Turfgrass Seed Variety Evaluation Process

Eric Watkins, Principal Investigator
Horticultural Science
University of Minnesota

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Our project addresses two critical needs: to update existing MnDOT turfgrass recommendation lists and to develop a new process to keep lists continually updated in a fair manner with data-driven recommendations. We evaluated the current list of MnDOT-approved turfgrass varieties and found underperforming varieties that should be removed. We then found new, improved varieties that should be considered for inclusion on the MnDOT lists. To facilitate a process to keep lists updated for the future, we first conducted a survey of seed distributors. Using their input, we developed a new process that MnDOT can use to approve turfgrass varieties for inclusion as official seed mixtures. Ultimately, this will lead to a more nimble, consistent, and clear process so that existing and new seed vendors can have complete confidence in data-driven decision making by MnDOT.

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Turfgrass Seed Variety Evaluation Process

FINAL REPORT

Prepared by:

Eric Watkins
Chengyan Yue
Andrew Hollman
Kristine Moncada
Department of Horticultural Science
University of Minnesota

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ACKNOWLEDGMENTS

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LIST OF ABBREVIATIONS

CBG – Canada bluegrass (*Poa compressa*)

CHF – Chewings fescue (*Festuca rubra* ssp. *commutata*)

CRF – Creeping red fescue (*Festuca rubra*)

CTBT – Cooperative Turfgrass Breeders Trial

DT – Drought tolerance

FF – Fine fescue

FW – Fewer weeds

GC – Green cover

HDF – Hard fescue (*Festuca brevipila*)

HS – Heat stress

KBG – Kentucky bluegrass (*Poa pratensis*)

MnDOT – Minnesota Department of Transportation

NTEP – National Turfgrass Evaluation Program

SHF – Sheep fescue complex (*Festuca* spp.)

SLCRF – Slender creeping red fescue (*Festuca rubra* ssp. *littoralis*)

SS – Summer stress

STCRF – Strong creeping red fescue (*Festuca rubra* ssp. *rubra*)

TQ – Turf quality

WD – Winter decline

WQ – Wear quality

EXECUTIVE SUMMARY

There is an urgent need to update existing MnDOT turfgrass recommendation lists and to develop a fair process for keeping lists updated with data-driven recommendations. The goals of this project were to (1) re-evaluate the list of MnDOT approved turfgrass varieties and determine if there were varieties that should be removed due to underperformance in recent field trials and also whether additional varieties should be considered for inclusion on the approved varieties list, and (2) recommend an annual approval process through which turfgrass varieties could be considered for inclusion on the approved turfgrass varieties list.

First, we evaluated current MnDOT turfgrass cultivar lists for turfgrass species included primarily in MNDOT 21-000, 22-000 and 25-000 series seed mixes. Based on all available data (state reports from Minnesota and other locations, National Turfgrass Evaluation Program results, likelihood of seed availability, etc.), a recommendation was made for each cultivar as to whether it should remain on the current recommended lists. We identified six varieties that should be removed from MnDOT recommended lists, and another two varieties that should be considered for removal after further consultation with stakeholders.

Next, we reviewed variety testing reports and peer-reviewed research papers to identify varieties not currently on MnDOT lists that would be good additions based on several different criteria, including documented performance in a low-input management turfgrass situation. Based on this review, we found 41 Kentucky bluegrass varieties, 8 hard fescue varieties, 7 Chewings fescue varieties, 6 strong creeping red fescue varieties, 5 slender creeping red fescue varieties, and 2 sheep fescue varieties that would be good additions to MnDOT recommended variety lists.

Finally, we surveyed turfgrass seed vendors in Minnesota to gather input on a new process for approving or removing seed varieties from MnDOT lists. As a result of this stakeholder input, and consultation with MnDOT representatives, we proposed a new process that will allow MnDOT seed lists to be annually updated with high-quality options for stakeholders in Minnesota.

CHAPTER 1: INTRODUCTION

Turfgrass breeders, both public and private, spend time and resources developing improved turfgrass varieties that can have better turf quality, drought tolerance, better establishment and other improved traits that can benefit roadside plantings. Not only are there newer varieties that perform better, but there are also older turfgrass varieties still on the market and still used that perform poorly, hindering the goals of growing healthy and productive turf on roadsides. A simple, direct, and immediate way to improve existing MnDOT seed lists is to figure which new existing varieties to add and find poor performers to remove. A longer-term way to improve seed mixes is to update the existing process of determining which future new varieties should be added.

Our goal for this research project is to lay the groundwork for a needed reset of the approved seed variety list to exclude seed varieties that may no longer be available in the desired quantities or that have recent field trials that indicate poor performance compared to other varieties that are not currently on the approved list. If current lists are not updated, and a process isn't developed, MnDOT seed mixes will once again revert to being of low quality, thereby reducing roadside turfgrass establishment success on projects.

1.1 BENEFITS OF IMPROVED TURFGRASS VARIETIES FOR ROADSIDES

This project will yield several benefits including reduced environmental impacts of poorly established roadsides, improved stands of turfgrass that are easier to maintain, seed recommendations that are better suited for a changing climate, updated lists of seed options that are well-adapted to Minnesota, and a transparent process for future turfgrass seed recommendations for Minnesota roadsides.

Higher-quality turfgrass products will result in better stands of vegetation and less need for reseeding and erosion damage repairs that will result in savings on maintenance labor costs. Better-quality turfgrass varieties will have a longer expected life span and should require fewer intensive efforts and materials to maintain, making them more self-supporting and less of a drain on MnDOT labor and material resources.

CHAPTER 2: RECOMMENDATIONS FOR CURRENT TURFGRASS VARIETIES TO REMOVE

We re-evaluated the list of MnDOT-approved turfgrass varieties to determine varieties that need to be removed from the approved varieties list due to underperformance in recent field trials.

2.1 METHODS

The first step was to examine all varieties currently listed on the General Roadsides and Turf Seed Mixture Component Requirements for the 25-000 series mixes approved substitution list (Table 2.1) along with varieties listed in the current specification tables for the series.

We conducted a literature review for field trials that included these varieties. Data for all varieties currently accepted in the 25-000 roadside turfgrass mixture was identified from several reputable sources: (1) National Turfgrass Evaluation Program (NTEP), (2) Cooperative Turfgrass Breeders Trial (CTBT), and (3) Rutgers University Turfgrass Trials.

Based on our previous experience working with roadside turfgrasses, we determined that data should be considered from the following categories:

Higher priority

- *Turfgrass quality when maintained under low-input conditions*: Trials that have limited inputs of water, fertilizer, and pesticides more closely mimic the harsh roadside conditions in Minnesota, except for spring salt stress.
- *Performance under drought*: Turfgrass varieties that do well during prolonged drought periods are well suited for success on Minnesota roadsides.
- *Salt-stress*: Perhaps the most limiting factor for successful turfgrass growth in Minnesota is salt stress from winter de-icing operations. Grasses that do well in controlled and field trials for salt stress should be considered for roadside use in northern climates.

Lower priority

- *Establishment*: Poorly establishing varieties (relative to others within the same species) will struggle to do well on a roadside)
- *Shade*: Many roadsides have occasional vegetative shade cover. This is not a primary attribute but should receive some attention.
- *Heat stress tolerance*: The temperature experienced by vegetation along roadsides can be well above ambient. This is an important stress to consider when identifying top roadside turfgrasses
- *Wear/traffic*: In many urban roadside turfgrass environments, there is significant foot traffic. When turfgrasses are growing under low-input conditions, this traffic could be challenging.

2.2 RESULTS

Our findings are summarized in Table 2.2. Comparing results from multiple trials is challenging and there is not a statistically valid approach for doing so, especially given that in many variety trials, means separation statistics will show that many varieties perform similarly. Based on our experience evaluating turfgrass varieties, we decided that a variety performing in the bottom 25% of a given trial for turfgrass quality or other important abiotic stress trait indicates that there are likely better options. Of course, some varieties may perform poorly in one trial and not another.

In this evaluation, we focused on identifying those varieties that are consistently in the bottom 25% of all varieties in the included trials. For each rating, we have provided information on where the variety ranked in comparison to other entries in the trial (1 = top 25%, 2 = middle 50%, 3 = bottom 25%). Those varieties that had numerous bottom quartile performance, or a lack of recent data, are considered for removal from the specification and are described in the following sections. All other varieties are recommended to stay in the guidance and are not discussed below. This task only deals with series 25-000 as there are no turfgrass varieties of note in the other specifications currently. The "guesswork" involved in the current process points to a need for better field evaluation approaches to identify well-adapted turfgrasses for harsh roadside environments.

2.2.1 Kentucky bluegrass varieties

2.2.1.1 'Camas'

This variety did poorly in all evaluations other than establishment. Of particular concern is its poor performance in multiple variety trials at Rutgers. This is listed as a low-maintenance option; however, little evidence exists that it is suitable for roadsides in Minnesota. We recommend **removal** from the specification.

2.2.1.2 'Kenblue'

This variety was a consistently poor performer for turfgrass quality and possesses no other traits that would make it useful in a roadside turfgrass mixture. We recommend **removal** from the specification.

2.2.1.3 'Park'

Because this variety was developed many decades ago, and was originally a mixture of several apomictic genotypes, the genetic identity of individual seed lots of this variety are likely varied. Due to the history of this grass on roadsides, and the economic benefits to multiple levels of the turfgrass industry in Minnesota, maintaining inclusion in roadside mixtures is probably acceptable; however, it should only be used in limited circumstances for turf areas where aesthetics are important. Very little data exists on performance of currently available seed lots of 'Park' on roadsides in Minnesota. We recommend **possible removal** from the specification.

2.2.1.4 'Jackpot'

We were unable to find sufficient public data in low maintenance trials for this variety, therefore, we recommend **possible removal** from the specification. However, based on seed industry comments, this variety should be considered for inclusion through the new approval process that comes out of this project.

2.2.1.5 'Merit'

Very little recent data exists for this variety (most recent trial seeded in 2000). Even so, its performance in the included trials was generally poor. We recommend **removal** from the specification.

2.2.2 Strong creeping red fescue varieties

2.2.2.1 'Boreal'

This ubiquitous variety has not performed well in managed turf trials regardless of location. In recent years, turfgrass breeders have released several varieties with far superior performance for important traits. Beyond cost of seed, there is no reason to keep this variety as an option. We recommend **removal** from the specification.

2.2.2.2 'Navigator'

Little data was found from recent trials for this variety. There are superior options available, including options from the same seed company. We recommend **removal** from the specification.

2.2.3 Sheep fescue varieties

2.2.3.1 'Black Sheep'

We were not able to find data for this variety and therefore recommend **removal** from the specification.

2.3 CONCLUSION

We have taken a very conservative approach and only recommended consideration for removal to the very lowest performing varieties. Unfortunately, evaluation for varieties suffers from a lack of roadside evaluation trials.

Table 2.1 General roadsides and turf seed mixture component requirements (25-000 series mixes) effective date 3/1/2019. Most recent substitutions are highlighted in orange.

Specifications				Authorized Substitution				
Common Name	Scientific Name	Acceptable Varieties/Origin	Certification Required	Common Name	Scientific Name	Acceptable Varieties/Origin (refer to footnotes at bottom of page)	Certification Required	Authorization Date
Alfalfa, creeping	*Medicago sativa*	Rambler, Rangelander, Spredor 2,	Yes					
				Alfalfa, creeping	*Medicago sativa*	Rambler, Rangelander, Spredor 2,	No*	3/1/2021
Bluegrass, Canada	*Poa compressa*	Common, Reubens, Talon	Yes	Bluegrass, Canada	*Poa compressa*	Common, Reubens, Talon	No*	3/1/2021
				Sheeps Fescue complex	*Festuca spp.*	Azure, Big Horn, Black Sheep, Blueray, MX 86, Quatro, SR3000	No*	3/1/2021
Bluegrass, Fowl	*Poa palustris*	MN	Yellow tag	Bluegrass, Fowl	*Poa palustris*	1-5 or Canada	No*	3/1/2021
				50% Fowl Bluegrass 25% Virginia Wildrye 25% Switchgrass	50% *Poa palustris* 25% *Elymus virginicus* 25% *Panicum virgatum*	1-5 or Canada 1-4 Dakotah or Forestburg	No*	3/1/2021
				50% Fowl Bluegrass 45% Virginia Wildrye 5% Woolgrass	50% *Poa palustris* 45% *Elymus virginicus* 5% *Scirpus cyperinus*	1-5 or Canada 1-4 1-4	No*	3/1/2021
				50% Fowl Bluegrass 40% Virginia Wildrye 10% Prairie Cordgrass	50% *Poa palustris* 40% *Elymus virginicus* 10% *Spartina pectinata*	1-5 or Canada 1-4 1-4	No*	3/1/2021
Bluegrass, Kentucky	*Poa pratensis*	Park	Blue tag					3/1/2021
Bluegrass, Kentucky - Elite	*Poa pratensis*	Arrowhead, Award, Diva, Fargo, Fielder, Glade, Merit, Midnight, NuGlade, Rhythm, Volt	Yes	Bluegrass, Kentucky - Elite	*Poa pratensis*	Arrowhead, Award, Diva, Fargo, Fielder, Glade, Merit, Midnight, NuGlade, Rhythm, Volt	No*	3/1/2021
Bluegrass, Kentucky - Improved	*Poa pratensis*	Appalachian, Arc, Baron, Blue Angel, Jackpot, Rugby II, Shamrock	Yes	Bluegrass, Kentucky - Improved	*Poa pratensis*	Appalachian, Arc, Baron, Blue Angel, Jackpot, Rugby II, Shamrock	No*	3/1/2021
Bluegrass, Kentucky - Low Maintenance	*Poa pratensis*	Action, Blue Angel, Camas, Certified Park	Yes	Bluegrass, Kentucky - Low Maintenance	*Poa pratensis*	Action, Blue Angel, Camas, Certified Park	No*	3/1/2021
Bluestem, little	*Schizachyrium scoparium*	Itasca germplasm	Yes	Bluestem, little	*Schizachyrium scoparium*	1-5	No*	3/1/2021
Brome, smooth	*Bromus inermis*	Carlton, Lincoln, Manchar, Sac, Signal	Yes	Brome, smooth	*Bromus inermis*	Carlton, Lincoln, Manchar, Sac, Signal	No*	3/1/2021
				Brome, meadow	*Bromus biebersteinii*	***	No*	3/1/2021
Clover, red	*Trifolium pratense*	Arlington, Dynamite, Lakeland, Mar	Yes	Clover, red	*Trifolium pratense*	Arlington, Dynamite, Lakeland, Ma	No*	3/1/2021

Table 2.1 (continued) General roadsides and turf seed mixture component requirements (25-000 series mixes) effective date 3/1/2019. Most recent substitutions are highlighted in orange.

Specifications				Authorized Substitution				
Common Name	Scientific Name	Acceptable Varieties/Origin	Certification Required	Common Name	Scientific Name	Acceptable Varieties/Origin (refer to footnotes at bottom of page)	Certification Required	Authorization Date
Clover, white	*Trifolium repens*	***	Yes	Clover, white	*Trifolium repens*	***	No*	3/1/2021
Dropseed, sand	*Sporobolus cryptandrus*	MN	Yellow tag	Dropseed, sand	*Sporobolus cryptandrus*	1-5	No*	3/1/2021
Fescue, Chewings	*Festuca rubra ssp.*	Fairmont, Longfellow 3, Radar	Yes	Fescue, Chewings	*Festuca rubra ssp.*	Fairmont, Longfellow 3, Radar,	No*	3/1/2021
Fescue, hard	*Festuca trachyphylla*	Beacon, Chariot, Gladiator Reliant IV	Yes	Fescue, hard	*Festuca trachyphylla*	Beacon, Chariot, Gladiator Reliant IV	No*	3/1/2021
Fescue, red creeping	*Festuca rubra*	Boreal, Epic, Navigator, Seabreeze	Yes	Fescue, red creeping	*Festuca rubra*	Boreal, Epic, Navigator, Seabreeze	No*	3/1/2021
Fescue, sheeps	*Festuca ovina*	***	Yes	Fescue, sheeps	*Festuca ovina*	***	No*	3/1/2021
Prairie clover, purple	*Dalea purpurea*	MN	Yellow tag	Prairie clover, purple	*Dalea purpurea*	1-5	No*	3/1/2021
Ryegrass, perennial	*Lolium perenne*	***	Yes	Ryegrass, perennial	*Lolium perenne*	***	No*	3/1/2021
Switchgrass	*Panicum virgatum*	MN	Yes	Switchgrass	*Panicum virgatum*	Dakotah, Forestburg	No*	3/1/2021
Timothy	*Phleum pratense*	***	Yes	Timothy	*Phleum pratense*	***	No*	3/1/2021
Wheatgrass, slender	*Elymus trachycaulus*	Pryor, Revenue	Yes	Wheatgrass, slender	*Elymus trachycaulus*	Pryor, Revenue	No*	3/1/2021

*Certification may be required through special provision

***any variety of that crop

1 MCIA certified Source Identified class; origin MN or adjoining portion of adjacent states as described in Mn/DOT Specification 3876.

2 Source Identified class certified by a seed certifying agency other than MCIA; origin MN or adjoining portion of adjacent states as described in Mn/DOT Specification 3876.

3 Certified seed of varieties/germplasm listed in Table 3876-1 (Certified, Selected or Tested class as applicable).

4 Wild type from MN or adjoining portion of adjacent states as described in Mn/DOT Specification 3876.

5 Wild type from adjacent states (ND, SD, IA, WI)

Table 2.2 Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Action													7.3	1	2016				2015 KBG high maintenance trial	Rutgers
KBG	Action													51.70%	1	2012	3.3	2	2013	2011 KBG Trial	Rutgers
KBG	Action													5	2	2013	2	3	2014	2012 KBG Trial	Rutgers
KBG	Action	3.1	3	2015										6	1	2013				2012 KBG Low maintenance	Rutgers
KBG	Action													6	1	2015	1.5	3	2016	2014 KBG Trial	Rutgers
KBG	Action													8	1	2011				2010 KBG trial	Rutgers
KBG	Action	4.2	2	2012							3.3/3.7	3	2012/2011	4.3	2	2010				2009 KBG Low Maintenance	Rutgers
KBG	Action													6.7	2	2010	3.8	2	2011	2009 KBG trial	Rutgers
KBG	Action	4.2	2	2012							3.7	3	2011	8.7	1	2011				2010 KBG Low Maintenance	Rutgers
KBG	Blue Angel													9	1	2004				2003 KBG Trial	Rutgers
KBG	Blue Angel													61.70%	2	2006				2005 KBG Trial (with NTEP)	Rutgers
KBG	Camas													5	2	2013	3	3	2014	2012 KBG Trial	Rutgers
KBG	Camas													6.5	1	2015	1	3	2016	2014 KBG Trial	Rutgers
KBG	Camas	2.4	3	2015										5	2	2013				2012 KBG Low maintenance	Rutgers
KBG	Camas													8.7	1	2011				2010 KBG trial	Rutgers
KBG	Camas													8.7	1	2010	1.3	3	2011	2009 KBG trial	Rutgers
KBG	Camas										1.7	3	2011	5.7	2	2010	2	3	2012	2009 KBG Low Maintenance	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Camas	3.6	3	2012							4	3	2011	9	1	2011				2010 KBG Low Maintenance	Rutgers
KBG	Certified Park	3.3	3	1996																1991 KBG trial	Rutgers
KBG	Certified Park	4.2	3	91-95																1990 NTEP - Low Input (1991-1995)	NTEP
KBG	Desert Moon (K10-111)													6	2	2020				2019 KBG high maintenance	
KBG	Desert Moon (K10-111)																			2009 KBG CTBT (NJ - Shade)	CTBT
KBG	Desert Moon (K10-111)	4.58	2	15-16																2014 KBG CTBT (OR - Low Maintenance)	CTBT
KBG	Desert Moon (K10-111)										6.42	2	15-16							2014 KBG CTBT (OR - Drought)	CTBT
KBG	Desert Moon (K10-111)	4.4	2	2012							5.3		2011	6.7		2011				2010 KBG Low Maintenance	
KBG	Desert Moon (K10-111)	5.8	1	2015										5.3		2013				2012 KBG Low Maintenance	
KBG	Desert Moon (K10-111)																5		2013	2011 KBG trial	
KBG	Desert Moon (K10-111)													5	2	2013	8.3	1	2014	2012 KBG trial	
KBG	Desert Moon (K10-111)	5.3	1	2015							5		2014	6	2	2014				2013 KBG Low Maintenance	
KBG	Desert Moon (K10-111)													4.3		2015	6		2016	2014 KBG trial (includes CTBT)	
KBG	Endurance (PST-K4-7)													6	2	2020				2019 KBG high maintenance	
KBG	Endurance (PST-K4-7)													2.7	3	2020				2018 KBG high maintenance	
KBG	Endurance (PST-K4-7)	4.5	2	2019										3.3	3	2017				2016 KBG high maintenance	
KBG	Endurance (PST-K4-7)	5.9	1	2016										5.3	2	2013	6.3	1	2014	2012 KBG trial	

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Endurance (PST-K4-7)	5.4	1	2016										6	2	2014				2013 KBG trial	
KBG	Endurance (PST-K4-7)	4.4	2	2015										5.7	2	2013				2012 KBG Low maintenance	
KBG	Endurance (PST-K4-7)	4.5	2	2015							5	2	2014	5.7	2	2014				2013 KBG low maintenance	
KBG	Endurance (PST-K4-7)	6	1	2014										6.3	2	2011				2010 KBG trial	
KBG	Endurance (PST-K4-7)													7	2	2010	3.8	3	2011	2009 KBG trial	
KBG	Endurance (PST-K4-7)													2	3	2008	5.3	1	2011	2007 KBG trial	
KBG	Endurance (PST-K4-7)										6.7	1	2013							2011 NTEP (IN 2013)	NTEP
KBG	Endurance (PST-K4-7)	6	1	2010																2009 KBG CTBT (NJ - Shade)	CTBT
KBG	Kenblue	4.2	2	2020							4.7	1	2018	7.3	1	2018				2017 KBG low maintenance	
KBG	Kenblue													5.7	2	2019				2018 KBG high maintenance	
KBG	Kenblue													5.7	2	2018				2017 KBG high maintenance	
KBG	Kenblue																2.3	3	2016	2014 KBG (CTBT)	
KBG	Kenblue													6.7		2014				2013 KBG trial	
KBG	Kenblue	4.4	2	2011										7.3	1	2010				2009 KBG Shade	
KBG	Kenblue													6		2010	5.5	1	2011	2009 KBG (CTBT)	
KBG	Kenblue							3	3	2001				7.4	1	2001	1.5/2.1	3	2004/2003	2000 KBG include Med-High NTEP	
KBG	Kenblue	3.2	3	1999																1995 KBG NTEP low input	

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Kenblue							6.7	1	1997	4	2	1997							1995 KBG NTEP Medium High	
KBG	Kenblue	3.3	3	1995																1990 KBG low maintenance	
KBG	Kenblue	2.7	3	1995																1990 KBG NTEP - low maintenance	
KBG	Kenblue	4.9	2	96-00																1995 NTEP - Low Input (1996-2000)	NTEP
KBG	Kenblue	4.17	3	91-95																1990 NTEP - Low Input (1991-1995)	NTEP
KBG	Kenblue	5	3	86-90																1985 NTEP - Low Input (1986-1990)	NTEP
KBG	Kenblue	3.3	3	96-00																1995 NTEP (MD Dense Shade 96-00)	NTEP
KBG	Kenblue										5.7	2	2002							2000 NTEP (WY 2002)	NTEP
KBG	Kenblue										2.7	3	2001							2000 NTEP (NJ1 2001)	NTEP
KBG	Kenblue										4	3	2013							2011 NTEP (IN 2013)	NTEP
KBG	Kenblue										4.3	3	2009							2005 NTEP (MN 2009)	NTEP
KBG	Kenblue										3.3	3	2008							2005 NTEP (MN 2008)	NTEP
KBG	Kenblue										2.7	3	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Kenblue										2.7	3	2006							2005 NTEP (MN 2006)	NTEP
KBG	Kenblue										2.7	2	1999							1995 NTEP (KS1 1999)	NTEP
KBG	Kenblue										7.7	2	1998							1995 NTEP (MN1 1998)	NTEP
KBG	Kenblue										5.7	2	1997							1995 NTEP (NJ2 1997)	NTEP

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Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Kenblue										3.2	3	1996							1995 NTEP (KS1 & UT1 1996)	NTEP
KBG	Kenblue										2.3	3	1992							1990 NTEP (NJ1 1992)	NTEP
KBG	Kenblue										4	2	1992							1990 NTEP (VA2 1992)	NTEP
KBG	Kenblue										4.3	2	1991							1990 NTEP (ON1 1991)	NTEP
KBG	Kenblue										2.7	3	1991							1990 NTEP (IL2 1991)	NTEP
KBG	Kenblue										4.8	3	2019							2017 NTEP (KY 2019)	NTEP
KBG	Kenblue	4.67	2	2010																2009 KBG CTBT (NJ - Shade)	CTBT
KBG	Kenblue										4.78	3	15-16							2014 KBG CTBT (OR - Drought)	CTBT
KBG	Kenblue	2.72	3	15-16																2014 KBG CTBT (OR - Low Maintenance)	CTBT
KBG	Kenblue										1.7	2	2016							2015 NTEP Cool Season Low Input (MI1 - 16)	
KBG	Kenblue	2.4	3	2020																2015 NTEP Cool Season Low Input (MN - 20)	
KBG	Tirem													6.7		2019				2018 KBG trial high maintenance	
KBG	Tirem													6.3		2020				2019 KBG High Maintenance	
KBG	Tirem													6.7		2016				2016 KBG High Maintenance	
KBG	Moonlight SLT (PST-101-390)													6.7		2014				2013 KBG trial	
KBG	Moonlight SLT													4.5	2	2015	4.5	2	2015	2014 KBG trial	
KBG	Moonlight SLT													48.30%	2	2012	2	3	2013	2011 KBG trial	

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Moonlight SLT	4.6	2	2015							3.7		2014	6.7		2014				2013 KBG low maintenance	
KBG	Moonlight SLT													7.3	1	2008	3.7	2	2011	2007 KBG trial (adelphia)	
KBG	Moonlight SLT													6		2008	1.7	3	2011	2007 KBG trial (new brunswick)	
KBG	Moonlight SLT																			2005 KBG trial, include NTEP	
KBG	Moonlight SLT													6		2007	5	2	2010	2006 KBG trial	
KBG	Moonlight SLT																3.7	2	2008	2004 KBG trial - Adelphia	
KBG	Moonlight SLT (PST-101-390)										5.3	2	2009							2005 NTEP (MN 2009)	NTEP
KBG	Moonlight SLT (PST-101-390)										5.7	2	2008							2005 NTEP (MN 2008)	NTEP
KBG	Moonlight SLT (PST-101-390)										4.7	2	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Moonlight SLT (PST-101-390)										4.3	3	2006							2005 NTEP (MN 2006)	NTEP
KBG	P-105	4.9	1	2020							3.7	2	2018	9	1	2017				2017 KBG low maintenance	
KBG	P-105													5.7		2019				2018 KBG high maintenance	
KBG	P-105													1.3	3	2017				2016 KBG high maintenance	
KBG	P-105	4	2	2019										1.7	3	2016				2016 KBG low maintenance	
KBG	P-105													6	2	2017				2017 KBG high maintenance	
KBG	P-105													3		2016				2015 KBG high maintenance	
KBG	P-105													4.7		2013	3.7	2	2014	2012 KBG trial	

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	P-105																			2013 KBG trial	
KBG	P-105													4.5		2015	4	2	2016	2014 KBG trial	
KBG	P-105													36.70%		2012	3	2	2013	2011 KBG trial	
KBG	P-105	4.5	2	2015										5.3		2013				2012 KBG low maintenance	
KBG	P-105	4.9	2	2015							5	2	2014	6.7		2014				2013 KBG low maintenance	
KBG	P-105	5	1	2012							8	1	2011	5.7	2	2010	4.3	2	2012	2009 KBG low maintenance	
KBG	P-105	5.1	1	2012							7	1	2011	7		2011				2010 KBG low maintenance	
KBG	P-105																5	1	2011	2007 KBG trial - Adelphia	
KBG	P-105																4.3	2	2011	2007 KBG trial - North Brunswick	
KBG	P-105	5.1	1	2001				6	1	2010	5.7	2	2011	8	1	2009				2008 KBG low maintenance	
KBG	P-105													7		2010	4.7	2	2011	2009 KBG trial	
KBG	P-105																5.3	2	2010	2006 KBG trial	
KBG	P-105 (Princeton 105)	5.2	1	96-00																1995 NTEP (MD Dense Shade 96-00)	
KBG	P-105 (Princeton 105)										2.3	2	1999							1995 NTEP (KS1 1999)	
KBG	P-105 (Princeton 105)										8.7	1	1998							1995 NTEP (MN1 1998)	NTEP
KBG	P-105 (Princeton 105)										6.7	1	1997							1995 NTEP (NJ2 1997)	NTEP
KBG	P-105 (Princeton 105)										3	3	1996							1995 NTEP (KS1 & UT1 1996)	NTEP

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Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	P-105 (Princeton 105)																			2015 NTEP Cool Season Low Input (MI1 - 16)	
KBG	P-105 (Princeton 105)																3.7		2008	2004 KBG trial - Adelphia	
KBG	P-105 (Princeton 105)																6		2008	2004 KBG trial - New Brunswick	
KBG	P-105 (Princeton 105)	5.2	2	2010										6	2	2009	3.8	2	2010	2008 low maintenance (FF)	
KBG	Appalachian													7	1	2017				2016 KBG high maintenance	Rutgers
KBG	Appalachian	4.6	2	2019										5	2	2017				2016 KBG Low Maintenance	Rutgers
KBG	Appalachian													4.5	2	2015	2	3	2016	2014 KBG Trial	Rutgers
KBG	Appalachian													7.7	2	2003				2002 KBG trial	Rutgers
KBG	Appalachian							5	3	2001				4.8	2	2001	4.2	2	2004	2000 KBG Trial	Rutgers
KBG	Appalachian (A98-139)										5.7	2	2002							2000 NTEP (WY 2002)	NTEP
KBG	Appalachian (A98-139)										5	2	2001							2000 NTEP (NJ1 2001)	NTEP
KBG	Arc													6.7	2	2017				2016 KBG high maintenance trial	Rutgers
KBG	Arc	3.6	3	2019										6	2	2017				2016 KBG Low Maintenance	Rutgers
KBG	Arc													3.7	2	2019				2018 KBG high maintenance	Rutgers
KBG	Arc													4.3	2	2016				2015 KBG high maintenance trial	Rutgers
KBG	Arc													5	2	2013	3.3	3	2014	2012 KBG trial	Rutgers
KBG	Arc													5.3	2	2014				2013 KBG trial	Rutgers

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Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Arc													4	3	2015	4	2	2016	2014 KBG trial	Rutgers
KBG	Arc													40%	2	2012	2.3	3	2013	2011 KBG trial	Rutgers
KBG	Arc	4.6	2	2015										6.7	1	2013				2012 KBG Low maintenance	Rutgers
KBG	Arc	4.6	2	2015							5.7	2	2014	5.7	2	2014				2013 KBG low maintenance	Rutgers
KBG	Baron													5	2	2019				2018 KBG high maintenance	Rutgers
KBG	Baron													48.30%	2	2012				2011 KBG trial	Rutgers
KBG	Baron													6.7	2	2013	5.3	2	2014	2012 KBG trial	Rutgers
KBG	Baron	4	2	2015										6	2	2013				2012 KBG Low maintenance	Rutgers
KBG	Baron													5.3	2	2014				2013 KBG trial	Rutgers
KBG	Baron													6	3	2010	4.5	2	2011	2009 KBG trial	Rutgers
KBG	Baron													5	2	2008	3.7	2	2011	2007 KBG trial	Rutgers
KBG	Baron	4.1	3	2011				4.3	2	2010	3.3	2	2011	5	2	2009				2008 KBG low maintenance	Rutgers
KBG	Baron	3.4	3	2011										6.3	1	2010				2009 KBG shaded	Rutgers
KBG	Baron	3.5	2	2010										4.7	2	2009	2.7	3	2010	2008 low maintenance (FF)	Rutgers
KBG	Baron										6	2	2013							2011 NTEP (IN 2013)	NTEP
KBG	Baron										5	2	2009							2005 NTEP (MN 2009)	NTEP
KBG	Baron										4.3	2	2008							2005 NTEP (MN 2008)	NTEP

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Baron										4.2	2	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Baron										4.7	2	2006							2005 NTEP (MN 2006)	NTEP
KBG	Baron										7	1	2002							2000 NTEP (WY 2002)	NTEP
KBG	Baron										7	1	2001							2000 NTEP (NJ1 2001)	NTEP
KBG	Baron										2.3	2	1999							1995 NTEP (KS1 1999)	NTEP
KBG	Baron										5.3	2	1998							1995 NTEP (MN1 1998)	NTEP
KBG	Baron										5.7	2	1997							1995 NTEP (NJ2 1997)	NTEP
KBG	Baron										3.3	3	1996							1995 NTEP (KS1 & UT1 1996)	NTEP
KBG	Baron										3.3	3	1992							1990 NTEP (NJ1 1992)	NTEP
KBG	Baron										4	2	1992							1990 NTEP (VA2 1992)	NTEP
KBG	Baron										4.7	2	1991							1990 NTEP (ON1 1991)	NTEP
KBG	Baron										3	3	1991							1990 NTEP (IL2 1991)	NTEP
KBG	Baron	5.1	2	96-00																1995 NTEP - Low Input (1996-2000)	NTEP
KBG	Baron	4.77	2	91-95																1990 NTEP - Low Input (1991-1995)	NTEP
KBG	Baron	5.7	2	86-90																1985 NTEP - Low Input (1986-1990)	NTEP
KBG	Baron	2.92	3	2010																2009 KBG CTBT (NJ - Shade)	CTBT
KBG	Baron				6.4	2	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP

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Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Baron	3.3	3	96-00																1995 NTEP (MD Dense Shade 96-00)	
KBG	Baron																2	3	2008	2004 KBG trial - Adelphia	
KBG	Blue Angel													9	1	2004				2003 KBG trial	Rutgers
KBG	Blue Angel													61.7	2	2006				2005 KBG trial	Rutgers
KBG	Jackpot (J-920)													5	2	2019				2018 KBG High maintenance	
KBG	Jackpot (J-920)													6.3	2	2019				2019 KBG Hight maintenance	
KBG	Rugby II													6.7	1	2019				2018 KBG High maintenance	Rutgers
KBG	Rugby II													4.7	2	2016				2015 KBG high maintenance trial	Rutgers
KBG	Rugby II													7.7	1	2013	4.7	2	2014	2012 KBG trial	Rutgers
KBG	Rugby II													7	1	2014				2013 KBG trial	Rutgers
KBG	Rugby II													43.30%	2	2012	5	1	2013	2011 KBG trial	Rutgers
KBG	Rugby II	4.9	2	2015										6	2	2013				2012 KBG low maintenance	Rutgers
KBG	Rugby II	4.1	2	2015							3.7	3	2014	8.3	1	2014				2013 KBG low maintenance	Rutgers
KBG	Rugby II													6.7	2	2011				2010 KBG trial	Rutgers
KBG	Rugby II													6.3	2	2010	3	3	2012	2009 KBG trial	Rutgers
KBG	Rugby II	4.6	2	2012							4.7	2	2011	9	1	2011				2010 KBG Low Maintenance	Rutgers
KBG	Rugby II	4.8	2	2011							4.7	2	2011	5.7	2	2010	3	3	2012	2009 KBG Low Maintenance	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Rugby II	2.8	3	2010										4.5	2	2009	1.7	3	2010	2008 low maintenance	Rutgers
KBG	Rugby II										4.7	2	2009							2005 NTEP (MN 2009)	NTEP
KBG	Rugby II										4.7	2	2008							2005 NTEP (MN 2008)	NTEP
KBG	Rugby II										3.8	3	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Rugby II										4.7	2	2006							2005 NTEP (MN 2006)	NTEP
KBG	Rugby II										7.3	1	2002							2000 NTEP (WY 2002)	NTEP
KBG	Rugby II										5	2	2001							2000 NTEP (NJ1 2001)	NTEP
KBG	Rugby II										2.3	2	1999							1995 NTEP (KS1 1999)	NTEP
KBG	Rugby II										9	1	1998							1995 NTEP (MN1 1998)	NTEP
KBG	Rugby II										6	2	1997							1995 NTEP (NJ2 1997)	NTEP
KBG	Rugby II										5.3	1	1996							1995 NTEP (KS1 & UT1 1996)	NTEP
KBG	Rugby II				6.6	2	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP
KBG	Rugby II	4.3	2	96-00																1995 NTEP (MD Dense Shade 96-00)	
KBG	Rugby II																3	2	2008	2004 KBG trial - Adelphia	
KBG	Shamrock													5.7	2	2019				2018 KBG High maintenance	Rutgers
KBG	Shamrock													73.7 %	2	2018				2017 KBG trial	Rutgers
KBG	Shamrock													7.3	2	2011				2010 KBG trial	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Shamrock													7.3		2010	4.7	2	2011	2009 KBG trial CTBT	Rutgers
KBG	Shamrock													5.7	2	2010	4.7	2	2011	2009 KBG trial	Rutgers
KBG	Shamrock	4.6	2	2012							6	2	2011	3.7	2	2010	3.7	2	2012	2009 KBG Low maintenance	Rutgers
KBG	Shamrock													41.70%	2	2012				2011 KBG Trial NTEP	Rutgers
KBG	Shamrock	4.4	2	2011										6	2	2010				2009 KBG shaded	Rutgers
KBG	Shamrock										5.3	3	2019							2017 NTEP (Ky 2019)	NTEP
KBG	Shamrock										4.3	3	2013							2011 NTEP (IN 2013)	NTEP
KBG	Shamrock										4.3	3	2009							2005 NTEP (MN 2009)	NTEP
KBG	Shamrock										3.7	3	2008							2005 NTEP (MN 2008)	NTEP
KBG	Shamrock										3	3	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Shamrock										5	2	2006							2005 NTEP (MN 2006)	NTEP
KBG	Shamrock										6	2	2002							2000 NTEP (WY 2002)	NTEP
KBG	Shamrock										6.7	2	2001							2000 NTEP (NJ1 2001)	NTEP
KBG	Shamrock										3	1	1999							1995 NTEP (KS1 1999)	NTEP
KBG	Shamrock										5	2	1998							1995 NTEP (MN1 1998)	NTEP
KBG	Shamrock										5.3	2	1997							1995 NTEP (NJ2 1997)	NTEP
KBG	Shamrock										4	2	1996							1995 NTEP (KS1 & UT1 1996)	NTEP

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Shamrock										6.3	2	1992							1990 NTEP (NJ1 1992)	NTEP
KBG	Shamrock										4	2	1992							1990 NTEP (VA2 1992)	NTEP
KBG	Shamrock										4	3	1991							1990 NTEP (ON1 1991)	NTEP
KBG	Shamrock										4.7	1	1991							1990 NTEP (IL2 1991)	NTEP
KBG	Shamrock	4.63	2	2010																2009 KBG CTBT (NJ - Shade)	CTBT
KBG	Shamrock				6.5	2	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP
KBG	Shamrock	4.2	2	96-00																1995 NTEP (MD Dense Shade 96-00)	
KBG	Shamrock										5.3	2	2019							2017 NTEP (KY 2019)	NTEP
KBG	Shamrock																3	2	2008	2004 KBG trial - Adelphia	
KBG	Arrowhead													5	2	2019				2018 KBG High maintenance	Rutgers
KBG	Arrowhead	4	2	2019										7.7	1	2018				2016 KBG Low Maintenance	Rutgers
KBG	Arrowhead													5	2	2018				2017 KBG high maintenance	Rutgers
KBG	Arrowhead	3.4	3	2019							3	2	2018	6.7	2	2019				2017 KBG low maintenance	Rutgers
KBG	Arrowhead													7.3	1	2018				2016 KBG high maintenance	Rutgers
KBG	Arrowhead													7	1	2016				2015 KBG high maintenance	Rutgers
KBG	Arrowhead													50.00%	2	2012				2011 KBG trial with NTEP	Rutgers
KBG	Arrowhead													6.3	2	2013	4.7	2	2015	2012 KBG trial	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Arrowhead													5.5	2	2015	5	2	2016	2014 KBG trial	Rutgers
KBG	Arrowhead	4.6	2	2015										6	1	2013				2012 KBG low maintenance	Rutgers
KBG	Arrowhead													7	1	2014				2013 KBG trial	Rutgers
KBG	Arrowhead	3.5	3	2015							3.3	3	2014	7.7	1	2014				2013 KBG low maintenance	Rutgers
KBG	Arrowhead	4.9	1	2012										5.7	2	2010	4	2	2012	2009 KBG low maintenance	Rutgers
KBG	Arrowhead	3.9	3	2012							5	2	2011	8	1	2011				2010 KBG Low Maintenance	Rutgers
KBG	Arrowhead										5.3	2	2013							2011 NTEP (IN 2013)	NTEP
KBG	Arrowhead										6.7	1	2009							2005 NTEP (MN 2009)	NTEP
KBG	Arrowhead										6.3	1	2008							2005 NTEP (MN 2008)	NTEP
KBG	Arrowhead										4.8	1	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Arrowhead										5.3	2	2006							2005 NTEP (MN 2006)	NTEP
KBG	Arrowhead				6.2	2	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP
KBG	Arrowhead																4.3	2	2008	2004 KBG trial - Adelphia	
KBG	Arrowhead	4.8	2	2011				5.3	2	2010	3.7		2011	5.7	2	2009				2008 KBG low maintenance	
KBG	Award													6.3	2	2019				2018 KBG High maintenance	Rutgers
KBG	Award													6.3	2	2018				2015 KBG high maintenance	Rutgers
KBG	Award													21.7%	3	2012				2011 KBG trial with NTEP	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Award													6.7	1	2013	5	2	2014	2012 KBG trial	Rutgers
KBG	Award													8	1	2014				2013 KBG trial	Rutgers
KBG	Award													7	1	2015	5	2	2016	2014 KBG trial	Rutgers
KBG	Award													53.3%	2	2012	5.3	1	2013	2011 KBG trial	Rutgers
KBG	Award	5.6	1	2015										5.7	2	2013				2012 KBG low maintenance	Rutgers
KBG	Award	4.6	2	2015							3.7	3	2014	8	1	2014				2013 KBG low maintenance	Rutgers
KBG	Award													7.7	1	2011				2010 KBG trial	Rutgers
KBG	Award	4.9	2	2012							5	2	2011	6	1	2010				2009 KBG low maintenance	Rutgers
KBG	Award	5.1	1	2011				5	2	2010	4	2	2011	7	2	2009				2008 KBG low maintenance	Rutgers
KBG	Award										5	2	2013							2011 NTEP (IN 2013)	NTEP
KBG	Award										5.3	2	2009							2005 NTEP (MN 2009)	NTEP
KBG	Award										6	2	2008							2005 NTEP (MN 2008)	NTEP
KBG	Award										4.5	2	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Award										5	2	2006							2005 NTEP (MN 2006)	NTEP
KBG	Award										4.3	3	2002							2000 NTEP (WY 2002)	NTEP
KBG	Award										5.3	2	2001							2000 NTEP (NJ1 2001)	NTEP
KBG	Award										2.7	2	1999							1995 NTEP (KS1 1999)	NTEP

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Award										9	1	1998							1995 NTEP (MN1 1998)	NTEP
KBG	Award										6.3	2	1997							1995 NTEP (NJ2 1997)	NTEP
KBG	Award										4.7	2	1996							1995 NTEP (KS1 & UT1 1996)	NTEP
KBG	Award				6.7	2	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP
KBG	Award	4	2	96-00																1995 NTEP (MD Dense Shade 96-00)	
KBG	Award																2.7	2	2008	2004 KBG trial - Adelphia	
KBG	Diva													6.7	2	2018				2016 KBG High maintenance	Rutgers
KBG	Diva	4.8	1	2019										4.3	2	2019				2016 KBG Low Maintenance	Rutgers
KBG	Diva													5.3	2	2018				2017 KBG high maintenance	Rutgers
KBG	Diva	4.2	2	2019							3.7	2	2018	7.7	1	2018				2017 KBG low maintenance	Rutgers
KBG	Diva													6.3	2	2019				2018 KBG High maintenance	Rutgers
KBG	Diva													6.3	2	2018				2015 KBG high maintenance	Rutgers
KBG	Diva													5.7	2	2013	5.7	2	2014	2012 KBG trial	Rutgers
KBG	Diva													5.7	2	2014				2013 KBG trial	Rutgers
KBG	Diva													5.5	2	2015	5	2	2016	2014 KBG trial	Rutgers
KBG	Diva													6.7	2	2011				2010 KBG trial	Rutgers
KBG	Diva													50	2	2012	4.3	2	2013	2011 KBG trial	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Diva	5.7	1	2015										6.7	1	2013				2012 KBG low maintenance	Rutgers
KBG	Diva	4.8	2	2015							5	2	2014	5.3	2	2014				2013 KBG low maintenance	Rutgers
KBG	Diva	5	1	2012							4.3	3	2011	7.7	1	2011				2010 KBG Low Maintenance	Rutgers
KBG	Diva	5	1	2011				5.3	2	2010	3.7	2	2011	7.3	2	2009				2008 KBG low maintenance	Rutgers
KBG	Diva	4.9	2	2012							4.3	2	2011	6	1	2010	3.7	2	2012	2009 KBG low maintenance	Rutgers
KBG	Diva	6.7	1	2011										6.7	1	2010				2009 KBG shaded	Rutgers
KBG	Diva	3.6	2	2010										4.3	2	2009	2	3	2010	2008 low maintenance	Rutgers
KBG	Diva	4.9	2	2008							7	1	2006	6	2	2006				2005 low maintenance	Rutgers
KBG	Diva										4	3	2009							2005 NTEP (MN 2009)	NTEP
KBG	Diva										6	2	2008							2005 NTEP (MN 2008)	NTEP
KBG	Diva										3.7	3	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Diva										6	1	2006							2005 NTEP (MN 2006)	NTEP
KBG	Diva (Pro Seeds - 453)										6.7	2	2002							2000 NTEP (WY 2002)	NTEP
KBG	Diva (Pro Seeds - 453)										7	1	2001							2000 NTEP (NJ1 2001)	NTEP
KBG	Diva (Pro Seeds - 453)	7	1	2010																2009 KBG CTBT (NJ - Shade)	CTBT
KBG	Diva (Pro Seeds - 453)				6.5	2	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP
KBG	Diva (Pro Seeds - 453)																5.3	1	2008	2004 KBG trial - Adelphia	

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Diva (Pro Seeds - 453)																6	2	2008	2004 KBG trial - New Brunswick	
KBG	Fargo (A04-36)													40	2	2012				2011 KBG trial with NTEP	Rutgers
KBG	Fargo (A04-36)													46.7%	2	2012	4.3	2	2013	2011 KBG trial	Rutgers
KBG	Fargo (A04-36)													6.3	2	2011				2010 KBG trial	Rutgers
KBG	Fargo (A04-36)													7.3	1	2010	5.8	1	2011	2009 KBG trial	Rutgers
KBG	Fargo (A04-36)	4.7	2	2012							4.3	2	2011	4.7	2	2010	3.3	2	2012	2009 KBG low maintenance	Rutgers
KBG	Fargo (A04-36)										4.3	3	2013							2011 NTEP (IN 2013)	NTEP
KBG	Fargo (A04-36)																4.3	3	2008	2004 KBG trial - New Brunswick	
KBG	Fielder (SPTR 2959)													5	2	2018				2017 KBG high maintenance	Rutgers
KBG	Fielder (SPTR 2959)	4.1	2	2019							2	3	2018	6.3	2	2018				2017 KBG low maintenance	Rutgers
KBG	Fielder (SPTR 2959)													5	2	2019				2018 KBG High maintenance	Rutgers
KBG	Fielder (SPTR 2959)													6	2	2013	3	3	2014	2012 KBG trial	Rutgers
KBG	Fielder (SPTR 2959)													4.7	3	2014				2013 KBG trial	Rutgers
KBG	Fielder (SPTR 2959)	4.3	2	2015										5.3	2	2013				2012 KBG low maintenance	Rutgers
KBG	Fielder (SPTR 2959)	3.6	3	2015							5	2	2014	2.7	3	2014				2013 KBG low maintenance	Rutgers
KBG	Fielder (SPTR 2959)													-	-	2012	3.7	2	2013	2011 KBG trial	Rutgers
KBG	Fielder (SPTR 2959)													7	2	2011				2010 KBG trial	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Fielder (SPTR 2959)	3.6	3	2012							5.3	2	2011	7.3	2	2011				2010 KBG low maintenance	Rutgers
KBG	Fielder (SPTR 2959)										4.3	3	2009							2005 NTEP (MN 2009)	NTEP
KBG	Fielder (SPTR 2959)										4	1	2008							2005 NTEP (MN 2008)	NTEP
KBG	Fielder (SPTR 2959)										3.7	3	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Fielder (SPTR 2959)										5.7	2	2006							2005 NTEP (MN 2006)	NTEP
KBG	Fielder (SPTR 2959)				6.5	2	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP
KBG	Glade													6.3	2	2017				2016 KBG High maintenance	Rutgers
KBG	Glade	5.1	1	2019										5	2	2017				2016 KBG Low Maintenance	Rutgers
KBG	Glade										3.3	2	2002							1998 KBG trial	Rutgers
KBG	Glade																			1997 KBG trial	Rutgers
KBG	Glade																			1995 KBG trial include NTEP	Rutgers
KBG	Glade																			1996 KBG trial	Rutgers
KBG	Glade										1.7	3	1999							1995 NTEP (KS1 1999)	NTEP
KBG	Glade										5.7	2	1998							1995 NTEP (MN1 1998)	NTEP
KBG	Glade										6	2	1997							1995 NTEP (NJ2 1997)	NTEP
KBG	Glade										4.8	1	1996							1995 NTEP (KS1 & UT1 1996)	NTEP
KBG	Glade										2	3	1992							1990 NTEP (NJ1 1992)	NTEP

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Glade										5	1	1992							1990 NTEP (VA2 1992)	NTEP
KBG	Glade										5	1	1991							1990 NTEP (ON1 1991)	NTEP
KBG	Glade										3.7	2	1991							1990 NTEP (IL2 1991)	NTEP
KBG	Glade	5.8	1	86-90																1985 NTEP - Low Input (1986-1990)	NTEP
KBG	Glade	4.3	2	96-00																1995 NTEP (MD Dense Shade 96-00)	
KBG	Merit													4.3	3	2001				2000 KBG trial	Rutgers
KBG	Merit																1.3	3	1999	1994 KBG trial medium high	Rutgers
KBG	Merit	3.7	3	1998																1994 KBG low maintenance	Rutgers
KBG	Merit	4.4	2	1995																1990 KBG low maintenance include NTEP #2	Rutgers
KBG	Merit	5	1	1995																1990 KBG low maintenance include NTEP #1	Rutgers
KBG	Merit										3	3	1992							1990 NTEP (NJ1 1992)	NTEP
KBG	Merit										4.7	1	1992							1990 NTEP (VA2 1992)	NTEP
KBG	Merit										4.3	2	1991							1990 NTEP (ON1 1991)	NTEP
KBG	Merit										2.7	3	1991							1990 NTEP (IL2 1991)	NTEP
KBG	Merit	4.79	2	91-95																1990 NTEP - Low Input (1991-1995)	NTEP
KBG	Merit	5.6	2	86-90																1985 NTEP - Low Input (1986-1990)	NTEP
KBG	Midnight													7.3	1	2017				2016 KBG High maintenance	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Midnight	4.7	1	2019										7.7	1	2018				2016 KBG Low Maintenance	Rutgers
KBG	Midnight	5.6	2	2019										93.7%		2019				2017 KBG NTEP (low maintenance)	Rutgers
KBG	Midnight													6	2	2019				2018 KBG High maintenance	Rutgers
KBG	Midnight													5.7	2	2016				2015 KBG high maintenance	Rutgers
KBG	Midnight													56.7%	1	2012				2011 KBG trial with NTEP	Rutgers
KBG	Midnight													7.7	1	2013	5	2	2014	2012 KBG trial	Rutgers
KBG	Midnight													6.7	2	2014				2013 KBG trial	Rutgers
KBG	Midnight													5.3	2	2015	4.5	2	2016	2014 KBG trial	Rutgers
KBG	Midnight													5.3	2	2015	4.7	1	2016	2014 KBG trial with CTBT	Rutgers
KBG	Midnight													7.3	1	2011				2010 KBG trial	Rutgers
KBG	Midnight	5.7	1	2015										5.3	2	2013				2012 KBG low maintenance	Rutgers
KBG	Midnight	4.3	2	2015							4	2	2014	6	2	2014				2013 KBG low maintenance	Rutgers
KBG	Midnight	5	1	2012							5.3	2	2011	8.7	1	2011				2010 KBG Low Maintenance	Rutgers
KBG	Midnight	2.6	3	2011										4.3	3	2010				2009 KBG shaded	Rutgers
KBG	Midnight													6.3	2	2010	6.5	1	2011	2009 KBG trial with CTBT	Rutgers
KBG	Midnight	4.5	2	2008							6	2	2006	6.7	1	2006				2005 low maintenance	Rutgers
KBG	Midnight	3.7	2	2001										6	2	2002				2001 low maintenance	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Midnight																			2016 NTEP Drought	NTEP
KBG	Midnight										5.3	2	2013							2011 NTEP (IN 2013)	NTEP
KBG	Midnight										6	2	2009							2005 NTEP (MN 2009)	NTEP
KBG	Midnight										6	2	2008							2005 NTEP (MN 2008)	NTEP
KBG	Midnight										4	2	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Midnight										4.7	2	2006							2005 NTEP (MN 2006)	NTEP
KBG	Midnight										7.3	1	2002							2000 NTEP (WY 2002)	NTEP
KBG	Midnight										6	2	2001							2000 NTEP (NJ1 2001)	NTEP
KBG	Midnight										2.7	2	1999							1995 NTEP (KS1 1999)	NTEP
KBG	Midnight										8.7	1	1998							1995 NTEP (MN1 1998)	NTEP
KBG	Midnight										7	2	1997							1995 NTEP (NJ2 1997)	NTEP
KBG	Midnight										4.8	1	1996							1995 NTEP (KS1 & UT1 1996)	NTEP
KBG	Midnight	5.18	1	91-95																1990 NTEP - Low Input (1991-1995)	NTEP
KBG	Midnight	6.1	1	86-90																1985 NTEP - Low Input (1986-1990)	NTEP
KBG	Midnight	2.13	3	2010																2009 KBG CTBT (NJ - Shade)	CTBT
KBG	Midnight	4.59	2	15-16																2014 KBG CTBT (OR - Low Maintenance)	CTBT
KBG	Midnight										6.98	1	15-16							2014 KBG CTBT (OR - Drought)	CTBT

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Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Midnight				6.6	2	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP
KBG	Midnight	3.4	3	96-00																1995 NTEP (MD Dense Shade 96-00)	NTEP
KBG	Midnight										6.5	1	2019							2017 NTEP (KY 2019)	NTEP
KBG	Midnight																2.7	2	2008	2004 KBG trial - Adelphia	
KBG	Midnight																			2004 KBG trial - New Brunswick	
KBG	NuGlade													5.3	2	2016				2015 KBG high maintenance	Rutgers
KBG	NuGlade													7.3	1	2013	5.3	2	2014	2012 KBG trial	Rutgers
KBG	NuGlade													8	1	2014				2013 KBG trial	Rutgers
KBG	NuGlade													7	1	2015	4.5	2	2016	2014 KBG trial	Rutgers
KBG	NuGlade	5.7	1	2015										5.3	2	2013				2012 KBG low maintenance	Rutgers
KBG	NuGlade	4.6	2	2015							4.7	2	2014	8.3	1	2014				2013 KBG low maintenance	Rutgers
KBG	NuGlade													7.7	1	2011				2010 KBG trial	Rutgers
KBG	NuGlade	4.9	2	2012							5.7	2	2011	8.3	1	2011				2010 KBG Low Maintenance	Rutgers
KBG	NuGlade													5.3	2	2008	4.3	2	2011	2007 KBG trial	Rutgers
KBG	NuGlade													6.7	2	2008	7.3	1	2011	2007 KBG trial	Rutgers
KBG	NuGlade	2.6	3	2010										4.5	2	2009	1.7	3	2010	2008 low maintenance	Rutgers
KBG	NuGlade										5.7	2	2009							2005 NTEP (MN 2009)	NTEP

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Midnight				6.6	2	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP
KBG	Midnight	3.4	3	96-00																1995 NTEP (MD Dense Shade 96-00)	NTEP
KBG	Midnight										6.5	1	2019							2017 NTEP (KY 2019)	NTEP
KBG	Midnight																2.7	2	2008	2004 KBG trial - Adelphia	
KBG	Midnight																			2004 KBG trial - New Brunswick	
KBG	NuGlade													5.3	2	2016				2015 KBG high maintenance	Rutgers
KBG	NuGlade													7.3	1	2013	5.3	2	2014	2012 KBG trial	Rutgers
KBG	NuGlade													8	1	2014				2013 KBG trial	Rutgers
KBG	NuGlade													7	1	2015	4.5	2	2016	2014 KBG trial	Rutgers
KBG	NuGlade	5.7	1	2015										5.3	2	2013				2012 KBG low maintenance	Rutgers
KBG	NuGlade	4.6	2	2015							4.7	2	2014	8.3	1	2014				2013 KBG low maintenance	Rutgers
KBG	NuGlade													7.7	1	2011				2010 KBG trial	Rutgers
KBG	NuGlade	4.9	2	2012							5.7	2	2011	8.3	1	2011				2010 KBG Low Maintenance	Rutgers
KBG	NuGlade													5.3	2	2008	4.3	2	2011	2007 KBG trial	Rutgers
KBG	NuGlade													6.7	2	2008	7.3	1	2011	2007 KBG trial	Rutgers
KBG	NuGlade	2.6	3	2010										4.5	2	2009	1.7	3	2010	2008 low maintenance	Rutgers
KBG	NuGlade										5.7	2	2009							2005 NTEP (MN 2009)	NTEP

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	NuGlade										7	1	2008							2005 NTEP (MN 2008)	NTEP
KBG	NuGlade										4.5	2	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	NuGlade										5	2	2006							2005 NTEP (MN 2006)	NTEP
KBG	NuGlade										6.7	2	2002							2000 NTEP (WY 2002)	NTEP
KBG	NuGlade										5	2	2001							2000 NTEP (NJ1 2001)	NTEP
KBG	NuGlade										3	1	1999							1995 NTEP (KS1 1999)	NTEP
KBG	NuGlade										9	3	1998							1995 NTEP (MN1 1998)	NTEP
KBG	NuGlade										6.3	2	1997							1995 NTEP (NJ2 1997)	NTEP
KBG	NuGlade										5	1	1996							1995 NTEP (KS1 & UT1 1996)	NTEP
KBG	NuGlade				6.8	1	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP
KBG	NuGlade	4.8	1	96-00																1995 NTEP (MD Dense Shade 96-00)	
KBG	NuGlade																4		2008	2004 KBG trial - Adelphia	
KBG	NuGlade																4.8		2008	2004 KBG trial - New Brunswick	
KBG	Rhythm													6	2	2019				2017 KBG high maintenance	Rutgers
KBG	Rhythm	3.4	3	2020							2.3	3	2018	7	1	2019				2017 KBG low maintenance	Rutgers
KBG	Rhythm													4.7	2	2019				2018 KBG High maintenance	Rutgers
KBG	Rhythm	4.2	2	2015							4	2	2014	4.7	2	2014				2013 KBG low maintenance	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Rhythm													6.7	2	2010	5.7	1	2011	2009 KBG trial with CTBT	Rutgers
KBG	Rhythm										4.5	2	2010	5	2	2010	5.7	2	2011	2009 KBG trial	Rutgers
KBG	Rhythm	4.8	2	2012							5.3	2	2011	5	2	2010	4	2	2012	2009 KBG low maintenance	Rutgers
KBG	Rhythm																5	1	2011	2007 KBG trial	Rutgers
KBG	Rhythm	5.1	1	2011				6	1	2010	4.3	2	2011	6.7	2	2009				2008 KBG low maintenance	Rutgers
KBG	Rhythm	2.9	3	2011										6.3	1	2010				2009 KBG shaded	Rutgers
KBG	Rhythm	3	3	2010										5.3	2	2009	1.8	3	2010	2008 low maintenance	Rutgers
KBG	Rhythm										5	2	2009							2005 NTEP (MN 2009)	NTEP
KBG	Rhythm										5.7	2	2008							2005 NTEP (MN 2008)	NTEP
KBG	Rhythm										4.7	2	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Rhythm										4	3	2006							2005 NTEP (MN 2006)	NTEP
KBG	Rhythm				6.9	1	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP
KBG	Rhythm																3.3		2008	2004 KBG trial - Adelphia	
KBG	Volt													7.3	1	2017				2016 KBG High maintenance	Rutgers
KBG	Volt	4	2	2019										8	1	2017				2016 KBG Low Maintenance	Rutgers
KBG	Volt													7	1	2018				2017 KBG high maintenance	Rutgers
KBG	Volt	4.7	1	2020							2.7	2	2018	7.7	1	2018				2017 KBG low maintenance	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
KBG	Volt													1.7	3	2019				2018 KBG trial	Rutgers
KBG	Volt													7.3	1	2016				2015 KBG high maintenance	Rutgers
KBG	Volt													5.3	2	2013	3.7	2	2014	2012 KBG trial	Rutgers
KBG	Volt													7.3	1	2014				2013 KBG trial	Rutgers
KBG	Volt													5	2	2015	3.5	3	2016	2014 KBG trial	Rutgers
KBG	Volt	4.3	2	2015										5.7	2	2013				2012 KBG low maintenance	Rutgers
KBG	Volt	5.4	1	2015							4.3	2	2014	8.3	1	2014				2013 KBG low maintenance	Rutgers
KBG	Volt													6.3	2	2011				2010 KBG trial	Rutgers
KBG	Volt													7	1	2010	3.8	3	2011	2009 KBG trial with CTBT	Rutgers
KBG	Volt	4.7	2	2012				5	2	2010	5.3	2	2011	8.7	1	2011				2010 KBG Low Maintenance	Rutgers
KBG	Volt	5	2	2011							5	2	2011	8.3	1	2009				2008 KBG Low Maintenance	Rutgers
KBG	Volt	4.7	2	2011										5.3	2	2010				2009 KBG shaded	Rutgers
KBG	Volt										5.3	2	2009							2005 NTEP (MN 2009)	NTEP
KBG	Volt										5	2	2008							2005 NTEP (MN 2008)	NTEP
KBG	Volt										4	2	2007							2005 NTEP (IN &MN 2007)	NTEP
KBG	Volt										5.7	2	2006							2005 NTEP (MN 2006)	NTEP
KBG	Volt				6	3	2010													2005 NTEP (NM 2010 - Saline Irrigation)	NTEP

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
CHF	Fairmont													4.7	2	2015				2014 FF trial includes NTEP	Rutgers
CHF	Fairmont													7.3	2	2016				2015 FF trial	Rutgers
CHF	Fairmont																			2016 FF trial	Rutgers
CHF	Fairmont																			2017 FF trial	Rutgers
CHF	Fairmont													8.3	1	2013				2012 FF trial	Rutgers
CHF	Fairmont													85%	1	2009				2008 FF trial includes NTEP	Rutgers
CHF	Fairmont	6.5	1	2010										6.3		2009	4.7	2	2010	2008 low maintenance	Rutgers
CHF	Fairmont										6	2	2013							2008 NTEP FF (RI1 2013)	
CHF	Longfellow 3 (Longfellow III)																			2018 FF trial	Rutgers
CHF	Longfellow 3 (Longfellow III)																			2017 FF trial	Rutgers
CHF	Longfellow 3 (Longfellow III)													4.3	2	2013				2012 FF trial	Rutgers
CHF	Longfellow 3 (Longfellow III)													4.7	2	2012				2011 FF trial	Rutgers
CHF	Longfellow 3 (Longfellow III)																			2008 FF trial includes NTEP	Rutgers
CHF	Longfellow 3 (Longfellow III)													2.7	3	2012	4.3	2	2013	2011 FF trial includes CTBT	Rutgers
CHF	Longfellow 3 (Longfellow III)										6.3	2	2013							2008 NTEP FF (RI1 2013)	
CHF	Radar													7.7	1	2018				2017 FF trial includes CTBT	Rutgers
CHF	Radar													6.7		2018				2014 FF trial	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
CHF	Radar													5	2	2015				2014 FF trial includes NTEP	Rutgers
CHF	Radar													7.3	1	2016				2015 FF trial	Rutgers
CHF	Radar																			2016 FF trial	Rutgers
CHF	Radar																			2017 FF trial	Rutgers
CHF	Radar																			2018 FF trial	Rutgers
CHF	Radar													7.7	2	2012				2012 FF trial	Rutgers
CHF	Radar													6.7	1	2014				2013 FF trial	Rutgers
CHF	Radar													6	1	2012				2011 FF trial	Rutgers
CHF	Radar																			2008 FF trial includes NTEP	Rutgers
CHF	Radar													7.3	1	2012	5	2	2013	2011 FF trial includes CTBT	Rutgers
CHF	Radar																3.3	2	2012	2010 ff trial	Rutgers
CHF	Radar	6.6	1	2010													4.7	2	2010	2008 low maintenance	Rutgers
CHF	Radar	4.7	2	2019																2015 NTEP Low Input (MN1 2019)	NTEP
CHF	Radar	5	1	2018																2015 NTEP Low Input (MN1 2018)	NTEP
CHF	Radar	5.3	1	2017																2015 NTEP Low Input (MN1 2017)	NTEP
CHF	Radar	4.8	1	2016																2015 NTEP Low Input (MN1 2016)	NTEP
CHF	Radar										3	2	2016							2015 NTEP Low Input (MI1 2016)	NTEP

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
CHF	Radar										3.7	2	2016							2014 NTEP FF (MI1 & MI2 2016)	
CHF	Radar										6.7	1	2013							2008 NTEP FF (RI1 2013)	
HDF	Beacon													5	2	2018				2014 FF trial	Rutgers
HDF	Beacon													4.7	2	2015				2014 FF trial includes NTEP	Rutgers
HDF	Beacon													6.7	2	2016				2015 FF trial	Rutgers
HDF	Beacon																			2016 FF trial	Rutgers
HDF	Beacon																			2017 FF trial	Rutgers
HDF	Beacon													6.3	2	2018				2017 FF trial includes CTBT	Rutgers
HDF	Beacon																			2018 FF trial	Rutgers
HDF	Beacon													4.3	2	2014				2013 FF trial	Rutgers
HDF	Beacon													5.3	2	2012				2011 FF trial includes CTBT	Rutgers
HDF	Beacon																			2008 FF trial includes NTEP	Rutgers
HDF	Beacon													7.3	2	2013				2012 FF trial	Rutgers
HDF	Beacon																7.7	1	2011	2007 FF trial	Rutgers
HDF	Beacon	6.6	1	2010													7.5	1	2010	2008 low maintenance	Rutgers
HDF	Beacon											6.8	1	2016							2014 NTEP FF (MI1 & MI2 2016)	
HDF	Beacon											7.7	1	2013							2008 NTEP FF (RI1 2013)	

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
HDF	Chariot													5.7	1	2015				2014 FF trial includes NTEP	Rutgers
HDF	Chariot													6.3	2	2016				2015 FF trial	Rutgers
HDF	Chariot													5.7	1	2015				2014 FF trial includes NTEP	Rutgers
HDF	Chariot																			2006 FF trial	Rutgers
HDF	Chariot																			2003 FF trial includes NTEP	Rutgers
HDF	Gladiator													5	2	2015				2014 FF trial includes NTEP	Rutgers
HDF	Gladiator													7.3	1	2016				2015 FF trial	Rutgers
HDF	Gladiator																			2016 FF trial	Rutgers
HDF	Gladiator																			2017 FF trial	Rutgers
HDF	Gladiator																			2018 FF trial	Rutgers
HDF	Gladiator											7	1	2016							2014 NTEP FF (MI1 & MI2 2016)	
HDF	Reliant IV														6	1	2015				2014 FF trial includes NTEP	Rutgers
HDF	Reliant IV													5.3	2	2016				2015 FF trial	Rutgers
HDF	Reliant IV																			2016 FF trial	Rutgers
HDF	Reliant IV																			2017 FF trial	Rutgers
HDF	Reliant IV																			2018 FF trial	Rutgers
HDF	Reliant IV														1	3	2014				2013 FF trial	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
HDF	Reliant IV													4.7	3	2013				2012 FF trial	Rutgers
HDF	Reliant IV																7.3	1	2012	2010 FF trial	Rutgers
HDF	Reliant IV													4	3	2012				2011 FF trial	Rutgers
HDF	Reliant IV																			2008 FF trial includes NTEP	Rutgers
HDF	Reliant IV																7	1	2013	2011 FF trial includes CTBT	Rutgers
HDF	Reliant IV	7.1	1	2013							7.7	1	2011	8.7	1	2011	8.3	1	2013	2010 low maintenance trial	Rutgers
HDF	Reliant IV										8.7	1	2005							2003 NTEP FF (RI1 2005)	
CRF	Boreal													5.7	1	2019				2014 FF trial includes NTEP	Rutgers
CRF	Boreal													9	1	2019				2017 FF trial includes CTBT	Rutgers
CRF	Boreal													1.7	3	2014				2013 FF trial	Rutgers
CRF	Boreal													8.7	1	2013				2012 FF trial	Rutgers
CRF	Boreal																1	3	2012	2010 FF trial	Rutgers
CRF	Boreal													7	1	2012				2011 FF trial includes CTBT	Rutgers
CRF	Boreal																			2008 FF trial includes NTEP	Rutgers
CRF	Boreal	3.9	2	2010										4.3	2	2009	2.3	3	2010	2008 low maintenance	Rutgers
CRF	Boreal										3	3	2016							2014 NTEP FF (MI1 & MI2 2016)	
CRF	Boreal										6	2	2013							2008 NTEP FF (RI1 2013)	

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Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
CRF	Boreal										6.3	2	2005							2003 NTEP FF (RI1 2005)	
CRF	Boreal										4	2	1991							1989 NTEP FF (PA1 1991)	
CRF	Epic													3.3	3	2019				2014 FF trial includes NTEP	Rutgers
CRF	Epic																			2017 FF trial	Rutgers
CRF	Epic																			2018 FF trial	Rutgers
CRF	Epic													3.3	3	2018				2015 FF trial	Rutgers
CRF	Epic													4.7	3	2013				2012 FF trial	Rutgers
CRF	Epic													4.7	2	2012				2011 FF trial	Rutgers
CRF	Epic																			2008 FF trial includes NTEP	Rutgers
CRF	Epic																1	3	2013	2011 FF trial includes CTBT	Rutgers
CRF	Epic	5.3	2	2013							5.7	2	2011	7.7	2	2011	1.3	3	2013	2010 low maintenance trial	Rutgers
CRF	Epic																2	3	2012	2010 FF trial	Rutgers
CRF	Epic	6	2	2010										5.7	2	2009	2.7	3	2010	2008 low maintenance	Rutgers
CRF	Epic										2.7	3	2013							2008 NTEP FF (RI1 2013)	
CRF	Epic										7.3	2	2005							2003 NTEP FF (RI1 2005)	
CRF	Navigator																2.7	3	2012	2010 FF trial	Rutgers
CRF	Navigator																			2006 FF trial	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
CRF	Navigator																5.7	2	2005	2004 FF trial	Rutgers
CRF	Navigator																3.3	3	2004	2003 FF trial includes NTEP	Rutgers
CRF	Seabreeze																3	3	2004	2003 FF trial includes NTEP	Rutgers
CRF	Seabreeze																6.7	2	2003	2002 FF trial	Rutgers
CRF	Seabreeze																			1998 FF trial includes NTEP	Rutgers
CRF	Seabreeze																7.3	1	2002	2001 FF trial	Rutgers
CRF	Seabreeze																7	1	2001	2000 FF trial	Rutgers
CRF	Seabreeze											6.7	2	2005							2003 NTEP FF (RI1 2005)	
CRF	Seabreeze											3	2	1995							1993 NTEP FF (UB1 1995)	
CRF	Seabreeze											5.7	2	1997							1993 NTEP FF (UB1 1997)	
CRF	Seabreeze											4.7	2	1991							1989 NTEP FF (PA1 1991)	
CBG	Common																					
CBG	Reubens																					
CBG	Talon																					
SHF	Azure														4.7	2	2019				2014 FF trial includes NTEP	Rutgers
SHF	Azure																				2017 FF trial	Rutgers
SHF	Azure																				2018 FF trial	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
SHF	Azure																			2016 FF trial	Rutgers
SHF	Azure													6.3	2	2013				2012 FF trial	Rutgers
SHF	Azure													4.3	3	2012				2011 FF trial	Rutgers
SHF	Azure																			2009 FF trial	Rutgers
SHF	Azure																4.3	2	2013	2011 FF trial includes CTBT	Rutgers
SHF	Azure	4.7	2	2013							5	3	2011	7.7	2	2011	3.3	2	2013	2010 low maintenance trial	Rutgers
SHF	Azure																2.3	3	2012	2010 FF trial	Rutgers
SHF	Azure																3.3	3	2011	2007 FF trial	Rutgers
SHF	Big Horn (Bighorn)																			2008 FF trial includes NTEP	Rutgers
SHF	Big Horn (Bighorn)	5.5	2	2010													5.3	2	2010	2008 low maintenance	Rutgers
SHF	Big Horn (Bighorn)													4.3	3	1999				1998 FF trial includes NTEP	Rutgers
SHF	Big Horn (Bighorn)													2	3	2001				2000 FF trial	Rutgers
SHF	Black Sheep										7.3	1	1991							1989 NTEP FF (PA1 1991)	
SHF	Blueray & Blue Ray													3.3	3	2019				2014 FF trial includes NTEP	Rutgers
SHF	Blueray & Blue Ray													6	2	2016				2015 FF trial	Rutgers
SHF	Blueray & Blue Ray																			2016 FF trial	Rutgers
SHF	Blueray & Blue Ray																			2018 FF trial	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
SHF	Blueray & Blue Ray													3.7	2	2014				2013 FF trial	Rutgers
SHF	Blueray & Blue Ray																			2012 FF trial	Rutgers
SHF	Blueray & Blue Ray													5	2	2012	7	1	2013	2011 FF trial includes CTBT	Rutgers
SHF	MX 86													6.3	2	2002				2001 FF trial	Rutgers
SHF	MX 86	4.6	2	2001																1999 FF trial low maintenance	Rutgers
SHF	MX 86													4	2	1997	2.7	3	1999	1996 FF trial	Rutgers
SHF	MX 86																			1995 FF trial	Rutgers
SHF	MX 86																			1993 FF trial includes NTEP	Rutgers
SHF	MX 86																			1994 FF trial	Rutgers
SHF	MX 86										6.3	1	1991							1989 NTEP FF (PA1 1991)	Rutgers
SHF	Quatro													4.7		2019				2014 FF trial includes NTEP	Rutgers
SHF	Quatro																			2017 FF trial	Rutgers
SHF	Quatro																			2018 FF trial	Rutgers
SHF	Quatro													3	3	2004				2003 FF trial includes NTEP	Rutgers
SHF	Quatro													4.7	2	1999				1998 FF trial includes NTEP	Rutgers
SHF	Quatro													3.7	3	1999				1998 FF trial	Rutgers
SHF	Quatro																			1993 FF trial includes NTEP	Rutgers

Table 2.2 (continued) Summary of turfgrass data search for 25-000 turfgrass varieties. Instances when a variety ranked in the lower 25% of the trial are shaded light red. Varieties shaded in tan are those that were added as a result of the review process. For rank, 1= top 25%, 2 = middle 50% and 3 = bottom 25%. Turf quality (TQ) low input/shade is the average rating at the end of trial average.

Species	Cultivar	TQ (low input/shade)	Rank	Report year	Salt	Rank	Report year	Heat	Rank	Report year	Drought	Rank	Report year	Establishment	Rank	Report year	Wear	Rank	Report year	Trial	Source
SHF	Quatro	3.4	3	2019																2015 NTEP Low Input (MN1 2019)	
SHF	Quatro	2.4	3	2018																2015 NTEP Low Input (MN1 2018)	
SHF	Quatro	2.7	3	2017																2015 NTEP Low Input (MN1 2017)	
SHF	Quatro	3.8	2	2016																2015 NTEP Low Input (MN1 2016)	
SHF	Quatro										5.7	1	2016							2015 NTEP Low Input (MI1 2016)	
SHF	Quatro										5.2	2	2016							2014 NTEP FF (MI1 & MI2 2016)	
SHF	Quatro										6.3	2	2005							2003 NTEP FF (RI1 2005)	
SHF	Quatro										8	1	1995							1993 NTEP FF (UB1 1995)	
SHF	Quatro										7.7	1	1997							1993 NTEP FF (UB1 1997)	
SHF	SR 3000 (registered as HDF)													2.3	3	2004				2003 ff trial includes NTEP	Rutgers
SHF	SR 3000 (registered as HDF)													3.3	3	1998				1997 ff trial	Rutgers
SHF	SR 3000 (registered as HDF)										7.7	1	2005							2003 NTEP FF (RI1 2005)	
SHF	SR 3000 (registered as HDF)										7.7	1	1991							1989 NTEP FF (PA1 1991)	

CHAPTER 3: RECOMMENDATIONS FOR TURFGRASS VARIETIES TO ADD

We reviewed recent turfgrass trials and research information to identify promising varieties that should be included on MnDOT turfgrass variety lists for turfgrass species.

3.1 METHODS

Data for all varieties for turfgrass species adapted for a Minnesota climate was reviewed from several reputable sources: National Turfgrass Evaluation Program (NTEP); Cooperative Turfgrass Breeders Trial (CTBT); Rutgers University Turfgrass Trials; research conducted by the University of Minnesota turfgrass team, including trials conducted on roadsides; and peer-reviewed results from other research programs.

Based on our previous experience working with roadside turfgrasses, we determined that data should be considered from the following categories:

Higher priority
- *Turfgrass quality when maintained under low-input conditions*: Trials that have limited inputs of water, fertilizer, and pesticides more closely mimic the harsh roadside conditions in Minnesota, except for spring salt stress.
- *Performance under drought*: Turfgrass varieties that do well during prolonged drought periods are well suited for success on Minnesota roadsides.

Lower priority
- *Establishment*: Poorly establishing cultivars (relative to others within the same species) will struggle to do well on a roadside)
- *Shade*: Many roadsides have occasional vegetative shade cover. This is not a primary attribute but should receive some attention.
- *Heat stress tolerance*: The temperature experienced by vegetation along roadsides can be well above ambient. This is an important stress to consider when identifying top roadside turfgrasses
- *Wear/traffic*: In many urban roadside turfgrass environments, there is significant foot traffic. When turfgrasses are growing under low-input conditions, this traffic could be challenging.

3.2 RESULTS

We have summarized our findings by species in Tables 3.1 to 3.6. Comparing results from multiple trials is challenging and there is not a statistically valid approach for doing so, especially given that in many variety trials, means separation statistics will show that many varieties perform similarly. Based on our experience evaluating turfgrass varieties, we decided that a variety performing in the top statistical group of a given trial for turfgrass quality or other important abiotic stress trait indicates that there is potential for that cultivar. Of course, some varieties may perform well in one trial and not another. The

"guesswork" involved in the current process points to a need for better field evaluation approaches to identify well adapted turfgrasses for harsh roadside environments.

3.2.1.1 Kentucky bluegrass varieties

As Kentucky bluegrass is the most evaluated cool-season turfgrass species, we found evidence for 41 promising varieties (Table 3.1). In particular, 'Touché', 'Mystere', 'Blue Note' and 'Bewitched' performed well in more than one trial. While this species does not generally perform well on roadsides or under low-input conditions, it continues to be specified by MnDOT for many roadside applications and is desired by sod growers for speedier sod harvest; therefore, an expanded list of possible varieties is recommended.

3.2.1.2 Hard fescue varieties

Hard fescue continues to perform well in ongoing roadside trials in Minnesota. In our review of hard fescue, we found evidence for eight promising varieties (Table 3.2). 'Gladiator', 'Resolute', 'Jetty' and 'Minimus' had more than one trial to recommend them.

3.2.1.3 Chewings varieties

For Chewings fescue varieties, we found seven promising varieties (Table 3.3).

3.2.1.4 Strong creeping red fescue varieties

For strong creeping red fescue varieties, there were six promising varieties (Table 3.4), with 'Cardinal II' and 'Navigator II' standing out.

3.2.1.5 Slender creeping red fescue varieties

The five promising varieties of slender creeping red fescue are shown in Table 3.5. 'Seamist' and 'Beaudin' performed well in more than one trial.

3.2.1.6 Sheep fescue varieties

'Marco Polo' and 'Bighorn GT' were the two varieties of sheep fescue that had potential (Table 3.6).

3.3 CONCLUSION

We have taken a broad-minded approach to this task and found all the options for potentially better-performing varieties. The inclusion of these varieties will provide seed vendors with more options for fulfilling MnDOT specifications at a time when sourcing high quality turfgrass seed is challenging. There are likely varieties that were not included in the trials we reviewed that some stakeholders recommend for use that can be considered for adding to the approved MnDOT list in the future.

Table 3.1 Potential varieties of Kentucky bluegrass (*Poa pratensis*; KBG) based on turf quality (TQ), summer stress (SS), drought tolerance (DT), and wear quality (WQ). A = Adelphia, NJ; NB = New Brunswick, NJ; NTEP = National Turfgrass Evaluation Program.

Variety	Rationale	Trait	Trial[1]	Reference
Touché	Top statistical group in NJ (2018-2020)	TQ	2017 KBG Low Maintenance (A)	Wright et al., 2020
	Top statistical group in NJ (2018)	SS	2017 KBG Low Maintenance (A)	Wright et al., 2020
	Top statistical group in NJ (2018)	DT	2017 KBG Low Maintenance (A)	Wright et al., 2020
	Top statistical group in NJ (2013-2015)	TQ	2013 KBG Low Maintenance (A)	Grimshaw et al., 2015
	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011-2012)	TQ	2010 KBG Low Maintenance (A)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2010 KBG Low Maintenance (A)	Koch et al., 2012
Mystere	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011-2012)	TQ	2010 KBG Low Maintenance (A)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2010 KBG Low Maintenance (A)	Koch et al., 2012
	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011
Blue Note	Top statistical group in NJ (2013-2015)	TQ	2013 KBG Low Maintenance (A)	Grimshaw et al., 2015
	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top variety in MN (2012-2016)	TQ	2011 Kentucky Bluegrass NTEP	Hollman & Watkins et al., 2016
	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2010-2011)	TQ	2009 KBG Shaded (A)	Cross et al., 2011
Bewitched	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011

Table 3.1 (continued) Potential varieties of Kentucky bluegrass (*Poa pratensis*; KBG) based on turf quality (TQ), summer stress (SS), drought tolerance (DT), and wear quality (WQ). A = Adelphia, NJ; NB = New Brunswick, NJ; NTEP = National Turfgrass Evaluation Program.

Variety	Rationale	Trait	Trial[1]	Reference
Bolt	Top statistical group in NJ (2018-2020)	TQ	2017 KBG Low Maintenance (A)	Wright et al., 2020
	Top statistical group in NJ (2018)	SS	2017 KBG Low Maintenance (A)	Wright et al., 2020
	Top statistical group in NJ (2018)	DT	2017 KBG Low Maintenance (A)	Wright et al., 2020
	Top statistical group in NJ (2013-2015)	TQ	2013 KBG Low Maintenance (A)	Grimshaw et al., 2015
Avalanche	Top statistical group in NJ (2013-2015)	TQ	2013 KBG Low Maintenance (A)	Grimshaw et al., 2015
	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
Prosperity	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2010-2011)	TQ	2009 KBG Shaded (A)	Cross et al., 2011
Martha	One below top statistical group in NJ (2018-2020)	TQ	2017 KBG	Wright et al., 2020
	Top statistical group in NJ (2018)	SS	2017 KBG	Wright et al., 2020
	Top statistical group in NJ (2018)	DT	2017 KBG	Wright et al., 2020
Hampton	Top statistical group in NJ (2013-2015)	TQ	2013 KBG Low Maintenance (A)	Grimshaw et al., 2015
	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011
Juliet	Top statistical group in NJ (2013-2015)	TQ	2013 KBG Low Maintenance (A)	Grimshaw et al., 2015
	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011
Midnight II	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
Fullback	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012

Table 3.1 (continued) Potential varieties of Kentucky bluegrass (*Poa pratensis*; KBG) based on turf quality (TQ), summer stress (SS), drought tolerance (DT), and wear quality (WQ). A = Adelphia, NJ; NB = New Brunswick, NJ; NTEP = National Turfgrass Evaluation Program.

Variety	Rationale	Trait	Trial[1]	Reference
Rhapsody	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
4 Season	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
Nu Glade	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
Washington	Top statistical group in NJ (2010-2012)	TQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2011)	DT	2009 KBG Low Maintenance (NB)	Koch et al., 2012
	Top statistical group in NJ (2012)	WQ	2009 KBG Low Maintenance (NB)	Koch et al., 2012
Syrah	One below top statistical group in NJ (2018-2020)	TQ	2017 KBG	Wright et al., 2020
	Top variety over 6 states in NCR (2020)	TQ	2020 KBG NTEP	NTEP, 2020b
Impact	Top statistical group in NJ (2013-2015)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2015
	Top statistical group in NJ (2013-2014)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2014
Solar Eclipse	Top statistical group in NJ (2013-2015)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2015
	Top statistical group in NJ (2013-2014)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2014
Granite	Top statistical group in NJ (2013-2015)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2015
	Top statistical group in NJ (2013-2014)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2014
Beyond	Top statistical group in NJ (2013-2015)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2015
	Top statistical group in NJ (2013-2014)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2014
Liberator	Top statistical group in NJ (2013-2015)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2015
	Top statistical group in NJ (2013-2014)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2014
Diva	Top statistical group in NJ (2013-2014)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2014
	Top statistical group in NJ (2010-2011)	TQ	2009 KBG Shaded (A)	Cross et al., 2011
Eagleton	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011

Table 3.1 (continued) Potential varieties of Kentucky bluegrass (*Poa pratensis*; KBG) based on turf quality (TQ), summer stress (SS), drought tolerance (DT), and wear quality (WQ). A = Adelphia, NJ; NB = New Brunswick, NJ; NTEP = National Turfgrass Evaluation Program.

Variety	Rationale	Trait	Trial[1]	Reference
Yankee	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011
Bedazzled	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011
Ginney II	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011
Alexa II	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011
Solar Eclipse	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011
Zinfandel	Top statistical group in NJ (2009-2011)	TQ	2008 KBG Low Maintenance (NB)	Cross et al., 2011
	Top statistical group in NJ (2011)	DT	2008 KBG Low Maintenance (NB)	Cross et al., 2011
Bombay	Top variety in MN (2018-2021)	TQ	2021 KBG NTEP	Hollman & Watkins, 2022a
	Top variety over 5 states (2020)	TQ	2020 KBG NTEP (Schedule B)	NTEP, 2020a
Bluebank	Top statistical group in NJ (2013-2015)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2015
Pivot	Top statistical group in NJ (2013-2015)	TQ	2013 KBG Low Maintenance (A)	Grimshaw et al., 2015
Kenneland	Top statistical group in NJ (2013-2015)	TQ	2013 KBG Low Maintenance (A)	Grimshaw et al., 2015
Malbec	Top statistical group in NJ (2013-2015)	TQ	2013 KBG Low Maintenance (A)	Grimshaw et al., 2015
SR 2150	One below top statistical group in NJ (2018-2020)	TQ	2017 KBG	Wright et al., 2020
Fahrenheit 90	Top statistical group in NJ (2013-2014)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2014
Legend	Top statistical group in NJ (2013-2014)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2014
Midnight	Top statistical group in NJ (2013-2014)	TQ	2012 KBG Low Maintenance (NB)	Grimshaw et al., 2014
Washington II	Top statistical group in NJ (2013-2015)	TQ	2013 KBG Low Maintenance (A)	Grimshaw et al., 2015
Mozart 1	Top statistical group in NJ (2010-2011)	TQ	2009 KBG Shaded (A)	Cross et al., 2011

Table 3.2 Potential varieties of for hard fescue (*Festuca brevipila*; HDF) based on turf quality (TQ), drought tolerance (DT), heat stress (HS), green cover (GC), and fewer weeds (FW). NTEP = National Turfgrass Evaluation Program; A = Adelphia, NJ.

Variety	Rationale	Trait	Trial[1]	Reference
Gladiator	Top statistical group in NJ (2015-2019)	TQ	2014 Fine Fescue NTEP (A)	Wu et al., 2019
	Top statistical group in MN (2019)	TQ	2014 Fine Fescue NTEP	NTEP, 2019
	Top statistical group in MN (2015-2019)	TQ	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
	Top statistical group in MI (2016)	DT	2014 Fine Fescue NTEP	NTEP, 2016b
	Evidence of lower stress response compared to Soil Guard and Nanook	HS	Heat stress experiment	Breuillin-Sessoms & Watkins, 2020
Resolute	Top statistical group in NJ (2015-2019)	TQ	2014 Fine Fescue NTEP (A)	Wu et al., 2019
	Top statistical group in MN (2019)	TQ	2014 Fine Fescue NTEP	NTEP, 2019
	Top statistical group in MN (2015-2019)	TQ	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
	Top statistical group in MI (2016)	DT	2014 Fine Fescue NTEP	NTEP, 2016b
Jetty	Top statistical group in MN (2019)	TQ	2014 Fine Fescue NTEP	NTEP, 2019
	Top statistical group in MN (2015-2019)	TQ	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
	Top statistical group in MI (2016)	DT	2014 Fine Fescue NTEP	NTEP, 2016b
Minimus	Top statistical group in NJ (2018-2020)	TQ	2017 Fine Fescue (A)	Wu et al., 2020
	Top statistical group in western MD (2017-2019)	GC/FW	Salt Tolerant Roadside Trial	Engelhardt & Ratliff, 2019
Clarinet	Top statistical group in NJ (2015-2019)	TQ	2014 Fine Fescue NTEP (A)	Wu et al., 2019
Beacon	Top statistical group in MI (2016)	DT	2014 Fine Fescue NTEP	NTEP, 2016b
Sword	Top statistical group in MI (2016)	DT	2014 Fine Fescue NTEP	NTEP, 2016b
Spartan	Top statistical group in western MD (2017-2019)	GC	Salt Tolerant Roadside Trial	Engelhardt & Ratliff, 2019

Table 3.3 Potential varieties of Chewings fescue (*Festuca rubra* ssp. *commutata*; CHF) based on turf quality. A = Adelphia, NJ; NTEP = National Turfgrass Evaluation Program; CTBT = Cooperative Turfgrass Breeders Test.

Variety	Rationale	Trial[1]	Reference
Woodall	Turf quality increased each year in NJ (2017-2020)	2016 Fine Fescue (A)	Wu et al., 2020
	Turf quality increased each year in NJ (2018-2020)	2017 Fine Fescue (A)	Wu et al., 2020
Brittany II	Top CHF of 15 CHF entries in MN (2021)	2020 Fine Fescue NTEP	Hollman & Watkins, 2022b
	Ranked 2 of 51 fine fescue entries in MN (2021)	2020 Fine Fescue NTEP	Hollman & Watkins, 2022b
Compass II	One of top 4 CHF of 12 CHF entries in MN (2015-2019)	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
Bolster	One of top 4 CHF of 12 CHF entries in MN (2015-2019)	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
Momentum	One of top 4 CHF of 12 CHF entries in MN (2015-2019)	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
Radar	One of top 4 CHF of 12 CHF entries in MN (2015-2019)	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
Intrigue II	Top CHF of 25 CHF entries at MN (2012-2014)	2011 Fine Fescue CTBT	Hollman & Watkins, 2014a

Table 3.4 Potential varieties of strong creeping red fescue (*Festuca rubra*; STCRF) based on turf quality (TQ), drought tolerance (DT) and less winter decline (WD). NTEP = National Turfgrass Evaluation Program. NTEP = National Turfgrass Evaluation Program.

Variety	Rationale	Trait	Trial[1]	Reference
Cardinal II	Significantly higher than Boreal in MN (2015-2019)	TQ	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
	Significantly higher than Boreal in MN (2021)	TQ	2020 Fine Fescue NTEP	Hollman & Watkins, 2022b
	Top statistical group for STCRF in MI (2016)	DT	2014 Fine Fescue NTEP	NTEP, 2016a
Navigator II	Top statistical group for STCRF in MI (2014)	DT	2014 Fine Fescue NTEP	NTEP, 2016a
	Significantly better at one site in MN (winter 2017-18)	WD	Regional Roadside Turfgrass Testing	Watkins et al., 2019
Chantilly	Ranked 2 of 30 species/mixes in trial in MN (2016-2019)	TQ	2015 Low Input NTEP	Hollman & Watkins, 2015
Kent	Significantly better at one site in MN (winter 2017-18)	WD	Regional Roadside Turfgrass Testing	Watkins et al., 2019
Ruddy	Significantly better at one site in MN (winter 2017-18)	WD	Regional Roadside Turfgrass Testing	Watkins et al., 2019
Xeric	Significantly better at one site in MN (winter 2017-18)	WD	Regional Roadside Turfgrass Testing	Watkins et al., 2019

Table 3.5 Potential varieties of slender creeping red fescue (*Festuca rubra*; SLCRF) based on turf quality (TQ) and drought tolerance (DT). NTEP = National Turfgrass Evaluation Program.

Variety	Rationale	Trait	Trial[1]	Reference
Seamist	Top SLCRF of 4 SLCRF entries in MN (2015-2019)	TQ	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
	Significantly higher than Seabreeze GT in MN (2015-2019)	TQ	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
	Good performance in roadside research trials in MN	TQ	Regional Optimization	Christensen, 2021
Beaudin	Significantly higher than Seabreeze GT in MN (2015-2019)	TQ	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
	Top statistical group for SLCRF in MI (2016)	DT	2014 Fine Fescue NTEP	NTEP, 2016c
Sealink	Top SLCRF of 5 SLCRF entries in MN (2011-2012)	TQ	2010 Fine Fescue Trial	Hollman & Watkins, 2013
	Ranked 2 of all 51 fine fescue entries in MN (2011-2012)	TQ	2010 Fine Fescue Trial	Hollman & Watkins, 2013
Barpearl	Significantly higher than Seabreeze GT (2015-2019)	TQ	2014 Fine Fescue NTEP	Hollman & Watkins, 2014b
Seabreeze GT	Top statistical group for SLCRF in MI (2016)	DT	2014 Fine Fescue NTEP	NTEP, 2016c

Table 3.6 Potential varieties of Sheep fescue complex (*Festuca* spp.; SHF) based on turf quality. NTEP = National Turfgrass Evaluation Program; CTBT = Cooperative Turfgrass Breeders Test; A = Adelphia, NJ.

Variety	Rationale	Trial[1]	Reference
Marco Polo	Top SHF of 4 SHF entries in MN (2021)	2020 Fine Fescue NTEP	Hollman & Watkins, 2022b
Bighorn GT	Turf quality increased each year in NJ (2018-2020)	2017 Fine Fescue CTBT (A)	Wu et al., 2020

CHAPTER 4: SURVEY STAKEHOLDERS ABOUT THE VARIETY APPROVAL PROCESS

To gain input prior to the development of a new process to approve turfgrass varieties for inclusion for official seed mixtures, we developed a survey for stakeholders.

4.1 SEED VENDOR SURVEY

We developed an online survey that asked a series of questions aimed to determine how seed vendors viewed various process scenarios (Appendix A) including different choices such as frequency of having the option to add varieties, the source of data (university or private) needed to submit a variety for approval, the type of data (roadside, non-roadside field, greenhouse, etc.) and data transparency. A total of 6 seed vendors responded to the survey.

4.2 SURVEY RESULTS

In our survey of seed vendors who work with MnDOT, a few themes emerged.

1. The process should be electronic (email communication and website submission) and occur in the fall.
2. MnDOT should clearly communicate how decisions about turfgrass variety inclusion on recommended seed lists are made.
3. Data from both public and private testing should be acceptable for use in reviewing variety decisions.

These results, as well as input from the Technical Assistance Panel, were used to develop the variety approval process described in the next chapter.

CHAPTER 5: FINAL RECOMMENDATIONS FOR A VARIETY APPROVAL PROCESS

We are proposing a new process by which MnDOT approves turfgrass varieties for inclusion in official seed mixtures.

Our proposal builds on the existing process as shown in MnDOT's current *New Turfgrass Variety Preliminary Information Form,* found at:
www.dot.state.mn.us/environment/erosion/pdf/vegetation/turfgrass-form.pdf. Our intention is to create a more nimble, consistent, and clear process so that existing and new seed vendors can have complete confidence in data-driven decision making by MnDOT.

5.1 FORMAT AND TIMING

We recommend that MnDOT use an online form (such as a Google Form) that accepts requests on a rolling basis. MnDOT should send seed vendors an email each month that lists new proposed varieties, including the type of research and methodology to support the cultivar. The process of approving new varieties should begin in September each year, with final determinations made by November 15. This will allow seed vendors to sufficiently plan for the following season.

5.2 INFORMATION REQUESTED

The form should request the following information:

1. Name and company of requestor
2. Name of variety being proposed
3. Number of MnDOT seed mixture(s)
4. Justification for addition to list. This section should include a request for details related to the request, including but not limited to:
    a. Supporting data that shows the variety can be expected to perform adequately on a Minnesota roadside environment. Data and methods should be attached as a pdf. All research should be statistically analyzed. More information on date below under "*Preferred Data*"
    b. Supporting data can come from any of the following, with priority given in order listed below
        i. Replicated roadside turfgrass trial conducted by a public entity in Minnesota
        ii. Replicated roadside turfgrass trial conducted by a private entity in Minnesota
        iii. Replicated roadside turfgrass trial conducted by a public entity in a bordering state
        iv. Replicated roadside turfgrass trial conducted by a private entity in a bordering state

     v.   Controlled environment trial that evaluates abiotic stress(es) common on roadsides, either alone or in combination

1. Salt stress tolerance
2. Drought tolerance (acute or chronic)
3. Heat stress tolerance
4. Wear stress/disturbance tolerance
5. Ability to grow in compacted soils
6. Ice encasement tolerance
7. Low soil fertility tolerance

5.3 PREFERRED DATA

MnDOT should accept results from both public and private sources; however, we recommend that in both cases, submissions include details (or a link to details) about methodology. We also recommend that MnDOT prioritize roadside field evaluations over controlled environment or non-roadside trials. When available, data from Minnesota should be prioritized. In addition, use of quantitative data (species counts, digital image analysis, etc.) rather than subjective qualitative data (visual scale) should be prioritized. We do understand, however, that ratings using a visual scale of 1-9 are very common in turfgrass evaluation.

5.4 REVIEW COMMITTEE

A review committee should be formed to make recommendations to MnDOT through an annual process. The committee should be made up of an odd number of voting members representing important stakeholders. For positions with terms (see below), we suggest starting with shorter terms for some positions to create staggered terms.

We suggest membership as follows:

1. Two MnDOT employees
2. One seeding contractor (3-year term)
3. One public turfgrass researcher, from the University of Minnesota when possible (3-year term).
4. One representative from the Minnesota turfgrass industry with knowledge of turfgrasses but no direct connection with turfgrass seed sales. This representative could come from golf or sports turf management, chemical sales, consulting, etc. (3-year term).
5. One seed vendor (non-voting) from a company currently selling approved MnDOT seed mixtures (1-year term)

5.5 DECISION MEETING

The review committee should vote on all new proposals at a meeting to be held in person or online in mid- to late-October. All proposals should be sent to committee members at least three weeks prior to the meeting. During this time, all proposals should be made available for all-vendor input, which could

be accomplished by sending an email with relevant information to all vendors or by posting information online. This all-vendor review period should be a period of one week (five business days). For the final decision on approvals, we suggest a vote by the full committee for each proposal, with a majority decision required.

5.6 ADDITIONAL RECOMMENDATIONS

Annual confirmation of cultivar availability: To help ensure that seed lists accurately reflect market availability, MnDOT should annually, in the spring, query seed companies about current cultivar status (seed available, discontinued, out of production, etc.). Cultivars that are no longer available from Minnesota seed vendors and out of production should be automatically removed from approved lists.

Reviewing previously approved cultivars: Once a cultivar is approved, it should be reviewed periodically to make sure that it is still performing adequately in seed mixtures. Grasses used in roadside turfgrass seed mixtures are either open-pollinated or apomictic. Open-pollinated cultivars are not able to maintain consistent performance through many generations of seed production. Kentucky bluegrass, an apomictic species, can maintain very stable performance over time because seeds are mostly genetic clones of the plant from which they are harvested. For open-pollinated species (tall fescue, fine fescues, perennial ryegrass, alkaligrass), this review should occur every 7 years. For Kentucky bluegrass, this review should occur every 15 years. The review should take place during the regular annual cultivar approval process. MnDOT will need to contact seed vendors about cultivars coming due for re-approval in spring or early summer of the expiration year. Using this process will also eliminate the need to have a formal process to remove cultivars from the list.

Allowance for preceding years mixtures: MnDOT should consider allowing the use of mixtures consisting of cultivars from previous year's approved cultivars if the cultivar(s) in questions were removed from the list within five years.

Non-static approved cultivar list: MnDOT should explore moving away from static seed lists that only get updated when a new specification manual is published. Turfgrass breeders are continually developing new, innovative turfgrass cultivars that can improve roadside landscapes. A nimble approval process, as outlined above, should be paired with a non-static list of approved cultivars, maintained by MnDOT. A link to this page should be published in the specification book. Data-driven decisions on species components (which species are present and at which ratios) could be made at the time of specification manual publication, with input from the same committee as outlined above. The manual would then point readers to the MnDOT list of approved turfgrass cultivars instead of listing specific cultivar choices.

Communication: MnDOT should communicate a summary of changes annually to stakeholders (sod quality assurance sod growers, seed vendors, seeding contractors, etc.). This will help educate industry partners on the process and create transparency.

5.7 NEXT STEPS

If our proposed process is implemented, the target audience will need to be informed about the changes to the turfgrass variety approved list. We suggest this be communicated by electronic correspondence, posting on the MnDOT website, presentations at the annual seed vendors meeting and at other conferences, and through trade organizations such as the Minnesota Seeding Contractors Association.

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APPENDIX A GRASS VENDOR SURVEY QUESTIONS

Q1 MnDOT seed process survey

We are working with the Minnesota Department of Transportation to develop a fair, nimble process to put new turfgrass varieties on recommended lists or to remove older varieties.

Q2 How familiar are you with the current process MnDOT uses to add and remove turfgrass varieties?

○ Completely unfamiliar

○ Unfamiliar

○ Somewhat unfamiliar

○ Neutral

○ Somewhat familiar

○ Familiar

○ Completely familiar

Q3 How satisfied are you with the current process MnDOT uses?

○ Completely unsatisfied

○ Unsatisfied

○ Somewhat unsatisfied

○ Neutral

○ Somewhat satisfied

○ Satisfied

○ Completely satisfied

Q4 Describe a feature of the current MnDOT seed selection process **that works well.**

Q5 Describe a feature of the current MnDOT seed selection process **that doesn't work well.**

Q6 In the next few questions, you will be presented with a scenario for a new seed approval process. For each scenario, you will enter how satisfied you would be with that process, if it were implemented by MnDOT.

"How satisfied would you be with a process that had the following attributes?"

For each scenario, there are 4 features:

Frequency: This describes how often a process for requesting a turfgrass variety addition to MnDOT recommended seed mixtures should take place: (1) one time each year; (2) once every-other-year; or (3) on a rolling basis (you can submit requests throughout the year).

Data Source: This feature describes the type of data/evidence you would need to provide for approval of your turfgrass varieties: (1) data from a public university; or (2) data generated from a private company.

Data Type: This feature describes that type of research that would be considered worthwhile for use in making a turfgrass variety recommendation: (1) a roadside field evaluation; (2) a field evaluation that is not on a roadside; or (3) research that is not done in the field (greenhouse, growth chamber, lab).

Data Transparency: This describes who would see the data you and your competitors submit to MnDOT: (1) Your data is publicly available; (2) Your data is available to anyone who is registered to submit

varieties for approval by MnDOT; or (3) Your data is completely private so only MnDOT would know you are asking for approval (you would not know what your competitors are submitting).

Q7 How satisfied would you be with a process that had the following attributes? Please select your level of satisfaction.

Features	Details
Frequency	Once-every-other-year
Data source	Public university
Data type	A field evaluation that is not on a roadside
Data transparency	Your data is completely private so only MnDOT would know you are asking for approval (you would not know what your competitors are submitting)

○ Very unsatisfied

○ Somewhat unsatisfied

○ Slightly unsatisfied

○ Neither satisfied nor dissatisfied

○ Slightly satisfied

○ Somewhat satisfied

○ Very satisfied

Q8 How satisfied would you be with a process that had the following attributes? Please select your level of satisfaction.

Features	Details
Frequency	On a rolling basis (you can submit requests throughout the year)
Data source	Public university
Data type	A roadside field evaluation
Data transparency	Your data is completely private so only MnDOT would know you are asking for approval (you would not know what your competitors are submitting)

○ Very unsatisfied

○ Somewhat unsatisfied

○ Slightly unsatisfied

○ Neither satisfied nor dissatisfied

○ Slightly satisfied

○ Somewhat satisfied

○ Very satisfied

Q9 How satisfied would you be with a process that had the following attributes? Please select your level of satisfaction.

Features	Details
Frequency	On a rolling basis (you can submit requests throughout the year)
Data source	Public university
Data type	Research that is not done in the field (greenhouse, growth chamber, lab)
Data transparency	Your data is publicly available

○ Very unsatisfied

○ Somewhat unsatisfied

○ Slightly unsatisfied

○ Neither satisfied nor dissatisfied

○ Slightly satisfied

○ Somewhat satisfied

○ Very satisfied

Q10 How satisfied would you be with a process that had the following attributes? Please select your level of satisfaction.

Features	Details
Frequency	On a rolling basis (you can submit requests throughout the year)
Data source	Private company
Data type	A field evaluation that is not on a roadside
Data transparency	Your data is available to anyone who is registered to submit varieties for approval by MnDOT

○ Very unsatisfied

○ Somewhat unsatisfied

○ Slightly unsatisfied

○ Neither satisfied nor dissatisfied

○ Slightly satisfied

○ Somewhat satisfied

○ Very satisfied

Q11 How satisfied would you be with a process that had the following attributes? Please select your level of satisfaction.

Features	Details
Frequency	Once-every-other-year
Data source	Public university
Data type	Research that is not done in the field (greenhouse, growth chamber, lab)
Data transparency	Your data is available to anyone who is registered to submit varieties for approval by MnDOT

○ Very unsatisfied

○ Somewhat unsatisfied

○ Slightly unsatisfied

○ Neither satisfied nor dissatisfied

○ Slightly satisfied

○ Somewhat satisfied

○ Very satisfied

Q12 How satisfied would you be with a process that had the following attributes? Please select your level of satisfaction.

Features	Details
Frequency	One time each year
Data source	Public university
Data type	A field evaluation that is not on a roadside
Data transparency	Your data is publicly available

○ Very unsatisfied

○ Somewhat unsatisfied

○ Slightly unsatisfied

○ Neither satisfied nor dissatisfied

○ Slightly satisfied

○ Somewhat satisfied

○ Very satisfied

Q13 How satisfied would you be with a process that had the following attributes? Please select your level of satisfaction.

Features	Details
Frequency	Once-every-other-year
Data source	Private company
Data type	A roadside field evaluation
Data transparency	Your data is publicly available

○ Very unsatisfied

○ Somewhat unsatisfied

○ Slightly unsatisfied

○ Neither satisfied nor dissatisfied

○ Slightly satisfied

○ Somewhat satisfied

○ Very satisfied

Q14 How satisfied would you be with a process that had the following attributes? Please select your level of satisfaction.

Features	Details
Frequency	One time each year
Data source	Private company
Data type	Research that is not done in the field (greenhouse, growth chamber, lab)
Data transparency	Your data is completely private so only MnDOT would know you are asking for approval (you would not know what your competitors are submitting)

○ Very unsatisfied

○ Somewhat unsatisfied

○ Slightly unsatisfied

○ Neither satisfied nor dissatisfied

○ Slightly satisfied

○ Somewhat satisfied

○ Very satisfied

Q15 How satisfied would you be with a process that had the following attributes? Please select your level of satisfaction.

Features	Details
Frequency	One time each year
Data source	Public university
Data type	A roadside field evaluation
Data transparency	Your data is available to anyone who is registered to submit varieties for approval by MnDOT

○ Very unsatisfied

○ Somewhat unsatisfied

○ Slightly unsatisfied

○ Neither satisfied nor dissatisfied

○ Slightly satisfied

○ Somewhat satisfied

○ Very satisfied

Q16 In what month would you like the process for new varieties proposals to be considered for inclusion on MnDOT seed mixture recommendations?

Q16a Please explain why you prefer this month or why you have no preference?

Q17 What mode of submission would you prefer for this process?

○ Website submission

○ Email submission

○ Paper submission

Q18 What mode of communication would you prefer for this process?

○ Email communication

○ Paper communication

Q19 Is there any other features, concerns, or feedback that you would like to provide related to a new process?

Q20 How many employees does your company have?

Q21 Which of the following categories best represents the annual sales of grass during the past three years?

○ < $0.25M

○ $0.25M - $0.99

○ $1M - $4.99M

○ $5M - $9.99M

○ $10M - $19.99M

○ $20M - $29.9M

○ $30M - $39.99M

○ $40M - $49.99M

○ $50M - $99.99M

○ > $100M

Q22 How long have you been a grass vendor as the owner, manager, or primary decision maker?

○ Less than or equal to 5 years

○ 6 to 10 years

○ 11 to 15 years

○ 16 to 20 years

○ 21 to 25 years

○ 26 to 30 years

○ More than 30 years

Q23 How old are you?

○ 18 to 25 years old

○ 26 to 35 years old

○ 36 to 45 years old

○ 46 to 55 years old

○ 56 to 65 years old

○ Older than 65 years old

Q24 What is the highest level of formal education that you have completed

○ High school diploma or equivalent

○ Some college, but no degree

○ College degree

○ Graduate degree

Q25 Thank you for your time and responses related to this important process. If you have any other questions or concerns please feel free to reach out at any time to (Name and Email)