New Breeding Technology Speeds Innovations to Market

By Terrance P. Riordan

Throughout the short history of turfgrass breeding, the major objectives have been fairly consistent. For cultivars propagated vegetatively, the breeding objectives have been turfgrass quality, color, density, establishment vigor, sod strength and pest resistance. For cultivars that are propagated by seed, the breeding objectives also include seed yield, seed germination and seedling vigor in addition to the others.

It is interesting to study the National Turfgrass Evaluation Trial (NTEP) data to see how well turfgrass plant breeders have done in improving the various characteristics of the important species.

To evaluate the improvement, I looked at the NTEP final report data from the 1995 Kentucky bluegrass high-input trial. This report summarizes all the data that was taken on this trial from 1996 through 2000 at 29 locations throughout the United States. I've been involved with NTEP trials since the first one in the early 1980s and have developed a number of personal Kentucky bluegrass standards that can be used to compare to the current cultivars and experimentals that were included in this most recent trial.

This most important characteristic evaluated in all NTEP trials is turfgrass quality. This rating, along with all other ratings, is carried out using a 1 to 9 scale where 1 is a poor rating and 9 is outstanding.

The first evidence that plant breeders have made significant improvement is observing where certain cultivars, in this case my personal standards, rank in the trial. The standards I used and looked at in this trial and their rating, as well as their rank compared to other cultivars in the trials, respectively, are Midnight (6.4, 1), Glade (6.0, 23), Baron (5.5, 83) and Kenblue (4.7, 103). These cultivars — Midnight, Glade, Baron and Kenblue — represent my standards from the 1990s, 1980s 1970s and 1960s, respectively.

Midnight is an excellent cultivar and it has been at or near the top of the rankings since its release. Glade and Baron are good cultivars and, in the first NTEP trials, would have been some of the more highly ranked cultivars. They were used in blends for years and are probably components for much golf course turf and lawns of the last 25 years. Kenblue is an example of a common, non-improved cultivar, and its low rating sets a base for minimum turfgrass quality.

To show the improvement that has been made since the 1990 NTEP trial, the rating and ranking for these same four cultivars in the 1990 trial were Midnight (6.2, 1), Glade (5.9, 7), Baron (5.5, 76) and Kenblue (4.6, 122). It's interesting that the ratings did not change much from the 1990 to 1995 trials, but the ranking for Glade and Baron both moved down. This seems to suggest that there are higher ranked cultivars and experimentals, and this is what we should observe if breeders continue to improve cultivars.

The data discussed is the overall mean for the 29 locations over five years. Therefore, small differences are significant as indicated the lowest statistical difference (LSD) value of 0.1 indicates. Midnight, which I use as a personal standard, is still good in the 1995 trial, but there are other cultivars equally good.

In summary, we have more Kentucky bluegrasses with excellent turfgrass quality. Remember, however, that the overall mean score only indicates how broad-based the adaptation and performance is for a cultivar. You should look at all the turfgrass quality data by state and by region to determine which cultivars you should select for your blend or mixture.

Genetic color

Genetic color is another important characteristic where plant breeders have made improvements. In the 1990 NTEP trial, Midnight had the best color (7.5) and ranking (1) for genetic color. Blacksburg, Ascot and two other cultivars not included in the 1995 trial were rated 7.1 and ranked No. 2 for genetic color.

In the 1995 trial, Midnight is still rated and

ranked well (7.8, 3), but Moonlight (8.0, 1), Total Eclipse (7.8, 2) and an experimental VB 16015 (7.8, 4) are as good or better. Also, there are another 18 cultivars and experimentals that have a better genetic color than Ascot, the widely used cultivar in the 1990 trial. Genetic color is an easy characteristic to observe and measure, and it's obvious improvements were made.

Other areas of improvement relate to the tolerance to pests and other stresses. A review of data taken at various test sites shows that improvements have been made for a number of the problems of Kentucky bluegrass. Summer patch is a significant problem in bluegrass, and improvements in resistance to this disease can be used as an example of improvements in the resistance to other diseases. In the 1991, NTEP trial, Midnight, the highest ranked of my standards, received an average 7.5 rating, but there were 30 cultivars and experimentals that rated higher. However, the LSD value for this characteristic was 1.5 (summer patch is a much harder characteristic to evaluate), and thus Midnight was in the top-ranked statistical group.

The other three standards, Glade (7.3), Baron (6.8) and Kenblue (6.3), all ranked in the lower half of the trial. In the 1995 trial, the rating and ranking were fairly comparable: Midnight (7.8, 18), Glade (7.4, 36), Baron (6.9, 67) and Kenblue (6.1, 90). With more, and probably better, data taken, the LSD value was a lower .8. In the 1990 trial, although ratings were slightly higher, there were only a few cultivars and experimentals than were included in the 1995 trial, making it slightly more difficult to gauge improvement.

The new, higher-rated cultivars in the 1995 trial were Apollo, Princeton, Unique, Platini, Baritone, Showcase and Unique. Although several of these new cultivars have shown excellent turfgrass quality, it will be interesting to see if their resistance to summer patch continues.

Billbugs, drought

Two other important characteristics are billbug tolerance and drought tolerance. Midnight has fairly good billbug tolerance. In evaluations at three locations, it had a rating of 7.3 and was the eighth best cultivar. Glade (6.2), Baron (5.8) and Kenblue (5.9) were only average in performance.

Several new experimentals (ZPS-2183 and PST-P46) and cultivars (Bartitia, Blackstone, Moonlight, Ascot and North Star) were rated above Midnight and show potential improvement in this characteristic. This is important because the amount of pesticide can be reduced each time a plant breeder incorporates tolerance or resistance to a turfgrass pest.

Drought tolerance was evaluated at three potentially drier locations — Kansas, Minnesota and Utah — in the 1995 trial. Midnight was the best of my standards with a rating of (6.1,16), and the other standards had the following ratings and rankings, respectively: Glade (5.1, 42), Baron (4.0, 91) and Kenblue (4.7, 63). As water becomes a more precious natural resource and alternative species are considered that will conserve water, drought tolerance in Kentucky bluegrass becomes important. Even thought Midnight, Glade and Baron are good cultivars with excellent turfgrass quality, obviously they are not particularly tolerant of drought conditions. However, the performance of Unique (7.2), Apollo (7.2), Brilliant (7.1) and Showcase (7.1) show improvements have been made and will be made in the future. I hope I've shown that turfgrass breeders have made significant progress over the last 10 to 20 years in Kentucky bluegrass.

Other varieties

Equally significant improvements have been made in tall fescue, perennial ryegrass, creeping bentgrass, bermudagrass, zoysiagrass and buffalograss. Improvements have been made across the board in turfgrass quality, genetic color, pest tolerance, drought tolerance and almost every other characteristic that relates to the use of the various turfgrass species.

We now have better performing species and cultivars that have greater sod strength, wear tolerance and establishment vigor. It's possible that we could continue to carry out conventional breeding work in the future, but breeders now have new tools and the potential for improvements is almost unlimited.

Biotechnology

Let's look briefly how biotechnology will affect those of us working with turfgrasses.

For example, if we make a turfgrass more disease or insect resistant, we will not need to apply as much pesticide to control the problems. Another reason biotechnology is being considered for use in the turfgrasses is new cultivars can be protected by a patent. Therefore, the company that invests in biotechnology will be rewarded. Another reason that we are using biotechnology is that we now have the tools required to transfer a gene from one organism to another.

Years of research using agronomic crops moved science to the point where it is possible to do in a laboratory in a few months what it took breeders years to do, if it could be done at all. The potential improvements that can be made using the tools of biotechnology include improved color, slower growth, insect and disease resistance, drought and heat tolerance, cold tolerance, and finally Round-Up resistance, the characteristic we hear the most about.

What the risks are

Are there risks to this technology we should be concerned about? In my work with buffalograss and Round-Up resistance, I have thought about this a great deal. First of all, I don't think we're changing the species enough to have a significant ecological effect. Adding Round-Up resistance has no more ecological effect than improving color, density or quality using conventional breeding procedures. It's probably more of a factor when a breeder develops a cultivar that has increased vigor or rate of spread than making it Round-Up resistant.

This article demonstrates some of the progress that has been made over the past 25 years with turfgrasses using conventional plant breeding procedures. I have tried to show that biotechnology is going to allow us to continue making progress at a more rapid rate.

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Midnight, Glade, Baron and Kenblue represent standards from the 1990's, 1980's 1970's and 1960's, respectively. They are also included in the NTEP Trials.