Bermudagrass

Cynodon dactylon var. dactylon, Cynodon transvaalensis, Cynodon transvaalensis, Cynodon x magennisii, and Cynodon incompletes var. hirautus

Bermudagrass is a low maintenance grass that establishes quickly and produces a deep and fibrous root system that binds the soil and provides excellent erosion control services. However, the species is rated as Fair (grade= C) owing to several management concerns that decrease the species' overall usefulness for roadside management:

Bermudagrass is an aggressive competitor that can become weedy and invasive. It will enter dormancy in cooler climates, leaving the ground bare and increasing potential for erosion. Ecosystem benefits are therefore rated as very poor.

Costs of acquiring planting material are high.

Bermudagrass needs to be mowed to minimize blooms and avoid scalping. Maintenance requirements are therefore not reduced despite the low stature.

Bermudagrass is intolerant of low fertility soils and has lower tolerance to freezing temperatures than some species. Thus, it is not a resilient species under many of the environmental conditions encountered along Maryland roadsides.





Bermudagrass is adapted to warm climates and is therefore not recommended for Western Maryland. The species may not thrive in Central Maryland but it is well adapted for Southern Maryland and the Eastern Shore.



Vegetative bermudagrass cultivars include Latitude 36, Northbridge, Patriot, and Tifton 10 and new variety Premier.

Bermudagrass (Cynodon dactylon var. dactylon, Cynodon transvaalensis, Cynodon x magennisii, Cynodon incompletes var. hirautus)

Biology: Bermudagrass is a complex of nine species and ten varieties within the genus Cynodon that was introduced to Colonial America and spread rapidly with the migration of settlers (Taliaferro 2003). Of all perennial warm season grasses, the Cynodon species that are the most important to turf production are listed above. Several additional Cynodon species are cultivated with minor turf importance (Taliaferro 2003). Bermudagrass is widely distributed throughout humid, tropical, and subtropical regions of the world for use in lawns, parks, sports fields, fairways, cemeteries, and along roadsides and airfields (Beard 1973, Taliaferro 2003). Although adapted to milder climates, bermudagrass may be used in temperate climates or regions of transition between warm and cool season grasses (Taliaferro 2003). Sometimes characterized as a weed in nature (Harlan and de Wet 1969), it only occurs as pure stands under artificial conditions. In natural settings, bermudagrass only thrives in disturbed open areas and will generally not invade natural grasslands or forests (Harlan and de Wet 1969) owing to intolerance to shading and established competitors. However, because bermudagrass can form an aggressive turf with high shoot density and a fibrous and deep root system (Beard 1973) it has the potential to become invasive. Thus, vegetative propagation through sprigs, plugs and sod (Beard 1973) is often recommended to minimize this risk to neighboring ecosystems.

Because bermudagrass can be an aggressive competitors, sodding is the only accepted establishment approach in Maryland.

*Seeds per pound:725,000 seeds per pound in 'Riviera' bermudagrass.

*Cost per pound: \$15 per pound for 'Yukon' bermudagrass from Chesapeake Valley Seed

*Cost per acre: \$675.00 per acre

*Suggested sowing rate: 45 pounds per acre (Turner pers. communication) *Sowing depth: ¼ inch

**Germination time:* 2.5 to 13.5 days (50% germination; Deaton and Williams 2013), 10-30 days (University of California IPM)

Seeding timing: as early as 15 May but later dates have faster germination times (Deaton and Williams 2013). Patton et al. (2004) suggest between June 1 to July 15.

Length of growing season: Spring to fall

Leaf height: Not reported but unmowed height is acceptable for roadsides (Brede 2002).

Height at seed head stage: Not reported because bermudagrass is typically mowed before it blooms.

Shade tolerance: intolerant of shading (Beard 1973, Taliaferro 2003, Jiang et al. 2004, 2005, Wiecko 2008)

Suggested mowing height: 1.5 inch cutting height (Turner pers. communication). *Tolerance of wet conditions:* can withstand flooding for extended periods (Beard 1973, Taliaferro 2003)

Humidity tolerance: adapted to humid regions (Beard 1973)

Disease resistance: Susceptible to a variety of diseases including brown patch, *Helminthosporium*, dollar spot, and spring dead spot (Beard 1973). Leaf, stem, and crown rots caused by *Bipolaris cynodontis* are among the more serious diseases in humid climates (Taliaferro 2003). Spring dead spot is a more serious disease in colder climates (Taliaferro 2003). Nematodes and insects such as sod webworms, armyworms, mole crickets, bermudagrass mite, and frit fry are also considered pests (Beard 1973).

Services:

Commercial availability and cost: Bermudagrass is commercially available as seed, sod, sprigs, and plugs. Maryland only allows sod to be planted along roadsides, which increases cost.

Rate of establishment: In Maryland, bermudagrass can only be established via sodding. Establishment of bermudagrass seed, however, is rated as excellent (Beard 1973). Bermudagrass seeded in Indiana reached 95% cover within 30 to 60 days (Patton et al. 2004). Rate of establishment in Turkey was also fast compared to zoysia, buffalograss, and centipedegrass (Severmutlu et al. 2011). However, establishment of bermudagrass along a roadside in Texas was lower than expected due to high water demand during the first week after sowing (Tinsley et al. 2006). Germination rate was highest for cultivar 'Casino Royal' (2.5 to 4.9 days for 50% germination, and 93-100% overall germination) and lowest for cultivar 'Riviera' (6.3 to 13.5 days and 5-52% overall germination; Deaton and Williams 2013). Fall seeding resulted in poor establishment, however (Leinauer et al. 2010). Bermudagrass has the most rapid growth rate of the warm season turfgrasses, has a very rapid establishment rate, and recuperates quickly after disturbance (Beard 1973). Greenhouse experiments observed a growth rate for bermudagrass as high as 9.2% per day which was the highest rate observed among 6 warm season grass species (Busey and Myers 1979).

Ease of maintenance: Bermudagrass is adapted to low maintenance conditions where vegetative cultivars are more sensitive to changes in maintenance than seeded cultivars (Brede 2002). Bermudagrass has a decumbent growth habit, which might suggest that it does not have to be mowed as frequently. However, bermudagrass needs to be mowed to minimize blooms and therefore the risk of invasion into neighboring systems. Blooms are especially frequent under stressful conditions such as roadsides. Frequent mowing is also required to avoid scalping because thatch has a tendency to accumulate (Taliaferro 2003). The cultural requirement of maintaining good quality turf is high for bermudagrass (Taliaferro 2003). Although drought tolerant, bermudagrass requires adequate soil moisture for sustained growth, color and sod density. It also responds well to fertilizer with nitrogen being the most limiting nutrient (Taliaferro 2003).

Erosion control: The root system is fibrous, extensive, and deep (Beard 1973, Wiecko 2008) suggesting that bermudagrass is a good species to use for erosion control. Forty-eight percent of total root length in bermudagrass was located below 30 cm soil depth (Qian et al. 1997), similar to drought resistant buffalograss. However, bermudagrass had significantly lower root length density the next year of the study owing to root disease. 'Tifway' bermudagrass developed the most extensive deep root system within 20-60 cm soil depth in a study comparing seven turfgrass species/cultivars common to the Piedmont region of the southeastern United States (Carrow 1996). Common bermudagrass rooting was less extensive at 20-60 soil depth but equal to Rebel II tall fescue and higher than 'Kentucky 31' tall fescue and zoysia (Carrow 1996). These results, however, were confounded by edaphic stresses that impacted root growth. Nitrogen fertilization and higher cutting height can alleviate some stresses and enhance root extension in bermudagrass (Wherley et al. 2011). For example, in unmowed bermudagrass, roots can extend up to 2.4 m in depth (Burton et al. 1954 in Qian et al. 1997). Cultivar 'La Paloma' had the best root length density and root weight density among 5 bermudagrass and zoysia cultivars whereas cultivar 'Yukon' had the lowest weighted means (Macolino et al. 2012).

Ecosystem benefits: Owing to its aggressive growth, bermudagrass can become a weed and invade neighboring habitats (Beard 1973). In California and Arizona, bermudagrass is considered an invasive weed of cool-season turfgrasses (Cudney et al. 1997) and a serious pest of

irrigated alfalfa fields (Taliaferro 2003). In cooler climates, bermudagrass will become dormant, leaving the ground bare and increasing erosion and run-off.

S<u>Resilience</u>:

Drought: Bermudagrass has excellent tolerance to drought and heat (Beard 1973, Wallner et al. 1982, Wiecko 2008) owing in part to a deep and extensive root system (Carrow 1996, Qian et al. 1997, Brede 2002). However, substantial variation among cultivars has been documented for dehydration avoidance, drought tolerance, and water use (Taliaferro 2003, Zhou et al. 2013, 2014). Drought resistant genotypes were identified among 460 bermudagrass accessions; however, none of the drought resistant genotypes were commercial cultivars (Zhou et al. 2013) suggesting that collections could be made to increase drought resistance. Drought resistant genotypes had greater soil water extraction and a higher water uptake rate (Zhou et al. 2014). Superior drought resistance was also characterized by a large rhizome network and a higher post-harvest regrowth rate (Zhou et al. 2015). Bermudagrass cultivars selected for use in temperate climates (cold tolerance) were generally ranked lower in drought tolerance (Taliaferro 2003). Bermudagrass has a low evapotranspiration rate (Kim 1983, Feldhake et al. 1984, Kim and Beard 1988, Beard and Kim 1989, Carrow 1995) and had the lowest transpiration rates among 10 warm and cool season turfgrasses (Biran et al. 1981). Bermudagrass required a minimum annual irrigation of 244 mm and maintained acceptable turfgrass quality at 40% actual evapotranspiration rate because it could tolerate lower leaf relative water content and higher levels of electrolyte leakage compared to zoysia, Kentucky bluegrass and tall fescue (Fu et al. 2004). Similarly, in field experiments, bermudagrass cultivar 'Tifway' maintained acceptable turf quality at 35% pan evaporation (Qian and Engelke 1999), which was lower than tall fescue (67%), zoysia (68%), and St. Augustinegrass (44%) but higher than buffalograss (26%). In greenhouse studies (Qian and Fry 1997), bermudagrass had lower osmotic adjustments during dry down (0.60 MPa) than buffalograss (0.84 MPa) and zoysia (0.77 MPa) but greater adjustments than tall fescue (0.34 MPa). Bermudagrass maintained higher quality and equal to higher root density up to 40 cm soil depth than zoysia under non-irrigated conditions (Rimi et al. 2012). Bermudagrass cultivar 'Yukon' maintained the best turf quality whereas cultivar 'La Paloma' developed the best root structure across all soil depths. Root mass density and root length density at 25-40 cm soil depth was positively correlated with turf quality suggesting that those cultivars that can access water resources at lower soil depths are able to avoid drought (Taliaferro 2003).

Low fertility: Bermudagrass is best adapted to fertile soils (Taliaferro 2003) and requires a higher fertilizer rate (Beard 1973, Booze-Daniels et al. 2000, Brede 2002) to maintain quality (Rimi et al. 2013) and resist disease (Carrow et al. 1987). In comparison with centipedegrass, St. Augustinegrass and zoysia, bermudagrass was very responsive to nitrogen application, exhibiting periods of growth and also deficiency depending on the supply of resources (Bowman et al. 2002). This makes bermudagrass an aggressive grower in nutrient rich environments but a poor performer when nutrients are limited.

Freezing: In climatic regions that rarely reach freezing temperatures, bermudagrass will stay green throughout the year and will only show slight discoloration at cooler temperatures. In colder regions, bermudagrass will enter dormancy in the winter months with new growth initiated in the spring from crown buds and rhizomes (Taliaferro 2003). Low temperature tolerance is an important goal in the development of bermudagrass

cultivars and genetic gains may be achieved by selecting for color retention, spring greenup and texture (Stefaniak et al. 2009). Stier and Fei (2008) rank the low-temperature tolerance of bermudagrass as 'medium', lower than buffalograss, blue grama and zoysia but higher than centipedegrass, seashore paspalum, St. Augustinegrass and bahiagrass. Bhowmik et al. (2008) rank cold hardiness of bermudagrass as poor with turf seriously thinned when exposed to low temperatures (Beard 1973). In Maryland, therefore, use of bermudagrass is restricted to the southern coastal plain region (Bhowmik et al. 2008), although new cultivars show promise in tolerating cooler temperatures. Bermudagrass cultivars vary considerably in freezing tolerance (Taliaferro 2003) with cultivars 'Arizona Common' and 'Tifgreen' being the least tolerant (mortality at -6.6 to -7.1°C respectively) and cultivars 'A-12195', and 'Midiron' the most tolerant (-9.9 to -10.5°C) (Anderson and Taliaferro 2002). Plants that are winter hardy may be more susceptible to disease and less tolerant to low pH and fertility (Harlan and de Wet 1969).

Salinity: Bermudagrass shows high tolerance for salinity (Beard 1973, Harivandi et al. 1992, Marcum 2002, Marcum 2008a,b) and is associated with selective transport of potassium ions versus sodium ions from the roots (Chen et al. 2014) and with sodiumselective secretion via salt glands (Marcum 2002, 2008b, 1999, Marcum and Pessarakli 2006). Saline irrigation water did not affect nitrogen leaching from bermudagrass turf suggesting that bermudagrass is tolerant of saline water (Bowman et al. 2006c). Bermudagrass has greater salinity tolerance than perennial ryegrass (Marcum 2008b), and buffalograss (Marcum (2002, 1999) but less than seashore paspalum (Lee et al. 2004) a,b, Uddin 2009, Gaetani et al. 2013), alkaligrass (Marcum 2008b), seaside bentgrass (Lunt et al. 1964), some dropseed species (Marcum 2008b, 1999, Hameed et al. 2008), desert saltgrass (Marcum 2002, 2008b, 1999, Marcum et al. 2005, Pessarakli and Kopec 2008), and St. Augustinegrass (Uddin et al. 2011). Depending on experimental conditions and cultivars, bermudagrass has greater (Marcum 2008b, Gaetani et al. 2013) or equal (Marcum 1999) salinity tolerance to zoysia. Salinity tolerance, measured as 50% reduction in shoot dry weight, varied from 26 to 40 dS/m among cultivars (Marcum and Pessarakly 2006), highlighting that bermudagrass has wide adaptability to salinity stress (Hameed et al. 2008, Marcum 2008a) with the hybrid line 'CH048' (Chen et al. 2014) and cultivar 'Tifway' (Nadeem et al. 2012) and 'Tifgreen' (Shahba 2010) exhibiting the highest salt tolerance. In contrast, cultivars 'Satiri' and 'Tifdwarf' are ranked moderately tolerant (6-10 dS/m) and moderately sensitive (3-6 dS/m) of salinity, respectively (Uddin et al. 2011a,b, 2012, Uddin 2013). Further differences were observed in a study comparing six bermudagrass cultivars to six salinity treatments (Peacock et al. 2004). The cultivars with the greatest shoot biomass ('Quickstand', 'Tifton', and 'Tifway') also had the greatest reduction in shoot weight at the highest salinity level (41-43%), but no differences were observed in root or crown weights.

Acidity: Bermudagrass is adapted to a wide range of soil conditions and can tolerate soil pHs between 5.5 to 7.5 (Beard 1973). It has high tolerance to aluminum, and hence acid soils (Liu et al. 2008) similar to Zoysia. In a study of 10 warm season turfgrass species (Baldwin et al. 2005), bermudagrass was less tolerant to aluminum than zoysia and carpetgrass but was less sensitive than seashore paspalum, bahiagrass and buffalograss.

Wear tolerance: Bermudagrass has very good wear tolerance (Wiecko 2008) but lower than the wear tolerance of zoysia (Beard 1973). Bermudagrass had lower stem flexibility than lovegrass, dropseed and perennial ryegrass suggesting that bermudagrass may have

lower survival and resistance to trampling than these other species (Sun and Liddle 1993). Overseeding with perennial ryegrass increased green cover, bulk density, thatch accumulation, and saturated hydraulic conductivity suggesting that the practice of overseeding may protect bermudagrass from wear and compaction (Thoms et al. 2011). Cultivars 'Tifway' and 'Riviera' were more wear tolerant than cultivar 'Patriot' whereas cultivar 'Mississippi Choice' ranked intermediate in experiments that manipulated mowing regime (Thoms et al. 2011).

Competition: Bermudagrass was the most efficient grass for nitrogen absorption when compared to 4 other warm season grass species (Bowman et al. 2002) suggesting that it is highly competitive for nitrogen resources. Bermudagrass is an aggressive competitor (Brede 2002) and can displace cool season grasses, such as tall fescue (Cutulle et al. 2014) and Kentucky bluegrass (Davis 1958).

<u>Mixes</u>: Bermudagrass can be overseeded with cool season grasses (Beard 1973, Cockerham et al. 1990, Dunn et al. 1994, Longer 1999, Richardson 2004, Nelson and Crowder 2005, Richardson et al. 2007, Rimi and Macolino 2013, Volterrani et al. 2004, McElroy et al. 2011, Trappe et al. 2012) and clover (Dudeck and Peacock 1983, Han et al. 2012, McCurdy et al. 2013a,b) to maintain a higher quality turfgrass surface in the winter when bermudagrass is dormant.

<u>Cultivars</u>: Erosion of natural genetic variability does not appear to be a big concern in most bermudagrass lines (Talioferro 1995). Early cultivars of Bermudagrass were developed in South Africa starting in 1907 (Taliaferro 2003). Cultivars 'Tifgreen' and 'Tifway' were introduced in the United States in 1956 and 1969, respectively (Taliaferro 2003) and are still the most widely propagated and distributed cultivars today. Cultivars 'Midlawn' and 'Tifsport' show higher tolerance to freezing (Taliaferro 2003). Cultivar 'FloraTex' was developed to be used under low-maintenance conditions (Taliaferro 2003).

<u>Hybrids</u>: Tetraploid *Cynodon dactylon* is often hybridized with diploid *C. transvaalensis* to produce the sterile triploid clonal cultivars 'Tiffine', 'Tifgreen', and 'Tifway' developed in Georgia. Cultivars 'Midway', 'Midiron', 'Midlawn', and 'Midfield' are triploid hybrids bred in Kansas. Mutant clones are produced through ionizing radiation.