Tall fescue

Festuca arundinacea, Schedonorus arundinaceus, Lolium arundinaceum

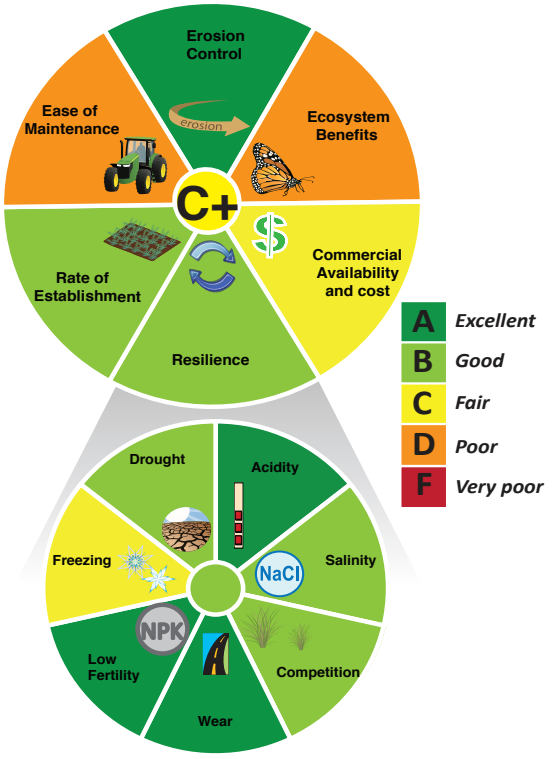
Tall fescue is a popular species to use along roadsides in the mid-Atlantic region because it is widely available commercially; is a soil stabilizer; establishes relatively quickly, and is resilient to many environmental conditions, including management abuse. Tall fescue as a roadside grass is rated as Fair to Good (grade = C+) with several management concerns:

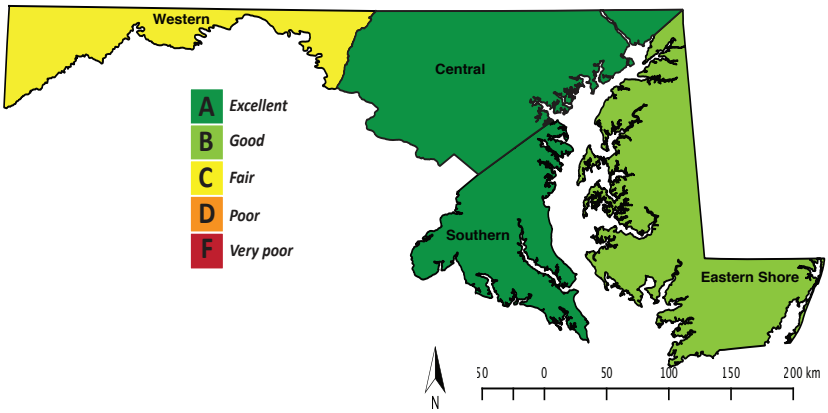
Tall fescue provides poor ecosystem benefits for pollinators, mammals, and birds, and has the capacity to become weedy in Maryalnd. Tall fescue is not a diversity enhancer; rather, through its production of allelochemicals in some cultivars, it suppresses other species where it is dominant.

Because of its vigorous growth and tall growth habit, tall fescue has to be mowed frequently, which increases the maintenance costs of roadside habitat that needs to be maintained as low turf.

Tall fescue germinates rapidly but mature root systems establish slowly. Plants are therefore negatively affected by drought, frost heaving, and traffic within the first 6-12 months of growth.

Seed cost per pound for tall fescue is very affordable, however seeding rate per acre is high. Thus, planting over a large area can be moderately expensive.





Tall fescue is well adapted to grow throughout the Southern and Central portions of Maryland, including the Eastern Shore. It is prone to low temperature injury, resulting in thinning and weediness. Tall fescue is therefore not recommended as a roadside species for Western Maryland.

Cultivars that may enhance tall fescue performance in Maryland include '4th Millenium SRP', 'Titanium 2LS', and 'Traverse 2SRP', which all are on the recommended list for Maryland and perform within the top 25% for drought tolerance, quality under low maintenance, and wear tolerance. Cultivar 'Mustang 4' is a slow growing variety and may therefore require less mowing. Updates to recommended cultivars in Maryland are published annually in the University of Maryland Turfgrass Technical Update TT77 (Maryland Turfgrass Council).

Biology: Tall fescue is a long-lived perennial cool season grass species that is native to Europe (Beard 1973) but was introduced to the United States by European settlers over 100 years ago (Meyer and Watkins 2003). Since then, it has proven to be pre-adapted to the Mid-Atlantic region of the Eastern US, thriving along roadsides in Maryland, Pennsylvania, and Virginia. Tall fescue is valued as a resilient grass that grows under a variety of growing conditions (Beard 1973, Meyer and Watkins 2003, Bughrara 2007, Watkins et al 2011, Watkins et al 2014) and is therefore a preferred turfgrass species when stressful environmental conditions are likely. Owing to its symbiotic association with the intercellular endophyte fungus Neotyphodium coenophialum (USDA Plant Guide), tall fescue can grow under marginal conditions including soils that are acidic (Park and Murphy 2016), poorly drained (Beard 1973), and have low fertility (USDA Fact Sheet); harsh management conditions such as heavy grazing or frequent mowing (Bughrara 2007); and drought (Qiang et al. 1997, Wilman et al. 1998, Fu et al. 2007). Tall fescue is now widely used in home lawns, sports fields, parks, pastures, and airfields, and is a popular species for use along roadsides for soil stabilization and erosion control (Beard 1973, Bughrara 2007). Short rhizomes can be produced in some habitats (Meyer and Watkins 2003) but vegetative spread is slow such that seed dispersal is the dominant form of propagation.

Seeds per pound: 227,000 seeds per pound
Cost per pound: $1.60 per pound from Chesapeake Valley Seed
Cost per acre: $320.00 per acre
Suggested sowing rate: 200 pounds per acre (T. Turner *pers. communication*)
Sowing depth: 1/8 inch
Germination time: 7-12 days
Seeding timing: Seeding in summer not recommended as plants will develop heat stress.
Length of growing season: Long
Leaf height: up to 24 inches (3 feet; Meyer and Watkins 2003)
Height at seed head stage: up to 6 feet (Meyer and Watkins 2003)
Shade tolerance: Performs best in the sun but is moderately shade tolerant (Beard 1972).
Suggested mowing height: 2-4 inches (1.5- 3 inches best mowing height; Meyer and Watkins 2003)
Tolerance of wet conditions: Tolerates wet soil conditions and extended periods of submersion. It can therefore be used in drainage ways (Beard 1972).
Humidity tolerance: Tall fescue has a very high water use and evapotranspiration rate (Feldhake et al. 1983, Kim 1983, Beard and Kim 1988, Carrow 1995, Qiang and Fry 1997) such that it requires more water to maintain good turf quality (Biran et al. 1981, Fu et al. 2004, Barnes et al. 2014). It is therefore not an ideal species to use in dry climates but thrives in humid climates such as the mid-Atlantic region.
Disease resistance: Diseases include snow molds, brown patch (*Rhizoctonia solani*), net blotch, red thread, ruse and pythium blight (Bughrara 2007). In non-irrigated areas, tall fescue can take longer to recover from brown patch disease (Dunn et al 2002).

Services:

Commercial availability and cost: Tall fescue is a valuable turf grass species in the United States. Commercial availability and cost of seed ($1.60 per pound) is excellent. Planting tall fescue over a large area can be moderately expensive due to a high sowing rate per acre.

Rate of establishment: Although the species germinates quickly (McKernan et al. 2001), a deep and extensive root system requires a full growing season to establish (Bughrara 2007). Thus, young tall fescue stands are susceptible to drought, freezing, and diseases in the first year of establishment (Bughrara 2007). Once fully mature, however, tall fescue has excellent tolerance to stressful conditions. Timing and rate of seeding are therefore critical considerations that can greatly affect outcomes, as are proper soil preparation, and adequate nitrogen fertilization and irrigation in the first year.

Ease of maintenance: Tall fescue is highly productive and produces higher biomass than many turfgrass species (e.g., Barnes et al. 2014). For that reason, roadsides planted with tall fescue need to be mowed frequently (at least 3 times during the growing season in Maryland), increasing maintenance costs and placing machinery operators into danger. Although cultivars have been developed that grow more slowly and are shorter in stature (see below), these new traits can yield a shallower root structure (but see Kim et al. 1999) with consequences for erosion control and drought resistance.

Erosion control: Tall fescue has an extensive and deep root system (Sprague 1933, Beard 1972) reaching 60-75cm in depth (Kim et al. 1999, Brown et al. 2010). Brown et al. (2010) in a Rhode Island study found that tall fescue had a significantly larger root system than 19 other species. However, in a California study that compared the root system of tall fescue with perennial ryegrass and the hybrid Festulolium showed no difference in root morphology among entries (Barnes et al. 2014). Water was not limiting in the study and so plants did not need to respond to drought conditions through extending roots deeper into the round. Owing to its deep and extensive roots, tall fescue can stabilize soil (Beard 1973) and is therefore considered to be one of the best choices for anchoring roadside slopes (Brown et al. 2010). Carbon sequestration increases in endophyte infected tall fescue because productivity is increased while the rate of decomposition is decreased. Higher soil organic matter increases infiltration, reduces erosion and increases soil fertility.

Ecosystem benefits: Tall fescue is a non-native species that has been planted in the United States for over 100 years. Old cultivars may be considered naturalized although new cultivars may not be depending on their origins. Through seed dispersal and some vegetative expansion, tall fescue has the capacity to become invasive in some states but not Maryland. In California native prairies, for example, tall fescue is considered a noxious weed. An endophyte fungus produces alkaloids in some cultivars, which deters insect and nematode herbivory and increases disease resistance of the species (Bughara 2007). Tall fescue exhibited the lowest soil nitrate concentrations and the lowest nitrate leaching potential compared to perennial ryegrass and Kentucky bluegrass (Liu et al. 1997). Cultivars differed significantly in their effects on nitrate loss. Effects were not consistent through time but were the lowest for tall fescue cultivars ‘Rebel II’ and ‘SYN GA’.

Resilience:

Drought: Cool season grasses are generally not as tolerant of high temperature and drought stresses than warm season grasses (Su et al. 2007). However, owing to its deep and extensive roots, tall fescue can access soil water to withstand drought stress to a greater degree than other major cool season grasses (Beard and Kim 1989, Fry and Butler 1989, Cougnan et al. 1990, Wilman et al. 1998, Meyer and Watkins 2003, Barnes et al. 2014) and even some warm season grasses (Qian et al. 1997). Water shortage did not negatively affect tall fescue rooting and, at some rooting depths and irrigation levels, enhanced rooting depth (Fu et al. 2007). Similarly, Qian et al. (1997) determined that tall fescue roots were deeper during drought than three warm-season turfgrass species. This may explain why tall fescue survived 4 years with severe water shortage whereas meadow fescue, annual ryegrass, perennial ryegrass and Fescue x Lolium hybrids died within 12-24 months of water shortage (Wilman et al. 1998). Tall fescue has a very high evapotranspiration rate (Beard and Kim 1989) and therefore a higher water use rate with higher sustained stomatal opening (Sun et al. 2013), which maintains photosynthesis and root growth under high temperature and drought (Sun et al. 2013) and decreases heat injury compared to other cool season grasses (Wallner et al. 1982). Given this physiology, tall fescue is not actually drought tolerant, but a good drought avoider by avoiding low leaf water potential (Qiang and Fry 1997). Despite these favorable reports on tall fescue drought 'tolerance', some studies report failure of tall fescue to withstand drought. A study in Maryland (Dernoeden et al. 1994) found that tall fescue was invaded by smooth crabgrass (*Digitaria ischaemum*) to a greater extent than two fine fescues species after a drought, suggesting that tall fescue becomes less competitive under drought stress. In 4-year low-maintenance trials in Virginia (Doak et al. 2004), 19 out of 39 tall fescue cultivars maintained >70% after recovering from a severe drought at a Virginia Ridge and Valley site. However, only 4 of the 39 cultivars recovered to 70% cover at a Virginia Piedmont site. The best performing tall fescue cultivar across both sites was 'Regiment'. In another trial in Blacksburg, VA, Doak et al. (2004) observed tall fescue cover to decrease from 83% in the second year after establishment to 8% in the 6th year after a severe drought the previous year. Islam et al. (2013) in a study conducted in Wyoming found that tall fescue performance was highest among 4 species under irrigated conditions but not rain-fed conditions when warm-season grasses were superior. In a Canadian study, McKernan et al. (2001) found that tall fescue did not survive a drought period, where mortality may have also been compounded by overwinter freezing injury. A growth chamber study (Su et al. 2007) found no difference in drought resistance between tall fescue, Kentucky bluegrass and 'Thermal Blue', a hybrid between Kentucky bluegrass and Texas bluegrass (*Poa arachnifera*).

Low fertility: Tall fescue, hard fescue, and sheep fescue showed the best quality under low-input conditions in Maryland (Dernoeden et al. 1998). Similarly, an evaluation of the response of 11 turfgrass species to low-input maintenance (Diesburg et al. 1997) found that tall fescue and sheep fescue had the best persistence across locations. Wakefield et al. (1974) evaluated persistence of turfgrass species along roadsides in Rhode Island and found that tall fescue had the best coverage along roadsides one year after seeding, but cover was reduced after 2 years. Similarly, Watkins et al. (2010) compared 17 turfgrass species in a low-input fairway study and found that tall fescue turf produced the 5th best turf quality (after 3 bentgrass species and Kentucky bluegrass) the first year after establishment; however, turf quality declined to unacceptable levels the second year.

Freezing*:* Temperature extremes limit the distribution of tall fescue, where winter survival is affected by extended periods of ice sheeting and snow cover (Meyer and Watkins 2003, Watkins et al. 2014). Tall fescue had medium cold hardiness compared to

12 cool-season turfgrasses (Beard 1973, Bhowmik et al. 2008, Beard 1973) and is therefore prone to low temperature injury (Beard 1973), which leads to gradual thinning and eventual weediness. While spring seeding is popular to allow plants to establish before the next winter, germination may be delayed by cold temperatures (Meyer and Watkins 2003).

Salinity: Tall fescue is rated as moderately tolerant to salinity of 6-10 dS/m (Harvandi et al. 1992, Marcum 2008, Uddin 2013; Table 1). Tall fescue germination (Lunt 1961, Schiavon et al. 2013) and yield (Lunt 1964) were not sensitive to salinity, and tall fescue had the best salt tolerance of 10 species (Roberts and Zybura 1967). Tall fescue was more tolerant of salinity than Kentucky bluegrass owing to the maintenance of a high root to shoot ratio (Alshammary et al. 2004). At the end of salinity tolerance trials by Friell et al (2013), tall fescue cultivars showed the best performance over other species after two weeks of being exposed to 14-24 dS/m salinity levels. However, observations along Illinois roadsides that are treated with salt suggest that tall fescue is succeeded by quackgrass that is then invaded and outcompeted by weeping alkaligrass when salt content is high (Butler et al. 1971). Cultivars differed in salinity tolerance (Horst and Beadle 1984).


Acidity: Tolerance of alkaline soils is better than most cool season grasses (Beard 1972). Soils of pH 5.5. to 6.5 are preferred but soils of pH 4.7 to 8.5 are tolerated (Beard 1972).


Wear tolerance: Beard et al. (1973) argues that tall fescue is one of the most wear tolerant cool season grasses and can therefore be used in areas of intensive traffic. However, during establishment, tall fescue is sensitive to traffic, which negatively affects growth and allows weeds to outcompete tall fescue. Thus, tall fescue is not as effective in renovating disturbed areas than perennial ryegrass and Kentucky bluegrass, which can better withstand wear during establishment (Meyer and Watkins 2003). In a low-input fairway study in Minnesota, Watkins et al. (2010) observed similar declines in turfgrass quality in tall fescue and Kentucky bluegrass in the first year of the study whereas whereas bentgrasses, perennial ryegrass, and supine bluegrass were largely unaffected by traffic treatments; poor quality was further reduced by traffic in the second year. Similarly, wear tolerance trials showed that turf quality of tall fescue decreased when subjected to traffic (Cockerham et al. 1990). Bughrara (2007) suggests that tall fescue is less wear tolerant than Kentucky bluegrass and is therefore best used in areas that are not exposed to heavy traffic.


Competition: Despite having weed suppressive effects through the production of allelochemicals (Peters and Zam 1981), tall fescue is susceptible to competition with other species, especially perennial ryegrass (Harkess 1970). The only species that can be effectively mixed with tall fescue appears to be Kentucky bluegrass and then only 5-10% of Kentucky bluegrass, by seed weight, should be used (Meyer and Watkins 2003). Tall fescue produces coarse textured clumps when grown with fine fescue (Bughrara 2007) and is less competitive than hard fescue in cooler regions of Virginia (Doak et al. 2004). Tall fescue performed well within the first year of establishment with little input of irrigation, fertilizer, or herbicides, but after the first year, tall fescue was outperformed by fine fescues and invaded by smooth crabgrass and clover after a spring drought (Dernoeden et al. 1994). Large crabgrass, smooth crabgrass and, southern crabgrass are problematic weed species for tall fescue (Cutulle et al 2014).

Mixes: Because tall fescue does not produce abundant rhizomes, the species is often mixed with Kentucky bluegrass (Beard 1973) to increase sod strength especially under extreme wear conditions (Hunt and Dunn 1993). A 95/5 percent by weight tall fescue to Kentucky bluegrass mixture produces a stand with approximately equal number of both species; however, composition of the mixture can gradually shift to Kentucky bluegrass at lower mowing heights, greater nitrogen fertility and more frequent irrigation which are conditions that favor Kentucky bluegrass. Perennial ryegrass can also be used in mixes with tall fescue, however it tends be the more dominant species in the mix (Dunn et al 2002). Even small amounts of perennial ryegrass can result in 90% cover of perennial ryegrass after establishment (Park and Murphy 2016).

Cultivars: Cultivars 'Alta' and 'Kentucky 31' were the first cultivars released in the early 1940's (Meyer and Watkins 2003). 'Kentucky 31' was and still is the dominant cultivar grown in the US because of its vigor, wide adaptation to variable soil pH, rainfall and sunlight, drought tolerance, and resistance to pests (Meyer and Watkins 2003). In a 1967 study, Roberts and Zybura found that 'Kentucky 31' showed the best physiological and growth characteristics for placement along roadsides affected by salt. Since these early cultivars, breeders have created numerous cultivars with darker color, narrower leaves, better disease resistance, and shorter stature. The cultivar 'Rebel' was released in 1979 as the first turf-type tall fescue with reduced vertical growth to decrease mowing frequency. Rebel was soon followed by the cultivars 'Falcon' and 'Olympic' (Meyer and Watkins 2003). However, mature heights still ranged 130-145cm. Now dwarfing cultivars are available, such as 'Matador' and 'Bonsai', which attain the same height as the lower growing fine fescues. However, dwarf-type tall fescue is more prone to disease owing to higher tiller density and is subject to heat stress. Semi-dwarf cultivars are now showing the best performance in the United States and include 'Millenium', 'Rembrandt', and 'Plantation', as well as earlier maturing cultivars 'Prospect', 'Empress', and 'Endeavor'. Continued breeding is selecting for brown patch disease resistance, density, endophyte enhancement, acid tolerance, and genetic diversity (Meyer and Watkins 2003).

In low-maintenance trials in Virginia to select tall fescue cultivars for use along roadsides, Doak et al. (2004) showed that cultivars 'Anthem II', 'Aztec II', 'Crewcut', 'JT-1', 'SR 8300', and 'Tarhill' reached 85% cover after 3 years of growth in a Ridge and Valley site. Cultivars 'SR 8300', and 'Tarhill' performed at the same level (>85%) at a Piedmont site but at a coastal plain site these same cultivars only reached 60% and 43% cover, respectively after a severe drought. The best performing cultivars at the coastal plain site were 'Anthem II', 'Kittyhawk SST', 'Laramie', and 'Regiment' with 70-75% cover. Kim et al. 1999 compared the rooting depth of 16 cultivars and found that five entries could reach soil depths of 75cm. Dwarf- and turf-type tall fescues do not have reduced rooting depth and rooting extent than intermediate or forage type tall fescue (Kim et al. 1999). Selection for deep root production enhances drought tolerance in cultivars (Bonos et al. 2004, Karcher et al. 2008). A blend of tall fescue cultivars, 'Greenskeeper', 'Coyote II', ' Tarheel II', and 'Fidelity', outperformed other mixtures in trials by Miller et al (2013). The trials were under mow and no mow conditions in low fertility soils. The outcome of the Miller et al 2013 trials showed that blends of cultivars may have a potential broad use under low-maintenance conditions. Recent evidence suggests that the genetic diversity in existing turf-type germplasm is too narrow to promise significant progress in breeding in the future (Baird et al. 2012).

Hybrids: Tall fescue can hybridize with perennial ryegrass and annual ryegrass (Buckner 1960).