

A Taxonomic Key for Selected Turf-Type Bermudagrasses

Tim R. Pannkuk¹

Sam Houston State University, P.O. Box 2088, Huntsville, TX, 77341

ABSTRACT

Bermudagrass is a widely used turfgrass on golf courses and athletic fields of the southern United States. Correct identification of individual cultivars is essential for plant breeders and when managing established turf. Contamination of bermudagrass with off-types is common. The objective is to provide data in a format that will aid in identifying turf-type bermudagrasses. Thirteen cultivars were selected, measured, and evaluated on taxonomic characteristics. A dichotomous taxonomic key was developed, and a table of data for mean leaf blade widths, vein number, and leaf margin serrations.

KEY WORDS: bermudagrass, taxonomic key, turfgrass

INTRODUCTION

Hybrid bermudagrass (*Cynodon dactylon* x *C. transvaalensis*) is one of the major turf-type grasses used in golf courses and athletic fields in the southern United States. Its use extends from the hot, humid Gulf coastal states to the arid southwestern states and north into the lower Midwest. Most clonal turf bermudagrass cultivars are developed from crosses involving two species: common bermudagrass (*Cynodon dactylon*) and African bermudagrass (*C.transvaalensis*) (Turgeon 2005). Some clonal cultivars are selections from common bermudagrass or African bermudagrass. Bermudagrass is adaptable to a wide range of soil pH, soil texture, fertility levels, and mowing heights. Established bermudagrass is a network of shoots, rhizomes, stolons, and crown tissue together that usually form a dense plant canopy. This dense plant canopy can be used to propagate clonal varieties by sod, sprigs, or plugs. In recent years, plantings of bermudagrass cultivars used for propagation have exhibited distinctive patches of variant morphology (Caetano-Anolles et al., 1997). This occurrence causes severe problems and millions of dollars of loss particularly in the golf course industry. These variant morphologies are often referred to as "off-types". The off-types having a different color and/or texture perform differently than the surrounding turfgrass and usually require removal. The occurrence of off-type bermudagrass varieties in vegetative sources is a recurring problem (Foy et al., 2004). Turfgrass managers expect a pure variety when receiving sod, springs, or plugs for establishment of turf.

There is a need to develop an easy and reliable technique of clonal turf bermudagrass identification (Vermeulen et al., 1991). DNA fingerprinting is a technique used to identify individual plants and cultivars by their respective DNA profile. DNA

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fingerprinting is an invaluable tool for plant breeders developing improved cultivars. It is also used in disease diagnosis. Caetano-Anolles et al. (1995) provided a detailed study of genetic relationships between bermudagrass cultivars and species. Their study determined the levels of genetic variation within and between selected species of bermudagrass that exhibit a wide range of leaf blade morphologies. Caetano-Anolles et al. (1997) used DNA fingerprinting to certify authenticity of bermudagrass cultivar stocks and evaluate bermudagrass off-types origin. Their study also determined the off-types were genetically diverse and the origin clearly being from contamination rather than somatic mutation. Likewise, the study provided a foundation for contamination in sod fields and identification of mistakes in plantings. Wang et al. (2010) examined simple sequence repeat (SSR) markers for their ability to distinguish commonly grown clonal turf bermudagrass cultivars. SSR markers are locus-specific, highly polymorphic, codominant, and reproducible. SSR markers have been widely used for cultivar identification in a wide range of horticultural and agronomic crops. Wang et al. (2010) concluded that SSR markers could be used as a reliable tool to accurately identify commercially available turf type bermudagrasses. Their study demonstrated the usefulness of these markers as applications for quality control purposes and in tracing infringements on plant breeders' rights. Examples of quality control purposes could be determination of off-types in sod or sprigs on golf courses and sod farms. However, the cost for analysis of a bermudagrass sample submitted to a laboratory performing this identification is likely prohibitive, and perhaps too time consuming for the entity requiring immediate results. It is estimated that the cost of the SSR technique is in excess of \$1,000 per sample and may require up to two weeks for results (Wu 2010).

Fermanian et al. (1989) documented the ability of individuals to use grass morphological characteristics in correctly identifying grass species. Their results indicated no significant differences between trained and untrained individuals' ability in identifying grass species, based on characteristics like ligule, leaf sheath, blade width, and pubescence. A sequential dichotomous key is a tool used to categorize plant species based on logical choices in fixed steps. Taxonomic keys have been developed for a wide range of cultivated plants (Winston 1999). Dichotomous keys allow the user to identify plants directly in the field or in the laboratory based on morphological features. The objectives of this study were to: a) develop a taxonomic key for selected bermudagrass cultivars; and b) measure some of the leaf blade characteristics that could also be used to aid in identification of selected cultivars.

MATERIALS AND METHODS

Bermudagrass cultivars included 'Celebration', 'Champion', 'EmeraldDwarf' (taxonomic key only), 'ForaDwarf', 'MiniVerde', 'MS Choice', 'Princess 77', 'TifDwarf', 'TifEagle', 'TifSport', 'TifWay', 'Tift 3', and 'Tift 4'. Plugs, 10.8 cm diameter of each cultivar, were obtained from the Texas A&M University's turfgrass field lab in College Station, TX and were placed into 183 cm³ plastic pots with a media mixture of 50% sand: 50% peat moss (v:v). Specimens were labeled, maintained in an environmentally controlled facility, and trimmed every one or two weeks to 2.5 cm cutting height.

Leaf blades used for width, vein number, and marginal serration measurement were the third and fourth fully-expanded, undamaged leaves on stems. Twelve leaves were measured for each cultivar. Blade width was measured at the midpoint of the leaf blade using a micrometer capable of measurements to 0.1mm. After width measurement, the

blade was removed from the plant and taped to a glass slide for viewing through a microscope at 10X. Vein number was then counted for each leaf.

Blade margin serration data were measured in a different event. After selection, blades were removed from the plant and taped to a glass slide having graduations allowing calibration to 0.001mm when placed under the microscope. Lengths are an average for 10 consecutive serrations occurring along the midpoint of the blade margin.

Third and fourth fully-expanded undamaged leaf blades were also examined for the presence of trichomes on both adaxial and abaxial blade surfaces, presence of trichomes near the ligule, and ligule characteristics. Accurate length measurement of the trichomes was not possible with available equipment, and therefore not included. We have included trichome characteristics in terms of relative length and relative number in order to provide another distinguishing characteristic of each cultivar when the key is utilized by the practitioner. These characteristics were used to construct a dichotomous taxonomic key.

RESULTS AND DISCUSSION

The results of leaf blade width, vein number, and marginal serration width by cultivar are summarized in Table 1. The taxonomic key is presented in Figure 1.

Table 1. Leaf blade width, vein number, and marginal serration width for the third and fourth leaf by cultivar.

Cultivar	Third Leaf (mm)	Fourth Leaf (mm)	Third Leaf veins	Fourth Leaf veins	Serrations Third Leaf (mm)	Serrations Fourth Leaf (mm)
Celebration	1.3(0.2)	1.3(0.2)	13(1.5)	12.3(2.0)	0.088	0.082
Champion	1.9(0.2)	1.8(0.3)	18.4(1.6)	17.8(1.5)	0.056	0.056
FloraDwarf	2.0(0.3)	1.9(0.3)	18.4(1.4)	17.9(1.9)	0.056	0.056
MiniVerde	2.0(0.2)	1.9(0.1)	18.6(1.2)	18.2(1.0)	0.062	0.060
MS Choice	1.4(0.2)	1.4(0.3)	14.2(2.0)	15.5(2.0)	0.081	0.083
Princess 77	1.6(0.4)	1.5(0.5)	14.3(2.8)	13.8(2.8)	0.089	0.078
TifDwarf	1.7(0.1)	1.7(0.1)	17.4(1.1)	16.7(1.6)	0.072	0.070
TifEagle	2.0(0.1)	1.9(0.1)	18.9(0.7)	18.7(1.0)	0.060	0.062
TifSport	1.2(0.1)	1.3(0.1)	15.8(1.7)	15.6(1.7)	0.055	0.059
TifWay	1.2(0.2)	1.2(0.3)	16.6(1.5)	16.6(2.2)	0.066	0.065
Tift 3	1.3(0.2)	1.2(0.2)	16.3(3.7)	15.5(2.1)	0.077	0.073
Tift 4	1.2(0.2)	1.2(0.3)	14.7(1.2)	14.0(1.3)	0.074	0.065

Each number is the mean of ten subsamples. Numbers in parentheses are standard deviation.

Information in Table 1, and the taxonomic key in Figure 1, may be used together as tools to potentially determine the identity of an unknown specimen, or to verify the identity of a known specimen. The user of the key and table should gather data from a minimum of 12 samples (leaves) per specimen and sample several specimens. The users of the taxonomic key who lack plant science training will most likely require additional resources that define botanical terminology and provide visual examples. The data and taxonomic key provide a quick and inexpensive way to potentially determine the cultivar in question.

These tools are valuable to the person in the field that is making a management decision. Contamination in sod and sprigs continues to be problematic in bermudagrass sources.

1. Leaf Blades glabrous (8)
1. Leaf Blades have trichomes (2)
 2. Blades have trichomes on the adaxial side only **Princess 77**
 2. Blades have trichomes on both the adaxial and abaxial sides (3)
 3. Trichomes on both sides of the blade sometimes, but may also have trichomes on just the adaxial side, and may also sometimes be glabrous (4)
 3. Appear to always have trichomes on both sides of the blade (6)
 4. Hairy ligule is small and not very prominent (Note: do not confuse the trichomes coming off the collar for the ligule; if the ligule is prominent, one should be able to see it by pushing down the blade rather than pulling the sheath away from the stem.) Also has trichomes off the front and back of the sheath **MS Choice**
 4. Hairy ligule is obvious without pulling the sheath away from the stem (5)
 5. Many long trichomes off the side of the collar and small ligule **Tift 4**
 5. Few short trichomes off the side of the collar and large ligule **Tift 3**
 6. Hairy ligule is small and not very prominent (Note: do not confuse the trichomes coming off the collar for the ligule; if the ligule is prominent, one should be able to see it by pushing down the blade rather than pulling the sheath away from the stem.) Also has long trichomes behind the small ligule off the top of the collar **Celebration**
 6. Hairy ligule is obvious without pulling the sheath away from the stem (7)
 7. Less than 10 short trichomes arising at the corners of the collar **TifWay**
 7. More than 10 semi-long trichomes arising at the corners of the collar. Also has some trichomes on front side of the sheath **TifSport**
 8. One or two long trichomes arising at each corner of the collar **Emerald Dwarf**
 8. More than two trichomes arising at each corner of the collar (9)
 9. Short trichomes that are rather difficult to see (20X magnification) arising at each corner of the collar **Champion**
 9. Rather visible trichomes arising at each corner of the collar (10)
 10. One trichome present on the abaxial side of the blade near the collar on at least one of the leaves of the sample **FloraDwarf**
 10. No trichomes present on the blade (11)
 11. Has 5 to 10 trichomes arising at each corner of the collar, which appear to be spread out rather than in a group **TifDwarf**
 11. Trichomes arising at corner of the collar are in a group (12)
 12. Has 3 to 5 medium length trichomes arising at each corner of the collar, one of these trichomes is much longer than the others **MiniVerde**
 12. Has a few short trichomes arising from the corner of the collar with one or two being much longer. **TifEagle**

Figure 1. Taxonomic key for selected bermudagrass cultivars.

However, this key and table data are not inclusive of all bermudagrass cultivars available in the USA. New cultivars are continually being released by plant breeders. Most likely, no bermudagrass taxonomic key will ever be complete with all available cultivars. Our goal has been to provide a useful and inexpensive tool to aid the practitioner in identifying unknown bermudagrass.

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