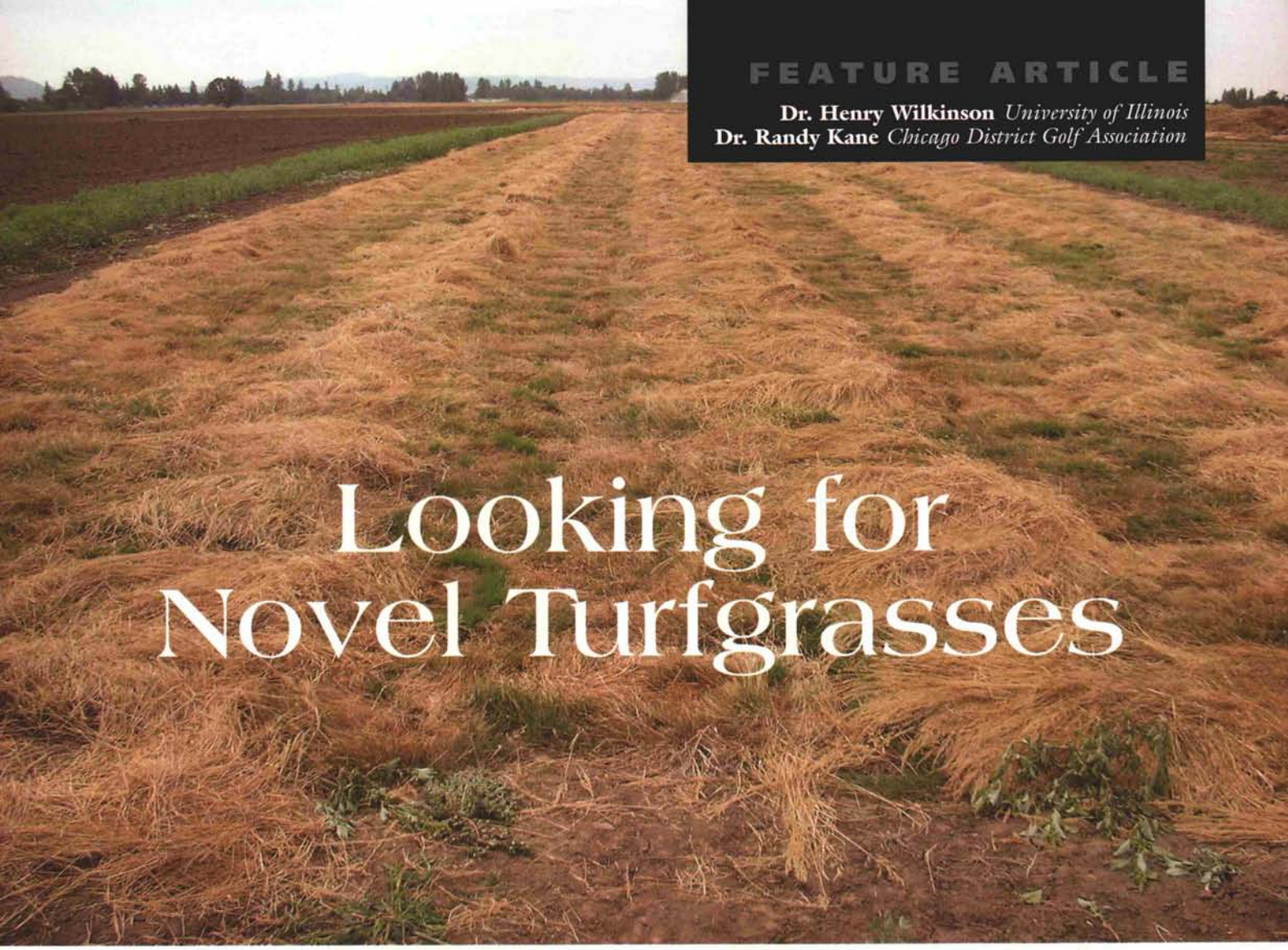
FEATURE ARTICLE

Dr. Henry Wilkinson *University of Illinois*
Dr. Randy Kane *Chicago District Golf Association*

Looking for Novel Turfgrasses



A new bentgrass, from and for Illinois. It was naturally developed and spent an additional 11 years in refinement.

More than 9,000 known grass species grow on this earth, with probably many yet to be discovered. There are more grass species on earth than any other species of plant. While only about 20 species of grasses are used for turf applications, these include hundreds of varieties. As you know, a turfgrass is simply a population of grass plants that are mowed! So why are there only 20 grass species used for turf, when there are more than 9,000 grass plants?

What does it mean to find a "novel turfgrass?" How is it accomplished? What new types of turfgrasses might we expect in the future?

Here are a few of the reasons: most grass plants will not tolerate close mowing; many grasses are only adapted to grow in specific climates; and we have not tried all 9,000 grasses to see if they would make a turf. In this article, we will describe what it means to find a NOVEL TURFGRASS, how it is accomplished, and what new types of turfgrasses might be developed in the future.

What Is A Novel Turfgrass?

To qualify as a novel or new turfgrass variety, it must be distinct in some way from what is currently recorded by the USDA. This sounds simple enough, but "*how different?*" is the real question. Historically, how plants look has been used to determine if they are different. Major differences exist between warm-season and cool-season turfs, many of which you can see, describe and measure, i.e., morphological differences. However, major morphological differences also exist between zoysiagrass, St. Augustinegrass and Bermudagrass, and all of these are warm-season grasses. There are major differences between ryegrass,

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bluegrass and fescues, and these are all cool-season grasses. Grasses that differ in big ways, i.e., they look different, will also have a significant number of genetic or DNA differences between them too. More recently, the importance of DNA as the real determinant of morphology has come into our world. Quite simply put, the reason one grass plant is morphologically different from the next is all due to differences in DNA.

What might surprise you to know is that grass-plant DNA is mostly the same in all of the 9,000 species and only a small fraction (but still a lot of molecules) of the total DNA in a plant actually accounts for the differences among them. The same can be said of all the humans in the world: most of the DNA in all humans is the same, but there are enough differences to account for 6 billion people that mostly look different. To put it into perspective, consider this: the coauthors of this article have 99%-plus of the same DNA, but wow does that little difference add up to be a REAL BIG DIFFERENCE!

Back to turf! There are grass plants that differ by only one gene and yet they will act completely differently. How can this be? Is one gene enough to distinguish one turfgrass from another? This may not seem important to you, but it is if you want to make sure the "new" turfgrass you are buying is really "different" from what was sold last year. Let me give you an example to ponder! If I took Kentucky bluegrass variety 'Merion' and put a new gene into it that did nothing to change the behavior of Merion (therefore, a dummy gene), would it be new? Technically yes, but it would not be different in terms of how it behaved as a turfgrass plant. Simply put, it could be sold as "new" Merion, but it would be no better than the old Merion. A second example: Plant breeders have found genes that give a grass plant resistance to the rust fungus. This means that the grass plant without the rust gene is killed, while the other plant, which differs only by one gene, will not be attacked.

Remember: New or different does not always mean BETTER—but it can!

Is There a Minimum Difference Between an Old and an Improved Grass Plant Before It Can Be Labeled as New?

Presently the rules are not very clear, but the lawyers, not turfgrass breeders, will probably decide what a grass plant must have to be called new! At the present, for a turfgrass variety to be protected by law, much like an invention is by a patent, the variety must be morphologically distinct (still the old system). Grass breeders make and report many different measurements to convince government officials that their "new" grass is really different. However, all this is changing with the advent of GMOs (genetically modified organisms).

Fairway bentgrasses being evaluated at Midwest Golf House in Lemont, IL. These bentgrasses are nearly or already market-ready, but still have to be evaluated for adaptation to Illinois and the various types of management Chicagoland superintendents will apply to them.

So How Do You Really Determine If a "New" Turfgrass Is Really Different *and* Better?

Here are some guidelines:

1. Look beyond the "new" name. A newly named turfgrass variety does not mean it is necessarily better than an older variety!

2. Determine exactly what makes the "new" grass plant different. Consider the following traits: dwarfism, disease resistance or quality. Some fescues are marketed as dwarfs, and they are when allowed to grow unmowed, but not when they are mowed at 2 or 3 inches. Disease resistance can be measured, but it is difficult to do, so be skeptical of major claims of improvement. Quality is a subjective trait and evaluation programs often try and "split hairs" when ranking varieties. Ask yourself, is a new turf rated 8.2/9.0 practically different than an old one rated 7.8/9.0? Remember, statistics are used to test experimental data for differences, but statistics do not address the biological importance of the difference, that is up to people! One of the best ways to evaluate grass varieties is "in your backyard." That is what the trials at the Midwest Golf House offer you!

3. Determine how BIG of a difference there really is between the old and "new" turfgrass! A difference can be very small and have no practical effect on how the grass behaves or be unrelated to *your* need! For example, a grass with an increased level of ergot disease resistance (a horrible disease in seed production fields in the Northwest) would be both new and better to turf-seed producers, but useless to turf managers.

4. Do not focus on just *one trait* of a new grass! When a newly offered grass hits the market, it might have been changed in more than one way, but only marketed for one trait. For example, it might be darker, but more susceptible to leaf rust or summer patch. Be careful when you first look at GMO turfs. They will be different and they will have an easily identifiable trait, e.g., herbicide resistance, but they could also be very susceptible to a disease like dollar spot or brown patch.

5. Focus on the traits of turf that are *important to you* (and your golfers)! Do not get caught by the lure of marketing. Understand and prioritize what are the most important characteristics of the turf you want. For example, if early spring and late fall color are important, then find varieties, new or old, that offer these features. Then take your second-most-desired trait and find the top five or so in that category. When you do this for each of your desired traits, you will end up with a short list to select from. You will be surprised to find that "new" varieties often will fall out of your list. It takes many years to develop and test new varieties of turf, including assessing their performance in the marketplace after they are initially offered.

How Are New Turfgrass Varieties Developed?

A number of different methods can lead to new grass varieties, but common to all of these is the fact that any change in a plant results from a change in the DNA. So how can the DNA of a grass plant be changed?

1. Natural DNA changes. This has been the most important means for developing new turfgrasses. Remember those 9,000 grass species that we mentioned above? They are the work of natural DNA changes. These natural changes occur all of the time, but most go unnoticed. It takes many years and many changes for nature to produce a new and better plant. Scientists and turf managers are still finding new grass varieties growing in nature. These are called *clonal variants* and they are collected from all over the world. Below we will describe a new bentgrass that was found this way.

2. Controlled breeding! We are all familiar with the power of breeding by virtue of corn, rice and soybeans that produce bigger and more nutritious grains. Controlled breeding means that a selected plant is forced to pollinate with another plant. The limiting factor is that the two plants must be biologically compatible. For example, you can cross two ryegrasses, but not ryegrass and bluegrass. Sometimes you can "trick" a plant to cross with a plant with which it would not naturally cross. Breeding allows new grasses to be developed faster than they would be developed in nature and also with a greater degree of control over what characteristics the new plants will have. While it is faster than nature, controlled breeding takes 10 to 15 years and a lot of money to develop and test a new variety.

3. Genetically Modified Organisms (GMOs)! This is a fancy way of saying we have artificially inserted DNA into a plant that "naturally" did not have the gene. GMO technology also avoids some of the problems of incompatibility. Most of us think of GMOs as a "space age" method of creating new plants, but that is not the case. Yes, we do put the new DNA into a plant cell with guns and needles, but that is only the method

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of delivery. In fact, Mother Nature has been genetically modifying grass plants and most other forms of life for billions of years. For example, a virus can live in one plant, "pick up" a piece of the plant DNA, attach to an insect sucking on the plant, and then the plant DNA deposits into another plant where the insect lands and feeds. When the virus delivers the new DNA into the plant and the plant "makes the DNA work," *voila!*, the plant is now a GMO. Ah, you say, the insect will only feed on a certain type of plant! Not so! Most insects test and taste many different plants in order to find just the right one for feeding. In the meantime, they are depositing viruses all over the place. We often wonder about those little mosquitoes that feed on different humans! Not a pretty thought!

The bottom line for evaluating a "new" turfgrass variety is not how it was created, but what its characteristics are as a turfgrass!

In the Coming Decade, What Will the NEW Turfgrasses Be Like and Where Will They Come From?

Here are our picks in order of their predicted availability and timeframe.

1. Herbicide-resistant. These will come mainly from GMOs, but some will emerge with slightly less tolerance through natural selection. The reason is simple; herbicide resistance is controlled by a single gene, hence, the DNA change is small. **(Within five years)**

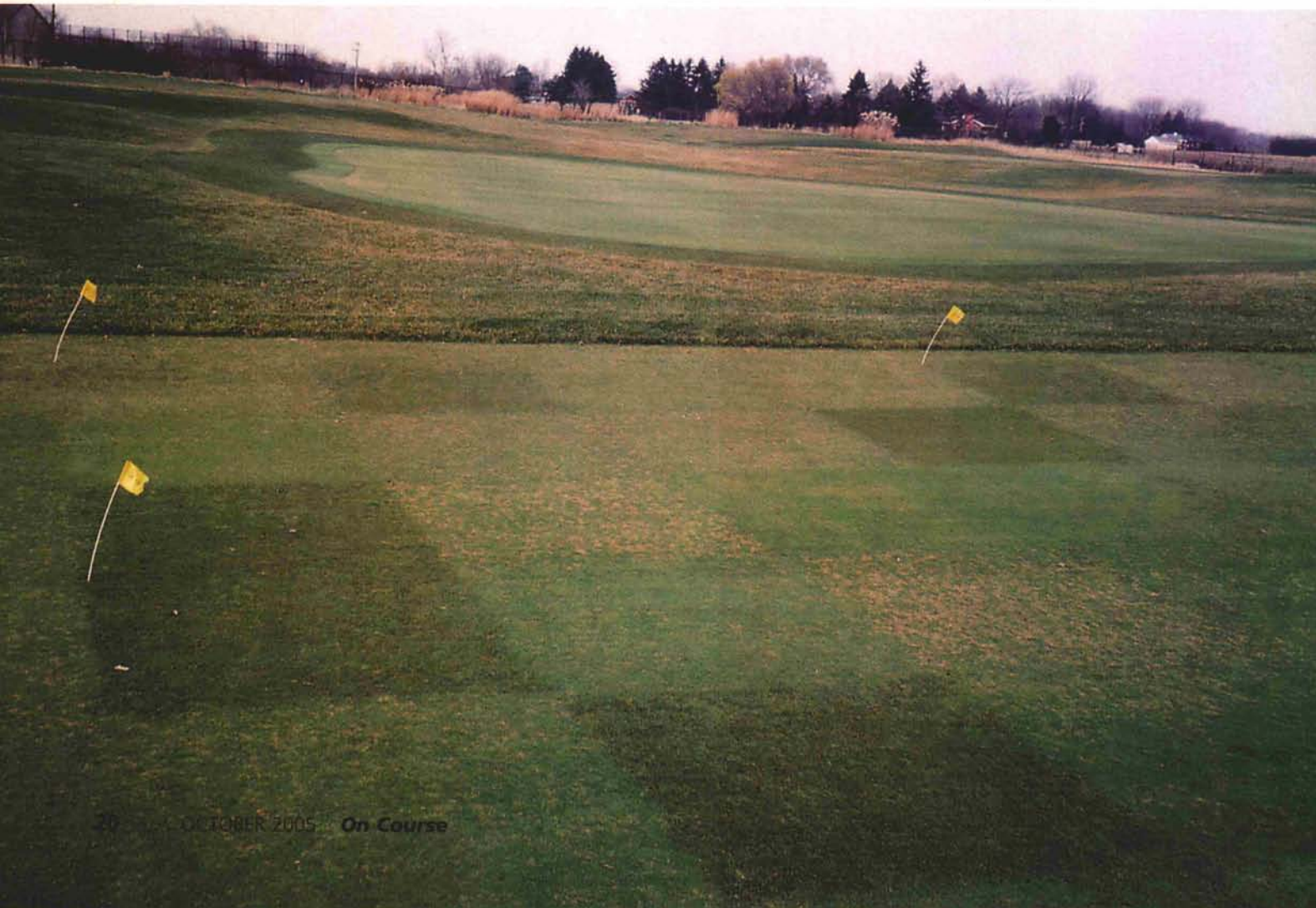
2. Heat- or cold-tolerant. These will come mainly from GMOs, but again, some will emerge from natural selection. Heat and cold tolerance are controlled by only a few genes, so changing a grass plant will be basic procedure. **(Five to 10 years)**

3. Disease-resistant. This will change slowly and through natural selection for many diseases. The reason is that disease resistance is generally controlled by a number of different genes, most of which we have not identified. For example, summer patch, necrotic ring spot and take-all patch all require multiple genes to confer resistance; this is more likely to have developed during the past billion years, so keep looking for natural clones. On the other hand, look for big, new changes against a disease like rust, which requires only one gene to confer resistance. **(10 to 20 years)**

4. Root-chewing insect-resistant! This is a guess, but we believe that GMO technology could result in grass roots that produce a nasty-tasting chemical in the roots that deters insect feeding. **(Five years)**

Beware! New and better turfgrass varieties will be produced, but this will take time. Beware of "overnight" miracle grasses or grass varieties that are ranked superior, but are actually not realistically better than the industry standards.

Greens, tees and collars are all different when it comes to grass performance. The various grasses that are used for golf courses usually are managed as either greens, tees or fairways. Each grass must be evaluated for the different types of management that will be applied to these specialty uses.



It is all about genes! Every feature of a grass plant, including disease resistance (dollar spot shown), is controlled by DNA or genes. Changing or adding one gene can completely change the behavior of a plant.

What Are the University of Illinois and CDGA Doing to Develop and Evaluate New Turfgrasses?

At both the University of Illinois and the Midwest Golf House in Lemont, IL, several different turfgrass development activities are underway. Each year, hundreds of new and old turfgrass varieties are planted and evaluated for three to five years. Some of them involve grass entries into the National Turfgrass Evaluation Program (NTEP) and others are varieties, blends and mixtures that researchers want to learn about. The goal is to determine what grows best in Illinois for golf, sports fields, roadways and lawns.

We also collect naturally adapted turfgrasses for possible development in the Midwest. In 2006, the first "Illinois bentgrass" will be available for testing in Illinois. This has been an 11-year project done in cooperation with the turf-seed industry. Molecular work is also underway at Illinois. Darin Lichtfeld, Tom Voigt and Andy Hamblin used grass DNA to study the behavior of blended bluegrasses and published their ideas on how to prepare better blends. In the Henry Wilkinson program, grass-transformation technology is being developed that will speed up the rate at which GMO plants can be created. Further, Shelby Henning and Wilkinson are evaluating sod blends and mixtures for adaptation to the Midwest and use as sports fields in cooperation with Barenbrug USA. In addition, a cooperation with the Scotts Company was recently completed that involved testing and evaluation of GMO bentgrass for herbicide resistance and disease resistance. Tom Fermanian, Bruce Branham and William Sharp are testing and evaluating herbicide-resistant Scotts' GMO bentgrass in Urbana under putting-green conditions. At Golf House, the CDGA is evaluating some new varieties and experimental lines of golf turf that are nearer the market or available for purchase currently. Also at Golf House, we are evaluating cool- and warm-season species for use in primary roughs and out-of-play areas on golf courses, in a program spearheaded by Voigt.

While many turf developments are ongoing, the future is even brighter. Within the next five to 10 years, expect an explosion of knowledge about plants and animals as more and more complete genomes are deciphered. This will open up tremendous research opportunities for plant improvement.