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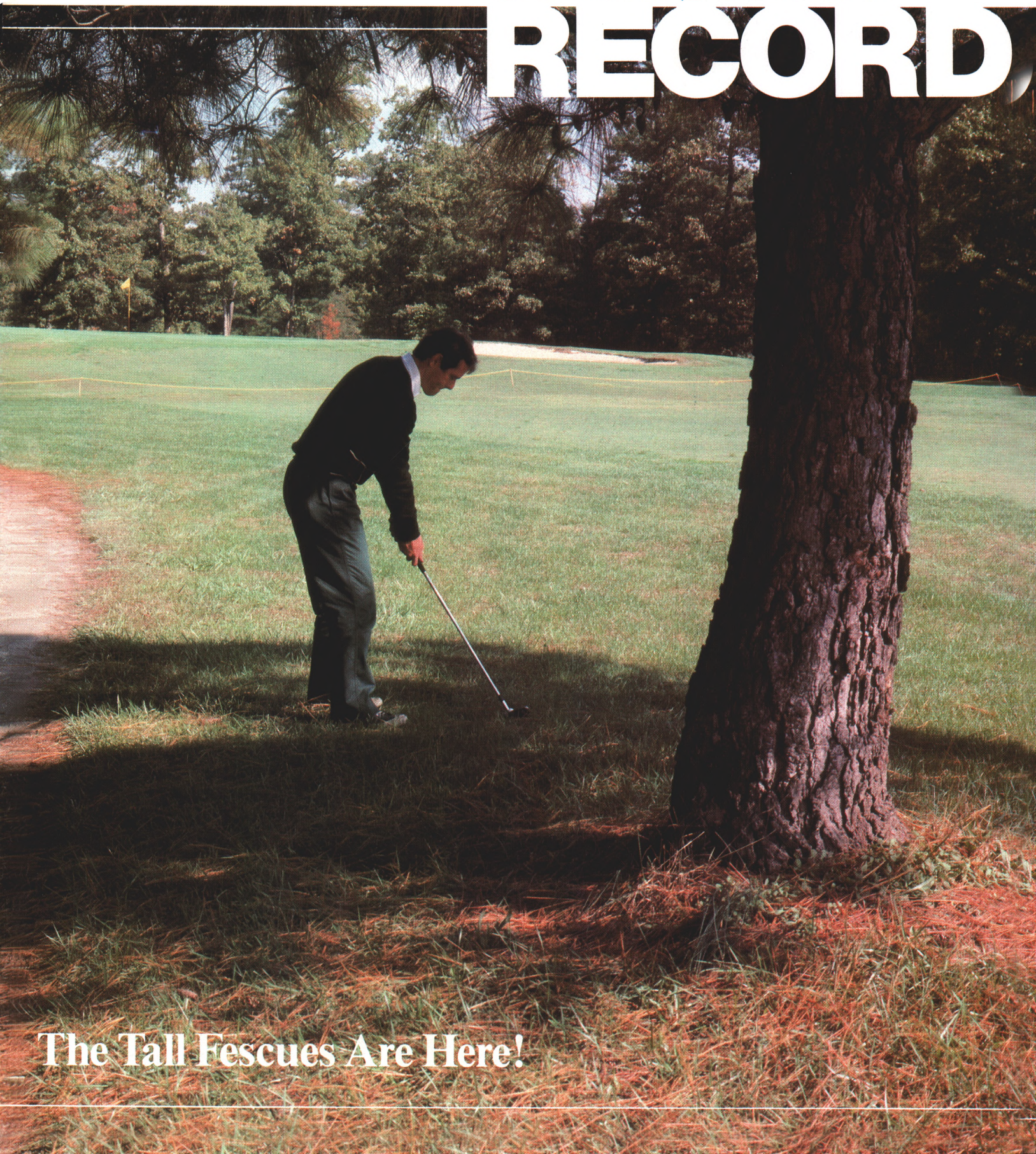

The Tall Fescues Are Here!

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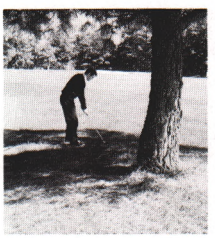

Cover Photo:
The tall fescues are here!

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The plant breeder has improved tall fescues for turfgrass use. The new Rebel (left) compared with the old Kentucky-31 (right).

Turf-Type Tall Fescues Are Here!

by PATRICK M. O'BRIEN
Agronomist, Mid-Atlantic Region, USGA Green Section
and DR. RICHARD HURLEY
Vice President, Director of Research and Agronomy, Lofts Seed, Inc.

THAT A COOL season grass for non-irrigated, low maintenance areas is not easy to find should not surprise anyone. Such areas are synonymous with poor, droughty soils, low fertility rates, and general neglect. Add high summer temperature and disease stress, sometimes heavy traffic, and shade problems, and not many turfgrass species are available for the job. Not until the new turf-type tall fescues came onto the scene recently.

In earlier days, a mixture of Kentucky bluegrass and fine fescue (creeping red, chewings, hard, or sheep) was the popular and the accepted choice. Unfortunately, these grasses become dormant during the summer, and the turf turns brown even at a cut above two inches. Fortunately, however, these grasses rejuvenate quickly with the return of moist and cool nights in the fall.

In the mid to late 1970s, formulations of commercial seed mixes began to change. Fine fescues were replaced with improved perennial ryegrasses, the ryes established themselves easily and were quite compatible with Kentucky bluegrass, and these mixes continue to be popular.

Today, however, so many more choices are available in seed mixes for non-irrigated turf areas that one must constantly be reminded that no one grass, mixture, or blend is going to be a panacea. Nevertheless, the new turf-type tall fescues seem to have a way of persisting and retaining their color better during long, hot, dry summers than any other type of cool-season grasses we know.

Tall fescue was first described in 1771 by Schreber, a German botanist, then introduced from Europe to the United States prior to 1850 by early settlers. Since 1940, it has been used widely for lawns, roadsides, pastures, airfields, athletic fields, waterways, utility rights-of-way, and for soil conservation purposes. This broad use has been due in part to its adaptability to a wide range of soil types and climatic conditions. However, the extensive and rapid acceptance of tall fescue since 1950 has been caused by its valuable qualities as a pasture grass.

The most widely used variety of tall fescue to date has been Kentucky-31.

The parental plants of Kentucky-31 were found growing on a hillside of the William M. Suitter farm, in Menifee County, Kentucky, and brought to the attention of E. N. Fergus, an agronomist, in 1931. They were released as a variety in 1943 by the University of Kentucky. Kentucky-31 is valuable for pasture and erosion control because of its deep root system and sod-forming qualities. Its ability to survive and remain green under drought and cold weather conditions makes it unique among cool season grasses.

Until recently, tall fescue was not widely considered a desirable species for turf except in a few areas. It has generally been considered a weed in fine-leaf lines. Prior to 1979, only Kentucky-31 and Alta, among the pasture-type tall fescues, were even considered for turf situations. They adapted well to heat and drought, diseases, insects, poor drainage, and shade, and they made an acceptable lawn where Kentucky bluegrass and the fine-leaf fescues grew poorly. Unfortunately, they also had the undesirable traits of being very coarse, with a wide leaf blade and a marked tendency to become clumpy and to bunch up after several years.

THE ERA of the turf-type tall fescues was initiated with the release of Rebel, in 1979. Rebel is a landmark variety because it displays all the advantages of Kentucky-31 tall fescue while producing a turf much finer (up to 33%) and denser (up to 188% more tillers) than Kentucky-31. For the first time, a tall fescue could produce a turf that was heat and drought-tolerant, attractive, and persistant without the coarse leaf and clump-type growth habit characteristic of pasture-type varieties.

Dr. C. R. Funk, turfgrass breeder at Rutgers University, in New Jersey, is responsible for the development of the turf-type tall fescues. Dr. Funk's tall fescue breeding program started in the early 1960s with a collection of plants selected from old turf areas in New Jersey and

TABLE 1

KY-31 Tall Fescue Characteristics

Advantages	Disadvantages
1. Greater heat and drought tolerance compared to Kentucky bluegrass, perennial ryegrass, hard, chewings, creeping red fescues and bentgrass.	1. Will not tolerate a close height of cut. Recommended cutting height of 3 to 4 inches.
2. Produces an extensive, deep root system	2. Produces a bunch type growth habit.
3. Provides a traffic-tolerant turf that is tough, durable, and persistant.	3. Does not blend well with other grasses as a result of its bunching growth habit.
4. Adaptable to a wide range of soil types, pH, moisture, and growing conditions.	4. Coarse blades, light leaf color, and clumping reduces attractiveness.
5. Adapted for use in full sun to moderate shade.	5. Minimal ability to spread with occasional rhizome activity. Poor recuperative capacity.
6. Produces no thatch.	
7. Tall fescue is moderately tolerant to salinity, alkalinity, and waterlogged conditions.	

TABLE 3

Selecting Tall Fescue Varieties for Turf Use

Turf-Types with Improved Performance*	Low Maintenance Varieties with Moderate Turf Quality**	Pasture Types with Poor Turf Quality and Persistance***
Rebel	Clemfine	KY-31
Rebel II	Galway	Alta
Bonanza		Kenhy
Jaguar		Goar
Mustang		Fawn
Apache		Johnstone
Arid		Triumph
Falcon		
Olympic		
Adventure		
Houndog		
Finelawn		
Mojave		
Brookston		

* Improved Turf-Type Varieties have a finer leaf texture with increased turf density. These varieties will produce a darker green color, are more attractive and can withstand a closer height of cut compared to KY-31 types. These varieties have generally shown improved shade performance.

** Provides better turf performance compared to KY-31 types. Good choice for low maintenance lawns, parks and cemeteries.

*** Not desirable for high quality turfs.

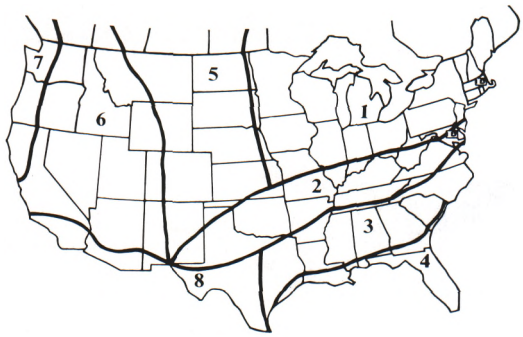
Dr. Richard Hurley, 1985

TABLE 2-A

Tall Fescue Adaptation

For golf course use, tall fescue is best adapted in Zones 2, 3, 7 and 8 and the lower half of Zones 1, 5 and 6.

Zones of Grass Adaptation in the United States



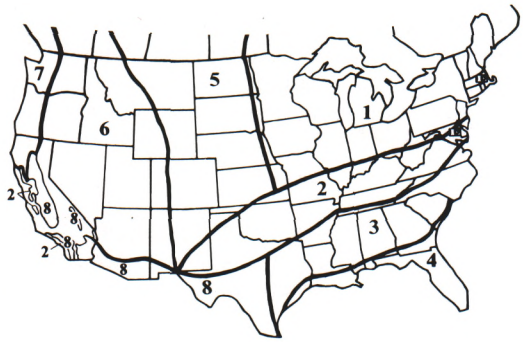
Key to Climate Zones:
1. Cool — Humid
2. Transition
3. Warm — Humid
4. Tropical
5. Cool — Semi-Arid Plains
6. Cool — Semi-Arid Inter-Mountain
7. Cool — Humid
8. Warm — Arid

TABLE 2-B

Tall Fescue Adaptation

For golf course use, tall fescue is best adapted in Zones 2, 3, 7 and 8 and the lower half of Zones 1, 5 and 6.

Zones of Grass Adaptation in the United States



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

surrounding eastern states. These plants were the source for most of the germplasm constituting Rebel. Additionally, some parental germplasm was obtained from a number of accessions received from the Plant Germplasm Resource Laboratory of the U.S.D.A. and from tri-species hybrids of tall fescue, meadow fescue, and perennial ryegrass obtained from the U.S. Regional Pasture Research Laboratory, University Park, Pennsylvania. Clones of the original germplasm were initially evaluated in turfs subjected to frequent close mowing (3/4 of an inch). The ultimate goal was to develop all fescue varieties displaying finer leaf texture, denser turf, darker green color, and improved resistance to insects and disease with good heat and drought tolerance.

Superintendents in the South probably were the first golf course superintendents to appreciate the new turf-type tall fescues. They tried seeding them into moderate shady areas where bermudagrass and other warm season grasses would not persist. Happily, it worked, and southern golfers now had grass lies in partially shaded areas. Obviously, most turfgrasses perform poorly in full shade or in areas with excessive tree root competition, but the cooling effect of the shade canopy seems to help tall fescue persist through the summer in southern areas.

Recent university research indicates that mixing a shade-tolerant Kentucky bluegrass such as Glade or Ram I with a turf-type tall fescue will improve overall performance in shaded areas. The addition of Kentucky bluegrass seems to give an even finer-leaf texture to the turf. A shade-tolerant Kentucky bluegrass may be used in a mixture with tall fescue, but it should be limited to no more than 10 percent by weight of the mixture.

Turf-type tall fescues are more shade tolerant than Kentucky-31 fescue. They also take on an even finer-leaf texture in shade. This difference in shade tolerance between Kentucky-31 and the turf-type tall fescues shows up better at moderate to high maintenance levels, however.

Heat and drought tolerance are the major advantages the turf-type tall fescues have over any other cool season grasses. Obviously, these are important characteristics for rough grasses on a golf course. Tall fescue will retain green color longer into a drought and become green faster with the return of moisture than Kentucky bluegrass or perennial ryegrass. The narrow blade and more erect growth of the new tall fescues will provide a good rough, although still not equal to Kentucky bluegrass maintained in an adaptable climate. Tall fescue, with its short rhizomes, recovers poorly from divots. For this reason, Kentucky bluegrass is still desirable in favorable climates, especially in the secondary roughs adjacent to the fairways. However, the turf-type tall fescues are always a good choice for the primary rough, and secondary rough, too, where Kentucky bluegrass or warm season grasses are poorly adapted because of no irrigation or the lack of shade tolerance.

Tall fescue makes an ideal bunker edge.

OTHER USES OF the turf-type tall fescues are around bunkers, on grass mounds, or in depressions. Their deep penetrating root system is ideally suited to the adverse sandy conditions around bunkers. Extensive root development also helps prevent the bunker edges from collapsing. With mounds regaining popularity as a desirable design feature, the new fescues will stay greener longer for the same reason. The driving range landing area is another good site for their use. The Congressional Country Club, in Bethesda, Maryland, seeded its reconstructed driving range to Rebel tall fescue in 1981, and it has performed very well.

There are many other possible uses of the turf-type tall fescues on the golf course, including tee banks, pond and stream banks, non-mowed or natural areas, and the clubhouse lawn. Natural, or non-mowed areas are a feature on more courses today. If not mowed, the turf-type tall fescues will grow to approximately 18 to 24 inches tall. Obviously this practice is only advisable outside the

primary rough areas. Tall fescue will persist and stay green without irrigation under this kind of management.

There are golf course sites where tall fescues are not well adapted and are not recommended for use. Fairways and tees both require a close height of cut (1/2-inch to 3/4-inch). *Poa annua* invasion is almost a certainty. Since tall fescue still has a bunch-type growth pattern, it will recover slowly from divot scars. Furthermore, compared to perennial ryegrass, tall fescue germinates and establishes itself more slowly. It is intolerant of a close cut and it has less plant density. For these reasons, turf-type tall fescues are best adapted for areas other than tees and fairways. Some universities, however, successfully maintain these grasses on test plots at 3/4-inch cut with irrigation and fertilization. Plant breeders predict new varieties will someday be suited for the more intensely played areas on the golf course.

New stands of the tall fescue can be seriously damaged by allowing traffic on newly seeded areas prematurely. It does not germinate as quickly as perennial ryegrass, although it is seven to 10 days faster than Kentucky bluegrass.

Because it also matures more slowly than perennial ryegrass, a new planting should not receive traffic the first winter, especially if the ground is wet.

Presently, there is limited advantage in blending the turf-type tall fescues. Most of the new varieties have the same desirable characteristics — that is, relatively fine-leafed, excellent heat and drought tolerance, and the same weaknesses, such as susceptibility to brown patch and *Pythium*. This factor minimizes the importance of blending, unlike other grasses, especially bluegrasses. As a precaution, avoid blending any of the pasture-type tall fescue varieties, such as Kentucky-31 with the turf-type tall fescues.

There is a growing common practice to mix the new tall fescue seed with 10 percent Kentucky bluegrass. This is most important to sod producers, since the rhizomes of Kentucky bluegrass add strength to the sod and improve recuperative potential. One important factor is to select a Kentucky bluegrass variety that is only moderately aggressive. The varieties A-34, Sydsport, Touchdown, Midnight, and Mystic are examples of Kentucky bluegrass varieties that will out-compete tall fescues and create a bluegrass mono-culture three to four years after seeding. The Kentucky bluegrass varieties that are not overly aggressive and are desirable for use in tall fescue mixtures include Baron, Merit, Victa, Ram I, Nassau, Glade, and the common types Kenblue, Newport, Argyle, Delta, and South Dakota certified.

TURF-TYPE tall fescues may be seeded at lower rates than those recommended for Kentucky-31. For golf course use, a seeding rate of five to six pounds per 1,000 square feet is adequate. For a more rapid establishment, higher seeding rates may be used with fall seedings. This will produce a turf with good density and fine-leaf texture. For very low maintenance areas, seeding rates of three to five pounds per 1,000 square feet will give good results.

Fortunately, it appears the new turf-type tall fescues minimize the need for annual reseeding, unless unexpected loss occurs. The turf-type tall fescues improve with age, because of more tillers and leaves. Overseeding is easily accomplished since tall fescue essentially produces little thatch.

In addition to establishment by seeding, turf-type tall fescue sod is becoming increasingly available. It can be just as attractive as bluegrass. Use of tall fescue sod provides the golf course superintendent an additional alternative for grassing

TABLE 4

Performance of Turfgrass Varieties Seeded under Two Different Levels of Artificial Shade at North Brunswick, New Jersey after Four Years.

	Turf Performance Score 9 = Best November 11, 1980		
Variety	76% Shade*	92% Shade*	Avg.
Rebel Tall Fescue	5.9	5.2	5.6
A-34 Kentucky Bluegrass	6.0	4.9	5.5
Reliant Hard Fescue	5.1	4.0	4.6
Scaldis Hard Fescue	5.3	3.5	4.4
Jamestown Chewings Fescue	4.7	4.0	4.4
Biljart Hard Fescue	5.0	3.4	4.2
Banner Chewings Fescue	5.0	3.4	4.2
Kentucky-31 Tall Fescue	4.1	3.9	4.0
Pennfine Perennial Ryegrass	5.2	2.4	3.8
Fortress Strong Creeping Red Fescue	4.0	3.1	3.6
Nugget Kentucky Bluegrass	3.9	2.9	3.4
Highlight Chewings Fescue	4.7	1.8	3.3
Ruby Creeping Red Fescue	3.3	2.3	2.8
Park Kentucky Bluegrass	3.7	1.6	2.7
Glade Kentucky Bluegrass	3.1	1.7	2.4
Linn Perennial Ryegrass	2.4	1.3	1.9
LSD at 5%	1.0	1.2	0.8

*Light reduction ratings of shade cloth used.

TABLE 5

Use of "Turf-Type" Tall Fescue on Golf Courses

Location	Seed Mixture	Seeding Rates	Seeding Dates	Zones of Adaptation
Roughs	a) 90% Tall Fescue 10% Kentucky Blue	150-200 #/acre	4/1 - 5/30 or 8/15 - 10/15	Lower Half of 1, 5 & 6
	b) 100% Tall Fescue	200-250 #/acre	8/15 - 10/15	2
				2
Shaded Sites	a) 90% Tall Fescue 10% Kentucky Blue	150-200 #/acre	8/15 - 10/15	Lower Half of 1, 5, & 6
	b) 100% Tall Fescue	200-250 #/acre	8/15 - 10/15	2, 3 & 8
Driving Range	a) 90% Tall Fescue 10% Kentucky Blue	150-200 #/acre	4/1 - 5/30 or 8/15 - 10/15	Lower Half of 1, 5 & 6
	b) 100% Tall Fescue	200-250 #/acre	8/15 - 10/15	2
Clubhouse Lawns	a) 90% Tall Fescue 10% Kentucky Blue	150-200 #/acre* *(4-5#/1,000 sq. ft.)	4/1 - 5/30 or 8/15 - 10/15	Lower Half of 1, 5 & 6
	b) 100% Tall Fescue	200-250 #/acre* *(5-6#/1,000 sq. ft.)	8/15 - 10/15	2
Tee, Green and Bunker Banks	100% Tall Fescue	200-250 #/acre	8/15 - 10/15	2
Pond and Stream Banks	90% Tall Fescue 10% Kentucky Blue	150-200 #/acre	4/1 - 5/30 or 8/15 - 10/15	Lower Half of 1, 5, 6 & 2
Mounds	100% Tall Fescue	150-200 #/acre	8/15 - 10/15	2
No Mow Areas or Natural	100% Tall Fescue	120-200 #/acre	4/1 - 5/30 or 8/15 - 10/15	Lower Half of 1, 5, 6 & 2

Where mounds are in, tall fescue is up.

It even grows well in partial shade.

clubhouse or half-way house lawn sites and tee, green, and bunker banks or steep pond or stream embankments that are subject to erosion.

One major difference between the new tall fescues and Kentucky bluegrass/perennial ryegrass turf is the fertility requirement. Tall fescue requires only half the amount of nitrogen. Its requirement is similar to that of the fine-leaf fescues. Usually 1 1/2 to 2 pounds nitrogen per 1,000 square feet per six-month growing season is adequate to maintain the stand. If fertilizer is completely withheld, however, density and fine-leaf texture will be lost. On the other hand, tall fescue responds to higher fertilization levels with a darker green color and faster growth.

Another major advantage is the excellent resistance and tolerance of the tall fescues to insects, especially grubs. Sod webworms are not a problem either. Many perennial ryegrass varieties are badly affected by this insect pest.

The major disease problems are Brown Patch and *Pythium*. They also occur on Kentucky-31, but are rarely considered a serious problem on low maintenance lawns. Fortunately, the diseases are largely cosmetic in most areas and regrowth of new leaves eventually occurs from the crown. Leaf Spot (Net blotch) is another disease. The new tall fescues generally have improved resistance compared to the pasture-types. The leaf infection causes the turf to look off-color with a tan appearance due to the characteristic color of the Leaf Spot lesions on individual leaves. Further improvement looks promising with the release of new varieties displaying improved Leaf Spot resistance.

Over the past 30 years we have witnessed many trends and improvements in cool season turfgrasses. In the 1950s, Merion Kentucky bluegrass became popular. In the 60s and 70s many improved Kentucky bluegrasses became commercially available. The 1970s was the decade for the improvement, commercial release, and acceptance of perennial ryegrasses. The 1980s seems to be the decade for the turf-type tall fescues, and rightly so.

ACKNOWLEDGEMENT

The authors would like to thank Dr. Joseph M. DiPaola, associate professor, North Carolina State University, for his helpful suggestions.

Pesticides — Changing An Image

by GARY WATSCHKE
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THE WORD "pesticides" has carried a disgusting connotation in recent years, and more often than not it causes even the most stoic person to frown. Such phrases as "chemical plow" and "weed killers" have been replaced by "biocides," "plant exterminators," and "potential baby deformers." "Toxic threshold" leaves one clutching his throat and gasping for air. Enough negative rhetoric.

Toxic threshold may well be defined as the dose level of a test material below which toxic effects are not observed. This practical concept has been seriously challenged by the opposing concept of zero tolerance. From long experience, however, a fundamental fact emerges: In large enough doses, all chemicals, natural and synthetic, are capable of causing toxic symptoms in animals. The more important aspect is how much is required to cause toxic effects and under what conditions they occur. To illustrate — ordinary oxygen is essential for life and commonly is considered non-toxic, but too much oxygen administered to a premature baby can cause blindness. Too much oxygen, therefore, is toxic. Similarly, water is essential to life, but in the lungs can cause death. Vitamin A is a necessary part of our diet, but too much (as well as too little) can cause illness. Table salt taken in large quantities can be fatal, yet we consume it every day.

The proof of zero risk is patently impossible, both logically and scientifically, and strict application would impoverish the store of chemical tools now used to control dangerous pests and improve the environment.

Any substance may be toxic at some concentration or in some volume, and laws requiring proof of absolute freedom from toxicity are pointless. Chemists are now able to detect quantities of toxic materials so minute that their findings may be of little more than academic interest. One part per billion, for example, is equivalent to one minute in 1901 years and one part per trillion to about one minute in 1,901,000 years. It was neatly said by Paracelsus at the end of the Middle Ages in a Latin phrase that may be loosely translated, "The toxicity of a substance is determined by its dosage."

The converse is also true. Chemicals normally considered toxic or poisonous have some dosage below which they cause no harmful effect. For example, the poison arsenic is used safely as a medicine.

The majority of agricultural pesticides are used correctly and safely.

TABLE 1

Characteristics of a Disposal Tank

Dimensions — 12 feet × 30 feet × 4 feet deep

Construction — 8-inch reinforced concrete walls and bottom.

- Install a raised fixed cover of opaque corregated fiberglass which slopes to prevailing sun and with sufficient overhang to prevent rain from entering. Design cover to withstand maximum wind velocities for region where located.
- Enclose the disposal tank with 1/2-inch mesh hail screen attached to cover support posts, to keep children and animals from entering and debris from collecting on the tank surface.
- Install an enclosed wash rack for equipment in an adjacent structure with drain connected through a sump pump for disposal of wash water from spray tank and equipment. Wash rack must have a cleanout trap for removal or soil and other debris from equipment.
- Install a recirculating pump with a mist system for improved evaporation in more humid climates.
- Install tile around the base, and provide adequate sampling tubes to conform to federal and state monitoring regulations.
- Design capacity to needs based on environmental conditions of the region and state and local regulations.

Orientation —

- Full south and west exposure to sun and wind, which maximizes evaporation.
- Raised above ground to prevent flooding by surface water from heavy rains.

Contents —

- Two 1-inch layers of course gravel with a 1-inch layer of field soil containing an excess of 3-percent organic matter in between.

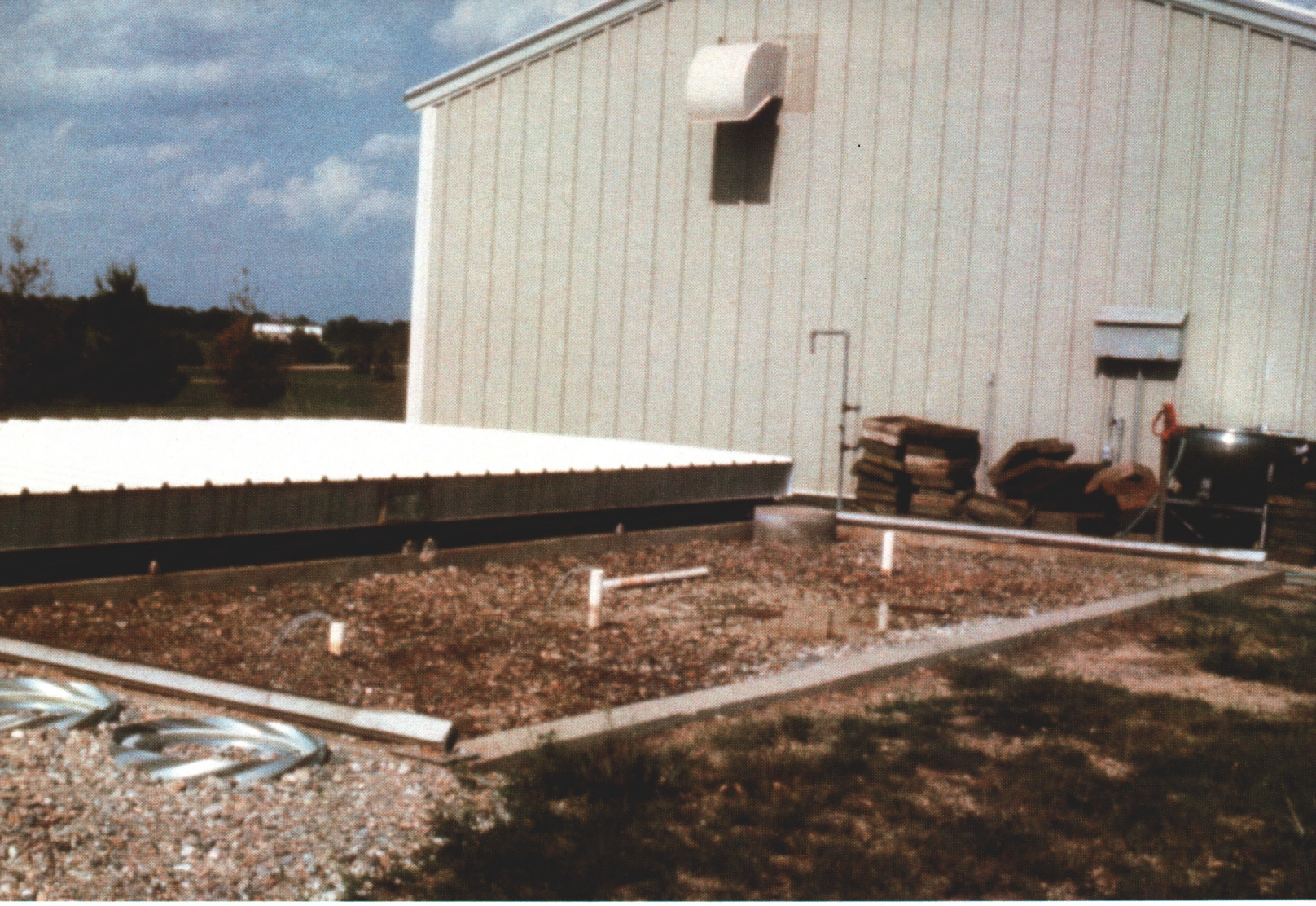


Figure 1. Concrete disposal tank with automated mobile cover and adjacent pesticide storage facility.

Poisonings and injuries from chemicals are very insignificant when compared to other industries, as pointed out by data gathered by the National Clearinghouse for Poison Control Centers.

Prepared by the Department of Health, Education and Welfare (HEW), *Table 2.* gives the number of deaths by age due to accidental poisoning by pesticides, fertilizers, and plant foods. The category "pesticides" includes rodenticides.

TABLE 2

Age	1970	1971	1972	1973
under 5	14	14	18	10
5-14	6	7	2	3
15-24	5	6	4	5
25-44	5	5	4	5
45-64	4	5	4	4
65 and over	10	6	6	5
Total	44	43	38	32

The number of deaths due to pesticide poisonings was relatively moderate even before the new generation of pesticides became available and arsenicals were still in common use. Carrying the data back to 1965, we find the total at that time was 65. In 1946 it was 77. Thus, there has been improvement, possibly from better safety education.

The hazard generally appears to be comparable to, and not more serious than that of common household poisons. The greater hazard is not to the user and not to the innocent bystander but to children, who should not be allowed access to the materials. Remember as well that the information prepared by HEW includes the agriculture industry as a whole. Similar data specifically detailed to the turfgrass industry would conjure up numbers so minute they would defy the Federal Agencies to find them. The barometer that measures fear and distrust continues to climb despite the proliferation of data that assures the general public of the integrity of the green industry, its concern for the environment and public safey, and its respect for pesticide legislation. What, then, can one individual do to help curb the unwarranted fear disseminated by doomsday alarmists? Know and understand how you are affected by state and local regulations, as well as the U.S. Environmental Protection Agency. Be certain of the principles involving pesticide use and storage. Understand the nature and handling of pesticide wastes and container disposal. Also, provide a system for safe disposal of pesticide wastes and rinsates.

Handling Wastes

Often pesticide wastes, which require special disposal facilities, are in a diluted form and result from rinsates from containers, spray tanks, and equipment wash water. These may originate from the small applicator or large commercial operator. Such wastes should be sprayed on an area for which they are labeled or placed in a safe disposal facility. Fairly large volumes of diluted mixtures at rec-

ommended concentrations occasionally result from overestimating the amount needed for a spray operation, and it must be discarded. For such operations, safe facilities or procedures are essential to protect human health and environmental safety.

If a hazardous chemical such as toxaphene is used, the waste should be properly contained because it requires many years to degrade. Most organophosphates and herbicides are readily biodegradable, however, and they can be spread on land in accordance with label recommendations. In all cases, disposal must be in accordance with the Federal Resource Conservation and Recovery Act and state and local regulations.

Pesticide wastes can and should be minimized by carefully calculating the precise amount of pesticide needed and then applying that entire amount on the area of intended use. All liquid containers should be triple rinsed, punctured, and disposed of in an authorized solid waste facility or properly recycled. Paper bags, plastic containers, etc., should be properly burned or taken to an authorized solid waste facility where state and local regulations permit.

In cases where pesticides are discontinued, banned, flooded, out of date, contaminated, or fire damaged, it is necessary to dispose of concentrated or formulated compounds. These are abnormal situations, and the State Department of Environmental Quality and the U.S. Environmental Protection Agency officials provide assistance in such emergencies. They should be notified immediately as required by federal and state law. In many such cases disposal can be accomplished over a period of time by dilution, containment, biodegradation, and evaporation. Combustion may be the most satisfactory method for non-biodegradable materials.

The problem of disposal of long term residual materials is not as important as it was 10 years ago due to discontinued use, better planning, high cost of chemicals, and use of more rapidly biodegradable pesticides. Some pesticides currently in use biodegrade so fast they are limited in effectiveness. However, it is important that nonbiodegradable chemicals be properly contained in accordance with federal regulation until they can be disposed of in an approved manner.

Safe Disposal

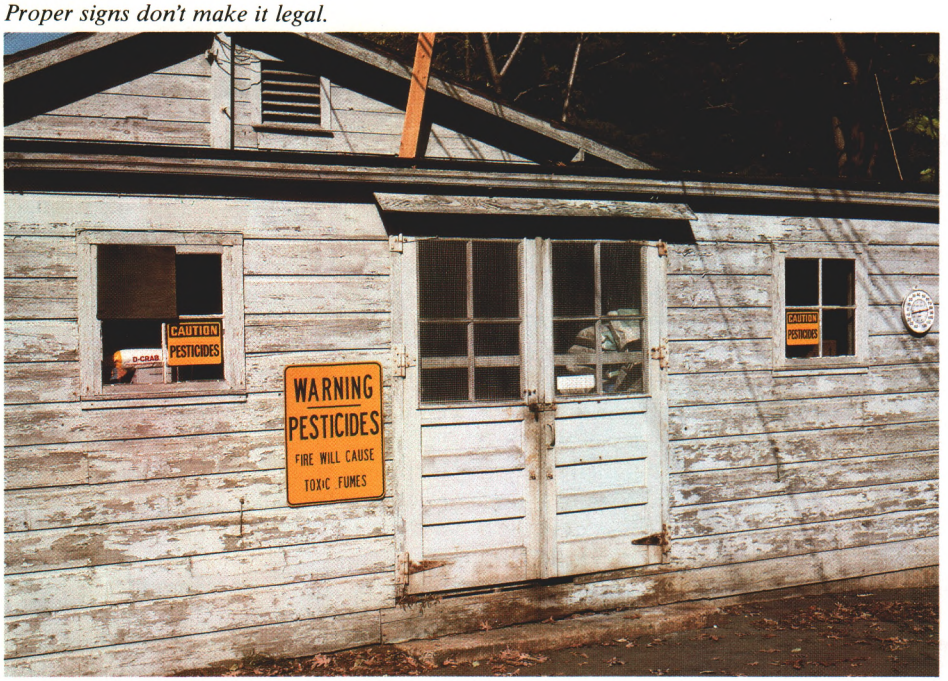
A disposal tank *(Figure 1.)* used at the Iowa State University Horticulture Station since 1970 was designed to contain surplus diluted insecticides, fungicides, herbicides, and growth regulators from spraying operations for fruit, vegetable, ornamental, and turfgrass research plantings. The farm consists of 229 acres with diversified plantings. Therefore, the operation is typical of many agricultural research and development centers located throughout the United States since it uses a wide variety of different pesticides that generate small quantities of concentrate and larger amounts of dilute pesticide mixtures. The disposal system was constructed to provide a safe and satisfactory solution to the problem of such wastes. Waste from over 45 pesticides was disposed of in the concrete tank between 1970 and 1976. Many of them, such as benomyl, bensulide, carbaryl, chorothalonil, 2, 4-D, dicamba, glyphosate, malathion, maneb, and MCPP are commonly used on golf courses.

Research involving six different university departments was sponsored by the U.S. Environmental Protection Agency over a three year period to evaluate the effectiveness of current disposal methods and to develop new systems. In addition, evaporation of dilute pesticide mixtures from a holding tank was compared with water evaporation from a standard weather evaporation pan and correlated with temperature, relative humidity, sky conditions, wind direction and velocity. Evaporation models were developed for predicting evaporative disposal needs for other geographic regions. Also, checks were made for leaks and air pollution.

Research results revealed that the concrete tank at the Horticulture Station didn't leak, didn't present a hazard of air pollution, and allowed chemical and microbial degradation of the deposited materials. The concrete tank, 12 feet × 30 feet × 4 feet deep, filled with a layer of gravel, 1 foot of soil, and another layer of gravel, was effective for evaporation of approximately 6,000 gallons of liquid wastes between April 1 and October 15. The soil layer within the tank contained relatively normal aerobic bacterial activity during that period. No chemical pollution was detected in the sampling tile located beneath the tank, in the well 50 yards away, or in the lake 1,000 yards downgrade from the disposal site.

Other containment systems, such as plastic lined pits, have been very questionable. There often appears to be some leakage or fluctuation of the liquid level. There is also continual danger of rupture of such liners by mechanical injury, chemical interaction and rodents, which could result in contamination of subsurface water where the water table is high. Even several layers of plastic could be inadequate for long-term containment. The problem would be less severe for most commonly used agricultural pesticides in more arid regions, especially

Proper signs don't make it legal.

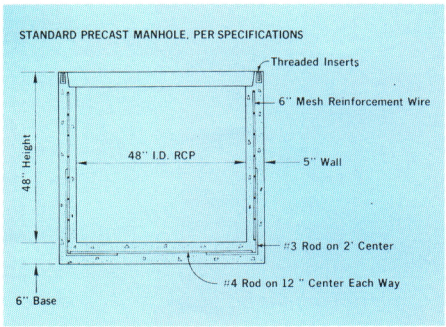


where the water table is 200 feet to 300 feet deep, with a deep clay subsoil layer between. However, local regulations must be considered in each case to ensure environmental safety.

Current Status

Based on research sponsored by the E.P.A. and long-term experiences at Iowa State University, some essential components of safe disposal of agricultural pesticide wastes were: 1) dilution, 2) containment in a structure that will not leak, overflow, flood, or otherwise pollute the environment, 3) evaporation of the water, and 4) biodegradation of most compounds.

This particular system is too large and elaborate for most golf courses, nurseries, and small parks. However, a precast concrete microtank was installed at the I.S.U. Horticulture Station in 1983 which may serve as a model for such small individual operators *(Figure 2. & 3.)*. The same functional components used in the microtank were incorporated to provide maximum evaporation, biodegradation, and environmental safety. Previous attempts to use plastic, fiberglass and other containers were unsuccessful because of freezing, thawing and rupturing problems in winter. This precast structure can withstand those conditions and incorporates the gravel-soil-gravel system used previously. The cover is similar to that suggested for the large tank and pipes are installed to permit sampling for leakage. Multiple units could easily be installed depending on evaporative needs and local evaporation rates. The same precautions should be used to avoid flooding and maximize evaporation. Also, similar precast concrete units should be available from local concrete products companies throughout the country at a rather nominal cost.



(Above) Figure 2. Structural specifications for a modified precast manhole structure. Tile for sampling should be located beneath the structure. (Top) Figure 3. A properly installed microtank at Iowa State University Horticulture Station. A reasonable approach to pesticide disposal for any golf course.

The large tank has been in use since 1970 and disposes over 6,000 gallons of pesticides wastes, rinsates and sprayer wash water each year. No contamination of surrounding soil, water or air has been detected. The system is obviously environmentally safe and could easily and inexpensively become an integral part of any golf course pesticide operation.

The alarmists have had their say. Rules and regulations will not go away. The best recourse for the green industry is to be heard and be seen. Counter the doomsday prophecy with factual information concerning the need for pesticides and their low risk to the environment when they are used correctly. Follow existing rules and regulations to the letter, and go one step further by employing a safe, environmentally sound disposal system as part of your pesticide operation.

Acknowledgement

Information from the American Chemical Society, Cornell University, Iowa State University and the Green Section files was liberally used in the preparation of this article. The author appreciates their contribution, especially that of Dr. Charles Hall, department of horticulture, Iowa State University.

Ironize Your Course for the Winter

by PAUL McGINNIS, CGCS,
Union Hills Country Club, Sun City, Arizona

(Above) Mix in a herbicide and produce a bermudagrass monoculture.

(Top) With bermudagrass dormant, the ironized fairways also take on greater definition and reduce glare.

WHEN YOU SEE pictures of winter golf in Arizona or in the Southwest in general, the golf course always has beautifully overseeded ryegrass fairways. Most of the winter golf in these areas however, is not played on ryegrass fairways; it is played on one of the best surfaces of all for golf — dormant bermudagrass. To help bermudagrass fairways retain their color longer in the winter, and become green more quickly in the spring, we "ironize" our course. It is one part of a three-part winter maintenance program.

I. Fertilization

A late fall fertilization is important. Fertilizer should be applied three to four weeks before the first anticipated frost. It should be of a slow release nitrogen variety and also be high in potash to promote winter hardiness. The concept here is to have the bermuda growing well and have plenty of nitrogen reserves as the turf goes into the winter.

II. Height of Cut

In order to insure an acceptable playing surface for the entire winter, the fairway height of cut is raised from normal 1/2-inch - 5/8-inch range to a 3/4-inch - 7/8-inch range. A good playing surface or mat will develop, which will support golf cart traffic throughout the winter. The timing of this change in the height of cut is critical in that it must be done early enough to allow the additional growth and mat to develop. It should coincide closely with the late fall fertilization.

III. Ironizing the Course

The use of ferrous sulfate on dormant bermudagrass is not a new concept. I first became aware of it while visiting Art and Jim Snyder at Paradise Valley Country Club some 10 years ago. The ferrous sulfate powder is mixed into solution and applied at a rate of 10 to 12 pounds per acre. The ferrous sulfate solution needs to be in a well-agitated spray tank so that it will not settle to the bottom.

The spray causes the leaf blades to become darker and therefore attract and hold more heat. It also relates to chlorophyll production within the plant during the growing season, and thereby increases carbohydrate production and storage. It encourages the bermuda to remain green longer into the winter and to turn green sooner in the spring. Once the bermuda fairways go dormant, the ferrous sulfate acts to outline them, giving the golfer a better target area, greatly reducing the glare of golden brown winter bermuda.

The cost of iron application is quite nominal with ferrous sulfate selling for between 20 cents and 30 cents a pound. Three or four applications may be necessary throughout the winter, but it is worth it. I have seen treated fairways turn green in the spring three to four weeks ahead of non-treated fairways. The golfers appreciate playing on green grass sooner than their neighbors. Besides, the late fall application of nitrogen pays off again as the nitrogen reserves in the plant and soil become available. If you really want to get fancy, a herbicide such as Kerb can be added to the tank mix for control of many winter weeds and *Poa annua*. Be careful, however, not to encroach on areas overseeded with ryegrass. It will take out the rye along with the unwanted grasses. Some great lines of definition can be drawn with Kerb around ryegrass collars.

Ferrous sulfate can be a very effective management tool on dormant bermudagrass fairways. This ironizing will delay the bermuda from going dormant in the fall and encourage earlier spring green-up. The purist golfer will agree that bermuda, even though dormant, makes an excellent fairway turf and the ironizing makes it better. This practice will become more important in the future as new, tighter water laws become effective and the excess water used for maintaining overseeded fairways becomes unacceptable, unaffordable and perhaps illegal. We will have to remember that golf is played on grass, not on color.

A Bermudagrass Primer and the Tifton Bermudagrass

by **WAYNE W. HANNA,** Research Geneticist, USDA-ARS,
Coastal Plain Experiment Station, Tifton, Georgia

BECAUSE bermudagrasses, *Cynodon* spp., are well adapted to a wide range of environmental conditions, they have adapted to areas from the tropics to well into the temperate zones and have been widely used in the United States for turf on golf courses, athletic fields, lawns, recreational areas, and for landscaping. The bermudagrasses are high temperature- and drought-tolerant, adapted to a wide soil pH range, tolerant to frequent close mowing, and adapted to most well-drained soils. However, they require frequent mowing, are not tolerant of heavy shade, and they become brown and dormant in the winter (except in frost-free areas where they remain green year-around).

There are two basic types of bermudagrass: (1) common and (2) the improved triploid hybrids.

Most common bermudagrass is of the *Cynodon dactylon* type. It produces seed and sheds pollen (which can cause allergy problems for some people). Common types can be seeded or vegetatively propagated, they usually have coarser leaves than triploid hybrids, and they produce good turf if they are fertilized and mowed regularly. The seeds and stolons of common types can become a weed problem, and common types established from seed can produce an uneven or mosaic-appearing turf from lack of plant uniformity. Vamont bermudagrass is an example of a more winter-hardy common selection released by Virginia Polytechnic Institute and State University.

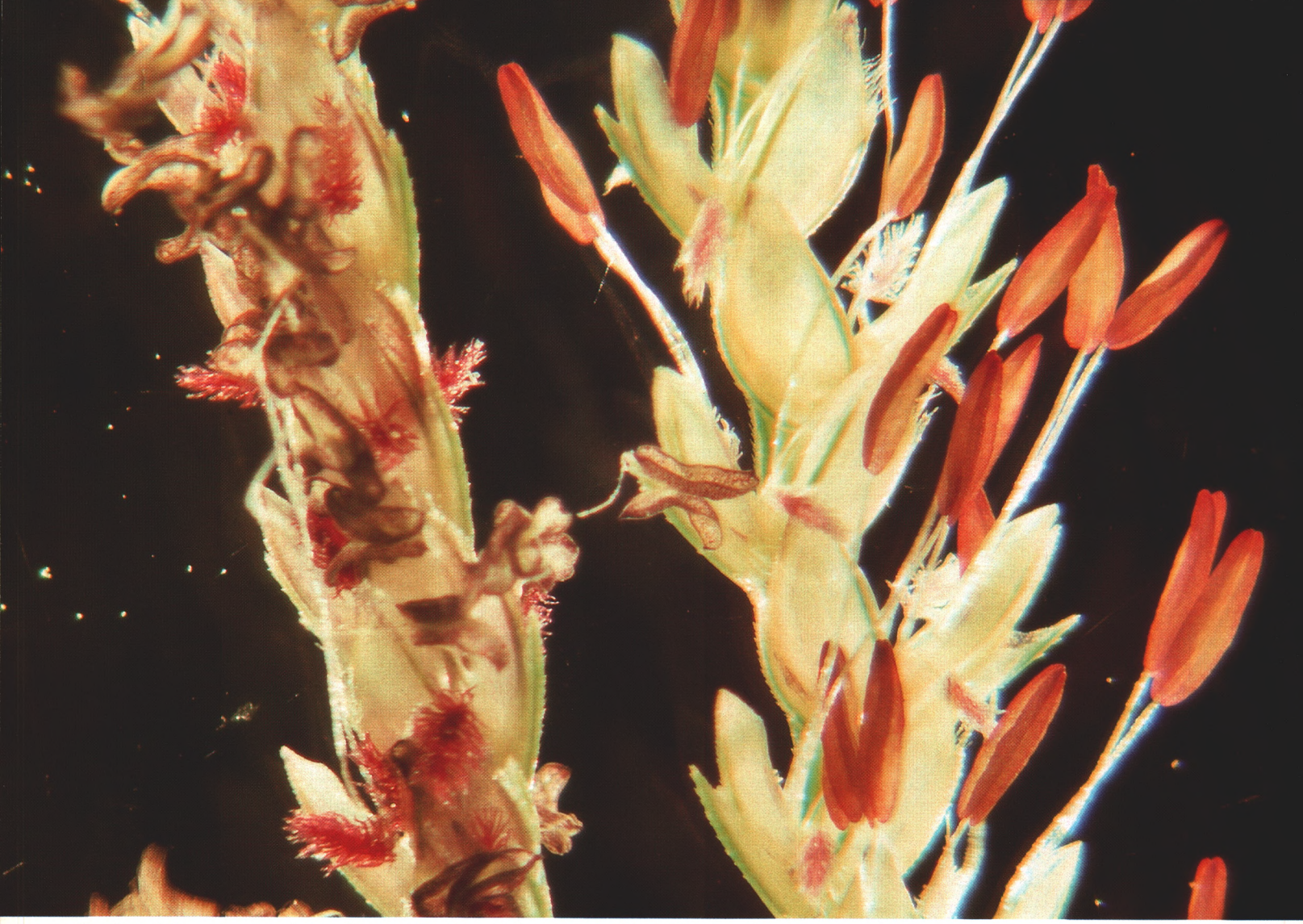
Another type of bermudagrass is *Cynodon transvaalensis.* It is a very fine-textured, usually low-growing species. It can make a good quality turf early in the season, but this quality usually declines rapidly. It also sheds pollen and produces seed. Usually it is not as wear tolerant or pest resistant as the improved triploid hybrids. One of the major research and breeding objectives at the Tifton Experiment Station is to find more cold hardy *C. transvaalensis* plants to cross with common *C. dactylon* to produce triploid hybrids with more cold hardiness. Readers are encouraged to contact the author if they have, or are aware of the location of *C. transvaalensis* accessions.

THE IMPROVED triploid hybrids are made by crossing *C. transvaalensis* with *C. dactylon,* two common types. The hybrids combine the fine texture of *C. tranvaalensis* with the pest resistance, wear tolerance, and cold tolerance of *C. dactylon.* The hybrids are sterile and produce no seed or pollen. The reason for this is that *C. transvaalensis* has 18 chromosomes (small genetic or biochemical units in each cell that control the plant characteristics) and *C. dactylon* has 36 chromosomes. The hybrids get half the chromosomes from each parent, or a total of 27 chromosomes (one set of nine chromosomes from *C. transvaalensis* and two sets of 9, or a total of 18 chromosomes from *C. dactylon* to give three sets, which is referred to as a triploid). Since the base number of chromosomes for bermudagrass is x = 9; by dividing 18, 36, and 27 by 9 we get 2, 4, and 3 sets of chromosomes for *C. transvaalensis*, *C. dactylon*, and the hybrids, respectively.

Even numbered sets of chromosomes result in seed and pollen production while odd numbered sets result in sterility (no seed or pollen production).

The production of pollen on common types, or lack of pollen production on the hybrids, is one of the easiest ways to distinguish between the two. Pollen production can be determined by thumping a head currently exerting anthers (brownish sacs on a white stem in each small flower) at 7 or 8 a.m. against a black piece of paper. Pollen will be seen as a powdery substance on the paper *(Figure 2.)*. Pollen production can also be determined at any time during the day

Old common bermudagrass fairway with significant mutations.



Head on, left — common bermudagrass. Head on, right — triploid hybrid bermudagrass.

by observing a seed head in flower, as in *Figure 1.*, with a small 10x pocket magnifier. Sterile triploids will have spongy anthers that have not opened on the sides, while anthers from common types will split on two sides of the anther to shed pollen *(Figure 1.)*.

The triploid hybrid bermudagrasses compared to common bermudagrass produce higher quality turf, are more pest resistant, make a denser turf, have fewer seedheads, are finer textured, produce no seed or pollen, and produce a more uniform turf because they are vegetatively propagated. The breeding and selection process insures survival of only the best plants. The Tif hybrids tolerate frequent close mowing. They may be more expensive to establish.

MOST OF THE widely used triploid bermudagrass hybrids have been developed and released by Dr. G. W. Burton, at the Coastal Plain Experiment Station, Tifton, Georgia. These include Tifgreen (328), Tifgreen II, Tifway (419), Tifway II, and Tifdwarf.

Tifgreen and Tifgreen II — Both Tifgreen hybrids are used mainly for putting greens but are also used for lawns and in landscaping. They have excellent putting qualities and are tolerant to overseeding. The hybrids have soft, forest green leaves and yellow anthers. They are low growing, disease resistant, spread rapidly and make a dense, weed-resistant turf. Tifgreen II compared to Tifgreen has a lighter green color, makes a denser and more weed-free turf, is more nematode resistant, more frost-tolerant, and has better springtime recovery. However, Tifgreen II may produce more seed heads during the winter (short days) in frost-free areas where the grass does not go dormant.

Tifdwarf — Tifdwarf is a natural vegetative mutant of Tifgreen that is used for putting greens and lawns. Compared to Tifgreen, it tolerates closer mowing (makes a denser turf when mowed at 3/16 inch), has small leaf, stem, and flower parts, takes less fertilizer to give it a comparable green color, has softer leaves, and fewer seed heads, and is more shade tolerant. Tifdwarf putting greens are faster-paced than Tifgreen, and when properly managed are comparable to bentgrass. Tifdwarf is more susceptible to weed competition if not properly managed. It has yellow anthers like Tifgreen.

Tifway (419) and Tifway II — Tifway and Tifway II are used for fairways, tees, athletic fields, lawns, recreational grounds, and industrial landscaping because they are tolerant to traffic. The Tifway hybrids are disease resistant, maintain a naturally darker green color with less nitrogen, make a dense weed resistant turf, and have stiff, upright leaves. Tifway II is a radiation induced mutant of Tifway. Compared to Tifway,

Tifway II makes a denser, more weed-free turf, is more resistant to root-knot, ring and sting nematodes, is more frost tolerant, and it turns green earlier in the spring, establishes faster, and has better quality turf. The Tifway hybrids exceed the Tifgreen hybrids in tolerance to traffic, sod webworm, and mole cricket resistance, and tolerance to 2, 4-D.

IN THE MID-1970s an increased awareness of off-type plants in triploid hybrid turf stimulated questions about their origin. There are three explanations for most of the off-types: (1) contamination — seeds scattered by birds or man, mixtures in planting materials, and/or live seed or stolons in the seedbed at establishment; (2) environmental — a result of fertilizer or chemical spills, soil differences, etc. These effects are usually not permanent. (3) mutations — a mutation is a permanent genetic change that can cause a plant to look different (such as taller or shorter, different color, finer or coarser leaves, etc.) than when it was originally planted. Mutations can occur spontaneously or they can be induced. Spontaneous mutations usually occur very infrequently, but they do occur.

From 1976 to 1980, James B. Moncrief, along with golf course superintendents in the South and Southeast sent to us 61 off type plants from Tifdwarf, Tifgreen, and Tifway turf on golf courses. Nine plants, or 15 percent were common types that resulted from contamination. Fifty-two plants were morphologically different from the variety originally planted, but they were triploid hybrids. These probably originated from a mutation. Finding 52 mutations under natural conditions in these hybrids is not unexpected, considering the billions of cell divisions that had to take place in the growing turf and the close scrutiny of the turf under uniform management.

A single rare offtype plant that is a triploid hybrid in your triploid hybrid turf would most probably be caused by mutation. Many offtype plants in your triploid hybrid turf would most probably be caused by contamination, or possibly the environment.

The Tifton bermudagrasses have made a significant contribution to golf and in all turfgrass areas across the southern United States and many other parts of the world. They are part of the theme "Golf Keeps America Beautiful." Our research on developing new turfgrass is continuing and the Tifton family of grasses will continue to grow.

Tifway fairway with Tifgreen contamination.

Tifway bermudagrass makes excellent tees, fairways, and roughs. Shoal Creek Country Club, Birmingham, Alabama.

TURF TWISTERS

COMMUNICATE

Question: I note increased awareness by members, employees, and even our neighbors in our use of pesticides on the golf course. What can I do to address their concern? (Illinois)

Answer: Communicate! Few people realize that it is the agriculturalist who is the leader in awareness, testing, training, and safely managing farm chemicals. Few golf club members realize their own superintendent is now licensed (and periodically retested) by State authorities in the use and care of pesticides on the golf course. (See Gary Watschke's "Pesticides — Changing An Image" in this issue). Today, agricultural chemicals are routinely applied with great precision; many at the rate of one pound or less per acre. By comparison, one heaping teaspoon of sugar on a bowl of cereal is equal to 2½ tons of sugar per acre! Six shakes of salt on a salad comes to about 36 pounds per acre. Agricultural chemicals are being managed very well!

THE TRUTH

Question: Could you please set me straight on the truth about gypsum as a soil conditioner and its use on a golf course? (Arkansas)

Answer: There is no scientific proof that gypsum is a soil conditioner nor is it a miracle panacea that is going to solve all drainage and other soil problems. It has been oversold in this sense. However, it does have some very beneficial uses under very specific circumstances. If you need a good source of calcium that will not significantly affect soil pH, gypsum is a good choice. If you have high sodium salts in your soil that are adversely affecting plant growth, gypsum will break up the sodium radical, thus allowing it to be leached from the root zone. But don't expect gypsum to take the place of a couple of good tile lines. It doesn't work that way!

DON'T ADD ON!

Question: We plan to enlarge a putting green next spring. Is it better to rebuild the entire green or just add on a new section only?

Answer: Overall, you will probably be ahead by redoing the entire green. This will insure uniform soils and drainage throughout, a more uniform turfgrass cover (especially if you seed or use a good, uniform sod nursery), and the contours of the new putting surface will blend and flow much more easily. And the irrigation system can be redone to insure coverage for the entire green. It's not impossible to do a good add-on job, but in the long run, the complete re-do usually works out best.