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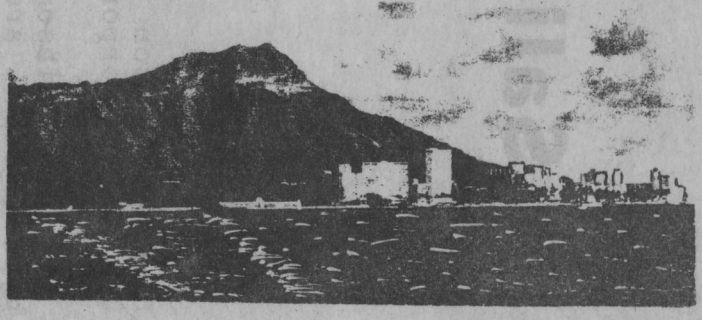
THE HARVEST MIX

The first Pan Pacific Turf Conference held in Honolulu, Hawaii September 24 - 25,1987 was packed full of excellent presentations. We would liked to have included all of them in this issue of Harvests. Reviews of selected topics by turf specialists from the U S mainland, Japan, Australia and Hawaii will provide some insight for a better understanding of turfgrass science in the Pacific region. Congratulations to The Hawaii Turfgrass Association for their leadership in sponsoring this international conference.



PAN PACIFIC TURF CONFERENCE

Honolulu, Hawaii
September 24-25,1987

HAWAII'S AGRICULTURE

Dean Noel P Kefford
University of Hawaii
College of Tropical Agriculture
& Human Resources

Honolulu, Hawaii

Dean Kefford greeted those attending the First Pan Pacific Turf Conference with these thoughts.

Man is an improver of nature, not a denegrator of nature. Man for centuries has acted as an improver of nature through management of turf and the landscape. We must continue to achieve in this area.

When one drives north on Oahu from the airport, the scenery includes lava rock and mountains. Man is in awe of nature because man cannot manage lava flows and land expansion from volcanic activity. When a turn is taken into a park, the previous environment is no longer evident. Here the landscape has been improved by man in cooperation with nature.

Each professional has his own view and approach to turf and landscaping. It is important to share these views.

Agricultural industries have had to change their approaches as prices have become unstable or product sales have declined. Notice has been taken of what the consumer wants and production has been redirected to these consumer desires. For example: the coffee industry started producing gourmet coffees which have a higher price than regular coffees but because the demand is stable, the price is also stable. The success of this venture has relied on providing a more unique and comprehensive experience for those who like coffee.

In the new approach, consumption drives marketing, which drives production. Previously, the approach was totally on production. Consumers respond to experiences which they perceive improve their quality of life.

Turf and landscaping provide the best total experience involving active participation in the environment. This is an experience of the place. Turf provides unique places - parks, cemeteries, golf courses. The experience is different in each. It is special to the location and related to the use of the turf. Combining plants, water and sky to satisfy a basic need for people wherever they live is to improve on nature. The landscaper creates an ambiance of atmosphere which makes up a large part of any recreational event.

A consumer experience is created by cooperative efforts by developers, designers, contractors and maintenance personnel. Communication, understanding and trust need to be developed between the cooperators. This conference will accomplish these things.

Overview of the Turfgrass Industry in the United States

Dr James Beard
Professor Turfgrass Science
Texas A & M University
College Station, Texas

Some observations about trends in the turfgrass industry in the continental United States have been presented by Dr James Beard. They include the following.

- Turfgrasses - growth and development applications:

1. Spring root decline of warm season turfgrasses:

- Grass requires a dormancy state for this condition to arise;
- Decline happens after green-up.
- There may have to be a total change in management of warm season grasses that go into dormancy.

2. Trend toward cultivars with slow leaf extension rate which means low water use rate.

- This can mean minimal irrigation.
- These cultivars show reduction in recuperative qualities;
- May end up with two types of grasses: those with slow leaf extension and those with rapid leaf extension.

3. Root enhancing agents - very interesting area.

4. There are many bermudagrass types available, including:

- Guymon - released in 1982 from Oklahoma; seeded type; dark green and coarse; better than common;
- TexTurf 10 - released 1957 from Texas; recently rediscovering its strong points. Has lowest nitrogen requirements of all bermudagrasses; not the quality of Tifway; low water use rate; best wear tolerance; low maintenance grass.
- Tifgreen II and Tifway II are not major improvements over Tifgreen and Tifway.
- Nu Mex S 1 - new seeded type from New Mexico; hasn't been tested much as yet.
- Other bermudagrasses include:

Common	Tifdwarf
Midiron	Tifgreen
Midway	Tifway
Ormond	Tufcote
Pee Dee	U-3
Santa Ana	Vamont
Sunturf	

5. There are several zoysiagrass cultivars, including:

- Belair - released 1985 - in 8 years of testing, advantages have not been detected.
- El Toro - released 1984 - an improved variety; retains color late in fall; greens up earlier in spring; best in water use.
- Other zoysiagrasses include:

Meyer
Emerald
FC-13521

OVERVIEW - USA CONTINUED

6. St Augustine cultivars include:

- Raleigh and Seville - released 1980 - both subject to summer decline. Raleigh has superior cold tolerance.

- Floralawn - resistant to chinch bugs; clone of Floratine; both are coarse; both are better under water stress.

- Other St Augustinegrasses include:

  Bitter Blue
  Floratine
  Floratam
  Texas common

7. Endophyte: Endophyte is a fungus in seed and in the plant that grows from the seed that gives significant levels of insect resistance.

- Unfortunately, endophyte has been found only in ryegrasses and fescues so far and not in warm season grasses.

- Varieties of ryegrasses and fescues have been released that have insect resistance as a result of endophytes.

8. New Species

- Seashore paspalum [Paspalum vaginatum] - Adalayd is one cultivar. Superior salt tolerance. Vegetatively planted - rhizomes and stolons - sprigs. Bright green; medium leaf texture; medium high density; preferred cutting height is 1 inch or less [at 1/2 inch it is beautiful]. Used in lawns and fairways [not tested for sports turf]. Higher water use rate than bermudagrass due to shallower root system.

- Root Zone Modification:

The USGA system remains the preferred approach to preparing root zones. Since there are easier ways, there is a trend toward modifying this system to 100 % sand greens which creates problems. There is a continuing need for buffering capacity from colloidal matter.

- 100 % sand is more vulnerable to rapid shifts in soil chemical, physical and biological characteristics. When a high sand root zone is used, hydrophobic soil problems may develop. Hydrophobic means it repels water due to a very high surface tension. Wetting agents can help [Hydrowet and Aquagro are good if wet in immediately after being applied.]

- Success of the USGA system is based on:

  * Soil adds buffering characteristics.

  * USGA system has a sound physics basis. Specifications cannot be varied from those determined by soil test.

- Fabric around drains creates a filter and filters clog. In order for a filter to work, it must be cleaned.

- Black layer is caused by blockage in downward movement of water which forms a waterlogged, anaerobic condition. Reduction reactions cause a foul smell and blackened soil. These are the final symptoms. The problem developed long before these appear. Black layer has been a problem for many decades.

  * Increased concern about Black Layer now comes from something that has changed. There are many things that contribute to its development:

    - lots of rainy weather, or too much irrigation;
    - lack of subsurface drainage;
    - lack of surface drainage;
    - impermeable soil layer, and/or sand topdressing;
    - 100 % sand root zone;
    - improper sand particle size distribution;
    - excessive nitrogen use;
    - excessive fungicidal use;
    - algae development that results in an impermeable organic layer;
    - extensive sulfur application.

  * Why does there seem to be an increase at this time ?

    - 100 % sand greens have increased;
    - high nitrogen rates on sands;
    - heavy use of fungicides;
    - increased use of sulfur [not original cause].

  * Black layers can be found in soil root zones too.

OVERVIEW - USA CONTINUED

- Mowing Trends:
  - Lightweight mowing machines, especially on fairways, result in less scarring.
  - Greens are being mowed too close. Grass can't sustain such low levels for a long time.
  - Soccer fields are not being mowed low enough - not down to International Standards.
  - Clipping disposal laws, ex in New Jersey clippings can't be put into trash for city to dispose of. This may increase sales of mulching mowers.

- Nutrition and Fertilization Trends:
  - Lower nitrogen levels [may have gone too far].
  - Potassium use in 1:1 ratio with nitrogen may become a common practice.
  - Iron use as a regular part of fertilization [in bermudagrass this gives striking results in rooting.]
  - Fertilizer timing based on tissue analysis may be a normal procedure in 5 years.
  - Micronutrients are necessary, but problems are being seen:
    * copper and zinc don't move in the soil;
    * copper and zinc toxicities have been noted.

- Trends in Irrigation:
  - Low pressure heads.
  - Computer interactive controls.
  - Programs based on radiation plus other environmental parameters.
  - Fertigation [works if the irrigation system can apply water evenly over all the turf].

- Turf Cultivation Trends:
  - Increased operating speed.
  - Development of deep hollow tine units.
  - Shatter-core cultivation doesn't really do what the name implies. New devices are being tested.

- Topdressing Trends:
  - There is a basic topdressing concept. It includes:
    * avoid soil layering;
    * use material free of weed seed;
    * soil mixture should be shredded.
  - Disenchantment with frequent sand topdressing programs.
  - Units have larger capacity and more rapid operating speed.
  - Increase in composting of topdressing, which is a plus.
  - Use USGA mix, not total sand.

- Thatch:

There are not as many questions now about thatch because management practices have been developed so there isn't as much thatch.

- Growth Regulators:
  - There is a new generation of PGR's available.
  - More diverse programs have been developed for use and application.
  - Future trends [5 years] - there will be a diverse range of chemicals to manage turfgrass including: increased use of growth regulators; anti-senescence agents; root enhancements; anti-transpirants.
  - Use will include: control of carbohydrate distribution, stress tolerance, and color enhancement.
  - Plant growth regulators will not be used just to replace mowing.

- Weed Control Trends:

More good herbicides are now available.

- Disease and Insect Trends:

Advances have been made in differentiating the patch diseases. These are all soil organisms and when the organisms are found, controls can be found.

- Conclusion:

"The closer one approaches perfection in turfgrass quality, the more obvious are the imperfections. This may make the end condition more frustrating." Advances in the turfgrass industry in the last few decades have been formidable. It is an exciting time with new tools and many advances.

Overview of the Turfgrass Industry in Japan

Saburo Kakuda
President
Nihon Green Keeper's Association
Yokohama, Japan

Saburo Kakuda presented an overview of the turfgrass industry in Japan. With the International Turfgrass Society scheduled to meet in Tokyo July 31 to August 5,1989, the following items are of special interest.

1. The History of Golf Courses in Japan

The first Golf Course in Japan was a 4 hole course at Mount Rokko near Kobe developed by Mr Arthur Hesker Groom, and Englishman, in 1901. This became the Kobe Golf Club in 1903.

It was a rather primitive course as we know them today - no turfgrass, round greens about 3,230 square feet in size, holes cut in the middle and consisting of red earth with scattered sand. The fairways and roughs were cut and trimmed by hand and gradually looked like they are today. The planting of Koraishiba [Zoysia spp] turf on the greens was started in 1929, and by 1933, all greens had been covered. But, today they are all covered with bentgrass.

Japanese started constructing the Komazawa course of the Tokyo golf club in 1914 and by 1926 all eighteen holes had been completed. Turfgrass was used from the beginning, but due to a shortage of supply, it was only sparsely used. Consequently, it became heavily infested with weeds. The impetus for the rapid development of golf was the victory of Ono and Nakamura at the Canada Cup [now World Cup] held at Kasumigaseki Country Club of Tokyo in 1955.

During the period 1973 to 1977, the total number of Japanese golf courses reached 596. Now, ten years later, the total is approximately 1500 and, due to the popularity of golf, more courses are being planned.

2. Topography and Meteorology of Japan

Japan, as you know, is an island country stretching about 1,865 miles from Okinawa on the south to Hokkaido on the north. Consequently, there are vast differences in climate creating many different circumstances for growing plants and a large variety of plants.

The most northern part [Soya promontory, Hakkaido] is 45-31'N Latitude and 141-53'E Longitude. The most southern part [Island Hateruma, Okinawa] is 24-01' N Latitude and 123-47'E Longitude.

To relate these Japanese areas to North American latitudes, Sapporo is at the level of Toronto; Sendai equals San Francisco; Tokyo [including Nagoya, Osaka, Hiroshima, Tokushima and Fukuoka] equals Atlanta; and Naha, Okinawa equals Miami. Therefore, one might say that Japan covers the same latitudes from the Canadian border to Florida. Annual average temperature on these places is almost the same, but annual amount of rainfall is different due to the fact that Japan is located at the Monsoon area.

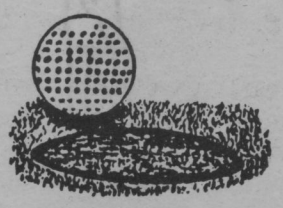
3.Kinds of Turfgrass in Various Parts of Japan

Japan, since it stretches 1,865 miles from north to south, naturally has different kinds of turfgrass. Hokkaido is the cool zone and plants turfgrass for cool temperatures, while Okinawa is in the tropical zone and plants turfgrass for warm temperatures.

4. Annual Number of Golfers on Japanese Golf Courses

About 40,000 golfers per 18 hole course played on Japanese courses in 1985. However, considering the fact that about 20,000 players used the Hokkaido and Tohoku courses, which are closed in winter, it appears that more than 40,000 per course use courses that have year-round operation. Consequently, the main cause of turf damage is traffic.

Koraishiba turf, which is planted on fairways of many courses in Japan, goes dormant in winter, stopping its growth. Naturally, considerable damage to Koraishiba turf due to traffic can be expected in winter.



5. Golf Course Maintenance Problems in Japan

[1] Greens

Most golf courses in Japan have adopted a two-green system consisting of bentgrass and Koraishiba turf. This is due to the fact that one kind of turf alone is unable to sustain a greens area evergreen throughout the year. Koraishiba turf goes dormant in winter and is severely damaged by traffic: while turfs for the cool zone suffer from high temperature and high humidity during the period from the raining season [mid/June - end/July] to the hot summer.

For this reason, the two-green systems of planting Koraishiba and bentgrass has been introduced at most golf courses.

However, it must be mentioned, that recently the one-green system of bentgrass has increased in number due to improvement in course management, improved ground construction of greens, players wishes, specifications of American golf designers, etc.

Tests of turf planted in cool zones was actually started by Soma and Marumo in 1928. However, information on what kind of turf was planted before 1945 is scarce. Since then, Highland bent, Astoria bent, Seaside bent and Penncross bent were introduced in that order.

In a very few cases, a type called Old Orchard was introduced. At present, Penncross bent has been introduced on almost all courses and there are no longer such Colonial types as Highland bent or Astoria bent. Penneagle and Pennlinks are now being tested but it appears that it will take a few years for them to penetrate the Japanese market.

Sand Used For Greens

During periods of harsh climatic conditions, it is important to allow air and water to penetrate the earth of the green to increase root development. For this reason, it is currently being recommended that sand be used in the construction of greens. Many Japanese courses have adopted this type of construction.

Contractors use USGA Green Section specifications with their own improvement and modifications to seek the perfect solutions to Japan's growing conditions.

Some emphasis is currently being placed on increasing the cation exchange capacity of the green's sand mixture.

In any event, it is essential to investigate the physical and chemical quality of the soil and the water permeation of the sand. Likewise, a study must also be made of the materials to be mixed with sand. Naturally, harm to turf is not only caused by the conditions of the earth but also is caused by other factors. Nevertheless, it is extremely important to understand the quality of earth in order to grow good turf.

[2] Tees

Most golf courses in the warm zones of Japan plant Koraishiba turf on tees, but Koraishiba tends to be damaged more heavily by traffic than other turfs due to its poor reproductivity. If planted more than 1,320 - 1,650 feet above sea level, both Noshiba and Koraishiba will suffer frost damage and poor reproductivity.

In order to overcome these problems, Japanese courses have begun to overseed cool zone turfs over Koraishiba on tees, which has appeared to be successful in reducing damage. Turfs for the cool zone grow faster and have strong reproductivity and grow actively in winter when Koraishiba goes dormant. To take advantage of this, some golf courses have adopted the two-tee system for the cool zone and for Koraishiba. Turfs, such as perennial ryegrass [Manhattan, Gator, Prelude, etc] for the cool zone are mostly used and sometimes tall fescue is used. It may also be possible to keep tees in good condition throughout the year by applying plural mixing of seeds.

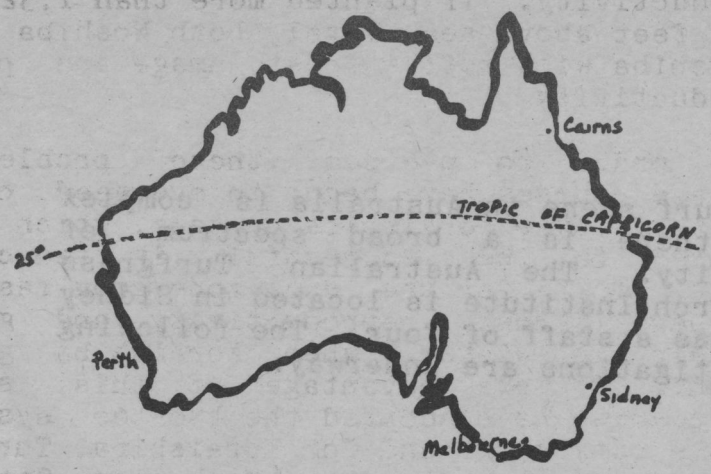
In closing, I wish to thank the Hawaii Turfgrass Association for giving me this opportunity to appear before you. Due to the limitations of time and language, I am afraid that I have not been able to give you the full picture of golf courses in Japan. Our problems are the same as yours and we feel we have much to learn from our American counterparts. Therefore, this cross fertilization of ideas should continue and even grow. Our 6th International Turfgrass Research Conference will be held July 31 to August 5,1989 in Tokyo. Hopefully, some of you will be able to attend this conference and continue this interchange of ideas.

Overview of the Turfgrass Industry in Australia

Mr Peter McMaugh, Turfgrass Specialist
NSW Australia

Peter McMaugh, in an overview of the turfgrass industry in Australia, made the following points of interest.

- Australia is as large as mainland USA with an appreciable portion of the country being warmer than the United States. The seasons are at opposite times from ours, with it being spring in Australia when autumn is starting in the United States.



- There is not a significant amount of snow. The climate is mild and dry. Population is close to 16 million with heaviest distribution around the ocean's edge. Over 1/2 of the population lives in the southeast corner with close to 4 million in Sidney and 3 million in Melbourne. Northern Australia is closer to the equator than is Hawaii.

- The native grass is a common couch [Cynoden spp] which grows under moist conditions and has good shade tolerance. It produces a turf with blue-green foliage that is highly desirable. It makes a fine lawn but there are some weeds that cause problems. It is also used for sports turf. Selections are being made now for improved cold tolerance, since it is sensitive to frost.

- Queensland blue couch [Digitaria spp] grows in moist conditions and has good shade tolerance. It is used extensively as a lawngrass and sports turf in the Queensland region and is highly prized for its blue-green color. It is not at all frost tolerant.

- Greenlees Park couch [Cynoden spp] is an improved type. It has a flat prostrate growth habit and is semi-dwarf growing about 3 inches tall. It has improved drought tolerance and can be cut as low as one-eighth of an inch. At this height, the turf is fully matted and high in quality.

- Another variety of common couch is Wintergreen which retains color to -4 degrees C [24-25 degrees F]. At 21-22 degrees F it loses color. This is a dense, very strong grass resistant to divoting. It has lateral runners but is not as low growing as Greenlees Park couch. It is more upright and more like hybrid couches.

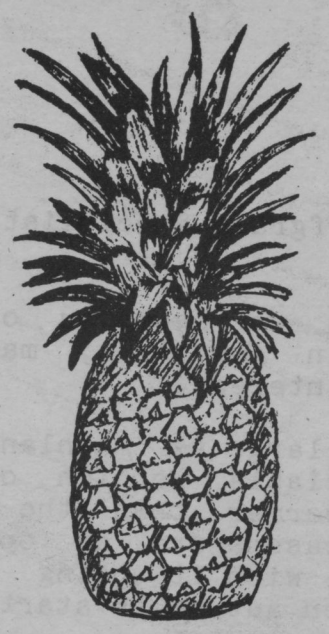
- Many new golf courses are being developed.

OVERVIEW - AUSTRALIA CONTINUED

- Kikuyugrass [Pennisetum spp] is used especially in the Sidney area. This accounts for 2/3 turf in Sidney. It is most widely used on playing surfaces for soccer, horse race tracks, and lawn bowls. Lawn bowls is a very intensive sport. There are 1500 clubs in New South Wales. It is a very companionable game.

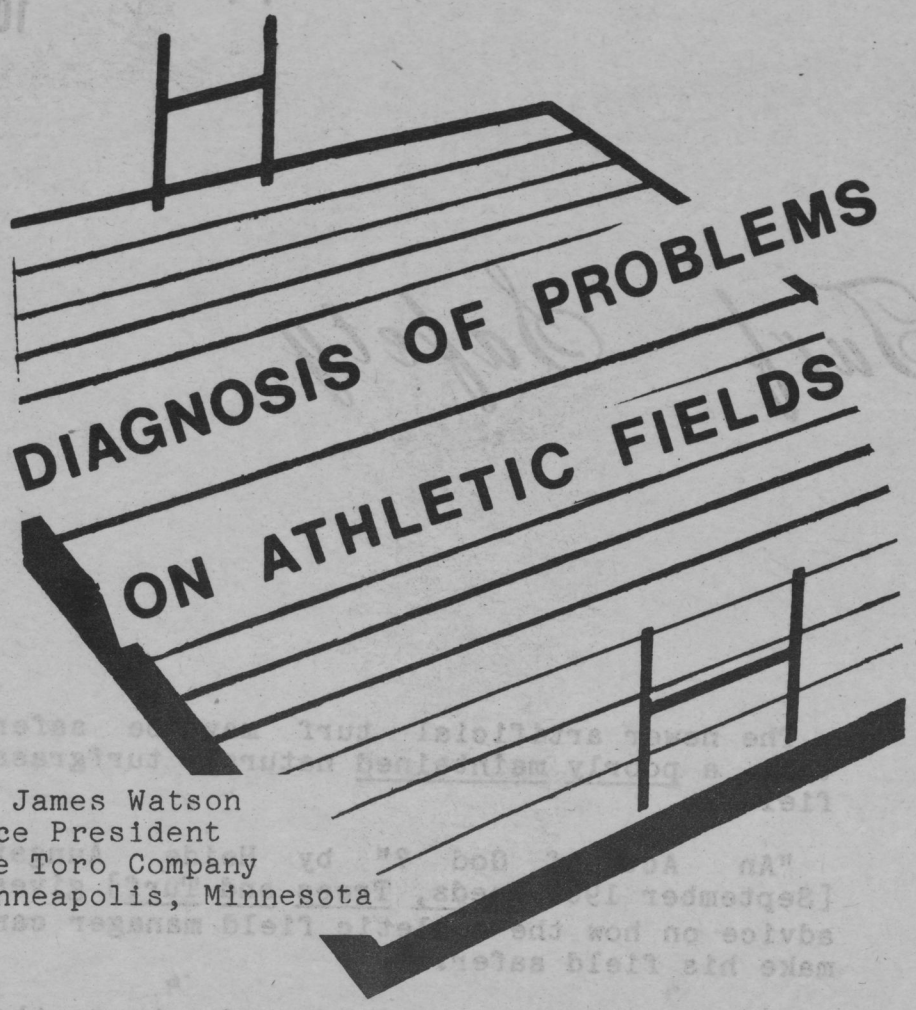
- A breeding program has helped to develop stronger lateral growth. A planting system has been developed to put slips into the ground. A single slip doesn't have to establish apical dominance and thus turf can be established in 6-7 weeks. Kikuyugrass wears badly on football fields. It is used on cricket ovals and grass skii slopes.

- Bermudagrass - looking for new cultivars that will tolerate low temperatures and that will grow in low light intensity. Tifdwarf has a spring dead spot problem. It is used in the northern [warmer] part of the country. The agent for this problem was named as early as 1964 in Australia. Looking for cultivars that retain high color in winter. Water use rates must be lower than in U S types.



- The turf scene in Australia is complex and there is a broad spectrum of activity. The Australian Turfgrass Research Institute is located in Sidney and has a staff of four. The following investigations are underway:

  * evaluation of maintenance practices for kikuyugrass on horse race tracks;
  * prospects for mixtures of turf type tall fescues and kikuyugrass;
  * cause and control of kikuyugrass yellows;
  * improve kikuyugrass wearability;
  * improve bermudagrass tolerance of cold and low light intensity;
  * avoidance of having to overseed dormant bermudagrass;
  * control of mat accumulation on sandy soils during wet winters;
  * weed control;
  * turf management on golf courses, football fields, cricket fields and grass skiing slopes.



Dr James Watson
Vice President
The Toro Company
Minneapolis, Minnesota

Dr Watson presented an overview of sports turf needs for safer playing surfaces. He placed emphasis on the following points.

- There is a great deal of public awareness that many sports fields are in poor shape and a growing feeling that this situation can and needs to be improved.

- There is also a growing awareness that artificial turf is not as safe a medium to play on as is natural turf.

- Many who are in charge of athletic fields either do not have adequate knowledge about improving field conditions or are unable to convince those in power to spend the money on proper maintenance. Sports turf problems are more a matter of economics than technology.

- Professional teams play on fields that have been funded by bonds. A diverse schedule of events take place in order to pay off the revenue bonds so the fields are all-purpose, rather than sports fields. In fact, the other uses are harder on the turf than the sports events.

- To diagnose sports field problems, there are questions that need to be answered:

  * How was the field built ?

  * Is there proper drainage ?

  * How deep is the seed bed ? [It takes 16 inches of permeable soil to pull water through.

  * What soils were used ? Were they mixed properly ? Were modifications made in the soil ? What are the physical and chemical properties of the soil ?

  * What water source is used for irrigation ? What are the chemical properties of the water ?

  * What grasses were planted ?

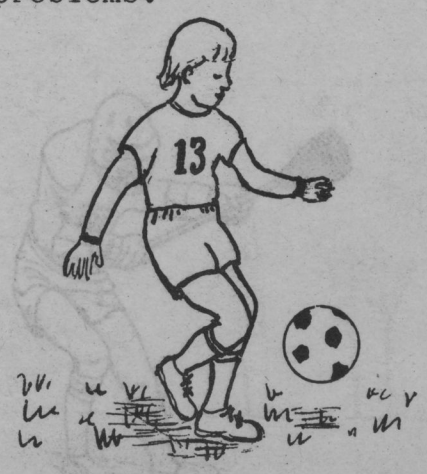
  * What management practices are used?

- There often are a combination of problems, like having brackish water and planting grasses that are not salt tolerant.

- Sports turf managers have to respond to the public awareness of grooming. On TV, quality of a field is often judged by color and uniformity. A sweeper, alternate mowing and good striping can do a lot to influence the public's expectations. But, those expectations have nothing to do with the quality of the playing surface.

- Most colleges and high schools do not have enough fields and have to practice sports and band on the main field. Traffic patterns develop from the band lines, the coach pacing on the sidelines, and equipment being used in the same pattern time after time.

- The soil is most important. Uniform mixing of soil and amendments used are important, both for the seed bed and for topdressing. Using 100 % sand causes problems.



Athletic Turf Safety

Heide Aungst
Managing Editor
Landscape Management
Cleveland, Ohio

Heide Aungst has been instrumental in helping to create greater awareness of the potential for injury resident in sports field surfaces. Through 2 feature presentations, entitled "Act of God" and "Sidelined", she has presented much good food for thought. These comments refer to sports turf injuries.

Injuries happen too often on sports fields and too often are caused by the surface of the field. Safe sports fields .have a positive impact on all our lives.

The case of Scott Halbrook, ["The Killing Field" by Heide Aungst, September 1986 Weeds, Trees and Turf] who fell on artificial turf while practicing baseball and died three days later, has brought up two issues on sports turf: 1) how hard is hard ? and, 2) should there be a standard for hardness on sports fields ? These issues apply to both natural and artificial turf.

Research is being done on hardness of playing fields. In some instances, a 5 year old synthetic turf field is as hard as asphalt due to degredation of the pad under the top surface.

Are turf managers liable for injuries which occur as a result of a poor playing surface ? The answer seems to be "yes".

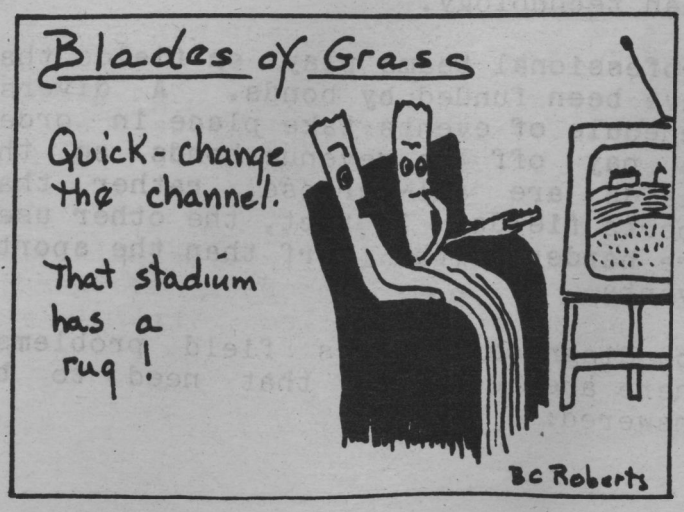
The newer artificial turf may be safer than a poorly maintained natural turfgrass field.

"An Act of God ?" by Heide Aungst [September 1986 Weeds, Trees and Turf] gives advice on how the athletic field manager can make his field safer.

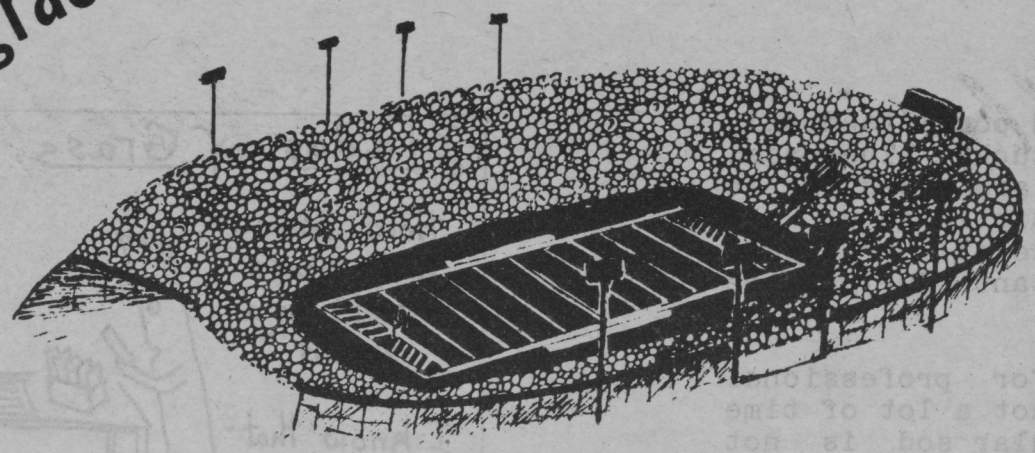
Athletes need to be informed about the properties of the surface they are going to play on. For instance, a green covering gives the illusion of soft grass and a player may not put an elbow down to cushion a fall and yet the surface may be hard.

G et advice
R ally community support
A erate often
S ample soil
S elect seed carefully - use named varieties.

Natural grass fields are returning to favor.



Turfgrass Management in a Multi-use Stadium



Steve Wightman
Director of Stadium Properties
Mile High Stadium
Denver, Colorado

Steve Wightman reviewed turf management practices in a multi-use stadium. He drew heavily on his considerable experience as Director of Stadium Properties. The following points were emphasized.

- Any athletic field is only as good as its construction: One of the most important issues that has to be addressed is where excess water will go. Thus, field construction has to be from the bottom up.

- Turf managers need to develop a plan of action, which, like a vacation map, gives direction but is flexible enough to allow necessary detours.

- A calendar of activities, color coded for types of events, allows the manager to see the windows that are available for management practices. An ability to see the entire year ahead helps in the planning process.

- Mowing is the most frequent management practice. The height of cut is correlated with root depth. Too close a cut results in shallow roots. Mow frequently on dry grass with a sharp mower.

- The optimal playability of any field depends on water. A properly designed and properly installed irrigation system is necessary.

- Fertilizer is basic for turfgrass. As a turf surface is used more, the grass needs more nutrients. This can't be done blindly. Core samples should be analysed as a basis for determining the fertilizer program.

- The single most important management practice is core aerification, which gives avenues for movement of air and water and for rapid drainage. It should be done 5 - 8 times a year on a heavily used field for a stronger turf surface. The process is detrimental to the turf at the time it is imposed. The plugs can be removed or allowed to dry and dragged in. Benefits from spiking and slicing don't last as long as core aerification so would have to be done more often. Football fields use lots of water based latex paint for markings and these areas need to be opened up to breathe.

- Topdressing should be applied in conjunction with aerification. A combination of sand, loam and organic matter is ideal. During heavy field use, pure sand topdressing will help provide good drainage and interferes less with field activity. Topdressing is dragged in which helps level the field. Core aerification is like punching holes in a sponge. The type of equipment that removes plugs is best. When the holes are filled with non-compactable material, the holes will remain open longer allowing root expansion and drainage.

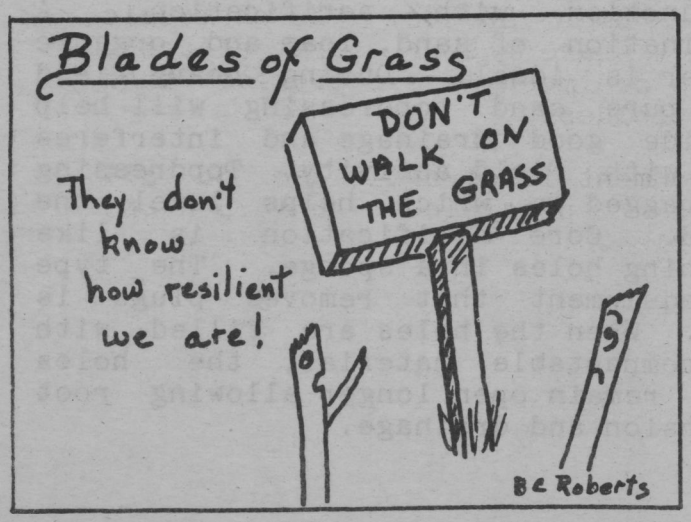
MULTI-USE STADIUM CONTINUED

- Mile High Stadium field consists mostly of A-34 Bensun Kentucky bluegrass. When several cultivars are mixed, it is like an investor's portfolio as no one variety is the answer to all problems. Overseeding is important during the season and post-season.

- Sodding is important for professional fields since there is not a lot of time between events. Regular sod is not thick enough to develop a quick root system so a thicker sod is used. The sod is laid down and played on.

- Pest control for weeds, insects and disease can be approached in three ways - 1) do nothing; 2) use a blanket control; and the best way 3) provide when needed.

- A multipurpose field means that football is played on the baseball infield. To prepare the field for baseball, it is scarified to loosen the soil with a spiker drag and leveled with a rail drag. Pregame preparation includes using a mat drag which fluffs and levels the soil. The grassline ridge needs to be leveled daily or at least periodically to make it safe. If the surface is loosened, the wind will blow the soil into the grass. Rake and drag the soil and wash out of the turf with a hose. Keep the dirt a little moist.



- The pitcher's plate and home plate will hold up better if they are all clay. Each day the loose portions are swept out and wet and then dry screened hard clay is put into the holes and tamped until compact. A portable pitchers mound consists of a circle 18 feet in diameter with 13 feet being used for the mound. Four U-bolts are part of the plate to anchor it down. It can be removed in 15 minutes by using plywood for a truck to travel on. A trailor is backed over the mound and the plate is lifted and dragged off the field. Pitchers like this system as the mound is consistent.

- Cold weather - snow. The field is heated underneath. Tarps are used on a well drained field. The black side is up if temperatures are below 50 degrees and the white side is up if the temperature is 50 degrees or more. A plow with a rubber strip on the bottom is used over the tarp to remove snow.

- When non-sporting events are held, the aim is to minimize the detrimental effects on the turf. Geo-textiles can be used over the grass with strips overlapped 2 inches and seams taped. Plywood can be added for walkways.

- When working with sports fields, think ahead and use the management team approach responsibly.

Pesticides and Public Health

Dr Bruce Anderson
Deputy Dir for Environmental Programs
Hawaii Dept of Health

Bruce Anderson reported on the importance of safe use of pesticides in Hawaii. He made clear the need for a sound investigative procedure that is just for both those that use pesticides and those that fear exposure to materials over which they have no control. The following points were made.

- Pesticides of are considerable concern to the public. In a recent survey in Hawaii, the number one concern was shown to be toxic chemicals in the environment. This concern will continue to grow. What people fear most is what they can't see or understand.

- There is no measure presently of how much illness in the state is related to pesticides. There is proposed legislation to require doctors to report all pesticide-related illnesses, starting next year. California is presently the only state that has such a law.

- A description of a recent situation in an exclusive residential area built in close proximity to two golf courses provides an example of the fear of pesticides. In 1980, the first complaint of illness attributed to pesticides by a resident was reported. This person continued to report headaches, nausea and depression over the next two years. The Department of Agriculture inspected and could find no problems. They looked for plant damage that might identify the problem and took water, air, dust and soil samples. Concern and complaints grew in the neighborhood. Blood samples were taken and arsonic was found but no evidence of undue exposure. Residents were called asking for more specific symptoms. Tests were conducted by spraying water rather than pesticides and whenever the sprayers were seen by residents, an increase in complaints of illness were noted. There was a clustering of cases on the edge of the golf course and there were complaints of odor. Sewerage effluent was used for watering the golf course. The sewerage system was checked and water samples showed contamination by pathogenic organisms. The plant had run out of chlorine at different times and continued to allow the effluent to be used. The sewerage plant was closed and city water then used for irrigation. Complaints subsided.

- One lesson learned was to be responsive to complaints and check all possibilities for sources of the problem.

- Pesticides need to be applied with the proper equipment and all safety requirements followed. Eighty percent of accidents associated with pesticides are from applicators not using proper equipment. Follow label instructions carefully. Prevent pesticides from drifting and don't allow people or animals to go into the area. Protect plants. Use pesticides with low acute toxicity - High LD-50s. Use chemicals that don't have long term effects. Herbicides are much less a problem than are insecticides.

- The environment is fragile so do all that is possible to prevent contamination.

Turfgrass Pest Problems in Japan

Saburo Kakuda
President
Nihon Green Keeper's Association
Yokohama, Japan

Saburo Kakuda described three major pest problems in Japan. These included control of annual bluegrass in bentgrass, large patch disease and fairy ring. He provided the following information.

1.- Annual Poa is an annual winter weed and is found almost everywhere from Hokkaido to Kyushu. It begins to grow from late summer to early autumn and has tendency to bloom even when cut short. This means that annual Poa grows especially on greens. As it blooms any time, it grows almost anywhere in the temperate zone. It withers in summer in the warm zone and survives in summer in the cool zone.

- This is an explanation of the normal annual Poa, but there are many kinds of annual Poa, as many as forty types. Some become perennial and grow throughout the year. It is believed that germination of annual Poa is from late summer to early autumn, but, as a matter of fact, we can see germination from seeds in spring.

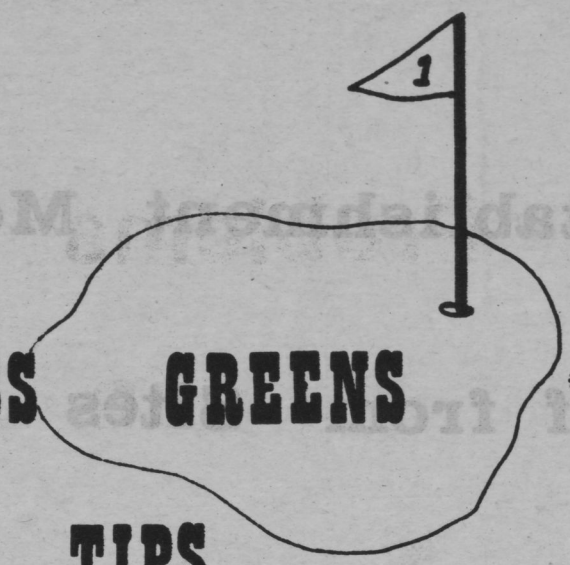
- To control annual Poa in a bentgrass green, it is not sufficient to apply herbicide but it must be picked by hand. It is essential that this be done as early as possible and repeated frequently.

POA ANNUA

2.- Large patch is caused by Rhizoctonia solani and is normally found in areas of stagnant water or waterways. But sometimes it even appears in dried spots. Some years ago, we only had a few spots, but now 60 % of the golf courses in southern parts on the Kanto district are suffering from large patch and further spread of the disease is feared. It breaks out twice a year, normally the beginning of April and the beginning of October, but sometimes in the cool, rainy season. When the temperature goes about 77 degrees F, the turf seems to recover from the disease, except in cool summer climate or in the cooler highlands.

- It is said that bad watering and accumulation of thatch may cause large patch and it consumes considerable time and money to control large patch in such big areas as fairways and roughs. Both the spraying of fungicide and recultivation of the fairway and rough may provide good results.

3.- Fairy ring shows dark green at first and then gradually spreads its ring up to more than 33 feet in diameter. It breaks out both in Koraishiba [Zoysia spp] and cool zone turf. Fairy ring has a dark green belt and, outside of the belt, mushrooms grow. It breaks out in the rainy season and calms down in summer but shows increased activity in autumn. As this is caused by the outbreak of mushrooms, it is necessary to remove thatch and provide good ventilation and water penetration. It is very difficult to control fairy ring by fungicide. However, it is reported that Daconil has demonstrated good results together with a wetting agent, by applying a large quantity of more than 1-2 gals/10 sq ft. However, further study of fairy ring is urgently needed.



BERMUDAGRASS GREENS MAINTENANCE TIPS

Charles "Bud" White
Southeastern Manager Golf Course Sales
LESCO

"Bud" White made the following observations about bermudagrass greens.

- There is a demand for faster, smoother, firmer greens. Unfortunately, the golfer thinks of the fine quality putting condition of greens seen during major tournaments on TV. This quality can't be maintained year round. Publicity leads one to feel that faster greens are better. There are some tips that can help improve greens.

* Grain control: There is more grain in higher fertilized greens. Grooming can help eliminate grain. Grass grows in one direction. A tight turf should have an upright, vertical growth habit.

* Core aerification in bermudagrass greens is practiced three times a year in the southeast and four times a year where there is heavy traffic to help provide good strong turfgrass.

* Topdressing periodically with 1/2 cubic yard per 1000 square feet is recommended. Follow this with vertical mowing to reintroduce soil into upper levels of the root zone. Mat into the crown area. This helps to break down thatch.

* Vertical mowing once a year in bermudagrass is needed to dethatch. Groom once a week to get rid of horizontal growth. The principle is the same for bentgrass, bermudagrass overseeded with ryegrass or pure bermudagrass. If grooves are still there in 5 days, it has been done too deeply.

* Bentgrass greens need to be spiked or sliced during the summer. This allows air and water to go down. This doesn't replace aerification. It should be done often during the growing and heavy rainy seasons.

* In Pinehurst, North Carolina, a street sweeper is used on bermudagrass after mowing, then the green is overseeded. This means better germination and establishment with less washing. Brushing is very beneficial for speed and uniformity of the putting surface. It improves the surface and makes it better, truer and faster. Some brush as they mow. Speed of the green is increased without lowering the mowing. The brush is put in front of the mower.

* Mowing creates a pattern so change the pattern each day. A grooved roller on the front of the mower prevents thatch. It stands the grass up to give a truer cut on the surface. There is a drawback if the same pattern is used each time.

* Whipping is a tremendous tool. Use a putting green mower 3-4 days to pick up dropped clippings and on other days whip around to clean up where mower drops.

* Watering greens with one green on one clock can cause difficulties. The low and high spots need different schedules. Hand water and sprinkler irrigate greens that have different requirements. Too much water around the cup creates pits, poor growing conditions and poor putting.

* Overseeding bermudagrass doesn't take away quality. In southern Florida when there are cooler temperatures at night the bermudagrass is not actively growing so can't recover from damage. Overseeding means color and recovery.

The end results of good management mean an upright growing habit, fine leaves, and uniform surface without lowering the cutting height. Five thirty-seconds inch can be as good as 1/8 inch.

The Effect of Establishment Method on Runoff from Sites

Dr Thomas L Watschke, Professor
Penn State University

Pennsylvania State University is providing leadership in research to improve our understanding of how soils and turf influence the quality of water that runs off the turf surface and infiltrates down into the soil. Dr Thomas Watschke placed emphasis on the following points.

- Concerns about water quality are increasing. Water quality and quantity are the number one issues for all of us today. We recognize that only 1/3 of our water is in aquifers; the other 2/3 runs off or evaporates.

- When runoff water is considered for consumption, a resevoir is needed. Any contamination the water encounters on the way to the resevoir needs to be determined. It is important to find out what effects turf and the landscape have on the rate of water runoff and also on the rate of penetration into the soil. Turf may become an important focal point related to the issue of runoff.

- Pennsylvania State University became involved in research on runoff as a result of headlines that shook the lawn care industry. Whenever applications of chemicals are made on turf, they involve questions about runoff, although this has not yet become the major focus of the media.

- The research plots became operational in 1982. Agriculture for years has used grassed strips as buffer zones. There is indirect evidence that most pesticides load onto particulate matter and as water leaves the cultivated area, particles fall out of the water in the grassed areas.

- These plots were used in 1936 for soil erosion studies which were a part of the research that developed the Universal Soil Loss Equation. The plots are designed with an average 11.5 % slope. At the bottom of each slope is a concrete catch basin. Irrigation with a potential for 3 inches an hour has been established in each of the twelve 23' X 61' plots. Lysimeters have been placed on each slope. Seeding, sodding and management practices consist of approved methods and a typical liquid lawn care approach has been used. Four applications of fertilizer a year have been made plus use of pesticides.

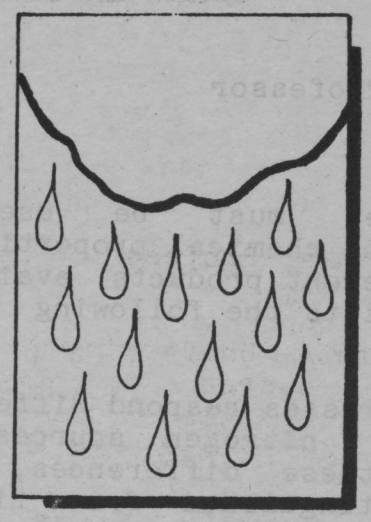
- Hydrologic implications:

  * stand density and thatch production have an effect on runoff;

  * thatch is a resevoir with water holding capacity so there is an advantage in having some thatch.

- In early observations, sodded plots looked better than seeded plots. On seeded plots, there was a compacting action by rain and irrigation water on the exposed soil surface. A good seed mix proved to be better than a contractors mix that produced a more open turf with grasses that lacked vigor to establish a dense cover. It is a slow process for the soil to get back to good structure when seeded. Sod, in effect, stops deterioration of soil structure.

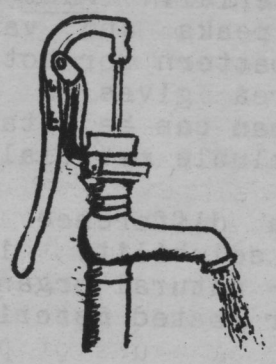
RUNOFF CONTINUED



- Infiltration rates on sodded slopes have been 7.6 inches an hour and on seeded slopes, 2.3 - 2.5 inches an hour.

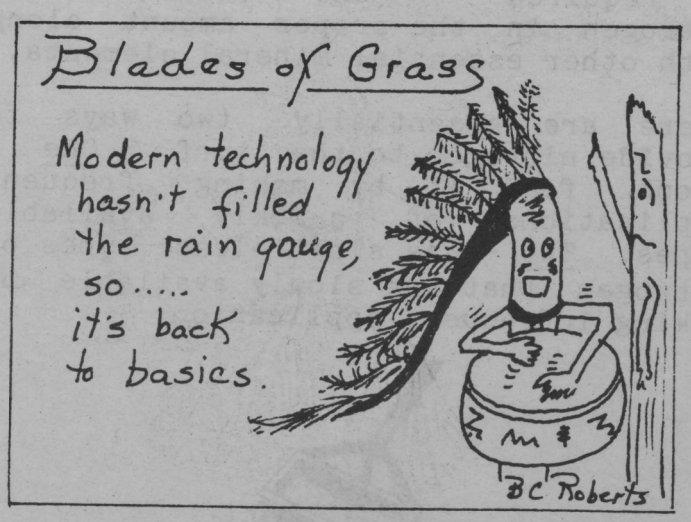
- To date, one insecticide, one pre- and one post-emergence herbicide have been used along with nitrogen, phosphorus and potassium fertilization. No fungicides have been applied.

- Laboratory work is costly so the turn around time on chemical analysis has been slow. It would seem from preliminary findings that turf has tremendous potential to buffer any inputs used to maintain it.



- Some nutrients have been recovered: nitrogen at 5 parts per million - maximum; phosphorus at 6 parts per million - maximum; potassium at 8 parts per million - maximum. Potassium concentration is higher in the irrigation water than in runoff water. A high quality turf will buffer any loss of nutrients in runoff water or in the leachate. It should be feasible to take effluent and use it on turf so as to clean up water that runs down through the soil. The value of this cleaning process could be sufficient to justify a monitary charge for this service. In development, some 60 percent loss in water infiltration results from construction of roofs, roads, sidewalks, etc. A specified number of acres of grass lands must be left to allow water to recharge underground supplies. It seems easier to justify the building of a lake to hold water than to preserve open space to enhance infiltration into the soil.

- The Penn State research should provide data needed to demonstrate the value of turf in helping to maintain a high quality environment. It should help to take turf managers from a defensive posture with environmentalists, who are demanding proof. It should help to establish sound regulations on use of pesticides. For example, insecticides that must be watered in to be effective, are in some locations restricted from use prior to rain. The net result is often poor results that require the application of more insecticide.



NITROGEN SOURCES FOR TURF FERTILIZATION

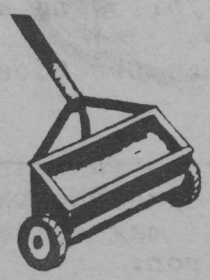
Dr Norman Hummel, Professor
Cornell University
Ithaca, New York

Nitrogen sources must be used in accordance with the chemical properties of the several different products available. Dr Norman Hummel lists the following points as important.

- Cool season grasses respond differently to different nitrogen sources. In determining these differences, fact must be distinguished from fiction. Nitrogen response on both cool season and warm season grasses is similar. The intensity of the response is often different. In addition, cultural practices influence turf response to fertilization.

- Turfgrasses require 16 elements. Three are: carbon, hydrogen and oxygen that come from air and water. The other thirteen are mineral nutrients. Nitrogen, phosphorus and potassium are recognized as most important. Also, larger amounts of these are required than for the others. If any are in short supply in the soil, additions must be made. Dollar for dollar, nitrogen produces the most plant response. This is noted in improved shoot and root growth, in better shoot density and in more attractive color of foliage. In addition, disease proneness; heat, cold and drought tolerance; and recuperative potential are related to nitrogen nutrition. Of course, a balanced fertilizer program is required - one that includes nitrogen in the proper amount along with other essential mineral elements.

- There are essentially two ways to provide nitrogen to the turf. One - spoon feed it by making frequent applications of quickly available types. Two - use slow release types of nitrogen that are slowly available by making infrequent application.



- Quickly available nitrogen sources include both ammonium nitrate and water soluble organic types. These nitrogen sources are generally low in cost, provide a rapid response, have minimal temperature dependency, are water soluble, have high salt indexes, provide a response of short duration and are subject to loses by leaching and volatilization.

- Nitrogen loss from urea by volatilization can be high. There is little of this type loss from IBDU. Also, leaching losses of nitrogen are greater from urea than from IBDU.

- Generally, several small applications of a water soluble nitrogen source are as good as fewer applications of a slow release material. Fact or Fiction ? There are peaks and valleys in the response pattern for both, but sulfur coated urea gives a more uniform response than can be obtained from use of water soluble materials.

- There is a difference in degree of nitrogen solubility in different materials - natural organics, synthetic organics or coated materials.

- Most slow release fertilizers are formulated - they are not sold pure. The guaranteed analysis may be 18-5-9. How much of the nitrogen is water insoluble ? Water insoluble nitrogen divided by total nitrogen times 100 equals the percent of the total nitrogen that is slow release. Fifty percent water insoluble nitrogen indicates that half is quickly available and half is slow release. Thirty to thirty five percent water insoluble nitrogen is common in most turf fertilizers. This amount is needed.

- Natural organic nitrogen sources include such materials as cow manure, bone meal and a wide variety of waste products. There is generally low foliar burn, reduced leaching and availability of some micronutrients. The nitrogen release rate is slow; there is a low rate of water soluble nitrogen; a high cost per unit of nitrogen; a low nitrogen analysis; a release of microbes from the product;

NITROGEN SOURCES CONTINUED

and a dependency on both temperature and moisture. Milorganite [6-2-0] represents this type of nitrogen source well. With natural organic materials, there are ups and downs in the release rate depending on the activity of microorganisms. These compounds contain carbon that serves as a source of energy for microbes. Natural organics contain less than 10 percent nitrogen.

- Synthetic organic nitrogen sources are also carbon containing compounds. Ureaformaldehyde and IBDU are good examples of this class. But - all ureaforms are slow release. Fact or Fiction? No! There are short chain ureaforms. Methyl ureas are soluble and quickly available.. Formoline contains 50 percent urea. Nitro-26 contains more than 15 percent urea. FLUF contains more than 16 percent urea. Fan contains 20 percent urea. Long chain ureaforms as contained in Nitroform are slow release. In these compounds, cold water soluble nitrogen is quickly available. Cold water insoluble nitrogen has residual activity. And hot water insoluble nitrogen is very slow to release. Different products contain different amounts of these types of nitrogen.

- Scotts short chain compounds give a more rapid response and have a 6 to 8 week duration. Nitroform 38 percent nitrogen with 70 percent water insoluble nitrogen has longer chains and lasts longer. Bacterial decomposition is required for breakdown and thus there is a long term residual supply of nitrogen. The initial turf response may be slow, but then as decomposition continues, the response picks up.

- IBDU release of nitrogen is affected by soil moisture only. Fact or Fiction ? Yes ! Moisture is required for nitrogen release. It is slightly water soluble, uniform, not dependent on soil microbes for release of nitrogen, but does depend on hydrolysis for nitrogen release. The initial response is slow. Then, when the release starts, it holds very well. IBDU, like other nitrogen sources, at times gets caught up in the thatch and takes longer to start nitrogen release than in the soil.

- Turf fertilizers may contain IBDU, water solubles and sulfur coated urea.

- Sulfur coated urea is produced by one of two methods - TVA or CIL. All sulfur coated ureas are alike. Fact or Fiction ? No ! In general, preheated urea is sprayed with molten sulfur. The sulfur hardens and produces a coating that keeps the urea in. As the sulfur shrinks, small pores are opened up. These are sealed or left open. O M Scott's sulfur coated urea is made by the TVA method without a sealant used. Release is more rapid - more like urea. LESCO and others are made by the TVA or CIL method that has more slow release characteristics - response may last up to 12 weeks. It also has a good initial response. Overall, the most uniform response possible. Where there are imperfectly coated particles, there is an immediate nitrogen response. With a thin coating, there is an intermediate nitrogen release. Thicker coatings produce a longer release pattern. The dissolution rate indicates rate of release in the soil. A higher rate means a faster rate of nitrogen release. The dissolution rate for the TVA method varies from 11 to 25. That for sulfur coated urea produced by the CIL method has a dissolution rate of 30. Particle size also has an affect. Fine particles release nitrogen more rapidly because the surface exposed to the soil is greater.

- Plastic coated urea - Astec product from Japan - has a soft coating with small pores. The number and size of the pores can be regulated. There may be good response from a mixture of sulfur coated urea and plastic coated urea.

- Factors affecting relative cost include:

  * initial cost of product;
  * release rate - length of response;
  * spreadability - particle uniformity;
  * safety - following application;
  * maintenance practices affected by use;
  * other plant nutrients contained, such as phosphorus, potassium, calcium, magnesium, manganese, sulfur, iron.

Developing Warm Season Turfgrassess

Dr Jeff Krans, Professor
Mississippi State University

Dr Jeff Krans lists the following points as important in understanding the development status of warm season turfgrasses.

- Most warm season grasses are not propagated by seed.

- Bermudagrass- [Cynodon spp].

In 1985 a National Bermudagrass Cultivar Trial was established. Eleven states in the south are participating. For the first time, all vegetative material at all locations is from the same stock. This will provide a good check on the purity of the grasses. Clipping height and fertility are being kept constant. There have been 28 entries in these trials.

Established cultivars include:

Tifgreen
Tifdwarf
Tifway
Texturf 10
Santa Ana
Ormond

New cultivars:

Tifgreen II and Tifway II [closely related to Tifgreen and Tifway]
Vamont - localized to east coast; more cold hardiness; aggressive; recuperative properties on sports fields.
Guymon - seeded type; unique in morphological and growth characteristics; good for low-maintenance and high cutting, like roadsides; improved cold tolerance; has forage qualities; coarser than common; seeds true to type therefore uniformity is high.
NuMex S 1 - seeded type; improved some above common but how much is still a question.
MSB 20 - shows signs of shade tolerance.

Future for bermudagrass:

- seeded types;
- improved cold tolerance
- improved shade tolerance
- plant material has been collected.

- Zoysiagrass - [Zoysia matrella].

Plots at USDA, Beltsville MD and Dallas TX.

Established cultivars:

Meyer
Emerald

New cultivars:

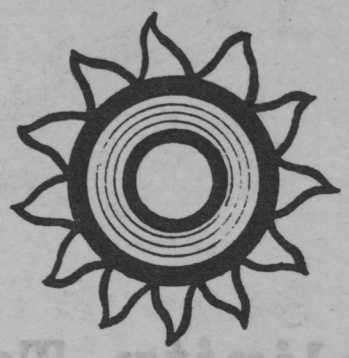
Belair [Zoysia japonica] - slow lateral spread; nice color;
El Toro [Zoysia japonica]

Future for zoysiagrass:

- seeded types;
- less proneness to thatch buildup;
- more rapid lateral spread which means recuperation after damage and faster establishment;
- more rhizomatous to be more wear tolerant and good sod production.

Zoysiagrass has unique qualities so there is a great deal of interest in this grass. The potential for development is good in these areas:

- less tendency for dormancy;
- types that take traffic;
- slow lateral spread as on a bunker face;
- differences in leaf width
  - more narrow leaves;
- more rhizomatous;
- sod production characteristics;
- variability in seeded types;
- blow sprigs into the ground with faster lateral spread by use of a hydro-mulcher.



- St Augustine - Florida - [Stenotaphrum secundatum]

Established cultivars:

Bitterblue
Floratine
Floratam
Texas common

New cultivars:

Raleigh - cold hardiness;
Seville - dwarf type;
Floralawn - chinch bug resistance.

Future for St Augustine:

- drought tolerance
- resistance to chinch bug and SAD virus
- dwarf types.

- Centipedegrass - [Eremochloa ophiuroides]

Established cultivars:

Oklawn
Georgia common [seed or vegetative]

New cultivars:

AU Centennial [Auburn] - improved green color; good alkaline tolerance

Future of centipedegrass:

- better green color;
- more alkaline pH tolerance.

- Bahiagrass - [Paspalum notatum]

Established cultivars:

Argentine
Pensacola

New varieties:

none in the 1980s

Future for bahiagrass:

- low maintenance turf
- reduced seedhead height and frequency of seeding;
- increased stand density;
- low water requirement.

-Buffalograss - [Buchloe spp]

Future grass for the arid south.

Bentgrass in Bermuda Country

- Dangerous. It's a cool season grass and has physiological problems in the southern region. Can never do what bermudagrass can do. Expect to see some bentgrass grown in the south.

- Hawaii used to have Seaside bentgrass and Old Orchard bentgrass on golf greens when play was much less. Now with heavier play, need bermudagrass greens.

- Bentgrass requires much more management during hot weather than bermudagrass. It can be lost quickly during these periods.

- Bentgrass roots grow at temperatures of 60 to 65 degrees Fahrenheit. At temperatures in the upper 70's, roots die - half may be gone. At temperatures of 110 degrees Fahrenheit, there is direct high temperature kill. Leaf temperature at this time will be higher than the air temperature. A 95 degree air temperature can produce a 115 to 120 degree leaf temperature. In addition, bentgrasses are not sufficiently salt tolerant for good use in Hawaii.

- Why is there interest in bentgrasses for warm regions of the country:

  * use to advantage during cooler parts of the year [doesn't apply particularly well to Hawaii];

  * better putting quality;

  * doesn't winter kill like bermudagrass [doesn't apply to Hawaii];

  * professional golfers like it.

Warvests 22

Salinity Tolerance

of Warm Season Turfgrassess

Kenneth Marcum
University of Hawaii

Kenneth Marcum is conducting research on salinity tolerance of warm season grasses in Hawaii. His results emphasize the following.

- Water stress in turfgrasses is often found to be the result of osmotic imbalances. There are also ion toxicities that contribute to these imbalances.
- Tifway, Tifdwarf and Tifgreen are good salt tolerant bermudagrasses. Futurf and Adalayd [Seashore Paspalums] also have good tolerance to salt.
- Ion exclusion is correlated with salt tolerance. If the turfgrass does not absorb sodium or chloride, it is likely to be more tolerant of its presence in the root zone.
- Root growth is often found to be stimulated some by increases in soil salinity. The osmotic potential of the plant sap increases and this indicates an adjustment to the increased osmotic pressure.
- St Augustinegrass and Paspalum vaginatum [Adalaydgrass] are more succulent under salt stress than other grasses. St Augustine accumulates more sodium and yet seems to tolerate it. Generally potassium content drops with increased salinity. This indicates that potassium is replaced by sodium. The potassium/sodium ratio drops with increasing salinity.
- Salt crystals form on the underside of bermudagrass leaves.

A Recent Survey

WHAT IS GRASS ?

The outstanding survey firm Searchit and Tellall Ltd asked the question "What is grass?"

Here are the results:

15 % thought it was a green soft carpet for children to play on and to wear pat in in that parents had to repair;

28 % thought grass was the fastest growing plant in the world;

5 % thought it was a dye that turned the knees of pants green;

19 % thought grass was a super plant that could grow up through concrete and flourish in flower gardens;

9 % thought it was something to smoke;

11 % thought it was the biggest star on TV;

13 % thought grass was human's best friend.

Salinity Control on Golf Courses

Dr Roger Gibson
U S Gypsum Corporation

Dr Roger Gibson reviewed the properties of gypsum that are important in its use on turfgrass. He emphasized the following points.

- Gypsum, calcium sulfate, is 150 times more soluble than limestone. It is used: as a calcium and sulfur source; to reduce the colloidal content of muddy ponds; to reduce aluminum toxicity in the southeast; to increase the electrolyte concentration in the soil solution; and to reduce exchangeable sodium.

- There are three sources of salinity: from ocean spray, saline ground water and saline irrigation water.

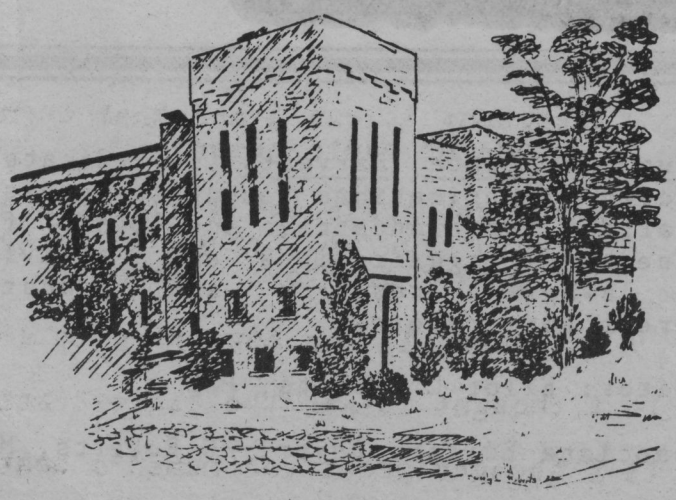
- Check the soil type and identify the source of the sodium problem. Look at the soil-water-plant interactions that may cause the loss in crop yields and the expected severity of the problem following long term use of the water. Check the management options available to prevent, correct or delay onset of problems.

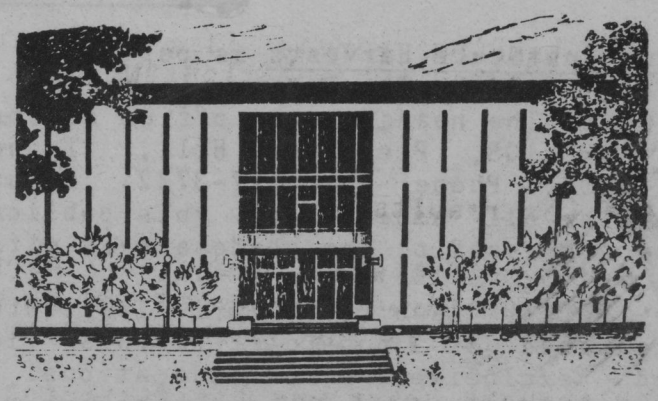
- To control saline conditions: 1] irrigate beyond plant moisture requirements to push sodium back into the ground water or at least down far enough to be away from the plant; 2] use a turfgrass tolerant of saline conditions; 3] supply good internal drainage when constructing and 4] use gypsum to replace the sodium.

- When calcium is added to water in the root zone, turfgrasses can tolerate larger amounts of sodium. The higher the salinity of the soil, the greater the reduction in turf quality. Soils that are generally low in calcium will have improved turf vigor when treated with gypsum.

- What is the proper rate of gypsum to apply ? Where the cation exchange capacity is low in calcium, from 1.7 to 17.2 tons of gypsum per acre has produced a favorable turf response. A good average is 5.2 tons per acre of gypsum. It is important to know the soil type, the kinds of clay minerals present and other physical and chemical soil properties.

- Gypsum can be applied from a spreader or injected into the irrigation water.





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Editor: Eliot C Roberts, PhD

Associate Editor: Beverly C Roberts, MA

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