27TH ILLINOIS TURFGRASS CONFERENCE

North Central Turfgrass Exposition
December 9 - 11, 1986

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ILLINOIS TURFGRASS FOUNDATION, INC.
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MIDWEST ASSOCIATION OF GOLF COURSE SUPERINTENDENTS
SPORTS TURF MANAGERS ASSOCIATION
SOD GROWERS ASSOCIATION OF MID-AMERICA

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This publication was compiled and edited by John C. Fech, Assistant Horticulturist, Turf, University of Illinois at Urbana-Champaign.

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INTRODUCTION TO ALTERNATIVE TURFS

A. Douglas Brede

Kentucky bluegrass, perennial ryegrass, tall fescue, and fine fescue are the predominant turf species throughout Illinois. These species provide highly desirable lawn characteristics and fairly rapid establishment. Breeding and development have produced improved bluegrasses, ryegrasses, and fescues that are superior in turf characteristics to nearly any other grass species.

However, under circumstances such as low maintenance, these grasses may not be the best choice. For example, our current bluegrass varieties perform best under medium to high maintenance regimens. Wabash is an exception to this: it was bred for use unde low maintenance.

Other grasses, such as buffalograss, wheatgrass, and grama are often better adapted to minimal maintenance conditions than our more popular turfgrass species.

When a turf manager sets out to establish an alternative turf, however, he or she discovers three surprising facts:

1. The price of low-maintenance turf seed is often several times higher than that of premium high-maintenance grass seed.

2. The availability of seed for low-maintenance species is often limited.

3. Low-maintenance grass species will not produce the quality of turf that we have come to expect with the "traditional" turf species.

Under minimal maintenance, tall fescue performs the best, followed by perennial ryegrass, and Kentucky bluegrass. The reaction of the fine fescues to low maintenance is mixed. Hard and chewings fescues tend to perform better than creeping red fescues.

Buffalograss is an excellent alternative turf species for low-maintenance conditions. It is one of America's only native lawn species. Zoysia, even though its cost and appearance would suggest a high-maintenance species, is actually a low-maintenance grass in terms of fertilizer and mowing requirements.

Other useful cool-season, alternative turfs include Reubens Canada bluegrass, Canby canbar bluegrass, Sherman big bluegrass, Fairway or Crested wheatgrass, Streaker redtop, Climax timothy, and Manchar, Bromar, and Regar bromegrasses. Warm-season alternative turfs include Blue Grama, Little bluestem, Side oats grama, Weeping lovegrass, and Alkaligrass.

A. Douglas Brede is Research Director, Jacklin Seed Company, Post Falls, Idaho.

Legumes and flowers can also be useful for low-maintenance or vista-type turf. White or Alsike clover, Black medic, Appar Lewis flax, or Pinto wildflower mix are useful nongrasses for low-maintenance conditions.

Availability of alternative turf is usually limited. From Illinois, alternative turfs can be purchased from Mangelsdorf Seed Company, St. Louis, Vaughan's Seed Company, Downers Grove, or LESCO, Inc., Rocky River, Ohio.

THE ROLE OF ENDOPHYTES IN TURF

Richard H. Hurley

Plant breeders are continually developing new varieties in which desirable characteristics and plant performance are optimized. Plant performance is a reflection of the sum total of many factors, including yield or productivity, appearance, vigor, resistance to weed invasion, recovery from injury, persistence, and density. Performance can be enhanced by improving pest resistance and tolerance of herbicides, defoliation, heat, and drought.

Resistance to insect predation is a very important factor in a plant's performance, and it can be controlled in three ways: (1) by using insect-resistant plant varieties; (2) by chemical pest control; and (3) by biological pest control.

Plant breeders continually seek to upgrade the insect resistance of important plant varieties; however, after a new variety providing resistance is developed, usually after years of painstaking breeding, insects may sooner or later evolve that are able to feed, without adverse effect, on the once insect-resistant plant. Thus, the ultimate grower of the new variety is faced with a number of alternatives. He can either await further development of a new pest-resistant plant variety or turn to either chemical pesticides or biological pest control.

If the cost or environmental impact of using chemical pesticides is a prohibiting factor, an alternative is biological pest control. Perhaps the best known use of biological pest control is the well publicized case of the screwworm fly. The discovery that screwworm flies mated only once led to the method whereby large numbers of laboratory-bred male flies were sterilized by X-ray irradiation. By subsequently releasing these sterile males, the females with which they mated could lay only infertile eggs. Thus, by exploiting the known mating habits of a particular insect pest, its numbers were effectively curtailed.

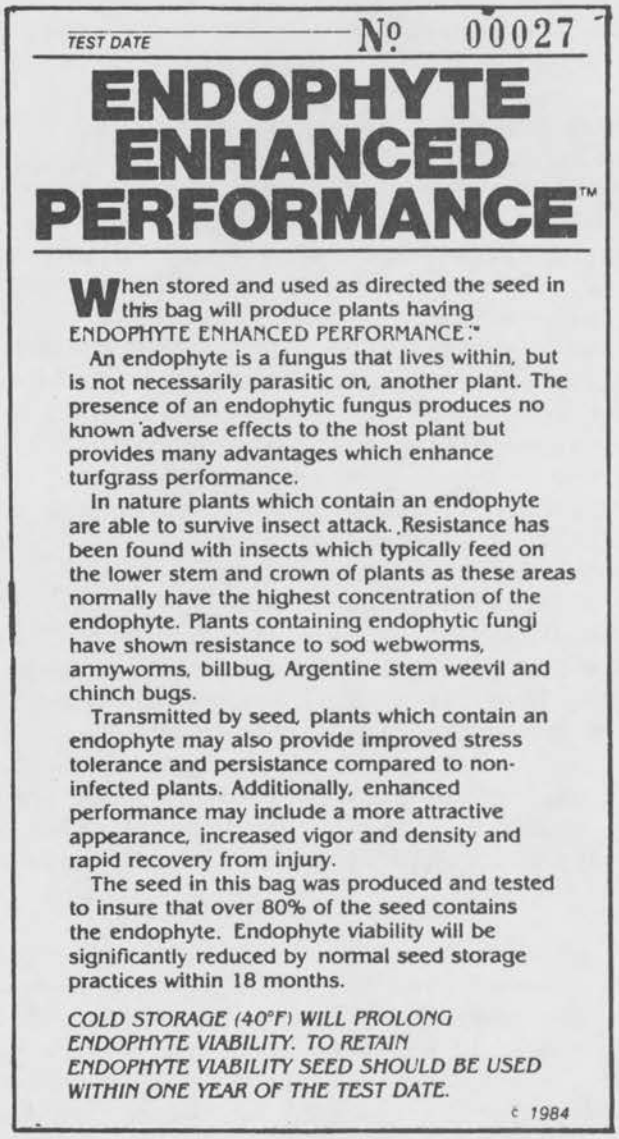
Another example of biological pest control includes the use of insect pathogens, such as certain lethal or debilitating insect viruses. Because these viruses are generally host-specific, the targeted insect pest can be readily controlled without harming beneficial species.

The advantages of biological control of insect pests are several. First, biological controls are generally self-limiting: once numbers of the target species are reduced, so too are the biological controls. Second, biological pest controls are usually host-specific and do not attack desirable species. Finally and perhaps most important, biological pest controls are normally environmentally compatible, unlike chemical pesticides that may persist in the environment and kill indiscriminately.

Richard H. Hurley, is Director of Research, Lofts Seed, Inc., Bound Brook, New Jersey.

A "new" biological pest control has recently been recognized. Certain plants host symbiotic endophytic fungi that confer, among other things, an enhanced resistance to insect predation on the host plant. For example, in perennial ryegrasses, a positive association has been demonstrated between the presence of an endophytic fungus (literally, a fungus living within its plant host) and resistance of the plant to attack by some of the most prevalent insect infestations encountered in the field, such as the sod webworm, the bluegrass billbug, the Argentine stem weevil, the Southern armyworm, and the chinch bug.

When purchasing seed to contain high endophyte levels, look for the following tag to ensure presence of the endophyte.



TEST DATE _____ Nº 00027

ENDOPHYTE ENHANCED PERFORMANCE™

When stored and used as directed the seed in this bag will produce plants having ENDOPHYTE ENHANCED PERFORMANCE.™

An endophyte is a fungus that lives within, but is not necessarily parasitic on, another plant. The presence of an endophytic fungus produces no known adverse effects to the host plant but provides many advantages which enhance turfgrass performance.

In nature plants which contain an endophyte are able to survive insect attack. Resistance has been found with insects which typically feed on the lower stem and crown of plants as these areas normally have the highest concentration of the endophyte. Plants containing endophytic fungi have shown resistance to sod webworms, armyworms, billbug, Argentine stem weevil and chinch bugs.

Transmitted by seed, plants which contain an endophyte may also provide improved stress tolerance and persistance compared to non-infected plants. Additionally, enhanced performance may include a more attractive appearance, increased vigor and density and rapid recovery from injury.

The seed in this bag was produced and tested to insure that over 80% of the seed contains the endophyte. Endophyte viability will be significantly reduced by normal seed storage practices within 18 months.

COLD STORAGE (40°F) WILL PROLONG ENDOPHYTE VIABILITY. TO RETAIN ENDOPHYTE VIABILITY SEED SHOULD BE USED WITHIN ONE YEAR OF THE TEST DATE.

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In particular, perennial ryegrasses hosting an endophytic fungus are highly resistant to feeding of the larval stages of sod webworms. Plants lacking the endophytic fungus can sustain substantial injury from feeding by sod webworm larvae. Resistance in ryegrasses hosting this fungus to feeding of the larval stages of the

bluegrass billbug has also been observed. Also, we have observed resistance to feeding by the chinch bug, and others have observed resistance in ryegrasses hosting endophytic fungus to the Argentine stem weevil. This endophytic-enhanced insect resistance in ryegrasses to three different orders of very prevalent chewing insects provides a broad-based mechanism for developing new plants having enhanced performance, including resistance to these insects.

The exact mechanism of this enhanced resistance to insect predation has not as yet been identified, although it is suspected that such resistance could involve the generation of chemicals toxic to insects feeding on plants containing the endophytic fungi. These chemicals might be produced by the endophytic fungus or by the host plants themselves in response to the invading fungus. The latter mechanism may mediate a generalized resistance to insects feeding on plant parts having the highest concentrations of endophytic fungi or their associated toxins.

In addition to the observed resistance to predation by insects, plants hosting the endophytic fungus have displayed a certain enhanced performance that includes improved ecological fitness, a more attractive appearance, increased vigor, reduced weed invasion, more rapid recovery from injury, improved persistence, increased density, and apparently greater stress tolerance. For example, in turf trials of tall fescue and perennial ryegrass varieties and single-plant progenies established during the late summer of 1976 at North Brunswick, New Jersey, those varieties containing a high level of endophytic fungus showed dramatically improved performance after seven years. Species tested included tall fesuce (*Festuca arundinacea*) and ryegrass (*Lolium perenne*). These plants were more persistent, showed reduced crabgrass invasion, produced a higher yield, had greater vigor, and displayed an improved appearance. Much of this improved performance of these fungal-endophyte-hosting plants appears to be associated with improved stress tolerance, such as tolerance of heat, drought, and defoliation. Similar enhanced performance, including resistance to the billbug and the chinch bug, has been observed for hard fescue and for chewings fescue.

The particular endophytic fungus involved in the above described insect resistance and enhanced performance in ryegrass has been provisionally designated the *Lolium* endophyte. A similar or identical endophyte fungus present within tall fescue has been identified as *Epichloe typhina* and was recently renamed *Acremonium coenophialum*.

The life cycles of endophytic fungi have been studied in detail. The fungus begins within the seed of the host plant, adjacent to the aleurone layer. When the seed germinates, the fungus spreads into the developing seedling. Apparently, as the seedling develops, the fungus grows into the rhizomes, leaf tissue, and flower stem and seeds, but avoids penetration into the roots.

As a prelude to the invasion of the fungus into its host's developing seed, the fungus concentrates its mycelia in the flower stem. As the seed develops, the fungus grows into the seed adjacent to the aleurone layer, initially avoiding the embryo. Upon germination, invasion of the seedling begins, and the fungus life cycle continues as just described. When seeds are harvested and then stored for later use, care must be taken to store them under cold, dry conditions. Long-term storage of 18 months or more of fungal endophyte-infected seed under normal storage practices is known to give rise to plants free of endophyte; this is due to lost viability of the fungal endophyte.

Endophyte levels in selected seedlots of ryegrass varieties are listed below:

High	Moderately High
Repel (GT-II)	Omega II
Citation II	Cowboy
Regal	Prelude
Pennant	All*Star
	Premier

Moderate	Low
Palmer	Manhattan II
Derby	Blazer
Dasher	Fiesta
Pennfine	Gator
Delray	Tara
Linn	Manhattan
	Elka
	Citation
	Ranger
	Omega
	Diplomat
	Yorktown II

LOW MAINTENANCE TURFS

H.L. Portz

The energy crisis of the 70s, potable water shortages and restrictions of the 80s, increasing pollution of the environment, rising labor costs, and other inputs have triggered the demand for low-maintenance turfs.

There are a number of ways to approach the subject of low-maintenance turfs, from selection of appropriate species and cultivars to reduced maintenance practices or to complete avoidance or substitution such as desert shrubs or Astroturf.

We see examples of low-maintenance turf when we watch golf on TV at St. Andrews in Scotland or see a football game at some muddy field or observe the unmowed tall fescue along a major highway. These contrast with the immaculate layout at Congressional Country Club or a well-manicured zoysiagrass lawn in St. Louis. Which of these situations do we want or which can we afford? For this discussion, I would like to propose a compromise. One, we do want acceptable quality turf for the particular use, whether it be intensive, such as for an athletic field or golf course, or for less demanding situations such as lawns or cemeteries; and two, this should be at the lowest cost and conservation of our valuable nonrenewable resources.

Turfgrass specialists in the North Central Region of the U.S. (NCR-10) suggested several research priorities in 1979, and in 1981 an Energy Efficient Turfgrass Committee was formed. The overall objective was to determine the lowest maintenance needed for acceptable turf for its various uses and specifically:

1. To consider energy conservation in terms of a) water, b) nutrients, c) pesticides, d) growth retardants, e) labor, and f) non-renewable energy resources.

2. To identify, develop, and evaluate appropriate species and cultivars for climatic zones in the regions.

In 1982, three proposed areas for cooperative projects were presented. They were: 1) breeding and selection, 2) cultural management practices, and 3) social and economic problems. The latter includes customer demands versus acceptance of lower visible quality such as color. These three areas will be discussed further. In 1983, there was a joint meeting of all Regional Research Committees at Beltsville, Maryland, during the ASA Meetings, and they further identified research needs.

For minimum maintenance research needs were: 1) use of native species, 2) research techniques on minimum maintenance, 3) test sites that will provide an appropriate stress environment, and 4) plant growth regulators. Nineteen additional needs under "water research" were also identified, from "potential reduction of evapotranspiration in turfgrass," to "plant breeding for water-efficient turfgrasses."

H.L. Portz is Professor Emeritus, Department of Plant and Soil Sciences, Southern Illinois University--Carbondale.

Dr. Terry Riordon of the University of Nebraska, the present Chairman of the NCR-10 Committee, has recently summarized the low-maintenance turfgrass research froma number of states. Especially notable are the number of experiments on Kentucky bluegrass and tall fescue, including complete sets of cultivars in the National Uniform Cultivar Tests that are under high and low maintenance levels. I began one at SIUC in 1985 on 72 Kentucky bluegrass cultivars under two maintenance levels. Riordon also noted subtle changes, such as evaluating breeding materials at 3 pounds, of nitrogen per 1,000 square feet, instead of the more typical higher levels of the past.

BREEDING AND SELECTION

Why is _____ a low-maintenance bluegrass? Because it requires less fertilizer to maintain a dark green color, has superior drought tolerance, produces less thatch, and has excellent resistance to Fusarium blight, leaf spot, red thread, pink snow mold, stem rust, and stripe smut. This resistance decreases the need for costly fungicide applications and _____. These are some of the characteristics that plant breeders such as Drs. Riordon, Reed Funk, at Rutgers, and Ray Keene at Kansas State are looking for in various species and cultivars.

Cool-Season Turfgrasses

Many of the cool-season turfgrasses can be rated for various low-maintenance characteristics. Tall fescue gets three stars for its overall low-maintenance characteristics, two stars for red fescue, especially in the shade, and two stars for sheep's fescue for its drought resistance. Redtop is rated one star for its tolerance to wet, acid soils, wheatgrass for the dry western plains, and smooth bromegrass that needs only one or two cuts, and selected cultivars of Kentucky bluegrass. Dr. Robert Newman at the University of Wisconsin states that, "There is nothing wrong with a good stand of bromegrass waving in the summer wind on unused out-of-bounds triangles and strips on golf courses. It cut once a year, the hay makes a good mulch around woody ornamentals and over perennial flower beds in winter." It certainly is a major grass for highway roadbank stabilization. I might add that even quackgrass can persist under low fertility and maintenance and is a major component in many lawns.

Warm-Season Turfgrasses

The outstanding low-maintenance, warm-season grass is buffalograss. Considerable research is under way in Texas, Kansas, Nebraska, Iowa, and even Illinois on this extremely drought-tolerant species. Dr. Larry Leuthold of Kansas State University indicates that it should be fertilized once in spring and mowed at 1 1/2 to 2 inches. He says, "It takes patience and understanding of nature when growing native prairie grass for home lawns -- too much water and fertilizer favor weeds and causes buffalograss to die out." Blue grama is another prairie grass that is very good in drought tolerance. Another excellent low-maintenance, warm-season turfgrass is zoysiagrass. It is both heat- and drought-tolerant and, although it goes dormant in winter, it does not suffer winterkill--even in southern Minnesota. Bermudagrass has excellent drought tolerance but is susceptible to winterkill in southern Illinois and even in Tennessee and northern Texas in some years. A warm-season native grass is broomsedge. Again, it is considered a weed, but does cover when other more desirable species disappear.

Wildflower and Native Prairie Grasses

There has been a growing interest in using wildflowers both to cut down maintenance and to provide more aesthetics to otherwise drab, monotonous landscapes. The

Dutch have designated zones along major highways where wildflowers or grass species are alternated to break up the monotony of their flat roadside areas. Why not use on a golf course or on institutional grounds such as at the Monsanto World Headquarters in St. Louis? Flowers and color change with the seasons--blue phlox in May, blanket flower and Coreopsis in summer, and purple cone flower and black-eyed Susan in early fall. A strip of buffalograss and blue grama in the center allows employees to walk through the bed to inspect the everchanging floral display. Several native prairie grasses have already been mentioned, but one of the major genera are the bluestems, such as little and big bluestem.

Natural Ground Covers

Few grasses can thrive in deep shade. Pachysandra and English Ivy are excellent low-maintenance ground covers for shady conditions. They certainly are more attractive than mulches of wood or gravel as are often used in Tucson, Arizona.

CULTURAL PRACTICES

In general, avoiding excesses in cultural practices makes for healthier turf and reduces cost. The well-groomed, manicured look of some lawns and even many present-day golf courses goes beyond the need of utility and certainly is at high cost. Perennial grasses with their deep, fibrous root systems have a great ability to withstand low fertility and minimal soil moisture. At my farm home in Wisconsin, I don't remember ever fertilizing or watering our rather expansive bluegrass lawn--just mowing with few clippings. Besides, we don't want vegetative yields; we want verdure--that's what's left after mowing. The cultural practices for low-maintenance turf may call for more careful planning and execution with an emphasis on prevention and timeliness.

Mowing Height and Frequency

Many times a somewhat higher cutting height means healthier turf. Usually there is a direct relationship between height of cut and root development--the higher the cut, the deeper the root system. Conversely, cutting bentgrass greens at 3/32 to 1/8 inch means short roots that can't get through summer heat without plenty of timely irrigation. Higher cutting heights mean better drought tolerance, more efficient fertilization use and more shading of the soil, which means lower temperatures. This shading also means less crabgrass or annual bluegrass, which need light to germinate. This weed control aspect can be noted in Figure 1. Considerable crabgrass developed under the low cut of 1 1/4 inches and irrigated plots. Kentucky bluegrass cultivars respond differently to cutting heights and levels of fertility as shown in Figure 1 and also in Figure 2. Bensun and Brunswick performed best under a high-maintenance regime, whereas Pennstar and Vantage were best under low fertility and high cut. Annual bluegrass was surpassed completely at a 3-inch cut.

In many lawn and park situations as well as fairway roughs, cutting heights for Kentucky bluegrass can be raised to 3 inches and tall fescue up to 5 inches. Frequency of cut is recommended at 40 percent leaf removal, but a slower growth rate from less fertilizer and less irrigation can reduce frequency of cut.

Fertilizer

There is a major trend to decrease fertilization, especially nitrogen. Beyond the amount needed to give adequate leaf growth, we are only increasing green color--along with a flush of growth that sets up disease susceptibility and increases mowing. Additions of iron with minimal N have given good color and better drought

hardiness. In tall fescue trials at Mead, Nebraska, 3 pounds of nitrogen per 1,000 square feet gave little better color; 5.9 versus 5.8 for 1 pound of nitrogen. Quality was only slightly lower. (See Figure 3.) Similar results were noted in a tall fescue trial at the University of Illinois where a 7 quality rating is certainly adequate with only K-31 falling below an acceptable level. (See Figure 4.)

Another change in fertility practices is the use of timely potash applications for various stress tolerances such as drought, heat, cold, and even wear. The higher osmotic pressure from the K^{++} ions holds the water in the cells more tightly and with other cell changes, it seems to fortify the plant for the various stresses.

Late fall N fertilization enhances winter color, gives an earlier spring greenup without excessive spring growth, reduces summer patch diseases, and produces stronger roots according to Drs. Koski and Street at Ohio State.

Pest Control

Few of us can get by without some use of expensive pesticides--but do we really try, or perhaps as Dr. A.J. Powel says, "Instead of detecting the weather factors and turf health for disease control applications, we schedule a preventive fungicide program." That's the real heart of an integrated pest management (IMP) program. It starts with selection of the right species and disease resistant cultivars or blends. Almost all diseases require moist, humid conditions for spore germination. Minimal irrigation applied in early morning and good drainage reduce sporalation and spread of such diseases as *Pythium* or brown patch.

The best weed control is a healthy, competitive stand of grass. Examples of timeliness in weed control would be proper timing of preemergence herbicides and early fall establishment of cool-season grasses rather than in spring when annual weeds will compete. Also, many herbicides will decrease root and rhizome growth, further reducing the competitive edge as compared to a well-rooted turf.

Cultivation

Whether to control thatch or to reduce compaction, timely cultivation can be important for a healthier turf. Coring is most helpful for heavily trafficked areas such as golf greens or athletic fields. Thatch removal, whether by verticutting or coring, increases effectiveness of insecticides, reduces disease, and improves water intake. Topdressing after coring also helps in thatch decomposition and air and water intake.

Irrigation and Drainage

The control of soil moisture, whether from rainfall or irrigation, is extremely important. And compaction on athletic fields increases the problem. Some negative effects of poor drainage are root damage, poor microbial activity, more disease, frost heaving, more compaction, and excess rain or irrigation water runoff. Although somewhat expensive and initially disruptive, underground drainage is a must for most heavily used turfgrass areas. Less expensive French drains along with good slope or crown can often be effective.

Use: Wear and Compaction

A roadside, cemetery, or most lawns receive minimal traffic and wear and therefore can be low maintenance. As use increases, maintaining a playable turf is more

difficult and costly. Both selection of wear-tolerant species and subsequent cultural practices are needed. We have combined the two most wear-tolerant species, tall fescue and zoysiagrass, on a football field at Carbondale High School's Bleyer Field. Seeding both species in the spring has given only fair results, but laying sod of the combined species, such as was done on the practice field, looks very promising.

Judicious use of cart paths and open cement blocks can save the turf on heavy-wear areas on golf courses. Practice fields for football and band practice can save the main football stadium.

Soil Modification

Soil modification can reduce subsequent costs and difficulties in maintenance of heavy use areas. Sometimes partial modification using frequent coring and topdressing can help improve soil characteristics.

WATER CONSERVATION

In most parts of the United States, there is an increasing demand for water for agriculture, industry, home use, and recreation. But our supply of potable ground water is steadily dwindling, due primarily to heavy usage and outdated agricultural irrigation practices. In addition, lakes, rivers, and groundwater are becoming polluted. Water use restrictions are imposed in many states, and many give low priority to the use of water for turfgrass. For example, Iowa has defined its water priority allocations to include eleven categories. Irrigation of turfgrass areas (home lawns, golf courses, athletic fields, etc.) is placed in category 9--recreation and leisure. Drs. Agnew and Carrow go on to indicate that this bill illustrates the importance of developing water conservation plans in the turfgrass industry.

Water Use Rates and Drought Resistance

1. COOL- AND WARM-SEASON TURFGRASSES. Generally, warm-season turfgrasses have lower water use rates (WUR), with buffalograss being the lowest. Our favorite cool-season grasses, such as Kentucky bluegrass and creeping bentgrass, have very high water use rates, as noted in Figure 5. The comparative drought resistance (DR) of different turfgrasses follows the same pattern. There are some shifts in the cool-season grasses, notably Kentucky bluegrass and tall fescue. Kentucky bluegrass has a partial avoidance mechanism--summer dormancy, while tall fescue has exceptionally deep roots. Several of our native cool-season grasses have medium to good drought resistance.

2. CHARACTERISTICS FOR A LOW WATER USE RATE. *Canopy resistance* to evapotranspiration makes up from 40 to 65 percent of the reduced water use rate. This includes:

   --high shoot density;
   --more horizontal leaf orientation;
   --slow vertical leaf extension rates; and
   --narrow leaf width.

The horizontal leaf orientation and somewhat slow vertical leaf extension rate are plusses for zoysiagrass, and the narrow leaf blades of the fine fescues give them their low water use rate and medium drought resistance.

Stomatal resistance accounts for 20 to 25 percent of reduced water rate. Evapotranspiration occurs through the stomata. They are primarily regulated by light. Cloudy, cool, humid days without wind suppress water loss. Full sunlight, dry atmosphere, moderate wind, and high temperatures increase water loss.

Cultural Practices to Lower Water Use Rate

1. *Lower cutting height.* Although the reduced leaf area from a low cutting height will reduce water use, it is at the expense of shorter roots and wilting grass.

2. *Decrease N.* Reduced succulence and growth from lower nitrogen applications will lower water use.

3. *Decrease irrigation.* Again, there are less succulent plants resulting from a decrease in irrigation and lower water use.

4. *Minimize leaf wounds.* Sharp mower blades and minimal disease injury will lower water use.

5. *Plant growth regulators* reduce plant growth. In fact, the senescing leaves will lower water use rates.

6. *Antitranspirants* reduce transpirational water loss. Phenyl mercury acetate (PMA) and other experimental materials have shown a degree of effectiveness in stomatal closure. Certain types of plant growth regulators such as Cutless (flurprimidol) and Embark (mefluidide) have reduced water use rates. Again, less growth and succulence. Surfactants, especially with coring, have helped move water into the rootzone such as in localized dry spots.

Use of Non-Potable and Effluent Water

The growing shortage of potable water and a near unlimited supply of nonpotable water indicates the need for getting off the city water line. Sources are:

1. *Ponds, lakes and rivers.* There are many ponds and lakes near or on golf courses and parks that are adequate for irrigation, and costs are certainly less than for potable city water. And there are no restrictions if it's your own pond.

2. *Wells.* Where ground aquifers are adequate but water is brackish, they can be utilized with care.

3. *Effluent.* Perhaps the best potential nonpotable water is from city effluent. Third-stage effluent can be used for irrigation of park lands, municipal properties, large planned developments including golf courses, and for fire fighting. Randolph Park, with a 36-hole golf course in Tucson, Arizona, has used effluent for many years. A municipal course at Bensenville, Illinois, has been using effluent for seven years. A new city park district golf course near Carbondale, Illinois, is planning to use effluent. Effluent from primarily domestic homes is usually less contaminated with heavy metals than that from industry, and there are more nutrients in the effluent as well. As water conservation becomes an increasingly critical issue, and with rising costs of potable water and use restrictions, the use of effluent to irrigate public and private lands is ever more feasible.

Maximize Root Absorption of Water

1. Soil environmental factors to maximize root growth and depth have been discussed, such as reducing compaction and aerifying to improve soil oxygen level. Also, reducing root damage by toxic herbicides and judicious use of insecticides to reduce feeding injury of grubs, etc., to the roots are positive factors.

2. Cultural factors to enhance rooting depth such as cutting height and proper fertilization are essential for deep rooting.

Benefits from Reduction in Water Use

1. Less water used and lower costs
2. Reduced mowing
3. More efficient use of fertilizer
4. Fewer weed problems
5. Less disease
6. Better playing surfaces
7. Reduced maintenance costs

SOCIAL AND ECONOMIC PROBLEMS

1. *Customer preference education.* This concept of lower maintenance sounds great, but can we put it across? We must please the customers! It will take good education programs to convince them that their slower growing grass with moderate green color and cut at two-plus inches is actually healthier than their neighbors' dark green carpets.

2. *Lawn care and other services.* Lawn care services are certainly willing to cut back on their application rates, etc., if the customer remains satisfied.

3. *The green industry -- have we oversold the word green?* Perhaps other segments of the green industry are less willing to cut back on their sales; however, use of slow-release fertilizers, special machinery, and tailored applications of pesticides may increase under parts of a low-maintenance regime.

4. *Lower maintenance turf with energy-efficient turfgrass.* The emphasis should be on lower maintenance without losing the quality turf needed. Breeding and selecting energy-efficient turfgrasses will be a major part of this effort.

EFFECT OF IRRIGATION AND CUTTING HEIGHT ON KENTUCKY BLUEGRASS CULTIVARS AT SIU-C, NOV. 18, 1981[1]

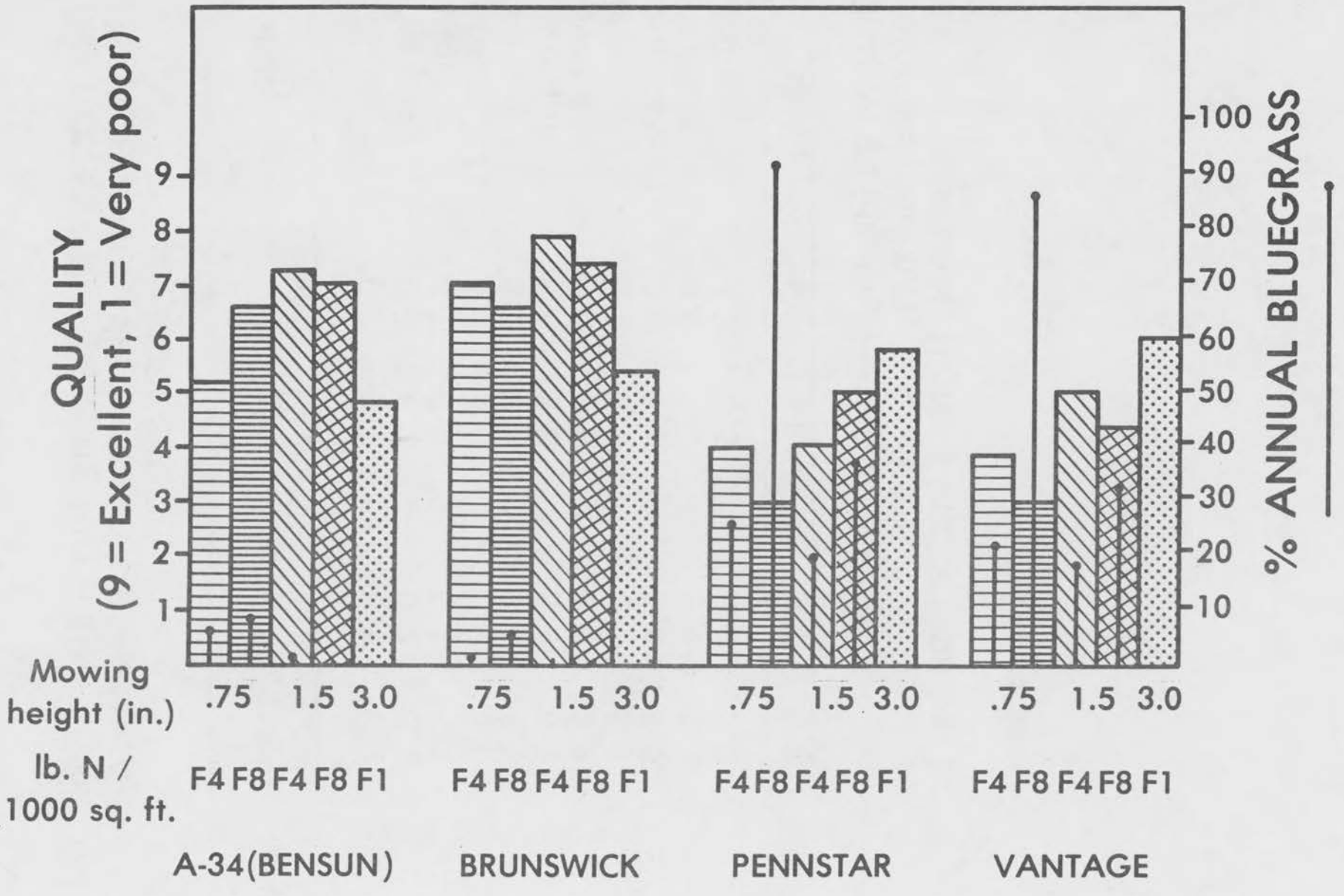
Cultivar	Irrigated		Non-irrigated	
	Low cut†	High cut	Low cut	High cut
Adelphi	5.3‡	9.0	8.0	8.3
Baron	4.2	7.7	6.5	7.0
Bensun	3.2	8.0	6.7	8.0
Bristol	4.2	8.0	6.5	8.7
Common	2.5	7.0	5.7	8.0
Majestic	4.5	8.0	6.5	7.7
Parade	5.2	7.5	7.2	8.3
Touchdown	5.7	7.5	5.2	6.8
Vantage	2.3	7.5	7.5	8.0
Ave.	4.1C	7.8	6.6	7.9

†Cutting height: low=1 1/4 in.; high=2 1/4 in.
‡Quality: 9=excellent. no weeds; 1=all dead, many weeds
C=heavy crabgrass infestation

[1]H. Portz

KENTUCKY BLUEGRASS CULTIVAR MANAGEMENT

QUALITY AND ANNUAL BLUEGRASS (U of I, 1978)



A.J. Turgeon and J.E. Haley

NATIONAL TALL FESCUE HIGH AND LOW MAINTENANCE TEST, MEAD, NEBRASKA, 1984-86[1]

Cultivar	Quality†		Color‡	
	High§	Low	High	Low
Arid	6.7	6.1	6.1	6.2
Olympic	6.7	6.2	6.2	6.3
Jaguar	6.7	6.0	6.1	6.2
Rebel	6.7	5.8	6.2	5.9
Mustang	6.5	6.1	6.4	6.1
Adventure	6.4	5.9	5.8	6.1
Apache	6.4	6.0	6.4	6.2
Falcon	5.9	6.0	5.7	5.9
Kentucky-31	5.5	5.1	5.4	5.2
Clemfine	4.9	5.6	5.4	5.3
Kenhy	3.7	4.5	5.4	5.0
Mean	5.9	5.6	5.9	5.8

†Quality: 9= ideal turf; 1= poor turf
‡Color: 9= ideal turf; 1= poor turf
§Maintenance level: High= 3 lbs. N/1000 sq. ft.; Low= 1 lb. N

[1]T. Riordan

EVALUATION OF TALL FESCUE CULTIVARS UNDER TWO MAINTENANCE LEVELS AT UNIVERSITY OF ILLINOIS-URBANA, 1985[1]

Cultivar	Quality, All Dates, 1985†	
	High‡	Low§
Jaguar	8.9	7.7
Rebel	8.7	7.5
Rebel/Baron KB 90/10	8.6	7.3
Olympic	8.5	7.5
Falcon	8.3	7.4
Mustang	8.3	7.3
Houndog	7.8	7.2
Clemfine	7.6	7.0
K-31	7.0	6.4
Ave.	8.2	7.3
LSD 0.05	0.5	0.4

† Quality evaluations: 9=excellent, 1=very poor

‡ Irrigation and high fertilization: 4 lbs. N/1000 sq. ft. 1983, 84; 2 lbs., 1985

§ No irrigation and low fertilization: 1 lb. N/1000 sq. ft. 1983, 84; no N, 1985

[1]J. Haley, T. Fermanian and D. Wehner

COMPARATIVE WATER USE RATES (WUR) OF MAJOR COOL AND WARM SEASON TURFGRASSES WITH PROPER CULTURE AND IRRIGATION AND COMPARATIVE DROUGHT RESISTANCE (DR)[1]

Relative Ranking		Turfgrass	
WUR	DR	Cool Season	Warm Season
Very low	Excellent to very good		Buffalograss Centipedegrass
Low	Good	Turf Alkaligrass	Bermudagrass Zoysiagrass Grama
Med.	Medium to fair	Fairway Wheatgrass Hard Fescue Chewings Fescue Red Fescue	Bahiagrass St. Augustine-grass
High	Poor	Perennial Ryegrass Tall Fescue	
Very high	Very poor	Rough Bluegrass Annual Bluegrass Creeping Bentgrass Kentucky Bluegrass Italian Ryegrass	

[1]K. Kim and J. Beard

SOIL TESTING IN TURF MANAGEMENT

T.R. Peck

Producing and maintaining desirable and appealing turf involves many management factors. Adequate soil acidity and fertility are major management variables. This paper is a discussion of the contribution of soil tests in ascertaining soil acidity and fertility factors.

LOCATION OF SOIL TESTING SERVICES IN ILLINOIS

Attached is a map showing the location of soil testing services in Illinois. Of course, these services are geared up to serve farmers: they know field crop soil fertility requirements better than turf grass requirements. Any of the services listed are able to give reliable test results, but you should inquire about their expertise with interpretations for turf or be prepared to make your own interpretations.

TESTS TO HAVE MADE

Following the list of soil testing services is a section on "Evaluating Special Soil Tests," with several soil tests rated for reliability, usefulness, and cost effectiveness. Commonly, we are accustomed to equating "value" with the cost of an item: not so with soil testing, where the most useful tests are the routine tests for acididty, plant available phosphorus, and potassium, which are usually the lowest costs. Not listed in this table but of high usefulness in turf management trouble shooting is the soluble salt soil test. This table reflects the state-of-the-art for field crops. Nitrogen soil tests in soils east of the Mississippi River have very limited usefulness in predicting crop response. However, with a high value crop like turf, if a nitrogen soil test for the nitrate form was made every two weeks, the usefulness could be greatly improved.

INTERPRETATIONS

A desirable pH level is in the range of 6.0 to 6.5 for turfgrass. A pH below 6.0 indicates an acidity condition, and the use of lime to neutralize the acidity is a recommended practice. A pH above 7 is higher than desirable because of reduced plant availability of nutrients in the soil. In particular, iron, which is of major significance to turf, is reduced, as are the minor turf nutrients manganese and zinc. Typically, it is common for turf to have a pH above 7, as the result of an accumulation of basic-reacting nutrients from irrigation water. While reducing the pH to below 7 may seem desirable (and it can be done by acidulating amendments such as sulfur or acids), in practice the problem of excessive soluble salts being produced in the acidulating process may be more serious than living with the pH above 7. Slow acidulation of soil with nitrogen carriers can be expected at the rate of 2 to 4 pounds of lime for each pound of nitrogen applied as ammonia urea or ammonium

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T.R. Peck is Professor of Soil Chemistry, Department of Agronomy, University of Illinois at Urbana-Champaign.

nitrate. The acidulating rate is more rapid with ammonium sulfate as the nitrogen carrier, approaching 6 to 8 pounds of lime for each pound of nitrogen. However, the tendency for a soil to acidify or neutralize depends upon the base status of the irrigation water, that is, the levels of calcium, magnesium, sodium, and potassium.

Levels of pH exceeding 8.3 are indicative of high sodium levels. Such conditions might develop where poor quality irrigation water high in sodium and bicarbonate is used. Living with soil pH levels above 7 requires more attention given to supplying iron. Chelated forms and periodic foliar sprays will assure a greener turf. Lime, which has been so beneficial to agricultural soils, should be used with caution on turf soils in Illinois.

Phosphorus levels in the range of 25 to 35 ppm are desirable. How low a level is adequate for desirable turf depends upon the nature of the soil. A loamy soil with good aeration will produce a good turf with lower available soil phosphorus than will a coarse sand soil or a clayey soil with poor drainage. Maintaining a higher available soil phosphorus level helps offset some of the effects of compaction and will yield a better turf.

How high a soil phosphorus level should be before additional phosphorus becomes uneconomical and makes no improvement in appearance is not well defined, but certainly at 50 ppm extensive use of phosphorus fertilizers is not prudent. However, at 30 ppm small applications in early spring or late fall will stimulate and provide a more favorable turf earlier in the spring, particularly in cold and wet spring seasons. Potassium soil test levels should be in the range of 150 to 200 ppm. Generally, areas that have been amended to enhance drainage have a lower capacity to hold potassium and if clippings are removed maintenance of soil potassium levels needs attention. As with soil phosphorus a high available soil potassium level helps offset some of the effects of compaction and will give a better turf.

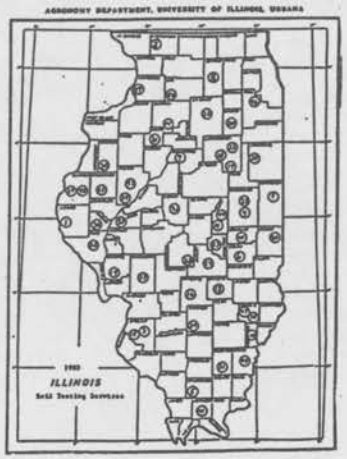
Care must be exercised with potassium fertilizers to preclude soluble salt problems. Thus, maintaining potassium test levels in the desirable range can be more critical for good turf than hitting the desirable range with pH and phosphorus.

Soil test values for phosphorus and potassium may or may not be reported in units of ppm. Commonly, units of pounds per acre are used. To convert pounds per acre to ppm, simply divide by 2 (lb/acre divided by 2 = ppm). When sampling soil, send at least a cupful of soil to the laboratory to perform the tests.

SOIL TESTING LABORATORIES - COUNTY LISTING

Refer to the alphabetical listing to identify the laboratory testing in each county by number.

County	Laboratory No.	County	Laboratory No.
Adams	1	Lee	50
Brown	38	Livingston	12,17,18
Bureau	14	Logan	42
Cass	33	McDonough	25
Champaign	4,37	Macoupin	27
Christian	22	Marion	34
Coles	6	Moultrie	23
DeKalb	8	Piatt	11,44
Douglas	40	Pike	32
Edgar	36	Richland	35,47
Edwards	10	St. Clair	3,15
Effingham	13	Shelby	24
Fayette	16	Stark	31
Fulton	39,43	Stephenson	2
Greene	19	Vermilion	9
Grundy	20	Warren	30
Hamilton	21	Whiteside	49
Hancock	29,45	Will	46
Iroquois	28	Williamson	5
Johnson	41	Woodford	7
LaSalle	26		



SOIL TESTING LABORATORIES - ALPHABETICAL LISTING
December 15, 1985

List of laboratories participating in the Round Robin Split Soil Sample Program and/or submitting soil samples for check testing to the Department of Agronomy, University of Illinois at Urbana-Champaign during 1985.

1. Adams County Farm Bureau
   Soil Testing Laboratory
   303 S. 36th St
   Quincy, IL 62301
   Adams County

2. Agra Soil Service
   312 Chestnut St
   Lena, IL 61048
   Stephenson County

3. Alvey Laboratory
   1511 E. Main
   Belleville, IL 62222
   St. Clair County

4. A.S.M. Service
   Don Van Engelenburg
   2403 Lyndhurst
   Champaign, IL 61820
   Champaign County

5. Cepheus Industries
   Box 525
   Marion, IL 62959
   Williamson County

6. Coles County Soil Service
   Lyle Wetzel
   R.R. #2, Box 210
   Charleston, IL 61920
   Coles County

7. Cropmate Soil Lab
   P.O. Box 128, Rt. 117N
   Goodfield, IL 61742
   Woodford County

8. DeKalb County Farm Bureau
   315 N. 6th St.
   DeKalb, IL 60115
   DeKalb County

9. Eastern Illinois Soil Testing
   114 S. Chicago
   Rossville, IL 60963
   Vermilion County

10. Edwards County Farm Bureau
    Soil Testing Laboratory
    15 S. Fifth St.
    Albion, IL 62806
    Edwards County

11. Edwards Farm Supply
    Box 9
    Cisco, IL 61830
    Piatt County

12. Edwards Soil Service
    601 N. Court St.
    Pontiac, IL 61764
    Livingston County

13. Effingham Equity
    Soil Testing Laboratory
    P.O. Box 488
    Effingham, IL 62401
    Effingham County

14. Farmers Soil Lab
    R. R. 1
    Wyanet, IL 61379
    Bureau County

15. Farm Testing Service
    Rt. #1, Box 12
    Mascoutah, IL 62258
    St. Clair County

16. Fayette County Soil Test Lab
    c/o Jan Wollerman
    Rt. 2, Box 274
    Ramsey, IL 62080
    Fayette County

17. G.M.S. Laboratory
    Rt. 1, Box 51
    Cropsey, IL 61731
    Livingston County

18. Graymont Co-op Association
    P.O. Box 56
    Graymont, IL 61743
    Livingston County

19. Greene County Farm Bureau
Soil Testing Laboratory
319 W. Side of Square
Carrollton, IL 62016
Greene County

20. Grundy County Farm Bureau
Soil Testing Laboratory
116 E. Washington
Morris, IL 60450
Grundy County

21. Hamilton County Soil Testing
Courthouse
McLeansboro, IL 62859
Hamilton County

22. Max Hutchens Fertilizer
R. R. #2, Box 68A
Assumption, IL 62510
Christian County

23. Kaiser Chemical Company
Soil Testing Laboratory
Box E, 910 W. Monroe
Sullivan, IL 61951
Moultrie County

24. Kaskaskia Soils Laboratory
P.O. Box 497
Shelbyville, IL 62565
Shelby County

25. Key Agricultural Services, Inc.
114 Shady Lane
Macomb, IL 61455
McDonough County

26. LaSalle County Farm Bureau
Soil Testing Laboratory
Rt 23 North & Dayton Road
Ottawa, IL 61350
LaSalle County

27. Macoupin County Farm Bureau
Soil Testing Laboratory
220 N. Broad St.
Carlinville, IL 62626
Macoupin County

28. Midwest Soil Testing Service
Box 125, 103 S. Front
Danforth, IL 60930
Iroquois County

29. Mississippi Valley Soil Testing
964 Broadway
Hamilton, IL 62341
Hancock County

30. Mississippi Valley Branch Office
R.R. #2, Swan Creek
Roseville, IL 61473
Warren County

31. Mowers Precision Crop Counseling
Service
107 N. Franklin, Box 518
Toulon, IL 61483
Stark County

32. Pike County Farm Bureau
Soil Testing Laboratory
Hwy 36E
Pittsfield, IL 62363
Pike County

33. Professional Agricultural Services
Division of County Real Estate
1400 State St.
Beardstown, IL 62618
Cass County

34. Richardson Ag. Service
104E. 7th St.
Centralia, IL 62801
Marion County

35. Rich-Law Service Co.
P.O. Box 403
S. Whittle Ave.
Olney, IL 62450
Richland County

36. Scottland Soil Service
Scottland, Rt. 2
Chrisman, IL 61924
Edgar County

37. Shields Soil Service
R.R. #1 Box 385
Dewey, IL 61840
Champaign County

38. Sides Crop Management
and Soil Testing
Box 13
Versailles, IL 62378
Brown COunty

39. Skiles Soil Service
Soil Testing Laboratory
P.O. Box 267
Astoria, IL 61501
Fulton County

40. Soil Lab, Inc.-Independent
Soil Testing Service
120-1/2 E. Sale St.
Tuscola, IL 61953
Douglas County

41. Southern Ill. Farm Foundation
Soil Testing Laboratory
P.O. Box 335
Vienna, IL 62995
Johnson County

42. Sparks Soil Testing Laboratory
122 S. McLean, Box 841
Lincoln, IL 62656
Logan County

43. Spoon River F.S. Inc.
Soil Testing Laboratory
Ellisville, IL 61431
Fulton County

44. S.S.T. Laboratory
Tom Stoddard
R.R. 1, Box 304
Monticello, IL 61856
Piatt County

45. Taylor Lab.
421 Wabash
Carthage, IL 62321

46. Top Soil Testing Service
27 Ash St., P.O. Box 340
Frankfort, IL 60423
Will County

47. Volk's Fertilizer Service
Star Route Box 47
Newton, IL 62448
Richland County

48. White County Farm Bureau
304 East Robinson
Carmi, IL 62821

49. Whiteside County Farm Bureau
Soil Testing Laboratory
100 E. Knox
Morrison, IL 61270

50. Zeller Laboratory
1711 W. 1st St.
Dixon, IL 61021
Lee County

OUT-OF-STATE LABORATORIES

51. Agrico-Chemical Co.
Soil Testing Laboratory
P.O. Drawer 639
Washington Court House, OH 43160

52. Agri. Labs Inc.
204 E. Plymouth
Bremen, IN 46506

53. A & L Ag. Lab.
411 N. Third St.
Memphis, TN 38105

54. A & L Great Lakes Agricultural Laboratory
5011 Decatur Rd
Fort Wayne, IN 46806

55. A & L Midwest Agricultural Laboratory
13611 B St
Omaha, NB 68144

56. Amax Coal Co./Central Lab
1540 Cullen Ave
Evansville, IN 47715

57. Brookside Research Laboratories
308 S. Main St
New Knoxville, OH 45871

58. Chemical & Technical Services
300 S. Adams St.
Mt. Pleasant, IA 52641

59. CLC Labs
325 Venture Dr.
Westerville, OH 43081

60. Farm Clinic
932 Robinson St
P.O. Box 3011
West Lafayette, IN 47906

61. Geophyta
2685 County Road 254
Vickery, OH 43464

62. Roger E. Hanes Co.
Soil Testing Laboratory
3765 Premier Cove
Memphis, TN 38118

63. Harris Laboratories, Inc.
P.O. Box 80837
624 Peach St
Lincoln, NB 68501

64. Indiana Farm Bureau
Central Lab.
120 East Market Street
Indianapolis, IN 46204

65. Int. Minerals & Chemicals Corp
Agronomic Services Lab
P.O. Box 207
1331 South First St.
Terre Haute, IN 47808

66. Iowa Testing Laboratory
Highway 17 North, Box 188
Eagle Grove, IA 50533

67. NaChurs Soil Testing Lab
421 Leader St.
Marion, OH 43302

68. Sohigro Soil Test Laboratory
P.O. Box 2700
Lima, OH 45802

69. U.S.S. Agri-Chemical
204 W. Main St., Box 99
Belmond, IA 50421

70. WDHIC Soil & Forage Center
106 N. Cecil St.
Bonduel, WI 54107

EVALUATING SPECIAL SOIL TESTS

Increasingly, Illinois farmers are beseiged with soil test reports showing the results of special tests by commercial laboratories. The purpose of this section is to provide a perspective for the evaluation of special soil tests. NO ENCOURAGEMENT OF THEIR USE IS INTENDED.

Anytime any soil test is made, information about that field becomes known which was previously unknown. The problem arises in making a meaningful interpretation that will prove useful to the farmer. Because costs are involved in instruments and labor to make the "special" tests, the cost of these tests to the farmer will usually be greater than the cost of regular tests for *lime*, *phosphorus*, and *potassium*. This expenditure can create greater expectations for yield increases than can be delivered. Therefore, undue emphasis on special tests may undermine the credibility of the valuable pH, phosphorus, and potassium tests.

The following rating of soil tests has been developed to give some perspective about the reliability, usefulness, and cost effectiveness of soil tests as a basis for planning a soil fertility and liming program for field crops in Illinois. These subjective ratings are on a scale ranging from 100 to zero, with a test rated 100 deemed very reliable, useful, and cost effective and a test rated zero deemed of little value. The ratings indicate the status quo for the 1980s. Additional research will undoubtedly improve some test ratings.

Peck's Rating of the Reliability, Usefulness, and Cost Effectiveness of Soil Tests

Soil test	Rating	Soil test	Rating
Water pH	100	Organic matter	75
Salt pH	30	Calcium	40
Buffer pH	30	Magnesium	40
Exch. H^+	10	C.E.C.	60
Phosphorus	85	Sulfur	40
Potassium	80	Zinc	45
Boron (alfalfa)	60	Manganese (>pH 7.5)	40
Boron (corn & soybeans)	10	Manganese (<pH 7.5)	10
Iron (>pH 7.5)	30	Copper (organic soil)	20
Iron (<pH 7.5)	10	Copper (mineral soil)	5
Molybdenum	0		
Available nitrogen (estimated from organic matter)			35
Total nitrogen (Kjeldahl analysis)			40
Present available nitrogen (nitrate)			50

TURFGRASS RENOVATION

John C. Fech

For many reasons, turf managers and homeowners decide to renovate and improve the turfgrass they maintain. This may involve a change in the species of turfgrass that is being grown or simply replacing the turf plants that have died out.

The horticulture fact sheet, "Selection of a Turfgrass in Illinois" (TG-1-86R), available at all county Extension offices throughout the state, provides information on turf species adapted to Illinois. Choose new planting material carefully. Using grasses that are not adapted to your area can result in poor quality turf and disappointment for many years to come. Both pest and nonpest problems can be reduced through proper selection of turf species and cultivars. It is imperative to select a turf species that will perform well under local conditions.

Many factors can be responsible for the decline of a turfgrass stand, including drought stress, insect damage, disease infestations, adverse environmental conditions, excessive shade, and improper cultural practices. The first step in the renovation process is to identify the cause of the damaged or thinned turf. Consider each of the previously mentioned factors as a possible cause. If you need help in diagnosing the problem, consult with your county Extension advisor.

Once the cause of the decline in the turf is identified, make appropriate changes in your cultural practices to prevent future failures. If this is not possible, choose a turf species that is tolerant of the factors that caused the decline. In either case, improved cultivars of the desired turf species should be used. Refer to Horticulture Fact Sheets TG-5-86 and TG-6-86, "Kentucky Bluegrass Turfs in Illinois" and "Tall Fescue Turfs in Illinois," for lists of improved cultivars of Kentucky bluegrass, fine fescue, perennial ryegrass, and tall fescue.

Begin the renovation process in midsummer by taking soil samples to determine the soil reaction (pH level) and nutrient requirements. Collect soil samples at a depth of 3 to 4 inches from several similar locations and mix them together to produce a composite soil sample. Have the soil sampled at a reputable soil testing laboratory. Laboratories for each county are listed in Horticulture Fact Sheet FL-13-81, "Taking Samples in the Yard and Garden." Several weeks may be required to obtain the results; allow ample time before beginning the site preparation.

The choice of whether or not to seed or sod is largely an individual one. In time, both procedures will produce comparable turfs, assuming the same cultivars are used. Sodding allows for turf establishment at any time the ground is not frozen and water is plentiful, but it is usually done in spring and fall when temperatures are cool. Sodding is usually more expensive than seeding.

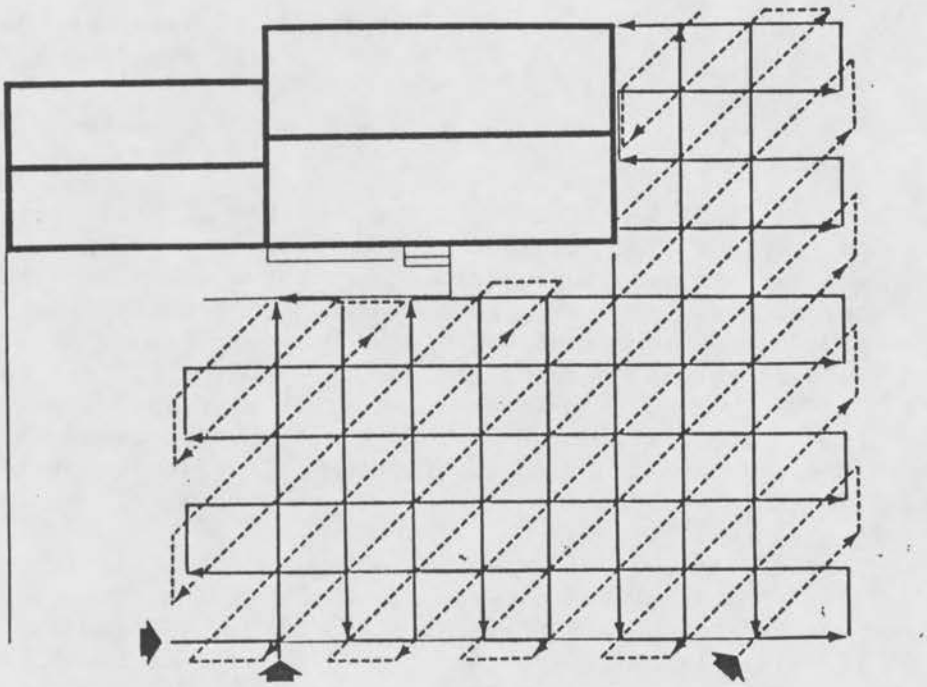
The best results with seeding occur in the spring or fall when the temperatures are cool. In the fall, germinating annual weed seeds offer little competition to new seedings. The warm days, cool nights, and expected rains of fall are also favorable to establishment; therefore, fall seedings are greatly preferred to spring seedings.

John C. Fech is Assistant Horticulturist, Department of Horticulture, University of Illinois at Urbana-Champaign.

Whether one seeds or sods, there are certain steps that must be taken to insure successful renovation. Proper site preparation begins with the control of perennial weeds such as smooth bromegrass, nimblewill, and yellow nutsedge. Control can be achieved with nonselective herbicides such as glyphosate (Roundup, Kleenup). Glyphosate should be applied 7 to 10 days before installing new plant materials.

Cultivate the area to be renovated prior to seeding or sodding. If extensive grading is necessary, remove the topsoil and stockpile it nearby. The underlying subsoil can then be shaped to the desired contour, and the topsoil can be redistributed. Most soils in Illinois will produce a satisfactory turf with proper care. A sandy loam or loam soil is preferred because management is easier on these soils. If heavy clay or very sandy soils are present, the area can be improved by incorporating organic matter such as peat moss, grass clippings, decomposed alfalfa hay, composted manure, rotted sawdust, or various combinations of these materials into the top 6 to 8 inches of existing soil. This is an ideal time to incorporate needed phosphorus and potassium based on the soil test results. Water the area to enhance settling and fill areas that settle unevenly to avoid standing water.

If extensive grading is not necessary, cultivate with a vertical mower (power rake) or aerification machine. These machines cause much less distruption to the turf than a rototiller or similar implement. Vertical mow or aerify a total of three times. The second pass should be at a right angle to the first pass; the third pass diagonally to the first two (Figure 1). Overseed with the improved cultivars of the desired turfgrass directly into the stubble left from the application of glyphosate. This stubble will prevent the soil from eroding and will serve as a seedbed for the new seedlings. Apply half the seed in one direction, and the other half moving at



right angles to the first pass. This will ensure uniform coverage. Refer to Tables 1 and 2 for suggested rates of each turf species. After seeding, lightly rake the area to partially cover the seed. If the soil is not compacted, the seedbed can be rolled lightly to firm the surface and provide good seed to soil contact.

Table 1. Suggested Seeding Rates for Turfs in Illinois

Turf species	Rate in lb/1,000 sq ft
Kentucky bluegrass	1.0 - 1.5
Perennial ryegrass	1.0 - 1.5
Tall fescue	6.0 - 8.0
Fine fescue	1.0 - 1.5
Creeping bentgrass	1.0 - 2.0
Buffalograss	2.0 - 2.5

Table 2. Suggested Vegetative Establishment Rates for Turfs

Turf species	Rate
Bermudagrass	1 bushel of sprigs or 2" plugs on 6" spacings requiring 55 sq ft of sod.
Zoysiagrass	2" plugs on 6" spacings in rows 6" apart requiring 55 sq ft of sod.

Lay sod as soon as possible after cutting and within 24 hours following cutting in warm weather. Butt sod strips together lightly with no overlapping, staggering them in a brick-like pattern. Avoid stretching the sod lengthwise because of the potential for shrinkage during drying. Lay sod lengthwise across the face slopes rather than up and down. Peg or stake sod pieces on steep slopes to avoid slippage. Roll the sodded areas as soon as possible to ensure good sod to soil contact. Apply water uniformly to a depth of 6 to 8 inches. Maintain a moist surface but do not saturate the sod. Continual saturation will increase the incidence of weeds and diseases, and can extend the time required for rooting. Traffic over the area should be kept to a minimum for 3 to 4 weeks.

Keep the seedbed continually moist with frequent light sprinklings until germination occurs. If a seeding mixture is used, be aware of the time required for germination for each species in the mixture. Kentucky bluegrass requires 14 to 21 days, tall fescue 7 to 14 days, perennial ryegrass 5 to 10 days, and fine fescues 7 to 14 days. As the seedlings emerge and grow, the frequency of watering should be decreased while the length of time of each watering is decreased.

Begin mowing as soon as the seedlings reach the desired mowing height. This will increase the aesthetic appeal of the new turf, and help to provide some broadleaf control. Bromoxynil (Buctril) may be used at three eighths lb/A if weed pressure is heavy. Once the turf has been mowed 3 to 4 times, standard broadleaf herbicides

may be used. Refer to Extension Circular 1076 for specific recommendations. Four to five weeks after the first mowing, apply 1 pound of slow release nitrogen/1,000 sq ft to provide an even greening effect and to meet the nutritional needs of the new turf.

SUMMARY OF RENOVATION STEPS

1. Identify the cause of the decline of the turf.
2. Change cultural practices/select new turf species.
3. In midsummer, control perennial weeds with glyphosate.
4. Have soil analyzed.
5. Cultivate with vertical mower, aerifier, or roto-tiller.
6. Modify soil if necessary.
7. Overseed with improved cultivars of the desired turf species.
8. Provide good post-seeding care.
9. Obtain appropriate literature on proper culture of the desired turf species.

SEED MIXES IN RENOVATION

A. Douglas Brede

Maintenance of beautiful lawn turf is an ongoing process, requiring continuous care to ensure optimal appearance. Occasionally, lawn appearance drops to a level where the usual management practices, such as watering, fertilization, and weed control, are no longer effective. Lawn renovation is an effective way to rejuvenate a tired, thinning, or problem lawn.

Grasses for overseeding include Kentucky bluegrass, perennial ryegrass, tall fescue, fine fescue, and others. A mixture of two or more of these components is generally advantageous. Combining two species will improve the genetic adaptability of that lawn under a broad range of management and edaphic conditions. However, because turf species differ considerably in seedling vigor and establishment rate, it is often necessary to adjust overseeding mixtures to ensure a desired result. For example, mixtures of Kentucky bluegrass and perennial ryegrass in a 50/50 ratio will often result in a predominately perennial ryegrass turf. This is due to the enormous seedling vigor of perennial ryegrass relative to Kentucky bluegrass. Understanding the competitive relationships among turf species will enable the turf manager or lawn care operator to make better use of seed mixtures for overseeding.

Over the past seven years, I have performed a number of different seeding and overseeding experiments in Pennsylvania and Oklahoma. My recent change of jobs to Research Director at Jacklin Seed Company will allow me to research seeding and overseeding under a third geographical location, the Pacific Northwest. Much of my research has centered on the competitive nature of grass species in the seedling stage. I have examined how and why grasses seem to perform better on bare seed beds, rather than under sod-seeded situations.

My research has shown that where Kentucky bluegrass, annual bluegrass, and perennial ryegrass were seeded onto a bare seed bed, growth of the perennial ryegrass and annual bluegrass dominated that of Kentucky bluegrass after six weeks. Similar results were found under sod-seeded situations. However, under sod seeding, perennial ryegrass tended to excel over all other grasses tested. This was due to the ability of perennial ryegrass to extend leaves of seedlings above the existing sod canopy. When overseeding with Kentucky bluegrass, I recommend that strenuous efforts be taken to weaken or open up the existing turf to allow for maximum establishment of the Kentucky bluegrass seedlings.

When establishing Kentucky bluegrass and perennial ryegrass as a mixture, a ratio of 75 to 95 percent bluegrass by weight should be used in the mixture to ensure adequate establishment of the bluegrass. Similar proportions should be used when establishing mixtures of Kentucky bluegrass with tall fescue. Reducing the percentage of bluegrass below 75 percent results in inadequate establishment of the bluegrass and a predominate stand of ryegrass or tall fescue. Using more than 95 percent bluegrass will result in a stand with a clumpy appearance from the low seeding rate of the grass.

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IRRIGATION TECHNIQUES

Clark Throssell

Turf managers are well aware of the need to implement proper irrigation practices. In order to implement these practices, the turf manager must first understand the role of water in turfgrass plants, how much water is lost from a turf site, and which techniques are available for determining when to irrigate.

Water has a major role in all the physiological processes of a plant. The most obvious role is as a constituent of individual cells. As a constituent of a cell, water performs the role of maintaining turgidity. When turgidity is lost, a plant wilts. About 80 to 90 percent of a plant, by weight, is water. Water is an essential component of the photosynthetic process, although only about 2 percent of the water taken up by a plant is used in photosynthesis. Water also serves as a catalyst for many reactions in the plant. Nutrients and carbohydrates are transported throughout the plant in a water medium. The physiological process that uses approximately 90 percent of the water is transpiration, the process by which a plant cools itself. A plant without the capacity to cool itself will die due to a lethal buildup of heat.

Since 90 percent of the water taken up by turf is used for transpiration, it is important to understand this process. Water is taken up by the roots and transported through the stem and into the leaves. On the leaf surfaces are small structures called stomata, small pores in the leaf that can be opened and closed by the plant. Stomata are essential so that CO_2 can move into the leaf and be used in photosynthesis. When stomata are open, water vapor from the leaf moves out into the atmosphere. The amount of water vapor moving out of the leaf is dependent upon the amount of water vapor in the atmosphere. If the water vapor content of the atmosphere is low, the potential is high for water loss through transpiration. When atmospheric water vapor content is high, transpiration potential is low.

Environmental factors that favor a low transpiration rate, and hence a low water use rate, are cool temperatures, cloudy, humid conditions, and little or no wind. Those factors that favor a high transpiration rate, and hence a high water use rate, are medium to high temperatures, low humidity, full sunlight, and moderate wind.

It is very difficult to state accurately what the water use rate for a given turf site may be. Many factors influence the water use rate including species and variety of turf, mowing height, mowing frequency, nitrogen fertility rate, level of potassium present, and irrigation practices. As a broad generality, in many areas of the country on a "typical" day, turf will use between 0.2 and 0.3 inches of water per day. In semi-arid regions, turfgrass may use up to 0.45 to 0.55 inches of water per day.

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Techniques for scheduling irrigations for turfgrass areas can be broken down into three categories: plant-based, soil-based and atmosphere-based. The most common plant-based irrigation scheduling technique is visual observation. The turf manager decides whether or not to irrigate based upon turf color, signs of footprinting in the turf, and evidence of wilting. To complement the visual observations, a turf manager may use a probe to help determine the moisture content of the soil and listen to weather reports. There are several other plant-based irrigation scheduling techniques that are primarily used by researchers, and these include irrigation based on plant temperature, plant water potential and stomatal resistance.

There are numerous instruments for measuring soil moisture content. The instrument that can be used most effectively on turf sites is a tensiometer. Tensiometers are fairly inexpensive and easy to use. They do require daily servicing and are accurate only for soils that have a fairly high moisture content. Research results from several universities have shown that irrigations scheduled by a tensiometer are more effective than irrigations based upon a set schedule or solely on the turf manager's judgment and experience. Not only were tensiometers effective in reducing the amount of water applied to the turf, but also turf quality showed no decline.

The third category of irrigation scheduling techniques is based upon atmospheric demand for water. Evaporation pans have been the most effective of the atmospheric methods for use on turf sites. An evaporation pan is an open, circular pan that is filled with water. The amount of water lost from the pan due to evaporation is measured daily. The amount of water used by a turfgrass stand is a certain percentage of the water lost from the evaporation pan. This amount of water can then be replaced to the turf system through irrigation. Research conducted in California has shown that irrigation scheduling based upon the use of an evaporation pan results in a reduction in water applied to the turf without a decline in turf quality when compared with irrigations scheduled by a turf manager.

Since turf managers do have an awareness of the need for conserving water, an understanding of how turf uses water will allow turf managers to make more informed decisions concerning their irrigation practices. Techniques are currently available that aid irrigation scheduling decisions, and through research, the future will bring improved instruments and technologies that will aid in irrigation scheduling.

TURF INSECTICIDE UPDATE

Roscoe Randell

There were control failures with some of the turf insecticides in 1985. Oftanol did not perform over an extended treatment period as it had in past years. But in 1986, most of the turf insecticides adequately controlled insect pests if applied at or near the time of infestation and damage.

INSECTICIDE USAGE IN 1986

The organic phosphate insecticides labeled for turf use include diazinon, Oftanol, trichlorfon (Proxol, Dylox), Dursban, and Mocap. Turcam and Sevin are carbamate insecticides also labeled for turf use. During 1986 the recommended grub control insecticides performed well.

In a test project, Oftanol was applied in replicated plots to turf areas previously treated for four, three, two, and one continuous year(s) plus an area with no previous history of an Oftanol treatment. Residues were determined weekly after application in each site. There was adequate Oftanol remaining in the soil after four weeks to control grubs effectively, regardless of previous treatment history. After eight weeks post-treatment, Oftanol residues decreased to low levels in all plots. In summary, Oftanol was effective for four weeks or slightly longer for grub control. This is comparable to the other grub insecticides: diazinon, Proxol, Dylox, and Turcam. Applicators who wish to control annual white grubs effectively in 1987 should time their preventive applications to correspond to egglaying and hatch in July. Damage, if it is to appear, will be observed in late August through October.

Two species of turfgrass chinch bugs are now present in Illinois. The southern chinch bug, a common insect pest of the Gulf States, especially Florida and Texas, is a pest of zoyziagrass in the southern and central sections of Illinois. The hairy chinch bug has been a pest of bluegrass in the northeastern U.S. for years. Recently it has become a problem in the urban areas of the northeastern section of Illinois. Kentucky bluegrass in the primary host of this new state insect pest.

Dursban controls both species of chinch bug and Proxol, Dylox, and diazinon are also effective on the hairy chinch bug.

There was very little greenbug activity in Illinois in 1986, but it could appear again in 1987 from migrating aphids from the southeastern U.S. Orthene and Dursban have been effective in past years.

Little or no billbug activity was reported in 1986. Oftanol and Dursban are the suggested insecticides for billbug control.

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DIAZINON SITUATION

Diazinon has had a label for turf use for over twenty years. The suggested labeled rate was 2 to 3 pounds of active ingredient per acre for surface feeding insects and 5 pounds for soil insect control. The new label for use on home lawns is a maximum of 4 pounds actual diazinon per acre in 1987. This is 10 ounces of 14G or 3 fluid ounces of the 4-pound-per-gallon formulation, AG500.

Use of diazinon on golf courses and sod farms has been canceled by the EPA, but this was appealed by Ciba-Geigy Corporation. More information will appear in trade magazines, newspapers, or newsletters prior to the 1987 turf season.

1987 CHEMICAL CONTROL SUGGESTIONS

Following is a table of the suggested insecticides and their uses on turfgrass insects. Be sure to check the labels for the rates.

Insect	Insecticide[a]	Formulation[b]	Suggestions
Annual white grubs Ataenius grubs	diazinon trichlorfon (Dylox, Proxol) Oftanol) bendiocarb (Turcam)	EC or G SP or G	Apply as spray or granules to small area and then *water in thoroughly* before treating another small area. Grub damage will usually occur in late August and September. Ataenius grubs occur in June, July and September.
Cicada killer and other soil-nesting wasps Ants	diazinon	EC or G	Apply as spray or granules and water in thoroughly. For individual nests pour 1% diazinon in nest and seal in with dirt.
Sod webworms	carbaryl (Sevin) diazinon chlorpyrifos (Dursban) trichlorfon (Dylox, Proxol)	WP or G EC or G EC or G SP or G	Webworms usually damage lawns in late July and August. As sprays, use at least 2 1/2 gal water per 1,000 sq ft. Do not water for 72 hours after treatment. As granules, apply from fertilizer spreader.
Millipedes and sowbugs	carbaryl (Sevin) diazinon	WP or G EC or G	Spray around home where millipedes or sowbugs are crawling. If numerous treat lawn.
Armyworms Cutworms	carbaryl (Sevin) chlorpyrifos trichlorfon (Dylox, Proxol)	WP or G EC or G SP or G	Apply as sprays or granules. Use 5 to 10 gal water per 1,000 sq ft
Chinch bugs	chlorpyrifos (Dursban) diazinon trichlorfon (Dylox, Proxol)	EC EC SP	Spray infested areas where chinch bugs are present.
Aphids	acephate (Orthene) chlorpyrifos (Dursban)	EC EC	Spray grass thoroughly.
Chiggers	diazinon	EC	Spray grass thoroughly.
Slugs	Mesurol	Bait	Apply where slugs are numerous. Scatter in grass. For use only in flower gardens and shrubbery beds.

[a]Use one of the insecticides recommended for a given group of insects, being sure to use the proper dosage for the formulation chosen. Follow labels as to correct rate of application.

TURF DISEASES OF 1986

Malcolm C. Shurtleff and Henry T. Wilkinson

Before a disease can be controlled, it is first necessary to diagnose the problem correctly. There are two general types of diseases: (1) noninfectious or abiotic, and (2) infectious or biotic.

Numerous noninfectious agents may injure turfgrasses and produce symptoms that closely mimic one or more infectious diseases. Included here are a thick thatch that can produce symptoms similar to drought, insect damage, or disease; a soil that is quite acid or alkaline (pH below about 5.5 or above 7.5); injury by dogs, birds, and other animals; damage from a dull or poorly adjusted mower; and cutting grass too short, which results in scalping and reduced root systems. We can also add excesses, deficiencies, or imbalances of water, light, air movement, 20 or more elements essential for normal growth of turfgrasses, soil compaction coupled with a lack of oxygen needed for deep root development, pesticide and fertilizer injury, extremely high or low temperatures when accompanied by cold or hot dry winds, and injurious impurities in the air or soil such as sulfur dioxide, ozone, or salt. Turfgrass plants in poor health due to unfavorable growing conditions--including poor cultural management practices--probably far outnumber diseases caused by pathogens. Suspect a noninfectious problem when other types of plants in the general vicinity are similarly affected at the same time.

More than 100 infectious diseases attack our major turfgrasses. These diseases are the result of the right combination of a susceptible grass plant, a pathogen, an air-soil environment favorable for infection, development and spread of the pathogen, plus the necessary time for disease to become evident.

Most infectious diseases of turfgrasses are caused by fungi. Over 400 different fungi have been reported growing on grass plants or as being pathogenic to grasses. Most fungi are identified by the spores that they produce. These spores come in a great variety of sizes, shapes, and colors. Unfortunately, you need a microscope to identify them. Many turgrass fungi feed on dead and decaying grass roots, stems, and leaves in the soil and thatch. Under favorable temperature and moisture conditions, living grass plants are attacked, especially where the turf is weak and lacks vigor. Most of the fungi that attack turfgrasses are spread by spores or fragments of diseased leaves carried on mowers, other turf equipment, shoes, flowing or splashing water, air currents, and in other ways.

Sound cultural management practices greatly reduce the development of diseases. Planting a blend or mixture of disease-resistant grasses is an important control measure. A vigorous, dense turf can best withstand wear and recover more quickly from various injuries, insect attack, or diseases.

Our 1986 turfgrass problems started with the heavy rainfall in November 1985, which was three times greater than normal over much of the Midwest. Attacks of red thread were not uncommon in western and northern Illinois near rivers and lakes. Red

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thread can be an important disease, especially of slow-growing, nitrogen-deficient turf during prolonged, cool, overcast, moisture-saturated air in spring and fall. It has been found under an early or late snow. When infection is severe, diseased turf is yellowed or "scorched" in circular to irregular patches, which are usually 2 to 6 inches in diameter. Red thread-infected turf has a ragged, uneven appearance. A number of spots may merge to form large, irregular areas of blighted turfgrass having a reddish-brown or tan cast. Fortunately, only the grass leaves and sheaths are infected. Red thread is best identified by coral-pink, orange, or red mycelial masses on the leaves and sheaths. The faintly pink web of mycelium may also mat the leaves and leaf sheaths together. The gelatinous masses are formed by strands of branched hyphae that often protrude from the leaf tips as antlerlike appendages. These coral-pink to blood-red mycelial strands harden and become "red threads" when they dry. The causal fungus survives from season to season as red threads in grass debris and is spread mechanically. Red Thread is controlled by the same cultural practices and fungicides as for dollar spot.

The excess of rainfall in November 1985 was followed by an unusually dry winter that resulted in only small amounts of snow molds in 1986.

As the turfgrasses began to green up in the spring, we received at the Plant Clinic, University of Illinois in Urbana-Champaign, hundreds of turf samples, telephone calls, and letters about dead areas of turf. The root systems on these turfs were much reduced and the dead grass could easily be pulled up. We believe that soilborne fungi, such as species of *Pythium, Rhizoctonia,* and *Fusarium* attacked the roots during late fall, winter, and early spring. Winter desiccation was also a serious factor. The result was that thousands of small to large dead turfgrass areas had to be reseeded or resodded.

During the spring and summer of 1986, we had the usual calls and samples of "Helminthosporium" and other leaf spots, followed later by crown and root rot or melting-out during hot dry weather. The best control for this disease complex is to grow a blend or mixture of resistant grasses.

In the area of research we found out more about such closely related patch diseases as take-all patch, summer patch, and necrotic ring spot. Take-all patch was diagnosed for the first time in Illinois in 1986 by Dr. Randy Kane on golf greens in the Chicago area. This disease is largely restricted to cool, moist regions. Take-all patch is most noticeable in spring and fall on closely cut bentgrasses that have been excessively limed, improperly fertilized, and are overly wet. The take-all fungus is also known to infect Kentucky and annual bluegrasses, perennial ryegrass, red fescues, tall fescue, and rough bluegrass, but to a much lesser extent than bentgrasses.

Expect take-all patch to appear in early spring as scattered, more or less circular, sunken, light yellow, reddish-brown, or bronzed patches of dead grass that continue to enlarge, turn a light brown, and become dull gray in winter. Typically, the sunken patches are invaded by annual bluegrass, fescues, other resistant grasses, or by broadleaf weeds, resulting in a "frogeye" or "doughnut" appearance. Around the margin of a patch where the fungus is active, there is a bronzed to reddish-brown ring of infected grass plants that have dark brown to blackened crowns with dark, shallow, and rotted roots. Dark "runner hyphae" of the take-all fungus can be seen growing over the roots. Take-all patches may continue to enlarge up to 10 inches per year for several years before disappearing.

Take-all patch is a disease we will have to be on the lookout for in the future. Dr. Kane obtained adequate control of the disease with tank mixes of PMAS

and thiram plus applications of flowable sulfur to help drop the soil pH well into the acid range. Control with this combination has also worked in Washington and Maryland where take-all is a serious disease. Controls for take-all patch also include providing good surface and subsurface drainage, periodic dethatching, avoidance of overwatering, planting a mixture of grasses, and practicing balanced soil fertility. Acid fertilizers, such as ammonium sulfate, monoammonium phosphate, ammonium chloride, muriate of potash, or other sulfur-bearing materials containing nitrogen will help to maintain an acid pH (close to 5.5). Three to five pounds per 1,000 square feet of elemental sulfur in a number of split applications is recommended in the Pacific Northwest where take-all is serious. The sulfur and acid fertilizer applications must continue for 2 or 3 years to bring the disease under control. Single sprays in December of Banner, Rubigan, and Bayleton have also proven effective.

Necrotic ring spot and summer patch (formerly called Fusarium blight) are caused by two soilborne fungi. Necrotic ring spot is caused by *Leptosphaeria korrae*, which is also the incitant of spring dead spot of bermudagrass. The *Leptosphaeria* fungus forms black pseudothecia on infected crowns and roots. Summer patch is caused by *Phialophora graminicola*, which is closely related to the take-all fungus. Both diseases produce near-identical symptoms. Necrotic ring spot infections occur during cool weather in the spring, but the typical frogeye or doughnut symptoms do not appear until after a period of hot, dry weather when temperatures are 75°F to 100°F during the day, over 70°F at night, and the turf is under stress.

Summer patch was severe this past growing season. Infections occur under moisture and heat stress, close mowing, a thick thatch, unbalanced applications of fertilizer (such as an excess of nitrogen and low levels of potash and/or phosphorus), high populations of parasitic nematodes, soil compaction, applications of a calcium arsenate herbicide, and other factors that predispose turf to stress conditions.

Summer patch increases in size over a period of several years and then, like take-all patch and spring dead spot, dramatically decreases in the fourth or fifth years.

Summer patch and necrotic ring spot of Kentucky bluegrass are generally not evident until the second or third years on newly laid sod and usually not for 4 years or more after seeding when the thatch has developed to over one-half inch.

The controls for summer patch and necrotic ring spot are the elimination of as many environmental stresses as possible, the promotion of deep root development, and keeping the grass growing steadily. Cutting height should be raised during the summer months, removing no more than one-third of the leaf surface at one mowing and keeping the soil and thatch at a pH of 6.5 to 7 by applying small amounts of lime or sulfur at frequent intervals. These cultural practices should be combined with the planting of a blend of resistant Kentucky bluegrass cultivars together with about 15 to 20 percent by weight of one or more of the newer perennial ryegrasses. A number of systemic fungicides are also available including Banner and Rubigan or a mixture of Bayleton or Chipco 26019 *plus* Tersan 1991, Fungo 50, or Cleary's 3336.

A "new" disease of *Poa annua*, called poa patch, is currently being investigated at the University of Illinois. It is caused by a fungus-like take-all but different from those that cause take-all and summer patch. Infected annual bluegrass plants turn yellow and die from a black rotting of the crowns and roots and a reduction in the root mass. Dark runner hyphae also grow over the roots. The disease can result in yellow frogeye patterns. The patches are later invaded by creeping bentgrass and perennial ryegrasses that are *not* susceptible or Kentucky bluegrass, which is only mildly susceptible. Poa patch is active when temperatures average 82° to 89°F for 10

to 14 days or longer. Water stress does not appear to be a factor in the development of poa patch. Control measures for this disease have not been worked out. The cultural and chemical controls outlined for summer patch, necrotic ring spot, and take-all patch may be effective.

Dollar spot came in late on Kentucky bluegrass in 1986 and was serious in dry soils following two consecutive wet days with an average temperature of 72°F or more and three or more consecutive wet days with an average temperature of 60°F or more. Dollar spot in Kentucky bluegrass turf is a disease we should pay more attention to.

Two other diseases appeared in Illinois sod fields: yellow ring, which we reported on last year, and a new disease of Kentucky bluegrass caused by the fungus *Pithomyces chartarum*. The sooty-black *Pithomyces* fungus only grows on dead or dying (senescent) bluegrass clippings. The fungus produces masses of dark spores on mowing and other turf equipment. The *Pithomyces* fungus does not appear to damage the quality of the sod, and no control measures are suggested. The fungus produces a mycotoxin, sporidesmin, which makes the *Pithomyces* a potential hazard to sheep, cattle, and possibly to humans. Bluegrass is grown in the Midwest for animal feed. Fortunately, no reports of animal disease from this mycotoxin have been made. This is the first report of *Pithomyces chartarum* in bluegrass sod in the North Central states: it was found in 1986 in Illinois, Indiana, and Wisconsin.

Yellow ring is a disease of Kentucky bluegrass caused by the soilborne fungus *Trechispora alnicola*. The disease is evident from May into early autumn as lemon to golden-yellow rings, about 4 inches wide and up to 4 feet or more in diameter. Yellow ring only appears in turf where the thatch is over 3/4-inch thick and on sod that has sufficient water and nutrients to remain green and lush during the entire growing season. A dense, white mycelial growth or spawn is evident in the thatch beneath the yellowed leaves. The white mycelial growth may be up to an inch or more thick. Diseased turf does not die and the yellow rings enlarge, just like fairy rings, from one year to the next. The best control for yellow ring is to dethatch the affected turf in spring and/or fall when it accumulates to one-half inch. Dethatching is much preferred to applications of PCNB, although they have also proven effective.

This past growing season was "the year of nematodes," especially in golf greens with a high sand content. More than 20 species of plant-parasitic nematodes feed on the roots of turfgrasses. The most common this past year in Illinois were species of pin, lance, and stunt nematodes. The damage these unsegmented roundworms do depends on the species present and their numbers. Some types are called "browsers," since they feed from the outside of roots; others enter, develop, and breed within turfgrass roots.

Nematode-infested turf lacks vigor and declines in growth. The grass appears yellowed to silver-gray, stunted, and bunchy. Such turf does not respond to applications of water, fertilizer, fungicides, increased aeration or coring, and thatch removal. In hot, dry, weather heavily infested turf may thin out, wilt, and die in scattered, round to irregular patches. Such turf is more susceptible to winter kill, drought, serious insect injury, and other diseases. The severity of symptoms varies with soil moisture, texture, and fertility plus the population of nematodes, which may number 10,000 or more in a pint of soil and grass roots. Nematode damage is easily confused with fertilizer or pesticide "burn," malnutrition, poor soil aeration and compaction, drought or excessive soil moisture, insect damage, diseases, and other types of injuries. If you suspect nematode damage, take samples from suspected areas and have the turf and soil assayed at a laboratory such as the Plant Clinic in Urbana or apply a granular nematicide such as Nemacur, Mocap, ProTurf Nematicide-Insecticide, or Dasanit. Apply several strips with a drop-type spreader, alternating

treated and untreated areas. The nematicide should be immediately drenched into the soil using 300 to 600 gallons of water per 1,000 square feet to ensure penetration of the nematicide into the root zone and also to prevent chemical injury to the grass. It is best to treat in the spring or fall when the soil temperature is above 55°F. Never apply a nematicide without first having a nematode analysis.

Bacterial wilt of Toronto or C-15 creeping bentgrass has continued to spread in Illinois for the past ten years or so. Besides Toronto, the disease has been reported as infecting Seaside and Nimisilia creeping bents and annual bluegrass. This past summer Randy Kane found it attacking Washington creeping bent in the Chicago area. Strains of the same bacterium, *Xanthomonas campestris* pathovar *graminis*, in Europe and New Zealand are reported to infect certain cultivars of perennial and annual ryegrasses, bluegrasses, tall and meadow fescues, as well as orchardgrass and timothy. Evidence is mounting in the United States that the bacterial wilt organism is adapting itself to other grasses, such as bluegrasses.

The leaves on individual plants rapidly wilt, appear blue-green, twisted, shrivel, and turn reddish-brown within 48 hours, resulting in irregular patterns of withered and dead grass. Diseased turf areas often show an uneven mottled effect with patches of green, healthy resistant grass cultivars or species.

To diagnose bacterial wilt in the laboratory, we cut off recently infected leaves or stems and place them in a drop of water under a microscope. The bacteria emerge as a whitish cloud in tremendous numbers from the water-conducting or xylem vessels. Under a scanning electron microscope you can see the bacterial cells filling the xylem vessels. The antibiotic oxytetracycline, sold as Mycoshield, can be applied to suppress disease symptoms during the growing season if bacterial wilt occurs early. This treatment is both time-consuming and expensive. Several applications are needed at 3- or 4-week intervals, and the antibiotic must be drenched into the turf using at least 50 gallons of water per 1,000 square feet. A much better solution in the long run is to search for disease resistance. Most golf course superintendents who have this problem have reseeded or resodded with a resistant creeping bentgrass such as Penncross or Penneagle. But how long will these grasses remain resistant? How long will it be before the bacterial wilt organism adapts itself to Kentucky bluegrass, red fescues, and perennial ryegrass in the Midwest? Grass breeders in the United States should be seriously addressing this problem now as their European counterparts have been doing for the past half dozen years.

Every year finds new disease-control chemicals on the market. This year it was Chipco Aliette, a Rhone-Poulenc product, which is specific for the control of Pythium blight. Resistance to *Pythium* has appeared in the East with Subdue, as expected, where turfgrass managers have used this product exclusively to control Pythium blight. To avoid resistance with Subdue, alternate suggested Pythium fungicides including Banol, Koban, chloroneb (sold as Teremec-SP and Terraneb-SP), and Terrazole. Perhaps a better solution to avoid resistance problems is to use half-rate mixes of Subdue-Banol, Banol-Aliette, or other mixes of suggested fungicides specific for the control of *Pythium*.

A trend in turf fungicides is to combine a systemic fungicide with a protective-contact material. For example, Scott's new ProTurf Fluid Fungicide is a mixture of iprodione (sold as Chipco 26019) and thiophanate-methyl (sold for turf use as Fungo 50). Mallinckrodt has been selling Duosan for several years. This product contains thiophanate-methyl and manocozeb (a mix of Fungo 50 and Fore). Such proprietary mixes, or those you might tank mix if they are physically and chemically compatible, may be the answer to several problems including (1) resistance to dollar spot, Pythium blight, pink snow mold, powdery mildew, brown patch, red thread, summer patch

and necrotic ring spot, or other diseases, and (2) controlling a broader spectrum of diseases with one spray. A number of possible, useful combinations include Banner (a new Ciba-Geigy fungicide), Rubigan, Bayleton, Vorlan, PCNB (sold mostly as Terraclor), and other fungicides mentioned earlier in the discussion. More proprietary fungicide mixes should be available in the future.

DIAGNOSTIC LABORATORY ANALYSIS

B.J. Joyner

At times we may be faced with plant problems that we cannot identify. We then seek help in solving those plant problems. Soil and plant laboratories may be utilized to get help in solving plant problems.

These laboratories can be either soil and plant analytical laboratories or plant diagnostic laboratories. The analytical laboratories primarily check soil or plant tissue for nutrients, pH, soluble salts, and pesticide residues. These laboratories are important and can help solve problems, but the discussion here will be limited to the latter group, the plant diagnostic laboratories.

What is a diagnostic laboratory? Who should use such a service and why? How does one get the most out of a diagnostic service? Is there a limitation on what these services can provide? These are a few of the questions one may ask about a diagnostic service and will be discussed here.

DIAGNOSTIC LABORATORIES

A diagnostic laboratory is a service that analyzes samples and/or information to help solve plant problems. These services go by such names as Plant Diagnostic Laboratory, Plant Disease Clinic, Plant Disease and Insect Clinic, Plant Clinic, etc. Almost every state has some form of diagnostic service through the state Cooperative Extension Service. A few diagnostic laboratories are operated by private industry, either for their customers or on a fee basis.

Generally the personnel performing the diagnoses in the laboratories include plant pathologists, entomologists, horticulturists, and agronomists. These individuals usually have several years experience working with plants and solving problems.

HOW TO USE A DIAGNOSTIC LABORATORY

Sending a sample and/or information to a diagnostic laboratory can be done to help indentify a plant, insect, or a problem that is unknown to you and to help gain more information about a problem that you know about or need to assure your customer that you know about.

Whatever the reason, there are certain things you must do to ensure a good diagnosis. Just sending in a sample does not guarantee a satisfactory answer. To increase the value of the answer, the laboratory must be provided with a good, representative sample and information concerning the problem. To do this, one actually goes through the process of diagnosis, which is simply investigating and gathering information.

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1) The first step in diagnosis is to keep an open mind and realize that you do not know everything. This approach ensures that you gather all the facts and do not overlook things that are necessary to diagnose the problem. The diagnostic laboratory needs the information that you will gather in your investigation.

2) The next step is to gather as much information as possible about the problem. Information about the following areas should be gathered:

Location or site: Evaluate the site or location where the problem is occurring compared with where plants are healthy. Consider shade, sun, or wind exposure, buildings or nearby paved surfaces, soil condition (type, low or wet areas, etc), and other things that you may consider important.

Plants Involved: Evaluate plants having the problem compared with those that seem to be fine. Compare these plants with other nearby landscapes. Are affected plants of the same species or different species than nonaffected plants?

Cultural practices: Evaluate cultural practices to see if they may be involved in the problem. On turf, check mowing, watering, fertility, etc. With ornamentals, check pruning, transplanting, watering, fertility, etc. Record any information about recent cultural practices, such as, was the lawn mowed just before the problem occurred?

Symptoms: Now begin to concentrate on the affected plant(s). Here you are looking for symptoms or signs that may help identify the problem. Start with the leaves, noting overall color and size, leaf spots for color and size, or brown areas. Next, check stems of ornamentals for cankers, mechanical damage, galls, or insects. Also check trunk and root areas on ornamentals. With turf, check crowns and roots, noting color or if, in fact, these areas remain alive. When recording information about symptoms, indicate when symptoms or any other changes began to occur.

Other information: Other information that is helpful includes plant age, condition of plant(s), any recent disturbance in the landscape, and weather conditions.

3) *Samples:* The next step is to take samples to send to the diagnostic laboratory. It is advisable to first check with the laboratory where the samples are going. Determine if they can actually help and then what they require for samples and information. Many laboratories will have sample forms to be sent with samples. These forms are helpful in gathering the required information.

The two most important elements in sending samples to a diagnostic service are the samples themselves and the way in which they are sent. First, the sample must be one representing the problem or problem area. Take the sample where the problem is occurring. Many times it is best to send a sample from an adjacent, unaffected area as well as from the problem area. Next, the sample should be large enough to work with. A good size for turf is approximately a 3-inch x 6-inch strip of sod, including roots and soil. Take the sample on the border of the problem area. Several branches with leaves should be taken from trees and shrubs. Again, try to include a sample from a healthy or unaffected plant.

Soil samples should be taken to root depth. In turf, this is generally to the 3-inch level. The majority of roots are in the top 3 inches. Depending upon the type of problem, soil samples should be taken from various areas, perhaps 10 to 20 cores, and then mixed together. However, do not mix the good and the bad.

How one sends the sample is also very important. Improperly packaged samples are often impossible to diagnose. Most samples should be placed in a plastic bag, packed tightly into a box, and sent immediately to the laboratory. The fresher the sample upon arrival at the laboratory, the better the answer. Do not add water to samples. If the sample is wet when taken, allow the sample to dry. No water should be on the foliage before placing it into the plastic bag.

WHAT CAN A DIAGNOSTIC LABORATORY DO?

The laboratory can analyze the plant sample for problems caused by disease, insects, cultural practices, environmental conditions, and pesticides. Plants and/or insects can also be identified. In some cases, both the plant and soil are required to solve problems related to pesticide injury, nematodes, and plant nutrition.

If the laboratory identifies the problem, then in most cases, they can give you recommended controls. However, if the problem is not identified, they may be able to give you information that can help you identify the problem.

LIMITATIONS

It is important to remember that the quality of answers is dependent upon a representative sample, a fresh sample, and sufficient information pertaining to the problem. There is nothing magical about a diagnostic service. A diagnostic service generally reports what they find or do not find on a sample. In some cases, they may also speculate on the problem or indicate what other information is needed.

In selecting a diagnostic service, make sure they can help you. Often, this depends on the training and/or experience of the diagnostic service. What you are seeking is a practical, useable solution to your customer's problem. The service needs to be somewhat familiar with your type of operation.

Again, there are many services available, some free of charge. Learn what they can and cannot do for you as a tool to use in serving your customers.

PROTECTIVE CLOTHING

Majorie A. Sohn

A primary function of clothing is to provide protection for the human body. In general, the effectiveness of clothing as protection is determined by how resistant the fibers, fabric, and garment design are to permeation and penetration by a given substance.

Research studies have indicated that dermal exposure to pesticides is a serious health hazard. Dermal exposure may result from direct contact of the pesticide with the skin or from absorption of the chemical by clothing which transfers it to the skin. In either case, the pesticide could cause dermititis or be absorbed through the skin into the body system. Factors that determine the severity of risk of dermal exposure include the dermal toxicity of the pesticide material, the rate of dermal absorption, the size of the skin area contaminated, and the length of time the material is in contact with the skin. The use of clothing as a protective barrier is considered vital for minimizing dermal exposure for those who work with pesticides.

Chemical-resistant apparel is available for use by pesticide applicators. These garments are generally classified as reuseable or disposable garments. One of the disposable types--Tyvek--is constructed from spunbonded olefin. This nonwoven fabric provides an effective barrier to many types of chemicals. Although nonwoven fabric garments are usually considered to be disposable after one use, Tyvek garments have been found to withstand up to four launderings before disposal is necessary. However, if the garment is contaminated with a concentrated chemical, it is safer and more economical to dispose of it rather than to clean the garment.

Another fabric, Gore-Tex, has been undergoing tests in experimental garment designs to determine its ability to provide dermal protection from pesticides. Gore-Tex is a microporous membrane (film) that is laminated between a shell fabric and a suitable fabric lining. This type of fabric has several characteristics that would provide the advantage of comfort to pesticide-protective clothing. It not only allows moisture to escape from the skin, it also prevents the penetration of liquid, water, and wind due to the size and arrangement of the membrane pores.

Although special protective clothing is available, recent surveys indicate that the majority of pesticide users wear traditional work clothing when mixing, handling, and applying pesticides. Reasons stated for wearing ordinary work clothing rather than special protective clothing include thermal properties, comfort, cost, availability, and doubt of need for protective benefits. Data documenting the dermal protection provided by work clothing fabrics has been limited. In addition, information on the best methods for cleaning pesticide contaminants from reuseable garments is needed.

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Textile scientists have been addressing these problems and concerns in research projects throughout the United States as well as internationally. A North Central Region (NCR) research project has focused on the effectiveness of work clothing fabrics as protective barriers against dermal exposure to pesticide chemicals and effective cleaning methods for decontaminating these fabrics. Dr. Mastura Raheel, Textile Scientist at the University of Illinois, has been a participating researcher in the NCR project.

The researchers have investigated the effect of fiber content, fabric construction, and use of functional finishes on the absorbency and transfer of pesticides from the surface of traditional work clothing fabrics (garments) to underlayers or skin. Pesticides used in the research studies represented the pesticide classes most used by applicators in the researchers' states.

Two fiber/fabric characteristics important to chemical resistance are absorbency and wicking. Common fiber content fabrics tested for chemical resistance included cotton and polyester/cotton blend fabrics, as well as 100 percent polyester, nylon, acrylic, and spunbonded olefin. The 100 percent cotton fabric exhibited the highest rate of absorbency, indicating retention of a large amount of pesticide solution and transport to underclothing or skin. Cotton/polyester blends exhibited moderate absorbency and wicking levels. The synthetic fibers--acrylic, nylon, and polyester--had low absorbency. However, these fabrics exhibited the highest wicking levels. This indicates rapid transport of pesticide solution from garment to the skin surface. The spunbonded olefin fabric exhibited the lowest absorbency and wicking level of the fiber contents tested.

When fabrics with functional finishes were tested, the cotton/polyester blend fabric with consumer-applied fluorocarbon soil-repellent (SR) finish inhibited pesticide absorption, permeation, and spreading much more effectively than the durable press finished fabric. The results indicate the same magnitude of protection provided by spunbonded olefin fabric.

The experiments related to the effect of fabric geometry on resisting pesticide penetration included three common fabric constructions used for clothing: broadcloth, poplin, and twill. Although the results indicate that the lightweight fabric, broadcloth, had the lowest absorbency, it also exhibited a very rapid rate of wicking. The tight weave of broadcloth appears to transport pesticide solution more rapidly and to a greater extent to the underlayer or skin due to the wicking action.

The results of these research studies provide a basis for the following recommendations for choice of clothing to wear when mixing, handling, and applying pesticides.

1. Spunbonded olefin fabric, Tyvek, used for disposable protective clothing, is an excellent barrier against pesticide penetration and provides extra protection when worn over work clothes.

2. Knit undershirts provide more protection than a single layer of clothing.

3. Consumer-applied fluorocarbon soil-repellent (SR) finished clothing provides as good protection as spunbonded olefin with the added quality of comfort.

4. The durability of consumer-applied SR finish in laudering is limited. It should be reapplied after three to four launderings.

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WEED CONTROL RESEARCH AT THE UNIVERSITY OF ILLINOIS

Jean E. Haley

A weed is an undesirable plant because it disrupts the aesthetic appearance, stabilizing capacity, or overall utility of a turfgrass stand. Weeds also compete with turf for water, sunlight, and nutrients. The best way to control weeds is to follow cultural practices that encourage turfgrass growth. However, if this approach is not enough, then the only alternative is to kill the weeds with herbicides.

The high cost of pesticide development has prohibited the introduction of new herbicides used exclusively for the control of weeds in turfgrass stands. Therefore, manufacturers are evaluating new formulations of standard turfgrass herbicides and seeking data to expand the labels of products used on field crops.

The type of weed that is present determines the best approach needed for controlling it. The ideal time to control both grass weeds and broadleaf weeds is prior to their emergence from the soil. Frequently, this method of control is unsuccessful because the weed problem isn't recognized until the weeds are large enough to be visible. Sometimes, too many preemergence herbicide applications are needed to successfully control the weeds throughout the entire growing season. If this is the case, a postemergent herbicide will be the best means for controlling the weed problem.

CRABGRASS CONTROL

Crabgrass (*Digitaria sp.*) is most easily controlled with preemergence herbicides. In the first preemergence crabgrass control experiment, several preemergence herbicides currently used by the turfgrass industry were compared with some new herbicide formulations (Table 1.) The formulation of pendimethalin tested was LESCO's Pre M 60% DG. Included in the evaluation was an Elanco product called Team. This is a combination of Balan (benefin) and Treflan (trifluralin) formulated for turf as a 2 percent granular material and as a 28 percent dry flowable. Another Elanco product tested, EL 161 (ethalfluralin), is a turf formulation of Sonalan, a preplant soil incorporated annual grass and broadleaf weed control used with many field crops. A 60 percent dry, flowable formulation of Balan was also evaluated. New products or formulations tested that are manufactured by Rhone Poulenc included Ronstar 50WP (oxadiazon) and Regal Star, a combination of Balan (benefit) and Ronstar. New herbicides manufactured by Ciba-Geigy that were included in the test were Pennant 5G (metolachlor) and Prime + 1.2E, a material used for sucker control in tobacco.

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Dacthal 75WP, Balan 2.5G, Betasan 4E and Ronstar 2G were applied at standard label rates. Application rates for pendimethalin were 1.5 and 3.0 lb ai/A. Team 2G and Team 60DF were applied at a total of 2 lb ai/A (1 lb ai/A Balan and 1 lb ai/A Treflan) and 3 lb ai/A (1.5 ai/A Balan and 1.5 lb ai/A Treflan). Balan 60DF was applied at 2 or 3 lb ai.A. El-161 50DF was applied at 1, 1.5, and 2 lb ai/A. Ronstar 50WP was applied at 1, 1.5, and 2 lb ai/A. Regal Star was applied at 3.5 and 4.5 lb commercial product/1,000 sq ft. Pennant 5G was applied at 2 and 4 lb ai/A. Prime + 1.2E was applied at 1.2 lb ai/A. Each treatment was replicated 3 times and an untreated check plot was included with each replication. Herbicide applications were made on April 11 to a common Kentucky bluegrass turf. The spray volume was 40 gallons per acre. Granular materials were applied by hand. Data was recorded as the percent of plot covered by crabgrass. In 1986, crabgrass populations were extremely high. This should be kept in mind when interpreting all crabgrass control data.

All treatments at the rates presented in Table 2 gave good control of the crabgrass plant when compared with the untreated check. Team 2G, Pre M 60WDG, Regal Star, and Dacthal provided better crabgrass control than Team 28DF, EL-161 50DF, and Pennant 5G. There was some indication that dry flowable formulations provided less crabgrass control than granular or wettable powder formulations. This was observed when comparing Balan 2.5G with Balan 60DF (Table 3). The standard rate of Balan 2.5G at 2 lb ai/A with a second applications of 2 lb ai/A six weeks later provided superior crabgrass control when compared with Balan 60DF at 3 lb ai/A at 82 and 102 days after treatment. This same trend was also observed with Team 2G and Team 28DF. On both rating dates the plots treated with the dry flowable formulation had a greater percent of the plot covered with crabgrass than those treated with granular Team (Table 3). The wettable powder formulation of Ronstar at 1.5 and 2 lb ai/A performed as well as the 3 lb ai/A rate of Ronstar 2G (Table 3).

A second preemergence crabgrass control experiment was conducted to evaluate prodiamine, a product used for weed control in cotton. In this experiment, bensulide (Betamec 4E) at 2 lb ai/A and DCPA (Dacthal 75WP) at 10.5 lb ai/A were used as industry standards. Pendimethalin (LESCO's Pre-M) was also included in the test at 3 lb ai/A. Prodiamine was applied at 0.5, 0.75, and 1 lb ai/A. Herbicides were applied on April 18 at a spray volume of 40 gallons per acre. Granular materials were applied by hand. Good crabgrass control was achieved with all materials and excellent control was achieved with pendimethalin and prodiamine at 0.75 and 1 lb ai/A (Table 4).

Because prodiamine appears to be so effective as a preemergence crabgrass control, it is necessary to evaluate its long-term effects on the turf. A study was begun in the fall of 1984 to evaluate the long-term effects of prodiamine on a common Kentucky bluegrass turf. Prodiamine and Dacthal were applied to one set of plots in the fall (November 6, 1984, October 3, 1985 and October 24, 1986) and to another set of plots in the spring (April 20, 1985 and April 18, 1986). This evaluation consists of treatments of Prodiamine at 0.25, 0.50, 0.75, and 2.0 lb ai/A and Dacthal at 5.25, 10.5, and 21.0 lb ai/A. An untreated control is included in each fall and spring application for all replications. Materials were applied in a spray volume of 40 gallons per acre to 3 by 10 foot plots of common Kentucky bluegrass.

In 1986, crabgrass control was excellent with all spring applications of herbicides except Dacthal at 5.25 lb ai/A (Table 5). When plots were treated only in the fall, excellent crabgrass control was observed with all rates of prodiamine the following growing season (Table 5). Moderate turfgrass injury was found on plots treated with prodiamine in the fall when applied at 2.0 lb ai/A (Table 6). Some turf damage was observed on spring treated plots although not as severe. This would suggest that there is some carry over with this herbicide that needs further evaluation.

If crabgrass isn't controlled prior to emergence from the soil, there are materials available to control it once germination has occurred. The most frequently used of postemergence control herbicides are the organic arsenicals with MSMA (Daconate 6) being the most common of these. In the 1986 postemergence crabgrass control evaluation, Acclaim (fenoxaprop), a herbicide newly labeled for turf, and Curfew (tridiphane) were compared with MSMA. Two formulations of Acclaim were evaluated, Acclaim EC (emulsifiable concentrate) and Acclaim EW (Table 7). The EW formulation is a water-based formulation that is thought to be more effective than the EC formulation when used at high spray volumes. Both formulations of Acclaim were applied at 0.18 and 0.35 lb ai/A, and Curfew was applied at 1, 2, and 1 + 1 lb ai/A. The second application of Curfew was made 3 weeks following the first application (July 18). MSMA (Daconate 6) was applied at 2 lb ai/A with a second application of 2 lb ai/A made 2 weeks following the first (on July 3). All rates of Acclaim and Curfew were applied at spray volumes of 40 and 172 gallons per acre. The 172 gpa spray volume simulated the application methods used by the lawn care industry. All materials applied at the 172 gpa spray volume provided good control of crabgrass when compared with the untreated check (Table 8). There was no significance difference in crabgrass control between spray volumes with Acclaim or Curfew, or between formulations of Acclaim.

A second postemergence crabgrass control trial was established to examine the effects of Acclaim on a creeping bentgrass green mowed at 0.25 inch in height. Turf was treated with Acclaim alone and in tank mixes with safeners. The safeners consisted of 1/2 lb Fe/A in the form of Sequestrene and 1/2 lb N/1,000 sq ft in the form of FLUF. The safeners were added to see if they could mask or prevent any phytotoxicity that might occur to the bentgrass plant. Acclaim was applied alone at 0.06 and 0.12 plus 0.06 lb ai/A. Acclaim was applied alone and also with safeners at 0.12, 0.06 plus 0.06 and 0.04 plus 0.04 lb ai/A. All treatments were made on July 7. Where repeat treatments were applied, applications were made 2 weeks apart on July 22 and/or August 4. A spray volume of 40 gallons per acre was used. Plots were rated for percent cover with crabgrass and phytotoxicity to the creeping bentgrass. The phytotoxicity ratings were made following each herbicide application using a scale of 1 through 9 where 9 = no visible damage to the turf and 1 = complete necrosis. When evaluating crabgrass control where Acclaim was applied without safeners, the best control was found with the 0.12 lb ai/A and the 0.12 plus 0.06 lb ai/A rates. Phytotoxicity evaluations made after the first spray showed the highest rate of injury with the 0.12 lb ai/a rate (Table 9). In this study it did appear that safeners were useful in masking or preventing phytotoxicity with the 0.04 lb ai/A rate applied 3 times 2 weeks apart (Table 10). Phytotoxicity ratings taken 9 days after the last spray 0.04 lb ai/A showed more injury to the bentgrass turf where no safeners were used.

BROADLEAF WEED CONTROL IN TURF

Broadleaf weeds are frequently controlled only after they become visible. Generally a combination of 2,4-D, MCPP (proprionic acid) and dicamba will effectively control a wide spectrum of broadleaf weeds found on any home lawns. There are many products on the market with this combination of herbicides. In the first broadleaf weed evaluation, a formulation 2,4-D, MCPP and dicamba was compared with several other new formulations of herbicides for broadleaf weed control (Table 11). Herbicides were applied June 13 at 40 gallons per acre. Weeds present on the unirrigated site at this time were buckhorn plantain, broadleaf plantain, and white clover. Evaluations were made on a scale of 1 through 9, where 9 = weeds present and actively growing and 1 = no weeds present. Evaluations made 13 days after herbicide application show the plantain controlled with all herbicide treatments. However the amine

formulation of 2,4-D and triclopyr appeared less effective than the other treatments presented. White clover was controlled by all the herbicides with the exception of 2,4-D applied alone.

A second broadleaf weed control trial was established to examine the effect timing of the herbicide application has on weed control. Materials were applied to different plots 3 times throughout the summer on June 3, July 8, and August 18. The spray volume was 40 gallons per acre. Following the first treatment all materials but fluroxypyr provided good control of plantains (Table 12). In general, ratings made following the other application dates showed good control of plantain and no difference in control among the herbicides. Following the June and July applications, the best control of white clover was seen with fluroxypyr (Table 13). White clover control was good with the other herbicides. Following the August application there was no difference in white clover control among the herbicides. In general, both plantain and white clover are best controlled with June applications of herbicides.

If you are interested in any of these new products or formulations, contact your herbicide dealer. When using any herbicide, be sure to follow the label instructions that suit your particular situation. The best weed control program will be useless unless you follow maintenance practices that promote a strong, healthy turf stand.

Table 1. Some Herbicides for Preemergence Control of Crabgrass in a Kentucky Bluegrass Turf

Common name	Trade name
DCPA	Dacthal 75WP
bensulide	Betasan 4E
benefin	Balan 2.5G, Balan 60DF
benefin plus trifluralin	Team 2G, Team 28DF
oxadiazon	Ronstar 2G, Ronstar 50WP
benefin plus oxadiazon	Regal Star
pendimethalin	Pre M 60WDG
ethalfluralin	EL-161 50DF
metolachlor	Pennant 5G
??	Prime + 1.2E

Table 2. The Evaluation of Herbicides for Preemergence Control of Crabgrass in a Kentucky Bluegrass Turf Applied April 11, 1986[1]

Material	Rate lb ai/A	% Crabgrass[2] 7/02
Dacthal 75WP	10.5	8.3e-h
Team 2G	3.0	2.7f-h
Team 28DF	3.0	18.3c-e
Regal Star	4.5 lb cf/1,000 sq ft	1.7f-h
Pre M 60WDG	3.0	8.3e-h
EL 161 50DF	2.0	18.3c-e
Pennant 5G	4.0	13.3d-f
check	...	90.0a

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference Test.
[2]Percent crabgrass represents the percent cover of the plot with crabgrass plants.

Table 3. Preemergence Control of Crabgrass with Balan[1]

Material	Rate lb ai/a	% Crabgrass[2] 82 DAT*	102 DAT
Balan 2.5G	2.0	18.3c-e	40.0c-f
Balan 2.5G	2. + 2	0h	8.3k
Balan 60DF	2.0	30.0c	68.3c
Balan 60DF	3.0	18.3c-e	50.0d
check	...	90.0a	100.0a
Team 2G	2.0	6.7e-h	28.3f-h
Team 2G	3.0	2.7f-h	21.7h-j
Team 28DF	2.0	30.0c	70.0bc
Team 28DF	3.0	18.3c-e	63.3c
check	...	90.0a	100.0a
Ronstar 2G	3.0	0.3h	5.0k
Ronstar 50WP	1.0	10.0e-h	23.3g-i
Ronstar 50WP	1.5	1.0gh	13.3i-k
Ronstar 50WP	2.0	0h	9.3jk
check	...	90.0a	100.0a

*DAT refers to days after treatment.
[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference Test.
[2]Percent crabgrass represents the percent cover of the plot with crabgrass plants.

Table 4. The Evaluation of Prodiamine and Other Preemergence Herbicides for Control of Crabgrass in a Kentucky Bluegrass Turf[1]

Herbicide	Rate lb ai/A	% Crabgrass[2] 7/02	7/21
benefin	2.0 + 3.0	2.7b	18.3bc
DCPA	10.5	6.0b	26.7b
pendimethalin	3.0	0.0b	5.0d
prodiamine	0.50	1.7b	10.3cd
prodiamine	0.75	0.0b	5.0d
prodiamine	1.0	0.0b	3.7d
check	...	68.3a	86.7a

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference Test.
[2]Percent crabgrass represents the percent cover of the plot with crabgrass plants.

Table 5. The Evaluation of Prodiamine Applied in the Spring and Fall[1]

Material	Rate lb ai/A	% Crabgrass[2] 7/24
----------Spring applied----------		
Dacthal	5.25	11ef
Dacthal	10.25	4f
Dacthal	21.0	5f
Prodiamine	0.25	8ef
Prodiamine	0.5	4f
Prodiamine	0.75	1f
Prodiamine	2.0	0f
Check	...	
----------Fall applied----------		
Dacthal	5.25	60c
Dacthal	10.25	67bc
Dacthal	21.0	60c
Prodiamine	0.25	32d
Prodiamine	0.5	17df
Prodiamine	0.75	8ef
Prodiamine	2.0	0f
Check	...	

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference Test.
[2]Percent crabgrass represents the percent of the plot covered with crabgrass plants.

Table 6. Phytotoxicity of prodiamine applied to Kentucky bluegrass in the spring and fall[1]

Material	Rate lb ai/A	Fall applied	Spring applied
prodiamine	0.50	9.0a	8.7ab
prodiamine	0.75	8.3b	8.3b
prodiamine	2.0	5.7d	7.3c

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference Test. Phytotoxicity evaluations are made on a 1 to 9 scale where 9 = visible phytotoxic effects and 1 = complete necrosis.

Table 7. Some Herbicides for Postemergence Control of Crabgrass in Turfgrass

Common Name	trade name
MSMA and other organic arsenicals	Daconate 6 and others
fenoxaprop	Acclaim EW and Acclaim EC
tridiphane	Curfew

Table 8. Postemergence Control of Crabgrass Using a Spray Volume of 172 Gallons per Acre[1]

Material	Rate lb ai/A	% Crabgrass[2] 7/10
Daconate 6	2 + 2 (40 gpa)	0i
Acclaim EW	0.18	0.7hi
Acclaim EC	0.18	2.7e-i
Acclaim EW	0.35	0i
Acclaim EC	0.35	0.7hi
Curfew	1.0	6.7c-e
Curfew	2.0	5.0d-g
Curfew	1 + 1	4.3d-h
check	...	26.7a

[1]All values represent the mean of 3 replications. Means in the ...ne column with the same letter are not significantly different ... the 0.05 level as determined by Fisher's Least Significant ...ference Test.

...rcent crabgrass represents the percent cover of the plot with ...bgrass plants.

Table 9. Postemergence Control with Acclaim Applied to a Creeping Bentgrass Turf Mowed at 0.25 Inch in Height[1]

Material	Rate lb ai/A	% Crabgrass[2] 8/20	Phytotoxicity[3] 7/17
Acclaim	0.06	28.3a	8.7ab
Acclaim	0.12	9.3b	7.0d
Acclaim	.06 + .06	3.7b	8.3a-c
Acclaim	.12 + .06	1.7b	7.7cd
Acclaim	.04 + .04 + .04	1.0b	8.0bc
check	...	25.0a	9.0a

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference Test.
[2]Percent crabgrass represents the percent cover of the plot with crabgrass plants.
[3]Phytotoxicity evaluations are made on a 1 to 9 scale where 9 = no visible phytotoxic effects and 1 = complete necrosis.

Table 10. Phytotoxicity of Acclaim when Applied to a Creeping Bentgrass Turf Mowed at 0.25 Inch in Height[1]

Material	Rate lb ai/A	%Crabgrass 8/20	Phytotoxicity[3] 8/13
Acclaim	.04 + .04 + .04	1.0b	6.7b
Acclaim plus safeners	.04 + .04 + .04	5.3b	9.0a
check	...	25.0a	9.0a

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference Test.
[2]Percent crabgrass represents the percent cover of the plot with crabgrass plants.
[3]Phytotoxicity evaluations are made on a 1 to 9 scale where 9 = no visible phytotoxic effects and 1 = complete necrosis.

Table 11. Postemergence Control of Broadleaf Weeds 13 Days after Application of Herbicides[1]

Material	Rate pt product/A	White clover[4]	Plantain[4]
2,4-D	3.0	4.0b	1.0d
2,4-D + MCPP + dicamba	3.0	1.0c	1.3cd
2,4-D + 2,4-DP (ester)	4.3	1.0c	1.0d
2,4-D + triclopyr (ester)	3.0	1.0c	1.7b-d
2,4-D + triclopyr (amine)	3.0	1.0c	3.3bc
fluroxypyr	2.4	1.0c	1.3cd

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference Test.
[2]Percent crabgrass represents the percent cover of the plot with crabgrass plants.
[3]Phytotoxicity evaluations are made on a 1 to 9 scale where 9 = no visible phytotoxic effects and 1 = complete necrosis.
[4]Weed evaluations are made on a scale of 1 to 9, where 9 = no control of the weed species and 1 = no weeds present.

Table 12. Postemergence Control of White Clover Applied Early, Mid-, and Late Summer[1]

Material	Rate pt product/A	White clover control[2] of materials applied on June 3 35 DAT*	July 8 20 DAT	Aug 18 19 DAT
2,4-D + triclopyr (amine)	3.0	3.7c	4.3b	2.7bc
2,4-D + triclopyr (ester)	3.0	3.0cd	3.7bc	2.3c
2,4-D + MCPP + dicamba	3.0	2.0c-e	4.3b	3.0bc
fluroxypyr	0.51b ai/A	1.0e	1.7c	2.7bc

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference Test.
*DAT refers to days after treatment.

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2,4-D + MCPP + dicamba	3.0	1.0c	3.7b	3.0b
fluroxypyr	0.51b ai/A	5.3b	4.0b	3.7b

[1]All values represent the mean of 3 replications. Means in the same column with the same letter are not significantly different at the 0.05 level as determined by Fisher's Least Significant Difference Test.
[2]Weed control evaluations are made on a scale of 1 to 9, where 9 = no control of the weed species and 1 = no weeds present.
*DAT refers to days after treatment.

PLANT GROWTH REGULATOR APPLICATIONS IN LANDSCAPE MANAGEMENT

Thomas W. Fermanian

Much discussion in recent years has centered on the use of plant growth regulators (PGR) in turf. I want to clarify the misconception about the name "PGR." The primary interest in growth regulators is to retard growth in a general sense. Therefore, these materials should most likely be referred to as "retardants" and not "regulators." The regulator functions of PGRs are still under investigation and hold promise for the future, but presently, the most important use is for minimizing turf growth.

Initial investigations into the possibility of chemically retarding turfgrass growth began in the early 1950's. A number of compounds were found which showed great promise in limiting the growth of the turf. These applications were generally applied to turf situations, like highway rights of way, where mowing costs represented the greatest portion of the maintenance budget. In addition, hard-to-mow areas or dangerous slopes were also prime candidates for the use of turfgrass growth retardants because of their ease in application and their ability to minimize the required mowing. As efficiency of mowing machines advanced, so did the need for more sophisticated uses of growth retardants. At present, retardants have a wide range of potential uses. They are used not only on low or minimum maintenance turfs, but also on some high maintenance turfs during periods when they would not necessarily be used, such as an athletic field in an off-season. They are also used quite extensively on general grounds. In addition, they can help reduce the trimming requirements when used around the bases of trees, gravestones, or other objects within a turfed area.

Currently "Embark", "Limit", and "Cutless" are potential turfgrass growth retardants that are available (Table 1). Cutless does not have a full label and is available only on an experimental use permit. However, a label is projected for the 1986 season. The oldest material of the group, Embark, has been on the market for over five years. Known as melfluidide, it is available in a 2 lb ai/gal solution and can be used with most turf species. Embark is in the class of growth retardants that affect cell division within the meristematic regions of the plant. Not only does it affect the growth of the plant, but also its development and, if applied early enough, Embark can effectively stop the production of the grass flower. Embark is applied to the foliage, where it is absorbed and translocated to the meristematic areas. Therefore, it is necessary to apply it much like a postemergent herbicide in a carrier volume that will provide good coverage.

Timing is critical with the application of Embark as with most other growth retardants. In general, if seedhead control is desired, Embark must be applied early enough in the season to prevent the development of this portion of the plant. If applied too early, however, it drastically retards the green-up phase of the turf. In an investigation at the University of Illinois to determine the optimum time for the application of Embark, applications were timed by calendar date. Changing

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Table 1. Turfgrass Growth Retardants and Their Properties.

Trade name	Common name	Mode of action	Formulation	Site of uptake in plant	Labeled species	Application rate, lbs of active ingredient per acre	Weeks of effective growth reduction	Seedhead suppression	Comments
Embark	Melfluidide	Growth and development	2S	Foliar	Kentucky and annual bluegrass fescues, perennial ryegrass, timothy, reed canarygrass, quackgrass, kikuyugrass, crested wheatgrass, orchardgrass, smooth bromegrass, centipedegrass, & St. Augustinegrass	0.063 to 0.12 and 0.25 to 0.38	4 to 8	Excellent	Lower rates are for seedhead control of Poa annua without growth reduction for fine turf areas. rates in excess of those recommended can cause discoloration or severe turf. Surfactant should be added to Embark except for Poa annua seedhead control.
Limit	Amidochlor	Growth and development	4F	Roots	Kentucky bluegrass, fescues, and perennial ryegrass	2.5	4 to 8	Very good	Effectiveness of Limit can be reduced if not watered in within a short period of time after application. Application during rain is optimum.
Cutless	Flurprimidol	Growth suppression only	50WP	Roots	Annual bluegrass,* creeping bentgrass	0.5 to 1.0	6 to 10	None	Cutless can provide greater growth suppression of annual bluegrass in mixed turfs providing for the eventual elimination of annual bluegrass. The growth suppression effects of Cutless can be minimized through the application of gibberalic acid.

*Cutless is not currently labeled for use on turf. However, a turf label is expected in the near future.

weather patterns from year to year, however, made this system extremely variable without offering much assitance to correct timing. A system was designed using measurements of heat similar to degree days. Degree days are a measure of the accumulated heat from day to day. We tried to compare the heat units accumulated with the development of a Kentucky bluegrass plant. This study indicated that when the seedhead had fully developed but was not yet visible, it was still possible to apply Embark and retard further seedhead development. Once the seedhead began to show from the surrounding sheath, seedhead control was no longer possible.

Overapplication of Embark can severely injure the turf. Calibration of spray equipment and accurate application are necessary for its use. Additional information about Embark and other turfgrass growth retardants is listed in Table 1.

Another genral purpose turfgrass growth retardant is "Limit." Limit, commonly known as Amidochlor, is relatively new to turf. It has been used commercially only over the past two seasons. Like Embark, the principal site of activity with Limit is the meristematic regions of the turfgrass plant. Here Limit has a direct effect on cell division, therefore affecting both growth and development of a plant. Unlike Embark, however, Limit is absorbed into the plant through the root system and is translocated upward to the crown region of the plant. Its application, therefore, resembles that of a preemergent herbicide with the necessity for it to be watered well into the turf. If Limit is allowed to remain on the leaf blade surfaces for extended periods of time, it can be absorbed into this tissue with very little effect on the turf. The root absorption of Limit has potential benefits. It allows application during rainy weather, when other materials normally cannot be applied and during the early growing season, when the crew often is restricted to indoor activities.

The timing of Limit applications is very similar to that of Embark, with earlier applications showing greater efficiency of turf reduction than applications made later in the season. The earliest applications, however, must be made when the turf has assumed 100 percent green-up or is in a state in which you as the manager are satisfied with its appearance.

Unlike most other turf retardants, Limit has shown some variability in its response to different varieties of Kentucky bluegrass. For seedhead reduction, most varieties of Kentucky bluegrass respond as expected, with very good seedhead control with proper timing. However, there are a few varieties (listed in Table 2) that show poorer response to Limit for reduction of seedhead.

*Table 2. Kentucky Bluegrass Cultivars Exhibiting Poor Seedhead Control with Limit **

Argyle	A-20	Eclipse	Enmundi
Geronimo	Glade	Gnome	Harmony
I-13	Kenblue	K3-162	MLM 18011
Nallo	Nugget	Piedmont	PSU-150

*University of Illinois at Urbana-Champaign, 1983-1985.

Table 3 lists Kentucky bluegrass varieties that were not affected by the application of Limit. While this list of cultivars is short, they might be the major components of your turf. In even rarer cases, those Kentucky bluegrass varieties listed in Table 4 showed a negative reaction, or a loss of quality, to the application of Limit.

*Table 3. Kentucky Bluegrass Cultivars Showing No Significant Growth Reduction after the Application of Limit**

H-7	Nugget	Welcome

*University of Illinois at Urbana-Champaign, 1983-1985.

*Table 4. Kentucky Bluegrass Cultivars Showing Reduced Quality After the Application of Limit**

A20-6	I-13	Bono	Kimono
Piedmont	Touchdown	Wabash	

*University of Illinois at Urbana-Champaign, 1983-1985.

In general, however, Limit is an excellent turfgrass retardant. It has a very high degree of safety and is not sensitive to higher rates as is Embark. Overapplication of Limit generally does not cause a problem. Additional information on Limit can be found in Table 1.

"Cutless," commonly known as flurprimidol, can also be used as a general purpose turfgrass growth retardant. Due to its high manufacturing cost, however, when it does become widely available, it will generally not be cost-effective for general use. Cutless affects the turfgrass plant in a different manner than the two previously discussed retardants. When absorbed into the plant, it minimizes the production of gibberillic acid necessary for cell elongation. It has little effect on the development of new areas of the plant, however, and it has no effect on seedheads. In essence, Cutless produces a miniaturized version of the normal plant. This mode of action also allows for a unique system of switching the retarded growth back on. If gibberillic acid is applied to the retarded turf, it will provide the necessary cell elongation, and growth will resume at its normal pace. To a lesser degree, fertilization will provide the same benefit. In very visible areas, this might allow the manager to decide to resume normal turf growth if the turf becomes stressed for some reason.

One of the principle uses for Cutless will most likely be for the selective suppression for certain species of turf, primarily annual bluegrass, to allow the more competitive growth of other species, like creeping bentgrass. Recent studies at the University of Illinois have shown that Cutless can have considerable activity in the soil, affecting either young seedlings or germinating seeds. Overseeding of desired turfgrasses must be held off until soil concentrations of Cutless are reduced.

A few words must be said about growth retardants in general. Timing of the application of any retardant is critical. Probably the best rule to follow in application timing is to wait until the turf has reached a quality with which you are satisfied. Generally, after the second mowing in the spring, the turf has greened up to the point where an application of retardant will not slow down the greening process. Pest control is also very important where turfgrass retardants are applied. A major avenue of turf pest control is through the natural resistance or competitive nature of the turf itself. When the growth rate is reduced, this natural defense is also reduced. Broadleaf weed control is essential in retarded turfgrass stands where such weeds can be a potential problem. Broadleaf herbicides can be applied at the same time as the growth retardant. In areas of high disease activity, principally leaf spot, a form of preventative disease control should be considered. Although mowing will be reduced on a retarded turf, some mowing is still required to maintain an even appearance. Also expect to see enhanced color and a rapid rate of turf growth when the period of retardation ends.

SEED FOR GOLF COURSES

Richard H. Hurley

During the past 20 years, plant breeders have made tremendous strides in developing improved turfgrass varieties. The development of improved turf-type perennial ryegrasses has made this species more valuable for many types of turf. The best of the new fine-textured, turf-type ryegrasses is such an improvement over common perennial ryegrasses that many people do not recognize them as ryegrasses. Compared to common perennial ryegrass, they have finer leaves, they are more attractive, more persistent, more resistant to many diseases, more shade-tolerant, lower growing, easier to mow, leafier, and have much better turf-forming qualities. They are also quick to germinate, easy to establish, highly wear tolerant, and will grow in a wide range of soil types.

New lower growing Kentucky bluegrass varieties produce an attractive, durable, persistent, dependable turf under a wide range of environmental conditions. This species is becoming even more useful to the turfgrass industry.

Tall fescue is one of the most important grasses in the United States. Its ability to adapt to a wide range of soils and climatic conditions has made it one of the most widely used grasses for soil preservation, forage, and turf. A number of the newer turf-type varieties, including Rebel and Clemfine, have shown significant improvements in performance in turf trials.

Fine fescues include a number of different fine-leaved species and subspecies of the genus *Festuca*. As a group, they have fine, bristle-like leaves and a leafy turf-type growth habit. They are generally tolerant of infertile and droughty soils with good drainage. Fine fescues are also tolerant of moderate shade.

This paper will focus primarily on selection of species, blends, and mixtures for use on golf courses in areas where cool-season grasses are adapted.

MAJOR COOL-SEASON TURFGRASSES

Common name	Species	Adapted to zones
Kentucky bluegrass	*Poa pratensis*	1,2,5,6,7
Rough bluegrass	*Poa trivialis*	1,2,5,6,7
Creeping bentgrass	*Agrostis palustris*	1,2,5,6,7
Perennial ryegrass	*Lolium perenne*	1,2,5,6,7
Tall fescue	*Festuca arundinacea*	1,2,3,5,6,7
Fine fescues		
Hard	*Festuca longifolia*	1,2,5,6,7
Chewings	*Festuca rubra* var. *commutata*	1,2,5,6,7
Creeping red	*Festuca rubra* var. *rubra*	1,2,5,6,7

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ZONES FOR GRASS ADAPTATION
IN THE UNITED STATES AND CANADA

Key to Climate Zones:
1 Cool - Humid
2 Transition
3 Warm - Humid
4 Sub-Tropical
5 Cool - Semi-Arid Plains
6 Cool - Semi-Arid
Inter Mountain
7 Cool - Humid
8 Warm - Arid

GRASSES FOR PUTTING GREENS

Bentgrasses are best adapted for growth in zones 1,5,6, and 7. The creeping bentgrass varietiy "Penncross" has been successfully grown as a perennial on greens in all zones except No. 4. "Penneagle" has shown desirable qualities for use on putting greens; however, reports of weakening under excessive heat, drought, and traffic have been noted. For establishing bentgrass greens in zones 2, 3, or 8, "Penncross" would be the desired choice.

MIXTURES RECOMMENDED FOR USE ON IRRIGATED FAIRWAYS AND TEES

Tournament Conditions

50% "Seaside" creeping bentgrass
50% "Penneagle" or "Penncross" creeping bentgrass

Bentgrass produces a high-quality playing surface and is best adapted for growth in zones 1 and 7. With proper care bentgrass fairways and tees have been successfully maintained in zones 5 and 6. "Penneagle" may be used where bentgrasses are best adapted, while "Penncross" is the desired variety when excessive heat, drought, and traffic are expected.

Municipal or Resort Course

80% "Baron," "Ram I," "Georgetown," and "Mystic" Kentucky bluegrass
20% "Palmer," "Prelude," or "Yorktown II" perennial ryegrass

Zones 1,2,5,6, and 7

For fairways and tees, use Kentucky bluegrass mixed with a turf-type perennial ryegrass. This mixture provides a turf that is attractive, durable, and easier to maintain than bentgrass.

MIXTURES FOR NON-IRRIGATED FAIRWAYS

70% "Reliant" hard fescue
30% "Jamestown" chewings fescue

Zones 1, 6, and 7

Hard and chewings fescues are low-maintenance turfgrasses requiring minimal fertilization. For the Scottish look, fine fescues are the desired choice.

MIXTURE FOR GREEN AND TEE BANKS

80% "Baron" and "Ram I" Kentucky bluegrass
20% "Palmer," "Prelude," or "Yorktown II," perennial ryegrass

Zones 1, 2, 5, 6, and 7

A Kentucky bluegrass perennial ryegrass mixture is easy to maintain, traffic tolerant, attractive, and persistent.

GRASSES FOR UNMOWN TEE BANKS

Weeping Lovegrass: Zones 2, 3, and 7 and southern one-third of 1, 5, and 6
"Reliant" hard fescue: Zones 1, 5, 6, and 7

These grasses persist under low maintenance and are visually appealing while providing a natural effect.

MIXTURE FOR ISLANDS IN SAND TRAPS AND CHOCOLATE DROPS

70% "Reliant" hard fescue
30% "Jamestown" chewings fescue

Zones 1, 2, 5, 6, and 7

Fine fescues provide the Scottish look, persist under low maintenance, and have a slower growth rate for minimal mowing compared to most turfgrasses.

MIXTURES FOR USE ON GOLF COURSE ROUGHS

80% "Baron" and "Ram I" Kentucky bluegrass
10% "Reliant" hard fescue
10% "Palmer," "Prelude," or "Yorktown II" perennial ryegrass

Zones 1, 6, and 7

This mixture is well suited for gold course roughs as it is attractive, durable, and persistent and is adaptable for use in sun or shade.

90% "Rebel" or "Clemfire" tall fescue
10% "Baron" Kentucky bluegrass

Zone 2

Tall fescues are traffic- and heat-tolerant, durable, and persistent while being adapted for use in sun or shade.

40% Buffalograss
40% Blue gramma
20% Hard fescue

Zone 5, west Texas and Oklahoma

Best adapted for use in the plains states from Texas to the Dakotas.

MIXTURE FOR DRIVING RANGES

80% "Baron" Kentucky bluegrass
20% "Prelude" perennial ryegrass

Zones 1, 5, 6, and 7

90% "Rebel" tall fescue
10% "Baron" Kentucky bluegrass

Zone 2

MIXTURE FOR UNMOWN SLOPES

70% "Reliant" hard fescue
30% "Jamestown" chewings fescue

Zones 1, 5, 6, and 7

Neat, attractive, visually appealing, while requiring minimum fertilization.

Weeping Lovegrass

Zones 2, 3, and southern one-third of 1, 5, and 6

40% Buffalograss
40% Blue gramma
20% Hard fescue

Zone 5, west Texas and Oklahoma

GRASSES PROVIDING SHADE TOLERANCE

Fine fescues: Creeping red, chewings, and hard

The fine fescues should be used for roughs and tee and green banks. They are best adapted for use in zones 1, 5, 6, and 7.

Tall Fescue

For shaded sites tall fescue is recommended for use in zones 2 and 3. Good for roughs and tee and green banks.

Poa trivialis

Zones 1, 2, 5, 6, and 7

Poa trivialis should be used on damp or moist, shaded sites. It withstands a close height of cut, 1/2 inch, and is attractive. For densely shaded tee areas, *Poa trivialis* may be the only alternative. Does not have good wear tolerance.

TURFGRASS VARIETIES TO BE AVOIDED

Presently there are many outstanding, commercially available turfgrass varieties that give improved performance. There are a few varieties that provide poor performance or have weaknesses to major disease problems. For golf course use it would be advisable to refrain from using the following varieties: "Park," "Arboretum," "South Dakota Certified," "Delta," "Newport," "Merion" Kentucky bluegrass, and "Highland" Colonial bentgrass.

GRASSES PROVIDING ACCENT AND CONTRAST

Grass species commonly referred to as "ornamental grasses" can be utilized in mass, unmown plantings to produce a dramatic visual effect. Ornamental grass plantings have been generally ignored as a tool for providing accent and contrast. Uses for ornamental grasses would include plantings on steep banks, island plantings in sand traps or adjacent to sand traps or grass bunkers, for tee banks, and for groupings in out-of-play rough areas. Out of approximately 50 grasses that are thought of as ornamental, the following seven are most useful on golf courses:

Chinese silvergrass, *Miscanthus sinensis (Eulalia japonica)*

Mature height: 7 to 13 feet
Adaptation: Perennial in Zones 1, 2, 3, 4, 5, 6, 7, and 8
Comments: Upright plant form, attractive pink or red fall plumes, tall, graceful appearance, propagated vegetatively.

Eulalia grass *Miscanthus sacchariflorus*

Mature height: 5 to 10 feet
Adaptation: Perennial in Zones 2, 3, 4, 7, and 8 and the southern one-third of 1, 5, and 6
Comments: Upright plant form, attractive silvery white fall plumes, tall, graceful appearance, propagated vegetatively or by seed.

Maiden grass *Miscanthus sinensis* "Gracillimus"

Mature height: 3 to 6 feet
Adaptation: Perennial in Zones 2, 3, 4, 7, and 8 and southern one-third of 1, 5, and 6
Comments: Upright, arching plant form, fine texture, attractive reddish-pink, beige plumes, long, curly arching leaves, propagated vegetatively.

Plume grass, Ravennae Grass *Erianthus ravennae*

Mature height: 7 to 15 feet
Adaptation: Perennial in Zones 2, 3, 4, 7, and 8 and southern one-third of 1, 5, and 6
Comments: Upright, open plant form, attractive, silvery white plumes, large appearance, easy to grow, propagated vegetatively.

Pampas grass, *Cortaderia selloana*

Mature height: 6 to 15 feet
Adaptation: Perennial in Zones 3, 4, and 8
Comments: Striking white plumes, attractive, upright plant form, propagated vegetatively or by seed.

Fountain grass, *Pennisetum alopecuroides*

Mature height: 4 to 4 1/2 feet
Adaptation: Perennial in Zones 2, 3, 4, 7, and 8 and southern one-third of 1, 5, and 6
Comments: Excellent upright form, numerous coppery tan or reddish plumes, showy fall color, propagated vegetatively or by seed.

Weeping Lovegrass, *Erogrostis curvula*

Mature height: 3 to 4 feet
Adaptation: Zones 2, 3, and southern one-third of 1, 5, and 6
Comments: Needs adequate room to develop, open and arching form, fine texture requires full sun, attractive form throughout summer, propagated by seeds.

AN APPROACH TO NEMATODES IN GREENS

Joel Purpur

With more and more superintendents switching to sandier soil mixes and topdressings, a variety of uncustomary problems are occurring with greater frequency. Nematode damage on sandy or sand-topdressed greens is becoming more common in cool climates.

Since nematode damage can resemble many other problems and the symptoms don't possess just one classic characteristic as with many diseases, recognizing this microscopic parasite can be difficult.

During the summer of 1985, Bartlett Hills Golf Course experienced nematode damage. Symptoms started in July when the greens looked weak, chlorotic, and didn't respond well to fertilizer applications at 1/2 pound n/m. Small yellow to yellow-orange spots 1/2 inch in diameter were observed throughout several greens. A closer look at the affected grass plants showed a yellowing starting at the tips of the grass blades, progressing inward towards the crown and affecting older leaves first. Larger areas a couple feet in diameter looked more like wilt, but the soil and the turf had plenty of moisture. Other areas resembled patch disease symptoms. Various fungicides were applied and seemed to suppress the "disease" but only for a few days in some cases. Damage severity also seemed to vary according to the turf species. *Poa annua* was most affected, while the coarser bents seemed least affected.

Suspecting nematodes, we reviewed facts about characteristics and life cycles. Nematodes are transparent worm-like parasites not visible to the naked eye. Parasitic nematodes are obligate parasites that need a living host to survive. Nonparasitic nematodes are beneficial to plants because they feed on fungi and bacteria that may damage turf. A needle-like mount part, called a stylet, is characteristic of parasitic nematodes and is used to pierce living tissue to feed on plant juices.

The life cycle of nematodes is similar to that of insects. It optimal conditions the life cycle is completed in three to four weeks. Mature females lay eggs that hatch into larvae and go through a series of four molts before becoming adults. Fertilization of eggs is usually by sexual means, but some reproduce by parthenogenesis. Survival is usually in the egg stage, and most lateral movement is in surface water. Movement in the soil seldom exceeds a few inches per year.

Symptoms include chlorosis, spotting, decline in growth, gradual thinning, premature wilting, and patches that may be circular or irregular in pattern. Symptoms are most evident in hot weather and other stressful situations.

Plant health is affected by both loss of plant fluids and physical damage from the stylet. Physical damage can cause a variety of problems. Diseases can be brought on from plant fluids in the soil from injured turf. Damage to the turfgrass circulatory system by enzyme secretions during feeding causes galls, lesions, lateral roots, and kills meristematic tissue.

Joel Purpur is Superintendent, Bartlett Hills Country Club, Bartlett, Illinois.

Soil tests are helpful to confirm high parasitic nematode concentrations, since small numbers on nematodes are common in most soils. The University of Illinois as well as other agencies can run nematode tests fairly quickly. If a microscope is available, you can do a nematode extraction yourself.

Start by selecting the proper site. Since nematodes are obligate parasites, soil should be taken from plants that are still living but in the beginning stages of infection. Collect 1/4 cup of soil in the rooting depth without including the thatch. Place the soil in a pouch made by connecting the corners of a one-ply tissue square. Place a screen in the bottom of a funnel for the soil to rest on. Slip a rubber tube over the bottom of the funnel and close it off with a surgical clamp or similar device. With the funnel supported in an upright position, place the soil in the funnel and add water until it is half way up the tissue bag. Don't let the sample become completely submerged or lose contact with the water for a 24 hour period. After 24 hours, open the clamp enough to fill a 15ml test tube 2/3 full. This water, now contains most of the nematodes that were in the soil and fell to the bottom of the funnel.

Fill the rest of the tube with a 4 percent formaldehyde concentration to kill the live nematodes. After one hour, remove an eye dropperful from the bottom of the tube containing the nematodes that have settled to the bottom.

Place the nematode solution on a counting slide prepared by laying a 1/8 inch bead of Duco cement around all four sides to hold the solution and by drawing a grid of lines on the backside 1/8 inch apart with a fine-tipped black waterproof marker to aid in counting.

With the proper microscope objective, count all the parasitic nematodes with stylets. Don't let the objective come in contact with the solution because formaldehyde can damage the lens. After all the parasitic nematodes have been counted, multiply that number by 8 to give the number of nematodes per pint of soil. Although experts don't agree fully on the threshold levels, the presence of 500 or more parasitic nematodes per pint of soil is sufficient to damage turf and may require a nematicide treatment.

Professional soil tests are generally more accurate and easier if proper equipment is not available. Running a test strip with a nematicide is also a good way to test for nematodes. If the turf responds to the nematicide by becoming darker green and more vigorous, one might consider a complete application.

After soil tests from the University of Illinois confirmed the presence of parasitic nematodes at Bartlett Hills Golf Course and the damage continued, we decided to treat all the greens with a nematicide.

Nematicides are considered to be very dangerous chemicals because most or all of them have very low LD_{50} ratings. Some are potentially "hot" to turf and can cause discoloration. Nemacur 15 percent granular was selected and applied at 2 pounds material per 1,000 square feet. The course was closed during treatment for safety, and the chemical was watered in immediately with a minimum of 1/2 inch of water. Nemacur claims control for up to seven months, so only one treatment was made. We experienced no discoloration or burn on the turf after heavily watering in the chemical, and the health of the greens improved with no recurring symptoms.

I've learned a great deal about nematodes but have come up with more questions than answers. We know this may be a recurring problem at Bartlett Hills and are much too familiar with the symptoms. Nematode activity was suppressed this year, but next year may be a whole new ball game.

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1986 GOLF TURF IN REVIEW

R.T. Kane

INTRODUCTION

This past growing season was my first as University of Illinois Turfgrass Advisor for the Chicago District Golf Association and northern Illinois. My primary duty is to help solve turf pest and management problems by using diagnostic and consultative techniques. In this article, I will review some of the turf maladies I encountered over the last twelve months. The majority of turf problems in 1986 were tied in with severe or unusual weather patterns. Many temperature and precipitation records were broken through the year, beginning with the heavy rainfall of November 1985 and ending with the November 1986 cold wave. It was a tough year to maintain fine turfgrass, but it was a good year to develop and evaluate some of the problem-solving services I am to provide.

WINTER DAMAGE

Much of the winter damage that occured in late 1985 and early 1986 was not evident until mid to late March, when unseasonably warm temperatures stimulated turf growth. Many areas of *Poa*, rye, and bentgrass were damaged, especially where low-lying or poorly drained areas retained surface water from November rainfall. Excessive moisture delayed hardening-off processes and led to crown hydration so that plants were damaged or killed by the subsequent hard freeze in early December.

In some locations, lack of snow cover through the winter may have contributed further to turf damage because of desiccation of exposed sites. *Poa annua* on greens and in some fairways was most affected. Finally, freeze-thaw cycles in late January and February may have contributed to winter-kill problems in some locations.

SLOW RECOVERY

After an early warm trend, the spring of 1986 turned cool and dry. Because of the lack of warm spring rains, soil temperatures remained cool and winter-damaged turf was very slow to recover. In general, green-up and resumption of growth was delayed several weeks. Problems were especially severe on putting greens with older varieties of bent (including Penncross) and on greens with a lot of *Poa annua*. The variety "Penneagle" appears to be more tolerant of cool soil temperatures, since early growth and color of Penneagle was better than that of Penncross, Washington, etc.

SPRING DISEASES

There were very few fungal disease problems during the spring, primarily due to the cool, dry conditions that prevailed. Leaf spot pressure was fairly light, except

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in higher cut bluegrasses, such as in the roughs where moisture in the canopy was more favorable. In early June, take-all patch was found at two locations, one north side, one south, both on Penncross bent. Symptoms were similar to those reported on the east and west coasts where the disease is more common. *Gaeumannomyces graminis* was isolated from diseased roots at both locations, and this may be the first documented occurrance of take-all patch in this area.

SUMMER RAIN AND HEAT

Heavy rain coupled with high temperatures and heavy play caused some serious problems on Chicago area putting greens in early and mid-July. Seven inches of rain fell in seven days on the north side with daytime temperatures in the mid to upper 90s°F. Temperatures near or above 100°F occurred to the west and south, but rainfall amounts were less. In either case, shallow-rooted *Poa annua* and bent on greens mowed at 1/8 to 9/64 inch were severely stressed, and large-scale loss of turf occurred.

Heat, traffic, and mowing height may not have been the only contributing factors. Layered sand topdressing over soil/sand root zones may contribute to stress problems for several reasons: (1) wear damage and thinning may be increased by the abrasive action of sands; (2) water may be perched in the topdress layer because of different permeabilities between sand and underlying soil; (3) high surface moisture favors algal developmnet and anaerobic conditions in the rootzone; and (4) sand layers may favor nematode build-up and root pruning. Excessive moisture, algae, and anaerobic conditions may team up to cause the "black plague," the black fetid layer in soils that is now receiving widespread attention.

Summer heat stress also led to *Poa* problems on fairways. Pythium blight (*P. apanidermatum,* etc.) was common during mid-July rain, heat, and humidity. Also in July, *Poa* was frequently lost in high wear/high compaction areas or in low-lying areas. In many cases, *Poa* died suddenly in circular or patchy patterns, which was sometimes mistaken for Pythium blight. However, in most cases, this was probably a form of summer patch ("Poa patch") caused by *Phialophora* spp. possibly including *Ph. graminicola*. Roots from yellowed or wilted plants along the perimeter of affected areas were shallow and rotted, and *Phialophora* was readily isolated from these tissues. Studies on species identity, pathogenicity, and disease control are in the planning stages or under way.

Bentgrass and bent/*Poa* fairways under lightweight mowing, reduced fertility, and reduced water management came through the summer with very few problems. This illustrates the durability and stress tolerance of bents when maintained at fairway heights of 1/2 to 5/8 inch with newer management techniques.

BACTERIAL WILT

Bacterial wilt, that nemesis of Toronto (C-15) bentgrass, is still fairly widespread on Illinois golf courses with susceptible grasses. Bacterial wilt occurred thoughout the summer, even when temperatures were peaking in mid-July. This is somewhat contrary to past observations of this disease, since bacterial wilt is normally more severe when temperatures are moderate or cool. However, the heat and heavy rains we experienced at times this summer may have favored bacterial development at the same time that it increased plant stress.

Most bentgrass varieties, *Poa annua*, and other turfgrasses apparently have field resistance" to bacterial wilt, despite reports of susceptibility in greenhouse tests.

Even on severely affected greens, *Poa*, C1, C7, and newer varieties appear to be immune or highly resistant. However, I have found bacterial wilt on a few dark-colored clones of segregating Washington or "south German bent" greens. The disease was sometimes severe in isolated areas of a green, but most of the other clonal types of bent and *Poa* on these old greens appear to be resistant. This problem will require close observation in the future to see if the pathogen attacks other clones of Washington.

NEMATODE DAMAGE

Spotty nematode problems were observed through the season, beginning in early June. Nematode damage can sometimes be characterized by well-defined symptoms such as shallow, swollen roots or loss of branch roots, and definite patchy or circular areas may be affected. However, in other instances, elevated nematode counts may be associated with less well-defined symptoms such as poor growth and color or lack of response to fertility or pesticides. Loss of turf may be the result of nematode attack alone or the result of several factors interacting together to cause plant stress, such as other root parasites, heat, drought, or anaerobiosis.

For the most part, turf damage from elevated nematode counts was observed this year on soil or soil/sand-mix putting greens with a sand topdressing layer. Sand layers may favor nematode buildup to damaging levels ("threshold level") because of favorable aeration, porosity, and moisture. On the other hand, management practices to maximize putting speed and uniformity can cause shallow rooting and plant stress, thus reducing the threshold nematode population required to cause visible damage. So our current management practices may be favoring nematode feeding and reproduction at the same time those practices reduce plant vigor and stress tolerance.

OTHER PROBLEMS OF NOTE

A severe fairy ring problem was observed on *Poa* fairways in DuPage County. The problem was compounded by compacted, high organic matter soils, heavy thatch, and shallow *Poa* roots. Anthracnose (*Colletotrichum graminicola)* caused turf loss on susceptible bent clones and on *Poa* in some areas. Cool conditions in August gave rise to yellow tuft symptoms on Penncross greens, although it was hard to confirm the diagnosis because of difficulties in visualizing the pathogen *(Sclerophthora macrospora)*.

SEASON'S END--MORE CALAMITY

What had been a tough year anyway ended on another sour note. Heavy rains in late September led to record flood stages in rivers and canals. Many courses along waterways sustained damage. Fall seeding and construction projects were washed out or set back, and physical damage to soils in some areas will necessitate reconstruction. To top it all off, record cold temperatures in early November were experienced throughout the Midwest and Northeast. We thought last November was bad news! Effects of this latest weather anomaly may not be evident until spring of 1987.

THE USE OF EMBARK IN BENTGRASS CONVERSION

Dave Mahoney

I have been the golf course superintendent at Naperville Country Club since fall, 1983. Like most golf clubs in the early 80s, we had 90 percent *Poa annua* on the fairways. A previous program of three years of slit seeding with bent had very minimal results. At the time there was no desire to go to lighweight mowing or to kill off the *Poa* and overseed it with bent.

So we were forced to make the *Poa* the best possible fairway surface. This is when I first started using Embark. The prolific *Poa annua* seeds of spring contribute to poor playing conditions and severe allergic reactions for many players. Being an avid golfer myself and one who also suffers from hay fever, we personally wanted to prevent the emergence of seedheads.

Using the rate of 8 ounces per acre, or 1/3 the full growth regulator rate, we sprayed 17 fairways in 1984. The results were impressive. We had 75 to 80 percent control of seedheads. Conditions were up and allergies were down. In addition, the turf responded better to summer stress as compared to our control fairway. This bonus was observed through early August. In mid-August, the sprayed and control areas appeared to have similar stress tolerance.

When sprayed on April 15, the turf was stunted for three weeks. The turf that had just greened up returned to the off-color look of late winter. I was surprised that the low rate stunted the turf for so long. A return to normal growth occurred after the first week of May.

Previous efforts to introduce bent into *Poa* failed because the existing *Poa annua* simply squelched and out-competed the young bent seedlings. With a stunting of three weeks, the bent could germinate and mature slightly before the *Poa* kicked back in.

By 1985, there was a growing desire to have bentgrass fairways. So we started a three-year program to establish bentgrass fairways using Embark as our foot in the door.

First, why a three-year plan? I feel that if we had 100 percent bentgrass fairways tomorrow, it would be a disaster. We are not fully equipped to keep 100 percent bent with our present equipment or budget. At three years, we plan to be fully equipped to handle predominantly bent fairways.

The first year, we wanted to get a 20 percent bent population, the second year 50 percent, and the third year 80 percent. We wanted to make a gradual conversion without the "scorched earth" look or browning out the *Poa*. In fact, the Embark would allow this transition while giving us a stronger *Poa annua* in the summer.

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Here's our program: Double-cut the fairways at 1/2 inch and blow off clippings to give a clear working surface. Then aerify with Greensaires, 5/8-inch tines. The plugs are then ground up with Greensmaster verticutt units. This smooths and firms the surface and pats down any turf puffing or tearing.

We then overseeded in a diamond pattern with a Jacobsen 548 overseeder. We used a 1-1-1 mixture of Penneagle, Penncross, and Seaside seeded at 20 pounds per acre. Areas that were severely torn by the seeder were patched and hand-seeded with the bent mixture and Pennfine.

Seeding was followed by 180 pounds per acre of 6-24-24 fertilizer and an application of 8 ounces per square meter of Aqua-gro. We began a constant syringe to keep the top 1 1/2 inches of the soil moist. All seeding was done by April 17.

We applied Embark at 8 ounces per acre four days after a fairway was seeded. The Embark has no activity prior to seed germination. The soil life is rapidly broken down within a day after application. All work was scheduled so that the Embark would be applied at the time critical to preventing seedhead emergence.

Although the seeding date for *Poa annua* fluctuates from year to year, the third week in April has been the average. If we need to hold off because of delayed green-up in spring, we can afford some leeway. If the turf isn't greening up, conditions also won't be ripe for bentgrass seed germination.

Some of my uncertainties about a spring seeding included the temperature at which the bent would begin to germinate. Soil temperatures should be consistently in the mid-fifties. This is concurrent with about a week after green-up. Our first strong signs of germination occurred on April 24. Soil temperatures were in the high 50s and low 60s.

Also, spring is noted for drastic weather changes. In a span of ten days, we had a 1 1/2 inches of snow and ambient temperatures in the mid 80s. Fortunately, the snow didn't come after germination.

The seedlings came up in the grooves and aerifier holes, but after germination progress was slow. The seedlings stayed in the one-leaf stage with little top growth for over two weeks. At this time, the *Poa annua* was just beginning to break its forced dormancy. So we applied Lesco Fe & N at 2 ounces per square meter. This gave the seedlings a slight push.

When the *Poa annua* breaks dormancy the flush of growth masks all the new seedlings. It appeared we were back to square one. But through the year, we saw the mature seedlings begin to coalesce and spread.

The 20 to 30 percent goal of bent was met. This may seem a low ratio for all the work we did. But for a golf course still dragging gang mowers, I feel this is a strong foothold. And the program is designed for a gradual transition, so that agronomics and economics stay on the same level.

Summing up, we used the Embark to prevent seedheads on *Poa annua*. The stunting of the turf allows the bent to germinate and thrive without competition. This allows a gradual transition to bent while maintaining a stronger summer stand of *Poa annua*.

PUTTING GREEN SPEED

Clark Throssell

Putting green speed is a familiar and much-discussed topic among golfers and golf course superintendents. With the introduction of the Stimpmeter in 1977 by the United States Golf Association, putting green speed could be measured rather than relying on the subjective judgments of golfers. The Stimpmeter was introduced to aid golf course superintendents in achieving a uniform speed among all greens on the course.

Unfortunately, the intended use of the Stimpmeter and the actual use are quite different. Instead of using the Stimpmeter to help achieve uniformity in speed among greens, Stimpmeter measurements are often used to force an increase in speed. The speed measured on a golf course is often compared to the guidelines established by the U.S.G.A. and to speeds measured at other local courses. The prevailing opinion is that faster greens provide more of a challenge to the golfer and are better greens. Therefore, golf course superintendents are under increasing pressure to provide faster greens for play.

Before discussing putting green management and speed, we should consider the notion that faster greens are better greens. A high-quality putting green will have many attributes, one of which is a reasonable putting green speed. Each golf course should decide on a reasonable speed for greens, based on the desires of the members, the amount of play the course receives, the money and equipment available to maintain the greens, and the superintendent's knowledge and experience. In addition to a reasonable putting speed, a high-quality green should be uniformly turfed and free of disruptions from disease and insects. The green should have a high shoot density of the desired species, and individual leaves and tillers should be oriented vertically to eliminate graininess. Also, the green should offer some resiliency to shots played to it. Each of the attributes mentioned above contributes equally to a good golf green. To emphasize putting green speed at the expense of the other components of a good golf green would be a poor management strategy, resulting in the diminished quality of the green.

With the above caution in mind, we will proceed with a review of the results of a study conducted at Pennsylvania State University to determine the effect of management practices on putting green speed. All experiments were conducted on creeping bentgrass, and speed was measured using a Stimpmeter.

Of all the factors evaluated, mowing height had the greatest impact on speed. Three moving heights, 2/32, 3/32, and 6/32 inch, were tested on a season-long basis. It was demonstrated that as mowing is lowered, putting green speed increases. Putting green speed increased from an average of 7 feet 10 inches at 6/32-inch

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mowing height, to 9 feet 11 inches at 3/32-inch mowing height, to 10 feet 5 inches at 2/32-inch mowing height. For each 1/32-inch change in mowing height, putting green speed will change by approximately 8 inches. An increase in mowing height will cause a decrease in speed, while a decrease in mowing height will cause an increase in speed. It is very tempting to lower the mowing height to increase putting speed, but extremely low mowing heights should be avoided. At extremely low mowing heights shoot density will decline, weed encroachment will increase, and the turf will be very susceptible to any stress.

Another interesting aspect of this research was the variation in putting speed from week to week. Speed will fluctuate from season to season and even day to day. These fluctuations are thought to be due to climatic and weather changes. It would be unreasonable to expect putting green speed to remain constant through an entire week, let alone an entire golfing season.

Regular mowing is an important tool in developing and maintaining a high-quality putting green. Over a three-month period, it was found that as a number of mowings per week increased from three to seven, putting green speed also increased. However, with each increase in the number of days per week the turf was mowed,the amount of the increase in putting green speed grew smaller. The practical significance of this is that a decrease in mowing frequency from 7 to 6 days a week will have a very minor long-term effect on putting speed, except on the day the green is left unmowed.

Double mowing is a common and effective way to increase putting green speed for a tournament. The maximum effect of double mowing is seen after three consecutive days of double mowing. When comparing single versus double-mowed research plots, one day of double mowing increased speed 4 inches, two consecutive days of double mowing increased speed 6 inches, and three consecutive days of double mowing increased speed about 8 inches. After three consecutive days of double mowing, further consecutive days of double mowing only served to maintain the 8-inch gain in putting green speed. The day double mowing was stopped, the 8-inch gain in putting speed was lost. If double mowing is to be used to increase speed for a tournament, to achieve maximum effect, double mowing should begin two days prior to the start of the tournament and continue for the length of the tournament.

Nitrogen fertility management is another key aspect of putting green maintenance. When trying to decide on the proper nitrogen level, putting green speed is one of the factors that should be considered. The relationship between nitrogen level and putting green speed is that for each pound of actual nitrogen applied per 1,000 square feet during the season, putting green speed will decrease approximately 4 inches. The decrease in speed is due to increased growth stimulated by nitrogen fertilization. The increased growth increases resistance to a rolling golf ball, causing a decrease in putting green speed.

Aerification and topdressing are two common practices necessary for proper putting green maintenance. Each practice has a dramatic effect on putting green speed. As expected, aerification without being followed by topdressing caused a decrease in putting green speed. Aerification with 1/4-inch diameter times decreased speed 2 inches, and aerification with 1/2-inch diameter times decreased speed 5 inches. The decrease in speed due to aerification lasted 28 days when the aerification was not followed by topdressing.

Light and heavy topdressing following aerification decreased speed up to 5 and 9 inches, respectively, for eight days following topdressing. After eight days, light and heavy topdressing increased speed up to 6 and 15 inches, respectively, for the next 21 days. Possible reasons for the increase in speed measured eight days after topdressing are that it took several days for the topdressing to work through the turf canopy down to the soil surface, and over the eight-day period, excessive topdressing was picked up and removed by mowing.

Although aerification and topdressing initially cause a decrease in speed, this does not mean these practices should be discontinued. Both aerification and topdressing are essential to the maintenance of a high-quality putting green. The information presented here should be used to schedule aerification and topdressing operations when a short-term decrease in speed will not be too disruptive to play. Topdressing is often used to increase putting speed for a tournament. If topdressing is used for this purpose, schedule the topdressing application eight to ten days prior to the first day of the tournament so the maximum benefit of the topdressing is realized.

Some of the common management practices and their effect on speed have been discussed here. Uniform speed among all greens should be the goal of superintendents when using the Stimpmeter. If there is a demand for greater putting green speed, it is important to remember that many factors affect speed, and the overall management of the greens should be designed to increase putting green speed. It would be poor management to rely solely on a single management factor to alter the speed. Although there have been no long-term studies on greens managed to maximize speed, it appears that most management factors that increase speed diminish the quality of turf grown on the green.

SOD INTERFACING AND CORE AERIFICATION

Robert C. Avenius and Henry T. Wilkinson

The successful establishment of sod at a new residential site is a major concern of the sod industry today. Many of the problems that develop with sod are due to inappropriate establishment practices. Problems usually occur one to two years after planting, but they may occur immediately or even five years later.

A majority of new homes built today have sod installed in their yards. Many times the main problem in these lawns is that the topsoil was removed during construction so the sod was laid on compacted subsoil. Turf roots have difficulty growing in these soil conditions and tend to remain near the surface or grow in the thatch layer. After six months the homeowner has shallow-rooted turf that is very susceptible to drought, temperature extremes, and pathogen attack. These conditions have enhanced the destructiveness of patch diseases such as nectrotic ring spot and summer patch. The development of an extensive root system is vital for successful sod establishment and longevity.

Our research is really taking a proactive stance: we are trying to discover how we can avoid these problems before they happen.

After observing many of these situations it seemed that more information was needed on the factors that influence sod establishment. Should sod be grown on the soil type on which it will be installed? Does sod age influence establishment? How should the ground be prepared before sod installation? Can sod be established successfully in clay soils? Does the nitrogen source at the time of sod installation affect rooting? Would aerification help root establishment of sod? Studies were set up to answer these questions about sod establishment or sod interfacing. Sod interfacing is the growth and establishment of sod into the soil upon which the sod is transplanted. We have explored the question of whether aerification preceding sod establishment will enhance sod root growth and provide a greater area for soil contact.

We all realize the benefits of aerification on the golf course, but not until recently did we promote this practice on home lawns. Even today most of the aerification done is reactive instead of proactive. We tend to aerate a lawn after a problem has developed rather than before.

Once a lawn begins to have problems the thatch layer is usually excessive, and one aeration treatment will not be sufficient. In most instances yearly aerification for four or five years is needed, along with better cultural practices.

Aerification facilitates root development by providing a space in the soil where roots can grow and develop easily. The larger the root system, the better the plant is able to cope with stress and disease without symptom expression.

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RESEARCH PROCEDURE

In order to duplicate the conditions found in a home lawn situation, it was necessary to alter the plots at the Research Station. This was done by removing the existing soil to a depth of two feet and replacing it with a high clay content subsoil. The area was then leveled and compacted with heavy equipment before the selected areas were aerified and sod was laid.

Sod of varied age and soil type was obtained. It was then cut into squares and placed in metal pans. Each pan consisted of an angle-iron frame with an expanded metal bottom. Hooks at each corner facilitated taking root strength readings.

Installation of the pans involved placing them in the plot and mounding the sides with soil to avoid desiccation. Following installation the sod was irrigated on a daily basis for the next three weeks and was never under moisture stress.

At four weeks, eight weeks, twelve weeks, and one year, pans were pulled from the various treatments and root strength was recorded. All of these studies were conducted on plots that were amended with clay subsoil as described earlier and duplicated with the soil found on the research station. The treatments consisted of the following:

1. Mineral versus peat sod
2. One-year-old sod versus three-year-old sod
3. Coring versus non-cored
4. Fertilizers: slow-release versus quick-release

RESULTS

Only a general interpretation of the data will be discussed since the results currently analyzed represent only a portion of all the data collected.

FERTILIZATION TREATMENTS

Nitrogen fertilization was beneficial to young, one-year-old sod and older three-year-old sod. Young sod with a more active root system was able to use the nitrogen more efficiently. This encouraged quicker root development, which was apparent at four and twelve weeks after treatment. The quick-release, nitrogen-source urea gave better response at the four-week period than the slow-release sources, although after four weeks, the slow-release sources started outperforming the urea in root development.

In general the response of the three-year-old sod to the nitrogen application was much slower compared to one-year-old sod with one exception: nitroform fertilizer at 0.5 pounds per meter had significantly better rooting than the other slow- or quick-release fertilizers. Reasons for this result are unknown at present.

Sod establishment was also influenced by the rate of nitrogen applied. In general the higher nitrogen rate of 1 pound per meter stimulated more initial root growth than the 0.5 pound rate. However, starting at twelve weeks after establishment, just the opposite occurred: the 0.5 pounds per meter rate stimulated better root growth. All of our fertilizer work indicates that nitrogen applied prior to transplantation of sod is beneficial to root establishment. Nitrogen incorporation into soil should be coordinated with soil analyses for best results.

CORED VERSUS NON-CORED

The benefits of core aerification increase with time. After only eight weeks, sod installed on previously cored silt loam soil had significantly more root growth than the same soil uncored. Sod laid on clay soil did not respond as fast and it was only in the twelfth week that root strength readings were greater than uncored areas.

Core aerification holes made in clay soil were still present in the soil after one year. At this time, sod roots had grown into these holes and proliferated. The benefits of core aerification during early sod establishment are most pronounced one year after treatment. Since these holes were still present after one year, sod interfacing will continue beyond one year. And it is very likely the greatest benefit of this practice will occur two or three years after sod installation. A more extensive root system at this time would reduce the susceptibility of the turf to stress and patch diseases such as necrotic ring spot and summer patch.

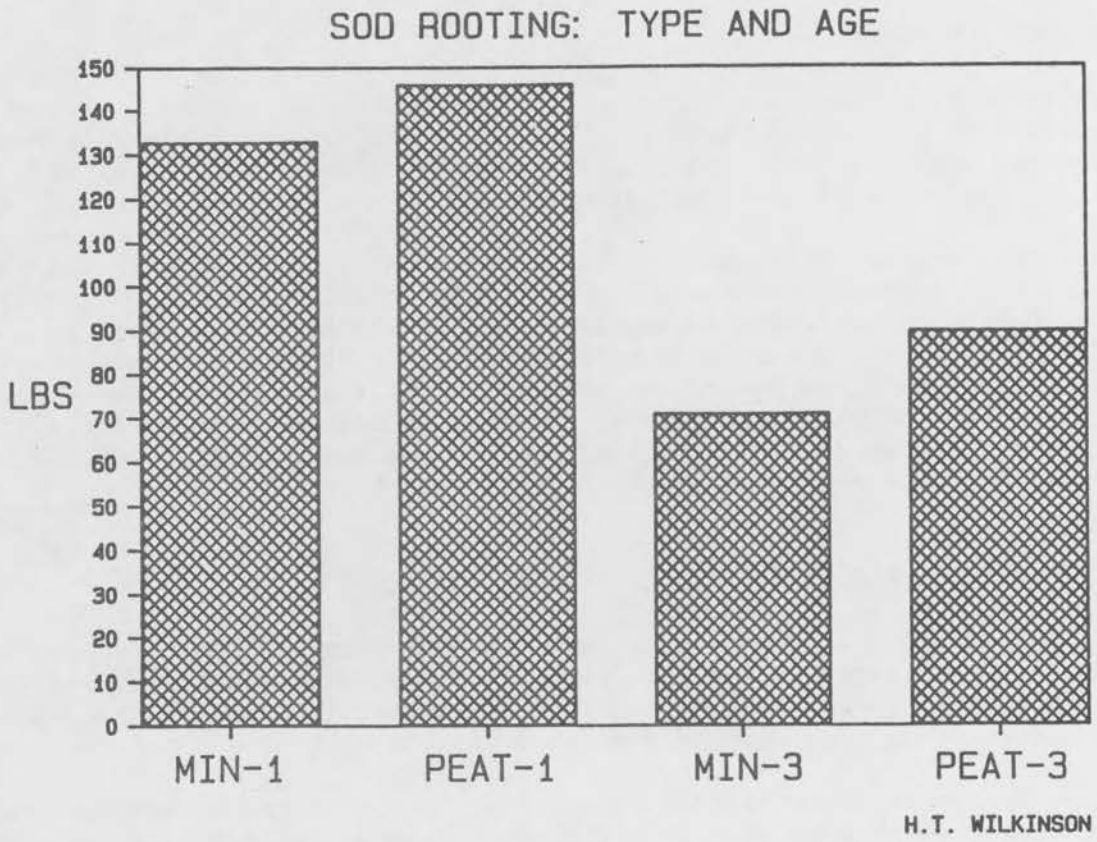
SOD AGE: ONE-YEAR-OLD VERSUS THREE-YEAR-OLD SOD

Three-year-old sod is slower to root than one-year-old sod. For instance, the force necessary to remove one square foot of one-year-old sod is between 130 and 145 pounds, while three-year-old mineral or peat sod was in the 65- to 85-pound range. Mineral and peat one-year-old sod exhibited similar root growth rates.

After an establishment period of one year, the differences between one-year and three-year-old sod were greatly reduced. The three-year-old sod had developed a root system comparable to that of the one-year-old sod. The sod rooting strength was 263 pounds for one-year-old sod versus 238 for three-year-old sod. When sod is maintained properly after installation, one-year-old sod will always show better root development than three-year-old sod in the initial eight weeks after installation. Only after a year has passed will three-year-old sod approach the root biomass developed by one-year-old sod.

MINERAL VERSUS PEAT SOD

Among the most encouraging results obtained from this research is that when transplanted properly, mineral and peat sod showed little difference in root development. This contrasts with other studies where mineral sod was shown superior to peat sod. In fact, in our studies, peat sod had slightly better root establishment readings than mineral sod. The difference between mineral and peat sod root establishment was not significant.



H.T. WILKINSON

SUMMARY

1. The difference between peat and mineral sod root establishment is not apparent when transplanting one-year-old sod.

2. Three-year-old sod is slower to root and will need more attention than one-year-old sod.

3. Aerification of clay soil at the time of sod establishment did not show significant benefits until twelve weeks after treatment. Benefits of core aerification increased with time.

4. Fertilization with various nitrogen sources at the time of establishment was beneficial, but a reliable statement cannot be made at this time comparing the attributes of each nitrogen source.

SODBED PREPARATION

James A. Fizzell

Sod has received a lot of bad publicity over the last few years. Much of the dissatisfaction with sodded lawns stems both from the ease with which sod can be installed on sites where seeded lawns would have had a tough time starting and from a sodded lawn's capacity to take quite a bit of abuse, for 2 to 3 years after installation, before it gives up. Because sod is so adaptable, we have developed unreasonable expections for it. Yet there is no reason why a properly installed, sodded lawn shouldn't provide many years of satisfaction. Most do.

Some of the biggest users of sod, for example, developments like resorts, motels, office complexes, and show homes or townhouse-condos, are essentially "out of business" until the lawn is in. Athletic fields, golf courses, and sports complexes are in a similar position. These establishments rely on sod, successfully I might add, because they know how to take care of it and what they can expect from it. Success takes quality sod, proper site preparation, careful installation, and intelligent handling after installation.

Quality sod is young, pest-free, somewhat hungry, and thinly cut. It should be grown on a soil similar to that on which it will be installed and blended from varieties adapted to local conditions. Don't buy sod that is thatchy, dried out, heated, or old and yellow.

Prepare the Site as you would for seeding. Kill existing vegetation with glyphosate; till to a fine seedbed; and remove clods, dead weeds, turf and other debris that would prevent good sod-to-soil contact. Spread a starter fertilizer at no more than 1/2 pound of nitrogen per 1,000 square feet. Moisten the site. Don't lay sod on hot, dry, compact soil, and don't apply nitrogen over the top of newly laid sod.

Lay sod strips with edges fitting snugly together and the ends staggered so that there are no surface cracks. Don't stretch the sod it will shrink when it drys, opening cracks. Roll the sod with a light roller to ensure good soil-to-sod contact and eliminate air pockets.

Management of installed sod is often the Achilles' heel. Even when properly installed, the best sod is still at the mercy of the people who maintain it. And often, this is where the professional landscaper loses control: turning the job over to the property owner.

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When good, lean sod is installed on good soil, few problems should be anticipated. But such ideal conditions rarely exist. Most likely, sod will be installed on badly disturbed soils. Sometimes heroic efforts are needed to get anything to grow. Management practices must be aimed at getting the sod to produce a vigorous, deep root system as quickly as possible.

Watering: Newly laid sod must be soaked thoroughly every day until knitting takes place. Then, reduce the frequency of watering just as wilting takes place. Alternating deep watering with thorough aeration is essential for deep rooting, There will be no rooting if soil is kept continously saturated. If soils dry excessively, new roots will be killed. Lawns watered by a timeclock are in serious trouble because grass can't tell time. Peat sod is very light and may float, so it might need rolling 24 hours after the first soaking to ensure that it remains in good contact with the soil beneath it.

Mow the newly laid sod when the grass is about 50 percent higher than the desired mowing height. A 2 1/2-to 3-inch height is recommended for even the new Kentucky bluegrass varieties. Mow the grass with a sharp mower when it reaches 3 1/2 to four inches in height. The grass leaves are the "factories" that produce foodstuffs for vigorous roots.

Cultivation, such as core aerification or slicing, will be needed where the sod is on a soil quite different from that on which it will be installed (for example, peat sod on a compact clay). Be sure the sod is well knitted before coring or it may be lifted, tearing newly developing roots. Coring may be needed as often as 3 to 4 times per season until any semblance of layering is eliminated.

Apply fertilizer to maintain a moderate green color in the turf. Try to avoid the urge to have the greenest grass in the neighborhood. If you want dark green grass, plant a dark green variety. The deepest green grass is like a 300 pound teenager, well fed but not healthy. Recent studies have shown that slow release nitrogen sources such as ureaform or sulfur-coated ureas at 1/4 to 1/2 pound of nitrogen per 1,000 square feet of turf are adequate for developing a sound root system without stimulating the excessive top growth, characteristic of that produced by immediately available nitrogen sources. This is particularly true on two-to three-year-old sod, the age when many problems begin to show up.

Try to apply fertilizer to take advantage of maximum periods of growth, such as spring or fall in the case of the cool season grasses. Or apply fertilizer when the grass begins to go off color, indicating inadequate nitrogen availability.

Continous observation of the turf is the key to success. People who maintain high quality turf are artists. They watch the grass. They carry a shovel and dig to see what is going on underground. They tend to have green knees and elbows from crawling around and looking. And when they see something happening to the grass, they immediately apply proper, corrective measures.

It is true that, with the introduction of new grass varieties, there has been an increase in the number of problems we see with sod installation. We are beginning to see that those of us who use the sod probably need to shoulder much of the blame. These new hybrid grass varieties are not unlike race horses. If you take care of them, they are beautiful and make money for you. If you neglect them, they just don't go the distance.

IDENTIFICATION AND CONTROL OF MAJOR TURF DISEASES

B.J. Joyner

Today, there are many approaches available to help control diseases of turfgrass. However, there is no single approach to control all these diseases. This means that correctly identifying and knowing something about a disease is the first step in selecting a control approach. How then do we correctly identify a disease problem?

DISEASE IDENTIFICATION

All too often, disease identification is based on matching observed symptoms with symptoms a pathogen is "supposed" to produce without consideration of other factors. This often results in misdiagnosis, as several pathogens may produce similar symptoms under the right circumstances. This misdiagnosis may lead to an incorrect control approach and leave the disease uncontrolled.

Accurate identification of any disease is based on several factors, including symptoms expressed, host affected, time of occurrence (weather and cultural conditions), and pathogen identification. These factors and suggested controls will be considered for major diseases that occur on turfgrass sod.

Although the potential exists for a variety of diseases to occur on turfgrass grown for sod, the following major diseases will be considered in some detail:

- Helminthosporium leaf spot and melting out
- Rhizoctonia blight (or brown patch)
- Red thread

HELMINTHOSPORIUM LEAF SPOT AND MELTING OUT

This disease is easily recognized in the intial stages by development of tiny, circular spots primarily on Kentucky bluegrass and fine fescue. The spots finally enlarge and turn purple with light brown centers. The difficulty is not in identifying the disease but in controlling the problem. Most of the control difficulties occur because attempts are made after the problem has become severe.

On susceptible turfgrasses, such as older common cultivars of Kentucky bluegrass and fine fescue, certain conditions are required before this disease becomes a real problem. Knowing this and either changing the conditions and/or applying fungicides

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when these conditions occur enhances control of this disease. Conditions that favor this disease include:

- Cool (50° to 70°F) and wet weather
- Overcast skies
- Poor mowing practices
- Susceptible turfgrass cultivars

Although this disease normally occurs in spring and fall, it is most severe during cool wet springs. Control is best initiated during early spring. Begin by mowing the turf properly and not allowing it to get too tall before mowing. Apply a fungicide such as Daconil 2787, Dyrene, Banner, Borlan, Fore, or Chipco 26019 during early spring before severe leaf spot develops. Several applications may be required depending upon the fungicide selected. One or two applications in April or May of Chipco 26019 will provide acceptable control, especially if coupled with good watering practices later, presumably in the summer.

RHIZOCTONIA BLIGHT (BROWN PATCH)

Rhizoctonia blight can be difficult to identify from overall symptoms. These overall symptoms include circular patches that resemble several other patch diseases. Therefore, to diagnose this problem, one must also look carefully at individual grass plants and evaluate temperature and moisture conditions.

A leaf spot symptom will often occur on the turfgrass. It is especially evident on tall fescue. The leaf spot generally begins as an irregular, water-soaked area. Later, the center of the leaf spot turns straw-brown or ash-brown in color. Most often the leaf spot is surrounded by a dark border. The size of the spot will vary, but generally it is slightly smaller than the leaf blade width. It appears much like a dollar spot lesion, except with darker and more irregular margins. The lower leaf sheaths often turn brown, and the leaf collapses. The crown and lower leaf sheaths are often covered with a network of fungal mycelia and sclerotia. These signs of the fungus can be observed with the naked eye or with the aid of a 10X hand lens and often are used as a diagnostic aid.

Rhizoctonia blight is most severe when temperatures are warm--75° to 85°F-- and moisture is available. The problem often occurs when the turf is being improperly irrigated, such as with frequent, light waterings.

Control of Rhizoctonia blight should consist of adjusting irrigation practices and/or applying fungicides when conditions exist for disease development. Fungicides recommended for Rhizoctonia blight include Daconil 2787, Tersan 1991, Dyrene, Chipco 26019, and Bayleton.

RED THREAD

The disease that had been known in the past as red thread has been identified as two diseases in recent years. Red thread, caused by *Laetisaria fuciformis*, occurs on bentgrass, fine fescue, ryegrass, and bluegrass, while pink patch, caused by *Limonomyces roseipellis*, occurs on perennial ryegrass and red fescue. It is believed that red thread is the more common disease, and the red thread-like structures on the turfgrass blades provide a fairly easy method to identify it.

Red thread has been occurring on a more widespread basis in recent years. It was formerly thought to occur during the cool, moist spring and fall, but it appears that the only requirements are moderate temperatures, above 32° and below 85°F, and moisture. The fact that outbreaks can occur almost anytime of the year makes the disease difficult to control.

Satisfactory disease control can be obtained if control measures are initiated before the disease becomes severe. Work over the past few years in Ohio indicates that two fungicide applications, one in April and one in May, offered nearly season-long control. However, if the first application was delayed, then satisfactory control was very difficult to obtain and required several fungicide applications. Fungicides that are recommended include Daconil 2787, Chipco 26019, and Bayleton. One application of Bayleton at 1 to 2 ounces per 1,000 square feet will provide excellent control if applied in early spring--perhaps as much as twelve weeks of control.

PATCH DISEASES

Patch diseases have been causing severe problems on lawns. These patch diseases seem to occur primarily on lawns that have been sodded recently, such as in the last two to four years. In most of these cases, the turfgrass had developed a poor root system, in that roots never penetrated the soil beneath the sod. This turfgrass is then susceptible to many problems, including several patch diseases. What is actually occurring is little understood at this time and, in fact, little is known about the patch diseases. Therefore, control is next to impossible.

Several patch diseases are reported to occur, including yellow patch, Fusarium blight, summer patch, necrotic ring spot, and Leptosphaeria blight. About the only successful treatment of these diseases has been to renovate, either partly or totally, and to reestablish the turf.

The patch diseases are mentioned here to alert you to a problem that is occurring in sodded lawns. Unfortunately, patch diseases are poorly understood at present.

SUMMARY

There are many other diseases that can occur on turfgrass grown for sod. However, the principles discussed here apply to the other diseases. That is, each disease has to be correctly identified and then correctly treated based on its identity.

THE IMPACT OF THE NEW KID ON THE BLOCK

Kent W. Kurtz

Moving into a new neighborhood can be a frightening experience, especially to a young, unseasoned individual. The person can be readily accepted, mildly rejected, or completely ignored. Sometimes people will be friendly in the beginning, but as time goes on, they will lose interest and merely go about their business. For the sports turf manager and their national association (STMA), the new neighborhood is the turfgrass management field where groups such as the golf course superintendents, landscape contractors, professional grounds managers, lawn care applicators, cemetery managers, sod producers, park and recreation groups, and many others are actively pursuing their own endeavors throughout the United States and providing valuable support to their groups. The STMA is the "new kid on the block" and has many challenges.[1] Initially, the concept of STMA, as conceived by its founders, was strong, but the machinery was not available to drive it forward. Within the past two years new members, new officers, new ideas, and new energy have been inserted and the new, rebuilt, rejuvenated STMA is once again "chugging along the tracks."

Early sports turf pioneers were overshadowed by the strong emphasis on education and research to support golf course management. In 1956, Tom Mascaro and colleagues surveyed the athletic field and recreational field markets and found that the little red school house was gone and in its place, there were large sprawling physical plants that offered a wide range of recreational facilities. To everyone's surprise, this survey revealed that in Pennsylvania in 1956, there were 400 golf courses and over 7,000 athletic fields.[2,3] And that was 30 years ago! They discovered that the athletic field market was far larger than any other phase of the turfgrass industry and then as now, every community has recreational areas. Schools today, like yesterday, are extremely interested in providing safe, usable turf areas for their students. More time and effort need to be devoted to the improvement and betterment of school athletic fields and community recreational areas. Assistance and help is urgently needed.

The sports turf industry has been stagnant far too long, a sleeping giant. Look around at many of our local high school ball fields, community playgrounds, and youth sports facilities, and you can see deteriorated turfgrass areas. Sports turf facilities have taken the back seat to other priorities in budgets, financial considerations, and importance. Many facilities are so degraded through neglect that they must be completely rebuilt or renovated. On a moderate budget, with weekly maintenance, many of these crisis situations may have been prevented.

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Those of you who have made the effort to attend this meeting today, who have joined the ITF and STMA and who have made certain sacrifices are to be commended. STMA members are truly pioneers in a profession that very soon will explode into something never before witnessed or seen in the green industry. Each of you has had the foresight to get involved, to improve yourselves, and to improve your facilities. In 1985 when industry leaders met in Beltsville, Maryland, as the National Sports Turf Council (NSTC), the noted agronomist and turfgrass science pioneer, Dr. Fred Grau, remarked, "We have taken a mighty big step toward safer sports turf. The shot fired here will be heard and seen around the world."

THE CURRENT CRISIS IN THE NFL

At the present time all National Football League clubs are limited to 45-man squads. These 45-man squads increase the likelihood of chronic injuries since players are pushed to return to the field too soon after being injured. The players want the owners to consider returning to 49-man rosters. Another factor affected by the injury controversy is the endless dispute over artificial turf. The National Football League Players Association (NFLPA) is considering implementing salary bonuses for players whose clubs play on plastic grass. The NFLPA would like to see more research on the shoes worn on artificial turf. They will seek a moratorium on new artificial turf stadiums or conversions; however, while they wait, the injury grievance list is growing. To date in 1986, over 300 players went on injured reserve.

LAWSUITS, INJURIES, AND INSURANCE

Litigation in the sports world is a serious problem, especially on our school and municipal playgrounds and sports fields. In 1984 more than 189,000 children in the U.S. required hospital care for playground injuries. In 1980 there were 130 awards of one million dollars or more across the U.S. By 1984 there were a record 401 awards of one million dollars or more, and many were related to playground injuries. Here in Chicago a two-year-old child fell eleven feet to a hard surface from a playground slide and received severe brain damage. The settlement cost the City of Chicago over $20 million and resulted in the removal of all slides over 6.5 feet tall from 513 parks. Ridiculous? Yes, but since most injuries occur from hard surfaces such as hard clay, every sports turf manager is open to a lawsuit if the surface is not acceptable and capable of impact-absorbing characteristics. The current problem is obtaining and keeping liability insurance. The costs have accelerated, and many entities cannot either afford it, or even find it.

THE CHALLENGE

In the early 1960s, sports fields and in particular football fields on all levels of competition consisted of "five yards and a cloud of dust." When it rained, these worn-out, over-used pastures turned into mud bogs. When they dried out, they were hard and compacted, and numerous injuries resulted. During this era, technology, research, education, and advancements on sports turf lagged far behind the accomplishments and developments occurring in the field of golf turf management. Manufacturers of synthetic surfaces took advantage of this passive period in sports turf history and began replacing natural grass fields with their products. For over twenty years, natural grass advocates and the sports turf industry have been attempting to recover and gain back their lost prestige.

The time is now! With the mounting number of severe injuries and the overwhelming opposition to artificial turf by over 80 percent of the NFL players, natural grass is once again gaining favor and is being looked upon as the hope and salvation for the sports turf industry.

STMA and the sports turf industry must meet this challenge, but it will take an all-out effort by everyone to bring the technology, ideas, research, innovations, products and education into alignment with what is needed and expected in the next decade. It will require putting aside selfish interests, petty jealousies, and personal accolades to pull together and join the team for a common cause. Natural grass that is well-maintained can be a powerful factor in reducing injuries to athletes because it is resilient and forgiving.

REMOVING THE PAST IMAGE

To the average spectator or casual observer, the image of the sports turf manager is that of a custodian, janitor, or farmer. We are frequently seen in work clothes adjusting sprinkler heads, fertilizing fields, mowing grass, putting out chalk lines, spraying weeds, trapping gophers, topdressing with sand, sowing seed, or just admiring the grass.

It is time to begin changing direction and removing this misconception to gain the respect and receive the recognition so long overdue in this profession. Today's sports turf manager can be compared to the greenskeeper of 40 or 50 years ago. That greenskeeper is now a golf course superintendent, but his recognition, status, and professional image did not emerge overnight. He spent many years of hard work, image building, and education to achieve and earn has professionalism. The Golf Course Superintendents Association of America was organized 60 years ago with the intent to upgrade their members and improve their profession. For the most part, they have accomplished their goals by sponsoring an annual conference and trade show, conducting national and regional seminars, initiating a certification program, developing a continuing education program, and encouraging young aspiring superintendents to get a degree at either a two-year or four-year turfgrass institution. They support this latter area with scholarships and research grants.

STMA recognizes the need for similar accomplishments, and its leaders maintain the desire for STMA to build a strong foundation similar to GCSAA.

THE FUTURE

The primary goal for STMA is to increase membership and interest among those individuals who care for this nation's playgrounds and sports fields from the supervisor of the high school ball fields to the professional stadium manager. The future is now! To remain current in the field of sports turf management, everyone involved must combine the science of growing turfgrass with the art of maintaining sports turf.

The progressive sports turf manager, just to stay current with this everchanging field, will find it essential to attend seminars and workshops,

industry-sponsored training sessions, regional and national conferences, and trade shows and may find it necessary to take classes taught by continuing education centers, universities, or technical centers. The future involves a great deal of reading, digestion of information, studying, and planning just to catch up with the golf course profession. Anyone who doesn't want to pay the price for this success should move aside and let others take the leadership role and experience the excitement and enthusiasm derived from providing the athlete with the very best, safest, and healthiest sports turf possible.

Sports turf is entering a very challenging and exciting era, and "the new kid on the block" can make a very important and significant impact on the future of the sports turf industry. It is the responsibility of everyone concerned or connected with the management of sports turf to work hard to make this dream a reality. Only through joining the forces of industry, education, research, and the sports turf management can the future be realized. One solid foundation can be the strength to build the future. The Sports Turf Manager's Association has the foundation and the resources to unify and unite this industry. We need each and every one of you to provide the strength to accomplish this endeavor. For it was once said, "to know anything thoroughly, teach it to others." Let STMA, the new kid on the block, provide the impact and help in the teaching. Get involved today and be a part of its future.

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WETTING AGENTS CONTRIBUTION TO A BETTER PLAYING SURFACE

Demie Powell

NO ONE ANSWER or WONDER PRODUCT will do your job for you. The many products and practices available to you must be MANAGED together to establish and maintain a quality playing surface. I am going to concentrate on just one of these products or "tools": soil wetting agents.

There are numerous wetting agents available, and there are differences between them. You must know what to use, how, and why--but I'm not here to talk about that. Come to the trade fair for that information. This time is designed, instead, to talk with you about the general contribution of wetting agents to optimum sports turf.

WHAT CONSTITUTES A GOOD PLAYING SURFACE?

Borrowing from a fairly recent article in *SportsTURF* magazine, a good playing surface is the goal of professional sports turf managers. A good playing surface is a playing surface with a dense, uniform stand of turfgrass that provides optimum footing, a resilient cushion for falling athletes, and a reliable bounce. Therefore, a key component of a good playing surface is uniformity of turf cover.

WHY DO WE NEED BETTER PLAYING SURFACES?

Unfortunately, none of us has to think too long to have some not-so-good playing surfaces come to mind--and they are not all overused municipal fields. So even though we know what constitutes a good playing surface, achieving one is apparently not that easy. Often, poor drainage and compaction work against dense and uniform turf. The result is nonuniform turf cover, poor footing, no cushion for falling athletes, unreliable bounces, and--perhaps worse of all--cancelled games. Hence, we need better playing surfaces because too many sports fields are in poor condition. This works against the professional image of sports turf managers and the acceptable image of natural grass playing fields.

I ask you to consider some of the basic requirements for vigorously growing turf. A key factor is a vigorously growing root system. The surface condition of any turf is, to a great degree, determined by the below-the-surface condition of the roots.

Now consider some of the basic requirements for good root growth. A key factor is sufficient soil moisture. Thus, infiltration, drainage, and uniform wetting are necessary for good root growth, which is necessary for good turf growth, which is necessary for a better playing surface.

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In light of this, it is interesting to note that the most common water-related problems in turf management are localized dry spots, slow infiltration, and poor drainage. These are all factors in those major sports turf management problems of compaction, wet areas, and unplayable turf.

Thus, a product or practice that alleviates these water-related problems and contributes to sufficient soil moisture will, in turn, contribute to better playing surfaces. Soil wetting agents are such products.

WHAT ARE SOIL WETTING AGENTS?

Soil wetting agents are a) types of wetting agents specifically designed for use in soil; b) surfactants, which means they lower surface and interfacial tensions of liquids. For our purpose, we are loosening or lowering these tensions in water to let the *water move*; c) water management tools used in many of the green industries to give you control over where water moves after it is applied; and d) organic chemicals that work with water in a physical way as it moves across or through things.

WHAT DO SOIL WETTING AGENTS DO?

a) As mentioned, a soil wetting agent is a surfactant, which means it works at surfaces: the surfaces of water molecule to water molecule and the surfaces of water to something else, such as thatch.

b) At these surfaces, soil wetting agents lower the tensions or "loosen the skin" that forms around water molecules and between water and other things. A molecule of soil wetting agent has one part that is water soluble and one part that is water insoluble. Because of this, the soil wetting agent collects at the surfaces and, in essence, pokes through the "skin."

c) The result of this lowering tension or "loosening the skin," is that the water spreads out and crosses interfaces more easily.

d) Another aspect of this freely moving water is that anything in the water or anything moved by water, such as fertilizer, pesticides, air, etc., will be moved more easily too.

e) One last thing a good soil wetting agent does is to stay in the soil so you have continued control over water movement because there is a continuous loosening of the tensions.

Well, that is what constitutes a good playing surface, why there is a need for better playing surfaces, and what soil wetting agents are and do. Now comes the all-important question to tie these things together:

WHY OR HOW DO SOIL WETTING AGENTS CONTRIBUTE TO BETTER PLAYING SURFACES?

Remember that some of the key factors contributing to poor playing surfaces are problems associated with poor water movement into, out of, and uniformly throughout the soil.

Remember also that a soil wetting agent's primary function is to improve water movement into, out of, and uniformly throughout the soil.

It stands to reason then that soil wetting agents, by improving water movement and alleviating water-related problems, will indeed contribute to the establishment and maintenance of better playing surfaces.

Now, that is a logical conclusion, but we all know that what is reasonable is not necessarily true. So I want to finish up by relating the experiences of several of your colleagues with regard to how soil wetting agents contribute to better playing surfaces for them.

Due to some public relations and endorsement restrictions, I am not at liberty to specifically quote all the professional sports turf managers who are using wetting agents in their turf programs. However, I am at liberty to quote some of them and to tell you about the benefits being realized by others. Four recurring comments are:

1. Better drainage
2. Less compaction
3. Better fertilizer response
4. Better rooting

More specifically, wetting agents have helped on bowling greens to alleviate localized dry and hard spots and to enhance the effects of fertilizer. The result is more uniform turf and a better playing surface.

On world lacrosse championship fields at a university, wetting agents contributed to what the players said was a better playing surface because it wasn't wet on top. This sports turf manager also noted less compaction and a denser turf.

Then there is John Van Brunt at the Randolph Township Park and Recreation Department in New Jersey who relates the following contributions that wetting agents make to better playing surfaces: "One park we maintain had problems with channeling water causing puddles, poor rooting, and disease. A wetting agent program has allowed those areas to drain well because of uniform water infiltration. The result is vastly improved rooting and turf condition."

"The other park with six soccer fields and four baseball fields that are used seven days a week has shallow topsoil, so there is compaction and poor infiltration. The wetting agent there has evened out the water movement and helped with the compaction so the turf growth and cover is better."

It's easy to hear that wetting agents help Randolph Township by contributing to turf growth through better infiltration and enhanced fertilizer response. Better turf growth makes a softer, safer, and a better playing surface.

Even in areas where games are played on artificial turf, practice fields are often natural grass, as is the case in Kansas City. There a wetting agent program is used to ensure sufficient soil moisture for optimum rooting of newly sprigged turf. This same benefit is realized when looking for strong sod establishment on sports grounds. The wetting agent program also contributes to managing compaction. Better water movement means less compaction, which means less wear from traffic, which means better turf, which contributes to a better playing surface.

John Liburdi, the head groundskeeper at Heritage Park, home of the "AA" Albany Colonie Yankees Farm Club, says the greatest contribution wetting agents make for him is fewer games postponed due to poor field conditions. Specifically, he has less standing water, a deeper root system, and finds that it takes less time, labor, and expense to get the fields ready.

Finally, probably the toughest test is the situation of the natural turfgrass major league stadium. The contribution that wetting agent programs can make to a better playing surface there has been described in the following ways: drainage is the number one concern. Wetting agents keep the water moving so there is less perched water in the rootzone profile. Better drainage means less compaction from the traffic and definitely contributes to better rooting. A better root system means better turf, and that means a better playing surface.

AERIFICATION, TOPDRESSING, AND FOLLOW-UP MAINTENANCE

Steve Wightman

Proper aeration, topdressing, and maintenance of an athletic field can and should promote a playing surface that will provide the ultimate playability under virtually any weather condition and field activity. A good turf management program cannot exist without these important items.

If the outcome of the game was determined by the competing team's abilities rather than by field conditions, then we've done our jobs as field managers. However the old adage, "We get nothing for nothing," certainly applies to the management of sports fields. Unlike the Timex watch, an athletic field cannot "Take a licking and keep on ticking" without replenishing the field with the items that are taken from it.

Field activity will take away turf, soil, and drainage properties. With overseeding, topdressing, and aerification, we can put back those items. The more use a field has, the more care it must be given, for there are no miracles to take the place of a well-formulated and executed maintenance plan.

AERIFICATION

Aerification is, without a doubt, the most important item within the turf management program and yet, perhaps, the most neglected. Aerification provides the avenue to the plant for oxygen, water, and nutrients. This allows for more efficient use of water and nutrients, which leads to deeper, stronger, and massive root structure providing the turf with better wearability. A good aeration program will also allow excess surface water to drain away from the surface more quickly so a game can be played under better conditions.

Aeration includes anything that opens up the ground allowing the turf to "breathe." Coring, slicing, and spiking are good aeration methods to accomplish this, and core aeration is perhaps the best because it maximizes the duration of the aeration process.

A three-to four-inch deep penetration with a 1/2-inch to 3/4-inch diameter hole spaced every two to four inches would be a good aeration pattern. If the aeration holes are too close together or too shallow, there could be a problem with the turf ripping out during activity such as a football game.

The process of core aeration does create field damage, which makes application time important relative to field activity. One certainly would not want to core aerify on game day!

Steve Wightman is Field Manager, Mile High Stadium, Denver, Colorado.

Slicing is also a good way to open up the ground to promote drainage. A thin cut does very little damage to the surface, so slicing is a good aeration method if time is of the essence. Slicing could be done even on game day, however the duration of its effectiveness is much shorter compared to core aeration.

A good core aerification program on a heavily used field would normally amount to five to eight times per year and double that if slicing is used. A majority of the aerations should be administered during the summer months when temperatures are hot and greater amounts of water can be applied.

For maximum penetration from aeration, it's best to have the ground soft and pliable, such as after heavy irrigation or rainfall. Along those same lines, a greater amount of compaction occurs when the ground is wet. So if a particular turf area is scheduled for heavy activity, it would be best to have the ground a little on the dry side.

The proper moisture content within the turf area is critical for maximizing playability, and with proper aeration a field can better withstand the damaging effects of play under wet conditions. Surface water, whether it be from rain or melting snow, can be drained away more quickly into the turf's growth medium to allow for better playing conditions. However, the effectiveness of the aeration process is diminished by the field's substructure.

If a field is made up predominately of clay and silt, it will be some time down the road until the full benefits of aeration and topdressing will be fully realized. To maximize the field's playability, it must be built from the bottom up rather than from the top down. If a field contains a deep, porous substructure, the water will have a place to go where it can be stored until it is taken up by the plant. The important thing is to try and get it as far away from the surface as possible so good footing can be achieved.

The decision made as to the field's substructure will have a lot to do with the fields's playability for many years to come.

TOPDRESSING

Topdressing is another important element we must put back into the field if it is to "keep on ticking." Proper topdressing should be done in conjunction with aeration to maintain a level, porous, stable surface.

There are three basic types of topdressing materials, each having some advantages as well as disadvantages. The best in promoting drainage is washed sand and various soil amendments that will not compact. And since good drainage is usually the biggest problem with athletic fields, it makes these materials excellent as topdressing materials.

Washed sand and soil amendments are easy to level and apply, interfere very little with field activity, provide an easy growth medium for the turf, and they can be purchased with uniformity and consistency.

The disadvantage with sand is that it is virtually void of all nutrients, so an increased fertilization program may be necessary if sand is used extensively.

Another basic type of topdressing material is loam soil. By definition, loam soils contain a certain amount of clay and silt, which are good materials for holding moisture for seed germination but they compact.

Loams are good for leveling and providing a firm growth medium for the turf, but they interfere with field activity if wet conditions prevail. Loams also contain some nutrients and heat-generating qualities. A big disadvantage with loams is their inconsistent texture and cleanliness. Careful consideration should be given to the composition of a loam topdressing to avoid applying material full of twigs, rocks, and weed seeds which can lead to much unnecessary work and expense to eradicate.

The third basic type of topdressing materials are the organics, which include peatmoss and manures. The biggest advantages with these are their nutrient and heat-generating qualities, which make them excellent for seed germination and turf development.

Disadvantages include odor, interference with field activity under wet conditions, and compaction which, if compacted enough, can actually seal off the surface, preventing water and oxygen movement.

The ideal topdressing material would incorporate all three materials into one mix so that the advantages of one would outweigh the disadvantages of the other. During field renovation, which usually occurs immediately after the season, a mix of 60 percent washed sand, 20 percent sandy loam, and 20 percent organic material would dress the field quite well in preparation for the next season.

Under heavy field use, it would probably be necessary to topdress during the season to maintain a suitable surface. In this case, a pure washed sand material in conjunction with aeration would address the problem of compaction, which is the most important element at this time. Also, sand interferes the least with field activity.

There are many different types of topdressers available, but I think the important thing is to provide uniform coverage in the right amounts. Having piles of material here and there can lead to suffocated turf and a bumpy surface. To get the material down into the turf it should be applied when the grass and material are dry and then worked in by the use of a dragmat. This will also help to level the area as well. Another good leveling tool is heavy irrigation, which will also move the material down into the turf area.

Topdressing should be applied when the ground is dry, following aeration and overseeding. The dry ground will withstand unnecessary compaction from the topdressing equipment.

An excellent time to fertilize would be just before irrigation after topdressing since the ground is dry and scheduled to be heavily irrigated.

A well formulated plan executed at the optimal time to maximize the benefits of each item will provide for optimal playability all season long. Aerification and topdressing are only a part of the total turf management program, yet I feel they are the most important in providing a playing surface that is strong and wear-tolerant. A good management program can provide a field that is timeless and one that can "Take a licking and keep on ticking" year after year.

TIMELY TIPS ON ACHIEVING A GOOD BALL FIELD

Roger Bossard

A top groundskeeper who maintains a good ballfield can be worth ten to twelve games. Of course, this can mean the difference not only in the standings, but also in the pocketbook. The difference between first and second place can mean thousands of dollars, so a good field is extremely important. Some of the ways to achieve a good ballfield are:

1. Working habits and knowledge. To have a top ballfield, a lot of hours and hard work have to be put into it. Along with this, knowledge of different soils, fungicides, and players' needs is very important.

2. Infield soils. Seventy percent of all action on a ballfield is on the infield. This area has to be perfect at all times. The proper mixture for this is clay/surface and water at different degrees, depending on the ballplayer and the team you are playing.

3. Drainage and pitch of field. These two things are the second most important parts of the field. If not done in a proper manner, it will not only reflect on the field, but also on the ability of the players.

4. Different types of grass. As we all know, there are a number of varieties that are available and accessible. When mixed together properly, they will ensure you of an excellent playing surface.

   The other things I will be covering will be soil incompatibility, bringing grass out of dormancy, and tricks of the trade to help your team win.

Roger Bossard is Head Groundskeeper, Chicago White Sox Baseball, Inc., Chicago, Illinois.

CONSTRUCTION OF A CHAMPIONSHIP SOFTBALL FIELD

Mark Hodnick

If you decided that you were going to construct a building, you would follow a definite series of steps to ensure that the structure was appropriate for the use and that it is properly constructed. Unfortunately, many people do not exercise the same care when constructing a sports field on which they or their children could be playing. All too often, playing fields, and especially ball fields, are merely cleared and graded off parcels of land, with some grass seed scattered over them. This presentation deals with all of the steps that were followed during the construction of a women's softball facility at Cal Poly Pomona as an example of the way in which a sports field should be planned and constructed.

THE DESIGN PROCESS

The success of any project is a direct reflection on how well it was planned, and this is especially true in athletic field construction. Before the first pencil mark is put on a piece of paper, certain decisions must be made concerning the field and how it will be used. The first of these decisions concerns the "level of play" on the field. The level of play includes addressing the question of who will use the field. Is it a Division I NCAA field used exclusively for intercollegiate play? Or is it going to be open to all of the local leagues and pick-up games that are always looking for a place to play? What are the dimensions of the field? Is it going to be used by both men and women? Are youth leagues going to use the facility? At this point, if the field is going to be used by both men and women or youth leagues, a decision must be made concerning the outfield fencing: whether to have it at all or to make it portable. The final step in determining the level of play on the field is to determine how much play you anticipate the field getting and whether or not it is going to need lights.

The second step in the design process is the one that is most often ignored or forgotten about: the maintenance level. Are the people who are responsible for the new field able to maintain it and to what extent? The primary issues that should be addressed when deciding how elaborate or basic the new field should be include (a) how much money will be available for maintenance; (b) personnel resources--will there be people available for the maintenance or will it require the hiring of additional staff; (c) what kind of equipment is available for the maintenance and is it appropriate; and (d) what level of maintenance will the user of the field require? So many injuries and their accompanying law suits have been the result of people not addressing the question of maintenance in the very beginning.

Once the questions concerning the level of play and maintenance of the field have been addressed, the design criteria or physical requirements of the facility

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should be communicated to the architect. To state it another way, this is the time when the superintendent sits down with the designer and discusses the "nuts and bolts" as to how the field will be constructed. Important aspects that should be covered at this time include the grading plans and the drainage of the field. When the field was constructed at Cal Poly, we felt that because of the soil conditions and the location of the field, it was necessary to include a subsurface drain system under the infield to ensure that any excess water would be carried off quickly.

An item always of major concern in Southern California is what type of irrigation system the new field will have. At Cal Poly, we are standardized as to what types of controllers, heads, and valves are installed on all of our new projects. This has simplified our maintenance as well as our parts inventory. Other considerations that should be made when the requirements for the irrigation system are being discussed include the location of the quick-coupler valves for infield watering and whether or not moisture sensing devices will be installed on the field.

The next item on the list of design criteria is the turf type and the planting method to be used. The turf should be appropriate to the sport that is going to be played on the field and compatible with the maintenance that it will receive. On the Women's Field at Cal Poly, we chose Tifgreen Hybrid Bermudagrass. The primary reasons were that our other intercollegiate fields have the same type of turf, and the coaching staff prefers the low height of cut at which we can maintain the turf.

Other requirements that should be communicated to the architect include what type of infield mix is preferred if the new facility is a ball field; the dimensions of the warning tracks; types and heights of fences and backstops; and the spectator requirements. Included in the spectator requirements should be the amount and types of seating, the type of public address system, parking requirements, restroom facilities, and facilities for concessions.

THE BID PROCESS

Once the plans and specifications are complete, it is time to find a contractor to build the facility. Cal Poly is a state-owned school and therefore must put all major construction projects out for competitive bid, and the contract must be awarded to the lowest responsible bidder. Therefore to ensure that we get the quality of work that we desire, we require that all of the bidders meet certain prequalifications before we will accept their bids. They must provide evidence to us that they have successfully constructed several projects of the same size and scope. With this evidence, they must include the name of the owner as well as the inspector and where they can be contacted. The bidders must also attend a mandatory "Job Walk." This is a prebid conference at which all of the contract documents are reviewed and the construction site is visited. This "Job Walk" is critical to having a successful project because it is at this time that the plans and specifications are clarified and questions concerning the job can be answered so that there are no surprises for either side once the project is under way.

THE CONSTRUCTION PROCESS

Once the field is finally under construction, there are a few more guidelines that should be followed. From the beginning you should develop a good working relationship with the contractor. Avoid the pitfall of an adversarial attitude. Remember that your goal is to build a championship field; the contractor wants the same plus a profit. Make continual site inspections and be willing to discuss problems that arise so that they can be solved quickly. Finally, keep accurate

records of the project. This includes making records of conversations and verbal agreements. Be sure to put all major agreements into writing.

A championship field, just like a championship team, does not just happen. It must be properly planned, formed, constructed, and maintained. The process requires commitment and at times perseverance, but like a championship team, the field too will be a winnner.

OPTIONS IN DRAINING SPORTS FIELDS

Dave Heiss

Bypass drainage is a technique for properly draining sports-turf areas. The need to drain soils used for sports turf has long been recognized, but many people install an agricultural tile system and expect it to properly drain a specialized sports-turf area. The farmer stays off his ground when it is excessively wet, whereas the sports-turf area is used irrespective of the weather.

Bypass drainage is sometimes called sand slitting, and both terms accurately describe the function. To understand sports-turf drainage is to recognize that surface water must move rapidly to the drain tile. Tiles are passive structures that can carry water but that have no ability to "pull" water from the soil. Tiles that are placed with soil between the tile and the surface leave a barrier between the tile and the surface water. The surface moisture must move through the soil before it can enter the tile. Bypass drainage uses a column of fine-grained sand to extend to the surface where the turf is growing. These columns of sand have a known infiltration rate and allow water to move rapidly to the tile. Additionally, the site requires a sand top dressing to prevent the lines from becoming closed with soil.

The ideal sand used is 1/4 millimeter in diameter with at least 80 percent of the sand being uniform. A sand of this nature allows for rapid movement of water, while at the same time exerting a strong capillary action to pull excess moisture from the surrounding soil. Trench width must never exceed 2 inches. Otherwise, the line can become droughty under dry conditions in mid summer and cause wilting of the grass over the sand slit. A 35-millimeter perforated tile is placed in the bottom of the 20-inch column for rapid water movement. Finally, these lines are placed 40 to 60 inches apart and are crossed at right angles on 20-inch centers, with narrower columns of sand 5/8 inch in width and again extending to the surface.

The above system is designed according to an engineering formula for guaranteed moisture removal within a stated period of time. Bypass drainage will function as designed and always remove the stated amount of water, provided the installation is not allowed to downgrade through poor management technique and the outflow is not restricted. The bypass drainage system thus described is not an experimental product. Rather, it has been installed in many parts of the world and has been proven successful. Its success, however, is contingent upon proper engineering and installation techniques.

Dave Heiss is Technical Representative, Turf Services, Inc., Spring Lake, Michigan.

AGRI-DIAGNOSTICS

Vonnie Estes

INTRODUCTION

Golf course superintendents spent more than $65 million in 1985 on fungicides to prevent and cure turf diseases. How does the golf course superintendent distinguish one disease from another? And more importantly, how can the disease be detected before it is too late? Up to now, disease diagnosis has been based on the individual golf course superintendent's training and experience. Or it involves a two-week wait until results come back from a lab.

Now there is a new alternative called the Agri-Diagnostic Disease Detection System for Turf. Each kit is designed to detect a specific turf disease quickly, accurately, and easily. The Agri-Diagnostic Disease Detection System for Turf is an immunoassay test using monoclonal antibodies to identify turf diseases. Detection kits for Pythium blight, dollar spot and brown patch will be available.

MEDICAL TECHNOLOGY

Antibody-based diagnostic tests have been used by the medical industry for ten to fifteen years. Current uses of Antibody-based tests are now used in the medical field for pregnancy, infectious disease diagnosis, levels of drugs of abuse, tumor markers, and levels of therapeutic drugs.

AGRONOMIC USES OF TECHNOLOGY

Antibody-based tests can be useful tools in managing agronomic practices. The tests are rapid, reliable, and economical. Diagnostic tests have a number of applications in agriculture. They can be used for detection of plant diseases such as fungi, bacteria, and viruses; detection of plant pests such as nematodes and insects; chemical analysis for residue, reapplication, and exposure; in the seed industry for breeding trials, certification, and genetic purity; and crop management for drought stress, nutrient deficiency, crop maturity, and plant hormone levels. Detecting levels of these substances influences management decisions such as crop rotation patterns, variety selection, use and choice of seed treatments and fungicides, crop destruction, and post-harvest handling and treatment.

Many applications exist for antibody-based tests for plant disease diagnosis: rapid diagnosis of diseases, detection of infection prior to symptom development, detection and quantification of pathogens, and quantification of disease levels.

Vonnie Estes is Product Support Specialist, Agri-Diagnostics Associates, Cinnaminson, New Jersey.

The Agri-Diagnostic Disease Detection Kits for Turf are based on antibodies. Our scientists have created very specific antibodies that attach to specific plant pathogens. After creating the antibodies, the challenge was to put the test in a format that can be used in a golf course superintendent's office. The traditional method of antibody-based tests is a multiwell format where a color change in a well indicates a positive for the specific disease. This requires expensive lab equipment. Agri-Diagnostics has transformed this format to a dipstick convenient for field use.

TEST PROCEDURE

The elapsed time for running a test is about three hours. Actual, hands-on time is about 20 minutes. Here's how it works: first, collect samples. Sample collection is one of the most important parts of the test. The results can only be as good as the sample tested. You may want to sample from disease spots to confirm diagnosis before treatment or from off-color spots of unknown cause or from areas of possible disease problems to monitor pathogen development.

Label your samples and take them back to your office or bench. Grind the sample with the EXTRAK™ Sample Preparation Pad until the strips are covered with plant sap. Any pathogen that was present in your sample is now on the EXTRAK™. Place the strip into Tube 1 and shake. If your sample was diseased, the pathogen is now in Tube 1. Remove the strips and add liquid from Bottle 1, which contains disease detection solution. Place a dipstick into Tube 1. Any pathogen present in Tube 1 from your sample will now attach to the membrane at the bottom of the dipstick. Rinse and place the dipstick in Tube 2. Add solution from Bottle 3 to fill line of Tube 3. Rinse the dipstick and place it in Tube 3. This step causes a color change. If your sample contained the specified disease, a violet dot will appear on the membrane. Use the electronic meter to find out how rampant the disease is.

FEATURES AND BENEFITS

The Agri-Diagnostic Disease Detection Kits for Turf offer a variety of features and benefits. The kits allow for early disease detection so that the golf course superintendent can apply the correct management practice to prevent turf damage. Positive disease detection allows the golf course superintendent to select the correct chemical at the correct level. The test gives rapid results so same-day decisions can be made. The golf course superintendent can monitor disease levels in order to apply chemicals with optimal timing. By using the latest technology, golf course superintendents can manage their courses scientifically. The digital meter helps the golf course superintendent keep precise disease records. The Agri-Diagnostic Disease Detection Kits for Turf help the golf course superintendent decide when to spray, what to spray, and how much to spray. All this is done with a certainty previously unavailable.

CURRENT STATUS

Kits for Pythium blight, brown patch, and dollar spot have been field tested by Agri-Diagnostics, university cooperators, and golf course superintendents. The tests will be test marketed in select regions in the spring of 1987.

COMPUTERS IN GOLF COURSE MANAGEMENT

Tom Guttschow

Does every golf course superintendent and turf manager need a computer in his or her office? This is a question that I will try to clarify and answer for you.

There has been a lot of publicity about computers and how they can make your job easier, save you time, and make you a better manager. In reality, sometimes, it makes your job much harder, makes you a crisis oriented manager, and causes a great deal of frustration. Hopefully, we can lay down some guidelines so you can avoid the second scenario and get to the first part of the statement. You have to think of a computer as a tool and a machine, not a mystery box. The mysteries surrounding a computer are not a "cure-all" for all your problems. Thus, a computer is like a telephone, one more tool for you to use, and it can become a very time-saving tool. The computer technology is reaching the state today where it is like the telephone, in that you don't have to know a great deal about it to use it. You could live very well without the telephone, but let's face it, it does save time: you pick it up, dial, and talk. Not a long learning process, and very easy to use. The computer is slowly reaching this level. It wasn't always this way.

To learn to use a computer and run software programs took 30 to 40 hours of very intense reading and doing, and in most cases, it was very boring reading. Now, in 15 minutes you can scan a short manual and get a computer up and running and be producing memos and letters in half an hour. A computer is just a machine, and a very dumb machine at that. Self-standing, without your direction, it is helpless and wouldn't even make a good boat anchor. It is like a telephone without wires: not being connected to a point, it cannot work. The computer's "smarts" come from software. Software is just a means of telling the computer what you want it to do. It is like you and your crew. Unless you lay out on the black board what they are to do, they will mill around and spend the day doing nothing. You have to tell one to mow greens, the other to set cups, etc. You also go a step farther and lay out the patterns for mowing greens and for setting cups. They use your directions, and this is the same thing software does for a computer. It lays out the directions and tells the computer how to do the job. That's all software is--a means for giving the computer directions.

With this in mind, let's look at the types of directions (software) that you can pursue. Many people have written a lot of articles about software (the directions) and what it does. I feel you can break it down into five categories, and I will try to explain how each category or application will fit into your life as a dedicated golf course superintendent. These categories are as follows:

1. Word processors
2. Data bases
3. Spreadsheets
4. Discipline programs (accounting service)
5. Specialized programs (imagination software)

Tom Guttschow is Superintendent of Golf Courses, Highland Park Golf Club, Bloomington, Illinois

WORD PROCESSORS

A word processor is just the same as having a typewriter that never makes mistakes. It is a program to write letters and memos and your son and daughter's term papers. If you make a mistake, you can back-track or change the word, sentence, or letter to make it fit your needs and then print it out. You can save it on a disc, refer back to it, change the address, and send it again. You can add a spell checker to it, and have it correct your spelling. It is a software program that you will wonder how you ever got along without, and it will cause you to put your typewriter in the corner and probably not use it again.

DATA BASES

A data base is just a file system. You probably have all the business cards of your vendors and people you deal with in a file box or have them all rubber banded together. This is a data base. It has information for you. The vendor's name, address, phone number, and what he or she sells. If you have them in alphabetical order, you can probably find the person you want very quickly. Then again, if you are trying to find that person who sells hand water pumps to pump out irrigation valve boxes, you probably have to leaf through the 200 to 300 cards you have and find it that way. This could be on your computer as a data base, and if so, you could do a "search function" for water, or water pumps, and within two seconds have the person's name.

You could have your chemical records on the computer. Suppose you want to know how much Dacthal you sprayed for 1985. You could find this answer within two seconds. Sure, if written down it can be found, but you will have to leaf through your pages until you get to April and then sort through the days that you sprayed Dacthal and add it up. On the computer, with the data base, you type in Dacthal and assuming you typed it in last April, it will be there with the amount total in three to four seconds. What did I spray in 1984 and 1983? Same data here, same "find" command. A great time saver and an excellent way to control your chemical inventory.

SPREADSHEETS

A spreadsheet is just a fast calculator. The software tells the computer to add, subtract, multiply, and divide. It is a great tool for budgets and keeping track of budgets. It can tell you very easily what you have spent or better yet, how much you have overspent. It is fast. We all have to make up budgets. My budget, working for the city, is usually fifty pages long. It used to take me 40 to 50 hours to grind it out. We justify everything in our budget. Now on the computer, once being entered into it, I can do the budget in less than six hours, including printing it out with no mistakes, everything justified, and added correctly. This is only one use for a spreadsheet program.

DISCIPLINE SOFTWARE

You won't need the discipline software unless you buy your own golf course (not recommended) or become club manager (also not recommended). This covers things like accounting, a general ledger, accounts payable, accounts receivable, payroll, etc. They do the job very well, but are more expensive, and I feel on most golf course

operations, this overkill for the golf course superintendents. Unless you are running a golf complex and doing payroll yourself with all the deductions and generating the checks to the employees, you can do most of this with the first three applications. This is software written for a specific market; thus it costs more and in most cases, it is more complicated -- thus potentially less of a time-saver.

SPECIALIZED SOFTWARE

This is software written for a very narrow market, such as on Toro's automatic irrigation program, controlling the computer that controls the field satellite, telling them how long to water. You may use software like this, but in most cases, the majority of us won't, so I will not cover this area.

Thus, we have covered the areas in which software can help us. Most of us will use only word processing, data bases, and spreadsheets. We should also spell out a little more about the computer itself. They are not all the same. Some of them require extensive training and time learning how to use them. Avoid these. It is foolish to waste your time trying to learn how to use this type of computer. I feel you have more important things to do. One computer that is easy to use and can have you up and running in a very short time is the Apple Macintosh. It comes with a "mouse," which is a pointing device so you do not have to memorize how to do anything. You just roll the mouse, which produces a pointer on the computer screen, and all your commands are at the top of the screen in English. In most cases, you never even open the manual. It is a very good computer, very small, very fast, and quick to learn. It would be my first choice. A second choice would be the IBM, or its clones. It does take more time to learn, but it has a very strong software base, and this is a big plus.

In conclusion, we have covered how to use a computer as a golf superintendent. We have shown you ways to use it. It is not a mystery; it is just a tool like a telephone. It is not there to impress people; it is there to save you time. A computer will make a poor manager worse. You put junk into a computer; you will get greater junk out. It will not cure problems for you. You have to be a good manager to start with, and then this machine can fit into your overall game plan of operations: just as your new Toro aerifier does or your new Jac HF-5 fairway mower does. It is just one more tool to make you a better and more efficient golf course superintendent.

POSITIVE EMPLOYEE RELATIONS — A TEAM APPROACH

Peter A. Mani

Today's business world is a complicated maze of products and services waiting to be marketed. Satisfying those markets has become more challenging as we move to a global economy where competition is keen. Through it all, certain variables of success remain constant. One such variable is the need to satisfy both our customers and our employees continually and completely. Ladies and gentlemen, in your businesses of golf clubs and sports complexes, the valued employees interact directly with your customers on a routine basis. These same employees must reflect the professionalism you as a manager want your business to project. In a nutshell, our employees can "make or break" our business. Therefore, it behooves us to employ "turned on," driven team members who are committed to excellence. As managers, we are charged with heeding, listening, and answering employee needs on a continued basis. Should we not, a vacuum is created and often filled by an outside third party. Third parties can be labor unions, who are quite adept at finding these vacuums and filling the need. Union representation has dropped in half, from 36 percent to somewhere around 18 percent, in the last 50 years. Although managers have become better at answering employee needs, unions have likewise become increasingly creative in their organizing efforts.

Our charge, in my mind, is simply to make unions unnecessary. We must espouse a positive employee relations philosophy and should be cautious not to be labeled as anti-union. Our position should focus on the simple premise that we do not need a labor union. Our personnel systems must therefore treat our employees with respect and dignity and permit them to realize their full potential. Vicky Saporta, a renowned teamsters union organizer, highlighted this thought when she said,

> "...Let me tell you, you are vulnerable and you make yourself vulnerable because you are not in tune with your workers' needs. You are not responsive to what your workers' problems are, and to put it plain and simple, a lot of you just sit there and say, 'Well, we really don't have to respond' and all of a sudden they start to organize and you go into a panic...."

This morning, I would like to share with you a human resource model that makes unions unnecessary. Obviously, the specifics of any model must be massaged to fit with your organizations' needs and objectives. However, addressing the components of this model in a positive manner, I believe, will ensure committed employees who will close the door to any organizer. Second, I wish to review some "dos and don'ts" should a union organizing campaign develop at your workplace.

Peter A. Mani is Public Relations Specialist, Union Camp Corporation, Savanna, Georgia.

ASSESSMENT OF EMPLOYEE NEEDS

Let's take a moment and rank the employee needs survey: Number 1 is most important and Number 10 is least important. Our objective is to become attuned to what truly motivates our employees. Then we will be in a position to understand a human resource model that works.

A dichotomy often exists between what we as managers rank and what today's workers rank. We perceive wages and benefits to typically top the list. It is interesting to note that employees rank recognition and involvement factors highest.

HUMAN RESOURCE MODEL

We all wish to have successful businesses, or if I may coin a popular phrase, "to be on the leading edge of our business." I have been in this zany business of industrial relations for seven years and have found through managing six plants and three plant start-ups that there are seven key ingredients to the "people managing" side of our business.

EXCELLENCE
TEAMWORK
COMMITMENT
WORKING SAFELY
RESPECT & DIGNITY
INDIVIDUAL GROWTH

These ingredients are the cornerstone of any human resource management system. How well you manage them will have a direct impact on achieving excellent performances from your employees. Let's take the next few moments and look at key components of each ingredient.

PHILOSOPHY

The nucleus of any HR model is a plant operating philosophy. Typically written by top management, it is a series of statements focusing on how you want to run your business and the values upon which you build a culture. In essence, everything you do with and in your business emanates from this philosophy. It is vital that every manager, supervisor, and employee commit to the philosophy, both in belief and practice. Take your time in developing your philosophy; it's probably the single most important ingredient in an HR model.

All operating philosophies have key values.

EXCELLENCE relates to quality: that is, doing the job right the first time and to the very best of your abilities. Excellent performances must permeate throughout our organizations from the greens keepers to maintenance persons to restaurant associates to management. No one is immune from the expectations of excellence. My advice to you is to talk excellence constantly. It is a word that cannot be overused.

TEAMWORK has numerous meanings and connotations, some formal, others informal. The goal is for our employees to work together toward common goals. For instance, if a team member has finished a task and has free time, he should be willing to forego a

break and assist other team members in need. Synergy comes from teamwork. Chaos develops when employees forego team objectives for individual concerns. Get used to the philosophy of teamwork. It's flourishing in most industries and is here to stay. Those of us who resist its premise and ramifications may not be competitive in the future.

COMMITMENT is the intrinsic attitude and drive that is needed to achieve corporate goals. It focuses on sacrificing individual needs for those of the team. Probably the most efficient way of determining commitment in potential employees is through the employment process. We will discuss this aspect of the HR model in a few moments.

SAFETY is a top priority with union camp, and I am sure it is with you all as well. Safety should be a major cornerstone of your philosophy. It is an individual responsibility. I think we all agree that a significant percentage of accidents are caused by unsafe acts.

RESPECT AND DIGNITY may sound a little "pie in the sky" to some of us. Remember our earlier assessment of employee needs. As managers we would continually strive to satisfy the high need for self-esteem inherent in all of us. When we hire solid employees, let us recognize them as adults and treat them as such.

Finally, your operating philosophy should establish systems for INDIVIDUAL GROWTH. Today's worker thrives on variety in his tasks. Let us take advantage of this desire for variety and gain work flexibility through multi-skill assignments.

EMPLOYMENT

Upon completion of your operating philosophy, you may initiate your search for potential employees who are committed to your philosophy. In my mind, there is perhaps no more important task in business than hiring the right people. It pays huge dividends to select people who fit with your organization's goals and values. As you well know, once hired, it is difficult or at best a lengthy process to terminate poor performers.

The following list illustrates a suggested employment flow. The process could take up to eleven weeks and works most efficiently when you are hiring large numbers of employees. Should you hire on a singular basis, the process can be utilized in a condensed manner.

COMMUNITY MEETINGS provide you the opportunity of informing the public of who you are, what you are looking for, and the opportunities at your workplace. If your goal is to be union-free, that message should be explicitly communicated. Potential employees should be told that you prefer to deal directly with people and not through a third party.

JOB SERVICE TESTING. Your state employment service can be of assistance in the employment process and specifically serve to screen out candidates. A job service can also suggest a battery of validated tests that serves as a meaningful indication of potential success on the job. Candidates scoring above a minimal desired score (MDS) are then referred to you for further processing.

TESTING. You may wish to administer additional tests, although I would not recommend it unless a qualified consultant is hired to advise you of test validity.

GROUP INTERVIEWS. A structured panel interview with prepared questions and rating guidelines ensures that candidates are generally asked the same questions and rated using the same criteria. The panel consists of three supervisory/management personnel. Each panel member plays a role in asking questions, while the remaining members listen as the candidate answers. Major subject areas discussed include prior work experience, training, educational background, interpersonal skills and intrinsic/extrinsic motivation. A well designed group interview should take no longer than 45 minutes to an hour.

QUIK-START PRE-EMPLOYMENT. Numerous innovative employers have begun a 10- to 20-hour pre-employment training class for prospective employees. Candidates attend this class, which is conducted by the employer, on their own time. The objective is for each of us, as the employer, to learn more about the candidate and for the candidate to learn more about our company before a formal employment offer is extended. We mutually want the "fit" to be right. Subject matter may include a further discussion of your operating philosophy, review of your operations and available positions, and teamwork exercises. During this period you can observe candidates' punctuality, energy, enthusiasm, willingness to work as a team, and often their feelings about having someone else represent them. It is your prerogative at the end of this training to select only those candidates for employment that you feel will make a valuable contribution to the team.

CORE TRAINING, TEAM TRAINING. Candidates selected from the pre-employment class are offered positions contingent upon successfully passing a reference check and pre-placement physical. It is common and highly recommended that your physical include a drug screen. We have found approximately an 8 percent positive drug screen rate. As previously mentioned, the selection process is perhaps your most critical function as a manager. Now that team members have been hired, training your new employees becomes the critical task at hand. We will address core and team training in a few moments.

SALARIES & FRINGES

"Simple," "competitive," and "clear expectations" are words and phrases that describe a salary and fringe package that will be understood and accepted by your team members. A word of caution: you will not stay union-free by paying sub-par wages and benefits. Annual surveys should be conducted in your local area to determine what range of wages and benefits are paid for similar jobs with like skills. I suggest you structure a wage package that is average to slightly above average for your local area. Team members should be aware that you conduct annual surveys. Further, they should possess a basic understanding of business economics--that is, profit/loss responsibility. Attempt to structure a communications program that keeps your employees informed of your business, likely trends (both positive and negative), and how well you are performing financially. Remember your operating philosophy and the words respect, dignity, and treating people like adults.

New trends in wage and salary administration include paying your employees a guaranteed salary and structuring work assignments on a "team concept." Paying workers a guaranteed salary, based on 40 hours times an average hourly rate, reflects the trust and respect you have for your employees. Their self-esteem is heightened. We have experienced decreased learning curves and subsequent higher levels of productivity. Our team members sense a greater responsibility to perform.

The "team concept" can be a trial to implement; primarily so, because we, as managers, have been conditioned to a structured, traditional workplace where workers

have "boxes" around their jobs. Quite frankly, beyond a few structural precepts and concepts, there is no "black magic" to implementing the team concept. It simply focuses on employees working together in flexible work units to accomplish the business goals. The following list addresses highlights of a salary structure built upon the team concept.

SALARY STRUCTURE - OPERATIONS

HIGHLIGHTS

1) Replace traditional job titles with operations associate and operations specialist for greater flexibility.

2) All personnel begin as trainees.

3) Performance criteria (productivity, quality, technical knowledge, safety and housekeeping, teamwork and cooperation) are developed for each classification and pay progression within a classification.

4) Time lines for pay progressions are guidelines only. Pay progressions can be expected with skills acquisition.

5) New, experienced personnel will begin as trainee for six (6) weeks and then be placed at performance measured spot in progression consistent with criteria.

6) Operations teams will be developed and implemented.

7) Progression is "up or out."

TRAINING

Without a doubt, our human resources are not optimized if we neglect to develop and implement formal training programs for both our employees and supervisors. I personally believe that people want to do a good job and want to be the best at what they do. If not trained, employee frustration surfaces, expectations are not clear, mistakes are made, our customers aren't satisfied, and our business suffers. Permit me to reemphasize the notion of employee frustration. Often that frustration goes unnoticed and/or unheeded by us, the managers. Where does the employee turn for consolation? Yes, to the union. I mentioned earlier that hiring the right people is the single most important task you have as a manager. Well, the second most important task you have is to train those same employees. Training satisfies the employees' intrinsic need to "know how" and to "know what is expected." It also satisfies management's need to get the job done right the first time.

OPERATIONS TRAINING actually begins in the pre-employment stage of the selection process. It is synonymous with orientation and introduces the potential employee to your philosophy and values. You may wish to discuss your golf club or sports complex operations and "who does what" to make it all tick. If you haven't already done so, I suggest you adopt a quality philosophy that focuses on excellence and on being customer driven. Most of you have heard of Dr. E. Demming and his involvement in Japanese quality. Read his fourteen points and adopt them as your own. In so many ways, they fit with our philosophy of treating people as adults by permitting people to control their work processes and not having someone constantly looking over our employees' shoulders to ensure the job is being done correctly.

CORE TRAINING should encompass the first week or two of employment. The focus is on the "big picture." Spend time discussing business economics: that is, the costs associated with running your business. Employees should believe that profit is not a "dirty word." Some of you may hesitate to share such information. To what degree you share is your decision. I assure you, though, the more the better. Also, permit the employee to spend meaningful time in each area of your club's operations. Although he may be employed as a greenskeeper, he will become a more complete team player if he possesses a basic understanding of what maintenance, the restaurant staff, and others do. And I am certain that whatever tasks one performs, there are certain ripple effects on others. Communications systems should be explained to the new team member during orientation. Your open door policy and systems for solving employee concerns should be clear to the new employees. Further, discuss the role of safety and the responsibilities the employee has.

TEAM TRAINING can be as lengthy or brief as need be, depending on the complexity of tasks to be learned. In our plastics business, this training consists of four weeks of classroom and on-the-job training. Training manuals have been written to assist the trainer/supervisor in providing an orderly flow of material. In your businesses, training manuals may not be necessary. At a minimum, you should have instructional objectives outlined. In other words, what does the employee need to know to get the job done? Richard Mager's *Setting Instructional Objectives* can provide useful insight into this subject. This point should be clear: put together some form of formalized training. Do not "throw" a new employee to an experienced employee, telling the latter to train the former. That system does not work optimally. An experienced employee can be an excellent source for training, but only after he has guidance in "what" and "how" of training someone.

TEAM SUPERVISORS TRAINING cannot be overstated or underestimated in importance. Poor or weak supervision is a common trait of all facilities who have become unionized. If your business does not have an inside trainer, look to outside consulting firms or your state's industrial training services for assistance. At a minimum, your first-line supervisors should have a basic 40-hour supervisory skills course. In addition, safety training is a must. I also recommend interviewing-skills training for supervisors and, whenever possible, involve them in the selection process at the interviewing stage. Supervisors tend to take greater interest--or at least they have more at stake--in those employees they helped to hire.

TEAM SUPERVISORS'TRAINING

Supervisory Skills

Instructor Training

Interviewing

Personnel Practices

Positive Employee Relations

Safety, CPR, First Aid

Problem Solving

Operations

Quality Assurance, SPC

Environmental

Ladies and gentlemen, again let me emphasize that training is your second most vital task. Many companies do a poor job of training. I believe these companies are only interested in short-term profits. We need vision--the vision to see beyond this year or next year. We need consistency of service to our customers. We need employees who share in our vision and know how to accomplish what is expected of them. Training can provide the vision, consistency in service, and employee knowledge. It is a long-term commitment, but one that pays.

SAFETY

I could talk all day about the role of safety, safety organization, and how to make safety an equal piece of the puzzle to quality and productivity. I am certain you all are committed to providing a safe and healthy work environment, and I probably don't need to remind you that unsafe working conditions were a major reason for the rise of labor unions in our country at the turn of the century. If you do not have a formal, structured safety program, may I suggest you address the following items:

SAFETY

Plant Safety & Health Organization
...Management Commitment
...Safety Director
...Safety Committee
...Inspections, Surveys
...Team Safety Meetings

SAFETY TRAINING

...Dupont N.E.S.T.
...TJA Built into Technical Training
...Chemical Hazards
...First Aid, CPR
...Fire Brigade

WORKERS COMPENSATION

...Local Doctor
...Insurance Company
...Return to Work Programs

PLANT DESIGN

...Manual Handling
...Other Hazardous Conditions

The key to organization is a visible, ongoing management commitment to a safe work policy. Employees take their "cue" from the top guy. If he doesn't actively support and participate in safety then your employees won't be committed. Further employee involvement through safety committees, conducting formal inspections, and team meetings help to solidify their constancy of commitment.

Specific safety training should include DuPont's "New Employee Safety Training," (NEST) which takes approximately 45 minutes to complete and introduces the employee

to the philosophy that all accidents can be prevented. A 1986 federal law focusing on hazardous communications requires all employers to train employees in the use of hazardous chemicals. Also, whenever you can, sponsor employees to learn First Aid and CPR. The tendency after taking this course is a heightened employee safety consciousness.

Federal and state laws require workers' compensation insurance. Your premiums can obviously be reduced through safe work and no accidents. And your premiums can be managed optimally through a good relationship with your local doctor and return-to-work programs. It behooves you to have your doctor visit your facility annually to familiarize himself with employees' tasks and the physical demands associated with those tasks.

Safety cannot be an afterthought. We like to use the symbol "SQP"; safety, quality, and productivity are equal ingredients in importance to success in the management process.

EMPLOYEE RELATIONS

Employees relations is nothing more than good old-fashioned communications. It is the creation of understanding between a sender and receiver. Subject matter may include personnel practices, performance assessments, voicing concerns to management, or providing suggestions to improve efficiencies or work flows. Sounds so simple, so routine, doesn't it? However, we heard Vicky Saporta claim earlier this morning that we, as managers, don't communicate with our workers. I think we have a tendency to take for granted that employees are not interested in how our business is faring or what our customers really think of us. Often we don't wish to discuss a new personnel practice with our employees before it is implemented because we have the feeling that it's our right to set policy. Why involve our employees in policy-setting?

Ladies and gentlemen, break down the "We - They" barriers in employee relations. Do away with private parking spaces, separate cafeterias, separate restrooms. It is the little things that project management is different from employees. Permit me to read a passage from a poem written by a United Auto Worker union official:

"Are these men and women
Workers of the world?
Or is it an overgrown nursery
with children--goosing, slapping, boys
giggling, snotty girls?

"What is it about that entrance way,
those gates to the plant? Is it the
guards, the showing of your badge--the smell?
Is there some invisible eye
that pierces you through and
transforms your being? Some aura
or ether, that brain and spirit washes you
and commands, 'For eight hours
you shall be different.'

What is it that instantaneously makes
a child out of a man?
Moments before he was a father, a husband,
an owner of property,
a voter, a lover, an adult.

"When he spoke at least some listened.
Salesmen courted his favor.
Insurance men appealed to his family
responsibility
and by chance the church sought his help...

"But that was before he shuffled past the guard,
climbed the steps,
hung up his coat and
took his place along the line."

I'm not suggesting we create a democracy in the workplace where we vote on all decisions. I am not suggesting that we do away with basic respect for management and employees and their roles and responsibilities. I'm simply suggesting a level of employee communications where we involve team members in varying degrees of our business.

ORGANIZING STRATEGY

Thus far, we have discussed a human resource model whose primary focus is to optimize employee performance while making unions unnecessary. I don't think we should ever become complacent with our human resource systems and feel we have done our best. Look for weaknesses in your system; concentrate not only on what you are doing right but what could go wrong.

I would like to direct our focus for the remainder of the morning on why it is important to remain union-free and on what you can do when an organizing drive initiates. First, I believe there are four major reasons to remain union-free:

1. The primary concern is that values research illustrates that unions have a vested interest in keeping employee morale low. They create conflicts. There is a negative effect on attitudes and simply how happy people are on the job.

2. Unions proliferate confrontation with management. I believe they condone an adversary relationship to justify their existence. Often, the supervisor becomes the target of this negative confrontation.

3. With a union, you lose flexibility in running your business. All terms and conditions of employment become a negotiating subject. Work jurisdictions, promotions, and overtime assignments are no longer dictated by skill and abilities, but rather by job classification and seniority.

4. Studies have shown that having union representation at your workplace can add 20 percent to your administrative costs.

There are situations in certain geographical segments of the country and within certain industries where union organizing efforts are strong. The Chicago and St. Louis metropolitan areas are traditional strongholds for unions. Do not feel you have failed in your human resource system if an organizer knocks on the door. It may have been inevitable. Knocking on the door is one thing, getting a foothold in your workplace, though, is another.

It is often difficult for management to know when union activity has begun in the workplace. Union organizers, as well as those employees who support the union, will keep their activities secret until they feel they've gained significant support. It is important, though, that we become aware of early warning signs of organization so that the position of the company can be reaffirmed and any union misrepresentations can be corrected. Some warning signs to be cognizant of include:

1. A substantial increase in the number of complaints or grievances.

2. An unusual number of requests for time off on the same day.

3. The number and composition of informal employee groups at lunch or during coffee breaks increases or changes.

4. An obvious change in employee attitudes or reactions to supervisors.

5. Employees getting together in out-of-the-way places.

6. Supervisors receiving questions relating our benefits to those of other companies.

7. Pro-union notes appear in the workplace.

As a side note, I recommend a strong "no solicitation policy" at your workplace. Such a policy that is strictly adhered to will protect you from union literature being displayed in the plant and being distributed in working areas. An example follows:

NO SOLICITATION/DISTRIBUTION POLICY

To prevent interruption of employees and in the interest of maintaining a good working atmosphere, solicitation and/or distribution of literature by non-employees on company property is prohibited. Solicitation by employees on company property is prohibited when the person soliciting or the person being solicited is on working time. Working time is the time employees are expected to be working and does not include rest, meal, or other authorized breaks. To avoid litter and in the interest of maintaining a good working atmosphere, an employee is not permitted to distribute literature during working time, as defined above, or in work areas at any time.

THE CAMPAIGN

A campaign may begin with an outside organizer contacting employees and soliciting their support. More often, however, a disgruntled employee will contact an organizer to seek assistance. Regardless of the initial approach, organizers attempt to find "leaders" at the workplace. To assist them in the drive, and through these leaders information is gained concerning internal problems and concerns of employees.

An organizer may complete an initial assessment survey to determine the potential likelihood of organizing that particular workplace. Should efforts look promising, the organizer will solicit signatures on union authorization cards. An executed card is essentially a power of attorney and the employee actually gives up his rights to bargain directly with management. A union needs only 30 percent of the employees in a proposed bargaining unit to sign cards before petitioning to the National Labor Relations Board for an election. A few points to be aware of follow:

1. Authorization cards come in many shapes and sizes.

2. The card says "I authorize the union to request the NLRB to hold an election." It instead authorizes the union to represent the worker in collective bargaining.

3. If unfair labor practices are found by the NLRB and more than 50 percent of the employees have signed an authorization card, the company may be ordered to bargain with the union without an election.

If you or any member of your management team are presented with signed authorization cards by an employee or an outsider, you should have nothing to do with them. Never count or look to see who signed the cards. Encourage the sender to forward them to the NLRB. If forced to, place them in an envelope and give it directly to your employee relations department.

Never permit an organizer on company premises. Remember that employees do have the right to solicit union support during nonworking time and in nonworking areas such as parking lots, restrooms, and cafeterias.

It is vitally important to communicate openly with your employees regarding authorization cards. Tell your employees they have a right to sign the cards. They also have an equal right not to sign the cards. Your position should state that you hope they don't sign the cards because you do not believe a third party is necessary or desirable at your workplace. Believe it or not, some employees do not know whether we want them to sign the cards or not.

DO's AND DON'Ts

The National Labor Relations Act guarantees management's right of free speech during an organizing campaign. Effective communications become critical during the course of a campaign. There are, however, limitations placed on management in its methods of communication. Some actions are illegal and may constitute an unfair labor practice. Such actions are called by the acronym "TIPS," short for threaten, interrogate, promise, or spy. Examples are as follows:

THREATS. We cannot threaten an employee's job, pay, benefits, or the future of our plant if he or she supports the union.

INTERROGATE. We cannot interrogate employees concerning whether or not they will vote for the union, support the union, or what's going on at union meetings. Also, during the employment interview process, do not ask a candidate his union preference. Although we cannot ask about union sentiments, we are permitted to listen. Usually your supervisors are in the best position to hear from willing employees about happenings around union activities. During a campaign, this listening can be a valuable source of information.

PROMISES. We cannot promise employees greater wages, benefits, or improved working conditions during a campaign. This is not to suggest that certain changes may not occur during a campaign, but they must be legally construed and presented.

SPY. Management cannot spy at union meetings or other gatherings of union supporters.

A final potential area of unfair labor practice lies in discrimination. Generally, we cannot discriminate in our hiring, promotion, or discipline of employees because of their union sentiments.

A key point to remember during a campaign is that the union can and does promise our employees anything if they support the union. Conducting an effective campaign against unionization is no simple task. I believe your most important objective during a campaign is to educate employees about the true facts, analyze your human resource systems, and adapt as needed. In educating your employees, certain points should be driven home:

1. Remind employees that unions can promise the "world"; however, only management is in the position to give. Negotiation does not mean automatic raises in wages and benefits.
2. Tell employees that you feel concerns can be worked out between the two parties; an outside third party is not needed. Your employees do not need someone else to do their talking for them.

3. Inform team members of some disadvantages of belonging to a union, such as the possibility of strikes, dues, fines, assessments.

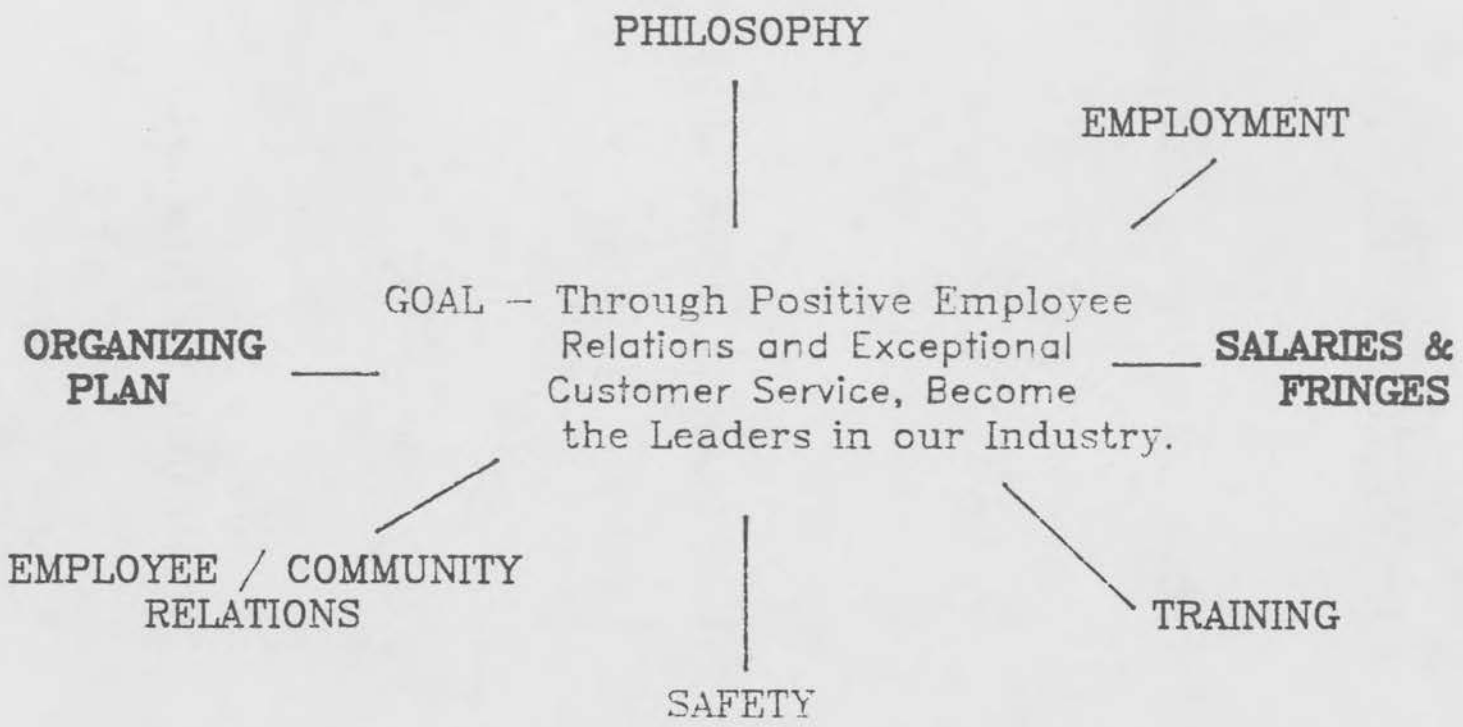
4. Inform employees about the state of unionized plants across the country, that is, the plant shutdowns and layoffs.

Your first-line supervisors are a vital link between our employees and management during a campaign. Educate your supervisors about how to listen and the legal "do's" or "don'ts." What they say to employees or fail to say may win or lose your campaign.

CONCLUSION

In summary, I have always contended that the most difficult part of a manager's job is the "people side" of managing. If you think for a moment what area of business takes most of your time, I think you will agree on personnel matters. People are all different and like to be treated differently under varying circumstances. It is tough to satisfy all your employees at all times. The best we hope for is acceptance of our fairness and consistency. Fairness and consistency: two simple words that have a tremendous impact on the morale of our people.

If I could leave you with any advice, it would, in addition to fairness and consistency, focus in hiring the right people, taking the time and resources to train properly, and always to communicate and listen.


PHILOSOPHY
EMPLOYMENT
GOAL – Through Positive Employee Relations and Exceptional Customer Service, Become the Leaders in our Industry.
ORGANIZING PLAN
SALARIES & FRINGES
EMPLOYEE / COMMUNITY RELATIONS
SAFETY
TRAINING

VIS15

OPERATIONS TRAINING

QUIK START (20–40 HRS.)

VALUES, PHILOSOPHY
SAFETY
OPERATIONS
QUALITY & CUSTOMER SATISFACTION
SYSTEMS
MATH & INSTRUMENTATION

CORE TRAINING (40–80 HRS.)

BUSINESS ECONOMICS
TEAM BUILDING, LEADING EDGE
COMMUNICATIONS
PROBLEM SOLVING
SAFETY
OPERATIONS
MAINTENANCE
QUALITY & CUSTOMER SATISFACTION

TEAM TRAINING (160 HRS.)

CLASS
OJT
VENDOR

VIS17