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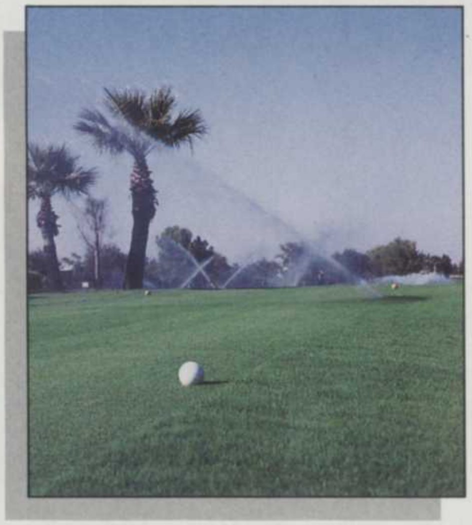

Maintaining one of the heaviest played executive golf courses in Southern California is a challenging job. An average of 290 rounds of golf a day puts tough demands on the turf, and on the irrigation system. That's why golf course superintendent Robert Stuczynski recently installed Weather-matic rotary pop-up sprinklers to upgrade the system at the Palm Desert Greens Country Club.

Stuczynski was won away from a brand he's used for more than a decade by Weather-matic's high quality design and features. The exclusive adjustable armspring allows fine-tuning while the sprinkler is on or off, and *stays* adjusted once set — a must for handling Palm Desert's exacting schedule of watering or fertilizing.

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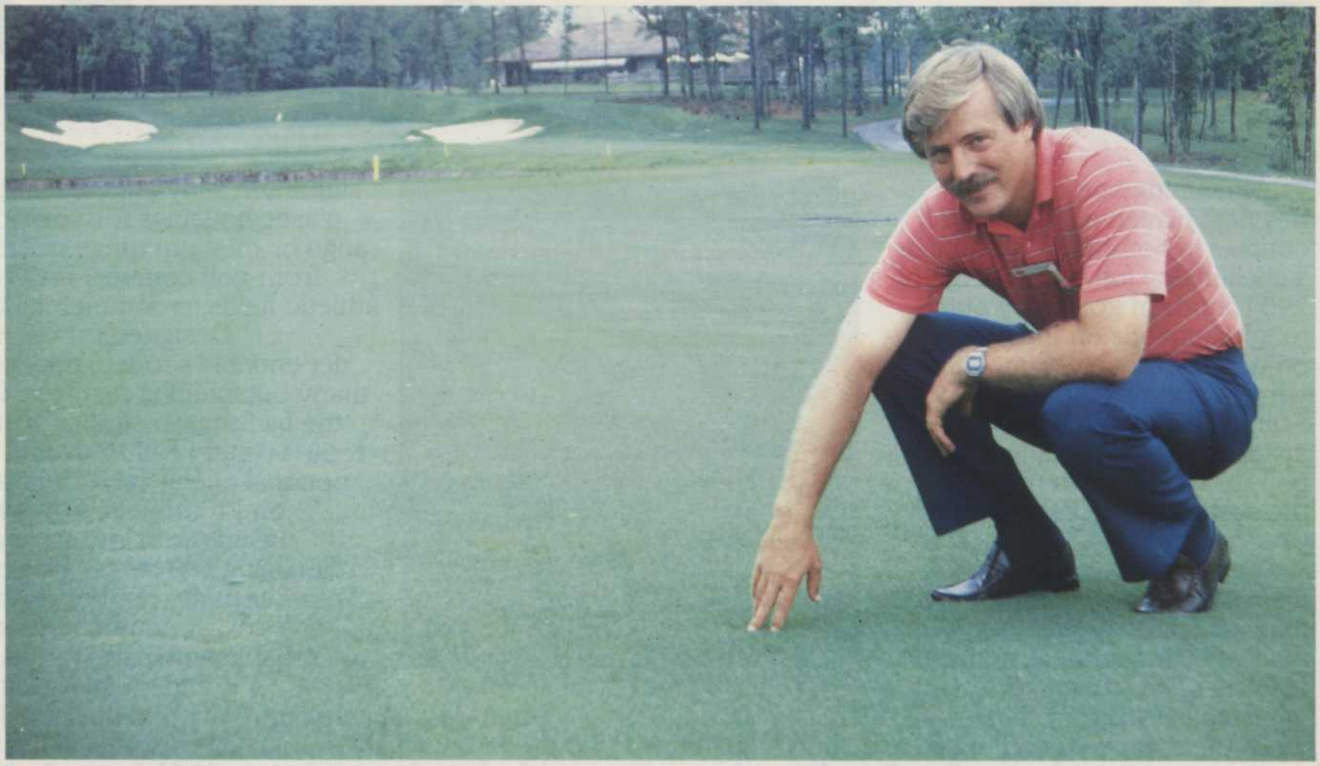

Superintendent Harold Franklin says that bentgrass fairways improve the playability and "showcase" image of Stonehenge.

expensive, but we place a high value on the premium playing surface."

Stonehenge could use bentgrass because of the course's elevation. "The heat in the South normally makes maintenance of bentgrass fairways extremely difficult," Franklin says. "But we're located on the Cumberland Plateau, with an average elevation of 2,000 feet. Our temperatures don't get quite as hot during the day, and it cools into the high 60s most nights. The cool temperatures give the grass relief and a chance to recover."

Even with the advantages of a high elevation, the heat and humidity promote disease development. From June through mid-September, Franklin uses a monthly preventative fungicide program on the fairways, with tees and greens treated every three weeks.

Battling brown patch

Brown patch is his biggest disease problem during summer, and dollar spot, red thread and snow mold are additional threats at various times of the year.

"We use Chipco fungicide in the preventative program, alternating every third application with Bayleton or 2787," Franklin says. "We also have to go in at times between the monthly sprays under high disease pressure situations to hold brown patch in check."

Franklin supplements his preventative spray program by culturally managing fertility to reduce disease pressure. He applies potassium nitrate in mid-May and again in mid-September, to build the potassium levels for drought and disease resistance.

"During the summer months, we don't fertilize the bentgrass because we don't want to promote rapid growth during the disease-prone period," Franklin relates. "High levels of nitrogen just prior to the onset of hot, humid weather increases the severity of the disease, so we try to hold off and keep the bent on the 'lean' side."

Franklin concentrates on keeping the bluegrass rough as weed-free as possible to control potential weed contamination in the bentgrass. He uses Presan liquid as a pre-emergent spray on tees and greens, and the same product in a dry form, blended with 19-4-9 fertilizer, on the fairways. In the bluegrass rough, he uses the 19-4-9 mixed with Chipco Ronstar G for annual grass control.

Going hog wild

Franklin uses a thorough insecticide program to maintain the fairways. Sod webworm and black cutworm are two of the major insect pests.

Compounding the normal grub problems are uninvited guests—wild hogs—which can cause some unusual turf damage to the rural, wooded course.

"If we don't keep the grubs under control, wild hogs can come onto the course and start rooting for them," Franklin says. "This gives us an additional incentive to keeping our grub problems under control."

Before the bentgrass could be established at Stonehenge, Franklin and his staff had to contend with a rock problem on the course. Rock had to be blasted out in places to allow for installation of the Toro irrigation system, which also contributed to difficulty in maintaining a proper ground for the system's safety during storms. Rock just beneath the soil surface had to be removed, fill brought in, and then additional topsoil applied to prepare an adequate seedbed.

"We hydroseeded the entire course and the bentgrass established itself very well," Franklin says. "The grass was all ready for play by June, but we had to pave cart paths and get the bunkers ready in order to open."

All the work and maintenance necessary to care for bentgrass fairways pays off for the players, especially since it can be mowed closely. Stonehenge hosted the 1985 Tennessee Open in only its second year of existence.

"It's obvious that you want the course to look and play well, but you want the players to feel good about the course after they've left," Franklin summarizes. "We want them to appreciate the condition and playability of the course, and I think the appearance and playability of bentgrass fairways helps them to do so." **WT&T**

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An a-Perm-o-Green employee uses a hand-held nozzle to spray a home lawn in Austin, Texas.

A GUIDE TO LAWN/LANDSCAPE FERTILIZATION

Fertilizers have a definite impact on root growth, carbohydrate reserves and stress tolerance. The dedicated turf manager closely monitors his fertilizer application timing, rate and method.

By Richard Rathgens, The Davey Company

Since the early 1970s, care of many residential and commercial lawns has shifted from the homeowner or property manager to the professional turfgrass specialist. This change in responsibility is evidenced by the tremendous growth of lawn care and landscape maintenance companies.

There are many benefits of professional lawn care for the homeowner and property manager. Using the expertise of a professional can optimize the potential beauty of a lawn. Many homeowners and property managers have realized a significant cost savings by contacting to have a lawn maintained as compared to purchasing the equipment and products themselves. Another benefit is a time savings which can be used for leisure activities by the homeowner or for other maintenance tasks by the property manager.

Traditionally, turfgrass managers have applied fertilizer during spring and fall using color and the amount of leaf growth as a guide to the rate and frequency of application. Although promoting good color and stimulating shoot growth are important objectives, often overlooked are nutrient influences on root growth, carbohydrate reserves and the plant's ability to tolerate disease and environmental stress. An understanding of the impact of fertilizer applications on these factors can refine a fertilization program resulting in a balance between the best in visual quality and a healthy turfgrass plant.

Timing

An important objective in the timing of fertilizer applications should be to promote root development and build carbohydrate reserves. The response of warm-season and cool-season turfgrasses differ in this respect.

The predominant cool-season turfgrasses (bluegrass, ryegrass and fescue) initiate and develop their root systems in the early spring and fall. For this reason, fall applications of nitrogen are important to increase root growth. Favorable environmental conditions exist in the fall for rhizome and tiller development. Fertilization at this time will also improve turf density.

In addition to regular fall fertilization (Sept. to early Oct.), late fall or late season fertilization is being included in most maintenance programs. Late fall fertilization is applied when shoot growth slows or approximately at the time of the last regular mowing of the season. Nitrogen applied at this time greatly enhances the photosynthetic production of carbohydrates. These carbohydrates are not only used for fall root growth, but are also stored for use the following growing season, providing earlier spring green-up and an energy source for turfgrasses to recuperate from environmental and mechanical stress.

Another advantage of late fall fertilization is that it reduces the need for high amounts of spring-applied nitrogen. Excessive spring fertilization can actually reduce carbohydrate reserves and root development by stimulating rapid shoot growth. This is because growing shoots take priority over roots for carbohydrate use. Both spring and summer fertilization should be used to maintain the color and density produced with fall fertilization the previous year. Fertilization at these times should not produce succulent plant tissue which can increase the severity of turfgrass disease and reduce the plant's ability to withstand heat, drought, mowing or wear stresses. Applications of potassium will greatly contribute to the hardiness of the plant and help to "temper" the stimulating effects of nitrogen.

In contrast, most root growth in the warm season grasses, (bermudagrass, zoysiagrass, St. Augustinegrass) occurs during the spring and summer. Fertilization during these periods will stimulate root growth. However, only moderate amounts of fertilizer should be applied in early spring in areas where warm season grasses experience winter dormancy. Bermudagrass and St. Augustinegrass are subject to spring root dieback following spring green-up. Heavy fertilization during early spring may result in an additional stress during this critical survival period.

Like cool season turfgrasses, warm season turfgrasses accumulate carbohydrate reserves in the fall when shoot growth activity slows. Care must be taken with the timing of fall fertilization since late application may decrease low temperature hardiness. Maintaining adequate potassium levels in fall will increase the tolerance of warm season grasses to low temperatures.

Charlie McGinty of McGinty & Sons watches a boom spray fertilizer application to a large commercial landscape.

As with cool season turfgrasses, indiscriminate use of nitrogen fertilization in the summer can increase injury of warm season grass subjected to disease or environmental stress. As mentioned previously, maintaining adequate soil potassium levels will help warm season turfgrasses in their tolerance of heat, cold, mowing and wear stresses, and reduce their susceptibility to the numerous turfgrass diseases.

Rate

The annual nitrogen requirement (lbs. per 1,000 sq. ft.) for turfgrass is determined by considering the length of growing season, level of quality desired, and the species and cultivars present.

The length of growing season or number of days (months) between the last killing frost in the spring and the first in the fall varies greatly. Along the Gulf of Mexico and in certain areas of Arizona and California, the average growing season is more than eight months. In contrast, northern portions of Maine and Minnesota have as little as three-and-a-half months of growing season. Obviously, the longer the length of growing season, the greater the amount of nitrogen needed to maintain turfgrass quality.

Residential and commercial lawns can range from a weed-free turf of acceptable color and density to a season-long turf of premium appearance. For this reason, the rate of fertilization can be tailored to meet the expectations of the homeowner or property manager.

A common practice on large commercial lawns is to survey the property and classify portions of lawns into high versus low maintenance areas. Those designated high maintenance or having the most visibility receive higher rates of fertilization.

Turfgrass species and cultivars within a species can vary in amount of nitrogen required to maximize quality. Within the cool season grasses, sheeps, hard and red fescues require a low level of fertility, Kentucky bluegrass a medium level of fertility.

Cultural practices such as irrigation and clipping removal may require the use of higher annual nitrogen rates to maintain the desired turfgrass quality. Supplemental watering will increase the rate at which nitrogen is leached from the root zone. Losses of nitrogen are substantial, particularly when quick-release sources are applied to sandier soils.

Collection of clippings following mowing has been estimated to remove approximately 20 percent of the nitrogen applied to turfgrass. Should clippings be routinely removed from turf, additional nitrogen should be factored into the yearly total.

Phosphorus and potassium have been routinely applied with nitrogen, using fertilizer with ratios such as 3:1:2, 5:1:2 or 4:1:1. These ratios are based on the relative amounts of nitrogen, phosphorus and potassium found in turfgrass clippings but do not take into consideration the inherent levels found in the soil. Rather than applying phosphorus and potassium each time nitrogen is applied, their use should be based on a soil test. The importance of determining inherent soil levels is exemplified when considering phosphorus application. Since many turfgrass soils contain high levels of phosphorus, little if any response is obtained when phosphorus is applied to established turf.

Two factors to be considered in making individual nitrogen applications are the nitrogen source and the time of year.

Applications using quick-release sources of nitrogen are commonly limited to no more than 1 lb. of nitrogen per 1,000 sq. ft. Lower rates of quick-release nitrogen sources will also minimize the potential of fertilizer burn.

In contrast, applications of nitrogen using controlled-release sources are generally made at rates from 1 to 3 lbs. of nitrogen per 1,000 sq. ft. The longer residual of controlled-release nitrogen sources reduces the need for more frequent applications required when using quick-release sources.

Suggested Nitrogen (N) Fertilization for Common Lawn Grasses (1)

Species	Time of Application (2) season	Rate of Application (3) pounds N per 1,000 square feet per year	Comments
cool season turfgrasses			
1. Fine Fescue	fall, late fall, late spring	1-4	Relatively low level of N required.
2. Tall Fescue	"	2-6	Generally receives less N than Kentucky bluegrass.
3. Kentucky Bluegrass alone or in combination with fine fescue and/or perennial ryegrass.	"	2-8	3-4 typical.
warm season turfgrasses			
1. Zoysiagrass	late spring, summer early fall	1-6	Relatively low level of N required.
2. Bermudagrass	"	4-10	Less N generally used on common Bermudagrass.
3. St. Augustine grass	"	2-8	---

(1) Consult with local turfgrass specialists for specific N recommendations for your area.
(2) Seasons of the year when fertilization should be emphasized.
(3) Rate of N used will vary with length of growing season, level of quality desired, in addition to cultural practices such as irrigation and clipping removal.

Method

Fertilizers can be applied in either dry or liquid forms. Research has shown that turf response is equal regardless of the form when considering a source of nitrogen such as urea. The choice of application method, then, may be decided on the turf manager's perception of productivity and personal preference.

Two types of spreaders are used to apply granular fertilizers—the gravity and the centrifugal. The gravity spreader applies a defined swath of fertilizer which can avoid waste in confined turf areas. But the centrifugal (or broadcast) spreader is commonly used by commercial turf managers because it applies a wider swath and can treat large areas more quickly.

Liquid fertilizer is either solubilized or suspended in water and sprayed on the turf. The amount of water used normally varies from 1 to 5 gal. per 1,000 sq. ft. Equipment can be broadly classified into either low-pressure spray booms or high-pressure (hydraulic) sprayers. Both types of sprayers feature a tank for holding the fertilizer and water, pump to build pressure to force the liquid from the tank to the nozzle, pressure regulator to keep the the pressure at the level desired, strainers or screens to keep solids from clogging the pump or nozzle, and nozzle(s) which deliver the spray to the turf in a particular pattern.

Low-pressure spray booms are operated at pressures in the range of 15 to 60 lbs. per sq. in. (psi) and deliver 1 gal. or less per 1,000 sq. ft. of spray. Low-pressure spray booms are designed to be driven over large areas, delivering the spray from a series of nozzles in distinct swaths. This type of sprayer is frequently used to treat commercial properties greater than one acre in size.

High-pressure sprayers can create spray pressure of several hundred pounds or more and use a hose and hand-held nozzle for directed applications of the spray.

Pesticide combinations

Use of fertilizer/pesticide combinations has become an accepted practice among most turfgrass managers whether applying fertilizers in a dry or liquid form. This technique can result in both time and labor savings.

Fertilizer/pesticide combinations can include herbicides, insecticides and fungicides, along with fertilizer. To optimize results, the label of dry fertilizer/broadleaf combinations will frequently recommend making the application following rain or irrigation or when a dew is present. This improves the adherence of the herbicide to the leaf surface of weeds and allows the herbicide to be dissolved, which maximizes absorption.

Two important factors which can reduce the effectiveness of liquid-applied fertilizer-pesticide combinations are incompatibilities and alkaline hydrolysis. In addition to checking the pesticide(s) label, a wise precaution before tank-mixing is to conduct a jar test for compatibility. Incompatibilities can lead to an unstable mixture and/or a chemical reaction between two or more tank-mix components. These can result in one of more of the following: failure of the equipment to apply the tank mix, poor pest control or turf response, and phytotoxicity.

Alkaline hydrolysis is the degradation of a pesticide due to mixing the pesticide in water with pH higher than 7.0. Some common pesticides subject to aklaline hydrolysis are organophosphate insecticides (Dursban, diazinon, Dylox), herbicides (bensulide), carbamate insecticides (Sevin) and certain systemic fungicides such as benomyl.

To determine whether alkaline hydrolysis will affect the pesticide application, have the water's pH tested with a pH meter or litmus paper. Should the water prove to be alkaline, check with the pesticide manufacturer(s) for their suggestions on pH correction. **WT&T**

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ENDOPHYTES: AN UPDATE

In 1983, WEEDS TREES & TURF first reported on insect-resistant turf containing endophytes. Today, researchers are discovering more about the fungus.

It may be possible some day to buy red fescue seed containing insect-resistant endophytes. Dr. Bill Torello at the University of Massachussetts has successfully "cloned" red fescue plants from tissue cultures inoculated with endophytes. Torello is also working with bluegrass varieties.

An endophyte is a fungus found in certain turf varieties, particularly ryegrasses and tall fescues, which makes the turf resistant to various insects and possibly diseases. Although the fungi were first discovered in New Zealand in the 1940s, it's been in the last several years that intense research on endophytes has been done in the U.S.

Endophytes aren't found in bluegrass and are rare in red fescue. Breeding endophytes into these is impossible since they are maternally inherited. A ryegrass containing endophytes can't be bred with a bluegrass. Inoculating plants with endophytes kills the plant.

The only way to get endophytes into a turf plant is to take a group of cells from a plant, inoculate the callous cells with the fungus, then regenerate plants from the cells. "It's like taking a finger nail from you, and regenerating a new you," Torello says.

The plant generated from the inoculated tissue can then produce seed. "Once the endophyte is established, it goes through the plant and resides there," Torello explains. "When it produces seed, it sits in the seed too."

Such seed could eventually be marketed. But that's years away, says Torello.

Only field testing will reveal if the endophytic seed actually produces a more insect resistant turf than a variety already on the market.

Torello has had success generating red fescues containing endophytes, but hasn't gotten past the inoculation stage with bluegrass.

Torello admits the techniques need refinement. For one thing, researchers have discovered four or five different types of endophytes. So the endophytes found in ryegrass are not necessarily the same as the ones found in tall fescues.

ENDOPHYTE LEVELS IN PERENNIAL RYEGRASS VARIETIES

Variety	High	Moderately High	Moderate	Low
Allaire				x
All*Star		x		
Birdie II		x		
Blazer				x
Citation II	x			
Commander	x			
Cowboy		x		
Dasher		x		
Dasher II	x			
Delray			x	
Derby			x	
Elka				x
Fiesta				x
Fiesta II				x
Gator				x
Jazz		x		
Linn			x	
Manhattan II				x
Omega II		x		
Ovation				x
Palmer			x	
Patriot			x	
Pennant	x			
Pennfine			x	
Prelude		x		
Premier			x	
Ranger				x
Regal	x			
Regency			x	
Repell	x			
Rodeo				x
SR 4000	x			
ST 4100	x			
Sunrye	x			
Tara				x
Vintage		x		
Yorktown II				x
SR 3000 Hard fescue	x			

NOTE: This data from Rutgers University is obtained primarily from seed lots submitted to the National Testing Program. Seed lots may contain lower percentages of seeds containing viable endophytes because of possible loss of viability during seed storage.

Dr. Reed Funk at Rutgers University is working on characterizing the various endophytes, and pinpointing the role they play within the plant.

"The use of endophytes in plants can provide biological control against insects without using chemicals," Torello explains. "But it's not the answer. Eventually we want to change the genetics of plants."

Torello is one of the few researchers in the world trying to change the genes in turf through means other than breeding. Although private corporations have large genetic engineering research staffs, almost all the research deals with food crops, in an effort to increase yields.

"Tissue culture genetics is new to the turf area," Torello says. "People think it's a pipe dream. It just takes time." **WT&T**

Dr. Bill Torello thinks the industry will eventually change the genetics of plants.