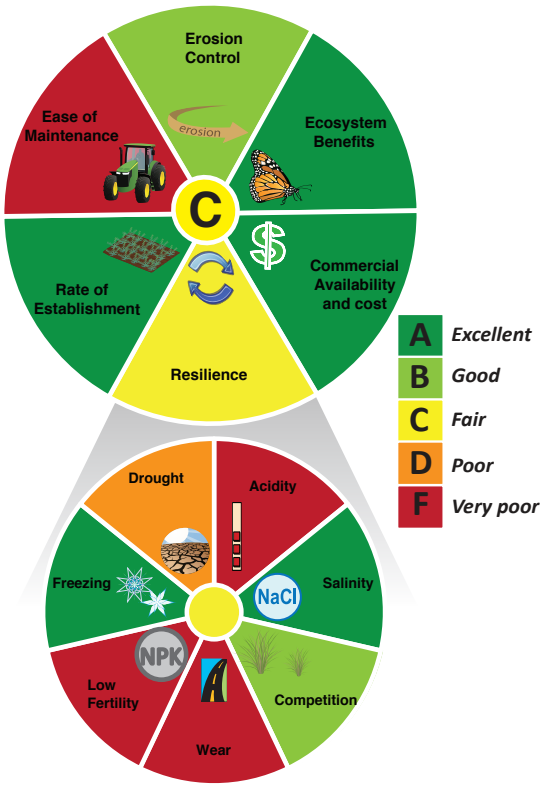
Alkaligrass

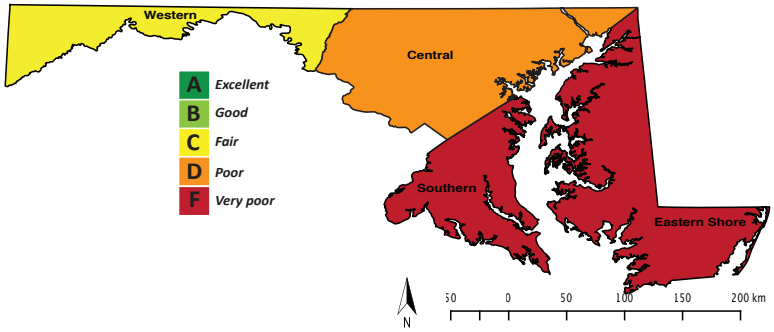
Puccinellia distans and Puccinellia nuttallii

Alkaligrass is a low-stature grass that grows well in saline soils where persistence of other species is low. This places alkaligrass in a unique niche among its peers. Commercial availability and cost of seed is reasonable for wide-spread use. The species has excellent establishment rates and ecosystem benefits through biodiversity enhancement. Two related management concerns, however, limit its use along roadsides, resulting in a Fair rating (grade=C):

Alkaligrass has poor resilience under most roadside conditions with low drought tolerance, high fertility requirements, low tolerance of acid soils, and low wear tolerance.

Although alkaligrass is short in stature and would not need to be mowed frequently, healthy sward is hard to maintain owing to high requirements for irrigation, fertilizer, and liming.





Alkaligrass may be suitable as a roadside grass in some areas of Western Maryland but is not recommended for many parts of Maryland.

Alkaligrass cultivars include Fults, Salty, and Salton Sea.

Biology: Alkaligrasses are low-growing, perennial bunchgrasses that grow in saline and alkaline areas of North America (Butler et al. 1971, Marcum 2008a). The species are adapted to cool climates and are therefore present in higher abundance in the northern United States and Canada. Nuttall's alkaligrass is native to cool semi-arid regions of the western United States; weeping alkaligrass is generally reported as native to Eurasia but seed companies will classify the species as native to the western and northeastern United States. Alkaligrasses are considered invasive weeds in northeastern Oregon where alkaligrass threatens to infest turfgrass farms (Tarasoff et al. 2009, 2010). Nuttall's alkaligrass is a tall erect plant with an open architecture whereas weeping alkaligrass has a short stature with dense plant architecture (Tarasoff et al. 2009). Alkaligrasses were first considered as turfgrass when they were observed to grow along roadsides (e.g., Chicago, Illinois – Hughes et al. 1975; Czech Republic – Sera 2010) where the use of deicing salts in the winter were negatively affecting the growth and survival of other turfgrasses (Marcum 2008a). They are now known as some of the most salt tolerant C_3 grasses in North America. Nuttall's alkaligrass prefers sodic soils whereas weeping alkaligrass does not require saline conditions for survival and actually prefers non-saline soils ('facultative halophyte'; Tarasoff et al. 2009). Alkaligrass is dependent on mycorrhizal associations (Dashtebani et al. 2014).

Seeds per pound: 1,200,000 seeds per pound (Ernst Conservation Seed)
Cost per pound: $4.23 per pound (Ernst Conservation Seed)
Cost per acre: $84.60 per acre
Suggested sowing rate: 20 pounds per acre (Chesapeake Valley Seed)
Sowing depth: ½ inch (Pawnee Buttes Seed)
Germination time: fast (a few days)
Seeding timing: spring or fall (Pickseed)
Length of growing season: not reported
Leaf length: weeping alkaligrass: 16 -20 inches; Nuttall's alkaligrass 31-39 inches (Tarasoff et al. 2009)
Height at seed head stage: 24 inches
Shade tolerance: can withstand partial shade
Suggested mowing height: Brede (2000) suggests that alkaligrass can tolerate mowing to 1.5 inches, with 3 inches as ideal. Other studies (see wear tolerance) suggest that alkaligrass is intolerant of mowing.
Tolerance of wet conditions: Alkaligrass is adapted to wetland soils but does not need these conditions to persist.
Humidity tolerance: Alkaligrass is adapted to semi-arid climates; a humid climate may therefore be suboptimal.
Disease resistance: Unknown

Services:

Commercial availability and cost: Alkaligrasses can be heavy seed producers. Weeping alkaligrass is commercially available from a variety of producers. The cost per pound of alkaligrass is $4.23, which makes it slightly more expensive than sheep fescue. A low sowing rate per acre for alkaligrass makes it very affordable for use over large areas.

Rate of establishment: Alkaligrass can establish rapidly and exhibit fast growth rates (Butler et al. 1971, Tarasoff et al. 2009) when environmental conditions are suitable. However, in many cases alkaligrass does not persist well. Nuttall's alkaligrass and weeping alkaligrass established well in a two-year experiment in Oregon but survival was 60% and 40%, respectively from year 1 to year 2. In contrast, Kentucky bluegrass had 98% survival (Tarasoff et al. 2009). In a Canadian study of 25 species and cultivars (McKernan et al. 2001), alkaligrass established relatively slowly at three locations compared to most other entries and consequently had poor weed density ratings. Nuttall's alkaligrass established poor (60%) cover in the first year and over a 3-year period decreased cover to 20% (Mintenko et al. 2002) in a northern Great Plains study.

Ease of maintenance: Alkaligrass is a short statured species that produced 20-33 cm height growth in lab and field trials (Brown et al. 2010). However, studies consistently show poor performance in the field across a range of environments (McKernan et al. 2001, Brown et al. 2011, Watkins et al. 2011) suggesting that the species needs continued maintenance of environmental conditions (liming, fertilizing, irrigation) to persist.

Erosion control: In three trials comparing 7-19 species, Brown et al (2010) observed 89-91% of alkaligrass root mass to occur within the top 7.5 cm of the soil. Mean rooting depth for alkaligrass in lab and field trials along roadsides was 30.4-58.9 cm, which was relatively shallow and comparable to hard and red fescue. Root mass production was medium.

Ecosystem benefits: Alkaligrass performs well in saline soils where many other species cannot grow well or survive. Weeping alkaligrass is an introduced species from Eurasia. Nuttall's alkaligrass is native to the United States and Canada, where it occurs in the west as well as in the north. In the eastern United States, Nuttall's alkaligrass is present as far south as New York but does not occur naturally in Maryland or surrounding states. When environmental conditions are suitable, alkaligrass persists well within a mix of species.

<u>Resilience</u>:

Drought: Performance was rated poor under conditions of limited water and fertility (Watkins et al. 2011). In a three year study in southern Alberta, alkaligrass had poor to fair drought tolerance (McKernan et al. 2001).

Low fertility: Persistence of alkaligrass was low in a low fertility environment in southern Alberta (McKernan et al. 2001). The species established poorly along roadsides without soil amendments (Brown and Gorres 2011) but persisted well with soil amendments. In a low-maintenance study across 8 states, alkaligrass performed poorly and was therefore not recommended to be used as a turfgrass (Watkins et al. 2011).

Freezing*:* Adapted to northern climates, weeping alkaligrass and Nuttall's alkaligrass have excellent freezing tolerance.

Salinity: Studies comparing different turfgrass species consistently show that alkaligrasses have excellent salinity tolerance (Lunt et al. 1961, 1964, Butler et al. 1971, Hughes et al. 1975, Torello and Symington 1984, Greub et al. 1985, Marcar 1987, Harivandi et al. 1992, Biesboer et al. 1998, Marcum 2008a, b, Brown et al. 2011, Zhang et al. 2011, Uddin and Juraimi 2013) that is higher than seashore paspalum but not as high as saltgrass (Distichlis spicata; Alshammary et al. 2004, Marcum 2008a). Alkaligrass is

therefore well adapted to grow along roadsides that receive deicing salts. Alkaligrass have been found growing along roadsides at 20,000 to 30,000 ppm total soluble salts and 4,000 to 10,000 ppm sodium (Butler et al. 1971). Nuttall's alkaligrass is commonly associated with sodic soils suggesting inherent adaptation to saline environments (Tarasoff et al. 2010). In contrast, weeping alkaligrass does not require saline conditions for survival. It responds positively to normal non-saline soil conditions (Tarasoff et al. 2009) and will increase root growth to increase its tolerance to salinity (Alshammary et al. 2004). Germination can be inhibited by osmotic stress (Harivandi et al. 1982, Harivandi et al. 1992) but not more so than other turfgrass species (Marcum 2008a). Germination in control versus saline conditions were 88% versus 81%, respectively, and was only negatively affected by salt application when fertilized with gypsum at high concentrations (Neid and Biesboer et al. 2004). A half concentration sea water solution reduced growth of alkaligrass by 25% and turned leaf color noticeably darker (Lunt et al. 1961). Biomass yield of weeping alkaligrass was reduced by 23% at 20,000 ppm, whereas yield of all other grass species was reduced by at least 40% (Hughes et al. 1975); salt treatment of 30,000 ppm resulted in mortality in all species. In the same study, weeping alkaligrass was 'unusually' tolerant of foliar application of salt. From this and the previous results, Hughes et al. (1975) concluded that weeping alkaligrass is of value for vegetating saline roadsides. Winter survival was good at roadside locations in Minnesota in a comparison of 74 cold-season turfgrass species and cultivars (Friell et al. 2012) but establishment and persistence was found to be unacceptable in a roadside trial in New England (Brown and Gorres 2011). Friell et al. (2013) observed that percent green tissue in alkaligrass cultivars was lower than tall fescue and slender creeping red fescue and equal to most other turfgrass species when exposed to salinity. Similarly, 'Fults' alkaligrass exhibited lower (Torello and Symington 1984) but also higher (Harviandi et al. 1982, Friell et al. 2012) salinity tolerance than 'Dawson' red fescue in salinity experiments. The generally high, but inconsistent, salinity tolerance of alkaligrass suggests that it could be used in mixtures to improve turf quality in areas that receive high concentrations of deicing salts. However, Yuan et al. (2014) observed no improvement in turf quality when alkaligrass was mixed with Kentucky bluegrass and red fescue and subjected to 320 lb/acre of deicing salts in North Dakota. In Minnesota, alkaligrass cultivars 'Fults', 'Salty', 'Oceania', 'Salton Sea' performed well at one road site but not another (Friell et al. 2012). Inoculations of arbuscular mycorrhizal fungi increased tolerance of weeping alkaligrass to salinity by enhancing photosynthesis and ion homeostasis, improving water relations and protecting against oxidative damage in leaves (Dashtebani et al. 2014).


Acidity: Alkaligrass is not adapted to acidic soils. Nuttall's alkaligrass was observed in soils of pH 8.47 and high levels of calcium.


Wear tolerance: In a Minnesota fairway study of 17 species subjected to traffic simulations, Watkins et al. (2010) showed that weeping alkaligrass did not perform well under any mowing regimes with ending stand densities less than 5%. Survival of weeping alkaligrass was 40% and Nuttall's alkaligrass 60% after a July harvest, whereas Kentucky bluegrass had almost 100% survival following the harvest (Tarasoff et al. 2009). Similarly, percent cover of Nuttall's alkaligrass dropped by almost 50% within 15 months when subjected to weekly mowing (Mintenko et al. 2002).


Competition: Tarasoff et al. (2010) suggests that the only factor limiting establishment and abundance of weeping alkaligrass in northeastern Oregon is plant competition. In sodic areas of Kentucky bluegrass fields, alkaligrass is a dominant perennial weedy

species (Tarasoff et al. 2009). Weeping alkaligrass was more competitive than Nuttall's alkaligrass and both were more competitive than Kentucky bluegrass in year 1 of a 2-year study (Tarasoff et al. 2009). The authors speculate that alkaligrass grows rapidly and may inhibit slower growing Kentucky bluegrass through shading and soil water depletion. Even though the two alkaligrasses had poor survival (40% and 60%, respectively) and Kentucky bluegrass yield increased in year 2, weeping alkaligrass was still able to decrease Kentucky bluegrass yield by 20%. Observations along Illinois roadsides suggest that Kentucky bluegrass and tall fescue are succeeded by quackgrass that is subsequently invaded and outcompeted by weeping alkaligrass when salt content is high (Butler et al. 1971). Brede (2000) also notes that alkaligrass is persistent and competitive with other species in salty conditions. However, under low salt and neutral or acidic pH conditions, this species is not competitive in a mixture (Brede 2000).

Mixes: Friell et al. 2012 suggests that alkaligrass can be used in seed mixes to establish turf that is better adapted to low-input conditions. Similarly, Brede (2000) suggests that alkaligrass is a useful species to include in any mixes where salt is or may become an issue. However, under low salt and neutral pH conditions, alkaligrass is an inferior competitor to ryegrasses and bluegrasses (Brede 2000). Persistence within the community requires alkaline conditions.

Cultivars: Alkaligrass cultivar 'Fults' was developed in Colorado and is advertised as a versatile grass that can be used in many different landscapes (Simplot.com). It became commercially available in 1979 for use in salty areas of golf courses, then along roadsides in the Midwest where winter deicing is a common occurrence. Density of 'Fults' is positively correlated with salt concentrations in soils. 'Fults' has been found persisting in areas where tall fescue could not survive even after several seedings (Simplot.com). 'Fults' can withstand low- and no-mow conditions, and will readily re-seed itself when left unmowed (Ampac Seed Company). When combined with slender red fescue and Kentucky bluegrass, 'Fults' has the best performance in a mixture (Ampac Seed Company). 'Salty', is a cultivar adapted for use along coastal regions in New England and the Pacific Northwest (AgronoTec Seed Company, Proseeds Marketing). It is well suited for any turf that may be subject to salt sprays during winter deicing (AgronoTec Seed Company, Proseeds Marketing). 'Salton Sea' alkaligrass can also be used for roadsides that are heavily affected by deicing (Turf Merchants, Inc).