TURFGRASSES IN THE NEXT MILLENNIUM

Robert C. Shearman
Dept. of Horticulture
University of Nebraska

What will the grasses of the next millennium look like? Will they be considerably different from the grasses of today?

It's hard to speculate what turfgrasses will be like toward the end of the next century, let alone the end of the millennium. With the advent of biotechnology and molecular techniques, the potential for change is mind-boggling! As science progresses, who knows what technology might come along to replace molecular techniques and what impacts this technology may have on turfgrass cultivar development and the turfgrass industry.

It may be best to tackle the question of what turfgrasses may look like in the next millennium, using two approaches: 1) Contemporary trends, and 2) Futuristic trends.

Contemporary Trends

Turfgrass improvement was really accelerated in the past few decades. The industry has seen tremendous improvements in turfgrass species, like perennial ryegrass, tall fescue, creeping bentgrass, bermudagrass and zoysiagrass. New cultivars of species, like annual bluegrass, buffalograss, and seashore paspalum have been improved and released, as well. These improvements have come through conventional plant breeding techniques. We will continue to see marked improvements in turfgrass adaptation and performance through these conventional approaches.

More recently, biotechnology (i.e. molecular and cellular biology) has introduced significant changes in the improvement of agricultural crops, like corn, soybeans, and tomatoes. The introduction of Round-Up resistance in soybeans, Bt-genes in corn, and Flavr Savr® in tomatoes are examples of these improvements. Interestingly, the molecular and cellular techniques recently used for crop improvement have worked extremely well with turfgrasses.

Researchers are preparing to release Round-Up resistant creeping bentgrass, bermudagrass, and buffalograss cultivars. Some of these releases will come early in the next decade. Considerable progress has been made with creeping bentgrass, herbicide resistant cultivars. Round-Up resistant cultivars offer some unique management advantages. For example, annual bluegrass control in creeping bentgrass putting greens. However, there are also potential disadvantages as well. Some researchers and practitioners are concerned about developing wild-types with Round-Up resistance due to potential outcrossing with cross pollinated species. Herbicide resistance in fertile common bermudagrass and buffalograss might spread them as weed problems. To counter this potential problem, researchers are using this approach only with sterile hybrids. Thus, eliminating the potential for the outcrossing problem. In addition, other herbicides might be used to control these transgenic cultivars.

Some perennial ryegrass, fine fescue and tall fescue cultivars already have fungal endophytes that provide improved insect resistance and stress tolerance. Researchers are attempting to identify the genes that control the synergism between the turfgrass species and fungal endophytes. Once this is accomplished, it is hoped that the benefits of endophytes can be transferred to other turfgrass species.

Other characteristics may be introduced in future cultivars through biotechnology. The introduction of genes for disease resistance, insect resistance, and abiotic stresses are among those that might significantly improve turfgrass performance in the future, and reduce inputs of pesticides, as well. If a plant response has a gene that can be isolated for its control, there is a potential for introducing into another cultivar. These processes sound simple, and in theory they are, but considerable research and testing is needed to make it work. In fact, the molecular and cellular techniques used do not ensure the agronomic characteristics that may be highly desirable in cultivars prior to their transformation. This requires use of traditional plant breeding approaches.

Realistically, contemporary trends in turfgrass development won't change the current appearance of turfgrasses to any great extent. However, we can expect significant improvement in their adaptation and performance. Many of these improvements will be evident in early parts of the next century.

Futuristic Trends

Futurists have the opportunity to let their imaginations run free, to speculate what the future may hold, and to share their vision of future trends. Most of us have a little of these characteristics and some times we find ourselves day dreaming. Yes, day dreaming! Wondering what the future may be like.

What will turfgrasses be like at the end of the next millennium? Will they look the same as they do now? Well, based on what's happening with current trends in turfgrass development and how rapidly grasses are changing, we might speculate that grasses may look and perform differently then they do today.

Molecular and cellular approaches will be refined as science develops a better understanding of turfgrass genetics and the genes that control the various desirable characteristics. This will require considerable research and testing to develop this information. We will likely see tremendous improvements through the process of transformation. Researchers are already developing some of the more simple characteristics associated with disease, insect and herbicide resistance. More complex changes will take considerable improvement in our understanding of the plants genetics and improved scientific procedures.

In the future, turfgrasses will have to be managed with fewer inputs, less fertilizer and pesticides, and with nonpotable water sources. They will have to tolerate intense use and increased environmental stresses. These are tremendous challenges.

Researchers are already making inroads into these challenges for future turfgrass performance. We are developing grasses that can perform extremely well under saline/sodic conditions. Seashore paspalum is an example of such a grass. As we develop a better understanding of the processes that control seashore paspalum's ability to tolerate these conditions, we likely will be able to transfer these responses to other species. We might even find these desirable traits in non-plant species, like bacteria. When we do, we can use molecular and cellular techniques to transfer them to desirable cultivars.

How about improved heat tolerance in cool-season turfgrass species? Again, we have made improvements in the performance of creeping bentgrass cultivars, but what improvements could be made through transformation? Could we transfer genes from bacteria and algae that are adapted to growth in hot springs and mineral pools associated with geothermal areas? Improved understanding of heat shock proteins in response to high temperature stress may result in approaches to improve adaptation of cool-season turfgrasses to supraoptimal temperature stress conditions.

How about improved cold tolerance in warm-season turfgrass species? Researchers are making considerable progress with bermudagrass cold tolerance through conventional approaches. We are also learning more about cell wall membrane permeability changes during exposure to cold temperatures and the production of chitinase during cold acclimation. We might also identify means of transferring cool season species adaptation from grasses and other species to warm season species.

Reduced fertilizer inputs will be the norm in the future. Obviously, nitrogen is so important to turfgrass performance, and if it is limited, turfgrass performance under intense use is likely to be limited. How about grasses that fix their own nitrogen? The synergistic process between the legumes and bacteria, resulting in nitrogen fixation, might be transferable to other species. Researchers are working with crops, like soybeans, to develop a better understanding of the biochemical and genetic processes that influence nitrogen fixation. As we develop this understanding, it is likely that we will be able to transfer this process to other crops.

Turfgrasses of the Next Millennium

What will turfgrasses look like in the next millennium? Hopefully, they won't look much different then they do today. However, they likely will have considerably different adaptation and performance then the grasses of today. Think about it. Grasses that resist most diseases, insects, nematodes, and other pests. Grasses that tolerate sea water for irrigation. Grasses that perform equally as well in warm and cool climates. Grasses that require no additional nitrogen fertilization. All of these characteristics wrapped in one package. Cultivars may simply offer the opportunity to address specific adaptation and use needs.

It is difficult to speculate what turfgrasses will be like at the end of the next millennium. However, it is easy to speculate that they will be considerably improved over those that we see today. The discipline of turfgrass science will meet those challenges and see that these improvements are met.