IMPROVING A NATIVE PRAIRIE GRASS FOR TURF

By Eric Watkins

In the United States, increased attention has been focused on the environmental effects of turfgrass areas such as golf courses and home lawns. In Minnesota, the most well-known of these efforts is the ban on phosphorus fertilisers for turf areas in the Twin Cities metro area (Horgan et al., 2003). This legislation has since been extended to include all 82 counties of the state. Plant breeders need to develop new options for golf course managers and greenkeepers so that further restrictions of commonly-used turfgrass inputs do not negatively affect the golf industry in the US.

Grass species that are native to North America should be better able to cope with our environment and could lead to overall reductions in inputs such as fertilisers, pesticides, and water. Prairie junegrass (Koeleria macrantha), a bunch-type grass native to the Great Plains of the United States, has shown the potential to be successfully used as a turfgrass in lower-input environments (Mintenko et al., 2002). The species is widely distributed throughout much of the western United States (Hitchcock, 1950) and it can also be found throughout much of Europe and Asia (Dixon, 2000). Based on data that has been collected in recent years, this species appears to perform well in Minnesota under low-input conditions (no irrigation, limited nitrogen application, and no fungicide or insecticide applications).

Prairie junegrass has several attributes that would make it a useful low-input turfgrass including: tolerance of droughty and alkaline soils, tolerance of sandy areas, survival of low and high temperature extremes, and reduced growth rates (Dixon, 2000). 'Barkoel', released by Barenbrug Holland, was the first cultivar of this species specifically developed for use as a turfgrass; however, this cultivar was developed with ecotypes from Europe (Alderson and Sharp, 1994). We have initiated a prairie junegrass breeding programme with the ultimate goal being the development of a cultivar using germplasm native to North America that can be used for golf course roughs, parks, home lawns, low-input athletic fields and roadsides.

Fig 1

Challenges

It is clear that this grass has several traits that make it a potentially great low-input turfgrass. Unfortunately, there are several challenges that will need to be overcome before our goal of a useful turf cultivar can be accomplished. The primary challenge that we are encountering with native germplasm is very low mowing quality due to tough vascular tissue that is found in the prairie junegrass leaf. This trait may have some advantages (wear and traffic tolerance, summer stress tolerance, etc.); however, the high amount of leaf shredding that can be seen after a mowing would be unacceptable to turfgrass managers (See Fig. 1).

Turfgrass establishment may also become a major issue in this species. The slow vertical growth rate of prairie junegrass, which can greatly reduce mowing frequency, makes it an attractive option for low-input environments. While this trait is advantageous in an already-established turf, slow growth rate during establishment can lead to poor turf density and increased weed invasion.

This species can survive in very dry conditions; however, it may do so by going dormant. Turfgrass managers would prefer a grass that cannot only survive dry conditions, but also stay green during stress. We are screening our breeding material for drought tolerance in order to find plants that are able to maintain green color throughout periods of stress.

Although we have not yet identified any diseases that are a major problem with this species, rust and leaf spot do appear under certain conditions in our turf plots (See Fig. 2) We are continuously selecting for disease resistance in our breeding populations.

Although turfgrass quality is the primary breeding goal of our programme, in order to be used by consumers, a turfgrass cultivar must be able to produce sufficient quantities of seed. Yields from our nurseries in 2007 and 2008 indicate that seed production in Minnesota should be possible; however, it is unknown if it can produce economically adequate amounts of seed that can be efficiently harvested and cleaned.

Germplasm

The major limitation when developing a breeding programme for a 'new' species is the availability of germplasm from which a useful cultivar can be developed. During the past several years, we have collected throughout the north central United States. To this point, we have made collections in North Dakota, South Dakota, Minnesota (See Fig 3), Nebraska, and Colorado.

When collecting, we are primarily focused on plants that exhibit good colour and high amounts of seed production even under dry, hot conditions. Seeds are collected from plants in native stands and then planted in the greenhouse. Eventually, seedlings are transferred to a breeding nursery where they are allowed to cross once they have gone through one winter in the field (See Fig. 4). The best plants are then allowed to cross and harvested seed is then evaluated for important traits.

Fig 2

Fig 3

Evaluation

We have used material from our collections along with germplasm from government collections to establish multiple research trials that will address the aforementioned breeding challenges. Currently, we are collecting data on mowed spaced plants in order to determine if there are individual genotypes and lines in our collection that possess unique traits that can be utilised in the breeding programme. Characteristics that we are evaluating include leaf density, colour, mowing quality, disease resistance, vertical growth rate, leaf texture and drought tolerance. Other trials that are currently in progress include seed production evaluations and turf trials. Plants that perform well in these evaluations will be advanced in our breeding programme. Eventually, after several years of breeding and evaluation, a group of elite plants will constitute a new cultivar of this species.

Future Plans

Developing a new cultivar of any grass takes several years; this is especially the case for a somewhat undomesticated species such as prairie junegrass. During the next few years, our programme will continue to make germplasm collections throughout North America. We are currently working on expanding prairie junegrass research efforts by collaborating with other researchers throughout the US. Once we are able to develop a viable turfgrass cultivar, there will also need to be research conducted on the proper management of the species.

Conclusion

The ultimate goal of our project is the release of an improved prairie junegrass cultivar that can be used by golf course managers and greenkeepers and other turfgrass managers. This will lead to an improved environment and reduced costs. This research is important because it is imperative that turfgrass managers are provided with viable options for low-input environments. As environmental awareness continues to increase, golf courses and other turf areas will be expected, and often required, to reduce inputs such as fertilisers, fungicides and insecticides. Improving the genetic potential of a native species such as prairie junegrass may solve future turf management dilemmas that arise due to environmental concerns.

Acknowledgments

This project would not be possible if not for the generous support from the following organisations: United States Golf Association, United States Department of Agriculture – Agricultural Research Service, Minnesota Turf and Grounds Foundation, and the Grant-in-Aid programme from the Graduate School, University of Minnesota.

About the author

Eric Watkins is an Assistant Professor in the Department of Horticultural Science at the University of Minnesota (USA). Eric received his Ph.D. in Plant Biology from Rutgers University in New Jersey. His research focuses on the development of low-input turfgrass cultivars for use in cold climates. Research activities involve germplasm improvement of several cool-season turfgrass species including tall fescue, Kentucky bluegrass and perennial ryegrass. A major focus of his research is breeding native grasses such as prairie junegrass (Koeleria macrantha) and tufted hairgrass (Deschampsia cespitosa) for use as low-input turf. He is also involved with turfgrass cultivar evaluation and other turfgrass science research. Eric teaches three undergraduate turfgrass science courses.

References

Alderson, J., and W.C. Sharp. 1994. Grass varieties in the United States. Lewis Publishers, Boca Raton, FL.

Dixon, J.M. 2000. Koeleria macrantha (Ledeb.) Schultes (K. alpigena Domin, K. cristata (L.) Pers. pro parte, K. gracilis Pers., K. albescens auct. non DC.). J. Ecol. 88:709-726.

Hitchcock, A.S. 1950. Manual of the grasses of the United States. 2nd ed. USDA Misc. Publ. 200.

Horgan, B.P., P. Bierman, and C.R. Rosen. 2003. Developing a phosphorus fertilization training program for golf course personnel. J. Extension 41:www.joe.org.

Mintenko, A.S., S.R. Smith, and D.J. Cattani. 2002. Turfgrass evaluation of native grasses for the northern Great Plains region. Crop Sci. 42:2018-2024.

Fig 4