less desirable.

All of the perennial ryegrass cultivars that were best performing cultivars in the shade trial had high performance in the sun. But, in addition, many additional cultivars performed equally well in sun. These cultivars are listed in Table 1 along with the average quality ratings received during the second season.

*Tall Fescue*. Tall fescue has always been a widely used turfgrass species in the U.S. In fact, its total yearly usage exceeds the individual uses of either Kentucky bluegrass or perennial ryegrass. In the Pacific Northwest, however, tall fescue is not an important turfgrass species.

In the past eight years or so a number of new finer leaved turftype tall fescue cultivars have been developed. However, with the development of much improved cultivars of this species, at least with regard to color, texture, density and dwarf growth habit, some cultivars of this species may become more important particularly for shade, non-irrigated or moisture or nutritionally stressed sites. The tall fescue evaluations were seeded in the late summer of 1983 and only one complete year of data is currently available for this summary. This is insufficient time to provide evidence of long-term performance, but these evaluations do provide some indication of the level of improvement of turf quality, color and density as compared to national performance.

Table 2 lists the average performance of the best, medium and average groupings of tall fescue cultivars for average annual turf quality during the first year following seeding. The table shows the significant improvement in density and color associated with the groupings but also shows the significant improvement of all turftype cultivars over common forage-type tall fescue cultivars.

The average performance of tall fescue cultivars is recorded in Table 3. Arid, Jaguar, Adventure, Falcon, Finelawn and Rebel were in the best quality group. The higher performance ratings of these cultivars seemed to be largely related to their darker color *and* better density. Some cultivars that did not perform in the top group commonly did so because they lacked good density *or* color. The cutting quality of all cultivars appeared substandard for good quality turf and appeared little improved over older standard cultivars during most seasons of the year.

*Fine Fescue*. Like the evaluations of perennial ryegrass, the fine-leaved fescues have been evaluated at Puyallup for the past 12 years. The past evaluations were conducted under conditions of medium management which included adequate moisture and fertility for non-stress performance. Under these conditions of management, the chewings fescues were superior to the creeping red fescues and the hard fescues. With the present evaluations, as with the tall fescue evaluations, the fine fescue cultivars are being evaluated under low fertility (nitrogen application at 1 lb N per 1000 $ft^2$ annually) and without supplemental water.

Under these conditions of management, the creeping red fescues retained greater

color and turf quality during the drought stress summer months than did the chewings fescues. Particularly, cultivars such as Estica were able to retain significantly greater color and quality than all other cultivars. Table 4 records the performance values of the groupings. The best quality was recorded for Estica, Pernille, Ensylva and Ruby among the creeping red fescue cultivars, while Pennlawn was significantly lower in quality than Estica, Pernille or Ensylva. Significantly lower qualities were recorded for Robot, Boreal, Commodore, Lovisa and Ceres.

Generally, the chewings fescues did not perform as well under nitrogen and moisture stress as did the creeping red fescues. This lower performance does not appear very significant when viewed in terms of average annual quality ratings, but the performance is highly significant when viewed on the basis of quality during the summer stress period. As is recorded in Table 5, a large significant difference was present in the performance of chewings fescues under moisture stress in summer with performance ranging from 2.3, or what is nearly brown, dormant turf to 5.7, or what is considered green, commercially acceptable turf. Thus, on the basis of 1985 drought performance data, Tamara, Longfellow or Checker might provide higher quality turf for a longer period of stress, but several of the creeping red fescue cultivars would be the best choice.

Many of the fine fescues are tolerant to low level application of glyphosate. This characteristic can be used to control the incidence of *Poa annua* in turfgrass. However, some fine fescues appear to be injured by glyphosate treatment. Tests during 1985 to test cultivar susceptibility indicate quite a range of resistance and susceptibility is present among cultivars. Wintergreen, Ivalo, Pernille, Tatjana, Ceres and Boreal were heavily discolored for a period of four to six weeks following application while many of the resistant cultivars listed in Table 6 showed various degrees of resistance ranging from no reaction to faint discoloration for up to one or two weeks.

## GROWTH REGULANTS

For the most part, the present growth regulants induce some discoloration of turf following application, and it is this possibility of discoloration or the unpredictability of discoloration effects that limit use on much of the better managed turf.

Studies conducted in 1985 suggest both application volume and iron additives may influence the discoloration effect in some instances. Figure 1 shows that the discoloration induced by Embark can be reduced by application volume and that the reduction in discoloration is dependent upon the rate of growth regulant applied. Rather extensive reductions in discoloration may be possible by doubling application volume at low rates of mefluidide while less avoidance of discoloration can be achieved at higher rates of mefluidide application.

At the same time, the addition of some iron compounds at the time of mefluidide

application appear to reduce toxicity of mefluidide, shorten the period of toxicity or perhaps even enhance the color of the turfgrass (Figure 2). It is not clear at this time under what conditions the addition of iron may improve turfgrass color or whether previous application of iron compounds have a similar influence upon turfgrass reaction to mefluidide.

**Table 1.** The average turf quality* of perennial ryegrass cultivars in the second year of evaluation at Puyallup, Washington in full sun and at Everett, Washington in dense shade (Brauen, McElhoe, Goss and Nus).

| Cultivars at Everett in shade | | Cultivars at Puyallup in full sun | |
|---|---|---|---|
| | Best Cultivars | | |
| Birdie II | 6.6 | Palmer | 7.5 |
| Repell | 6.3 | Blazer | 7.4 |
| Gator | 6.3 | Derby | 7.4 |
| Palmer | 6.1 | Acclaim | 7.3 |
| Citation II | 6.0 | Barry | 7.3 |
| Manhattan II | 5.9 | Citation II | 7.2 |
| Blazer | 5.8 | Manhattan II | 7.2 |
| Prelude | 5.7 | Regel | 7.2 |
| Manhattan | 5.6 | Omega | 7.2 |
| Elka | 5.5 | Cupido | 7.2 |
| | Medium Cultivars | | |
| Premier | 5.5 | Premier | 7.2 |
| Yorktown II | 5.5 | Yorktown II | 7.2 |
| Cowboy | 5.5 | Repell | 7.1 |
| All-Star | 5.4 | Birdie II | 7.0 |
| Acclaim | 5.4 | Ovation | 7.0 |
| Diplomat | 5.4 | All-Star | 7.0 |
| Cockade | 5.4 | Gator | 7.0 |
| Omega | 5.3 | Prelude | 7.0 |
| Barry | 5.3 | Cowboy | 7.0 |
| Fiesta | 5.3 | Diplomat | 7.0 |

* Average turfgrass quality for each month of 1984. Rated from 1 to 9 with 9 equal to the best turf quality.

**Table 2.** The average* turf quality, density and color of tall fescue cultivar groupings at Puyallup as compared to the average turfgrass rating at all test locations in the National Turfgrass Evaluation Program in 1984 (Brauen, Nus and Goss).

| Cultivar performance grouping | Quality | Density | Color | National quality |
|---|---|---|---|---|
| Best six | 6.9 | 8.1 | 6.9 | 5.9 |
| Medium five | 6.5 | 7.5 | 6.7 | 5.6 |
| Average seven | 5.8 | 7.2 | 6.3 | 5.3 |
| Kenhy, Ky-31 | 4.8 | 6.4 | 5.1 | 4.6 |

* Average turfgrass quality for each month of 1984 and average density and genetic color rating during several periods. Rated from 1 to 9 with 9 equal to the best turf quality.

**Table 3.** The average* turf quality, density, and color of tall fescue cultivars at Puyallup as compared to the average turfgrass rating at all test locations in the National Turfgrass Evaluation Program in 1984 (Brauen, Nus and Goss).

| | | | | |
|---|---|---|---|---|
| | | Best Cultivars | | |
| Arid | 7.4 | 8.3 | 7.0 | 6.1 |
| Jaguar | 7.1 | 7.7 | 7.2 | 5.9 |
| Adventure | 6.9 | 8.7 | 6.8 | 5.8 |
| Falcon | 6.8 | 8.3 | 6.7 | 5.7 |
| Finelawn | 6.7 | 8.3 | 6.7 | 5.7 |
| Rebel | 6.7 | 7.0 | 6.9 | 5.7 |
| | | Medium Cultivars | | |
| Tempo | 6.6 | 8.0 | 5.7 | 5.4 |
| Apache | 6.5 | 7.3 | 7.2 | 6.0 |
| Willamette | 6.5 | 7.7 | 6.6 | 5.3 |
| Olympic | 6.4 | 7.3 | 7.0 | 5.9 |
| Houndog | 6.4 | 7.3 | 7.0 | 5.6 |
| | | Average Cultivars | | |
| Pacer | 6.1 | 8.3 | 7.4 | 5.7 |
| Clemfine | 6.1 | 7.0 | 5.1 | 5.2 |
| Brookston | 6.0 | 8.0 | 6.1 | 5.3 |
| Barcel | 5.8 | 6.7 | 4.8 | 4.7 |
| Bonanza | 5.7 | 5.7 | 8.0 | 5.8 |
| Trident | 5.6 | 6.7 | 7.6 | 5.8 |
| Festorina | 5.4 | 7.7 | 4.8 | 4.9 |

* Average turfgrass quality for each month of 1984 and average density and genetic color rating during several periods. Rated from 1 to 9 with 9 equal to the best turf quality.

**Table 4.** The average turf quality* of creeping red fescue cultivars in the second year of evaluation at Puyallup, Washington (Brauen, Goss and Nus).

| Cultivar | Annual turf quality | Mid-late summer |
|---|---|---|
| | Best Cultivars | |
| Estica | 6.8 | 6.8 |
| Pernille | 5.7 | 5.2 |
| Ensylva | 5.7 | 5.1 |
| Ruby | 5.6 | 4.7 |
| Flyer | 5.4 | 4.8 |
| Pennlawn | 5.1 | 3.6 |
| | Average Cultivars | |
| Robot | 5.0 | 3.0 |
| Boreal | 4.9 | 4.4 |
| Commodore | 4.7 | 3.3 |
| Lovisa | 4.4 | 5.2 |
| Ceres | 4.3 | 3.0 |

* Average turfgrass quality for each month of 1984. Rated from 1 to 9 with 9 equal to the best turf quality.

**Table 5.** The average turf quality* of chewings fescue cultivars in the second year of evaluation at Puyallup, Washington (Brauen, Goss and Nus).

| Cultivar | Annual turf quality | Mid-late summer |
|---|---|---|
| | Best Cultivars | |
| Ivalo | 5.7 | 3.1 |
| Highlight | 5.6 | 3.3 |
| Tamara | 5.5 | 5.1 |
| Victory | 5.5 | 4.7 |
| Longfellow | 5.4 | 5.0 |
| Checker | 5.4 | 5.0 |
| Banner | 5.3 | 3.7 |
| | Average Cultivars | |
| Weekend | 5.3 | 4.2 |
| Shadow | 5.3 | 4.0 |
| Tatjana | 5.3 | 2.3 |
| Koket | 5.2 | 3.0 |
| Beauty | 5.1 | 4.6 |
| Jamestown | 5.0 | 3.8 |

* Average turfgrass quality for each month of 1984. Rated from 1 to 9 with 9 equal to the best turn quality.

**Table 6.** Sensitivity of fine fescue cultivars to glyphosate phytotoxicity for *Poa annua* control.

| Resistant cultivars | | Susceptible cultivars |
|---|---|---|
| Lovisa | Reliant | Wintergreen |
| Longfellow | Magenta | Ivalo |
| Victory | Epsom | Pernille |
| Shadow | Aurora | Tatjana |
| Waldorf | Estica | Ceres |
| Atlanta | Enjoy | Boreal |
| Spartan | Mary | |

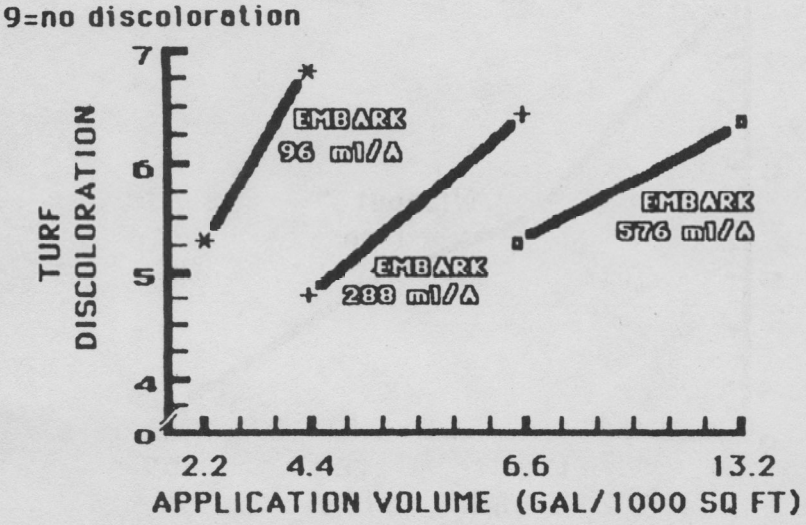


*Figure 1. The influence of application volume in applying mefluidide on the discoloration of bentgrass/*Poa annua *turf (Brauen, Nus and Goss)*

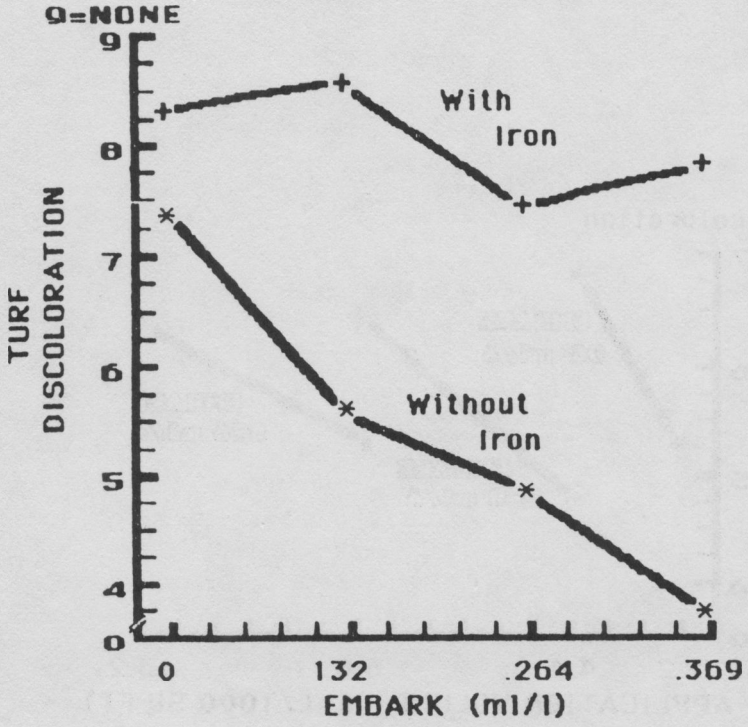


*Figure 2. The influence of iron in combination with mefluidide growth regulant on the discoloration of bentgrass/*Poa annua *turf (Brauen, Nus and Goss)*

# FLORAL DISPLAYS FOR YOUR CLUB[1]

Warren Bidwell[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Turf Consultant, Tee-2-Green, Matteson, IL.

The achievement of Excellence in Golfing Turfgrass throughout this country is accepted by the golfing public as standard. In the private club operation, anything short of this usually means that a change in turf managers will soon be forthcoming.

During the last five years the trend toward triplex mowing of fairways has resulted in a new appreciation of the turf professional and his ability to manage vase acreage having putting green-like appearance and playability for his membership. This has brought new pride to the membership, a very definite plus in his being a member of the very best in town.

Where clubs could afford this new concept of turf excellence, and some who could not but are doing it anyway by some means or other, the membership have found that Joe, the superintendent, has, once again, proven that he is a true professional in all categories at his club. He has managed the funds made available to him by the board, usually insufficient for the type of playing surface they desire but always surprised by the condition of the course as compared to others in the surrounding community.

Competition among clubs desiring to have the best in town has always motivated club committees to do something different, better or more challenging. Seldom, if ever, have I known of clubs having a lady on the Board of Directors. Yet that still, small voice has a way of being heard; often a moving factor in some small detail that the male member just simply does not see or take into account.

At the Belle Meade Club in Nashville, Tennessee quite a few years ago, the Ladies' Golfing Committee wanted flowers at the entrance to their locker room to the extent that they took up donations and did the actual planting, then proceeded to tell the board members how they started the floral program. The following year the funds became a part of the grounds program.

## FLORAL DISPLAYS FOR YOUR CLUB

The usual manipulation by the Ladies Committee comes about when their golf team plays at another club having an excellent floral program. They return to their home club with raves, not about how they beat the opposing club in their match, but how beautiful the entrance to the ladies' locker room was, or perhaps how the outdoor patio was decorated with boxes or urns as they entered the area. The

usual obvious question then became a conversation piece, "Why can't we have our patio planted like that?" The word filters down to the board members and, chances are, they will get their wish come next year.

Provided that funding for floral programs are available, however, these foregoing examples should never take place. Superintendent Joe should anticipate these desires on the part of the membership and not wait to be prodded into making a move, for then the credit line belongs elsewhere. To emphasize my philosophy on this subject, I have built three greenhouses on club properties to round out my firm belief that flowers can only make the superintendent a more complete grounds manager. The head gardener was always a permanent member of the grounds department.

For those who convince themselves, "I don't have time", I can't accept such an attitude. Those who contend that funds are not available, find them! Inflate other items in the budget.

Floral displays can only enhance your position as a complete grounds manager, one whose knowledge is not limited to turf culture.

# INFLUENCE OF MEFLUIDIDE ON SEEDHEAD INHIBITION, QUALITY, AND PHOTOSYNTHATE DISTRIBUTION OF *POA ANNUA*[1]

Jeff Nus, Stan Brauen and Roy Goss[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Assistant Professor, Horticulture Department, Kansas State University, Manhattan, KS, Associate Agronomist and Extension Agronomist, Western Washington Research and Extension Center (WSU), Puyallup, WA.

## INTRODUCTION

Chemically retarding the growth of turfgrass may be desirable in several areas. Examples include hillsides on golf courses, roadside vegetation and homeowner lawns. Effective chemical retardation of turf growth would improve mowing safety along steep slopes, may prove to be cost effective along roadsides and add to the leisure time of the homeowner. To be used effectively as a turfgrass growth retardant, however, chemical products must meet several goals including reduction in leaf growth and inhibition of seed head formation, as well as the maintenance of tiller, rhizome and root growth. Treated turf should also retain disease and insect resistance as well as its aesthetic value. Mefluidide, N-(2,4-dimethyl-5-)(trifluoromethyl)sulfonyl)amino)-phenyl) acetamide, is currently commercially available for use on turf (3-M, St. Paul).

Annual bluegrass *(Poa annua)*, although generally classified as a turfgrass weed, may become a major component of irrigated, close-cut, intensely fertilized turfs. Although annual bluegrass forms a very fine textured turf of high shoot density under the proper cultural, environmental and soil conditions, its heat, drought and low temperature tolerances are quite poor. Turfs containing major portions of annual bluegrass are frequently subject to severe thinning during periods of drought.

The ability for plants to survive extended periods of limited soil moisture has been associated, in part, with their root-shoot ratios (1,4). Root-shoot ratios refer to the relative amount of root biomass compared to the shoot or above-ground biomass. Plants that have higher root-shoot ratios generally endure drought more successfully than those that possess less root mass relative to a given shoot mass.

Mefluidide has been shown to inhibit seedhead development very effectively (2). If mefluidide treatments do not inhibit the photosynthetic process, then it is reasonable to test whether photosynthates saved by seedhead inhibition might be redistributed in the plant. The result may be increased root-shoot ratios and an increase in the ability of *Poa annua* to survive drought.

## OBJECTIVE

The objectives of this study were to test for the effectiveness of mefluidide ('Embark' 2S) on *Poa annua* seedhead suppression, clipping yield, sward density, phytotoxicity, and root-shoot ratios.

## MATERIALS AND METHODS

*Field Study*. Seed was collected from selected areas at Farm 5 research plots on May 15, 1984, and air-dried for three weeks. After cleaning, 2 lb of seed was planted to an area of approximately 1000 $ft^2$ on October 1, 1984. Establishment fertilization included 1/2 lb N and 1 lb $P_2O_5$ per 1000 $ft^2$. In late November, a winter protective covering (DuPont 'Reemay') (3) was applied to aid establishment.

Mefluidide (Embark 2S) treatments were initiated on March 5, 1985 at rates of 0, 1/2, 1, 2 and 4 oz a.i. per acre. Treatments were applied using a pressure-regulated compressed air sprayer to 1 x 2 m plots. Experimental design was a randomized complete block utilizing five treatments and five replications. After seven weeks (May 7) plots were retreated in exactly the same randomization as the first application.

Seedhead estimates were taken on April 25 and May 1 for the first application. Seedhead estimates were expressed as a visual estimated percentage of untreated control plots. Phytotoxicity ratings were taken weekly for four weeks following each application and expressed as average subjective rating from 0-5 (0=no phytotoxicity and 5=severe phytotoxicity). Clipping yields (5/8 inch mowing height) were taken on May 2 for the first application and May 28 for the second. Color and sward density ratings were taken on May 1 and 7 for the first application and June 9 and 13 for the second application.

*Growth Chamber Study*. Growth chamber studies were initiated to test if increased root-shoot ratios could be obtained with mefluidide treatments. It was also important to know if such increases would come from photosynthates saved by seedhead inhibition or whether similar root-shoot ratio increases could be observed in seedling *Poa* before seedhead primordia had formed reflecting increased rooting in response to photosynthates saved from leaf growth inhibition alone. To test this, *Poa* was sampled at the 2-3 leaf stage from field sites on January 16, 1985 in "boot stage" where the seedhead was enveloped in the leaf sheaths. In a separate experiment, *Poa* seed was germinated and allowed to grow 17-20 days until a 2-3 leaf stage was observed. In both experiments the pressure-regulated compressed air sprayer was again used to treat pots containing 9 plants each with 'Embark' 2S at rates of 0, 0.063, 0.13, 0.25, 0.5, 1, 2, and 4 oz a.i. per acre. Each experiment utilized a randomized complete block design, 8 treatments, and five replications. Plants were separated into shoot and root fractions and oven-dried after 21 days growth post-treatment. Root-shoot ratios were thus obtained for each pot.

## RESULTS AND DISCUSSION

Mefluidide treatments were very effective in inhibiting seedhead formation at rates as low as 1 oz a.i. per acre (Figure 1). Seedhead inhibition was not as effective, however, with the second application as the first. This may be due to a more advanced physiological stage of the *Poa* when the second mefluidide treatment was applied due, in part, to loss of effectiveness during the sixth and seventh weeks of the first application period. At label rates (2 oz a.i. per acre), mefluidide resulted in average seedhead estimates of approximately 5 and 20% of control plots for first and second applications, respectively. Mefluidide treatments at reduced rates (below 2 oz a.i. per acre) may be an effective way to shift predominantly *Poa* putting greens to creeping bentgrass. By inhibiting seed production of the *Poa*, a gradual transition may be possible, since less *Poa* seed would be present to re-establish *Poa* annually and creeping bentgrass may thus be given a competitive advantage.

Mefluidide treatments were also effective in reducing clipping yields from *Poa* plots (Figure 2). In this study, such clipping reduction was due, in part, to seedhead inhibition, but leaf growth was also reduced. As with seedhead formation, repeat applications of mefluidide treatments were not as effective as initial treatments at equivalent rates (Figure 2).

Figure 3 shows that phytotoxicity of mefluidide-treated *Poa* was very rate dependent and lasted for a maximum of four weeks after application. Such discoloration and loss of visual quality may preclude mefluidide as an effective means for the gradual transition of *Poa* to creeping bentgrass suggested earlier. The phytotoxicity response was less severe for repeat applications (Figure 4), although it was still evident four weeks after the repeat application.

Figure 5 demonstrates that there is a trade off between sward density of mefluidide-treated *Poa* and color ratings. Color enhancement was striking. Untreated *Poa* averaged slightly over a 4 color rating. As mefluidide rates were increased, color ratings also increased to a maximum of 8 at the 4 oz a.i. per acre rate. Keep in mind, however, that color ratings were taken after phytotoxicity was no longer evident. Sward density (% fill) was reduced by mefluidide treatments, especially at higher rates (Figure 5). Such loss of ability to fill by the *Poa* may also suggest that reduced rates of mefluidide may be effective in shifting predominantly *Poa* greens to creeping bentgrass, since this may also impart a competitive advantage to creeping bentgrass.

The effect of mefluidide treatments on *Poa* root-shoot ratios depended on the physiological stage of the *Poa*. Figure 6 demonstrates that treating field-sampled *Poa*, that had already formed seedhead primordia (boot stage) with mefluidide, resulted in increased root-shoot ratios. Such increased root-shoot ratios were apparently due mostly to photosynthate savings from seedhead inhibition, since Figure 7 demonstrates that no such increases in root-shoot ratios were observed in seedlings

of *Poa* before seedhead primordia were formed and any increases in root-shoot ratios would have resulted in photosynthate savings from leaf growth inhibition only.

Although root-shoot ratios could be increased with mefluidide treatments, no increase in drought survival of treated *Poa* was observed in the field. The efficacy of using mefluidide to increase root-shoot ratios to impart increased drought tolerance of *Poa annua* seems doubtful based on data to date. Physiological studies are being continued, however, to test whether mefluidide affects basic drought tolerance mechanisms. This research suggests that mefluidide may prove useful at low concentrations to provide a gradual transition from *Poa* to creeping bentgrass. Research on the effects of mefluidide on populations of *Poa* versus bentgrass in mixed stands is needed.

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Figure 1. Average seedheads produced as a percentage of untreated (control) plots versus mefluidide rate (oz a.i. per acre) for first and second applications.

Figure 2. Average clipping yields from treated plots as a percentage of untreated (control) plots versus mefluidide rate (oz a.i. per acre) for first and second applications.

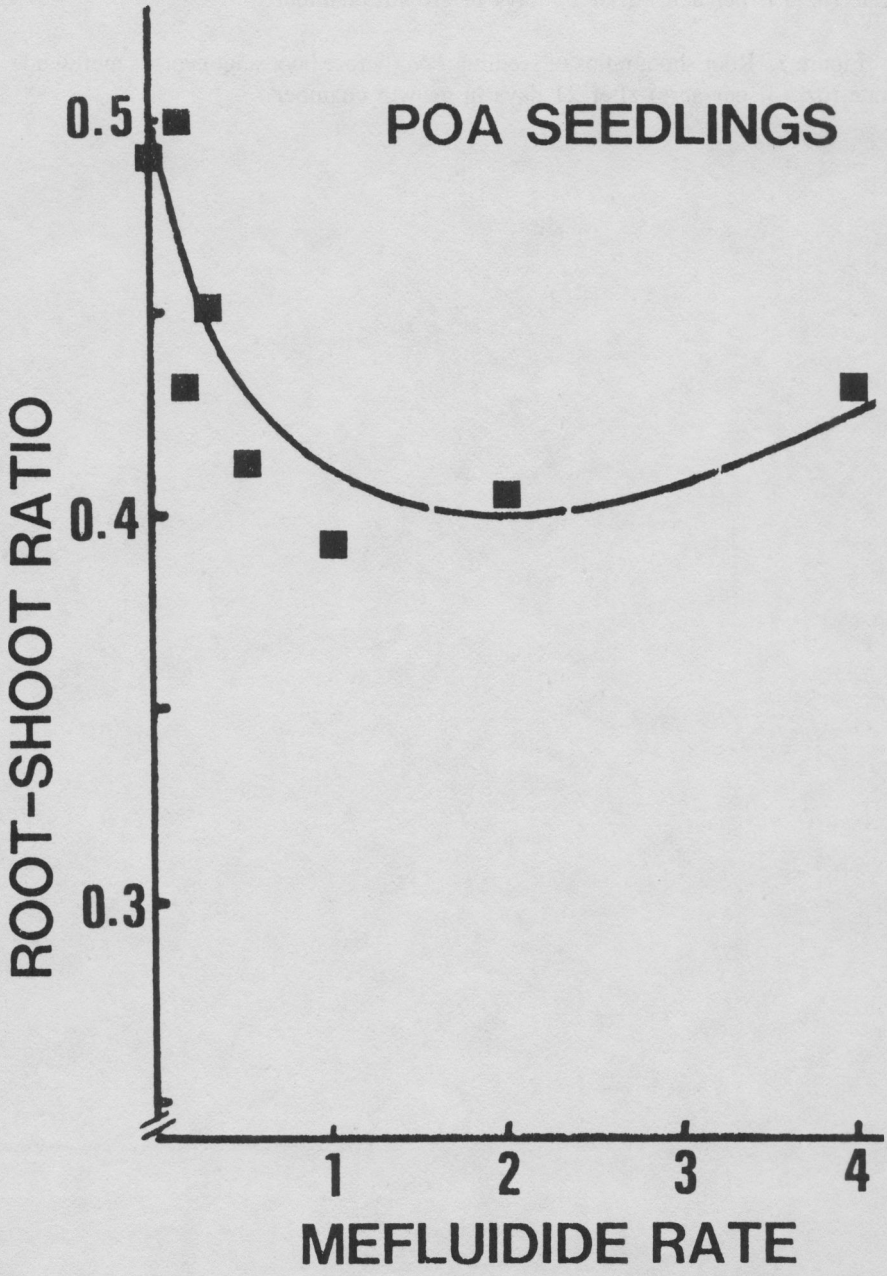
Figure 3. Average phytotoxicity ratings (0=no phytotoxicity and 5=severe phytotoxicity) for mefluidide treatments of 0.5, 1, 2, and 4 oz a.i. per acre versus weeks after first application.

Figure 4. Overall phytotoxicity ratings for mefluidide treatments for first and second applications versus weeks after application.

Figure 5. Color ratings (1-9, 1=straw colored, 0=very dark green) and sward density estimates (% fill) of mefluidide treated *Poa* versus mefluidide rate (oz a.i. per acre).

Figure 6. Root-shoot ratios of field-sampled *Poa* (boot stage) versus mefluidide rate (oz a.i. per acre) after 21 days in growth chamber.

Figure 7. Root-shoot ratios of seedling *Poa* (before boot stage) versus mefluidide rate (oz a.i. per acre) after 21 days in growth chamber.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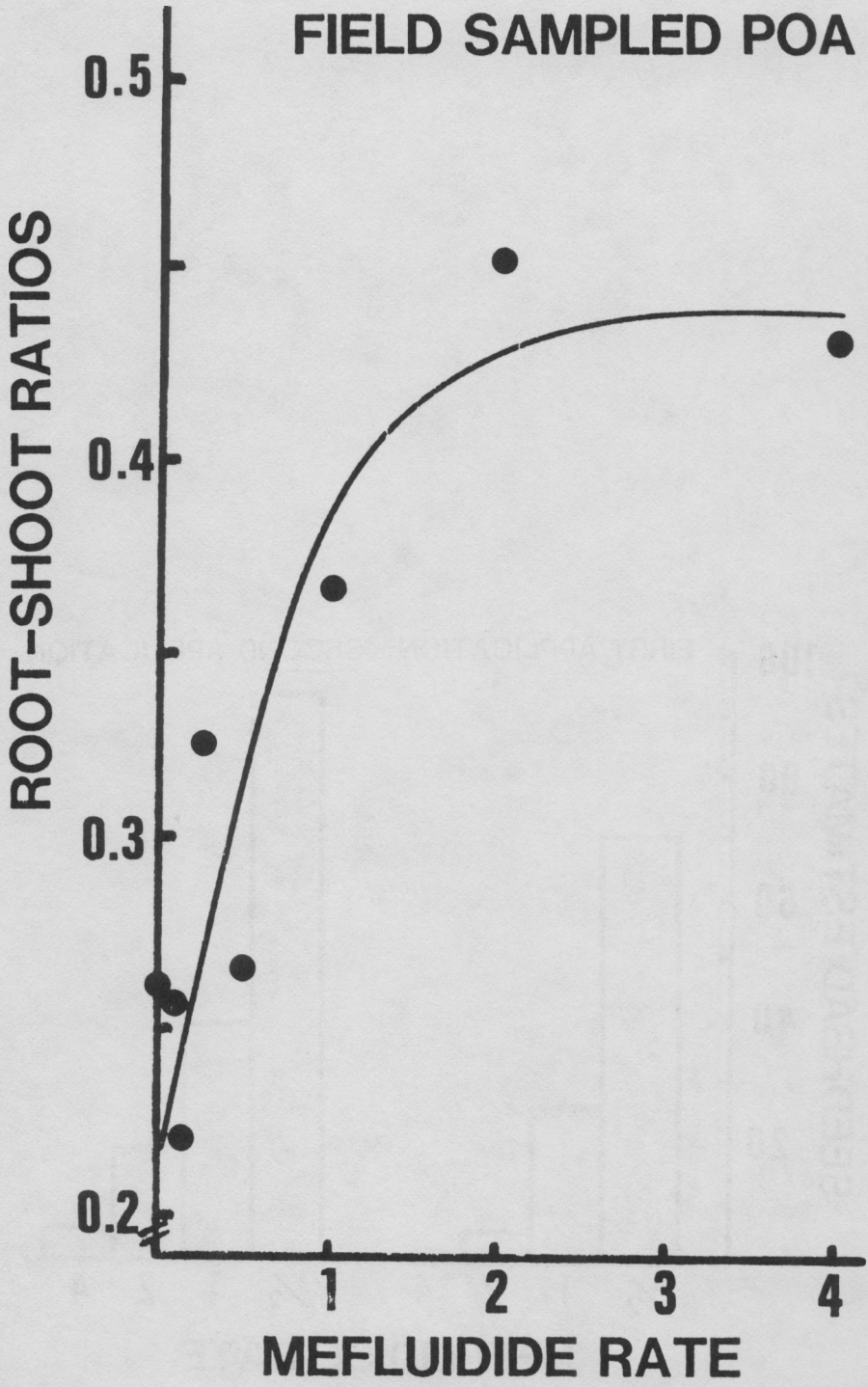
ROOT-SHOOT RATIO
0.5
0.4
0.3
1
2
3
4
MEFLUIDIDE RATE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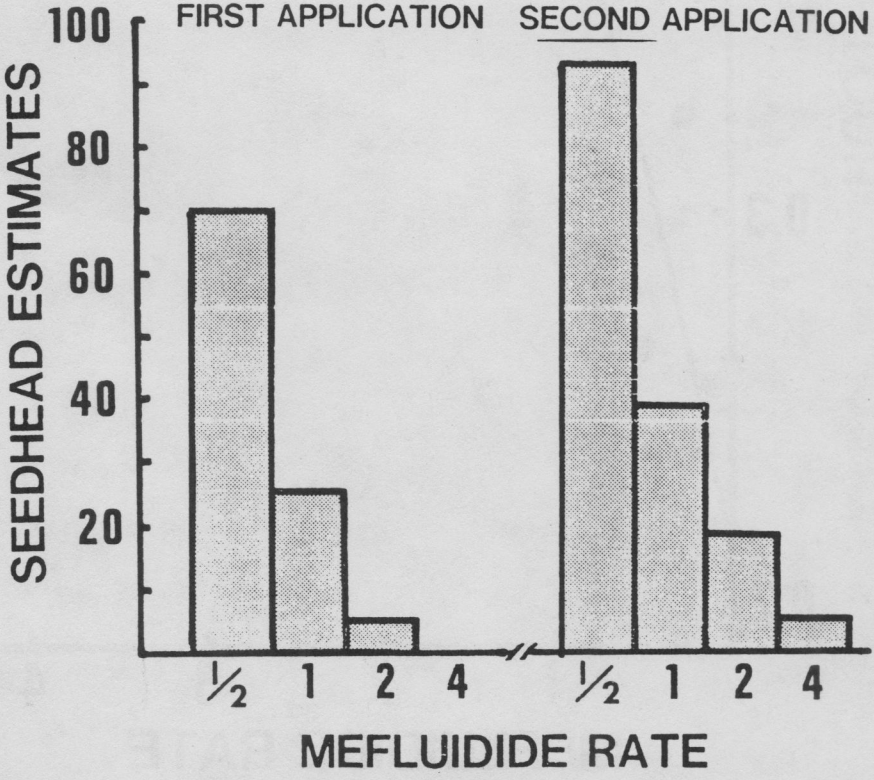
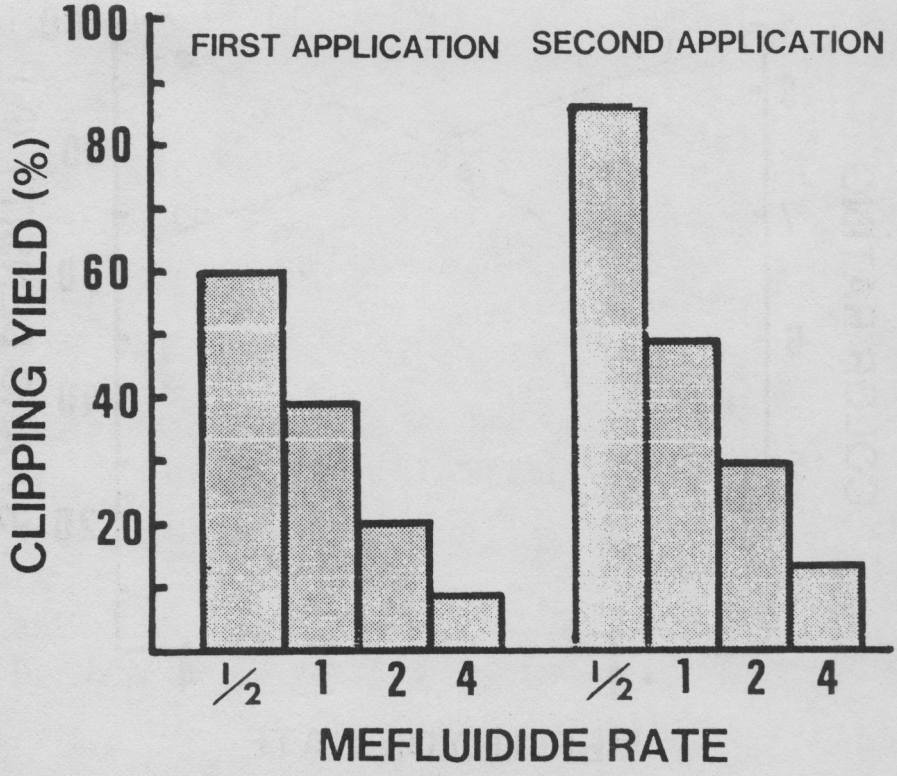
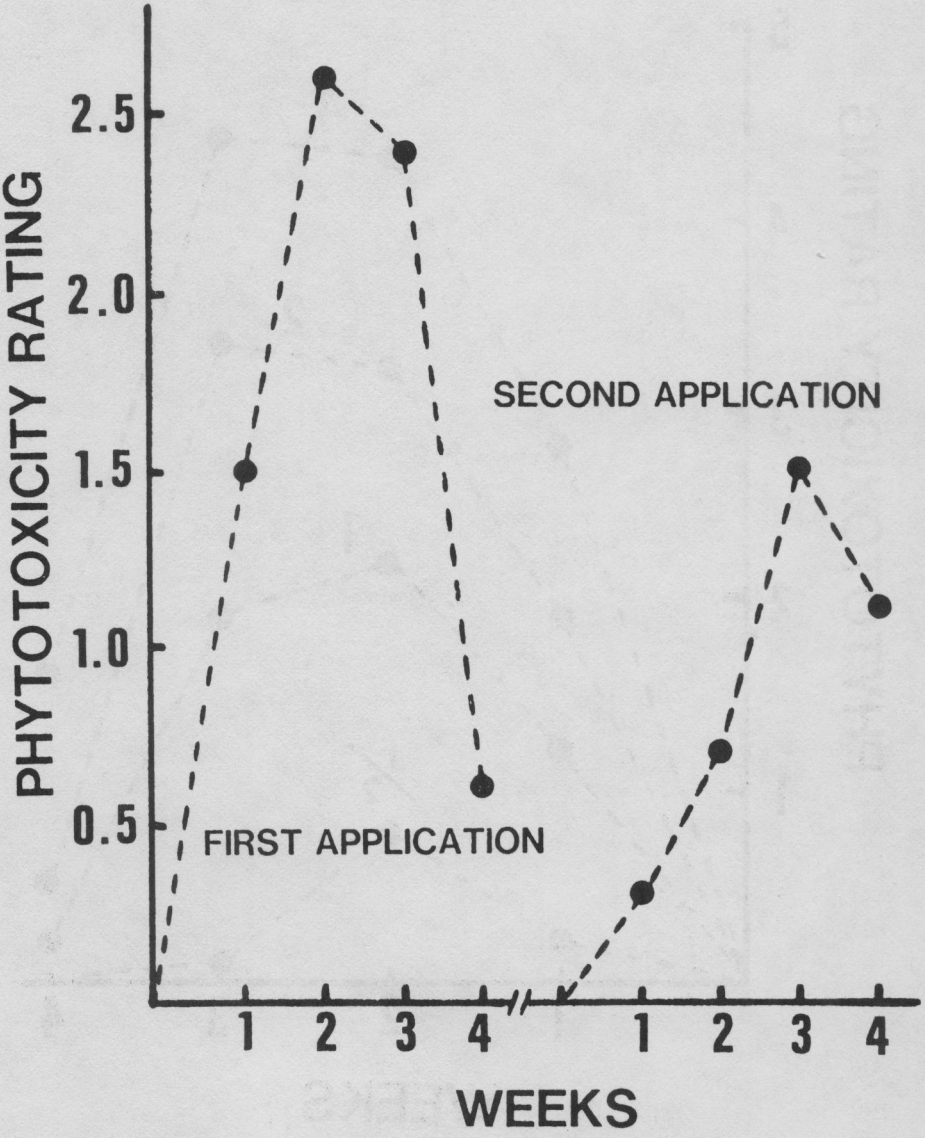
0.3
0.2
1
2
3
4
MEFLUIDIDE RATE


FIRST APPLICATION
SECOND APPLICATION
SEEDHEAD ESTIMATES
100
80
60
40
20
½
1
2
4
½
1
2
4
MEFLUIDIDE RATE

COLOR RATING
8
7
6
5
4
100
80
60
40
20
SWARD DENSITY (%)
1
2
3
4
MEFLUIDIDE RATE


100
80
60
40
20
CLIPPING YIELD (%)
FIRST APPLICATION
SECOND APPLICATION
½ 1 2 4
½ 1 2 4
MEFLUIDIDE RATE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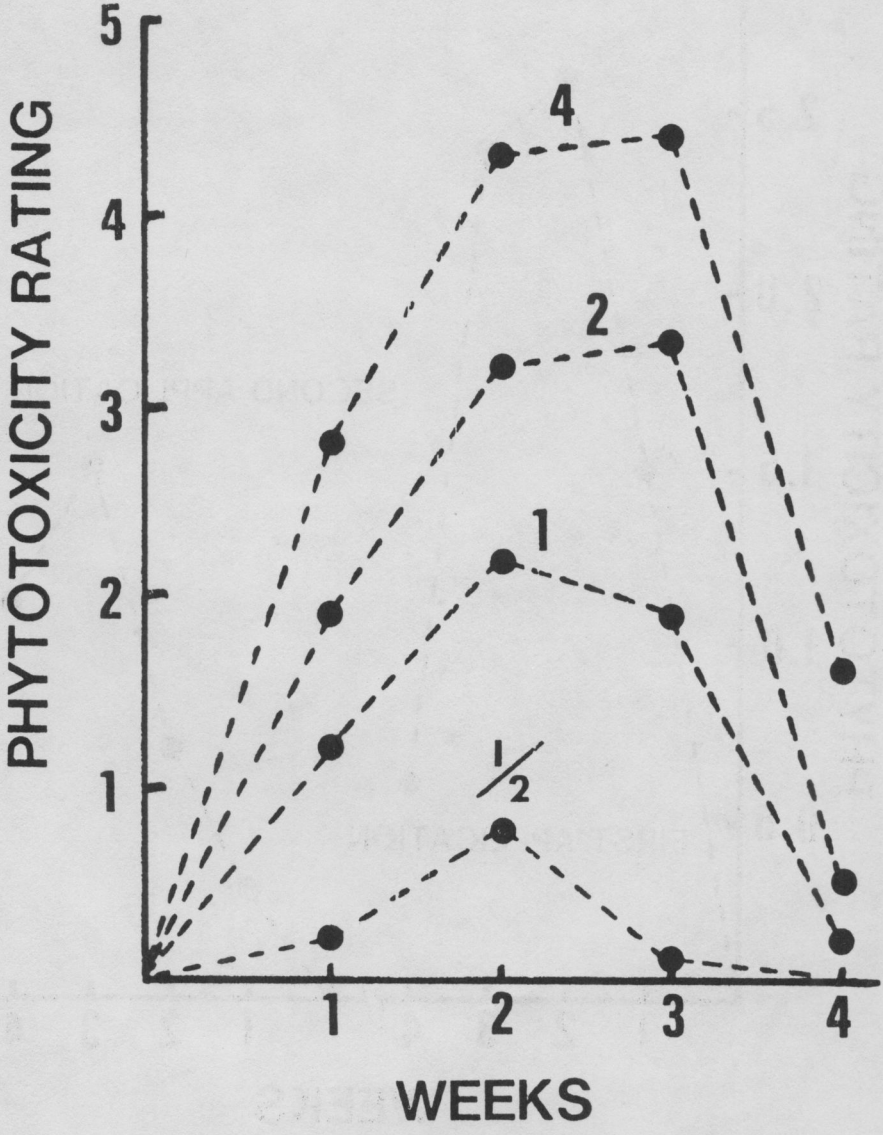
2.0
1.5
1.0
0.5
FIRST APPLICATION
SECOND APPLICATION
1
2
3
4
1
2
3
4
WEEKS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5
4
3
2
1
4
2
1
1/2
1
2
3
4
WEEKS

# CHEMICAL CONTROL OF SNOW MOLDS IN BRITISH COLUMBIA[1]

S. G. Fushtey[2]

[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Research Scientist, Agriculture Canada, Agassiz, BC, Canada.

Snow mold is a serious disease of fine turfgrass in temperate climatic regions of the world, especially those with heavy snowfall. In British Columbia the disease is caused by one or more of several fungal species:

1. Pink snow mold caused by *Gerlachia nivalis* (*Fusarium nivale*).

2. Gray snow mold caused by *Typhula incarnata* or *T. ishikariensis*.

A particular site can be affected by one, two or all three of these at the same time. Some degree of control can be achieved by cultural practices such as use of resistant cultivars and fertilizer management, but chemical control is usually necessary in highly managed, fine turf such as that in golf greens.

Mercurial fungicides provided a reliable means of control in the past, but the use of these materials is restricted in most parts of Canada and prohibited in B.C. Other fungicides vary in their effectiveness from one region to another; hence, it is necessary to continually evaluate available fungicides, both commercial and experimental, on a regional basis. With financial assistance from the Interior B.C. Superintendents Association and cooperation of respective golf club superintendents, trials were conducted at a number of sites in central to south-central B.C. over three winter seasons beginning in the fall of 1982 and ending in spring of 1985.

A total of 21 different fungicides were tested, as listed in Tables 1 and 2. These were applied at dosage rates recommended by the supplier and one or two additional rates, usually above the recommended rate, depending on performance in previous seasons. Tables 1 and 2 summarize the relative efficacy of the fungicides tested.

## DISCUSSION

*Actidione TGF* was ineffective at dosages as high as twice that recommended by the supplier. The partial control with *Actidione-thiram* is attributed to the thiram component. Effective control of *Actidione-RZ* is attributed to the quintozene component which was supplied at a dosage comparable to that in other quintozene-containing fungicides in the trial. *Thiram* was only partially effective at a dosage of 200 g a.i. per 100 $m^2$ and is not generally considered to be suitable for snow

mold control. *Rovral* was not fully effective at 180 g product, as recommended on the label, but efficacy was improved when dosage was increased to 240 g. *Dithane M-45* at 240 g product was surprisingly effective for pink snow mold but considerably less so for gray snow mold. *Arrest* did not provide satisfactory control at the recommended dosage or at 50% higher than the maximum recommended. *Daconil* gave satisfactory control when applied at the upper level of the recommended dosage range except in one instance where disease pressure with pink snow mold was extremely high. *Tersan SP* gave excellent control of gray snow mold and low levels of pink snow mold, but failed to give control where disease was severe and predominantly pink snow mold. *Tersan 1991* and *Easout* gave the reverse of *Tersan SP* in that they were more effective against pink snow mold. *Proturf FFII* was fully effective and resulted in superior early spring greenup.

The performance of the experimental fungicides as summarized in Table 2 was somewhat more variable. *CGA 64250* (Banner) gave good disease control at 16 g a.i. in all trials except the one in 1983 in which pink snow mold was unusually severe. *Bayleton*, which is still an experimental fungicide in Canada, gave excellent control of snow mold at all sites when applied at 40 g a.i., but did not do so well when dosage was reduced to 30 g, especially in 1984 when treatments were applied in a snowstorm onto a layer of snow. Likewise with *Proturf Fungicide VII*, *BC1-100*, and *Bloc*, which were fully effective in 1982 and 1983, but also gave only partial control in 1984. The last three fungicides were tested for the first time in 1984 and really did not get a fair trial because of the unfavorable conditions at time of treatment.

## CONCLUSIONS

There seems to be a reasonably good arsenal of fungicides, both registered and experimental, that can effectively control snow mold, but the manner in which these are used is extremely important. The importance of following the label directions cannot be over-emphasized, but not all the information you need is on the label and some of these directions may not apply to your circumstances. The results reported here show that:

1. In order to choose the right fungicide, you must know whether you have pink snow mold, gray snow mold or both.

2. Dosages on the label are there as a guide but do not necessarily fit all circumstances. The results show that, for good control, dosages at the upper level of a given range, or even higher, are sometimes needed. Higher dosages are usually needed where disease is unusually severe.

3. Treatments must be applied directly onto the turf surface. A layer of snow or ice, however thin, interferes with effective control.

(Presented at the 39th Annual Conference of the Northwest Turfgrass Association, September 23-26, 1985).

**Table 1.** Efficacy of registered fungicides used in snow mold control trials, 1982-85.

| Fungicide | Active ingredient(s) | Efficacy |
|---|---|---|
| Actidione TGF | cycloheximide | – |
| Actidiione thiram | cycloheximide plus thiram | + |
| Actidione RZ | cycloheximide plus quintozene | + + |
| Quintozene 75W | quintozene (PCNB) | + + |
| Tersan 75W | thiram | + |
| Rovral 50W | iprodione | + +[a] |
| Dithane M-45 | maneb | + +[a] |
| Arrest 75W | carbathiin plus oxycarboxin plus thiram | + |
| Daconil 2787 F1 | chlorothalonil | + +[a] |
| Tersan SP 65W | chloroneb | + +[a] |
| Tersan 1991 50W | benomyl | + +[a] |
| Easout 70W | thiophanate methyl | + +[a] |
| Proturf FFII | quintozene (PCNB) | + + |

[a] Effectiveness subject to conditions described in text.

**Table 2.** Efficacy of experimental fungicides used in snow mold control trials, 1982-85.

| Fungicidde | Active ingredient(s) | Efficacy |
|---|---|---|
| CGA 64240 (Banner) | propicanozol | + +[a] |
| Bayleton W | triadimefon | + +[a] |
| Proturf Fung. VII G | triadimefon | + +[a] |
| BC1-100 W | meclozolyn | + +[a] |
| Bloc (EL 222) L | fenarimol | + +[a] |
| DPX H64250L | (confidential) | + |
| Funginex L | triforine | + |
| TF 9021 G | chlorothalonil | + |

[a] Effectiveness subject to conditions described in text.

# LEARNING TO MANAGE UNION LABOR[1]

Rich Scholes[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Golf Course Superintendent, Rancho Murieta Country Club, Sacramento, CA.

Moving from a low-keyed, 18-hole, non-union country club in Oregon to a fast-paced, 36-hole, unionized facility in California has certainly been a learning experience.

Let me give you a brief history of this 36-hole country club. In 1970, the Operating Engineers Pension Trust Fund decided to invest a portion of their funds into a retirement facility for its members. They purchased 3,500 acres planning a potential 5,000 homesites, two 18-hole golf courses, and various other recreational facilities. When interest rates skyrocketed, their plans were modified to allow the public to purchase lots and homes on the property. Development has continued and recently the entire facility was sold to an individual.

I was hired as golf course superintendent in April 1984. At that time, the entire facility was owned and being developed by the Operating Engineers Union; therefore, the labor force on the facility belonged to this Union. I was required to join the Union, but after two months was negotiated out because I was in a management position. Immediately I was treated as an outsider by the business agent and our communication deteriorated for a short while. I began to understand the union contract and he began to better understand my role, so our communication improved.

Our union contract is very similar to most other union contracts. Our employees get nine paid holidays. If they work on a holiday, they are paid double time and a half. They are paid time and a half for their sixth day and double time for their seventh day. They earn one week vacation after one year of employment, two weeks after two years employment and three weeks vacation after five years of service. We have sixteen employees earning three weeks vacation per year. The employees have excellent medical and dental insurance for themselves and their families. Their total benefit package costs $265.00 per month per employee. In addition we pay $.60 per hour per employee into their pension plan.

During the fall of my first year, I was required to lay off six employees. I chose three for poor productivity and three on a seniority basis. This had never been done before so each employee filed a grievance with the Union. After many hours of hearings, the layoffs were upheld. Two of the three employees laid off for poor productivity then filed complaints with State Labor Department. After these hearings, I was required to reinstate one employee and the other case is still pending.

I feel the Union allowed the layoff because they were paying the bills at the time and this saved them money during the off-season. However, we lost the one case and probably will lose the pending case with the State due to lack of documentation of the employee's work habits and any disciplinary action that was taken.

Now the facility is owned by an individual, and union labor is still in force. The union may not be as lenient with layoffs or discipline as in the past. I will be prepared for any labor disputes because everything an employee does is documented. I have developed job descriptions and standard operation procedures that spell out what is expected of each employee. Any violations are handled with the following forms.

*Example 1* - Verbal warning form - given on the first violation.

*Example 2* - Written warning form - first written warning given after the verbal warning. If a second written warning is given, the employee is suspended for two days without pay. A third written warning means termination of employment.

Employees with documented verbal and written warnings are candidates for layoff. The employee, the Union, or the State can't argue with such documentation.

Unions do have their advantages. Employee turnover is almost non-existent because the wages and benefits are so good. Also, a third party is involved in disputes to protect the employees rights. This causes an increase in morale.

Some disadvantages are:

1. Union will increase your budget. Our labor budget including benefits for 1986 will be $645,000 which is 65% of our operating budget.

2. It is difficult to terminate a problem employee.

3. There is always the possibility of a strike during contract negotiations.

Union labor is nothing to be afraid of. I have learned to cope with Union problems by developing good communication with the business agent and shop steward, by knowing the contract inside and out, by documentation of all disciplinary action, and by standing my ground when I know I am working within the guidelines of the union contract.

MEMORANDUM CONFIRMING
VERBAL COUNSELING

MEMORANDUM

TO:

FROM:

DATED:

RE: Counseling session of _____

This memorandum is to summarize our counseling session of the above date.

During the counseling session, the following items were discussed:

During the counseling session, I offered you the following assistance:

During the counseling session, you were directed to:

If this is not an accurate summary of our counseling session, please notify me in writing by _____. If I do not hear from you, I will assume the above to be an accurate summary of our counseling session.

EMPLOYEE WARNING REPORT

Employee Name _____ Date of Warning _____ Dept ____

| | | | | |
|---|---|---|---|---|
| Type of Violation (Circle) | Attendance<br>Tardiness<br>Work Quality | Disobedience<br>Safety<br>Other | W A R N I N G | Violation Date: _____<br>Violation Time: _____<br>Place of Violation: _____ |
| Previous Warnings: YES NO<br>(Circle) : Verbal Written | | | | |

I. Impermissible conduct or performance:

II. Steps necessary to correct problem:

III. Date by which problem must be corrected:

IV. Further disciplinary action, if problem not corrected:

I have read this warning and understand it.

_____
Employee Signature Date

_____
Supervisor Signature Date

_____
Project Mgr/General Mgr Date

This warning report will be placed in the employee's personnel file. If the employee wishes to respond, such response will be placed in the employee's personnel file.

# SPECIAL SESSION - WEED IDENTIFICATION

Roy L. Goss, Extension Agronomist

Northwest Turfgrass Conference, Rippling River Resort
September 25, 1985

## IMPORTANT CHARACTERISTICS OF PLANT FAMILIES WITH IMPORTANT WEEDY MEMBERS

AMARANTHACEAE (pigweed family). All pigweeds. Leaves alternate, often reddish-tinged, no stipules. Flowers perfect or imperfect, with papery perianth, flower parts usually in fives, with small spines beneath flowers. Ovary superior, fruit dry, dehiscent, one-seeded. Seeds shiny, black, lens-shaped.

APOCYNACEAE (dogbane family): Leaves opposite, no stipules, sap usually milky. Flowers complete, regular, flower parts usually in fives. Petals fused below and flared out above. Ovary superior. Fruit dry, dehiscent, opening along one line. Important weeds - Indian hemp and *Vinca minor*.

ASCLEPIADACEAE (milkweed family): Leaves opposite, with minute stipules, plants having milky sap. Flowers complete, regular, parts in fives. Calyx reflexed, pollen borne in waxy clumps, ovary superior. Fruit dry, dehiscent, opening along one line, seeds with a tuft of hairs. Important weeds - showy milkweed.

BORAGINACEAE (bluebell family): Plants bristly-hairy (usually), leaves alternate, no stipules. Flowers complete, regular, parts in fives. Petals fused below, ovary superior. Flowers borne on a coiled stalk. Fruit dry, indehiscent, of four nutlets which may be roughened or spiny. Important weeds - tarweed and stickseed.

CARYOPHYLLACEAE (pink family): Leaves opposite, joined around the stem, which may be ridged, usually no stipules. Flowers complete, regular, parts in fives. Petals often notched, stamens usually ten, styles two to five. Ovary superior, placentation free-central. Fruit dry, dehiscent. Important weeds - all chickweeds including *Cerastium vulgatum* (mouse-eared chickweed) and *Spergula arvensis* (corn spurry).

CHENOPODIACEAE (goosefoot family): Leaves alternate, often mealy-surfaced and with wavy margins, no stipules. Stems usually striped or ridged. Perianth green, flowers very small, in dense clusters, often imperfect. Flower parts in fives, ovary superior. Fruit dry, dehiscent or indehiscent. Important weeds - lambsquarters, *Kochia scoparia* and Russian thistle, *Salsola kali*.

COMPOSITAE (sunflower family): Leaves most often alternate (may be opposite), often with three major veins, stems usually ridged, no stipules. Flowers very

small, in dense heads, often with marginal ray flowers. Anthers fused, ovary inferior. Fruit dry, indehiscent, often with a tuft of bristles or scales on top. Important weeds - English daisy, yarrow, *Cirsium* (thistles), *Centaurea* (more thistles), chicory, ragweed (ambrosia), dog fennel, sagebrush, sunflower, dandelion, groundsel, false dandelion, pineapple weeds, etc., (this is one of the biggest plants for weedy plants).

CONVOLVULACEAE (morning-glory family): Twining vines with usually milky sap and alternate leaves, no stipules. Flowers complete, regular, parts in fives. Petals fused, twisted in bud, ovary superior. Fruit dry, dehiscent. Important weeds - morning glory.

CRUCIFERAE (mustard family): Leaves alternate, often pinnately lobed or compound, often mustard-tasting, no stipules. Flowers complete, regular, parts in fours, but stamens 6 (4 long + 2 short). Ovary superior, fruit pod-like (dry, dehiscent), with a hyaline inner partition. Important weeds - all members of the mustard family, including all brassicas and barbarea, and sheperd's purse.

CYPERACEAE (sedge family): Leaves long, narrow, consisting of sheath and blade, venation parallel. Stems triangular, leaves three-ranked. Flowers reduced, some have a rudimentary perianth (bristles). Stamens usually two, ovary superior, flowers perfect or imperfect. Flowers borne in dense clusters (spikes), fruit dry, indehiscent. In Carex, fruit is enclosed in a husk. Important weeds - yellow nutsedge (*Cyperus esceulentus*).

EQUISETACEAE (horsetail family): Stems leafless and hollow, finely ridged and conspicuously jointed, no flowers, bear spores (no seeds) in a cone at the tip of the stem. Some species have separate vegetative (with many whorled branches) and reproductive (few or no branches) plants. Important weeds - *Equisetum aravense* and *Equisetum hyemale*.

GERANICEAE: Important weeds - the storksbills and cranesbills.

GRAMINAE (grass family): Leaves long, narrow, consisting of sheath and blade, venation parallel. Stem cylindrical, jointed, usually hollow. Flowers very reduced, lacking a perianth. Stamens usually two or three, ovary superior. Flowers most often perfect, borne in dense little clusters (spikelets). Spikelets arranged variously. Fruit dry, indehiscent, consisting of seed tightly enclosed in a husk. Important weeds - all of the grasses. The important genera include *Agropyron*, *Poa* (including *Poa annua*), *Festuca*, *Lolium*, *Cynodon*, *Digitaria* and others.

HYPERICACEAE (St. Johnswort family): Leaves opposite or whorled, often with small clear or black dots, no stipules. Flowers complete, regular, parts in fives except stamens numerous and grouped in bundles. Ovary superior, styles 3-5, fruit dry, dehiscent (capsule). Important weeds - St. Johnswort (*Hypericum perforatum*).

JUNCACEAE (rush family): Important weeds - all members of the rush family including *Juncus bufonis* (toad rush).

LABIATAE (mint family): Leaves opposite, no stipules, stems square, plants often aromatic. Flowers complete, irregular, sepals 5, fused, petals 5, fused. Stamens usually 4, ovary superior. Fruit of four nutlets (dry indehiscent). Important weeds - heal-all (*Prunella vulgaris*), catnip, and mint.

LEGUMINOSAE (pea family): Leaves alternate, usually compound, with obvious, often leaflike stipules. Flowers complete, often pea-shaped, parts in fives, stamens usually 10 (9 fused, 1 separate). Ovary superior, fruit a true pod (dry, dehiscent), opening along two lines. Important weeds - scotch broom, lupine, flat pea, black medic (Japanese clover) and vetches.

MALVACEAE (mallow family): Leaves alternate, usually with palmate venation, stipules present, sap often mucilaginous. Plants usually with star-shaped hairs. Flowers complete, regular, parts in fives, except stamens many and fused into 1 or 2 tubes around ovary. Ovary superior, fruits dry, disc-shaped, borne edge-up in a ring. Important weeds - mallow (*Malva rotundifolia*, etc.).

ONAGRACEAE (evening-primrose family): Leaves opposite or alternate, no stipules. Flowers complete, regular, usually with parts in fours, stamens 4 or 8, caylx and corolla fused together below, ovary inferior. Fruit dry, dehiscent, opening along 4 lines, seeds small and numerous. Important weeds - fireweeds.

PLANTAGINACEAE (plantain family): Leaves in a basal rosette, narrowly or broadly linear, venation appearing parallel, leaf bases often sheathing, no stipules. Flowers very small, in a dense, elongate cluster, stamens prominently exserted. Flowers complete, regular, parts in fours, ovary superior. Fruit dry, dehiscent (capsule), opening around the top so that a 'cap' falls off. Important weeds - all plantains.

POLEMONIACEAE (phlox family): Leaves opposite, simple or compound, no stipules. Flowers complete, regular, parts in fives. Petals fused below, flaring out above, stamens often attached at different levels, ovary superior, stigmas 3. Fruit dry, dehiscent (capsule), usually splitting open along 3 lines. Important weeds - all phlox and skunkweed.

POLYGONACEAE (buckwheat family): Leaves alternate, stipules sheathing, forming a papery collar on stem at nodes. Calyx and corolla not much different—perianth of six segments, colored. Flowers often imperfect, stamens usually 6, ovary superior. Fruit dry, indehiscent, three-sided. Important weeds - knotweed (*Polygunum aviculare*), smartweed (*P. pensylvanicum*), sheep sorrel (*Rumex acetosella*).

PORTULACACEAE (purslane family): Leaves opposite, succulent and fleshy, with small stipules. Flowers complete, regular, sepals two, petals usually 5, stamens

5, attached to petals, ovary superior, fruit dry, dehiscent (capsule), seeds black, shiny, lens-shaped. Important weeds - purselane (*Portulaca oleracea*).

RANUNCULACEAE (buttercup family): Leaves usually alternate and compound or lobed, palmate, no stipules. Flowers complete, regular or irregular, parts spirally arranged and indefinite in number, nectar glands present. Stamens numerous and separate, pistils numerous and separate, fruits dry, indehiscent or dehiscent. Important weeds - all buttercups including *Ranunculus acris* and *R. repens*.

ROSACEAE (rose family): Leaves usually alternate, simple or pinnately compound, with stipules. Flowers usually complete, regular, sepals 5, petals 5, stamens 5, 10, or numerous in whorls, pistils separate or fused, ovary superior or inferior. Fruit dry and indehiscent or dehiscent OR fleshy. Important weeds - potentilla and spirea.

RUBIACEAE (madder or bedstraw family): Leaves opposite or whorled, stipules present and sometimes indistinguishable from leaves, stem square. Flowers complete, regular, with parts in fours or fives. Ovary inferior. Fruit dry, indehiscent, composed of two round lobes, often bristly. Important weeds - all bedstraws.

SCROPHULARIACEAE (figwort or snapdragon family): Leaves usually opposite, no stipules, stems sometimes square (usually round). Flowers complete, irregular, sepals fused, petals fused, flower parts in fives. Stamens 4, ovary superior. Fruit dry, dehiscent (capsule). Important weeds - figwort, *Digitalis* (foxglove), toadflax, mullein, and all *Veronica* genera (including creeping speedwell).

SOLANACEAE (potato family): Leaves alternate, no stipules. Flowers complete, regular, petals fused below. Ovary superior, flower parts in fives. Fruit a berry or capsule. Important weeds - the deadly nightshade (*Solanum nigrum*) and other nightshades.

UMBELLIFERAE (parsley family): Leaves alternate, usually finely-dissected, with large sheathing petioles, no stipules. Flowers tiny, complete, regular, with parts in fives. Ovary inferior, flowers borne in umbels (flat-topped clusters with stalks all arising at one point). Fruit dry, indehiscent, separating into two one-seeded parts. Important weeds - water and poison hemlock, wild carrot, and lawn pennywort.

URTICACEAE (nettle family): Leaves opposite, stipules present, stems square. Often having stinging hairs. Flowers inconspicuous, lacking a corolla. Ovary superior, fruit dry and indehiscent. Important weeds - *Cannibis sativa* (goofweed), *Urtica diaica* (stinging nettle).

ZYGOPHYLLACEAE (caltrop family): Branches often jointed at nodes, leaves usually opposite, often fleshy or leathery, usually pinnately compound. Stipules

persistent and leathery, fleshy, hairy, or spiny. Flowers complete, regular, parts in fives. Ovary superior, usually furrowed, angled, or winged, stigma 1. Fruit dry and dehiscent (usually). Important weeds - puncture vine.

## REFERENCES FOR WEED IDENTIFICATION

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# FERTILIZER AND OTHER MEANS FOR MAXIMIZING TREE GROWTH[1]

Tom Cook[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Professor, Dept. of Horticulture, Oregon State University, Corvallis, OR

Trees are key elements in almost every landscape from city parks to golf courses to industrial site grounds. Unfortunately, trees in these landscapes rarely achieve the prominent role envisioned when they were planted. The reasons for this are varied but often boil down to a lack of fertilizer, a lack of water, and/or severe competition by weeds and turf during the establishment period. The following discussion will explore ways to encourage rapid growth of trees in the landscape with special emphasis on the use of fertilizer.

## TREE FERTILIZATION

There has been far less research on tree fertilization than you might expect, but several excellent studies have been conducted. Neely, Himelick, and Crowley (1970) conducted extensive tests in Illinois on several tree species and concluded the following:

1. Nitrogen is the only nutrient that produced significant growth responses. Phosphorus and potassium applications had no measurable impact on tree growth in their tests.

2. The optimum application rate of nitrogen appears to be 6 lb N/1000 ft$^2$ via broadcast application. Higher nitrogen rates increased growth over the 6 lb rate but only slightly.

3. Method of application was not important. Specifically, broadcast applications were as effective as placing fertilizer in holes drilled throughout the root zone of the tree, or injecting liquid fertilizer into the soil.

4. Optimum timing occurred when all fertilizer was applied in the spring just prior to growth. Applications at other times stimulated growth but not as much.

The study summarized above provided the basic guidelines that many people use today in developing their fertilization programs. Another study by Hendrick van de Werken (1981) helped characterize tree response to fertilizer in Tennessee. In his tests, newly planted deciduous trees did not respond to fertilization during the first three seasons after planting. Once established, growth was significantly greater for trees receiving nitrogen than for unfertilized trees. While fertilized trees

were taller than unfertilized trees, they were not tall and spindly as might be expected. Instead, they had denser canopies and thicker trunks than unfertilized trees.

Our own limited studies at Oregon State University support the observations of Neely et al and van de Werken. In trials conducted at the Lewis-Brown Horticulture Research Farm near Corvallis we used the hole punch method to fertilize *Liriodendron* trees for a three year period. Fertilizer rates were determined by measuring caliper diameter at 3 ft above the ground on each of the fertilized trees. Using the average diameter of all of the trees, nitrogen rates were computed based on 0.2 lb N/1 inch of trunk diameter. Five holes were dug for each inch of trunk diameter and scattered throughout the rootzone of the tree. Fertilizer was then placed in each hole. We used turf formulations with a 6-1-3 ration of N-P2O5-K2O. Nitrogen was from mixed soluble sources including urea, ammonium sulfate, and ammonium phosphate. The results have been amazing so far. Height increases in fertilized trees averaged almost 9 ft after three years while unfertilized trees averaged only 4.1 ft total growth (Table 1). Caliper increase followed a similar trend with an increase of 2.85 inches for fertilized trees and only .83 inch for unfertilized trees (Table 2).

It is obvious that tree growth can be stimulated dramatically by fertilizer. The biggest problem most people face is developing a simple but effective system to fertilize their trees. Based on research findings the answer is simple; use the broadcast method and apply your fertilizer at 6 lb N/1000 $ft^2$. Since most trees grow in association with turf, it is easy to see why this is not a popular option. Six pounds of N/1000 $ft^2$ would either cause severe burn or stimulate excess growth of the grass. Other options include the hole punch method and soil injection. While slower than the broadcast method, they allow us to apply most of the fertilizer deep enough that no major turf problems occur. In fact, the green tufts of grass that surround each hole or injection site serve as a reminder of which trees did or did not get fertilized.

If you choose one of the latter methods, how do you figure rates? The easiest way is to use the trunk diameter method in which caliper is measured at 3 ft above the ground and fertilizer is applied at a given rate per inch of trunk diameter (Table 3). With this approach bigger trees get more fertilizer and the fertilizer is distributed throughout the rootzone of the tree.

That is fine, but where are the roots? Historically, we have assumed most tree roots are somewhere between the trunk and the canopy dripline. Recent research has shown that roots often extend much further out than this imaginary line. From a practical standpoint, you can assume fertilizer can be effective if applied anywhere in the zone between the trunk and several feet beyond the dripline.

How many holes should be made? We have arbitrarily chosen 5 holes/1 inch of trunk (Table 3). I suspect fewer holes would do but how few I can't say. In

general terms, the fewest number of holes that will insure uniform placement of fertilizer in the rootzone is probably best.

If you are using only one fertilizer material and the hole punch method, you can develop a quick guide to speed up the process. For example, if you use a 20% N fertilizer it will take 1 lb of fertilizer for every inch of tree diameter. Since you ar making 5 holes for each inch of trunk diameter, each hole will get .2 lb of fertilizer. By determining the volume required to hold .2 lb of N you can come up with a standard measure (eg. 1/4 cup). From then on just measure the tree diameter, determine the number of holes, and put one scoop of fertilizer in each hole.

A similar approach can be used with the soil injection method. If you used the same 20% N material discussed above you would want to put .2 lb of fertilizer in each hole. Determine how many seconds it takes to inject a given amount of liquid in each hole. One-half gallon of solution per injection is common. Now you know you need to put .2 lb of fertilizer in the tank for each one-half gallon of water. A 100 gallon tank would require 40 lb of a 20% N fertilizer or 17.4 lb of a 46% N material such as urea to achieve the desired rate of application. Now you just have to measure the caliper, determine the number of injections necessary, and inject each hole for X number of seconds to deliver the desired amount of fertilizer. Normal injection depth runs around 12 inches.

Of the methods described above, soil injection is probably the most practical where turf grows at the base of the tree. The hole punch method is laborious and slow but is a good method if there are only a few trees to fertilize. The broadcast method would work best in mulch beds where no grass is present.

The most critical time for fertilizing trees is when they are young (i.e. 1-6 inches trunk diameter). The goal is to stimulate tree growth so trees will quickly achieve functional size in the landscape. Once this size is attained there is no real need to continue heavy fertilization on a regular basis unless there are unusual soil or site conditions that warrant it.

## COMPETITION EFFECTS

Turf can compete severely with young trees for nutrients and if allowed, will cause severe stunting of tree growth. These effects are most obvious when turf competes with young transplanted trees. In a classic research project, Richardson (1953) used a root observation chamber to study competition between perennial ryegrass and sycamore maple. As summarized by Messenger (1976), Richardson found the following:

1. The presence of perennial ryegrass depressed root growth rate, shortened the period of active growth, reduced density of root hairs, and restricted depth

and lateral spread of maple tree roots. As you might expect, shoot growth was also reduced.

2. Nitrogen deficiency reduced size and growth of maple roots while it increased elongation of perennial ryegrass roots.

3. Perennial ryegrass root growth began three weeks earlier than maple root growth. Ryegrass roots also grew faster.

4. Perennial ryegrass roots had a greater absorbing surface than maple in the same volume of soil.

All of the factors mentioned above explain why turf can retard growth of young trees. Simply removing turf in the rootzone area of young trees can improve tree growth considerably. Harris (1966) demonstrated improved growth in *Magnolia grandiflora* by removing varying amounts of tall fescue sod from around the base of the trees. Removing 4 $ft^2$ of turf increased height growth from 2.8 to 9.8 inches over a two year period. Removing 196 $ft^2$ of turf increased growth from 2.8 to 18.2 inches. Fertilizer improved tree growth even more and partially overcame the effects of turf around the base of the tree.

The optimum turf-free zone around young trees hasn't been determined but probably lies between two and four feet in diameter. A four-foot diameter tree well will reduce the chances of injuring young trees with mowing equipment (a common cause of tree mortality).

## IRRIGATION EFFECTS

Young transplanted trees require adequate irrigation to achieve maximum growth. Without irrigation, root regeneration and growth during the transplant year will be limited to the spring through early summer period throughout most of the Pacific Northwest. With irrigation, root growth can continue through most of the summer and fall period. Unirrigated transplanted trees are characterized by poor shoot growth. Poor growth in the transplant year generally means poor growth in the following year as well. Weekly irrigation is not too much for most transplanted trees although one thorough irrigation every two weeks through summer is probably adequate. If irrigation is not feasible, an alternative involves clearing a large area around the base of the tree at planting time (eg. 4-6 ft diameter tree well). After planting, the entire tree well should be mulched to a 4-6 inch depth to reduce moisture loss in the zone. Avoid covering the tree trunk with mulch but do mulch as deeply as possible. The moisture conserved by mulch may spell the difference between growth or mere survival for a young transplant.

## SUMMARY

Fertilizer, water, and elimination of competition from turf in the tree root zone are three important means for stimulating growth of young trees. Fertilizer is best applied in early spring prior to growth by broadcast, hole punch, or soil injection methods. Nitrogen is the most important element for stimulating tree growth. Adequate irrigation during the first several years will maximize early growth of young trees. A turf free zone of 4 feet in diameter will eliminate competition from grass roots and will further maximize tree growth.

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**Table 1.** Effect of N-P-K on height growth of *Liriodendron tulipifera*.

| | Vertical increase in inches | | | |
|---|---|---|---|---|
| | 1982 | 1983 | 1984 | Mean total growth |
| Fertilizer | 27 | 40.<br>25 | 40.5 | 107.75 |
| No fertilizer | 16 | 7.5 | 26 | 49.5 |

**Table 2.** Effect of N-P-K on caliper growth of *Liriodendron tulipifera*.

| | Caliper increase in inches | | | |
|---|---|---|---|---|
| | 1982 | 1983 | 1984 | Mean total growth |
| Fertilizer | .75 | 1.1 | 1.0 | 2.85 |
| No fertilizer | .25 | .38 | .2 | .83 |

**Table 3.** Rate calculations for N using the hole punch or soil injection method.

| Tree caliper in inches* | lb N/tree | No. of holes/tree |
|---|---|---|
| 1 | .2 | 5 |
| 2 | .4 | 10 |
| 3 | .6 | 15 |
| 4 | .8 | 20 |
| 5 | 1.0 | 25 |
| 6 | 1.2 | 30 |
| 7 | 1.4 | 35 |
| 8 | 1.6 | 40 |

* Caliper measured 3 feet above the soil surface.

# WHAT WE HAVE LEARNED ABOUT IRON FERTILIZATION[1]

Jack D. Butler and Jack D. Fry[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Professor and Graduate Research Assistant, Department of Horticulture, Colorado State University, Fort Collins, CO.

For about 15 years numerous studies evaluating the role of iron in turfgrass management have been conducted at Colorado State University. For those who wish to delve into the subject in more detail, some are listed below. The iron work has yielded some interesting results, and it seems to have had a significant impact on iron fertilization practices in the Rocky Mountain Region. In no way should this imply that we have given this subject nearly as much research attention as it deserves. There remains many questions, and little is known regarding the influence of iron fertilization on cold temperature hardiness, water requirements, wear tolerance, etc., that deserve in-depth study.

A limiting factor in the production of high quality turfgrass in more arid regions of the U.S. is iron chlorosis. Iron applications, even in rather humid areas, where soil available iron would appear to be adequate, are common practice. Iron applications in such situations often green the turf for only a short period. Mineral soils in the western U.S. may contain from 0.5 to 3.0% (5,000-30,000 ppm) total iron. The amount of total iron in the soil does not reflect the amount of iron available to plants.

Soils with high pH's and lime content (calcareous soils) are often deficient in plant available iron. Plants grown on such soils are subject to "lime induced" chlorosis.

Nitrogen fertilization can cause iron chlorosis of turfgrass to become more severe since it increases growth in an already limiting situation. Table 1 gives some information on the influence of various fertilizers and application rates on soil and turfgrass conditions.

Heavy phosphorus fertilization and high soil moisture can contribute to iron deficiencies. An imbalance of metallic ions, such as high availability of copper or manganese in relation to iron, can also induce iron deficiencies.

## IRON PROBLEMS

Chlorotic turf in irregular patches, streaks, or in association with sprinkler irrigation patterns often indicates iron problems. If the turf is weedy and lacks density,

the problem is likely nitrogen, not iron. An acute shortage of available iron may be expressed by a bleached, almost white, appearance of the turf. If the iron deficiency is severe, turfgrass may die.

The foliage of turf that shows iron deficiency is often quite weak. Mowing, especially with reel mowers, may produce ragged and matted turf. When very deficient in iron, and severely chlorotic, turf may be invaded by weeds.

If there is doubt regarding the deficient nutrient, it is possible to determine the nutrient(s) needed through trial applications of various fertilizers. The effect of applying iron containing materials, such as ferrous sulfate and ferrous ammonium sulfate, even when applied in granular form, can result in dramatic green-up in a few days.

In the West, a routine soil test may provide information on available iron. The DTPA soil test, developed by Lindsey and Norvell at Colorado State University, has proven to be a useful test for soil-available iron. This test has been quite helpful in predicting iron deficiencies and for developing iron fertilizer recommendations. Table 2 is currently used when making iron fertilizer recommendations for turf grown in the Rocky Mountain Region. It may also be possible to determine iron needs through tissue testing for chlorophyll and/or iron.

## SOLVING THE PROBLEM

Three approaches to solving turfgrass iron problems have been pursued at Colorado State University. These have been:

—Determine and use cultivars resistant to iron chlõrosis.

—Acidify the soil to make iron more available.

—Use iron fertilizers.

In instances of severe iron deficiencies more than one approach to problem solving may be desirable. The limited work at Colorado State University has not shown a need for preplant iron application even when soil iron availability is low. Our work has primarily been conducted on established turf on low iron soils. Sufficient work has not been conducted on soils with very low levels of available iron to know whether or not preplant applications would be beneficial.

## RESISTANT CULTIVARS

There is wide variability among cultivars (varieties) of Kentucky bluegrass, perennial ryegrass, etc. in their ability to maintain acceptable color at low levels of available iron. Some of the classical work in cultivar resistance is published in the

Proceedings of the 30th Northwest Turfgrass Conference. Cultivars such as Ram I, Adelphi and Sydsport Kentucky bluegrass generally have demonstrated resistance to iron chlorosis. Older perennial ryegrass cultivars - Citation, Derby, Diplomat, Yorktown and Pennfine - have performed quite well when grown on soils low in available iron. Information on levels of iron chlorosis of perennial ryegrasses included in the National Perennial Ryegrass Trials has been gathered. This will be made available at a later date.

Where observations or soil tests indicate that iron deficiencies are likely, choice of cultivars resistant to the problem seems advisable. Whereas, iron fertility is a valuable tool but does not offer a long term solution (at least partial solution) that results from planting blends or mixtures tolerant to iron chlorosis.

## ACIDIFY THE SOIL

One approach, although impractical on some calcareous soils, is to increase iron availability by acidifying (lowering the pH). Sulfur in some form, because of low cost and wide availability, is the material most often used for soil acidification. Acidifying the soil to plow layer depth (about 2,000,000 lb/acre) is rather impractical in most situations. However, acidifying the surface (after all only about 20 ppm out of the 5,000 - 30,000 ppm total needs to be available) seems reasonable. In turfgrass, sulfur, which is slow to break down, might provide acidification and good turf color for a fairly long time.

Our research results on greening grass with "heavy" sulfur applications have not been all that consistent. In general, on certain grasses and soils, and at heavy rates, sulfur has greened up the turf. In 1984, a study to determine tolerance of Kentucky bluegrass turf to sulfur applied during hot weather was undertaken. About a year after treatment, turf began to green where sulfur was applied at the heaviest rate (100 lb S/1000 $ft^2$); also noticeable damage was evident. Significant greening without injury occurred where sulfur was applied the previous summer at 50 and 25 lb S/1000 $ft^2$.

The possibility of lowering the pH with sulfur and thereby increasing iron availability seems to be worth considering. The slow process, possibility of turf damage, and the fact that similar results may occur with a lot less iron, etc., are factors that need to be considered.

## IRON FERTILIZATION

For years iron containing materials have been used to green turf. It is only in about the last 5-10 years that major emphasis has been put on this micronutrient in the western states. Since so little iron is required by plants (turfgrass) it is considered to be a micronutrient (minor element). In its total importance in keeping high quality turfgrass in the Rocky Mountain Region, it often might rank just after

nitrogen, and ahead of phosphorus and potassium. It is possible, in some instances, for turf managers to significantly reduce application of nitrogen and use small amounts of iron for improved turf.

The amount of iron needed to suitably green chlorotic turf will depend on severity of the problem, time of year, fertilizer formulation, and species and cultivar of grass.

At Colorado State university we have been able to suitably green grass by using iron containing inorganic salts, chelates, organic ligand, or mine tailing materials. The data given in Table 3 are from one of our experiments with iron containing materials. Probably the most surprising thing about this work was the long term greening that could be achieved by using certain materials.

Although iron can be a valuable tool in turf management, *Iron* fertilizers can cause turf burn and, in addition, it may stain sidewalks and be difficult to apply. Turfgrass professionals in much of the western U.S. and Canada need to determine the role that iron has in their turf maintenance programs.

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**Table 1.** Influence of fertilizers applied over a four year period on soil pH, NO3-N, Fe, and on turf color.

| Material | Rate-N/ 1000 ft²/yr (3 times/yr) | pH | NO3 | Fe | Color* |
|---|---|---|---|---|---|
| Urea | 3 lb | 7.4 | 16 ppm | 10.5 ppm | 4.2 |
| | 6 | 7.3 | 37 | 12.4 | 2.5 |
| Ammonium sulfate | 3 | 7.4 | 18 | 12.5 | 3.7 |
| | 6 | 7.3 | 32 | 14.9 | 2.3 |
| Ammonium nitrate | 3 | 7.5 | 18 | 11.8 | 3.8 |
| | 6 | 7.4 | 39 | 10.6 | 2.0 |
| U-F | 12 | 7.3 | 63 | 11.8 | 1.5 |
| Check | 0 | 7.4 | 4 | 10.0 | — |

*Fe chlorosis: 0 = none, 6 = severe, (final rating at end of experiment).

**Table 2.** Soil iron availability levels and fertilizer recommendations for Kentucky bluegrass and perennial ryegrass.

| Test level | Fe fertilizer recommendations |
|---|---|
| Under 5 ppm (VL) | 2 applications of 0.5 lb[2] Fe/1000 ft² |
| 5 - 14 ppm (L) | 1-2[3] applications of 0.5 lb[2] Fe/1000 ft² |
| 15 - 20 ppm (ML) | 1[4] application of 0.5 lb[2] Fe/1000 ft² |
| 21 - 100 (S) | 0 |
| Over 100 ppm (H)[5] | 0 |

1 First application of ferrous sulfate or ferrous ammonium sulfate in late May or early June, second about a month later.

2 If liquid is used apply according to label directions.

3 1 application of 1/2 lb Fe/1000 ft² may be sufficient for one season greening, if not, repeat application.

4 Usually needed only if a very dark green lawn is desired.

5 Often associated with acid soils that need liming.

**Table 3.** Iron fertilization of uniformly chlorotic Kentucky bluegrass turf. Applications made on September 5, 1981.

| Material | Fe rate lb/1000 ft² | Color rating* 9/13/81 | 9/22/81 | 10/14/81 | 9/24/82 |
|---|---|---|---|---|---|
| Sequestrene 330 (chelate) | 0.1 (S) | 9.0 | 8.5 | 8.2 | 4.3 |
| Ferrous sulfate (Iron salt) | 1.0 (D) | 7.8 | 9.0 | 9.0 | 8.7 |
| Ferrous sulfate (Iron salt) | .5 (D) | 6.2 | 6.8 | 7.3 | 7.7 |
| Ferrous sulfate (Iron salt) | .25 (D) | 4.8 | 5.5 | 6.8 | 6.0 |
| Acid Iron (mine tailing) | .5 (D) | 7.8 | 9.0 | 9.0 | 9.0 |
| Ammon. nit. (21-0-0) | —— (D) | 2.0 | 3.0 | 4.0 | 3.0 |
| Check | —— | 2.0 | 3.5 | 3.8 | 3.7 |

* 9.0 = very dark green, 7.0 = lowest acceptable color, 1.0 = light yellow.
S = Sprayed, D = Granular application.

# BASIC VS. APPLIED RESEARCH[1]

William J. Johnston[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Assistant Professor, Department of Agronomy and Soils, Washington State University, Pullman, WA.

When Tom Cook first assigned me this topic on "Basic vs. Applied Research", I at first thought, Why me? Then as I began to mull over the prospect of speaking on the subject, I thought, Well I do have a Doctorate of Philosophy degree, so I should be able to wax and wane philosophically once in my career on a non-turfgrass subject. However, I must admit, at times I did feel as Thomas H. Huxley (Huxley was Charles Darwin's bulldog who defended the idea of evolution for the shy and retiring Darwin) when he stated in his essay "Science and Culture" in 1860: "I often wish that this phrase applied science (as compared to basic science) had never been invented." If only Huxley had gotten his wish, I would not now have to address this subject.

Before we can discuss basic and applied research, we must define what we mean by research. Research is the process by which science is produced. Well that is a nice simple definition. Perhaps too simple, for it leads one to the obvious next question of, "What is science?" Is turfgrass science (an appropriate subject for the Northwest Turfgrass Association meeting) any different from other branches of science? The literature is filled with definitions of science, some giving a broad interpretation, others a narrow one. All have one thing in common—none are completely satisfactory. Since it appears impossible to give a good definition of science, none will be attempted here. I will simply state that the purpose of science is to ultimately discover the laws of nature, and turfgrass science is no different from any other science.

As you can tell, we must now discuss laws. A common topic of conversation is that science cannot tell which came first, the chicken or the egg. Or stated another way, which is the cause and which is the effect. The answer to the chicken and egg business is given by well-known scientific lawns, and science doesn't care which came first. A scientific law would state that from a viable, fertilized egg and proper environmental circumstances a chicken evolved. This says, and only says, that, given these circumstances, the chicken has followed the egg. If you have as given circumstances, the chicken and proper supporting conditions, the egg will result. Carefully note that laws are not concerned with labeling cause and effect, they merely describe what has happened under a given set of conditions.

Are there limits to what science can do? There certainly are and a few examples will illustrate the limitations of science. For example, in the realm of value judgment

science is out of its element. It is impossible for science to differentiate between good and evil. That field is of necessity left to ethics and religion. Neither can science make any judgment as to the beauty of a painting, landscape, golf course, or turfgrass research plot. This is one of the reasons so much disagreement exists among turfgrass researchers in cultivar plot evaluations. These are often " beauty contests" and science simply cannot judge beauty. Science can be used to determine the texture of the grass, the speed of the green, or the chemical composition of the leaf tissue; however, science is helpless to make any judgment about beauty. This is a value judgment and is beyond the capabilities of science.

Science is but one of several means whereby knowledge is created. This is fortunate as mankind's store of knowledge would be very meager if everything depended on science. Actually, most of our knowledge has come from experience and not research or science. Many of you in the turfgrass field recognize the truth in this statement. Turfgrass science is still a field in which it can truly be said, experience is the best teacher.

Is all research scientific? No, and there is a vast difference in scientific and non-scientific research. The former is a means of obtaining knowledge through the application of the "scientific method". Non-scientific research may also create new knowledge; the difference is in method. For example in 1967, Dr. Goss, et al. conducted a survey of the turfgrass industry in Washington. This was new knowledge that was useful to anyone involved in the turfgrass industry; however, it was not science, it was just a matter of enumeration and tabulation. Other fields where the research is of a non-scientific nature are history, theology, language, and philosophy.

With this background, let us turn to the task at hand—discussing basic vs. applied research. Research conducted for its own sake is often referred to as "pure" research or more commonly as "basic" research. Its objective is to provide a better understanding of the phenomenon being investigated, including the discovery of general principles or theories. It is conducted without regard to the application of these principles or, indeed, as to whether they will have any application at all. On the other hand, "applied" research is the application of science to the solution of practical problems. Greek philosophers considered the application of science to useful purposes as unworthy and even degrading. This viewpoint is no longer held by more than a very few. However, they are often a noisy few and often they state, "Basic research is what I do; applied research is what others do." It is a jesting statement that may be slightly serious as most scientists like to consider that their work is more basic than others might consider it to be.

Although we no longer defy basic research, we do recognize its value. Most people believe it is justified because many practical problems can best be solved by first getting some understanding of the underlying phenomena.

There has been much discussion in recent years of the relative values and needs

for basic and applied research, especially by those who believe that more basic research is needed. This belief may be well-founded, but there is a need to consider first whether a sharp distinction should even be made between the different categories of research. Funds usually are not appropriated specifically for basic research or for applied research. Usually there is a problem to be solved or a job to be done. This may turn out to be basic research or applied research or both, and more likely there will be differences of opinion as to which.

Whether a distinction should be made between basic and applied research is especially pertinent in turfgrass research. Much of the rapid progress is turfgrass science is directly attributable to the close tie between turfgrass research and practice. The impact of day-to-day problem solving is one of the greatest forces in stimulating new ideas in basic research. Much of the progress of turfgrass science has been due to people such as Dr. Goss who got out into the "trenches", so to speak, and solved the problems at hand by any means available to them.

Instead of attempting to classify research into categories, depending on whether they are basic or applied per se, we might do well to recognize different levels of research in which the prospects of success and the anticipated difficulties are of a different order. This might be begging the issue, or splitting hairs, but in reality most research is shades of gray rather than black and white, i.e. applied or basic. With this in mind, let's look at what might be a continuum or levels of research from applied to basic.

Level 1. At the upper or simpler level would be, for example, turfgrass cultivar, fertilizer, and date of planting trials. These are designed primarily to exploit known principles and to derive answers to immediate problems. They would be thought of as applied research. An example from our research at Pullman would be cultivar evaluations to determine the best perennial ryegrass for eastern Washington.

Level 2. A second level would be observation or experiments designed to determine to some degree why certain of the above practices are better than others. The reasons are often related to climate, weather, soil, insects, diseases, etc. In our ryegrass example, the reason for one cultivar of ryegrass being superior may be linked to its better cold tolerance and ability to survive the harsh winters of eastern Washington.

Level 3. At a third level would be research designed to determine the basic physiological or chemical reasons for resistance to insects and diseases, the inheritance of plant characteristics, etc. In our example, we might try to determine the role of carbohydrates in winter hardiness in perennial ryegrass.

Level 4. At a fourth level might be research designed to provide a better understanding of photosynthesis, photoperiodism, the nature of the gene, the relation

of molecular configuration to toxicity of pesticides, and other phenomena which presumably depend on particular molecules or portions of molecules and their interactions. At this level, we could look for the gene that controls the production of carbohydrates in perennial ryegrass.

Level 5. At the fifth and final level is research that is not directed or restricted in any way, i.e. "basic research". In our example, this could be biochemical genetic research of the complex interrelations of DNA, RNA, and carbohydrate synthesis. However, it should be understood by now that true basic research need not apply to a particular problem as used in our research example, i.e. carbohydrate synthesis in relation to winter hardiness.

Some of the lessons we have learned from conducting basic and applied research in turfgrass science are:

1. Basic research underlies all applied research.

2. Organized communication channels (such as these NTA meetings) can speed the transfer of basic into applied research.

3. It is a fallacy that discovery of an important basic principle automatically assures its practical use. A great amount of additional research is usually required.

4. Team research is the only effective way to solve complex problems.

5. Academic freedom is essential to productive research.

Of the five, the last is the most important. Given the freedom to inquire, solutions will be found. Of course, lots of funding, support personnel and equipment never hurt the effort.

# DEALING WITH CHANGE IN A POSITIVE WAY A PRACTICAL WORKSHOP[1]

Jan Weber[2]

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[1] Presented at the 39th Northwest Turfgrass Conference, Rippling River Resort, Welches, OR, September 24-26, 1985.

[2] Assistant Director, Oregon State University Division of Continuing Education, Corvallis, OR.

Dealing with change in a positive way has become the challenge to every manager in business, industry or education today. Change means things are going to be different and when differences occur, the human adjustment experiences a degree of stress. The important managerial challenge is to learn techniques of change management so the level or intensity of stress will be low and the end result will be harmony rather than conflict.

The topic of change management is not new. The significant difference today is the rate at which changes are occurring. This accelerated pace of change has increased daily stress for many people. Too many changes, in too many directions, occurring at once or in rapid succession produce pressure, chaos and stress. These pressures are felt in the individual's physical and mental adaptive mechanisms and in their ability to make decisions.

Stress might be broadly defined as the lack of harmony between an individual and the environment. A certain amount of discord may be necessary, and indeed acceptable, if positive changes are going to result. The challenge to the manager is to deal with change in a positive harmonious way. A way that alleviates the unhealthy stress keeping energy from being channeled into productive efforts affects business through increased sick leave, an overall lowering of morale and perhaps rapid turn-over of employees or low motivation of those who just stay on or "hang in there". Most of us recognize that great feeling of being full of energy; most of us know the feeling we experience when on empty, all used up, we've had it. The key to personal change management is to recognize when you are on the one-quarter tank mark. This means being sensitive to yourself when you are about to be used up and it takes practice and sensitivity to self to recognize this. Next time you have "had it", go back quickly in your mind's eye to see what led up to this feeling. How were you feeling just prior? Identifying these changes or sequence of events can help you alter your personal patterns to give yourself the same sensitive consideration to re-fuel that you give your automobile.

Not all change or stress is negative. Without some change no progress would be made; without some stress, no personal change or professional growth would occur. A normal adaptive stress reaction occurs when the source of the stress can be clearly defined. For example, you may wish to increase profits or add new

personnel to increase output. When the source of stress is ambiguous, undefined, prolonged, or when several sources exist at the same time, a person cannot rapidly adapt to becoming functional in the new situation.

Change does mean things are going to be different. When change occurs the control element is shaken and stress is the natural inner resistance to change countering that out-of-control feeling of chaos. Bringing order out of chaos requires transition, a process of adaptation during which the individual may experience some feelings or personal identities that are unfamiliar—that are foreign to the individuals going through the change as well as to those with whom they live and work. The greatest need for a manager implementing change is to be able to recognize the effect on individuals. When confronted with change, human beings basically do one of three things:

They **WITHDRAW.** This is a very human reaction. When something upsets us or changes us, we can withdraw verbally, physically or emotionally. The period of withdrawal seems to vary in relation to the type of change occurring and to the ability of the person(s) experiencing the change to deal with the change. Sometimes the best reaction may be to withdraw—if that is a conscious, rational choice; but in business, as in social situations, even if you are on the right track, if you unconsciously just sit down, you are likely to get run over.

Human beings also **BANDWAGON.** Jumping on a popular idea or involving oneself in a fad-movement before fully recognizing where the bandwagon will end up. One example may be the Oregon popularity of wood stoves. Many people have recently installed wood-burning heating stoves. Some of these people were elderly and could not chop wood and the other tasks that go along with keeping a fire going for heat, cleaning out ashes, etc. They found themselves deeply into the decision before they realized the implications for people at their age. If you jump on a bandwagon, you need to ask if you will be committed throughout the parade!

We might also take a **RATIONAL APPROACH** to the change and make some rational decisions and plans as to what might be done. The decision may be rationally made to get on with the change, it may be to leave things the way they were; but in any case the decision was consciously made and based on a rational goal.

People vary in their reactions to specific changes; one's attitude toward change is based on the individual's ability to deal with the demands of the change. Usually there is some degree of stress or resistance experienced in a change. These changes may be characterized as natural inevitable occurrences in life as well as those imposed on us. Either of these can be managed to maintain a low level of stress. Regardless of the change that is met, be it good or bad, there is a shift in the way we function for a time. The key is **TIME.** Some changes occur, we pull back, collect our thoughts, and bounce back into our routine. Other changes occur, we pull back and the adjustment period is much longer to gather the necessary resources

and then go on. That period of adjustment may be called "unsettling". It is necessary in the change process as it allows the individual to have time to settle into a new or adjusted routine to make a comeback. It is important to keep in mind that this settling is necessary for the adjustment in any changing situation—whether it is a positive change, such as a promotion or a negative change, such as loss of a loved one or loss of a job.

Viewing change as an equation helps isolate each component as a manageable factor. The level or intensity of stress (S) is directly related to the Degree or Dimension of the Change (Cd), the Number of Changes (Cn), and the Pace at which the Change occurs (Cp): S = Cd + Cn + Cp. If there are a great number of drastic changes occurring simultaneously, the individual may be overwhelmed with stress—an out-of-control-chaos-feeling.

If intensity exists in each component of stress, a high stress level would be expected. A sharp degree of constant change is the most common cause of stress. The period of indecision, withdrawal, and/or re-evaluation occurring between the time a change is imposed and the time the person decides the action is usually the most intensely stressful period. Stress isn't the problem, it is a symptom of unanticipated, un(or mis)-managed change of one or more of the factors in this equation. One of the goals of change management should be to exert the degree of freedom that exists in each of the change factors to keep the resulting stress at a minimum. For example, if there has been a significant dimensional change in your life, this might not be the right time to try out a new restaurant or vacation spot. If lots of things are changing for you personally or professionally, this might be a good time to set different deadlines and adjust the pace at which you are approaching these changes. Until the "change" causing the stress is isolated and dealt with through effective decision-making and management, the person's energy resources cannot be channeled into productive rather than destructive ends. One key concept in managing change effectively is called "anticipatory management". It focuses on precautions an individual could take to prepare for changes when they do occur. Anticipatory management refers to the procedure of managing now with an eye to the future. It means looking ahead at changes you plan to make, or that you anticipate encountering and doing something **NOW** to bring yourself into harmony with anticipated changes. It may involve preparation to remove yourself from an anticipated stressful situation resulting from changes beyond your control. Many changes could be anticipated if we took time to positively plan, and the stress that so often results might be alleviated. Consider the stress many people feel when all the kids leave home. All through childhood we prepare our children to be individuals, to stand on their own, to be educated to assume their roles as adults. When they do, marriages quake, depression often sets in to the parents and a feeling of rejection may be expressed because the children no longer need daily parental care and involvement at home.

Many employees experience intense on-the-job stress created by changes made

at the management level. When we realize that most managers do not have sharply developed skills in "change management", and that most employees have limited ability to manage stress, the necessity to focus on change becomes vitally important to maintaining a successful, working atmosphere.

Changes instigated by the employer may result in new reward systems for employees, new freedoms and/or constraints, new authority structures, new time regulations, new working environments. Changes in work situations may also call for social adaptations and alterations in relationships among individual employees, their supervisors, colleagues, subordinates, informal groups to which they belong and new employee contacts. A managerial change in the work situation often affects the degree of social contact and interaction between individuals—either real or perceived. In reducing the resistance or stress to change with individuals in your management group, it is key to recognize the issue at stake—the root of the problem, not just the symptoms you are recognizing in the resulting behaviors. Knowing each issue allows the manager to exert an appropriate degree of control in the system so the proper route is taken and, thus, the desired result or change occurs at a high level of harmony in the work group and within the individual.

Resistance to change can usually be tied to one of our issues. When faced with resistance to change, determine whether the issue is:

1. Support at the top - there will be no action or change if those who make decisions about resources are not supportive of the proposed change. The principle to remember is: resistance will be decreased if the change has support needed from the top. A decision to change made a subordinate levels of an organization will never get off the ground without the resource support needed to carry it to completion. Even changes that involve risk will most likely receive blessings from the top if they have been brought along in support of the risk-taking change. Often, no matter how important a change may be perceived at a lower level, without support from the top the opportunity may never be brought to fruition.

2. Ownership - those being affected by the change must have ownership proportional to their support needed for its accomplishment. The principle to keep in mind is that resistance will be less if the person(s) involved in the change see it as their own or that it will be to their advantage. The challenge to the manager is to determine ways in which a sense of ownership can be developed in the person(s) involved with the change.

   Since one of the basic needs of all human beings is that of security, the ownership issue cannot be ignored by managers in change situations. Resistance to change will cloud the rational approach if one's own security is threatened—be this real or perceived. Managers and employees with a high

degree of positional security and autonomy are in better positions to deal with organizational and personal changes.

3. Advantage - the value of the change and its advantages to various employees and management is also an important issue. This is true for personal as well as professional changes. The saying, ''Change for change sake'' is being challenged by this issue. Resistance will be less if the value of the change and the long and short range advantages can be seen. Most people are willing to endure some discomfort, inconvenience, etc., brought on by change if the resulting advantages are clear. We have no doubt experienced this in times of budgetary crunches. We were willing to tighten up a bit to preserve a position, make an investment for the long term or sacrifice a little now with the assurance that the long term benefits will be worth it. As a manager, the challenge is to communicate the advantages of the proposed change through demonstration or publicity so as resources shift the value of their placement is understood (ownership and security) and the needed support is present to see that the change will smoothly occur.

4. Difference or novelty - the uniqueness or difference of the change is an interesting but important issue for the manager. It is closely related to the advantage issue in that it also challenges the ''change for change sake'' idea. Much resistance is expressed if those involved really cannot see not only the advantages, but also that the differences resulting from the change are significant enough to have both support from the top and ownership from those required to see it through.

It becomes evident that the issues do not stand alone, nor does the application of the appropriate principles that are applied by managers to meet the challenges felt in resistance to change. Reflective isolation of the issue foremost in the resistance is beneficial for those who are challenged to actuate a change as well as individuals who find themselves resisting a change situation. This reflective issue identification is a positive approach to the ''settling'' period discussed earlier.

The challenge to effective managers are significant and multiple. Good managers have a special attitude toward change, a healthy philosophy about what might be improved and some of the consequences of what might happen. They are sensitive to change and how it will affect the industry, the company, and the employee both personally and professionally. **AND** they have the courage to implement change even knowing some stress will be produced.