EVALUATION OF FALL TRAFFIC TOLERANCE AND SURFACE PLAYABILITY OF SELECTED BERMUDAGRASSES

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Abstract:

Bermudagrass [*Cynodon* spp. (L.) Rich.] is the most preferred turfgrass species for athletic fields and golf courses in the southern and transition zones of the United States. It is also extensively used turfgrass species for sod production. Traffic tolerance is an important trait for turf in both the athletics and golf industries. Traffic injury caused by foot or athlete-surface interaction is one of the most critical problems athletic field managers face in maintaining the surface playability and aesthetic quality of sports fields. A 2-year field study was conducted on a Norge loam soil in Stillwater, Oklahoma, to evaluate 9 commercially available and 87 experimental bermudagrasses for fall traffic tolerance, fall color retention, and spring green-up. Twenty-five of these bermudagrasses were also evaluated for sod tensile strength and sod handling quality. Under traffic, 14 experimental and 4 cultivars were in the top statistical group on each date for each variable. Among these entries, 17-5200-4x11, 17-4200-19x9, 'Bimini', 'OKC1134 (NorthBridge), and OSU1664 also showed minimal variation from non-trafficked to trafficked conditions suggesting excellent traffic tolerance. The entries 18-8-1, 17-5200-31x3, and 'U-3-SIU' had excellent fall color retention under non-trafficked conditions, while the entries 18-8-3, 18-9-2, 17-5200-3x23, and 17-5200-4x11 shown excellent fall color retention when trafficked. Excellent spring green-up was demonstrated by entries OSU1609, 'OKC1131' (Tahoma 31), OSU1117, and OSU1638 across both traffic treatments. Simulated traffic stress reduced the shear strength and increased the surface hardness over time potentially due to compaction. Shear strength of 'DT-1' (TifTuf) and Tahoma 31 and surface hardness of NorthBridge were least affected by traffic stress. Simulated traffic stress reduced the fall color retention of all cultivars but enhanced the spring green-up of Astro, Bimini, and TifTuf. Bimini demonstrated the greatest mean sod tensile strength but was not statistically different from 18-7-1, 18-8-4, 18-8-7, NorthBridge, or TifTuf. Pearson's correlation coefficient analysis showed a positive correlation (r=0.62) between sod tensile strength and sod handling quality and a positive correlation (r=0.66) between sod tensile strength and shear strength. The sustainability and surface playability of athletice fields in the transition zone can be enhanced by selecting bermudagrass with good fall traffic tolerance, fall color retention, early spring green-up, and surface playability characteristics.

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CHAPTER I

LITERATURE REVIEW

BERMUDAGRASS: ADAPTATION, BIOLOGY, AND USES

Bermudagrasses [*Cynodon* spp. (L.) Rich.] are the most widely used warm-season turfgrass. They are distributed throughout warm humid, tropical, and subtropical regions of the world. The origin of the *Cynodon* species is centered around the Indian Ocean from eastern Africa to the East Indies (Beard, 1973). It was introduced into the United States in the mid-1700s. In the United States, it is adapted to the southern and transition zones. It is extensively used for sports fields, golf courses, lawns, parks, roadsides, greens, tees, and other areas (Christians, 2011).

Bermudagrass [*Cynodon dactylon* (L) Pers.] is most often a tetraploid (2n=2x=36) warm-season turfgrass having medium to coarse leaf texture. The stem ascends from a prostrate base of rhizomes and stolons that promote rapid establishment and forms a tight sod. Bermudagrass typically has folded vernation, a 1 to 3mm long ligule characterized as a fringe of white hairs, a compressed or loose sheath with hairs at the throat, a narrow to the medium broad glabrous collar, and 2.0 to 3.0 mm wide flat blades with short adaxial hairs. Bermudagrass typically has a medium-green color, an intermediate shoot growth rate, an intermediate shoot density, and prolific seedhead formation (Beard, 1973). Generally, flowering occurs in bermudagrass during spring when day lengths are longer and with increased temperature conditions (Taliaferro et al., 2004). The bermudagrass seedhead is composed of three to five racemes emerging from one or two whorls. The Bermudagrass has a fibrous root system and develops roots at the nodes. It is primarily propagated through vegetative means of sprigs, plugs, and sod (Beard, 1973). In addition to *C. dactylon,* African, bermudagrass (*C. transvaalensis* Burtt-Davy) is an important warm-season turfgrass having a diploid (2n=2x=18) genome, finer leaf texture, shorter internodes, and a yellowish-green color. Hybrid bermudagrass (*C. dactylon* x *C. transvaalensis*) is most often a sterile triploid (2n=2x=27) that is strictly propagated vegetatively and has fine leaf-textured, rich green color, and greater shoot density than *C. dactylon* (Carrow & Petrovic, 1992).

Bermudagrasses grow well in moderately well-drained, fine-textured soil but tolerates a wide range of soil types and soil pH range of 5.5 to 7.5. Its optimum temperature for growth ranges from 26.6 to 35˚C (80 to 95˚F) for growth (Beard, 1973). It has excellent heat tolerance but poor cold tolerance. Discoloration of leaves occurs due to low temperature in the fall resulting in a winter dormancy period for most regions of adaptation. Bermudagrass remains in a state of dormancy throughout the winter until the soil temperature remains above 10°C (50°F) for several days. It has excellent drought resistance but poor shade tolerance (Christians, 2011).

ATHLETIC FIELD TRAFFIC

Bermudagrasses (*Cynodon spp*.) are the most widely used turfgrasses on athletic fields in the United States due to their good recuperative potential and traffic tolerance in comparison to most other turfgrass species (Christians, 2011). Traffic is defined as the injury to turfgrass stand from pressure, tearing, and scuffing (Trenholm et al., 2000). Equipment and foot traffic cause damage to the turfgrass stand and also to the soil underneath it. There are generally four types of damage associated with traffic on turf sites: wear, soil compaction, rutting, or soil displacement and divoting (Carrow & Petrovic, 1992). Wear is crushing and tearing the turfgrass plant parts like the leaves, stems, and crowns (Beard, 1973). Soil compaction is the pressing of soil particles together which increases soil bulk density. Rutting is known as depression on turf sites caused by the displacement of soil particles due to pressure. Divoting refers to the removal of turf from a surface by the action of vehicular and foot traffic (Carrow & Petrovic, 1992). Repeated exposure of a turfgrass stand to traffic produces long-term detrimental effects such as an increase in soil bulk density and a decrease in turf density, and percent green cover (Kowalewski et al., 2013). Turfgrass root morphological features are also affected by traffic. Reduced root length, dry matter, and surface area are some significant effects of repeated traffic on turfgrass stand (Glab & Szewczyk, 2015).

To characterize the effect of traffic on turfgrass response, traffic simulation devices have been developed. As early as the 1940s, efforts had been made to simulate vehicular traffic and quantify turfgrass response (Kowalewski et al., 2013). In the 1950s, M.H. Kimball, a horticulturist of the University of California constructed a simple one-paddle wear-testing experimental model. Subsequently, the Engineering Department at the University of California developed the first mechanized wear-tester unit to simulate traffic stress (Perry, 1958). The most commonly used traffic simulators for turfgrass research are discussed below.

Brinkman traffic Simulator

Compaction, friction and scuffing wear, and lateral shear injury are the major turf injuries caused by cleated shoe traffic. In an attempt to simulate cleated-shoe sports traffic on a turfgrass stand, the Brinkman traffic simulator (BrTS) was developed at the University of California, Riverside (Cockerham & Brinkman, 1989). The BrTS was designed to simulate the combined effects of wear, compaction, and lateral shear on turf. It is tractor-driven and consists of two cleated drums. Cleats are made with bolts threaded into hex nuts welded to drums and are arranged on each roller in a spiral manner which allows smooth movement. The cleats on the roller were designed to approximate the diameter and length of the cleats on an American football shoe. The BrTS was designed such that two passes resulted in 56 cleat dents per square foot or 300 cleats dents per meter square per pass which was deemed equivalent to the Zone of Traffic Concentration (ZOTC) in one American football game (Cockerham & Brinkman, 1989). Although BTS is durable and produces significant traffic injury, it fails to simulate the some of the dynamic forces and multi-directional forces which occurs during a game. Furthermore, it produces lower compressive stress and net shear stress than real-life conditions (Kowalewski et al., 2013).

Cady Traffic Simulator

The Cady traffic simulator (CTS) is a modified walk behind the core cultivation unit (Henderson et al., 2005). Originally, tine holders of the aerification unit were replaced with cleated feet made from a looped section of 8-ply, load range D truck tire, and seven cleats attached to each foot. The CTS was an improvement from the BrTS due to ability to simulate three-dimensional dynamic forces and produce greater compaction stress and net shear stress (Henderson et al., 2005). Although the BrTS and CTS, produce a similar number of cleat marks per unit area (300 and 333 for the BrTS and CTS, respectively), the CTS produces more wear than the BrTS. According to ground force research, the CTS generates 5899 N of an average vertical force and 1613 N of net shear force (Kowalewski et al., 2013). The combined compressive stress of feet of the CTS, when operated in the forward direction, was reported to be 30 times higher than the combined stresses of both rollers of the BrTS. In the reverse direction, the CTS generates a higher angle of impact resulting in approximately one fifth of the compressive stress when operated in the forward direction (Henderson et al., 2005).

Baldree Traffic Simulator

The Baldree traffic simulator (BaTS) was originally built using a modified Ryan GA 30 riding aerification unit. The Baldree traffic simulator is similar to the CTS, but it uses a spring-loaded steel plates feet instead of feet made from a tire. The Baldree traffic simulator generates 1129 cleats marks per square meter per pass when operated at speed of 0.35 meter per second and the tine spacing lever maintained at 25 mm. This is equivalent to the number of cleats marks produced within the zone of traffic concentration in two American football games. The Baldree Traffic Simulator produces 9395 N of vertical force and 4866N of net shear force which is significantly greater than the force produced by the BrTS and the CTS. It produces a greater force (vertical and net shear) when operated in a backward direction than in the forward direction. In a limited number of passes, the Baldree traffic simulator can repeatably increase soil bulk density and decrease turf density and percent green turf cover (Kowalewski et al., 2013).

TRAFFIC TOLERANCE

Turfgrass species differ in their relative wear tolerance, with warm-season turfgrasses typically being more tolerant to wear stress than cool-season turfgrasses (Trenholm et al., 2000). Cultivars within a species can also differ in their ability to tolerate traffic (Youngner, 1961). In a study in Texas, variation among 17 bermudagrass cultivars were reported in terms of a percent reduction in verdure after a prescribed traffic treatment (Beard et al., 1981). More recently, Bigelow & Hardebeck (2006) evaluated the performance of four bermudagrass cultivar (‘Mirage’, ‘Riviera’, ‘Quickstand’ and ‘Yukon’) in response to autumn N applications and simulated traffic, and they reported ‘Riviera’ was more tolerant to traffic stress than Quicksand.

Williams et al., (2010) investigated the traffic tolerance and divot recovery of eight bermudagrass cultivars and reported ‘Riley’s Super Sport’ (Celebration) and ‘ST-5’ (TifGrand) as having high wear tolerance in comparison to the industry standard ‘Tifway’, and ‘T11’ as having faster divot recovery than ‘Tifway’. Trappe et al., (2011) investigated 42 bermudagrass cultivars in the summer and the fall of 2007 and 2008 for traffic tolerance based on green turf coverage retention. In their study, the cultivars Celebration, ‘Patriot’, Riviera, ‘PremierPro’ and several experimental genotypes were in the top statistical group for the green turf coverage retention. Segars (2013) conducted a two-year field study at Oklahoma State University to evaluate the 24 commercial and 16 experimental bermudagrasses for improved traffic tolerance. A CTS was used to simulate traffic stress and traffic tolerance was investigated by the means of visual turf quality ratings, traffic tolerance ratings, and percent green cover by digital image analysis. Segars used the turf performance index (TPI) method to summarize the results. Riviera, ‘OKC1134’ (NorthBridge), ‘OKC1119’ (Latitude 36), and ‘SWI 1057’ were reported to have high traffic tolerance among other entries in this study (Segars, 2013). Collectively, these studies show that some bermudagrass cultivars show superior traffic tolerance and some show poor traffic tolerance. To reduce maintenance and increase the sustainability of athletic fields, it is important to select bermudagrass having improved traffic tolerance.

Anatomical, physiological, and morphological features can determine the degree of wear tolerance among different species and cultivars. Shearman & Beard (1975a) used four quantitative methods to evaluate interspecies wear tolerance of seven cool-season turfgrass species,1) visual rating, 2) total cell wall content, 3) verdure and 4) chlorophyll content (Shearman & Beard, 1975a). The relative concentration of cell walls constituent's cellulose, lignocellulose, hemicellulose, total cell wall, and lignin did not show a correlation with wear tolerance when analyzed independently. However, the combined effect of all these cell wall constituents showed significant correlation with turfgrass wear tolerance (Shearman & Beard, 1975a).

The same authors also investigated the effect of shoot density, leaf width, verdure, leaf tensile strength, percent moisture, and percent relative turgidity among on wear tolerance. Only leaf tensile strength and leaf width contributed significant variation in turfgrass wear tolerance. A close association was reported between wear tolerance and percent sclerenchyma and lignification of cells (Shearman & Beard, 1975c). Low stem cellulose content and high stem moisture were found to enhance the wear tolerance of bermudagrasses. Others have reported wear tolerance being associated with high leaf moisture, shoot density, leaf lignin, stem and leaf lignocellulose, and concentration of K, Mn, and Mg (Trenholm et al., 2000).

A field study was conducted in Georgia to investigate the correlations between hybrid bermudagrass morphology and wear tolerance (Kowalewski et al., 2015). The study included 'Tifway', 'Tift 94' (TifSport), 'DT-1' (TifTuf), and an experimental hybrid named (04-76) with each being subjected to 6 weeks of traffic stress. Parameters such as leaf morphology (leaf width, length, and angle), dark green color index (DGCI), normalized difference vegetation index ratio (NDVI), and green coverage were measured to estimate wear tolerance. This study revealed that DGCI, leaf length, and leaf width were negatively correlated with traffic tolerance. Moreover, wear tolerance was positively correlated with green coverage before traffic (Kowalewski et al., 2015). Another study conducted on warm-season turfgrass species at the in Italy reported lignin was the main constituent that determined leaf, stolon, and rhizome tensile strength in the species tested. Leaf, stolon, and rhizome tensile strength was inversely proportional to the sugar (glucose, fructose and sucrose) content in these tissues (Lulli et al., 2012).

Plant growth regulators (PGRs) have been used to decrease vertical growth and to enhance the turfgrass quality of various turfgrass species (Christians, 2011). Heckman et al., (2005) reported that trinexapac-ethyl (TE) enhanced the traffic tolerance of bermudagrass by increasing the structural and non-structural content of carbohydrates in the root and shoot tissue. Brosnan et al., (2010) in 2-years of the study investigated the effects of different plant growth regulators on the traffic tolerance of Riviera bermudagrass. In their study, trafficked plots were treated with the following PGR treatment: 1) ethephon 2) trinexapac-ethyl (TE) 3) paclobutrazol 4) flurprimidol 5) flurprimidol + TE 6) ethephon + TE & 7) untreated. The TE treatment improved traffic tolerance as compared to other PGRs. Furthermore, ethephon and flurprimidol showed enhanced turfgrass quality and color when used with TE than ethephon and flurprimidol alone.

For intensively managed turf such as required for golf course greens and sports fields, topdressing is an essential cultural practice (Christians, 2011). Topdressing helps in improving infiltration rates, controlling thatch, increasing air porosity, smoother surface, and modifying the surface soil (Beard, 1973). Athletic fields high in clay and silt content are more easily affected by the compaction stress which can be managed by sand topdressing (Kowalewski et al., 2010). Due to the abrasive nature of sand, sand topdressing can reduce the playing qualities of the athletic field surfaces (Rogers et al., 1998). Non-soil materials such as crumb rubber have been reported to be effective in lessening traffic stress and maintain the softness of the athletic field surfaces (Christians, 2011). Rogers et al., (1998) reported crumb rubber used as a topdressing material enhanced the traffic tolerance of Kentucky bluegrass in Michigan. Data for visual percent living ground cover and shear strength were collected after topdressing application and subsequent trafficking. Both sand and crumb rubber topdressing have been reported to improve traffic tolerance but crumb rubber has been more effective in providing high turfgrass cover and shear strength than sand. It has been suggested to apply the layer of sand topdressing before crumb rubber to reduce the cost of topdressing material (Kowalewski et al., 2011).

With the onset of winter, warm-season grasses enter dormancy which is characterized by slowed growth and loss of green color. These dormant warm-season grasses are often seeded with cool-season turfgrasses to provide an actively growing winter cover and to enhance aesthetic quality during late fall and early winter (Beard, 1973). Perennial ryegrass (*Lolium perenne*) and rough bluegrass (*Poa trivialis*) are frequently used to provide green cover on bermudagrass fairways and putting greens (Christians, 2011). Thoms et al. (2009) found that Tifway hybrid bermudagrass overseeded with perennial ryegrass (897kg/ha) can enhance winter traffic tolerance. Deaton et al. (2010) studied the effect of perennial ryegrass overseeding during winter dormancy on the functional quality of two common bermudagrasses (Riviera and Celebration) and two hybrid bermudagrasses (Tifway and Patriot) under traffic stress. Overseeding improved the traffic tolerance of each bermudagrass by providing actively growing turf and more green color than not overseeding. Traffic tolerance of bermudagrass cultivars Tifway, Patriot, 'Mississippi Choice', and Riviera was evaluated under groomed conditions (Thoms et al., 2011). The authors reported that grooming provided lower-traffic tolerance due to a reduction in the percent green cover. Overseeding has been reported as helpful in improving traffic tolerance by reducing bulk density and increasing the percent green cover and thatch accumulation (Thoms et al., 2009).

ATHLETIC FIELD SURFACE QUALITY

An athletics field's surface quality includes both aesthetic and player-to-surface interactions (Brosnan et al., 2014). Athlete-to-surface interactions can be explained based on two important properties: the ability of the surface to absorb the energy generated upon impact (surface hardness) and the level of traction provided to the athlete by the surface (Brosnan et al., 2009). Traction is defined as the interaction forces associated with the player and turf surface which enable the player to get an appropriate grip to prevent possible fall or slip (Canaway & Bell, 1986). The term 'traction' is different from 'friction' as traction is associated with surface interactions with spiked or cleated shoe whereas friction is applied to smooth sole footwear (Canaway & Bell, 1986). A certain level of traction is required by the athlete from the athletic field surface to prevent excessive stress to joints and ligaments (McNitt et al., 2003). Traffic deteriorates the athletic field surface quality by imposing both wear and soil compaction stress. Traffic stress increases surface hardness which in turn increases the chances of lower extremity injury due to the excessive ground reaction force (Brosnan et al., 2014).

Various methods or equipment have been used to measure traction forces in turf but the rotational device by Canaway and Bell (1986) is the most widely accepted. Their device (hereafter referred to as the Canaway tester) used a rotational device with a cleated disc that measures the torque required to completely tear the turf, thus giving an estimate of the shear strength of the surface. Measurement of shear strength can be difficult due to variation in vertical force and rotational speeds of individuals using the tester. As traction force depends upon the shoe–surface interaction, the vertical force or loading weight should be comparable to the force applied by an athlete to the point of contact (Nigg, 1990). McNitt et al., (1997) constructed an apparatus called the 'PENNFOOT' which overcame this limitation. It consisted of a frame holding an artificial leg and foot assembly. An actual football shoe (studded) was fitted on a casted foot. A loading weight of 116kg was used to mimic the vertical force applied by an athlete. The PENNFOOT was capable of quantifying the rotational and linear traction by measuring the hydraulic pressure applied to the strike plate attached to a football shoe.

Clegg (1976) developed an impact testing device that consisted of an accelerometer attached to the laboratory compaction hammer. The hand-held meter attached to this device shows the peak output of the accelerometer as generated by the impact on the ground surface. Several devices have been used for surface hardness measurements but the Clegg impact tester has been widely used on natural turf surfaces (Aldahir & McElroy, 2014). Canaway et al., (1990) reported a close association between the player's perceptions of surface hardness for running, falling, or diving with the peak deceleration outputs from Clegg impact tester with a 0.5 kg hammer and 300mm of drop height.

Rogers et al. (1988) conducted a study on football fields of 12 high schools in central Pennsylvania to investigate the correlation between athletic field hardness and traction, soil properties, vegetation, and maintenance practices. This study concluded there was a strong negative relationship between soil moisture and athletic field hardness. According to this study, good maintenance practices and good field conditions such as high moisture, lower bulk density, and more turf cover are associated with lower impact or less surface hardness. Shear resistance was strongly correlated with vegetative factors such as turfgrass cover whereas it was only slightly associated with soil bulk density and soil moisture conditions (Rogers et al., 1988). In another study, Rogers et al. (1989) investigated the effect of tall fescue's cutting height and verdure on its traction and surface hardness using a shear vane and Clegg impact soil tester with three different hammers (0.5 kg, 2.25 kg, and 4.5 kg). Differences in peak deceleration among different cutting heights were only detected using the 0.5 kg hammer. Moreover, except for a low soil moisture period, different cutting heights had no effect on the traction of tall fescue. McNitt et al. (2003) re-examined the effect of cutting height on tall fescue turf using the PENNFOOT (McNitt et al., 1997) and reported high traction values for lower heights.

As early as 1975, Canaway (1976) reported differences in traction among *Poa pratensis, Lolium perenne, Phleum pretense, Agrostis tenuis, and Festuca rubra* using an early model of the Canaway shear tester. *Poa pratensis* provided the highest traction and *Festuca rubra* provided the lowest (Canaway, 1976). Another study conducted in Pennsylvania reported traction values for tall fescue and Kentucky bluegrass as being significantly higher than the traction values for perennial ryegrass and red fescue. Studies on warm-season turfgrasses showed playing surfaces established with 'Salam' seashore paspalum *(Paspalum vaginatum*) provided the hardest playing surface with a surface hardness of 60 Gmax (surface hardness index measured using Clegg impact soil tester) in comparison to the Tifway hybrid bermudagrass and 'Zeon' manilagrass (*Zoysia matrella*), though Tifway and 'Zeon' generated significantly higher traction or rotational resistance values than 'Salam' (Lulli et al., 2014). Deaton (2009) found a significant cultivar effect while evaluating the shear strength of the four bermudagrass cultivars Tifway, Riviera, Quickstand and Yukon using the Clegg turf shear tester (CST). Quickstand and Riviera generated significantly higher shear strength values than Tifway and Yukon (Deaton, 2009).

Topdressing is a cultural practice frequently used in order to alter the playing surface characteristics. Rogers et al., (1998) in 2 years of study investigated the effect of crumb rubber on shear resistance and surface hardness of Kentucky bluegrass and perennial ryegrass mixture subjected to traffic. The authors reported a 40 % decrease in shear resistance with the addition of crumb rubber for the first year and a decrease in shear resistance of 20 % in the second year. No significant difference was found for peak deceleration, but small crumb rubber size provided significant in providing greater impact time periods than large crumb rubber size. McNitt & Landschoot (2005) found that soil reinforcing materials had little effect on the traction values of turfgrass established on a sand root zone but can help reduce the divot size. Kowalewski et al. (2010) reported that 1.3 cm sand topdressing improved the surface shear strength and shoot density greater than 10 cm for Kentucky bluegrass + perennial ryegrass under traffic stress.

More recently, Dickson et al. (2018) evaluated the effect of soil water content (SWC) on Tifway bermudagrass athletic field safety established on either a cohesive (Sequatchie silt loam soil) or non-cohesive soil (sand meeting US Golf Association rootzone specifications). In their study, traffic was applied for five weeks using a Baldree traffic simulator and plots were assessed for soil bulk density, green turfgrass cover, shear strength, and surface hardness. These parameters were evaluated for varying SWC ranges defined as low (0.6-0.13 m^3m^{-3}), medium (0.14-0.21 m^3m^{-3}), medium-high (0.22-0.29 m^3m^{-3}) and high (0.30-0.37 m^3m^{-3}) for cohesive soil and low (0.20-0.11 m^3m^{-3}), medium (0.12-0.19) m^3m^{-3}, and high (0.20-0.27 m^3m^{-3}) for non-cohesive soil. In their study, surface hardness was measured using the Clegg impact tester (Turf-Tec International, Florida, USA) and shear strength was measured using the Turf-Tech shear strength tester (Turf-Tec International, Florida, USA). Surface hardness increased with a decreasing SWC in a similar manner for each soil type, while shear strength strongly negatively correlated with SWC on the cohesive root zone but not related to SWC on the sand root zone. This response for shear strength also corresponded to changes in green coverage. To increase the hybrid bermudagrass athletic field safety, it was suggested to adapt to low to medium soil water contents for both cohesive and non-cohesive root zones (Dickson et al., 2018).

SOD TENSILE STRENGTH AND HANDLING QUALITY

Sod is the harvested surface layer of turf which consists of interconnected turfgrass plant parts such as rhizomes and stolons, and soil attached to roots of turfgrass plants (Perez et al., 1995). Rapid establishment of a turfgrass stand can be achieved through the installation of turfgrass sod (Perez et al., 1995). In 1920, the commercial production of cultivated turfgrass sod began in the United States (Mitchell & Dickens, 1979). Advancement in sod harvest machinery and development of improved turfgrass varieties resulted in significant growth of the turfgrass industry in the 1950s (Beard & Rieke, 1969).

The major cool-season species used for sod production is Kentucky bluegrass (*Poa pratensis*). The market for creeping bentgrass (*Agrostis stolonifera*) sod is limited whereas the grasses such as perennial ryegrass (*Lolium perenne*) and fine fescue are not used for sod production due to their inability to form good sod (Christians, 2011). The commercial production of tall fescue (*Schedonorus arundinacea*) sod is usually performed with netting and often as a mixture of Kentucky bluegrass and tall fescue. Among warm-season grasses, bermudagrass is the most widely used for sod production with St. Augustinegrass (*Stenotaphrum secundatum*), zoysiagrass (*Zoysia* spp.), centipedegrass (*Eremochloa ophiuroides*), bahiagrass (*Paspalum notatum*), and buffalograss (*Bouteloua dactyloides*) also grown in regions specific to their market (Christians, 2011). The quality of turfgrass sod is greatly influenced by management practices such as mowing, fertilization, and pest management during sod formation. A good quality sod must have uniformity, high density, adequate carbohydrate reserve for effective rooting, less thatch, and proper sod strength, and handling quality (Beard, 1973).

Sod tensile strength is referred to as the resistance offered by a sod pad to tearing (McCallla et al., 2009) or the capacity of the sod to resist longitudinal stress (Shearman et al., 2001). The term sod strength or sod tensile strength holds importance in the sod industry (Beard, 1973). A sod with high tensile strength is desirable as it eases sod handling, transporting, and installation processes. Sod that is unable to hold together while handling can result in economic loss to the sod producer and landscape contractors. New turfgrass varieties developed are often evaluated for sod strength under varying conditions as it is a potentially limiting factor in the sod industry.

As early as 1968, a technique was developed to measure the sod strength. In this method, one end of the sod pad was held stationary and the other end was attached to the metal container through a cable. The sand was added to this container at a constant rate and the weight of sand required to tear the sod pad in two pieces taken as the sod strength (Rieke et al., 1968). Another device was developed at Mississippi State University which consisted of two sod pad holding frames, one moveable and the other frame was stationary. The movable frame was connected to a 0 to 45 kg force transducer which gives the value of sod strength or peak force (PF) required to tear the sod pad. This testing unit was capable of measuring several sod strength parameters – average force (AF), pull distance (PD), total work (TW), peak force (PF), peak work (PW), and average maximum work (AW) (Goatley et al., 1997). Another method was introduced by the University of Georgia to measure sod strength using an Instron universal testing instrument (Burns & Futral, 1980). This was a relatively expensive method but offered uniform measurements and adjustable speed, while measuring the pattern of breakage and measurement of sod elongation before breaking (Burns & Futral, 1980). A simple and inexpensive sod tensile strength testing device was developed by Louisiana State University, using a steel framework consisting of a stationary and movable sod pad holding clamp unit. A pivot mechanism of movable clamp caused a horizontal stretching of the sod pad. A 0.5-inch-drive torque wrench connected to this pivoting mechanism was used to measure the sod tensile strength of the sod pad (Parish, 1995).

A three-year study was conducted in Alabama, to investigate the effects of nitrogen application frequency, nitrogen rate (0.25 kg/acre, 0.5 kg/acre, and 1 kg/acre), and mowing height on tensile strength of Tifway and Tifgreen hybrid bermudagrass sod. The two-week application interval resulted in poor STS in comparison to the 4-week interval. The equal or higher sod tensile strength was reported for the 0.25 kg/acre rate in comparison to higher N rates. Sod tensile strengths were not affected by mowing height from (1.25 or 2.5 cm). Tifway had higher sod strength than Tifgreen apparently due to its massive stolon and rhizome production. These findings suggested that variation for sod tensile strength exists between different bermudagrass cultivars and sod tensile strength decreases with increased nitrogen application rate and decreased application frequency (Mitchell & Dickens, 1979).

The effects of preemergence herbicides-pendimethalin (3.36 kg ai ha^{-1}), dithiopyr (0.56 kg ai ha^{-1}), prodiamine (0.6 kg ai ha^{-1}), dimethenamid-P (3.36 kg ai ha^{-1}), prodiamine + sulfentrazone (0.84 + 0.41 kg ai ha^{-1}), oxadiazon (3.36 kg ai ha^{-1}), and indaziflam (0.03 and 0.05 kg ai ha^{-1}), on establishment rate and sod tensile strength of Tifway hybrid bermudagrass were evaluated in Tennessee. The results from this study suggested that days required to reach 50 % cover were higher for all herbicide-treated plots in comparison to the nontreated control. Furthermore, sod tensile strength was reduced by indaziflam treatment in the first year but not in the second year. No reduction in sod tensile strength was found for any other herbicide treatment at any time (Brosnan et al., 2014). More recent research conducted at Mississippi State University, evaluated the effect of preemergence herbicide-atrazine, atrazine + S-metachlor, dithiopyr, flumioxazin, indaziflam, oxadiazon, S-metachlor, pendimethalin, prodiamine, and simazine on tensile strength of newly sprigged ‘Latitude 36’ hybrid bermudagrass. No reduction in sod tensile strength was found for any herbicide-treated plots in either year (Begitschke, 2018).

A field study to evaluate sod handling quality (SHQ) and sod tensile strength (STS) of four hybrid bermudagrasses: (Patriot, Tifway, OKC 70-18, and Midlawn), was conducted in Oklahoma (Han, 2009). Sod handling quality was evaluated using the following rating scale developed by Han (2009), where

1 = complete breakage, inability to transport to sod tearing device (unacceptable quality),

2 = substantial cracking, but still transportable to sod tearing device,

3 = moderate cracking (minimally acceptable value for industry handling

4 = very mild cracking (preferred value for cultivar commercialization)

5 = no cracking.

Sod tensile strength of the selected grasses was measured using the Oklahoma State University 2003 version of a sod tensile strength testing device. Results showed that Patriot yielded sod tensile strength greater than that of Midlawn or OKC 70-18 on each of five dates, whereas tensile strength of ‘Patriot’ was greater or equal to Tifway. OKC 70-18 yielded lower sod tensile strength and sod handling quality than Tifway or Patriot on all five harvests. Patriot and Tifway exhibited suitable sod handling quality (SHQ) and sod tensile strength (STS) while Midlawn and OKC 70-18 were medium or poor performing entries (Han, 2009).

Gopinath (2015) conducted a field study at Oklahoma State University to evaluate the sod tensile strength and sod handling quality, of thirty-nine bermudagrass entries which included seeded and vegetatively propagated entries. The commercially available entries were Tifway, Latitude 36, Patriot, Celebration, ‘NuMex Sahara’, ‘Princess 77’, Riviera, Yukon, ‘North Shore SLT’, ‘Astro’, TifGrand, ‘U-3-NC’, ‘U-3-TGS’, and Quickstand. A positive correlation between sod tensile strength and sod handling quality (r^2= 0.85) was observed. The results showed that Latitude 36 yielded the highest STS of 74.6 kg dm^{-2} and PST-RT9S showed the lowest STS of 9.6 kg dm-2. Tifway, Latitude 36, Patriot, Princess 77, 12-TSB-1, TifTuf, FAES 1326, OKC 1302, Astro, Quickstand, Celebration, TifGrand, ‘U-3-SIU’, FAES 1327, and FAES 1325 were in the top statistical group for SHQ and STS on most of the harvesting dates. Riviera, Yukon, PST-R6T9S, PST-R6PO, JSC 2009-2, 11-T-251, U-3-TGS, and U-3-NC reported the lowest statistical group for STS. Results also suggested that seeded entries showed lower STS in comparison to vegetatively propagated with exception of seeded entries 12-TSB-1 and Princess-77 (Gopinath, 2015).

In another study conducted at Oklahoma State University, Segars et al. (2020) evaluated a few experimental and commercial bermudagrass ‘Latitude 36, NorthBridge, ‘OKC1131’ (Tahoma 31), Tifway, and Midlawn) for their STS and SHQ, to find the relationship between STS and SHQ, and also to see the impact of vegetative characteristics on sod strength. A positive correlation between SHQ and STS (r^2= 0.65) was reported. Tifway was rated higher for STS than Tahoma 31, NorthBridge, Latitude 36 and Midlawn and some experimental entries in 2015 data. Evaluation of STS was repeated in 2018 resulting NorthBridge being rated higher than Midlawn and some experimental entries. Rhizome characteristics such as rhizome strength and length did not affect the sod tensile strength (Segars et al., 2020).

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CHAPTER II

EVALUATION OF TRAFFIC TOLERANCE AMONG COMMERCIAL AND EXPERIMENTAL BERMUDAGRASSES

ABSTRACT

Bermudagrass [*Cynodon* spp. (L.) Rich.] is the most preferred turfgrass species for athletic fields and golf courses in the southern and transition zones of the United States. Traffic tolerance is a critical trait for turf in both the athletics and golf industries. A 2-year field study was conducted on a Norge loam soil in Stillwater, Oklahoma, to evaluate 9 commercially available and 87 experimental bermudagrasses for fall traffic tolerance, fall color retention, and spring green-up. The experiment was arranged as a split-block design with three replications, and plots were subjected to either non-trafficked conditions or simulated cleat traffic for 6 weeks in the fall of 2019 and 2020 using a Baldree Traffic Simulator. Bermudagrasses were evaluated weekly during the traffic period for turf quality, normalized difference vegetation index, and percent green cover by digital image analysis. Under traffic, 14 experimental and 4 cultivars were in the top statistical group on each date for each variable. Among these entries, 17-5200-4x11, 17-4200-19x9, 'Bimini', 'OKC1134' (NorthBridge), and OSU1664 also showed minimal variation from non-trafficked to trafficked conditions suggesting excellent traffic tolerance. The entries 18-8-1, 17-5200-31x3, and 'U-3-SIU' had excellent fall color retention under non-trafficked conditions, while the entries 18-8-3, 18-9-2, 17-5200-3x23, and 17-5200-4x11 shown excellent fall color retention when trafficked. Excellent spring green-up was demonstrated by entries OSU1609, 'OKC1131' (Tahoma 31), OSU1117, and OSU1638 across both traffic treatments. These results demonstrate the variability among bermudagrass for fall traffic tolerance, color retention, and post-dormancy regrowth. Findings also illustrate the importance of cultivar selection in enhancing the sustainability of bermudagrass turf surfaces under the transitional climatic zone.

INTRODUCTION

Bermudagrass [*Cynodon* spp. (L.) Rich] is the predominant warm-season turfgrass for athletic field use in the southern and transition zones of the United States (Beard, 1973). The widespread use of bermudagrass is due to its relative ease of establishment, wide mowing height tolerance range, tolerance to heat and traffic stress, and excellent recovery rate (Christians, 2011). Traffic stress can result in injury to a turfgrass stand from pressure, tearing, and scuffing (Trenholm, Carrow, et al., 2000). Generally, four types of damages are associated with traffic on turf sites: wear, soil compaction, rutting, or soil displacement and divoting (Carrow & Petrovic, 1992). Crushing and tearing of plant parts is referred to as 'wear'. Soil compaction causes a decline in porosity and increase in bulk density which leads to reduced growth of turfgrasses. The displacement of soil particles due to pressure causes depression on turf sites which is termed rutting. Divoting refers to the removal of turf from a surface due to vehicular or foot actions (Carrow & Petrovic, 1992). Repeated traffic stress due to turf equipment and athlete usage can result in an increase in soil bulk density, decrease in turf density, and a decrease in percent green cover (Kowalewski et al., 2013).

To characterize the effect of traffic on turfgrass response, several traffic simulation devices have been developed. A tractor driven cleated drum model known as the Brinkman traffic simulator was developed in California to simulate cleat traffic (Cockerham & Brinkman, 1989). Later, the Cady traffic simulator was introduced, as an improved machine able to simulate three-dimensional dynamic force, and increased stress that better mimicked true cleated traffic (Henderson et al., 2005). Most recently, the Baldree traffic simulator was developed a more durable and efficient version of the Cady trafficker (Kowalewski et al., 2013).

As early as 1961, Youngner reported differences among bermudagrass cultivars for their ability to tolerate traffic stress. In a study in Texas, variation among 17 bermudagrass cultivars were reported in terms of a percent reduction in verdure after a prescribed traffic treatment (Beard et al., 1981). Bigelow and Hardebeck (2006) evaluated the performance of four bermudagrass cultivars (‘Mirage’, ‘Riviera’, ‘Quickstand’ and ‘Yukon’) in response to autumn N applications and simulated traffic, and reported that ‘Riviera’ was more tolerant to traffic stress than Quickstand. In a separate study ‘Tifway’ and ‘Riviera’ were considered to have greater tolerance to traffic than Quickstand (Goddard et al., 2010). Williams et al. (2010) investigated the traffic tolerance and divot recovery of eight bermudagrass cultivars and reported ‘Riley’s Super Sport’ (hereafter referred to as Celebration) and ‘ST-5’ (TifGrand) as having high wear tolerance in comparison to the industry standard Tifway, and ‘T11’ as having faster divot recovery than Tifway. Thoms et al. (2011) determined Tifway and Riviera as having greater traffic tolerance than ‘Patriot’ based on percent green cover assessment under simulated traffic conditions.

Trappe et al. (2011) investigated 42 bermudagrass cultivars in the summer and the fall season for traffic tolerance using turf performance index (TPI) approach. The cultivars Celebration, PremierPro, Contesssa, and Barbdos and some experimental genotypes were considered to have relatively good traffic tolerance over both seasons (Trappe et al., 2011). A separate study conducted in Oklahoma determined Riviera, ‘OKC1134’ (herafter referred to as NorthBridge), and ‘OKC1119’ (hereafter referred to as Latitude 36) as the most traffic tolerant among 40 evaluated bermudagrasses (Segars, 2013). ‘DT-1’ (hereafter referred as TifTuf) was shown to have improved traffic tolerance compared to Tifway under six weeks of simulated traffic stress (Kowalewski et al., 2015) Collectively, these studies show that some bermudagrass cultivars show superior traffic tolerance and some show poor traffic tolerance. To reduce maintenance and increase the sustainability of athletic fields, it is important to select bermudagrass having improved traffic tolerance.

In much of the United States, bermudagrasses slow growth, begin losing green color, and enters a dormancy period when soil temperature fall below 12.7˚C (at 10cm depth) in late fall (Beard, 1973; Christians, 2011). Bermudagrass remains in this dormancy period for up to 5 months (Croce et al., 2003), before resuming active growth when soil temperature exceed 18.3°C (at 10 cm depth) for several days (Christians, 2011). The return to active growth has been termed spring green-up or post dormancy growth and is initiated with the metabolization of carbohydrate reserve under favorable conditions (Dipaola et al., 1992). The ability of bermudagrass to retain green color for a longer period during the fall or emerge early in the spring is particularly desirable in athletics where fall and winter sports often dictate overseeding with cool-season species. Reports from National Turfgrass Evaluation Program (NTEP) demonstrate bermudagrasses can vary in their relative fall color retention and post dormancy growth traits (NTEP, 2013, 2014). In some cases, fall color retention and spring green-up can be influenced by traffic and low temperateure survivability of the plant. An ideal bermudagrass cultivar would have good traffic tolerance, cold survivability, and an extended season of growth (Anderson et al., 2007). Continued efforts to select for these traits will contribute to improved sustainability of bermudagrass systems across the transition zone of the United States.

OBJECTIVES

- To quantify the differences among bermudagrass cultivars and experimental selections in their ability to tolerate fall cleat traffic stress.
- To quantify fall green color retention and post-dormancy regrowth of bermudagrass cultivars and experimental selections.

HYPOTHESES

- Bermudagrass cultivars and experimental selections will vary in their ability to tolerate fall cleat traffic stress.
- Bermudagrass cultivars and experimental selections will vary in their ability to retain fall green color and to regain post dormancy regrowth.

MATERIAL AND METHODS

Site description, establishment and plot maintenance

A field study was conducted in 2019 and 2020 at the Oklahoma State University (OSU) Turfgrass Research Center, Stillwater, Oklahoma. There were a total of 96 bermudagrass entries including 9 commercially available cultivars and 87 experimental selections developed by the OSU turfgrass breeding program. The cultivars used were Astro, Bimini (Obtained from Bethel farms, Florida), Celebration, Latitude 36, North Bridge, OKC1131 (hereafter referred as Tahoma 31), TifTuf, Tifway, and U-3-SIU (U-3 obtained from Southern Illinois University, hereafter referred to as U-3).

Bermudagrass entries were planted in Norge loam soil (Fine-silty, mixed, thermic, Udic Paleustoll) on 5 Jun. 2019 as 0.025 m plugs on 0.3 m spacing within 2.4m x 1.2m plots. A 0.23 m spacing was kept between the adjacent plots using glyphosate. Immediately after planting, fertilizer (25-0-10, N-P_2O_5-K_2O) was applied at a rate of (4.8 g m^{-2} N) and oxadiazon (Ronstar G, Bayer, NC) was applied at a rate of 2.24 kg ha^{-1} a.i. A preliminary soil test (Soil, Water and Forage Analytical Laboratory, Stillwater, OK) demonstrated moderately low soil P. In order to ensure the young plants were not limited by nutrient availability, one application of a complete fertilizer 10-20-10 (4.8 g m^{-2} N) was made on 21 Jun. 2019. Granular urea (46-0-0) was applied weekly at a rate of 4.8 gm^{-2} N for six weeks from 1 Jul. 2019 to 5 Aug. 2019 to promote rapid establishment. Irrigation was applied through in-ground sprinklers irrigation to meet the water requirement during establishment. A triplex reel mower (TR330, Jacobsen Corporation, Wisconsin, USA) was used to mow plots at 2.5cm with clippings returned starting at five weeks after planting and then three times per week during the growing season for the remainder of the study.

Diammonium phosphate (18-46-0) (4.8 g m^{-2} N) was applied in May 2020 again to ensure sufficient P for optimal plant growth. Granular urea (46-0-0) was applied monthly at a rate of 4.8 gm^{-2} N from June to August 2020. Oxadiazon (Ronstar Flo) was applied on 3 Mar. 2020 at a rate of 5.6 kg ha^{-1} a.i. to control summer annual weeds. Pendimethalin (Pendulum 3.3 EC) was applied on 2 Sep. 2020 at a rate of 7 kg ha^{-1} a.i. to control winter annual weeds.

Traffic Simulator Construction and traffic application

The Baldree traffic simulator was created by modifying a self-propelled core aerifier (ProCore 648, The Toro Company, Minnesota, USA) unit (Figure 1). Coring heads of aerifier units were replaced by six spring-loaded metal plates fitted with screw-in plastic cleats of 1.27 cm size (Figure 2) as described by Kowalewski et al. (2013). One pass (hereafter referred to as a traffic event) of this unit when operated at a ground speed of 0.38 m s^{-1} and at tine spacing of 25mm, created approximately 678 cleat marks per square meter, which has been described as equal to the number of cleat marks that occur within the zone of traffic concentration during one National Football League (NFL) or intercollege football game (Cockerham & Brinkman, 1989). Traffic application was done exclusively using the backward direction of the machine. Half of each plot was subjected to traffic while the other half of the plot was left as non-treated control. Traffic was applied from 16 Sept. to 26 Oct. in 2019 and from 7 Sept. to 16 Oct. 2020 to simulate fall traffic typical of American football seasons. Two traffic events were applied per day from Monday through Friday totaling 10 traffic events per week or 60 traffic events for a six-week period. Traffic was not applied on rainy days and missed traffic events were applied on a subsequent day to ensure 10 traffic events per week.

Data collection

The following measurements were conducted for both non-trafficked and trafficked plots: turfgrass quality (TQ), percent green coverage (PGC), normalized difference vegetation index (NDVI), visual fall color retention (VFC), fall PGC (FPGC), fall NDVI (FNDVI), visual spring green-up (VSG), and spring PGC (SPGC). During the traffic period, TQ, PGC, and NDVI were measured at 0, 10, 20, 30, 40, 50, and 60 traffic events in each year.

Turfgrass quality was rated based on color, density, uniformity, texture, and disease or environmental stress of the turf with 9 being the best and 1 being the poorest turfgrass cultivar. A rating of 6 was deemed to be minimally acceptable turf (Morris & Shearman, 1998). Percent green cover was measured using images collected with a digital camera (Powershot G5; Canon, Tokyo, Japan) and a controlled light box (Richardson et al., 2001). The images were analyzed using ImageJ 1.52a software (National Institute of Health, USA) using a custom macro and the color threshold feature. The software counts the number of the green pixels in the image then divides the green pixel count with the total pixel count of the image to estimate the percent green cover in the image. To determine NDVI, spectral reflectance was collected at 650 nm [red (R)] and 730 nm [near infrared (NIR)] bands using a multispectral crop canopy sensor (ACS470 Crop Circle, Holland Scientific, Lincoln, NE). These measurements were then used to compute NDVI using the following formula:

$$NDVI = \frac{(NIR-R)}{(NIR+R)}$$ (Trenholm et al. 1999).

After the traffic period but before dormancy, fall color retention was evaluated as VFC, FNDVI, and FPGC on Oct. 20, Nov. 3, and Nov 12 in 2019 and on Oct. 21, Nov. 2, and Nov. 14 in 2020. Spring green-up was evaluated as VSG and SPGC on Mar. 27, Apr. 10, and Apr. 26 in 2020. For both VFC and VSG, visual ratings were scored on a 1 to 9 scale where 9 is given to the whole plot with dark green color and 1 is given to straw or brown color using methods described by Morris and Shearman (1998). Measurement of FNDVI was similar as described for NDVI, and measurements of FPGC and SPGC were similar those described for PGC.

Data Analysis

The experiment was conducted as a split-block arrangement with three replications. The two factors were bermudagrass entry and traffic (trafficked versus non-trafficked). Because of the dataset size and complexity, separate analyses were conducted by date within each year, using Statistical Analysis System (Version 9.4; SAS Institute Inc., Cary, NC). All data were subjected to ANOVA using PROC GLIMMIX with the LINES statement adjusted to separate means using Tukey's honest significance test (α=0.05). Due to the large number of evaluation dates, a turf performance index (TPI) was calculated for each year as the number of times (dates) each entry appeared in the top statistical group for a given parameter (Wherley et al., 2011). Data collected during the six-week traffic period (PGC, TQ, and NDVI) were summed within the year and traffic conditions to develop a comprehensive estimate of relative turf performance for each environment. Separate TPI were calculated for fall color retention (FPGC, VFC, and FNDVI) and spring green-up (SPGC and VSG).

RESULTS

Traffic Period

Results of ANOVA

Analysis of PGC showed a significant entry*traffic interaction effect on six of seven rating dates in fall-2019 (Table 2). A significant entry *traffic interaction effect was observed for visual turf quality on three rating dates, while a significant entry main effect was observed on four rating dates, and a traffic main effect was observed on three of seven rating dates. A significant entry *traffic interaction effect was observed for NDVI on six rating dates, while the entry main effect was only significant on one rating date. In fall-2020, analysis of PGC showed significant entry*traffic interaction effect on six rating dates, and a significant entry main effect was observed on one rating date (Table 5). A significant entry *traffic interaction effect was observed for TQ on five rating dates, a significant entry main effect was observed on two rating dates, while a significant traffic main effect was observed on one rating date. Concerning NDVI, the significant entry*traffic interaction effect was observed on three rating dates, while a significant entry main effect was observed on four rating dates and a significant traffic main effect on three rating dates.

2019 Means Comparisons and TPI

Means for PGC, TQ, and NDVI (pooled across all non-trafficked entries) generally declined as a linear function of WAT resulting in values ranging from 76.7% to 43.7%, 8.0 to 6.6, and 0.732 to 0.562, for 0 and 6 WAT, respectively (data not presented). For non-trafficked bermudagrasses, significant differences among entries were present for TQ and NDVI on seven rating dates, and PGC on six of seven rating dates. The entries 18-8-1, 18-8-3, TifTuf, 18-8-7, and, OSU1101 had a perfect TPI of 21 indicating each was in the top statistical group on all 21 possible rating dates in fall 2019 (Table 7). U-3 had a TPI of 20, Tahoma 31 had a TPI of 19, and Bimini, Latitude 36, Celebration, NorthBridge, and Tifway each had a TPI of 18. Astro was the poorest performing bermudagrass cultivar having a TPI of only 15. 18-8-1 had greater PGC than Bimini, Latitude 36, NorthBridge, and Tifway on three rating dates, Tahoma 31 and

Celebration on two rating dates, and U-3 on one date. The poorest performing entries were OSU1649 and OSU1673 which had TPI's of 2 and 5 respectively.

Means for PGC, TQ, and NDVI (pooled across all trafficked entries) generally declined as a linear function of WAT resulting in values ranging from 78.4% to 32.3%, 7.9 to 4.7, and 0.762 to 0.471 for 0 and 60 traffic events, respectively (data not presented). For trafficked bermudagrasses, significant differences among entries were present for TQ and NDVI on all seven rating dates, and PGC on six of seven rating dates. Each of the bermudagrass cultivars and 47 of the experimental had a TPI of 21 (Table 8). Among these top performers, TifTuf, 18-8-3, 18-7-2, Bimini, OSU1101, 18-9-10, U-3, 18-8-7, OSU1217, and 18-8-1 were able to maintain PGC equal to or greater than 40 % after 60 traffic events. OSU1629, OSU1649, and OSU1639 were the poorest performing entries under traffic stress, having a TPI of 2, 8, and 10 respectively.

Traffic did not affect PGC on any rating for OSU1217, and not prior to 60 traffic events for TifTuf, Bimini, and 18-7-2 (Table 13). In contrast, traffic reduced PGC at only 50 traffic events for Latitude 36, Celebration, NorthBridge, Tifway, OSU1101,18-8-3, 18-8-7, and at 40 traffic events for Astro and Tahoma 31. The least traffic tolerant entries were OSU1629 and OSU1639 which demonstrated a significant effect after just 10 traffic events and resulted in a PGC of less than 30% after 60 traffic events.

2020 Means Comparisons and TPI

Means for PGC, TQ, and NDVI (pooled across all non-trafficked entries) generally declined as a linear function of WAT resulting in values ranging from 81.2% to 61.6%, 7.9 to 5.9, and 0.712 to 0.661, for 0 and 6 WAT, respectively (data not presented). For non-trafficked bermudagrasses, significant differences were present for PGC, TQ, and NDVI on all seven rating dates. Seven out of the nine named cultivars (TifTuf, Bimini, Tahoma 31, Latitude 36, Celebration, Tifway, and Astro) and 56 of the 87 experimental selections demonstrated a perfect TPI of 21 (Table 7). NorthBridge and U-3 had a TPI of

20. The poorest performing entries were OSU1673, 17-5200-11x9, and OSU1649 having a TPI of 3, 5, and 9 respectively.

Means for PGC, TQ, and NDVI (pooled across all trafficked entries) generally declined as a linear function of WAT resulting in values ranging from 82.3% to 43.3%, 7.8 to 3.9, and 0.715 to 0.542 for 0 and 60 traffic events, respectively (data not presented). For trafficked bermudagrasses, the significant differences among entries were present for PGC, TQ, and NDVI on all seven rating dates. Four out of the nine named cultivars (Bimini, Tahoma 31, Celebration, and NorthBridge) and 20 of the 86 experimental selections demonstrated a perfect TPI of 21 under traffic stress (Table 8). Latitude 36, TifTuf, and U-3 had a TPI of 20, Astro had a TPI of 19, and Tifway had a TPI of 16. The poorest performing entries were OSU1673, OSU1690, OSU1663, and OSU1649 having a TPI of 2, 3, 3, and 3 respectively.

Among top performers, Bimini, 17-5200-4x11, 18-8-7, 18-8-2, OSU1101, 17-4200-19x9, 18-8-3, 18-7-1, 18-7-6, 18-8-1, 18-9-3, 18-9-8, 17-4200-36x19, OSU1638, and 18-9-2 were able to maintain 50% or more PGC after 60 traffic events (data not presented). Traffic did not reduce the PGC of 18-8-3 prior to 60 traffic events and Bimini, 17-5200-4x11, 18-8-7, 18-9-2, and 17-4200-19x9 prior to 50 traffic events (Table 14). Traffic reduced the PGC of U-3 after 50 traffic events, Celebration after 40 traffic events, Latitude 36, Astro, and Tahoma 31 after 30 traffic events, while TifTuf and Tifway showed traffic effect after only 10 traffic events. Traffic had a highly significant effect on the PGC of the poorest performing entry OSU1690 on six of seven rating dates.

Fall Color Retention

Analysis of variance for FPGC showed a significant entry*traffic interaction effect on two rating dates and a significant entry main effect on one rating date in 2019 (Table 3). For VFC, a significant entry*traffic interaction effect was observed on each of the three rating dates. For FNDVI, there was a significant entry*traffic effect on each rating date. In 2020, analysis of variance for FPGC showed significant entry*traffic interaction effect on two rating dates and significant entry and traffic main effect on one rating date (Table 6). For VFC, the entry*traffic interaction effect was present on all three rating dates. The entry*traffic interaction effect was present for FNDVI on all three rating dates.

2019 Means Comparisons and TPI

For non-trafficked bermudagrasses, significant differences among entries were present for FPGC, VFC, and FNDVI on all three rating dates. Among experimental entries OSU1629 demonstrated excellent fall color, having a significantly higher FPGC (17.6%) than Astro (9.8%), Bimini (10.1%), NorthBridge (8.3%), and TifTuf (10.3%) on the 12 November rating (data not presented). On the basis of TPI, 18-8-1, U-3, 17-5200-31x3, OSU1629, and OSU1639 were the top performers for fall color retention with each having a TPI of 8 (Table 9). TifTuf had a TPI of 5, Latitude 36, Tahoma 31, Celebration, and Tifway had a TPI of 4, whereas Bimini and NorthBridge had a TPI of 3. Among the named cultivars, Astro was the worst performer for fall color retention having a TPI of 2. OSU1675, OSU1408, 18-9-1, and 18-9-6 demonstrated poor fall color retention with each having a TPI of 1.

For trafficked bermudagrasses, significant differences among entries were present for FPGC, VFC, and FNDVI on all three rating dates. The experimental 18-8-3, 17-5200-31x3, and 17-5200-3x23 were the top performers for fall color retention under traffic stress with each having a perfect TPI of 9 (Table 10). U-3 had a TPI of 7, while Bimini, Tahoma 31, TifTuf, and Tifway each had a TPI of 6, and Latitude 36 and Celebration had a TPI of 5, and NorthBridge had a TPI of 4. Astro was the worst-performing cultivar having a TPI of 4. OSU1408 and OSU1687 demonstrated poor fall color retention under traffic, having a TPI of 1 and 2 respectively.

2020 Means comparisons and TPI

For non-trafficked bermudagrasses, significant differences among entries were present on all 3 rating dates for FPGC, VFC, and FNDVI in 2020. The experimental 18-9-9 was among the top performers for this trait, having greater FPGC than Astro, Bimini, Celebration, Latitude 36, and

NorthBridge on the 14 November rating (data not presented). Three named cultivars (U-3, TifTuf, and Bimini) and 20 experimental selections resulted in a perfect TPI of 9 (Table 9). Tifway had a TPI of 8, Latitude 36 and Celebration had a TPI of 7, Astro and Tahoma 31 had a TPI of 6 and NorthBridge had a TPI of 4. 18-7-5 and 15-5200-11x9 were the poorest performing entries, with each having a TPI of 0.

For trafficked bermudagrasses, the significant differences among entries were present on all 3 rating dates for FPGC, VFC, and FNDVI. 18-8-3 was among the top-performing experimentals for this trait when under traffic, having greater FPGC than U-3, Tahoma 31, Astro, Latitude 36, NorthBridge, and Celebration on the 14 November rating date (data not presented). Three named cultivars (Bimini, TifTuf, and Tifway) and 12 experimental selections resulted in a perfect TPI of 9 (Table 10). U-3 and Latitude 36 had a TPI of 8, Celebration and NorthBridge had a TPI of 7, Tahoma 31 had a TPI of 6 and Astro had a TPI of 3. 18-7-5, OSU1649, OSU1661, and OSU1673 were the poorest entries for this trait, with each having a TPI of 0.

Spring Green-Up

Analysis of variance of SPGC and VSG showed significant entry*traffic interaction effect on all three rating dates in 2020 (Table 4).

For non-trafficked bermudagrasses, significant differences among entries were present on all three rating dates for SPGC and VSG. Among the experimentals, OSU1609 demonstrated excellent spring green-up as indicated by a significantly greater SPGC (43.9%) than TifTuf (20.3%), Tifway (15.5%), and Celebration (17.1%) on the 28 March rating date (data not presented). The entries OSU1117, OSU1609, OSU1638, OSU1639, and Tahoma 31 had a perfect TPI of 6 (Table 11). Latitude 36, NorthBridge, Bimini, Astro had a TPI of 5, TifTuf, and U-3 had a TPI of 4. Among named cultivars, Celebration and Tifway demonstrated the poorest spring green-up, with each having a TPI of 2. The worst performing entries were 18-7-4, 18-7-5, 18-8-1, 18-9-4, and 18-9-7, with each having a TPI of 0.

For trafficked bermudagrasses, significant differences among entries were present on all three rating dates for SPGC and VSG. OSU1609, OSU1638, OSU1117, OKC1221, and Tahoma 31 were the top-performing entries for spring green-up under traffic stress with each demonstrating a perfect TPI of 6 (Table 12). Latitude 36, NorthBridge, Bimini, Astro, and TifTuf had a TPI of 5, U-3 had a TPI of 4, and Celebration had a TPI of 3. Among named cultivars, Tifway demonstrated the poorest spring green-up, having a TPI of 2. The poorest performing trafficked entries for spring green-up were 18-7-4, 18-7-5, 18-8-1, 18-8-7, 18-9-4, 17-5200-13x9, OSU1611, OSU1629, and OSU1649, with each having a TPI of 0.

DISCUSSION

The relative rankings among bermudagrasses varied when subjected to traffic versus non-trafficked conditions. These findings are in agreement with Trappe & Karcher et al. (2011), where the performance of non-trafficked bermudagrasses (Princess 77, Riviera, Tift-94, and Tifway) differed from trafficked bermudagrasses when subjected to full sun or 49% shade conditions. A separate study in Arkansas reported the variation in rooting characteristics and traction of Riviera bermudagrass among non-treated and three shade levels (30%, 60%, and 90%) under both overseeded and non-overseeded conditions (Richardson et al., 2019). Most of the previous research in the field of traffic tolerance evaluation has been limited to one set of environmental conditions, namely trafficked (Kowalewski et al., 2015; Segars, 2013; Trappe et al., 2011). The present study illustrates how a non-trafficked control can aid in differentiating between traffic tolerance and entries which perform well simply due to having inherently superior turf quality. All these findings illustrate the importance of implementing a control, when investigating a trait potentially influenced by a genotype by environment interaction.

In the present study, calculating a separate TPI for trafficked and non-trafficked conditions was deemed appropriate since there is potential merit in selecting turfgrasses for different intended uses. For example, bermudagrasses performing well under traffic are likely to be preferred for use in sport fields or other highly-trafficked sites. On the other hand, bermudagrasses desired for lawns, parks, gardens, roadsides, and various other areas may not place such a premium on traffic tolerance. In such cases, the relative rankings for non-trafficked conditions may provide a more appropriate means of selection.

A prior study conducted in Arkansas similarly used TPI to report differences in fall traffic tolerance among 42 bermudagrasses, although their study did not implement a non-trafficked control to separate genotype by environment interactions (Trappe et al., 2011). In the present study, fall traffic tolerance for a given entry was defined as having a high TPI under trafficked conditions while also showing a delayed effect of traffic over time. Using this combined approach, the present study resulted in substantial variability in the relative traffic tolerance among entries. In most cases, entries showing high TPI's also showed a delayed effect of traffic. In at least a few cases (e.g., 18-8-1), entries showing a moderate to good TPI were affected by traffic fairly quickly. Such a result suggests some grasses had good turf traits and were well-adapted to the experimental conditions, but may not have had good traffic tolerance. Likewise, in at least a few cases (e.g., OSU1661 and 18-9-6) entries showing a poor TPI were not necessarily affected by traffic. These findings illustrate that some grasses might have good traffic tolerance but had poor turf traits in general.

Under two years of fall simulated traffic stress, four of the nine named cultivars and 13 experimental entries were considered top performers. The entries 17-4200-19x9, 17-5200-4x11, OSU1664, Bimini, and NorthBridge were identified as having the greatest traffic tolerance as well as excellent adaptation to the experimental conditions. Several of the other entries had a perfect TPI of 42 but were deemed marginally less traffic tolerant than this top group due to the early expression of traffic effects. The poor performance of Tifway relative to newer cultivars and even several experimentals is consistent with prior research conducted in Oklahoma, Georgia and the country of Turkey (Haselbauer et al., 2012; Segars, 2013; Sever Mutlu et al., 2020). Around 80% of bermudagrasses in our study had TPI greater than 30, demonstrating at least moderately good fall performance. More importantly, most of the recently released cultivars were superior to older releases like Tifway, while several experimental entries performed better than even the named cultivars illustrating the effect of bermudagrass breeding on increasing performance traits.

The greater decline over time in PGC, NDVI, and TQ for plots under trafficked conditions as compared to non-trafficked conditions is consistent with a similar study in Georgia and indicates the traffic regimes applied in the present study was sufficient to create stress (Kowaleski et al., 2013). Interestingly, greater PGC in the present study (pooled across all treatment combinations) in year 2 (52%) as compared to year 1 (38%) suggests the maturity of turf stand was more important for fall performance than any cumulative effect of traffic. This was particularly evident in a few entries (e.g. OSU 1629 and OSU1639) which demonstrated a slow establishment rate likely causing poor performance in the first year while they were largely in the top statistical group throughout the second year. Around 60% of bermudagrass entries in our study demonstrated excellent to moderate TPI under 60 games of simulated traffic stress. This suggests the need to further evaluate these entries under more than a 60 game regime to further distinguish those having elite traffic tolerance. Furthermore, a higher mowing height has been associated with greater traffic tolerance (Youngner et al., 1961). The present study used a mowing height of 2.54 cm which is common for many sports fields but not necessarily at the professional level which is often mowed between 1.3 and 1.9cm. Whether the present results are indicative of how entries would perform at these lower mowing heights is not certain.

Grasses able to maintain green color longer into the fall would potentially reduce the need for or rate of overseeding used to meet aesthetic expectations for late fall sporting events. The effect of fall-applied traffic on bermudagrass fall color retention has not been widely reported. Variation in fall color retention between trafficked and non-trafficked conditions suggests the potential influence of a genotype by environment interaction. Under non-trafficked conditions, the entries showing the most consistent performance for fall color retention were U-3, 18-8-1, and 17-5200-31x13. In contrast, 18-8-3 demonstrated the most consistent fall color retention when trafficked, having a perfect TPI of 18 over two years. Among entries that were identified as having elite traffic tolerance, only one experimental (17-

5200-4x11) also showed excellent good fall color retention under traffic. Our finding illustrates that even genotypes having good fall traffic tolerance could vary in late fall for green color retention. Fall color retention or chilling tolerance is known to be dependent on the integrity of plant cell and plastid membrane in response to late fall chilling stress (Fontanier et al., 2020; Kimball and Salisbury, 1973). Bermudagrass genotypes undergo a different level of physiological changes in response to low temperature which contributes to their varied fall color retention or chilling tolerance. Fontanier et al. (2020) reported Tifway as having greater fall color retention than Tahoma 31 and Celebration, due to greater unsaturation of fatty acid such as monogalactosyldiacylglycerol in response to chilling stress. All cultivars were in excellent to moderate range for this trait in both non-trafficked and trafficked conditions, except NorthBridge and Astro which were poorest. Our findings for Astro in non-trafficked conditions are consistent with the findings of the national bermudagrass test (NTEP, 2013). In contrast, a prior study in Oklahoma reported no differences between Astro and top performers for fall color retention like Tifway (Gopinath, 2015).

The entries OSU1609, OSU1117, OSU1638, and Tahoma 31 were identified as top performers for spring green-up across both traffic conditions, while 18-7-4, 18-7-5, 18-8-1, 18-8-7, 18-94, and 17-5200-13x19 were the poorest. Early spring green-up has been associated with high water-soluble carbohydrate in stolons (Macolino et al., 2010). Giolo et al. (2013) similarly found high starch-accumulating bermudagrasses demonstrated early spring green-up. Similar to findings for fall color retention, discrepancies between spring green-up of some entries (e.g., OSU1639) managed with or without traffic suggests a genotype by environment interaction for this trait. The superior spring green-up for Tahoma 31 among named cultivars, as well as the poor spring green-up for Tifway and Celebration under non-trafficked conditions, have been previously reported by Fontanier et al. (2020) and is in agreement with a recent national bermudagrass test (NTEP, 2013). The present findings are also in agreement with Segars (2013), who reported Latitude 36 and NorthBridge as having superior spring green-up to Celebration, U-3, and Tifway under trafficked conditions. In contrast to the present study, TifTuf and Astro were previously reported as having delayed spring green-up as compared to Latitude 36 under trafficked conditions in Kentucky (NTEP, 2017). The comparatively better performance of TifTuf in the present study may be indicative of differences in experimental conditions between studies. In particular, we speculate the relatively mild temperature experienced in winter 2019-20 (Figure 4) may have contributed to the performance of entries having lesser cold hardiness.

CONCLUSION

The present study concluded that the bermudagrasses could substantially vary in their ability to tolerate fall cleat traffic stress. There was a large group of entries that were in the top statistical group on all dates when trafficked including; 14 experimentals (17-4200-19x13, 17-5200-4x11, 17-5200-3x23, 17-4200-19x9, 18-8-2, 18-8-7, 18-9-2, OSU1101, OSU1156, OSU1257, OSU1337, OSU1631, OSU1664) and four cultivars (Bimini, Celebration, NorthBridge, and Tahoma 31). However, only entries 17-4200-19x9, 17-5200-4x11, OSU1664, Bimini, and NorthBridge were considered as having excellent adaptation to the fall trafficked conditions along with greatest traffic tolerance due to fewer consistent traffic effects on evaluated turf traits.

Variation for fall color retention and post-dormancy regrowth among bermudagrasses was observed. The entries (e.g. 18-8-1, 17-5200-31x3, and U-3) had excellent fall color retention under non-trafficked conditions, while entries (e.g. 18-8-3, 18-9-2, 17-5200-3x23, 17-5200-4x11) demonstrated excellent fall color retention when trafficked. The entries OSU1609, OSU1117, Tahoma 31, and OSU1638 demonstrated excellent post-dormancy regrowth across both traffic treatments.

Among the top performers of traffic bermudagrasses, only one entry (17-5200-4x11) showed good fall color retention as well but it did not perform well for post dormancy regrowth. From these findings, it can be concluded that even the bermudagrass entry with excellent traffic tolerance can substantially vary in late fall for fall color retention and in spring for post-dormancy-regrowth. In the transitional climatic zone, bermudagrasses undergo up to 5 months of the dormancy period. In order to increase the acceptability of bermudagrass for use under trafficked conditions, selecting a bermudagrass with improved traffic tolerance, fall color retention and spring green-up become important.

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Tables and Figures

Table 1. List of bermudagrasses evaluated for fall traffic tolerance, fall color retention, and spring green-up in a two-year field trial in Stillwater, OK.

No.	Entry Name	Description	No.	Entry Name	Description
1	Astro	Standard	49	OSU1101	Experimental
2	Bimini	Standard	50	OSU1117	Experimental
3	Celebration	Standard	51	OSU1127	Experimental
4	Latitude 36	Standard	52	OSU1132	Experimental
5	NorthBridge	Standard	53	OSU1156	Experimental
6	Tahoma 31	Standard	54	OSU1217	Experimental
7	TifTuf	Standard	55	OSU1257	Experimental
8	Tifway	Standard	56	OSU1318	Experimental
9	U-3	Standard	57	OSU1337	Experimental
10	15-4X15	Experimental	58	OSU1402	Experimental
11	15-8X3	Experimental	59	OSU1403	Experimental
12	17-4200-19X13	Experimental	60	OSU1406	Experimental
13	17-4200-19X21	Experimental	61	OSU1408	Experimental
14	17-4200-19X9	Experimental	62	OSU1409	Experimental
15	17-4200-36X19	Experimental	63	OSU1417	Experimental
16	17-5200-11X9	Experimental	64	OSU1418	Experimental
17	17-5200-13X9	Experimental	65	OSU1433	Experimental
18	17-5200-31X3	Experimental	66	OSU1439	Experimental
19	17-5200-3X23	Experimental	67	OSU1601	Experimental
20	17-5200-4X11	Experimental	68	OSU1609	Experimental
21	18-7-1	Experimental	69	OSU1611	Experimental
22	18-7-2	Experimental	70	OSU1617	Experimental
23	18-7-3	Experimental	71	OSU1620	Experimental
24	18-7-4	Experimental	72	OSU1625	Experimental
25	18-7-5	Experimental	73	OSU1628	Experimental
26	18-7-6	Experimental	74	OSU1629	Experimental
27	18-8-1	Experimental	75	OSU1631	Experimental
28	18-8-2	Experimental	76	OSU1638	Experimental
29	18-8-3	Experimental	77	OSU1639	Experimental
30	18-8-4	Experimental	78	OSU1641	Experimental
31	18-8-5	Experimental	79	OSU1646	Experimental
32	18-8-6	Experimental	80	OSU1649	Experimental
33	18-8-7	Experimental	81	OSU1651	Experimental
34	Tilin#5	Experimental	82	OSU1656	Experimental
35	18-9-1	Experimental	83	OSU1657	Experimental
36	18-9-10	Experimental	84	OSU1661	Experimental
37	18-9-11	Experimental	85	OSU1662	Experimental
38	18-9-12	Experimental	86	OSU1663	Experimental
39	18-9-2	Experimental	87	OSU1664	Experimental
40	18-9-3	Experimental	88	OSU1666	Experimental
41	18-9-4	Experimental	89	OSU1670	Experimental
42	18-9-5	Experimental	90	OSU1673	Experimental
43	18-9-6	Experimental	91	OSU1675	Experimental
44	18-9-7	Experimental	92	OSU1680	Experimental
45	18-9-8	Experimental	93	OSU1682	Experimental
46	18-9-9	Experimental	94	OSU1687	Experimental
47	2008-4X16	Experimental	95	OSU1690	Experimental
48	OKC1221	Experimental	96	OSU1699	Experimental

Table 2. Summary ANOVA table for percent green cover (PGC), turf quality (TQ), and normalized difference vegetation index (NDVI) of 96 bermudagrasses subjected to six-weeks of simulated cleat traffic in 2019.

	Source	15-Sep	20-Sep	27-Sep	4-Oct	11-Oct	18-Oct	25-Oct
		------------------	------------------	------------------	*p-value*	------------------	------------------	------------------
PGC	Entry	0.9206	0.0010	<0.0001	<0.001	<0.001	<0.0001	<0.0001
	Traffic	0.4260	0.0346	0.1836	0.8070	0.2327	0.0171	0.0014
	Entry*Traffic	0.4921	0.0039	0.0001	<0.001	<0.001	0.0003	0.0008
TQ	Entry	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.0001	<0.0001
	Traffic	0.6553	0.0069	<0.0001	<0.0157	0.0111	0.0033	0.0086
	Entry*traffic	0.4739	0.2346	0.2219	<0.5283	0.0176	0.0005	0.0005
NDVI	Entry	0.0160	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Traffic	0.4226	<0.0001	<0.3810	0.4101	0.3506	0.2194	0.1271
	Entry*Traffic	0.4921	<0.0301	<0.0001	0.0002	<0.0001	<0.0001	<0.0001

Table 3. Summary ANOVA table for fall percent green cover (FPGC), visual fall color (VFC), and fall normalized vegetation index (FNDVI) of 96 bermudagrasses subjected to six-weeks of simulated cleat traffic in 2019.

	Source	18-Oct	3-Nov	12-Nov
		------------------	*p-value*	------------------
FPGC	Entry	<0.0001	<0.0001	<0.0001
	Traffic	0.0171	0.5355	0.3101
	Entry*Traffic	0.0003	<0.0001	0.1176
VFC	Entry	<0.0001	0.0001	<0.0001
	Traffic	0.0004	0.0042	0.0315
	Entry*Traffic	0.0013	0.0005	<0.0001
FNDVI	Entry	<0.0001	<0.0001	<0.0001
	Traffic	0.2194	0.2194	0.1271
	Entry*Traffic	<0.0001	<0.0001	<0.0001

Table 4. Summary ANOVA table for spring percent green cover (SPGC) and visual spring green-up (VSG) of 96 bermudagrasses subjected to six-weeks of simulated cleat traffic in 2020.

	Source	27-Mar	10-Apr	26-April
		------------------	*p-value*	------------------
SPGC	Entry	<0.0001	<0.0001	<0.0001
	Traffic	0.312	0.2079	0.1202
	Entry*Traffic	<0.0001	<0.0001	<0.0001
VSG	Entry	<0.001	<0.0001	<0.0001
	Traffic	0.0053	0.0015	0.1681
	Entry*Traffic	0.0011	0.0024	0.0796

Table 5 Summary ANOVA table for percent green cover (PGC), turf quality (TQ), and normalized difference vegetation index (NDVI) of 96 bermudagrasses subjected to six-weeks of simulated cleat traffic in 2020

	Source	**6-Sep**	**11-Sep**	**18-Sep**	**25-Sep**	**2-Oct**	**9-Oct**	**16-Oct**
		--*p-value*--						
PGC	Entry	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Traffic	0.0939	0.0515	0.1364	0.0103	0.0112	0.0008	0.0115
	Entry*Traffic	0.6848	0.0382	0.0071	0.0002	0.0024	0.0075	0.0474
TQ	Entry	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Traffic	0.0897	0.0026	0.0021	0.0015	<0.0001	0.0009	0.0008
	Entry*Traffic	0.5375	0.1091	0.012	0.0007	<0.0001	<0.0001	<0.0001
NDVI	Entry	<0.0001	<0.0001	<0.0001	<0.001	<0.0001	<0.001	<0.0001
	Traffic	0.3400	0.0224	0.0155	0.0027	0.0167	0.0037	0.0073
	Entry*Traffic	0.1047	0.7589	0.0326	0.5949	0.1623	0.0047	0.0224

Table 6. Summary ANOVA table for fall percent green cover (FPGC), visual fall color (VFC), and fall normalized difference vegetation index (FNDVI) of 96 bermudagrasses subjected to six-weeks of simulated cleat traffic in 2020.

	Source	**18-Oct**	**1-Nov**	**14-Nov**
		------------------*p-value*-----------------		
FPGC	Entry	<0.0001	<0.0001	<0.0001
	Traffic	0.0115	0.0187	0.0152
	Entry*Traffic	0.0474	0.1315	<0.0001
VFC	Entry	<0.001	<0.0001	<0.0001
	Traffic	0.0053	0.0015	0.1681
	Entry*Traffic	0.0011	0.0024	0.0796
FNDVI	Entry	<0.0001	<0.0001	<0.0001
	Traffic	0.0073	0.0052	0.4783
	Entry*Traffic	0.0224	0.0076	0.0413

Table 7. Turf performance index (TPI) of non-trafficked bermudagrasses by evaluation parameters percent green cover (PGC), visual turf quality (TQ), and normalized difference vegetation index (NDVI) in fall 2019 and 2020.

Entry	Fall-2019				Fall-2020				Combined
	PGC	TQ	NDVI	Total	PGC	TQ	NDVI	Total	Total
	Turf Performance Index †								
18-8-1	7	7	7	21	7	7	7	21	42
18-8-3	7	7	7	21	7	7	7	21	42
18-8-7	7	7	7	21	7	7	7	21	42
OSU1101	7	7	7	21	7	7	7	21	42
TifTuf	7	7	7	21	7	7	7	21	42
18-7-6	6	7	7	20	7	7	7	21	41
17-5200-31X3	6	7	7	20	7	7	7	21	41
18-9-3	5	7	7	19	7	7	7	21	40
17-5200-3X23	5	7	7	19	7	7	7	21	40
OSU1617	5	7	7	19	7	7	7	21	40
Tahoma31	5	7	7	19	7	7	7	21	40
U-3	6	7	7	20	6	7	7	20	40
18-7-3	4	7	7	18	7	7	7	21	39
18-9-2	4	7	7	18	7	7	7	21	39
18-9-8	4	7	7	18	7	7	7	21	39
18-9-9	4	7	7	18	7	7	7	21	39
17-5200-4X11	4	7	7	18	7	7	7	21	39
Bimini	4	7	7	18	7	7	7	21	39
Celebration	5	7	6	18	7	7	7	21	39
Latitude36	4	7	7	18	7	7	7	21	39
OKC1221	4	7	7	18	7	7	7	21	39
OSU1156	4	7	7	18	7	7	7	21	39
OSU1318	4	7	7	18	7	7	7	21	39
OSU1418	4	7	7	18	7	7	7	21	39
OSU1439	4	7	7	18	7	7	7	21	39
OSU1625	4	7	7	18	7	7	7	21	39
OSU1662	4	7	7	18	7	7	7	21	39
Tifway	4	7	7	18	7	7	7	21	39
18-8-2	4	7	6	17	7	7	7	21	38
17-4200-36x19	4	7	6	17	7	7	7	21	38
2008-4x16	3	7	7	17	7	7	7	21	38
NorthBridge	4	7	7	18	6	7	7	20	38
OSU1257	3	7	7	17	7	7	7	21	38
OSU1337	4	7	6	17	7	7	7	21	38
OSU1403	4	7	7	18	6	7	7	20	38
OSU1609	3	7	7	17	7	7	7	21	38
OSU1631	4	7	7	18	6	7	7	20	38
OSU1664	4	7	7	18	6	7	7	20	38
OSU1670	4	7	6	17	7	7	7	21	38
OSU1690	4	7	7	18	6	7	7	20	38
15-4X15	4	7	5	16	7	7	7	21	37
18-7-2	4	7	5	16	7	7	7	21	37
18-9-7	4	7	5	16	7	7	7	21	37
17-4200-19x13	4	7	5	16	7	7	7	21	37
OSU1417	3	7	6	16	7	7	7	21	37
OSU1656	3	7	6	16	7	7	7	21	37
OSU1657	3	7	7	17	6	7	7	20	37
OSU1699	4	7	5	16	7	7	7	21	37
18-8-4	4	7	4	15	7	7	7	21	36
18-9-11	4	7	4	15	7	7	7	21	36
Astro	4	7	4	15	7	7	7	21	36
OSU1402	3	7	5	15	7	7	7	21	36
OSU1433	4	7	5	16	6	7	7	20	36
OSU1628	2	7	6	15	7	7	7	21	36
OSU1651	3	7	5	15	7	7	7	21	36

Tilin#5	4	7	4	15	7	7	7	21	36
18-7-1	4	7	3	14	7	7	7	21	35
18-9-4	4	7	6	17	7	4	7	18	35
17-4200-19x9	4	7	3	14	7	7	7	21	35
17-5200-13X9	2	7	5	14	7	7	7	21	35
OSU1217	4	7	5	16	5	7	7	19	35
OSU1409	4	7	3	14	7	7	7	21	35
OSU1601	4	7	4	15	6	7	7	20	35
18-8-5	4	7	4	15	5	7	7	19	34
OSU1117	3	7	4	14	6	7	7	20	34
OSU1127	3	7	7	17	3	7	7	17	34
OSU1132	3	7	6	16	4	7	7	18	34
OSU1406	4	7	7	18	5	6	5	16	34
OSU1638	2	7	4	13	7	7	7	21	34
OSU1687	4	6	5	15	5	7	7	19	34
15-8X3	2	7	3	12	7	7	7	21	33
18-7-4	4	7	4	15	5	7	6	18	33
18-8-6	4	7	1	12	7	7	7	21	33
OSU1620	3	7	3	13	6	7	7	20	33
OSU1639	6	0	6	12	7	7	7	21	33
18-9-12	2	7	2	11	7	7	7	21	32
17-4200-19x21	2	7	2	11	7	7	7	21	32
OSU1611	2	7	2	11	7	7	7	21	32
OSU1641	2	7	2	11	7	7	7	21	32
OSU1646	2	7	2	11	7	7	7	21	32
OSU1680	2	7	2	11	7	7	7	21	32
OSU1682	2	7	3	12	6	7	7	20	32
OSU1629	5	0	6	11	6	7	7	20	31
18-9-1	2	7	1	10	7	7	6	20	30
18-9-5	2	6	2	10	6	7	7	20	30
OSU1675	2	7	2	11	3	7	7	17	28
OSU1408	2	5	2	9	5	6	7	18	27
18-7-5	4	7	4	15	2	5	4	11	26
18-9-10	2	7	2	11	3	7	5	15	26
OSU1666	2	7	2	11	3	7	4	14	25
18-9-6	2	7	2	11	2	7	4	13	24
OSU1663	3	7	3	13	1	5	5	11	24
OSU1661	1	7	2	10	1	6	4	11	21
17-5200-11X9	3	7	4	14	1	4	0	5	19
OSU1649	1	1	0	2	1	5	3	9	11
OSU1673	2	1	2	5	0	2	1	3	8

† Number of times cultivar appeared in statistical group where mean separation had been performed using Tukey's HSD test at α=0.05.

Table 8. Turf Performance Index (TPI) of trafficked bermudagrasses by evaluation parameters percent green cover (PGC), visual turf quality (TQ), and normalized difference vegetation index (NDVI) in fall 2019 and 2020.

Entry	Fall-2019				Fall-2020				Combined
	PGC	TQ	NDVI	Total	PGC	TQ	NDVI	Total	Total
	Turf Performance Index †								
18-8-2	7	7	7	21	7	7	7	21	42
18-8-7	7	7	7	21	7	7	7	21	42
18-9-2	7	7	7	21	7	7	7	21	42
17-4200-19x13	7	7	7	21	7	7	7	21	42
17-4200-19x9	7	7	7	21	7	7	7	21	42
17-5200-3X23	7	7	7	21	7	7	7	21	42
17-5200-4X11	7	7	7	21	7	7	7	21	42
Bimini	7	7	7	21	7	7	7	21	42
Celebration	7	7	7	21	7	7	7	21	42
NorthBridge	7	7	7	21	7	7	7	21	42
OSU1101	7	7	7	21	7	7	7	21	42
OSU1156	7	7	7	21	7	7	7	21	42
OSU1257	7	7	7	21	7	7	7	21	42
OSU1337	7	7	7	21	7	7	7	21	42
OSU1631	7	7	7	21	7	7	7	21	42
OSU1664	7	7	7	21	7	7	7	21	42
Tahoma31	7	7	7	21	7	7	7	21	42
18-7-1	7	7	7	21	7	7	6	20	41
18-7-2	7	7	7	21	7	7	6	20	41
18-7-3	7	7	7	21	7	7	6	20	41
18-7-6	7	7	7	21	7	7	6	20	41
18-8-3	7	7	7	21	7	7	6	20	41
18-8-5	7	7	7	21	7	7	6	20	41
18-9-10	7	7	7	21	7	7	6	20	41
18-9-3	7	7	7	21	7	7	6	20	41
18-9-5	7	7	7	21	7	7	6	20	41
18-9-8	7	7	7	21	7	7	6	20	41
18-9-9	7	7	7	21	7	7	6	20	41
17-5200-31X3	7	7	7	21	7	6	7	20	41
Latitude36	7	7	7	21	7	7	6	20	41
OSU1217	7	7	7	21	7	7	6	20	41
OSU1439	6	7	7	20	7	7	7	21	41
OSU1601	6	7	7	20	7	7	7	21	41
OSU1617	7	6	7	20	7	7	7	21	41
OSU1651	7	7	7	21	7	7	6	20	41
OSU1670	7	7	7	21	7	7	6	20	41
TifTuf	7	7	7	21	7	7	6	20	41
Tilin#5	7	7	7	21	7	7	6	20	41
U-3	7	7	7	21	7	7	6	20	41
15-4X15	7	7	7	21	6	6	7	19	40
18-8-1	7	7	7	21	7	7	5	19	40
18-9-7	5	7	7	19	7	7	7	21	40
Astro	7	7	7	21	6	7	6	19	40
OSU1418	7	7	7	21	5	7	7	19	40
OSU1625	7	7	7	21	7	7	5	19	40
OSU1656	5	7	7	19	7	7	7	21	40
OSU1682	6	7	7	20	7	7	6	20	40
18-8-4	7	7	7	21	6	7	5	18	39
18-9-11	7	7	7	21	7	7	4	18	39
17-4200-36x19	7	7	7	21	7	4	7	18	39
2008-4x16	7	7	7	21	5	7	6	18	39
OKC1221	7	7	7	21	5	7	6	18	39
OSU1117	7	7	7	21	5	7	6	18	39
OSU1127	7	7	7	21	5	7	6	18	39
OSU1318	7	7	7	21	5	7	6	18	39

OSU1628	6	7	7	20	7	6	6	19	39
OSU1638	6	7	7	20	7	7	5	19	39
OSU1680	6	7	7	20	7	7	5	19	39
OSU1646	5	7	7	19	7	6	6	19	38
OSU1675	4	7	7	18	7	7	6	20	38
17-5200-13X9	6	6	7	19	7	5	6	18	37
OSU1403	6	7	7	20	5	6	6	17	37
OSU1409	7	6	7	20	6	5	6	17	37
OSU1417	6	7	7	20	4	7	6	17	37
Tifway	7	7	7	21	5	7	4	16	37
17-4200-19x21	4	6	5	15	7	7	7	21	36
OSU1433	7	7	7	21	3	6	6	15	36
OSU1662	7	7	7	21	4	6	5	15	36
18-7-4	7	7	7	21	4	6	4	14	35
18-8-6	7	7	7	21	6	5	2	13	34
18-9-12	4	7	5	16	7	6	5	18	34
OSU1641	5	7	7	19	7	5	3	15	34
OSU1699	1	7	7	15	7	5	7	19	34
OSU1132	7	6	7	20	3	5	5	13	33
OSU1408	2	5	7	14	5	6	7	18	32
OSU1609	5	7	7	19	5	4	4	13	32
OSU1687	4	5	7	16	5	5	6	16	32
OSU1402	4	7	7	18	2	5	6	13	31
OSU1639	6	0	4	10	7	7	7	21	31
OSU1657	2	6	7	15	4	6	6	16	31
15-8X3	3	7	7	17	6	3	4	13	30
18-7-5	6	7	7	20	2	5	3	10	30
18-9-1	4	4	5	13	6	7	4	17	30
OSU1406	7	7	7	21	1	5	3	9	30
OSU1620	5	7	7	19	4	2	5	11	30
18-9-6	5	7	7	19	2	6	2	10	29
OSU1661	2	7	7	16	4	4	5	13	29
18-9-4	1	3	7	11	6	5	6	17	28
17-5200-11X9	6	7	7	20	1	6	0	7	27
OSU1611	7	2	7	16	4	2	2	8	24
OSU1666	4	6	5	15	2	3	3	8	23
OSU1690	4	7	7	18	1	2	0	3	21
OSU1663	3	7	7	17	0	3	0	3	20
OSU1629	1	0	1	2	7	3	7	17	19
OSU1673	6	0	7	13	0	2	0	2	15
OSU1649	4	0	4	8	0	3	0	3	11

† Number of times cultivar appeared in statistical group where mean separation had been performed using Tukey's HSD test at α=0.05.

Table 9. Turf performance index (TPI) of non-trafficked 96 bermudagrasses by evaluation parameters fall percent green cover (FPGC), visual fall color (VFC), and fall normalized difference vegetation index (FNDVI) for fall color retention in 2019 and 2020.

Entry	2019				2020				Combined Total
	FPGC	VFC	FNDVI	Total	FPGC	VFC	FNDVI	Total	
	------*Turf Performance Index †*------								
18-8-1	3	2	3	8	3	3	3	9	17
17-5200-31X3	3	2	3	8	3	3	3	9	17
U-3	3	2	3	8	3	3	3	9	17
OSU1617	2	3	3	8	2	3	3	8	16
OSU1639	3	2	3	8	2	3	3	8	16
18-8-3	2	2	1	5	3	3	3	9	14
18-8-7	2	2	1	5	3	3	3	9	14
18-9-3	2	2	1	5	3	3	3	9	14
17-4200-19x13	1	2	2	5	3	3	3	9	14
17-5200-3X23	2	2	1	5	3	3	3	9	14
OSU1629	2	3	3	8	0	3	3	6	14
TifTuf	2	2	1	5	3	3	3	9	14
18-7-6	1	2	1	4	3	3	3	9	13
18-8-4	1	2	1	4	3	3	3	9	13
18-9-9	1	2	1	4	3	3	3	9	13
17-4200-36x19	1	2	1	4	3	3	3	9	13
17-5200-4X11	1	2	1	4	3	3	3	9	13
OSU1101	2	2	1	5	2	3	3	8	13
OSU1417	1	3	1	5	2	3	3	8	13
OSU1609	1	3	1	5	3	3	2	8	13
OSU1611	1	3	1	5	3	3	2	8	13
15-4X15	1	2	1	4	2	3	3	8	12
18-7-2	1	2	1	4	2	3	3	8	12
18-7-3	0	2	1	3	3	3	3	9	12
18-8-2	0	2	1	3	3	3	3	9	12
18-9-2	0	2	1	3	3	3	3	9	12
18-9-4	0	2	1	3	3	3	3	9	12
18-9-8	0	2	1	3	3	3	3	9	12
17-4200-19x21	1	2	0	3	3	3	3	9	12
Bimini	0	2	1	3	3	3	3	9	12
OSU1439	0	3	1	4	2	3	3	8	12
OSU1625	1	3	1	5	1	3	3	7	12
OSU1628	0	3	1	4	3	3	2	8	12
OSU1638	1	2	1	4	2	3	3	8	12
OSU1646	1	2	0	3	3	3	3	9	12
OSU1651	1	2	1	4	2	3	3	8	12
Tifway	1	2	1	4	2	3	3	8	12
18-8-5	0	2	0	2	3	3	3	9	11
Celebration	1	2	1	4	1	3	3	7	11
Latitude36	1	2	1	4	1	3	3	7	11
OKC1221	0	2	1	3	2	3	3	8	11
OSU1127	1	2	1	4	1	3	3	7	11
OSU1156	1	2	1	4	1	3	3	7	11
OSU1257	0	2	1	3	2	3	3	8	11
OSU1409	1	2	0	3	2	3	3	8	11
OSU1662	1	2	1	4	2	3	2	7	11
OSU1670	1	2	1	4	2	2	3	7	11
OSU1682	1	2	0	3	2	3	3	8	11
15-8X3	1	2	0	3	1	3	3	7	10
18-8-6	0	2	0	2	3	3	2	8	10
18-9-5	0	2	0	2	2	3	3	8	10
18-9-7	1	2	0	3	1	3	3	7	10
17-4200-19x9	1	2	0	3	1	3	3	7	10
2008-4x16	1	2	1	4	1	2	3	6	10

OSU1318	1	2	1	4	1	3	2	6	10
OSU1337	1	2	1	4	1	3	2	6	10
OSU1418	1	3	1	5	1	1	3	5	10
OSU1631	1	2	1	4	0	3	3	6	10
OSU1656	1	2	1	4	1	2	3	6	10
OSU1657	1	2	1	4	0	3	3	6	10
Tahoma31	1	2	1	4	1	3	2	6	10
18-9-1	0	1	0	1	2	3	3	8	9
18-9-10	1	2	0	3	0	3	3	6	9
18-9-11	1	2	0	3	1	3	2	6	9
18-9-12	0	2	0	2	1	3	3	7	9
17-5200-13X9	0	2	1	3	1	3	2	6	9
OSU1402	1	2	0	3	1	2	3	6	9
OSU1601	1	3	0	4	0	3	2	5	9
OSU1641	0	2	0	2	2	3	2	7	9
OSU1680	0	2	0	2	2	3	2	7	9
OSU1699	1	2	1	4	1	2	2	5	9
18-7-1	0	2	0	2	1	3	2	6	8
Astro	0	2	0	2	1	3	2	6	8
OSU1117	1	2	0	3	0	2	3	5	8
OSU1132	1	2	1	4	0	2	2	4	8
OSU1217	1	2	0	3	0	2	3	5	8
OSU1403	1	2	1	4	0	1	3	4	8
OSU1649	1	2	0	3	1	3	1	5	8
OSU1663	1	2	0	3	0	3	2	5	8
OSU1666	1	2	0	3	0	3	2	5	8
Tilin#5	1	2	0	3	1	3	1	5	8
NorthBridge	0	2	1	3	0	3	1	4	7
OSU1406	1	2	1	4	0	2	1	3	7
OSU1620	0	3	0	3	0	3	1	4	7
OSU1664	0	2	1	3	0	3	1	4	7
OSU1687	1	0	1	2	0	2	3	5	7
OSU1690	1	2	1	4	0	2	1	3	7
OSU1433	0	3	0	3	0	1	2	3	6
OSU1661	0	2	0	2	0	3	1	4	6
OSU1675	1	0	0	1	0	2	2	4	5
OSU1408	1	0	0	1	0	0	3	3	4
OSU1673	1	2	0	3	0	0	1	1	4
18-7-4	0	2	0	2	0	0	1	1	3
18-7-5	1	2	0	3	0	0	0	0	3
18-9-6	0	1	0	1	0	2	0	2	3
17-5200-11X9	1	2	0	3	0	0	0	0	3

† Number of times cultivar appeared in statistical group where mean separation had been performed using Tukey's HSD test at α=0.05.

Table 10. Turf performance index (TPI) of trafficked 96 bermudagrasses by evaluation parameters fall percent green cover (FPGC), visual fall color (VFC), and fall normalized difference vegetation index (FNDVI) for fall color retention in 2019 and 2020.

Entry	2019				2020				Combined
	FPGC	VFC	FNDVI	Total	FPGC	VFC	FNDVI	Total	Total
	----------	----------	----------	----------	*Turf Performance Index †*	----------	----------	----------	----------
18-8-3	3	3	3	9	3	3	3	9	18
18-9-2	3	3	2	8	3	3	3	9	17
17-5200-3X23	3	3	3	9	2	3	3	8	17
17-5200-4X11	3	3	2	8	3	3	3	9	17
18-8-1	3	3	2	8	2	3	3	8	16
18-8-7	3	3	1	7	3	3	3	9	16
17-4200-36x19	3	2	2	7	3	3	3	9	16
OSU1638	3	2	2	7	3	3	3	9	16
18-8-2	3	3	1	7	2	3	3	8	15
18-9-3	3	3	2	8	2	2	3	7	15
18-9-9	3	2	1	6	3	3	3	9	15
17-5200-31X3	3	3	3	9	1	3	2	6	15
Bimini	3	2	1	6	3	3	3	9	15
OSU1101	3	2	2	7	2	3	3	8	15
OSU1617	3	2	3	8	2	2	3	7	15
OSU1631	3	2	2	7	2	3	3	8	15
TifTuf	3	2	1	6	3	3	3	9	15
Tifway	3	2	1	6	3	3	3	9	15
U-3	3	2	2	7	2	3	3	8	15
15-4X15	2	2	1	5	3	3	3	9	14
18-7-3	3	2	1	6	2	3	3	8	14
18-7-6	3	2	1	6	2	3	3	8	14
18-9-10	3	2	1	6	3	3	2	8	14
17-4200-19x9	3	2	1	6	2	3	3	8	14
OSU1337	1	2	2	5	3	3	3	9	14
OSU1628	2	2	1	5	3	3	3	9	14
OSU1664	3	2	2	7	1	3	3	7	14
15-8X3	1	2	1	4	3	3	3	9	13
Latitude36	2	2	1	5	2	3	3	8	13
OSU1156	1	2	1	4	3	3	3	9	13
OSU1217	2	2	2	6	2	2	3	7	13
OSU1625	3	2	1	6	2	2	3	7	13
18-7-2	1	2	1	4	2	3	3	8	12
18-8-5	1	2	1	4	3	3	2	8	12
18-9-12	1	2	1	4	2	3	3	8	12
18-9-5	1	2	1	4	3	3	2	8	12
18-9-8	2	2	1	5	2	2	3	7	12
17-4200-19x13	2	2	1	5	2	2	3	7	12
17-4200-19x21	1	2	1	4	2	3	3	8	12
Celebration	2	2	1	5	2	2	3	7	12
OSU1127	3	2	1	6	1	3	2	6	12
OSU1257	2	2	1	5	2	2	3	7	12
OSU1629	1	3	1	5	2	2	3	7	12
OSU1639	3	1	1	5	2	2	3	7	12
OSU1641	2	2	1	5	3	3	1	7	12
OSU1670	3	2	1	6	2	2	2	6	12
Tahoma31	3	2	1	6	2	2	2	6	12
18-9-4	2	1	1	4	2	3	2	7	11
17-5200-13X9	3	2	1	6	1	2	2	5	11
NorthBridge	1	2	1	4	2	2	3	7	11
OSU1409	1	2	1	4	2	2	3	7	11
OSU1611	3	2	1	6	2	1	2	5	11
OSU1680	3	2	1	6	2	2	1	5	11
OSU1699	2	2	3	7	1	1	2	4	11

18-7-1	1	2	1	4	2	2	2	6	10
18-8-4	1	2	1	4	1	2	3	6	10
18-8-6	1	2	1	4	2	2	2	6	10
18-9-1	1	2	1	4	2	2	2	6	10
18-9-11	1	2	1	4	2	3	1	6	10
18-9-7	1	1	1	3	2	3	2	7	10
OSU1318	2	2	2	6	0	2	2	4	10
OSU1439	1	2	1	4	2	2	2	6	10
OSU1601	1	2	1	4	2	2	2	6	10
OSU1662	3	2	1	6	0	2	2	4	10
OSU1682	1	2	1	4	2	3	1	6	10
OKC1221	2	2	1	5	1	2	1	4	9
OSU1117	2	2	1	5	0	2	2	4	9
OSU1418	3	2	2	7	0	0	2	2	9
OSU1651	1	2	1	4	2	2	1	5	9
OSU1666	1	2	1	4	1	2	2	5	9
OSU1675	1	0	1	2	2	2	3	7	9
Tilin#5	1	2	1	4	2	2	1	5	9
17-5200-11X9	2	2	1	5	0	2	1	3	8
2008-4x16	1	2	1	4	0	2	2	4	8
OSU1417	1	2	1	4	0	2	2	4	8
OSU1609	1	2	1	4	1	2	1	4	8
OSU1620	2	2	1	5	0	2	1	3	8
OSU1646	1	1	1	3	2	2	1	5	8
OSU1656	2	2	1	5	1	1	1	3	8
OSU1690	2	2	2	6	0	0	2	2	8
Astro	1	2	1	4	0	2	1	3	7
OSU1657	1	2	1	4	0	1	2	3	7
OSU1663	1	2	1	4	0	1	2	3	7
OSU1687	0	1	1	2	1	2	2	5	7
18-9-6	1	2	1	4	0	2	0	2	6
OSU1132	1	1	1	3	0	2	1	3	6
OSU1402	0	2	1	3	0	2	1	3	6
OSU1403	1	2	1	4	0	1	1	2	6
OSU1406	1	2	1	4	0	1	1	2	6
OSU1433	1	2	1	4	0	1	1	2	6
18-7-4	1	2	1	4	0	0	1	1	5
18-7-5	1	2	1	4	0	0	0	0	4
OSU1649	2	1	1	4	0	0	0	0	4
OSU1408	0	0	1	1	0	0	2	2	3
OSU1661	0	2	1	3	0	0	0	0	3
OSU1673	1	1	1	3	0	0	0	0	3

† Number of times cultivar appeared in statistical group where mean separation had been performed using Tukey's HSD test at α=0.05.

Table 11. Turf Performance Index (TPI) of non-trafficked bermudagrasses by evaluation parameters spring percent green cover (SPGC) and visual spring green-up (VSG) for spring green-up in 2020.

Entry	Non-Traffic		
	SPGC	VSG	Total
	---------------*Turf performance index* †----------------		
OSU1117	3	3	6
OSU1609	3	3	6
OSU1638	3	3	6
OSU1639	3	3	6
Tahoma31	3	3	6
17-4200-19x21	3	2	5
Astro	3	2	5
17-5200-3X23	3	2	5
Bimini	3	2	5
2008-4x16	3	2	5
Latitude36	3	2	5
NorthBridge	3	2	5
OKC1221	3	2	5
OSU1156	3	2	5
OSU1217	3	2	5
OSU1257	3	2	5
OSU1318	3	2	5
OSU1337	3	2	5
OSU1403	3	2	5
OSU1409	3	2	5
OSU1417	3	2	5
OSU1439	3	2	5
OSU1617	3	2	5
OSU1625	3	2	5
OSU1631	3	2	5
OSU1651	3	2	5
OSU1657	3	2	5
OSU1661	3	2	5
OSU1675	3	2	5
OSU1682	3	2	5
OSU1690	3	2	5
OSU1699	3	2	5
18-7-3	3	1	4
18-8-5	3	1	4
18-9-1	3	1	4
18-9-10	3	1	4
18-9-2	2	2	4
18-9-8	3	1	4
17-5200-31X3	3	1	4
OSU1101	3	1	4
OSU1127	3	1	4
OSU1132	3	1	4
OSU1402	2	2	4
OSU1406	3	1	4
OSU1620	3	1	4
OSU1629	3	1	4
OSU1662	3	1	4
OSU1664	3	1	4
OSU1673	3	1	4
TifTuf	2	2	4
Tilin#5	3	1	4
U-3	3	1	4
15-4X15	2	1	3
15-8X3	2	1	3
18-7-1	2	1	3
18-7-2	1	2	3

17-4200-19x13	2	1	3
17-4200-19x9	1	2	3
OSU1408	2	1	3
OSU1628	2	1	3
OSU1641	2	1	3
OSU1656	1	2	3
OSU1666	2	1	3
OSU1680	1	2	3
18-7-6	1	1	2
18-8-3	1	1	2
18-9-11	1	1	2
18-9-12	1	1	2
18-9-5	1	1	2
18-9-6	1	1	2
17-5200-11X9	1	1	2
Celebration	1	1	2
OSU1433	1	1	2
OSU1611	1	1	2
OSU1646	1	1	2
OSU1649	1	1	2
OSU1670	1	1	2
Tifway	1	1	2
18-8-2	0	1	1
18-8-4	0	1	1
18-8-6	0	1	1
18-8-7	0	1	1
18-9-3	0	1	1
18-9-9	0	1	1
17-4200-36x19	1	0	1
17-5200-4X11	0	1	1
OSU1418	0	1	1
OSU1601	0	1	1
OSU1663	0	1	1
OSU1687	0	1	1
18-7-4	0	0	0
18-7-5	0	0	0
18-8-1	0	0	0
18-9-4	0	0	0
18-9-7	0	0	0
17-5200-13X9	0	0	0

† Number of times cultivar appeared in statistical group where mean separation had been performed using Tukey’s HSD test at $\alpha=0.05$.

Table 12. Turf Performance Index (TPI) of trafficked bermudagrasses by evaluation parameters spring percent green cover (SPGC) and visual spring green-up (VSG) for spring green-up in 2020.

Entry	Traffic		
	SPGC	VSG	Total
	---------------*Turf performance index* †--------------		
OKC1221	3	3	6
OSU1117	3	3	6
OSU1609	3	3	6
OSU1638	3	3	6
Tahoma31	3	3	6
18-7-1	3	2	5
18-8-5	3	2	5
18-9-10	3	2	5
18-9-8	3	2	5
17-4200-19x21	3	2	5
Astro	3	2	5
17-5200-3X23	3	2	5
Bimini	3	2	5
2008-4x16	3	2	5
Latitude36	3	2	5
NorthBridge	3	2	5
OSU1101	3	2	5
OSU1127	3	2	5
OSU1132	3	2	5
OSU1156	3	2	5
OSU1217	3	2	5
OSU1257	3	2	5
OSU1318	3	2	5
OSU1337	3	2	5
OSU1402	3	2	5
OSU1403	3	2	5
OSU1406	3	2	5
OSU1409	3	2	5
OSU1417	3	2	5
OSU1433	3	2	5
OSU1620	3	2	5
OSU1625	3	2	5
OSU1631	3	2	5
OSU1651	3	2	5
OSU1657	3	2	5
OSU1661	3	2	5
OSU1675	3	2	5
OSU1682	3	2	5
TifTuf	3	2	5
Tilin#5	3	2	5
18-7-2	2	2	4
18-9-2	2	2	4
18-9-6	2	2	4
17-4200-19x13	2	2	4
OSU1408	2	2	4
OSU1439	2	2	4
OSU1690	2	2	4
U-3	2	2	4
15-8X3	1	2	3
18-7-3	1	2	3
18-9-11	2	1	3
18-9-3	1	2	3
18-9-5	1	2	3
17-4200-19x9	1	2	3
Celebration	1	2	3
OSU1601	1	2	3

OSU1628	2	1	3
OSU1656	1	2	3
OSU1673	2	1	3
15-4X15	1	1	2
18-7-6	1	1	2
18-8-3	1	1	2
18-8-4	1	1	2
18-9-12	1	1	2
18-9-7	1	1	2
18-9-9	1	1	2
17-5200-31X3	1	1	2
OSU1418	1	1	2
OSU1617	0	2	2
OSU1641	1	1	2
OSU1646	1	1	2
OSU1662	1	1	2
OSU1663	1	1	2
OSU1664	1	1	2
OSU1666	1	1	2
OSU1680	1	1	2
OSU1699	1	1	2
Tifway	1	1	2
18-8-2	0	1	1
18-8-6	0	1	1
18-9-1	0	1	1
17-4200-36x19	0	1	1
17-5200-11X9	0	1	1
17-5200-4X11	0	1	1
OSU1639	0	1	1
OSU1670	0	1	1
OSU1687	0	1	1
18-7-4	0	0	0
18-7-5	0	0	0
18-8-1	0	0	0
18-8-7	0	0	0
18-9-4	0	0	0
17-5200-13X9	0	0	0
OSU1611	0	0	0
OSU1629	0	0	0
OSU1649	0	0	0

† Number of times cultivar appeared in statistical group where mean separation had been performed using Tukey's HSD test at α=0.05.

Table 13. Simple effects of traffic on percent green cover in fall 2019.

Entry	15-Sep (0 events)	20-Sep (10 events)	27-Sep (20 events)	4-Oct (30 events)	11-Oct (40 events)	18-Oct (50 events)	25-Oct (60 events)
				p-value			
15-4X15	0.9158	0.6108	0.7448	0.8525	0.714	0.0031	0.0007
15-8X3	0.9826	0.6038	0.4505	0.6648	0.0722	<.0001	<.0001
18-7-1	0.069	0.0362	0.5792	0.9717	0.5813	0.0071	0.0092
18-7-2	0.5309	0.6681	0.3081	0.4015	0.0587	0.1579	0.0483
18-7-3	0.6316	0.0936	0.6011	0.6768	0.5814	0.0011	<.0001
18-7-4	0.2713	0.7244	0.0176	0.2288	0.2211	0.4581	0.8176
18-7-5	0.6031	0.3278	0.8271	0.7429	0.8861	0.3575	0.5644
18-7-6	0.6416	0.0864	0.4277	0.8792	0.0971	0.0002	<.0001
18-8-1	0.3688	0.1538	0.3854	0.0177	<.0001	<.0001	<.0001
18-8-2	0.7728	0.4623	0.0116	0.3288	0.2696	0.0217	0.0064
18-8-3	0.8607	0.0031	0.6636	0.6048	0.2487	<.0001	<.0001
18-8-4	0.8587	0.5878	0.2536	0.6957	0.7022	0.0053	0.0001
18-8-5	0.7459	0.2062	0.0644	0.3271	0.968	0.1278	0.0057
18-8-6	0.8349	0.7251	0.0185	0.0486	0.0314	0.4462	0.197
18-8-7	0.832	0.462	0.8498	0.1672	0.1648	0.0018	<.0001
18-9-1	0.267	0.013	0.7495	0.4958	0.3012	0.0025	0.0627
18-9-10	0.3817	0.6241	0.0255	0.158	0.4591	0.5508	0.42
18-9-11	0.9404	0.7956	0.4169	0.1507	0.2573	0.0316	0.0031
18-9-12	0.668	0.3042	0.6674	0.4301	0.7907	0.0365	0.034
18-9-2	0.8613	0.0016	0.6636	0.6745	0.559	0.0001	0.0003
18-9-3	0.535	0.0806	0.5708	0.7816	0.0904	0.0037	0.0027
18-9-4	0.6959	0.0037	0.6883	0.013	0.002	<.0001	<.0001
18-9-5	0.5569	0.7474	0.0049	0.005	0.5441	0.176	0.0864
18-9-6	0.2661	0.5479	0.0067	0.3748	0.4464	0.5867	0.0333
18-9-7	0.7055	0.0114	0.7958	0.5258	0.0716	<.0001	0.0002
18-9-8	0.6719	0.1693	0.8872	0.492	0.4638	0.0343	<.0001
18-9-9	0.8651	0.7995	0.068	0.1097	0.9283	0.003	0.0007
17-4200-19x13	0.7301	0.0463	0.5236	0.4436	0.3597	0.0269	0.0043
17-4200-19x21	0.9136	0.0374	0.5806	0.8913	0.2566	0.0043	0.0063
17-4200-19x9	0.9334	0.5226	0.6533	0.6513	0.226	0.7502	0.9869
17-4200-36x19	0.737	0.2889	0.8667	0.9896	0.4552	0.0726	0.0521
Astro	0.531	0.1536	0.3641	0.5605	0.3444	0.0099	0.0013
17-5200-11X9	0.4227	0.4833	0.8182	0.8752	0.3101	0.2047	0.022
17-5200-13X9	0.7435	0.1503	0.0214	0.3391	0.7103	0.006	0.0004
17-5200-31X3	0.1365	0.0045	0.0632	0.0125	0.0212	<.0001	0.0007
17-5200-3X23	0.5	0.4084	0.3099	0.2155	0.1083	0.0017	0.0007
17-5200-4X11	0.7414	0.1493	0.2771	0.7696	0.4146	0.1396	0.0751
Bimini	0.9074	0.6438	0.3274	0.306	0.9321	0.242	0.0149
2008-4x16	0.0752	0.18	0.2991	0.415	0.867	0.0087	0.0011
Celebration	0.8942	0.3381	0.2085	0.4212	0.0977	0.024	0.0295
Latitude36	0.833	0.6797	0.6715	0.6614	0.3238	0.0217	0.0639
NorthBridge	0.5232	0.195	0.8974	0.656	0.7985	0.026	0.0013
OKC1221	0.4485	0.8907	0.2539	0.7619	0.7391	0.0177	0.0375
OSU1101	0.8417	0.3256	0.7744	0.5564	0.1325	0.0021	0.0002
OSU1117	0.2656	0.7557	0.0893	0.0126	0.9904	0.2001	0.0925
OSU1127	0.0097	0.2192	0.1327	0.0696	0.2487	0.0041	0.0053
OSU1132	0.3742	0.0791	0.216	0.1664	0.75	0.0265	0.0239
OSU1156	0.168	0.2128	0.4231	0.794	0.7578	0.0705	0.0002
OSU1217	0.143	0.1954	0.3803	0.0689	0.0582	0.9471	0.8305
OSU1257	0.6245	0.4251	0.0021	0.0048	0.5259	0.0377	0.0206
OSU1318	0.2607	0.0364	0.0649	0.426	0.7091	0.0087	0.0368
OSU1337	0.0261	0.3532	0.7527	0.2905	0.0492	0.0453	0.2238
OSU1402	0.6283	0.7598	0.594	0.7116	0.1945	0.1123	0.0283
OSU1403	0.9466	0.2228	0.825	0.1125	0.1612	0.0087	0.0113
OSU1406	0.4381	0.9555	0.7925	0.9915	0.0871	0.0337	0.1247
OSU1408	0.18	0.0008	0.2845	0.2793	0.7906	0.2638	0.3922

OSU1409	0.236	0.8341	0.2238	0.9627	0.4338	0.1485	0.1553
OSU1417	0.5652	0.1839	0.5898	0.4095	0.6577	0.0007	0.0002
OSU1418	0.7479	0.0471	0.4025	0.6369	0.1283	0.0013	0.0021
OSU1433	0.639	0.1837	0.4815	0.9296	0.1602	0.0033	0.0116
OSU1439	0.7757	0.0397	0.7504	0.457	0.0406	0.0048	<.0001
OSU1601	0.8391	0.2501	0.9791	0.6652	0.5204	0.3575	0.1529
OSU1609	0.428	0.4793	0.1157	0.8682	0.058	0.0009	<.0001
OSU1611	0.6868	0.5576	0.0351	0.877	0.6944	<.0001	0.0008
OSU1617	0.7047	0.1125	0.1303	0.276	0.0035	<.0001	<.0001
OSU1620	0.1064	0.005	0.1119	0.4335	0.4085	0.0068	0.0006
OSU1625	0.0001	0.9902	0.0243	0.049	0.389	0.0726	0.0492
OSU1628	0.794	0.719	0.1356	0.5721	0.882	0.0027	<.0001
OSU1629	0.8829	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
OSU1631	0.3028	0.5431	0.0039	0.2717	0.6286	0.0217	0.0023
OSU1638	0.3429	0.5436	0.0014	0.0964	0.9451	0.0102	0.0005
OSU1639	0.9105	0.0002	0.0252	<.0001	<.0001	<.0001	<.0001
OSU1641	0.662	0.3532	0.0987	0.3407	0.7867	0.0064	0.0014
OSU1646	0.8211	0.4555	0.0722	0.8957	0.4521	0.0177	0.0011
OSU1649	0.9221	0.0525	0.438	0.0698	0.0735	0.0001	0.0019
OSU1651	0.2452	0.8314	0.1003	0.0816	0.7174	0.0171	0.0056
OSU1656	0.9749	0.0159	0.5395	0.7334	0.2503	0.0049	0.0078
OSU1657	0.0963	0.03	0.3084	0.3468	0.0249	0.0004	0.0003
OSU1661	0.1907	0.558	0.0134	0.1019	0.7502	0.261	0.3742
OSU1662	0.4175	0.0118	0.7869	0.0693	0.017	<.0001	0.0027
OSU1663	0.2223	0.1093	0.7175	0.3301	0.9849	0.1485	0.0008
OSU1664	0.7889	0.4689	0.6937	0.5202	0.8719	0.0248	0.0778
OSU1666	0.9753	0.0374	0.4622	0.7127	0.5699	0.0033	0.0014
OSU1670	0.549	0.1297	0.7703	0.9667	0.4543	0.002	0.0042
OSU1673	0.7287	0.9189	0.1525	0.3796	0.5715	0.0858	0.091
OSU1675	0.2278	0.6482	0.1144	0.3363	0.2153	0.9524	0.7985
OSU1680	0.6235	0.9891	0.0886	0.1746	0.0776	0.261	0.267
OSU1682	0.0621	0.2939	0.094	0.083	0.2432	0.2899	0.0572
OSU1687	0.4421	0.2613	0.0712	0.7357	0.145	0.046	0.1483
OSU1690	0.4892	0.0012	0.3932	0.0481	0.0027	<.0001	0.0022
OSU1699	0.9882	0.0009	0.6396	0.302	0.0839	0.0007	0.0007
Tahoma31	0.9324	0.1954	0.8839	0.5676	0.0462	0.0034	0.0002
TifTuf	0.8857	0.7353	0.4446	0.9675	0.4643	0.0716	0.008
Tifway	0.7898	0.1108	0.8277	0.8846	0.3891	0.002	0.0326
Tilin#5	0.539	0.8528	0.3598	0.296	0.1856	0.6858	0.0346
U-3	0.7985	0.417	0.7839	0.7985	0.1918	0.0022	0.0037

Table 14. Simple effects of traffic on percent green cover in fall 2020.

Entry	6-Sep (0 events)	11-Sep (10 events)	18-Sep (20 events)	25-Sep (30 events)	2-Oct (40 events)	9-Oct (50 events)	16-Oct (60 events)
	p-value						
15-4X15	0.4941	0.2942	0.0654	0.0016	0.0014	0.0003	<.0001
15-8X3	0.449	0.0305	0.0313	<.0001	0.0309	<.0001	0.0003
18-7-1	0.2582	0.0264	0.2131	0.0811	0.1535	0.0103	0.0084
18-7-2	0.3178	0.5594	0.8002	0.2172	0.2705	0.181	0.0034
18-7-3	0.1039	0.4532	0.362	0.0018	0.1115	0.0083	0.0004
18-7-4	0.2804	0.2578	0.105	0.0254	0.0445	0.0128	0.0011
18-7-5	0.1569	0.0591	0.0873	0.0889	0.1986	0.0204	0.0262
18-7-6	0.9005	0.0338	0.0654	0.0033	0.2407	0.2019	0.0142
18-8-1	0.0518	0.0318	0.0174	<.0001	0.0028	<.0001	<.0001
18-8-2	0.8541	0.3727	0.2675	0.0042	0.0042	<.0001	<.0001
18-8-3	0.2936	0.4001	0.2775	0.2041	0.8805	0.0713	0.0133
18-8-4	0.8425	0.1394	0.0476	<.0001	0.0034	0.0004	<.0001
18-8-5	0.3359	0.1628	0.4779	0.4113	0.75	0.1509	0.0016
18-8-6	0.9413	0.2278	0.0892	0.0056	0.0143	0.0003	<.0001
18-8-7	0.4758	0.2215	0.2391	0.0044	0.0026	<.0001	<.0001
18-9-1	0.2259	0.334	0.0835	0.0089	0.3844	0.0057	0.0011
18-9-10	0.1613	0.5317	0.9507	0.8385	0.3877	0.6864	0.4251
18-9-11	0.1348	0.0066	0.0391	0.0056	0.0646	0.0016	0.0004
18-9-12	0.1527	0.2122	0.0266	0.003	0.2156	0.0425	0.0016
18-9-2	0.9296	0.0038	0.0449	0.0021	0.0681	0.0009	0.0017
18-9-3	0.3433	0.0803	0.105	0.0023	0.1089	0.016	0.0118
18-9-4	0.6858	0.021	0.0662	0.0003	0.0211	0.0001	0.0006
18-9-5	0.5035	0.6524	0.9803	0.0091	0.9808	0.0165	0.0024
18-9-6	0.1679	0.0106	0.1784	0.0763	0.2007	0.4415	0.0292
18-9-7	0.8888	0.3727	0.5598	0.0013	0.003	<.0001	<.0001
18-9-8	0.8541	0.9202	0.7954	0.2988	0.6392	0.0648	0.005
18-9-9	0.8714	0.1329	0.2215	0.0204	0.0503	0.0018	0.0001
17-4200-19x13	0.7573	0.0151	0.2459	0.0015	0.1312	0.0069	<.0001
17-4200-19x21	0.4273	0.8153	0.2801	0.0073	0.0445	0.0029	0.0005
17-4200-19x9	0.7406	0.4383	0.168	0.0662	0.0681	0.0023	0.0066
17-4200-36x19	0.5035	0.2004	0.2725	0.0641	0.1731	0.0301	0.0023
Astro	0.8253	0.2942	0.4892	0.0088	0.0439	0.004	<.0001
17-5200-11X9	0.0204	0.565	0.8002	0.3022	0.142	0.064	0.0079
17-5200-13X9	0.6858	0.8806	0.4596	0.0004	0.0707	0.0004	<.0001
17-5200-31X3	0.1966	0.1394	0.0263	0.0046	0.0015	0.0004	<.0001
17-5200-3X23	0.1569	0.7323	0.7391	0.0079	0.0698	0.0157	0.0001
17-5200-4X11	0.6804	0.0832	0.0845	0.0987	0.314	0.012	0.0083
Bimini	0.8714	0.3552	0.9409	0.2092	0.0646	0.0162	0.0017
2008-4x16	0.9063	0.0847	0.0429	<.0001	0.0002	<.0001	<.0001
Celebration	0.3108	0.3639	0.3149	0.0876	0.0065	0.0001	0.0003
Latitude36	0.6067	0.6888	0.5929	0.0333	0.0042	0.0311	0.0024
NorthBridge	0.012	0.3908	0.5436	0.8385	0.3651	0.0975	0.18
OKC1221	0.9238	0.0373	0.0826	0.0008	0.0124	<.0001	<.0001
OSU1101	0.2431	0.2278	0.2958	0.0082	0.0048	0.0043	0.0001
OSU1117	0.8946	0.1808	0.0414	0.0017	0.0096	0.0006	0.0002
OSU1127	0.5224	0.1075	0.3066	0.1726	0.0823	0.006	0.0026
OSU1132	0.8082	0.0499	0.4207	0.093	0.1965	0.0085	<.0001
OSU1156	0.6912	0.2153	0.2301	0.006	0.0192	0.002	0.0045
OSU1217	0.0108	0.9136	0.6184	0.8957	0.6739	0.4753	0.1335
OSU1257	0.6431	0.0057	0.0591	0.0159	0.0201	0.0001	<.0001
OSU1318	0.4188	0.3908	0.2577	0.0015	0.0024	0.0005	<.0001
OSU1337	0.8368	0.0445	0.0189	0.0005	0.0207	0.0067	0.0147
OSU1402	0.2373	<.0001	0.0041	<.0001	<.0001	<.0001	<.0001
OSU1403	0.038	0.8153	0.1749	0.0033	0.0067	0.0116	0.0007
OSU1406	0.532	0.0004	0.0061	<.0001	0.0013	0.0007	0.0017
OSU1408	0.2804	0.0988	0.0356	0.0067	0.0318	0.0135	0.0059

OSU1409	0.0373	0.1835	0.3468	0.0432	0.1485	0.0013	0.0006
OSU1417	0.7686	0.0248	0.1073	0.0003	0.0271	0.0012	0.0002
OSU1418	0.5368	0.008	0.008	0.0002	0.0004	<.0001	<.0001
OSU1433	0.2344	0.0445	0.0225	0.0008	0.0087	<.0001	<.0001
OSU1439	0.6118	0.113	0.0169	0.0014	0.0011	<.0001	<.0001
OSU1601	0.9355	0.1168	0.1132	0.0345	0.0854	0.0118	0.0216
OSU1609	0.9238	0.0862	0.0439	<.0001	0.0006	<.0001	<.0001
OSU1611	0.4849	0.2509	0.0558	<.0001	0.0017	<.0001	<.0001
OSU1617	0.8714	0.049	0.0152	<.0001	0.0004	<.0001	<.0001
OSU1620	0.297	0.0518	0.051	0.0016	0.0574	0.0011	0.0004
OSU1625	0.9648	0.0549	0.0552	<.0001	0.0014	<.0001	<.0001
OSU1628	0.5272	0.6584	0.7718	0.0123	0.2134	0.014	<.0001
OSU1629	0.883	0.0148	0.0165	<.0001	0.0021	0.0011	0.0567
OSU1631	0.2259	0.6827	0.2049	0.0417	0.0252	0.0013	0.0118
OSU1638	0.3508	0.3217	0.1857	0.0006	0.0622	0.0165	0.0347
OSU1639	0.9121	0.0014	0.0106	<.0001	<.0001	<.0001	<.0001
OSU1641	0.4758	0.189	0.2236	0.0095	0.0763	0.0011	0.0002
OSU1646	0.0802	0.5763	0.0396	<.0001	0.1297	0.0015	<.0001
OSU1649	0.8196	0.0176	0.1368	0.0001	0.1115	0.0033	<.0001
OSU1651	0.3433	0.4532	0.3906	0.0211	0.0096	0.0014	0.0003
OSU1656	0.713	0.7639	0.1169	0.0015	0.0018	0.0004	0.0002
OSU1657	0.2551	0.3137	0.0942	<.0001	0.0646	0.0015	0.0005
OSU1661	0.1842	0.4285	0.6184	0.467	0.8995	0.0666	0.0772
OSU1662	0.0144	0.0847	0.0873	<.0001	0.0003	<.0001	<.0001
OSU1663	0.5712	0.1372	0.054	0.0128	0.1327	0.0052	0.0005
OSU1664	0.0228	0.8478	0.8289	0.383	0.5282	0.1249	0.2255
OSU1666	0.9883	0.104	0.3498	0.0131	0.4974	0.0142	0.001
OSU1670	0.2739	0.4582	0.4523	0.0511	0.0404	0.0152	0.0017
OSU1673	0.022	0.1111	0.1285	0.4365	0.7545	0.1527	0.0103
OSU1675	0.028	0.2578	0.4559	0.323	0.2134	0.7514	0.2182
OSU1680	0.724	0.6464	0.3205	0.0109	0.0032	<.0001	<.0001
OSU1682	0.0067	0.8348	0.8578	0.1682	0.3496	0.0118	0.0019
OSU1687	0.2551	0.1729	0.3205	0.0011	0.0252	0.002	0.0122
OSU1690	0.7798	0.0004	0.0038	<.0001	<.0001	<.0001	<.0001
OSU1699	0.9005	0.0025	0.0021	<.0001	0.0068	0.0019	0.0021
Tahoma31	0.5813	0.0428	0.105	0.0018	0.0181	0.0002	0.0005
TifTuf	0.5613	0.0051	0.0079	0.0003	0.2223	0.0031	0.0002
Tifway	0.194	0.0118	0.0552	0.0007	0.0052	0.0002	0.0004
Tilin#5	0.1635	0.7136	0.7812	0.1431	0.1965	0.1264	0.0007
U-3	0.0652	0.8348	0.7207	0.6003	0.0698	0.0144	0.0036

Figure 1. Baldree traffic simulator constructed by modifying Toro ProCore 648 aerification unit

Figure 2. Spring-loaded metal plate feet in place of coring heads.

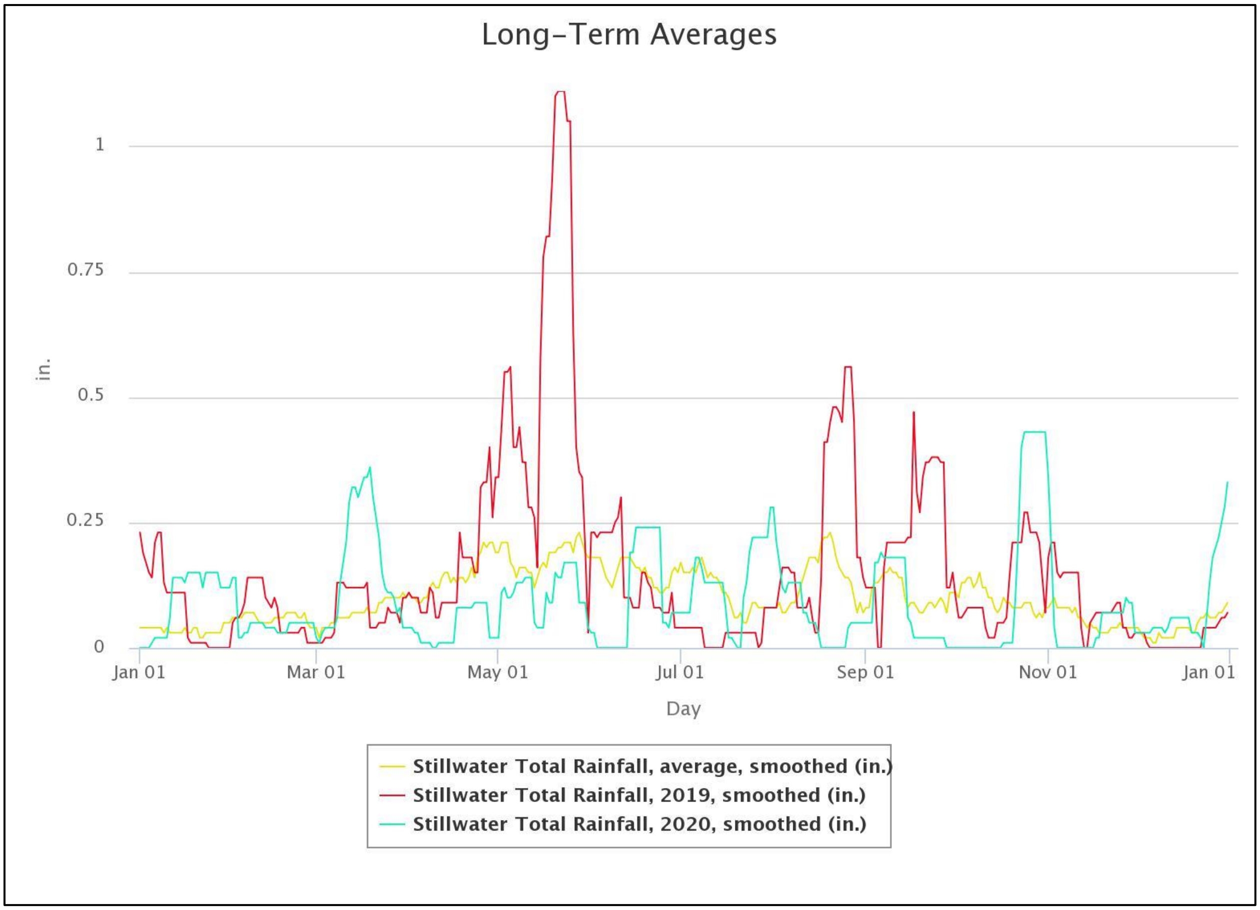

Figure 3. Average rainfall (in.) for 2019 and 2020

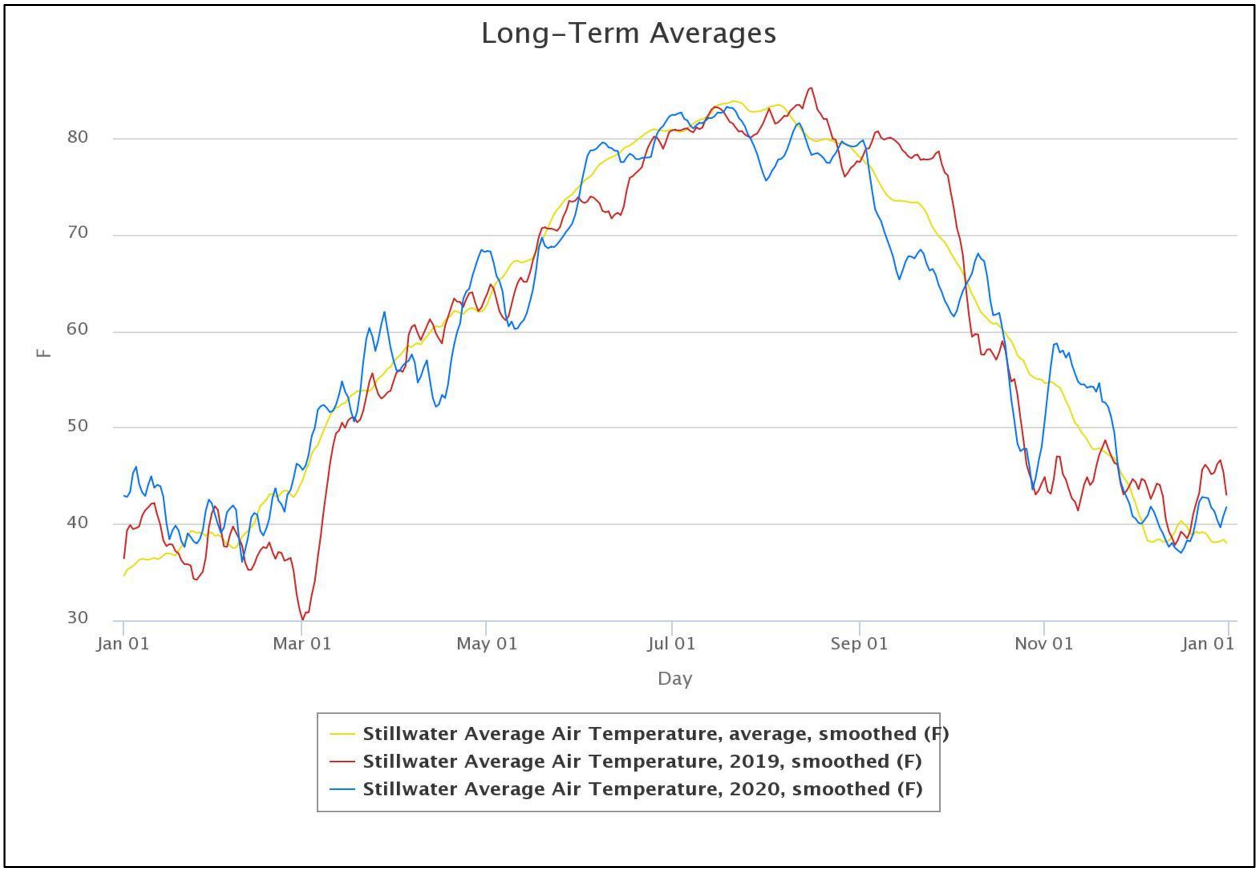

Figure 4. Average air temperature (°F) for 2019 and 2020.

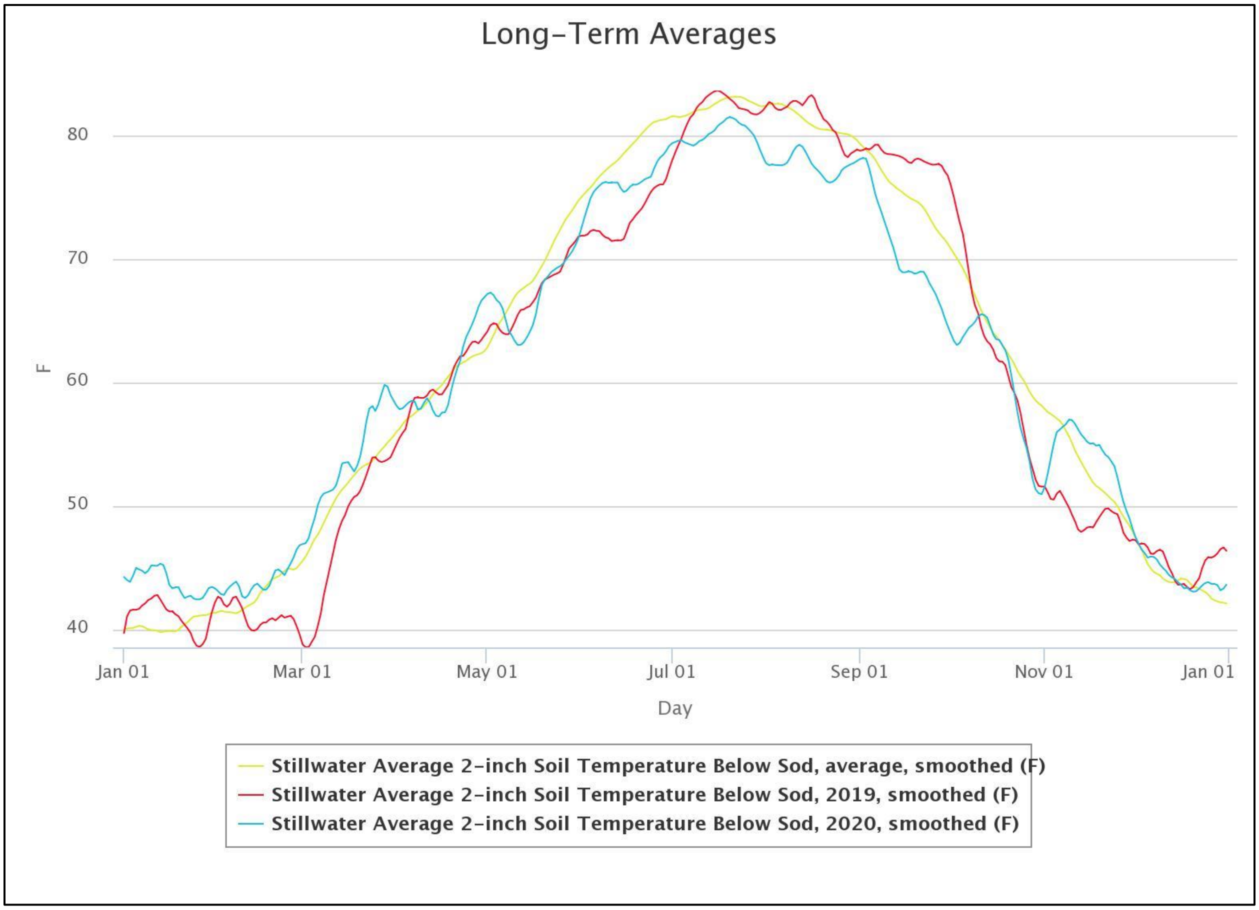

Figure 5. Average 2-inch soil temperature (°F) for 2019 and 2020.

CHAPTER III

EFFECT OF FALL TRAFFIC ON PERSISTENCE AND SURFACE PLAYABILITY OF COMMERCIAL BERMUDAGRASS CULTIVARS

ABSTRACT

Traffic injury caused by foot or athlete-surface interaction is one of the most critical problems athletic field managers face in maintaining the surface playability and aesthetic quality of sports fields. Bermudagrass [*Cynodon* spp. (L.) Rich.] is the most widely used turfgrass species on athletic fields in the transitional climatic zone. A 2-year field study was conducted to evaluate 9 commercially available bermudagrass cultivars for their persistence and surface playability under simulated fall traffic stress. The experiment was conducted as split-block design with three replications and traffic was applied for six weeks in fall 2019 and 2020 using a Baldree traffic simulator. Bimini was in the top statistical group for percent green cover (PGC) and normalized difference vegetation index (NDVI) on each date when trafficked and also demonstrated the fewest consistent traffic effects. All cultivars except Astro and Tifway demonstrated good surface playability characteristics. Simulated traffic stress reduced the shear strength and increases the surface hardness over time potentially due to compaction. Shear strength of ‘DT-1’ (TifTuf) and ‘OKC1131’ (Tahoma 31) and surface hardness of ‘OKC1134’ (NorthBridge) were least affected by simulated traffic stress. Bimini, ‘Riley’s Super Sport’ (Celebration), and TifTuf demonstrated excellent late fall color retention under non-trafficked conditions, while Bimini and TifTuf were top performers when trafficked. Tahoma 31 and ‘OKC1119’ (Latitude 36) had the earliest spring green-up across both traffic treatments while Celebration had the poorest. Simulated traffic stress reduced the fall color retention of all cultivars but enhanced the spring green-up of Astro, Bimini, and TifTuf.

INTRODUCTION

Bermudagrasses [*Cynodon* spp. (L.) Rich.] are widely used turfgrass species for athletic fields and golf courses in the southern and transition zones of the United States (Beard, 1973). It is preferred due to its higher traffic tolerance and recuperative potential in comparison to most other turfgrass species (Christians, 2011). Traffic is defined as a source of abiotic stress which can cause wear and compaction injury to the turfgrass (Trenholm et al., 2000). 'Wear' is considered as the tearing, scuffing, rubbing, and crushing of bermudagrass plant parts. The pressing of soil particles together is referred to as 'Compaction' which can affect the growth and development of bermudagrass (Carrow & Petrovic, 1992).

Athletic field turf experiences the continuous and damaging stress caused by foot traffic (Glab and Szewczyk, 2015). Even though bermudagrass has higher relative traffic tolerance, but variation among bermudagrass cultivars exists in their ability to persist and perform under continuous traffic stress (Youngner, 1961). Beard et al. (1981) reported the difference among 17 bermudagrass cultivars under traffic stress in terms of a percent reduction in a verdure. In another study, the bermudagrass cultivar 'Riviera' was reported as having higher traffic tolerance than the cultivar 'Quickstand' (Bigelow & Hardebeck, 2006). Williams et al. (2010) investigated eight bermudagrass cultivars for traffic tolerance and reported 'Riley's Super Sport (hereafter referred to as Celebration) and 'ST-5' (Tifgrand) had a high tolerance to traffic stress than 'Tifway'. Researchers at the University of Arkansas investigated 42 bermudagrass cultivars for performance under traffic stress during the summer and fall seasons over the course of two years. Variation in response to traffic stress was reported as only a few cultivars such as Celebration, Premier, Contesssa, and Barbados had higher turf performance indeces (TPI) for percent green coverage during summer and fall seasons of both years (Trappe et al. 2011). Thoms et al. (2011) determined Tifway and Riviera had greater traffic tolerance than 'Patriot' on the basis of percent green cover assessment under simulated traffic conditions. Riviera, 'OKC1134' (herafter referred as NorthBridge), 'OKC1119' (herafter referred to as Latitude 36), and 'SWI 1057' were reported to have high traffic tolerance among others 24 commercial and 16 experimental entries evaluated at Oklahoma State University (Segars, 2013). Kowalewski et al. (2015) determined 'DT-1' (hereafter referred to as TifTuf) as having greater tolerance to six-week of simulated traffic stress compared to 'Tifway'.

An athletic field's surface quality depends upon both aesthetic and athlete-to-surface interactions (Brosnan et al. 2014). Athlete-to-surface interactions or surface playability is generally explained on the basis of surface hardness and traction:Surface hardness known as the ability of the surface to absorb the energy generated upon impact (Brosnan et al., 2009). 'Traction' is defined as the interaction forces associated with the player and turf surface which enable the player to get an appropriate grip to prevent possible fall or slip and is often measured as shear strength (Canaway & Bell, 1986). Bermudagrass cultivars can have different surface playability characteristics when used as an athletic field surface. Munshaw et al. (2013) reported differences among 21 bermudagrass cultivars for surface hardness. Celebration and 'MS-Choice' had the lowest surface hardness while 'Midlawn' and 'Ashmore' demonstrated the hardest surface among others (Munshaw et al., 2013). Researchers in Australia, reported substantial differences among vegetative, seeded, and hybrid bermudagrasses for rotational traction (Roche et al., 2007). A separate study in Kentucky reported Riviera and Quickstand as having higher rotational traction or shear strength values compared to 'Tifway' and 'Yukon' (Deaton, 2009). Wear and compaction stress by frequent foot traffic on bermudagrass athletic turf surface can deteriorate the athletic field surface quality or surface playability. Frequent traffic stress results in harder playing surfaces and inappropriate footing or traction which in turn increases the chances of lower extremity injury due to the excessive ground reaction force (Brosnan et al. 2014). A separate study in Missouri reported the the decrease in traction (Nm) and increase in surface hardness on trafficked turf of bermudagrass and cool-season turfgrass mixture (Dunn et al., 1994).

Bermudagrasses lose their green color in fall and remain dormant for up to 5 months in the transitional climatic zone (Croce et al., 2003). When soil temperature in spring exceeds 18.3˚C (at 10 cm depth) for several days, bermudagrass starts breaking dormancy and regaining active spring growth

(Christians, 2011). Various studies have reported the differences among bermudagrass for their ability to retain green color in fall and to regain post-dormancy regrowth (Gopinath, 2015, Munshaw et al., 2006; NTEP, 2013; Segars, 2013; Serena et al., 2018). Bermudagrass cultivar with enhanced color retention in fall and early spring green-up are highly desirable for athletic field use, particularly those used for fall and winter sports.

With the advancement in breeding, numerous new bermudagrass cultivars have been developed over the past decade. There are limited studies conducted to investigate the effects of simulated traffic on surface playability, fall color retention, and spring green-up of individual cultivar's turf.

OBJECTIVES

- To investigate the effect of traffic on persistence and surface playability of nine bermudagrass cultivars.
- To investigate the fall color retention, post-dormancy regrowth, and effect of traffic on these traits of nine bermudagrass cultivars.

HYPOTHESES

- Bermudagrass cultivars vary in their persistence and surface playability under simulated traffic stress.
- Bermudagrass cultivars vary for fall color retention and post-dormancy regrowth under simulated traffic stress.

MATERIAL AND METHODS

Site description, establishment and plot maintenance

A field study was conducted in 2019 and 2020 at the Oklahoma State University Turfgrass Research Center, Stillwater, Oklahoma. Nine commercially available bermudagrass cultivars were planted in Norge loam soil (Fine-silty, mixed, thermic, Udic Paleustoll) on 5 Jun. 2019 as 0.025 plugs at 0.3 m spacing within 2.43m x 1.21m plots. Cultivars included the cultivars Astro, Bimini (Obtained from Bethel farms, Florida), (Celebration), Latitude 36, NorthBridge, OKC1131 (hereafter referred as Tahoma 31), TifTuf, Tifway, and U-3-SIU (U-3 obtained from Southern Illinois University, hereafter referred to as U-3). Immediately after planting, fertilizer (25-0-10, N-P_2O_5-K_2O) was applied at a rate of (4.8 g m^{-2} N) and oxadiazon (Ronstar G, Bayer, NC) was applied at a rate of 2.24 kg ha^{-1} a.i. A preliminary soil test (Soil, Water and Forage Analytical Laboratory, Stillwater, OK) demonstrated moderately low soil P. To ensure the young plants were not limited by nutrient availability, one application of a complete fertilizer 10-20-10 (4.8 g m^{-2} N) was made on 21 Jun. 2019. Granular urea (46-0-0) was applied weekly at a rate of 4.8 gm^{-2} N for six weeks from 1 Jul. 2019 to 5 Aug. 2019 to promote rapid establishment. Irrigation was applied through in-ground sprinklers irrigation to meet the water requirement during establishment. A triplex reel mower (TR330, Jacobsen Corporation, Wisconsin, USA) was used to mow plots at 2.5cm with clippings returned starting at five weeks after planting and then three times per week during the growing season for the remainder of the study.

Diammonium phosphate (18-46-0) (4.8 g m^{-2} N) was applied in May 2020 again to ensure sufficient P for optimal plant growth. Granular urea (46-0-0) was applied monthly at a rate of 4.8 gm^{-2} N from June to August 2020. Oxadiazon (Ronstar Flo) was applied on 3 Mar. 2020 at a rate of 5.6 kg ha^{-1} a.i. to control summer annual weeds. Pendimethalin (Pendulum 3.3 EC) was applied on 2 Sep. 2020 at a rate of 7 kg ha^{-1} a.i. to control winter annual weeds.

Traffic Application

Half of each plot was subjected to traffic while the other half of the plot was left as non-treated control. Traffic was applied using a Baldree traffic simulator which was created by modifying a self-propelled core aerifier (ProCore 648, The Toro Company, Minnesota, USA) unit. Coring heads of aerifier unit were replaced by six spring-loaded metal plates fitted with screw-in plastic cleats of 1.27 cm size as described by Kowalewski et al. (2013). One pass (hereafter referred to as a traffic event) of this unit when operated at a ground speed of 0.38 m s^{-1} and at tine spacing of 25 mm, created approximately 678 cleat marks per m^2, which has been described as equal to the number of cleat marks that occur within the zone of traffic concentration during one National Football League (NFL) or intercollege football game (Cockerham & Brinkman, 1989). Traffic was applied twice a day from Monday through Friday totaling 10 traffic events per week from 16 Sept. to 26 Oct. in 2019 and from 7 Sept. to 16 Oct. 2020 to simulate fall traffic typical of American football seasons. Each trafficked plot received 60 traffic events each year. Traffic was not applied on rainy days, and missed traffic events were applied on a subsequent day to ensure ten traffic events per week.

Data Collection

The following measurements were taken conducted for both non-trafficked and trafficked plots: percent green coverage (PGC), normalized difference vegetation index (NDVI), shear strength (SS), surface hardness (SH), visual fall color retention (VFC), fall PGC (FPGC), visual spring green-up (VSG), and spring PGC (SPGC). During the traffic period, PGC, NDVI, SS, and SH were measured at 0, 10, 20, 30, 40, 50, and 60 traffic events in each year.

Percent green cover was measured using images collected with a digital camera (Powershot G5; Canon, Tokyo, Japan) and a controlled light box (Richardson et al., 2001). The images were analyzed using ImageJ 1.52a software (National Institute of Health, USA) using a custom macro and the color threshold feature. The software counts the number of the green pixels in the image then divides the green pixel count with the total pixel count of the image to estimate the percent green cover in the image. To determine NDVI, spectral reflectance was collected at 650 nm [red (R)] and 730 nm [near infrared (NIR)] bands using a multispectral crop canopy sensor (ACS470 Crop Circle, Holland Scientific, Lincoln, NE). These measurements were then used to compute NDVI using the following formula:

$$NDVI = \frac{(NIR-R)}{(NIR+R)}$$ (Trenholm et al. 1999).

Fall color retention was evaluated as VFC and FPGC on Oct. 20, Nov. 3, and Nov 12 in 2019 and on Oct. 21, Nov. 2, and Nov. 14 in 2020. Spring green-up was evaluated as VSG and SPGC on Mar. 27, Apr. 10, and Apr. 26 in 2020. For both VFC and VSG, visual ratings were scored on a 1 to 9 scale where 9 is given to the whole plot with dark green color and 1 is given to straw or brown color using methods described by Morris and Shearman (1998). Measurements of FPGC and SPGC were similar those described for PGC.

A commercially available Turf-Tec shear strength tester (Turf-Tec International, Florida, USA) was modified and used to measure shear strength (Figure 1). As traction force depends upon the shoe–surface interaction, the vertical force or loading weight should be comparable to the force applied by the athlete to the point of contact (Nigg et al., 1990). To obtain consistent data, the Turf-Tec shear strength tester was modified according to Canaway's trolley mounted rotational device (Canaway & Bell, 1986). The Turf-Tec shear tester (3.4 kg) was loaded with weights (48.75 kg) which resulting a total weight of 48.75 kg for this apparatus. This loaded unit was mounted on the four-wheeled wooden trolley structure for transport on research plots. The apparatus was held in place on the wooden trolley by the support of two long iron bars which were fixed on one end and the other end was used to lift and drop the apparatus from the standard height of 60 mm or 6 cm. A protractor was fitted on the wooden trolley keeping the shaft of the loaded Turf-Tec unit on its axis and measuring the turning angle throughout the rotation of the loaded unit. The shear strength values were obtained on all plots using a 40˚ angle of rotation to obtain the maximum rotational traction (McNitt et al., 1997; Webb et al., 2014). The torque required to tear the turf was measured using the two-handled Turf-Tec Torque wrench which is scaled up to 30 Nm. The measured torque was taken as shear strength in 'Nm' units. The cleated foot was used to measure the shear strength instead of the shear vane foot. Three random locations were selected in each plot and average was noted as the shear strength of bermudagrass entry in that plot. In 2019 and 2020, shear strength measurements for cultivars were taken at 0, 10, 20, 30, 40, 50, and 60 traffic events.

A Clegg impact soil tester (Turf-Tec International, Florida, USA) with a 2.25-kg missile was used to measure the surface hardness of different bermudagrasses. The missile was dropped from 46cm. Upon impact, the hammer produces an electrical pulse, which is converted and displayed on the Control Unit in units of gravities 'Gmax' as the 'surface hardness'. Impact readings were taken as the mean of the four randomly selected testing units in each plot according to the ASTM standards (ASTM, 2007). In 2019 and

2020, surface hardness measurements were made for both traffic treatments at 0, 10, 20, 30, 40, 50, and 60 traffic events.

Data Analysis

The experiment was arranged as a split-block design with three replications. The first factor was bermudagrass cultivar and the second factor was traffic (Trafficked and Non-trafficked). Separate analyses were conducted for each year, using Statistical Analysis System (Version 9.4; SAS Institute Inc., Cary, NC). Analysis of variance was performed using PROC GLIMMIX with a repeated measures model for the following dependent variables: percent green cover (PGC), normalized difference vegetation index (NDVI), shear strength (SS), surface hardness (SH), fall PGC (FPGC), visual fall color (VFC), spring PGC (SPGC) and visual spring green-up (VSG). ANOVA tests were conducted. Means were separated using the Lines statement adjusted for Tukey's honest significance test (α=0.05). Variables associated with fall color retention (FPGC and VFC) and spring green-up (SPGC and VSG) were used to calculate, turf performance indices (TPI) for each year as the number of times (dates) each entry appeared in the top statistical group for a given trait.

RESULTS

Percent green cover (PGC)

Analysis of variance for PGC showed significant entry*week and traffic*week interaction effect in fall-2019, while significant traffic*week interaction effect and significant entry main effect was observed in fall-2020 (Table1). Over the course of six weeks, mean PGC for non-trafficked cultivars ranged from 79% in the first rating to 48 % in the final rating in 2019 and ranged from approximately 80% in the first rating to 64% in the final rating in 2020. Significant differences among non-trafficked cultivars were observed on four of seven rating dates in both years (Table 4). In 2019, U-3 had higher PGC than Astro, Tifway, and NorthBridge on Oct 18, while TifTuf had higher PGC than Astro, NorthBridge, Tifway, and Celebration on the last rating date. In 2020, Bimini had a higher PGC than

NorthBridge and U-3 on Oct 9, while Bimini had higher PGC than Latitude 36, Tahoma 31, Tifway, U-3, and NorthBridge on the last rating date (Table 4).

Mean PGC for trafficked cultivars ranged from approx 80% in the first rating to approx 37% in the final rating in 2019 and ranged from 82% to 47 % in the final rating in 2020. Significant differences among trafficked cultivars were present on 2 rating dates in 2019, and on five rating dates in 2020 (Table 5). In 2019, Latitude 36 demonstrated higher PGC than Tifway after 10 traffic events. In 2020, Bimini demonstrated higher PGC than TifTuf after 10 and 20 traffic events, higher PGC than Tifway after 10 and 30 traffic events, and higher PGC than Astro after 60 traffic events (Table 5).

Simple effects analysis of traffic on PGC in 2019 demonstrated that the PGC of Tahoma 31 was reduced by traffic after only 40 events (Table 6). Traffic reduced the PGC of Astro, Celebration, Latitude 36, NorthBridge, U-3, and Tifway after 50 events. Traffic did not reduce the PGC of Bimini and TifTuf until 60 events, while each maintained PGC greater than 40% after 60 traffic events (Table 5). In 2020, the effect of traffic was detectable for Tahoma 31, Tifway, and TifTuf after only 10 events, while Latitude 36 and Astro demonstrated traffic effect after 30 traffic events and Celebration after 40 traffic events. Traffic did not reduce PGC of Bimini and U-3 prior to 50 traffic events.

Normalized difference vegetation index (NDVI)

Analysis of variance for NDVI showed significant entry*week and traffic*week interaction effect in fall-2019, while the analysis showed significant traffic*week interaction and entry main effects in fall-2020 (Table 1). Mean NDVI of non-trafficked cultivars ranged from 0.748 in the first rating to 0.571 in the final rating of 2019 and ranged from 0.712 in the first rating to 0.665 in the final rating of 2020. Significant differences among non-trafficked cultivars were observed on four rating dates in 2019 and on six rating dates in 2020 (Table 7). In 2019, NorthBridge demonstrated higher NDVI than Astro on three rating dates, and higher than TifTuf, Bimini, and Tifway on one rating date. In 2020, Bimini showed higher NDVI than Tifway on six rating dates, Astro on five dates, U-3 on four rating dates, and Celebration, Latitude 36, TifTuf, and Tahoma 31 on last the two rating dates (9-Oct and 16-Oct).

Mean NDVI of trafficked cultivars ranged from 0.755 in the first rating to 0.480 in the final rating of 2019 and ranged from 0.714 in the first rating to 0.571 in the final rating of 2020. Significant differences among trafficked cultivars were observed on two rating dates in 2019, and on all seven rating dates in 2020 (Table 8). In 2019, Bimini had a greater NDVI than Astro and U-3 at 40 traffic events and had higher NDVI than Astro, Celebration, and U-3 at 60 traffic events. In 2020, Bimini had a greater NDVI than TifTuf at 0, 10, and 20 traffic events. Bimini demonstrated a greater NDVI than Astro and Tifway on four and five rating dates respectively. Tahoma 31 showed a lower NDVI than Bimini at 50 and 60 traffic events (Table 6).

In 2019, traffic reduced the NDVI of Astro, Celebration, Latitude 36, NorthBridge, Tahoma 31, Tifway, and U-3 after 50 traffic events (Table 9). No simple effect of traffic on NDVI was observed for Bimini and TifTuf on any rating date in 2019. In 2020, traffic reduced the NDVI of Tahoma 31, TifTuf, and Tifway as early as at 20 events, and of Astro, Celebration, Latitude 36, and U-3 at 30 events. Bimini and NorthBridge did not demonstrate a traffic effect before 50 events.

Shear strength (SS)

Analysis of variance for shear strength (SS) showed significant traffic*week interaction effect and entry main effect in 2019, while the analysis showed an entry*week interaction effect and a traffic main effect in 2020 (Table 1). Mean shear strength of non-trafficked cultivars ranged from approx 22 Nm in the first rating to 19 Nm in the final rating of fall-2019, and ranged from 22 Nm in the first rating to 21 Nm in the final rating of fall-2020. Significant differences among non-trafficked cultivars were present on one rating date in 2019, and four rating dates in 2020 (Table 10). In 2019, Bimini demonstrated greater shear strength than Astro on one date while other cultivars were similar to each other. In 2020, U-3 demonstrated greater shear strength than Tifway and Astro on one and two rating dates respectively (Table 10).

Mean shear strength of trafficked cultivars ranged from approx 22.0 Nm in the first rating to approx 17.5 Nm in the final rating of 2019, and ranged from 21.0 Nm in the first rating to approx 20.0 Nm in the final rating of 2020. No significant differences among trafficked cultivars were present on any rating date in 2019, while differences were observed on three of seven dates in 2020 (Table 11). In 2020, U-3 demonstrated greater shear strength than Astro prior to the start of traffic events, and Astro and Tifway at 10 traffic events. Latitude 36 had greater shear strength than NorthBridge and Tifway at 50 traffic events (Table 9). All other comparisons indicated there was no difference among cultivars for this trait.

Simple effects analysis for traffic on SS in 2019 revealed that traffic reduced the SS of Astro, Bimini, Celebration, NorthBridge, and Tifway after only 10 traffic events, while the reduction in SS of Latitude 36 and Tahoma 31 occurred first at 20 traffic events, and for U-3 at 30 traffic events. Traffic did not reduce the shear strength of TifTuf prior to 40 traffic events (Table 10). In total, traffic reduced the SS of Bimini on six dates, Astro, NorthBridge, Celebration, and Tifway on five dates, U-3 on four dates, and in TifTuf and Tahoma 31 only on two dates (Table12). In 2020, traffic reduced the SS of Astro, Bimini, Latitude 36, Tahoma 31, TifTuf, Tifway , and U-3 after just 10 traffic events**.** Celebration demonstrated a significant traffic effect for SS after 20 traffic events. In total, Astro, Tifway, NorthBridge, U-3, and Celebration demonstrated a significant traffic effect for SS on five dates, while Latitude 36, Tahoma 31, and TifTuf showed a traffic effect on four dates, and Bimini showed a traffic effect only on three dates in 2020 (Table 12). Interestingly, Latitude 36 and NorthBridge demonstrated a traffic effect prior to the start of traffic events in 2020.

Surface hardness (SH)

Analysis of variance for SH showed significant traffic*week interaction effect in 2019 and showed significant traffic and week main effect in 2020 (Table 1). Mean SH of non-trafficked cultivars ranged from 55 Gmax in the first rating to 50 Gmax in the final rating of 2019, and ranged from 55 Gmax in the first rating to 60 Gmax in the final rating of 2020. Significant differences among non-trafficked cultivars for SH were present on two dates in 2019, and one date in 2020. In 2019, Tifway demonstrated greater SH than TifTuf on Sept. 15, and Astro had greater SH than Latitude 36, NorthBridge, Tahoma 31, and U-3 on Sept. 20. In 2020, U-3 demonstrated greater SH than Tifway on Sept. 11 (Table 13).

Mean SH of trafficked cultivars ranged from 56 Gmax in the first rating to 57 Gmax in the final rating of 2019, and ranged from 60 Gmax in the first rating to 70 Gmax in the final rating of 2020. No significant differences among cultivars were present on any rating in either year (Table 14).

Simple effects of traffic on SH in 2019 revealed that traffic increased the SH of U-3 only after 10 traffic events, TifTuf, Tifway, and Latitude 36 after 20 traffic events, of Tahoma 31 after 30 traffic events (Table 15). The SH for Astro, Bimini, and Celebration was not affected by traffic prior to 40 events. In total, traffic had a significant effect on the SH of U-3 on five rating dates, while for Bimini, Celebration, Latitude 36, Astro, Tahoma 31, Tifway, and TifTuf on three rating dates. Traffic did not increase the SH of NorthBridge on any rating date in 2019. In 2020, Astro, Bimini, Latitude 36, NorthBridge, TifTuf, and U-3 demonstrated a significant traffic effect before resuming traffic for the year. Traffic increased the SH of Astro on all seven dates, TifTuf and U-3 on six dates, Latitude 36 and Tahoma 31 on five dates, and NorthBridge, Bimini, and Celebration on only four dates (Table 15).

Fall Color Retention

Analysis of variance for fall PGC (FPGC) and visual fall color (VFC) showed significant entry*date and traffic*date interaction effect in both 2019 and 2020 (Table 2).

For non-trafficked cultivars, significant differences were present on two rating dates for both FPGC and VFC in 2019, while on three rating dates for FPGC and on one rating date for VFC in 2020 (Table 16). In 2019, U-3 had a higher FPGC than Astro and NorthBridge on two rating dates, Latitude 36, Bimini, TifTuf, and Tifway on one rating date (Table 16). In 2020, TifTuf had a higher FPGC than NorthBridge on three rating dates, Astro, Latitude 36, Tahoma 31, and U-3 on two rating dates, and Celebration and Tifway on one rating date.

For trafficked cultivars, significant differences were present on one rating date for both FPGC and VFC in 2019, while on three rating dates for FPGC and on one rating date for VFC in 2020 (Table 16). In 2019, U-3 had a higher FPGC than NorthBridge and Astro on one rating date. In 2020, TifTuf had higher fall PGC than Astro, Celebration, Latitude 36, NorthBridge, Tahoma 31, and U-3 on one rating date. Also, Bimini had a higher FPGC than Astro on two rating dates, NorthBridge, Tahoma 31, and Celebration on one rating date.

Simple effect analysis of traffic on FPGC in 2019 revealed that traffic had no effect on Bimini and TifTuf on any rating date (Table 17). Traffic reduced the FPGC of Astro, Celebration, Tahoma 31, Tifway, and U-3 on one rating date, while Latitude 36 on two rating dates. In 2020, traffic reduced the FPGC of Bimini, Celebration, TifTuf, Tifway, and U-3 on all three rating dates, while Latitude 36 on 2 rating dates. Traffic did not affect the FPGC of NorthBridge on any rating date in 2020.

Spring Green-up

Analysis of variance for SPGC showed significant entry*date and entry*traffic interaction effects. For VSG, the analysis showed significant entry*date and traffic*date interaction effect in spring 2020 (Table 3).

For non-trafficked conditions, significant differences among cultivars were present for SPGC and VSG on all three rating dates in 2020 (Table 19). In spring 2020, Tahoma 31 had higher SPGC than Celebration and Tifway on three rating dates, TifTuf and U-3 on two rating dates, while Bimini on one rating date. For trafficked cultivars, significant differences were present for SPGC and VSG on all three rating dates in 2020 (Table 24). Tahoma 31 and Latitude 36 had higher spring PGC than Celebration, Tifway, and U-3 on all three rating dates. Also, Bimini and NorthBridge had higher spring PGC than Celebration on all three rating dates.

The simple effect of traffic analysis on SPGC in 2020 revealed that Tahoma 31, Latitude 36, NorthBridge, Tifway, and U-3 were not affected by the traffic on any rating date (Table 20). Traffic increased the SPGC of Bimini, Astro, and TifTuf on one rating date.

DISCUSSION

Traffic tolerance

Traffic stress is known to reduce turf canopy health resulting in corresponding declines in NDVI (Trenholm et al., 1999). Kowalewski et al. (2013) reported that six weeks of traffic reduced green coverage by nearly 50% compared to the non-treated control. These findings were in agreement with our results as a significant reduction in NDVI and PGC was observed due to simple traffic effects on several dates for all cultivars. In the present study, Bimini was considered the top performer due to consistently being in the top statistical group for canopy aesthetic measurements (PGC and NDVI) while also not showing the effect of traffic prior to 50 events in either year. NorthBridge was also consistently in the top statistical group for all measurements, but responses were more sensitive to traffic, most notably prior to starting the 2020 traffic event, which is presumed to be a residual effect from the 2019 season. After Bimini and NorthBridge, Latitude 36 performed well being consistently in the top statistical group but demonstrating greater traffic effects comparatively. U-3, Celebration, and Tahoma 31 were identified as having moderate traffic tolerance. We speculate that the surprisingly poor traffic tolerance of Tahoma 31 could be an artifact of the mowing height (2.54cm) as at higher mowing heights can cause dwarf turfgrasses (e.g. Tahoma 31) to develop a puffy growth habit, which in turn could increase visible traffic injury (Skorulski, 2013).

Although most cultivars showed relatively similar results from year 1 to year 2, TifTuf surprisingly went from a top performer in year 1 to showing the effects of traffic after just 10 events in year 2. These findings contradicts prior reports of TifTuf having excellent traffic tolerance (NTEP 2013; Kowalewski et al., 2015) and maybe influenced by the greater severity of traffic stress applied in the present study. The poorest performing cultivars (Astro and Tifway) were among the oldest cultivars used in this study. Their poor performance is consistent with several previous studies (Segars, 2013; Williams et al., 2010) and is indicative of the advancement in bermudagrass breeding over the past twenty years. Our findings are also in agreement with a study conducted in Georgia where TifTuf provided greater green color than Tifway when subjected to six weeks of simulated traffic (Kowalewski et al., 2015). But in this same study, no differences among evaluated bermudagrass was found for NDVI after 6 weeks of traffic stress. This might be due to the less diverse set of evaluated hybrid bermudagrass (TifTuf, Tifway, 'Tift 94' and 04-76) while a diverse set of bermudagrass (common and hybrid) in the present study results in significant variability for NDVI under traffic stress.

Performance under non-trafficked conditions

The non-trafficked treatment helped in understanding the traffic effect on each cultivar more efficiently. The top-performing cultivars under non-trafficked conditions were Bimini, TifTuf, Latitude 36, and Tahoma 31, as they appeared in the top statistical group for both PGC and NDVI on the most rating dates over the course of two years, while Tifway and Astro were the poorest. Results of the national bermudagrass test in Oklahoma were in agreement with our findings (NTEP, 2013). U-3 was a top-performing entry during the first year but its performance was not equivalent to other top performers in the second year. Celebration and NorthBridge performed well during early to mid-fall but generally declined in at least one parameter by late fall.

The present study is among the most exhaustive list of cultivars tested to date (Goddard et al., 2008; Haselbauer et al., 2012; Macolino and Ziliotto et al., 2010; Kowalewski et al., 2015; Segars, 2013; Sever Mutlu et al., 2020; Thoms et al., 2011; Trappe et al., 2011; Williams et al., 2010). Specifically, we believe this is among the first ever studies evaluating Bimini in the transition zone. Furthermore, U-3 is no longer found in certification which has resulted in ambiguity in the market. In the present study, U-3 was procured from Southern Illinois University (SIU) and is considered by some as the original selection. As a result, findings using the SIU selection may not apply to other turfgrasses sold as ‘U-3’.

Surface Playability

Excessive surface hardness of athletic field surfaces increases the chance of severe lower extremity or brain injury in athletes (Brosnan et al., 2015). The industry standards for athletic field surface hardness recommend not exceed 122.7 Gmax when measured using a 2.25 kg Clegg Impact Soil Tester (ASTM, 2000; Munshaw et al., 2013). None of the measurements in the present study showed higher surface hardness than the standard acceptable limit on any rating date over two years. Excessively high shear strength can ‘entrap’ an athlete’s foot, while too low of a shear strength contribute to slipping or possible fall (Serensitis et al., 2014). However, no such standard range for shear strength has been formally published. Dickson et al. (2018) suggested 18 Nm as the minimum threshold shear strength for acceptable hybrid bermudagrass on a cohesive root zone when measured using a Turf-Tec shear tester. More generally shear strength values lower than 10 Nm were considered unacceptable for athletic events (Steir et al., 1999).

In both non-trafficked and trafficked conditions, differences in SS were evident among bermudagrass cultivars. A separate study in Turkey also reported a difference among bermudagrasses for SS across both traffic treatments (Sever Mutlu et al., 2020). Bimini and U-3 were considered the top-performing entries for SS. In contrast, Astro was considered the worst performing cultivar for SS, regardless of traffic condition. Under non-trafficked conditions, cultivar effect was observed for SH, but no such effects were observed under trafficked conditions. Sever multu et al. (2020) also reported consistent results under simulated traffic stress and suggested SH might be the function of soil compaction and type rather than cultivar’s turf. The superior SS for U-3 corresponds to also having a consistently low SH. Whether these two variables are related is not known, but results suggest further exploration of these traits in conjunction with potential drivers of each such as canopy architecture, management practices, and season. Generally better performance of *C. dactylon* (Bimini and U-3) in comparison to interspecific hybrid bermudagrasses for SS is presumably due to inherent species difference in leaf texture and canopy architecture.

Under non-trafficked conditions, Tifway demonstrated greater SH than U-3 while no differences were observed in comparison to other cultivars. The similar SH for Tifway and Celebration was not in agreement with Munshaw et al. (2013) who reported, Tifway as having higher SH than common bermudagrass (Celebration). In the same study, Munshaw et al. (2013) reported a negative correlation between SH and thatch accumulation and also Celebration as having greater thatchiness than Tifway at 1.27 cm mowing height. We speculate that a higher mowing height of 2.54cm in the present study could potentially increase thatch accumulation for Tifway resulting in similar SH to Celebration. Furthermore, Gmax readings in the present study were lower than Munshaw et al. (2013), probably due to high average soil moisture of 35% in our study in comparison to only 16.5% in Munshaw's study. The present study was conducted on native soil which is generally known to have higher soil water holding capacity than sandy soils (Pitt et al., 2008; Dickson et al., 2018). Greater SH value can be expected from low soil moisture conditions as previous researches has reported a negative correlation between SH and soil moisture content (Dickson et al., 2018; Munshaw et al., 2013).

Effect of traffic on Surface Playability

Shear strength and traction have been previously reported to decline due to traffic (Dunn et al., 1994; Gibbs et al., 1989; Roche et al., 2007). Results of the present study are in agreement with this general pattern, although the specific response seems to be cultivar dependent. Specifically, Tahoma 31 and TifTuf were considered least affected by traffic stress, demonstrating declines in SS on only 6 of 14 dates over two years. In contrast, U-3, Celebration, NorthBridge, Bimini, and Latitude 36 were affected by traffic, on at least 8 of 14 dates over two years. Astro and Tifway were the poorest performings showing declines in SS on 10 of 14 dates. The decline in SS due to traffic was greater in the first year than in the second year. Less stoloniferous and rhizomatous growth during the first year of bermudagrass establishment might have resulted in a greater decline in shear strength comparatively.

Traffic can result in increased soil compaction over time (Dickson et al., 2018; Kowalewski et al., 2013). Prior research has also shown traffic can lead to measurable increases in SH in a fairly short time period, particularly on native soil pitches (Dunn et al., 1994). Even in the present study, a significant increase in surface hardness after 60 events was observed. A traffic study in Knoxville reported an increase in surface hardness of bermudagrasses after 25 simulated games (NTEP, 2016). However, variation in how SH of individual cultivars responds to traffic has not been previously reported. In the present study, Astro, Tifway, Celebration, Latitude 36, Tahoma 31, TifTuf, and Bimini were in moderate to highly affected range as demonstrating SH increase on several dates. In contrast, NorthBridge was least affected by traffic, demonstrating no increase in SH on any date in year 1 and only on a few dates in year 2. U-3 appeared to be most sensitive to traffic, demonstrating increased SH on most of the dates over two years.

It is worth noting that prior to the start of trafficking in 2020, Latitude 36 and NorthBridge demonstrated significant traffic effects for SS, and Astro, Bimini, Latitude 36, NorthBridge, TifTuf, and U-3 each demonstrated traffic effects for SH. These results suggest traffic from the prior year may have had a residual influence on SS and SH, potentially due to soil compaction. Our study suggests that even though the cultivar has greater traffic tolerance (in regards to visual aesthetics), it cannot be concluded that surface playability will be similarly tolerant to traffic. Such as case (e.g., Bimini) which was deemed as the most traffic tolerant in terms of PGC and NDVI, but its surface playability was somewhat inconsistent in how it responded to traffic. This illustrates the importance of evaluating the cultivar for both visual traffic tolerance and surface playability under traffic concurrently.

Fall Color Retention

There are few reports on the bermudagrass fall color retention in response to fall-applied traffic stress. In the present study, traffic was found to decrease the bermudagrass fall color retention as all cultivars demonstrated a reduction in FPGC over several dates. Decreased fall color retention is probably due to the reduction in leaf chlorophyll concentration under traffic stress (Han et al., 2008). Variation in fall color retention among trafficked and non-trafficked bermudagrasses illustrates the influence of a genotype by environment interaction. For example, Celebration demonstrated good fall color retention in non-trafficked conditions, while it was only a moderately good performer under traffic stress.. Latitude 36 and Tahoma 31 were both had good fall color retention under traffic conditions, but only moderately good when without traffic. The poor fall color retention for Astro is consistent with the national bermudagrass test, where it was deemed as having lower fall color retention compared to Tifway (NTEP, 2013). Variability among bermudagrasses for fall color retention is probably due to different levels of physiological changes in response to low temperature. Greater unsaturation of fatty acid such as monogalactosyldiacylglycerol in Tifway in response to chilling stress has been known to be associated with its greater fall color retention (Fontanier et al., 2020). Similarly, the better performance of TifTuf and Bimini in the present study may suggest these cultivars are similarly able to maintain unsaturation of lipid membranes.

Spring Green-up

Differences among bermudagrasses for post dormancy growth may be due to variation in non-structural carbohydrate content which supports active spring green growth (Steir and Fei, 2008). Giolo et al., (2013) reported that bermudagrass cultivar having high starch accumulating potential, were more likely to have an early spring green-up. A separate study determined that higher water-soluble carbohydrate content in stolons enhances the spring green-up of bermudagrass (Macolino et al., 2010). Across both traffic treatments, Tahoma 31, Latitude 36, and NorthBridge demonstrated the earliest spring green-up while Celebration, Tifway, and U-3 had the poorest spring green-up. Higher percent winter kill in Celebration and Tifway can explain their poor spring green-up (NTEP, 2013). Results of the present study were consistent with a previous study from Oklahoma, where Latitude 36 and NorthBridge demonstrated greater spring green-up than Celebration, Tifway, and U-3 (Segars, 2013). Again there was evidence for a genotype by environment interaction in the spring green up trait. For example, spring green-up for most cultivars was unaffected or delayed by traffic, while Bimini, Astro, and TifTuf actually showed greater spring green-up when trafficked. We speculate that this positive effect of traffic for some cultivars may be due to pressing of stolons into the soil, thus reducing exposure to cold weather.

CONCLUSION

Simulated traffic stress reduced bermudagrass percent green cover, normalized difference vegetation index, and shear strength while it increased the surface hardness potentially due to compaction. Bermudagrass cultivars varied for their persistence and surface playability characteristics under trafficked conditions. The present study considered Bimini as the most traffic tolerant for aesthetic properties, with NorthBridge performing similar in a number of aspects. Tahoma 31 and TifTuf were the most traffic tolerant when considering surface playibility properties. TifTuf performed well in the first year, but its traffic tolerance declined in the second year. Older cultivars such as Astro and Tifway were more sensitive to traffic damage than newer releases while also having the poorest surface playibility charaterstics. All cultivars were in the acceptable range for surface hardness and shear strength throughout the traffic period.

Variation for fall color retention and spring green-up was found across both trafficked and non-trafficked conditions. Bimini and TifTuf had excellent fall color retention in both non-trafficked and trafficked conditions, while Astro was the poorest. Tahoma 31 and Latitude 36 had the earliest spring green-up across both traffic treatments while Bimini demonstrated excellent spring green-up when trafficked only. Our findings illustrate the importance of evaluating surface playibility as well as aesthetic qualities when selecting cultivars for athletice field use.

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Tables and Figures

Table 1. Summary ANOVA table for percent green cover (PGC), normalized difference vegetation index (NDVI), shear strength (SS), and surface hardness (SH) of 9 bermudagrasses subjected to six-weeks of simulated cleat traffic in 2019 and 2020.

Source	**Fall-2019**				**Fall-2020**			
	PGC	**NDVI**	**SS**	**SH**	**PGC**	**NDVI**	**SS**	**SH**
	---------p-value---------							
Entry	0.0053	0.0272	0.0045	0.922	0.0015	<.0001	<.0001	0.1678
Week	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Traffic	<.0001	<.0001	0.0029	0.0143	0.0073	<.0001	0.0053	<.0001
Entry*Week	<.0001	<.0001	0.6181	0.0157	0.2145	0.2935	0.0003	0.163
Traffic*Week	<.0001	<.0001	0.0006	<.0001	<.0001	<.0001	0.429	0.154
Entry*Traffic	0.5217	0.1955	0.9494	0.7462	0.1678	0.1745	0.9618	0.8755
Entry*Traffic*Week	0.9995	1	0.9999	0.9984	0.4462	0.9742	0.8786	0.7146

Table 2. Summary ANOVA table for fall percent green cover (FPGC) and visual fall color (VFC) of 9 bermudagrasses subjected to six-weeks of simulated cleat traffic in 2019 and 2020.

Source	**Fall-2019**		**Fall-2020**	
	FPGC	**VFC**	**FPGC**	**VFC**
	---------p-value---------			
Entry	0.0003	0.0019	<0.0001	0.0014
Date	<0.0001	<0.0001	<0.0001	<0.0001
Traffic	0.0062	<0.0001	0.0119	<0.0001
Entry*Date	0.0001	0.0006	0.0016	0.0014
Traffic*Date	<0.0001	<0.0001	<0.0001	0.0011
Entry*Traffic	0.7913	0.8909	0.1675	0.2272
Entry*Traffic*Date	0.9733	0.8776	0.9348	0.9879

Table 3. Summary ANOVA table for spring percent green cover (SPGC) and visual spring green-up (VSG) of 9 bermudagrasses subjected to six-weeks of simulated cleat traffic in 2019 and 2020.

Source	**Spring-2020**	
	SPGC	**VSG**
	---------p-value--------	
Entry	<0.0001	<0.0001
Date	<0.0001	<0.0001
Traffic	0.0780	1
Entry*Date	<0.0001	<0.0001
Traffic*Date	0.0561	0.0183
Entry*Traffic	0.0075	0.5743
Entry*Traffic*Date	0.2081	0.9797

Table 4. Mean percent green cover (PGC) of non-trafficked bermudagrass cultivars on seven rating dates in fall 2019 and 2020.

Year	Cultivar	Week 0	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
		---%---						
2019	**Astro**	68	83ab	72.3b	64.5	51.2	43.2c	43.5b
	Bimini	81.2	82.7ab	76.5ab	70.5	57.6	50.6a-c	52.7ab
	Celebration	78.6	79.7ab	80.9ab	76.0	61.3	48.2a-c	43b
	Latitude 36	81.9	88.2a	77.5ab	72.5	54.1	49.1a-c	46.5ab
	NorthBridge	81.3	85.8ab	83.5a	76.3	55.9	46.1bc	43b
	Tahoma 31	85.5	85.4ab	79.6ab	73.4	61.9	50.6a-c	47.1ab
	TifTuf	85.1	84.8ab	76.3ab	75.0	63.4	58.2ab	56.4a
	Tifway	77.4	76.6b	72.3b	64.0	55.7	45bc	43.2b
	U-3	74	81.5ab	79.1ab	75.5	65.2	60.5a	53.5ab
2020	**Astro**	82.5	78.3ab	71.8ab	72.1	62.2	62b	62.8bc
	Bimini	86.1	75.2ab	76.6ab	78.4	74.7	76.1a	76.8a
	Celebration	84.1	81.5a	78ab	76.7	70.8	70.9ab	67.2ab
	Latitude 36	81.4	76.6ab	74.2ab	73.0	67.4	63.5ab	65.1bc
	NorthBridge	73.4	77.8ab	73.7ab	65.9	58.4	57.8b	54.4c
	Tahoma 31	82.9	83.3a	81a	78.3	69.8	64.8ab	63.1bc
	TifTuf	82.3	76.6ab	76ab	76.8	62.9	66.1ab	69.1ab
	Tifway	76.6	73.7ab	71.7b	67.7	61.1	63ab	63.2bc
	U-3	70.4	69.3b	68.8b	64.9	60.5	57.3b	57.6bc

† Means within columns followed by the same letters are not statistically different at P=0.05 based on Tukey's HSD test in each year respectively.

‡ Measurements were made 15-Sep, 20-Sep, 27-Sep, 4-Oct, 11-Oct, 18-Oct, and 27-Oct in 2019 and 6-Sep, 11-Sep, 18-Sep, 25-Sep, 2-Oct, 9-oct, and 16-Oct in 2020 for weeks 0-6 respectively

Table 5. Mean percent green cover (PGC) of trafficked bermudagrass cultivars on seven rating dates in fall 2019 and 2020.

Year	Cultivar	Week 0 (0 events)	Week 1 (10 events)	Week 2 (20 events)	Week 3 (30 events)	Week 4 (40 events)	Week 5 (50 events)	Week 6 (60 events)
		--			%--			
2019	**Astro**	71.2	76.1ab	76.8	67.9	46.3	30	30.4
	Bimini	81.8	84.9ab	81.3	76.3	57.1	44.8	42.8
	Celebration	81.7	75ab	74.7	71.4	52.6	36.6	34.2
	Latitude 36	84.3	86.2a	79.6	75	59.2	37.4	38.9
	NorthBridge	81.5	79.6ab	82.8	78.8	54.6	34.8	29.8
	Tahoma 31	87.5	79.2ab	78.8	70.2	51.4	35.5	31.9
	TifTuf	83.8	86.4a	80.1	74.8	59.6	49	45.6
	Tifway	78.8	68.9b	73.4	63.2	51.2	29	34.5
	U-3	77.7	77.6ab	80.5	74.1	58.4	44.8	41.6
2020	**Astro**	81.5ab	74a-c	68.1ab	59.9ab	50.9	46.3	39.3b
	Bimini	85.4ab	78.9a	77.1a	72.6a	64.3	63.1	60.1a
	Celebration	88.7a	77.8ab	72.4ab	68.9ab	55.2	50	47.7ab
	Latitude 36	83.7ab	75a-c	71.3ab	63.1ab	51	51.8	49ab
	NorthBridge	84.9ab	74.3a-c	70.3ab	65ab	53.4	48.9	47.6ab
	Tahoma 31	85.5ab	75.1a-c	71.8ab	63.7ab	56.4	44.2	44.5ab
	TifTuf	79.7ab	65.2bc	59.3b	59.6ab	56.1	50	48.9ab
	Tifway	70.6b	63.5c	60.4ab	51.9b	45.2	42.8	44.2ab
	U-3	78.8ab	70.1a-c	66.8ab	62.6ab	50.4	44	42.3ab

† Means within columns followed by the same letters are not statistically different at P=0.05 based on Tukey's HSD test in each year respectively.

‡ Measurements were made 15-Sep, 20-Sep, 27-Sep, 4-Oct, 11-Oct, 18-Oct, and 27-Oct in 2019 and 6-Sep, 11-Sep, 18-Sep, 25-Sep, 2-Oct, 9-oct, and 16-Oct in 2020 for weeks 0-6 respectively.

Table 6. Simple effects of traffic on percent green cover (PGC) of nine bermudagrass cultivars on seven rating dates in fall 2019 and 2020.

Year	Cultivar	Week 0 (0 events)	Week 1 (10 events)	Week 2 (20 events)	Week 3 (30 events)	Week 4 (40 events)	Week 5 (50 events)	Week 6 (60 events)
		----------	----------	----------	p-value	----------	----------	----------
2019	**Astro**	0.531	0.1536	0.3641	0.5605	0.3444	0.0099	0.0013
	Bimini	0.9074	0.6438	0.3274	0.306	0.9321	0.242	0.0149
	Celebration	0.8942	0.3381	0.2085	0.4212	0.0977	0.024	0.0295
	Latitude 36	0.833	0.6797	0.6715	0.6614	0.3238	0.0217	0.0639
	NorthBridge	0.5232	0.195	0.8974	0.656	0.7985	0.026	0.0013
	Tahoma 31	0.9324	0.1954	0.8839	0.5676	0.0462	0.0034	0.0002
	TifTuf	0.8857	0.7353	0.4446	0.9675	0.4643	0.0716	0.008
	Tifway	0.7898	0.1108	0.8277	0.8846	0.3891	0.002	0.0326
	U-3	0.7985	0.417	0.7839	0.7985	0.1918	0.0022	0.0037
2020	**Astro**	0.8253	0.2942	0.4892	0.0088	0.0439	0.004	<.0001
	Bimini	0.8714	0.3552	0.9409	0.2092	0.0646	0.0162	0.0017
	Celebration	0.3108	0.3639	0.3149	0.0876	0.0065	0.0001	0.0003
	Latitude 36	0.6067	0.6888	0.5929	0.0333	0.0042	0.0311	0.0024
	NorthBridge	0.012	0.3908	0.5436	0.8385	0.3651	0.0975	0.180
	Tahoma 31	0.5813	0.0528	0.105	0.0018	0.0181	0.0002	0.0005
	TifTuf	0.5613	0.0051	0.0079	0.0003	0.2223	0.0031	0.0002
	Tifway	0.194	0.0118	0.0552	0.0007	0.0052	0.0002	0.0004
	U-3	0.0652	0.8348	0.7207	0.6003	0.0698	0.0144	0.0036

Table 7. Mean normalized difference vegetation index (NDVI) of non-trafficked bermudagrass cultivars on seven rating dates in fall 2019 and 2020.

Year	Cultivar	Week 0	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
2019	**Astro**	0.740	0.748ab	0.661e	0.666b	0.604b	0.620	0.516
	Bimini	0.779	0.762ab	0.691b-e	0.717ab	0.663ab	0.593	0.587
	Celebration	0.763	0.769ab	0.736ab	0.739a	0.668ab	0.560	0.548
	Latitude 36	0.769	0.806a	0.722a-d	0.729ab	0.673ab	0.551	0.592
	NorthBridge	0.780	0.776ab	0.745a	0.740a	0.683a	0.597	0.572
	Tahoma 31	0.728	0.766ab	0.731a-c	0.733ab	0.686a	0.595	0.583
	TifTuf	0.720	0.750ab	0.674de	0.700ab	0.666ab	0.613	0.600
	Tifway	0.756	0.735b	0.682b-e	0.686ab	0.645ab	0.629	0.57
	U-3	0.745	0.746ab	0.722a-d	0.716ab	0.678a	0.613	0.608
2020	**Astro**	0.714	0.720ab	0.686b	0.691b	0.615c	0.611d	0.638c
	Bimini	0.739	0.740ab	0.741a	0.742a	0.685a	0.710a	0.734a
	Celebration	0.739	0.750a	0.722ab	0.725ab	0.674ab	0.66b	0.683b
	Latitude 36	0.732	0.740a	0.693ab	0.703ab	0.644a-c	0.64c-d	0.673b
	NorthBridge	0.684	0.730ab	0.697ab	0.696ab	0.644a-c	0.63c-d	0.662bc
	Tahoma 31	0.747	0.740ab	0.721ab	0.724ab	0.643a-c	0.620cd	0.658bc
	TifTuf	0.709	0.711ab	0.701ab	0.698ab	0.659a-c	0.650bc	0.676b
	Tifway	0.683	0.681b	0.678b	0.681b	0.634bc	0.63c-d	0.657bc
	U-3	0.712	0.713ab	0.676b	0.684b	0.638a-c	0.62c-d	0.657bc

† Means within columns followed by the same letters are not statistically different at P=0.05 based on Tukey’s HSD test in each year respectively.

‡ Measurements were made 15-Sep, 20-Sep, 27-Sep, 4-Oct, 11-Oct, 18-Oct, and 27-Oct in 2019 and 6-Sep, 11-Sep, 18-Sep, 25-Sep, 2-Oct, 9-oct, and 16-Oct in 2020 for weeks 0-6 respectively

Table 8. Mean normalized difference vegetation index (NDVI) of trafficked bermudagrass cultivars on seven rating dates in fall 2019 and 2020

Year	Cultivar	Week 0 (0 events)	Week 1 (10 events)	Week 2 (20 events)	Week 3 (30 events)	Week 4 (40 events)	Week 5 (50 events)	Week 6 (60 events)
2019	**Astro**	0.741	0.721	0.688	0.696	0.57b	0.64	0.429c
	Bimini	0.779	0.771	0.711	0.72	0.657a	0.587	0.556a
	Celebration	0.763	0.733	0.712	0.715	0.625ab	0.546	0.452bc
	Latitude 36	0.769	0.79	0.713	0.738	0.681a	0.555	0.528ab
	NorthBridge	0.784	0.777	0.742	0.744	0.672a	0.605	0.48a-c
	Tahoma 31	0.728	0.73	0.7	0.693	0.623ab	0.59	0.476a-c
	TifTuf	0.721	0.711	0.703	0.714	0.652ab	0.606	0.536ab
	Tifway	0.756	0.72	0.694	0.68	0.607ab	0.66	0.486a-c
	U-3	0.740	0.721	0.688	0.696	0.57b	0.64	0.429c
2020	**Astro**	0.709a-c	0.686a-c	0.628bc	0.608ab	0.528b	0.488b	0.538b
	Bimini	0.745ab	0.74a	0.712a	0.7a	0.642a	0.6a	0.655a
	Celebration	0.759a	0.729a	0.68a-c	0.66ab	0.565ab	0.528ab	0.584ab
	Latitude 36	0.706a-c	0.705ab	0.668a-c	0.62ab	0.553ab	0.532ab	0.559ab
	NorthBridge	0.757a	0.721ab	0.69ab	0.669ab	0.592ab	0.557ab	0.605ab
	Tahoma 31	0.732a-c	0.707ab	0.653a-c	0.617ab	0.544ab	0.482b	0.52b
	TifTuf	0.672c	0.661bc	0.627bc	0.6ab	0.574ab	0.514ab	0.59ab
	Tifway	0.687bc	0.638c	0.605c	0.577b	0.524b	0.516ab	0.554ab
	U-3	0.714a-c	0.704ab	0.652a-c	0.607ab	0.553ab	0.521ab	0.578ab

† Means within columns followed by the same letters are not statistically different at P=0.05 based on Tukey's HSD test in each year respectively.

‡ Measurements were made 15-Sep, 20-Sep, 27-Sep, 4-Oct, 11-Oct, 18-Oct, and 27-Oct in 2019 and 6-Sep, 11-Sep, 18-Sep, 25-Sep, 2-Oct, 9-oct, and 16-Oct in 2020 for weeks 0-6 respectively

Table 9. Simple effects of traffic on normalized difference vegetation index (NDVI) of nine bermudagrass cultivars on seven rating dates in fall 2019 and 2020.

Year	Cultivar	Week 0 (0 events)	Week 1 (10 events)	Week 2 (20 events)	Week 3 (30 events)	Week 4 (40 events)	Week 5 (50 events)	Week 6 (60 events)
		----------	----------	----------	p-value	----------	----------	----------
2019	**Astro**	0.569	0.2542	0.3972	0.3511	0.3543	0.0698	0.0115
	Bimini	0.6518	0.6892	0.526	0.9243	0.8778	0.9612	0.3612
	Celebration	0.4537	0.1327	0.4613	0.4506	0.243	0.1015	0.0048
	Latitude 36	05184	0.4961	0.7896	0.7835	0.8407	0.2461	0.0597
	NorthBridge	0.4434	0.9615	0.9197	0.9095	0.769	0.2734	0.0068
	Tahoma 31	0.205	0.1238	0.3171	0.2144	0.0882	0.1012	0.0019
	TifTuf	0.0919	0.0978	0.3698	0.663	0.7149	0.1991	0.0617
	Tifway	0.2896	0.528	0.6999	0.8525	0.3129	0.0622	0.0131
	U-3	0.3232	0.7734	0.5475	0.8948	0.3437	0.1714	0.011
2020	**Astro**	0.846	0.2126	0.1609	0.0293	0.0095	<.0001	0.0026
	Bimini	0.823	0.8364	0.2537	0.2008	0.1944	0.0006	0.0171
	Celebration	0.3942	0.4238	0.095	0.0467	0.0013	<.0001	0.003
	Latitude 36	0.2836	0.1415	0.3259	0.0116	0.0068	0.0007	0.0006
	NorthBridge	0.068	0.7932	0.7795	0.4089	0.1139	0.0242	0.0824
	Tahoma 31	0.5378	0.2909	0.0071	0.0013	0.0033	<.0001	<.0001
	TifTuf	0.1178	0.065	0.0034	0.0031	0.0116	<.0001	0.0097
	Tifway	0.8714	0.0804	0.0041	0.0018	0.0013	0.0003	0.002
	U-3	0.926	0.9626	0.3246	0.0191	0.0118	0.0011	0.0165

Table 10. Mean shear strength (SS) of non-trafficked bermudagrass cultivars on seven rating dates in fall 2019 and 2020.

Year	Cultivar	Week 0	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
		--------------------	--------------------	--------------------	--Nm § --	--------------------	--------------------	--------------------
2019	**Astro**	21.5	20.9	19.4b	19.5	20.1	19.3	18.9
	Bimini	23.7	23.6	22.4a	21.5	21.7	21	19.6
	Celebration	22.5	22.4	21.2ab	19.8	20.4	19.8	19.2
	Latitude 36	23.2	21.5	21.3ab	20.9	20.2	20.2	18.7
	NorthBridge	22.6	23.9	20.7ab	20.3	21.3	19.3	18.9
	Tahoma 31	21.2	22.3	20.4ab	20.3	20.4	18.8	18
	TifTuf	22.7	22.1	20.6ab	20	21.6	19.6	18.8
	Tifway	22.6	22.1	21.1ab	20.7	20.9	19.7	19.7
	U-3	21.3	22.8	21.3ab	20.3	22.6	20.6	19.4
2020	**Astro**	19.8b	20.9ab	21.1	21.3	21.1b	21.9	20.4b
	Bimini	23.1a	22.1ab	21.8	22.8	22.8a	22.1	21.4ab
	Celebration	22.2ab	21.8ab	22.6	22.8	22.1ab	22.8	21.5ab
	Latitude 36	22.6ab	21.3ab	21.9	22.7	22.3ab	22.9	21.6ab
	NorthBridge	23.4a	20.4b	21.6	22.2	21.4ab	21.7	21.3ab
	Tahoma 31	21.8ab	21ab	21.9	21.6	21.9ab	22.0	21.7ab
	TifTuf	22.3ab	21.4ab	21.3	21.7	22.7ab	22.2	21.4ab
	Tifway	20.8ab	20.8b	21.1	21.7	21.4ab	21.7	20.8ab
	U-3	22.5ab	23.2a	22.2	22.3	23a	22.6	21.9a

† Means within columns followed by the same letters are not statistically different at P=0.05 based on Tukey's HSD test in each year respectively.

‡ Measurements were made 15-Sep, 20-Sep, 27-Sep, 4-Oct, 11-Oct, 18-Oct, and 27-Oct in 2019 and 6-Sep, 11-Sep, 18-Sep, 25-Sep, 2-Oct, 9-oct, and 16-Oct in 2020 for weeks 0-6 respectively

§ Shear strength measurements were made using modified Turf-Tec shear tester, selecting three random locations per plot and average was reported as shear strength in Nm unit.

Table 11. Mean shear strength (SS) of trafficked bermudagrass cultivars on seven rating dates in fall 2019 and 2020.

Year	Cultivar	Week 0 (0 events)	Week 1 (10 events)	Week 2 (20 events)	Week 3 (30 events)	Week 4 (40 events)	Week 5 (50 events)	Week 6 (60 events)
		--			Nm §			--
2019	**Astro**	21.1	19.4	18.1	18.1	18.3	17.7	17.6
	Bimini	23.9	21.4	20.1	20.4	19.6	18.6	18.3
	Celebration	22.3	21.1	19.4	18.6	19.6	18.6	17.6
	Latitude 36	22.7	20.9	19.8	18.6	18.7	17.5	17.7
	NorthBridge	21.9	20.4	19.9	18.2	19.1	17.4	17.4
	Tahoma 31	21.3	21.2	18.4	18.4	19.6	17.9	17.4
	TifTuf	22.5	20.9	19.6	19.1	19.2	17.8	17.6
	Tifway	22.5	20.6	20.2	19.6	19.1	18	17.8
	U-3	21.5	21.8	20.3	19.0	19.7	18.3	17.3
2020	**Astro**	19.3b	19.6c	19.8	19.9	19.4	21.1a-c	19.3
	Bimini	22.2ab	20.9a-c	21.2	21.8	21.4	21.3a-c	20.4
	Celebration	21.5ab	21.1ab	21.0	21.4	21.1	21.5ab	19.1
	Latitude 36	21.1ab	20.2a-c	20.9	20.3	20.8	22a	20.4
	NorthBridge	21.4ab	19.9a-c	20.9	21.0	20.2	20bc	20.2
	Tahoma 31	20.7ab	19.9a-c	19.6	20.6	20.2	20.4a-c	21.1
	TifTuf	21ab	20.3a-c	19.7	19.8	21.1	21.2a-c	20.9
	Tifway	20.4ab	19.7bc	20.7	19.8	19.8	19.6c	19.0
	U-3	23.1a	21.1a	20.7	21.5	21.4	21.1a-c	20.3

† Means within columns followed by the same letters are not statistically different at P=0.05 based on Tukey's HSD test in each year respectively.

‡ Measurements were made 15-Sep, 20-Sep, 27-Sep, 4-Oct, 11-Oct, 18-Oct, and 27-Oct in 2019 and 6-Sep, 11-Sep, 18-Sep, 25-Sep, 2-Oct, 9-oct, and 16-Oct in 2020 for weeks 0-6 respectively.

§ Shear strength measurements were made using a modified Turf-Tec shear tester, selecting three random locations per plot, and average was reported as shear strength in Nm unit.

Table 12. Simple effects of traffic on shear strength (SS) of nine bermudagrass cultivars on seven rating dates in fall 2019 and 2020.

Year	Cultivar	Week 0 (0 events)	Week 1 (10 events)	Week 2 (20 events)	Week 3 (30 events)	Week 4 (40 events)	Week 5 (50 events)	Week 6 (60 events)
		--------------	--------------	--------------	p-value	--------------	--------------	--------------
2019	**Astro**	0.3976	0.0205	0.0126	0.0098	0.0225	0.0522	0.0157
	Bimini	0.6262	0.0013	0.0001	0.0397	0.0093	0.0069	0.0202
	Celebration	0.6262	0.0309	0.0016	0.02	0.302	0.1322	0.0048
	Latitude 36	0.092	0.2958	0.0059	0.0002	0.044	0.0028	0.0613
	NorthBridge	0.1557	<.0001	0.1482	0.0006	0.0043	0.0227	0.0098
	Tahoma 31	0.7144	0.0809	0.0005	0.0017	0.2688	0.2374	0.2392
	TifTuf	0.7144	0.056	0.0521	0.075	0.0035	0.0352	0.0202
	Tifway	0.9027	0.0138	0.0637	0.032	0.0227	0.04	0.0011
	U-3	0.6262	0.08	0.0507	0.02	0.0004	0.0093	0.0007
2020	**Astro**	0.4878	0.0094	0.0315	0.0153	0.0016	0.0931	0.0057
	Bimini	0.1782	0.0204	0.3226	0.0799	0.0061	0.0813	0.01
	Celebration	0.2719	0.1062	0.0109	0.0195	0.0303	0.0085	<.0001
	Latitude 36	0.025	0.0204	0.0843	0.0004	0.0047	0.051	0.0075
	NorthBridge	0.0056	0.29	0.2029	0.0362	0.0179	0.0017	0.01
	Tahoma 31	0.0967	0.0263	0.0006	0.0649	0.0012	0.0022	0.0973
	TifTuf	0.0591	0.0204	0.0086	0.0028	0.0028	0.051	0.1281
	Tifway	0.6062	0.0339	0.4251	0.0027	0.0028	0.0002	0.0003
	U-3	0.3471	0.0002	0.0109	0.1624	0.0027	0.0039	0.0005

Table 13. Mean surface hardness (SH) of non-trafficked bermudagrass cultivars on seven rating dates in fall 2019 and 2020.

Year	Cultivar	Week 0	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
		---Gmax §	--					
2019	**Astro**	51.6ab	68.6a	46.3	51.5	50.3	51.4	49.6
	Bimini	57.6ab	63.5ab	52.2	46.0	50.6	50.8	47.9
	Celebration	55.3ab	60ab	50.7	50.1	50.5	51.1	51.3
	Latitude 36	56.8ab	57.2b	46.0	48.0	49.9	48.4	48.0
	NorthBridge	56.4ab	57.8b	49.2	49.9	51.7	51.7	50.0
	Tahoma 31	53.5ab	58.3b	48.7	51.2	51.4	52.2	51.1
	TifTuf	48.54b	63ab	46.9	51.8	52.7	50.2	52.4
	Tifway	59.2a	61.2ab	51.2	49.0	53.1	50.2	52.2
	U-3	53.3ab	57.8b	46.6	50.1	48.5	50.7	48.8
Soil Moisture (%)		38.6	31.6	37.6	37.9	35.8	35.5	36.5
2020	**Astro**	55.6	54.3ab	52.8	55.8	65.9	59.7	61.1
	Bimini	52.5	56.1ab	51.2	52.4	55.2	55.8	57.5
	Celebration	56.1	52.8ab	52.1	53.3	56.6	52.7	59.1
	Latitude 36	55.6	55ab	50.3	54.4	58.8	54.5	57.9
	NorthBridge	57.3	54.1ab	53.1	53.5	60.1	55.0	55.9
	Tahoma 31	55.9	50.8ab	51.4	53.8	61.3	56.8	60.1
	TifTuf	56.0	54ab	54.2	55.0	58.0	56.2	64.2
	Tifway	55.3	57.7a	52.9	56.8	60.6	54.7	61.9
	U-3	50.8	46.1b	47.5	50.8	53.3	57.1	63.8
Soil Moisture (%)		35	36	37.2	32	31.2	33.7	34

† Means within columns followed by the same letters are not statistically different at P=0.05 based on Tukey's HSD test in each year respectively.

‡ Measurements were made 15-Sep, 20-Sep, 27-Sep, 4-Oct, 11-Oct, 18-Oct, and 27-Oct in 2019 and 6-Sep, 11-Sep, 18-Sep, 25-Sep, 2-Oct, 9-oct, and 16-Oct in 2020 for weeks 0-6 respectively.

§ Surface hardness measurements were made using a clegg impact soil tester with 2.25 kg missile, selecting four random locations per plot, and average was reported as surface hardness in Gmax unit.

Table 14. Mean surface hardness (SH) of trafficked bermudagrass cultivars on seven rating dates in fall 2019 and 2020.

Year	Cultivar	Week 0 (0 events)	Week 1 (10 events)	Week 2 (20 events)	Week 3 (30 events)	Week 4 (40 events)	Week 5 (50 events)	Week 6 (60 events)
		--Gmax § --						
2019	**Astro**	54.6	64.0	51.2	59.1	62.9	62.3	55.9
	Bimini	58.8	64.5	54.3	55.4	60.2	59.1	58.9
	Celebration	56.4	64.7	53.3	57.9	62.2	61.8	54.6
	Latitude 36	59.2	64.8	52.2	57.1	57.9	56.8	54.6
	NorthBridge	58.8	64.8	52.4	57.6	56.3	56.4	52.9
	Tahoma 31	53.4	66.7	51.3	62.6	58.0	59.1	55.0
	TifTuf	52.9	66.8	53.2	62.4	57.4	62.3	58.4
	Tifway	58.8	66.9	56.2	57.4	62.3	59.4	56.7
	U-3	56.0	71.0	56.6	59.2	57.9	59.9	60.1
Soil Moisture (%)		38.6	31.6	37.6	37.9	35.8	35.5	36.5
2020	**Astro**	60.9	60.2	61.0	64.8	73.3	67.7	76.3
	Bimini	59.5	59.2	58.6	61.8	63.0	62.7	63.1
	Celebration	56.6	60.8	57.7	60.8	64.4	66.4	66.6
	Latitude 36	61.7	59.3	59.2	62.3	69.7	60.0	70.7
	NorthBridge	62.9	59.0	57.7	65.2	66.3	64.7	65.9
	Tahoma 31	58.9	58.8	62.2	64.2	66.0	66.4	71.8
	TifTuf	62.7	60.7	60.2	64.5	67.4	64.4	68.6
	Tifway	58.5	62.8	61.8	66.0	70.0	73.5	68.2
	U-3	61.9	59.0	57.5	60.8	66.1	64.3	74.8
Soil Moisture (%)		35	36	37.2	32	31.2	33.7	34

† Means within columns followed by the same letters are not statistically different at P=0.05 based on Tukey's HSD test in each year respectively.

‡ Measurements were made 15-Sep, 20-Sep, 27-Sep, 4-Oct, 11-Oct, 18-Oct, and 27-Oct in 2019 and 6-Sep, 11-Sep, 18-Sep, 25-Sep, 2-Oct, 9-oct, and 16-Oct in 2020 for weeks 0-6 respectively.

§ Surface hardness measurements were made using a clegg impact soil tester with 2.25 kg missile, selecting four random locations per plot, and average was reported as surface hardness in Gmax unit.

Table 15. Simple effects of traffic on surface hardness (SH) of nine bermudagrass cultivars on seven rating dates in fall 2019 and 2020.

Year	Cultivar	Week 0 (0 events)	Week 1 (10 events)	Week 2 (20 events)	Week 3 (30 events)	Week 4 (40 events)	Week 5 (50 events)	Week 6 (60 events)
		-----------------	-----------------	-----------------	p-value	-----------------	-----------------	-----------------
2019	**Astro**	0.2562	0.4999	0.0704	0.1075	0.0001	0.0006	0.0697
	Bimini	0.6939	0.3528	0.4184	0.0513	0.0013	0.0048	0.0025
	Celebration	0.6557	0.2129	0.3116	0.1023	0.0002	0.0007	0.3393
	Latitude 36	0.3686	0.0552	0.0251	0.0583	0.0052	0.0046	0.0599
	NorthBridge	0.3531	0.0688	0.231	0.1034	0.0779	0.091	0.3995
	Tahoma 31	0.9732	0.0861	0.3187	0.0223	0.0159	0.0161	0.2553
	TifTuf	0.1167	0.3037	0.0244	0.0298	0.0756	0.0002	0.0858
	Tifway	0.8719	0.4472	0.067	0.0773	0.0019	0.0024	0.1898
	U-3	0.2928	0.023	0.0008	0.0576	0.0016	0.0024	0.002
2020	**Astro**	0.0461	0.0256	0.0074	0.0037	0.0372	0.04	0.0022
	Bimini	0.0125	0.2108	0.0132	0.0028	0.0287	0.0733	0.2253
	Celebration	0.8262	0.0044	0.0521	0.0129	0.0277	0.0014	0.1133
	Latitude 36	0.0272	0.0944	0.0042	0.0099	0.0038	0.1502	0.0084
	NorthBridge	0.0388	0.0614	0.1093	0.0004	0.0742	0.0152	0.0369
	Tahoma 31	0.2542	0.0042	0.0009	0.0012	0.1657	0.0158	0.0149
	TifTuf	0.0164	0.0137	0.0396	0.0027	0.0108	0.0372	0.3457
	Tifway	0.2181	0.0493	0.0041	0.0032	0.0102	<.0001	0.1788
	U-3	0.0004	<.0001	0.0016	0.0016	0.001	0.0605	0.0214

Table 16. Mean fall percent green cover (FPGC) of non-trafficked and trafficked cultivars on three rating dates in fall 2019 and 2020.

	Cultivar	Non-trafficked			Trafficked		
		-----------------%-----------------			---------------------%--------------------		
2019	**Astro**	43.2c	11.6bc	9.8	30	11b	9.4
	Bimini	50.6a-c	13.2bc	10.1	44.8	16ab	10.9
	Celebration	48.2a-c	15.5a-c	10.8	36.6	13.6ab	9.7
	Latitude 36	49.1a-c	10.9bc	11.8	37.4	14.2ab	8.2
	NorthBridge	46.1bc	10.3c	8.3	34.8	10.7b	9.5
	Tahoma 31	50.6a-c	17.9ab	11.8	35.5	16.6ab	12.1
	TifTuf	58.2ab	14.2bc	10.3	49	14.2ab	11.1
	Tifway	45bc	15.3a-c	13.2	29	19.3ab	11.7
	U-3	60.5a	21.8a	14.2	44.8	21.3a	11.9
2020	**Astro**	62.8bc	50.3ab	31.3cd	39.3b	33b	27bc
	Bimini	76.8a	66.7a	45.8ab	60.1a	53.8a	34.1ab
	Celebration	67.2ab	52.6ab	33cd	47.7ab	37.6ab	23.7c
	Latitude 36	65.1bc	52.5ab	27.5cd	49ab	39.7ab	27.2bc
	NorthBridge	54.4c	44.6b	25.8cd	47.6ab	38.1ab	23.5c
	Tahoma 31	63.1bc	49.4ab	22.7d	44.5ab	35.1ab	21.2c
	TifTuf	69.1ab	62.5a	48a	48.9ab	42.7ab	38.9a
	Tifway	63.2bc	52.2ab	47.4a	44.2ab	35ab	34.5ab
	U-3	57.6bc	55.8ab	35.4bc	42.3ab	35.1ab	27.3bc

† Means within columns followed by the same letters are not statistically different at P=0.05 based on Tukey's HSD test in each year respectively.

‡ Measurements were made 18-Oct, 3-Nov, and 12-Nov in 2019 and 18-Oct, 1-Nov, and 14-Nov in 2020.

Table 17. Simple effects of traffic on fall PGC of nine bermudagrasses in fall 2019 and 2020.

Year	**Cultivar**	**Simple traffic effect**		
		---------------------p-value-------------------		
2019	**Astro**	0.0099	0.7846	0.7965
	Bimini	0.242	0.2087	0.562
	Celebration	0.024	0.3873	0.4786
	Latitude 36	0.0217	0.1304	0.019
	NorthBridge	0.026	0.8673	0.4523
	Tahoma 31	0.0034	0.5539	0.8635
	TifTuf	0.0716	1	0.6365
	Tifway	0.002	0.0747	0.3342
	U-3	0.0022	0.808	0.1512
2020	**Astro**	<.0001	0.0011	0.1463
	Bimini	0.0017	0.013	<.0001
	Celebration	0.0003	0.0042	0.0016
	Latitude 36	0.0024	0.0136	0.8982
	NorthBridge	0.18	0.1996	0.4372
	Tahoma 31	0.0005	0.006	0.6123
	TifTuf	0.0002	0.0002	0.0019
	Tifway	0.0004	0.0012	<.0001
	U-3	0.0036	0.0001	0.0061

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Table 18. Turf Performance Index (TPI) for fall color retention of non-trafficked and trafficked cultivars in 2019 and 2020 respectively.

Cultivar	**Non-Trafficked**					**Trafficked**				
	2019		**2020**		**Total**	**2019**		**2020**		**Total**
	FPGC	**VFC**	**FPGC**	**VFC**		**FPGC**	**VFC**	**FPGC**	**VFC**	
	Turf performance index †									
Astro	1	2	1	3	7	2	2	0	3	7
Bimini	2	3	3	3	11	3	3	3	3	12
Celebration	3	3	2	3	11	3	2	2	2	9
Latitude 36	2	3	1	2	8	3	2	2	3	10
NorthBridge	1	2	0	3	6	2	2	2	3	9
Tahoma 31	3	2	1	2	8	3	3	2	3	11
TifTuf	2	3	3	3	11	3	3	3	3	12
Tifway	2	3	2	3	10	3	2	3	3	11
U-3	3	3	1	3	10	3	3	2	3	11

† Number of times cultivar appeared in the statistical group "a" where mean separation had been performed using Tukey's HSD at α=0.05.

Table 19. Mean spring PGC of non-trafficked and trafficked bermudagrass cultivars in spring 2020.

Year	**Cultivar**	**Non-trafficked**			**Trafficked**		
		%			%		
2020	**Astro**	24.5b-d	48.8a-c	74.1ab	31.7ab	56ab	82.1ab
	Bimini	23.3b-d	48.1a-c	74.4ab	29.8a-c	62.6a	81.4ab
	Celebration	17.1d	34.2cd	65.1b	16.5cd	35.8c	64.7d
	Latitude 36	34.3ab	57.1ab	82.1a	36ab	58.7a	84.1ab
	NorthBridge	33.3a-c	59.3ab	84.8a	35.2ab	61.7a	86.1a
	Tahoma 31	41.1a	64.5a	81.3a	37.1a	63.4a	82.9ab
	TifTuf	20.3cd	42.6b-d	79.8a	27.3a-d	57.7ab	85.7a
	Tifway	15.5d	29.6d	65.7b	15.5d	34.3c	75.2bc
	U-3	25.9b-d	47.3a-d	64b	23.4b-d	44.8bc	69.7cd

† Means within columns followed by the same letters are not statistically different at P=0.05 based on Tukey's HSD test.

‡ Measurements were made 28-Mar, 11-Apr, and 26-Apr in spring-2020.

Table 20. Simple effect of traffic on spring PGC of cultivars in 2020.

Year	Cultivar	Simple traffic effects		
		----------------p-value---------------		
2020	**Astro**	0.0456	0.1209	0.1222
	Bimini	0.069	0.002	0.1717
	Celebration	0.8569	0.7319	0.9294
	Latitude 36	0.6322	0.7295	0.7038
	NorthBridge	0.5967	0.5991	0.7945
	Tahoma 31	0.2618	0.8118	0.7616
	TifTuf	0.0506	0.0013	0.2485
	Tifway	0.9905	0.3145	0.0649
	U-3	0.469	0.5993	0.2654

Table 21. Turf Performance Index (TPI) for spring green-up of non-trafficked and trafficked cultivars in 2020.

Year	Cultivar	Non-Trafficked			Trafficked		
		SPGC	**VFC**	**Total**	**SPGC**	**VFC**	**Total**
		-------------------------*Turf performance index* † --------------------------					
2020	**Astro**	2	2	4	3	2	5
	Bimini	2	2	4	3	3	6
	Celebration	0	0	0	0	0	0
	Latitude 36	3	3	6	3	3	6
	NorthBridge	3	2	5	3	2	5
	Tahoma 31	3	3	6	3	3	6
	TifTuf	1	2	3	3	1	4
	Tifway	0	1	1	0	0	0
	U-3	1	1	2	0	0	0

† Number of times cultivar appeared in the statistical group "a" where mean separation had been performed using Tukey's HSD at α=0.05.

Figure 1. Modified Turf-Tec shear tester

CHAPTER IV

EVALUATION OF SOD TENSILE STRENGTH AND SOD HANDLING QUALITY OF SELECTED BERMUDAGRASS

ABSTRACT

Turfgrasses are required to maintain integrity through handling, transporting, and installation processes for commercial sod production. New cultivars should meet industry standards for these traits prior to commercialization. A field study was conducted to investigate 15 experimental and 9 commercially available bermudagrasses [‘Astro’, ‘Bimini’, ‘Riley’s Super sport’ (Celebration), ‘OKC1119’ (Latitude 36), ‘OKC1134’ (NorthBridge), ‘OKC131’ (Tahoma 31), ‘DT-1’ (TifTuf), ‘Tifway’, and ‘U-3-SIU’] for sod tensile strength and sod handling quality. Results of sod harvestability were compared to previous measurements of shear strength and to understand the relationship between these parameters. Significant variation for each evaluated parameter were observed. Bimini demonstrated the greatest mean sod tensile strength but was not statistically different from 18-7-1, 18-8-4, 18-8-7, NorthBridge, or TifTuf. Sod handling quality of Astro, OSU1117, OSU1402, and OSU1406 were lower than Bimini. The experimental 18-8-4 and Bimini showed higher shear strength than OSU1670 and OSU1628. Pearson’s correlation coefficient analysis showed a positive correlation (r=0.62) between sod tensile strength and sod handling quality and a positive correlation (r=0.66) between sod tensile strength and shear strength. Positive correlation suggests that shear strength could be and indicator for sod tensile strength estimation.

INTRODUCTION

Sodding is a common practice used across the green industry to efficiently establish or renovate turf. Perez et al., (1995) referred to ‘sod’ as the harvested surface layer of turf consisting of interconnected turfgrass plant parts such as rhizomes and stolons, and soil attached to roots of turfgrass plants. Among warm-season grasses, bermudagrass (*Cynodon* spp.*)* is the most widely used species for sod production with St. Augustinegrass (*Stenotaphrum secundatum*), zoysiagrass (*Zoysia* spp.), centipedegrass (*Eremochloa ophiuroides*), bahiagrass (*Paspalum notatum*), and buffalograss (*Bouteloua dactyloides*) also grown in regions specific to their market (Christians, 2011).

A good quality sod must have uniformity, high density, adequate carbohydrate reserve for effective rooting, less thatch, proper sod strength, and handling quality (Beard, 1973). For commercial sod production, turfgrasses able to maintain integrity through handling, transporting, and installation processes are highly desirable (Beard, 1973). Among many variables, sod strength or sod tensile strength is a potentially limited factor in the sod industry (Segars et al., 2020). Sod tensile strength is a quantitative measurement of the resistance offered by a sod pad to tearing (McCalla et al., 2009) or capacity of the sod to resist longitudinal stress (Segars et al., 2020; Shearman et al., 2001). Because sod strength is critical for production, new turfgrass varieties are often evaluated for this trait prior to commercialization.

A number of techniques and devices have been developed to measure sod tensile strength. Rieke et al. (1968) measured the sod strength as the weight of sand required to tear the sod while held stationary on one end. Researchers at Mississippi State University developed a sod testing unit having a movable and stationary sod pad holding frame. This unit was capable of measuring peak force or sod strength, pull distance, peak force, and peak work (Goatley et al., 1997). A sod strength testing device was constructed in Louisiana, in which movement of one sod holding clamp was done using a pivot mechanism while the other clamp was fixed (Parish, 1995). Segars et al. (2020) evaluated the sod tensile strength of bermudagrass entries using a testing device similar to Goatley et al. (1997) but measurements were made using a horizontal orientation instead of a vertical orientation.

Bermudagrasses are known to vary in sod tensile strength (Gopinath, 2015; Han, 2009; Jha, 2018; Segars, 2020). Han (2009) evaluated four hybrid bermudagrasses for sod tensile strength (STS) and sod handling quality (SHQ). 'Patriot' and 'Tifway' were reported having high or suitable STS and SHQ while 'Midlawn' and OKC 70-18 were medium or poor performing entries (Han, 2009). Gopinath (2015) reported differences among 39 bermudagrass entries for STS and SHQ. 'OKC1119' (hereafter referred to as Latitude 36) exhibited higher mean STS than Tifway, Patriot, 'Riviera', 'Riley's Super Sport' (hereafter referred as Celebration), 'Astro', 'DT-1' (hereafter referred as TifTuf), 'U-3-SIU', other commercial and experimental entries over three harvest dates (Gopinath, 2015). Variation among 29 bermudagrass entries for STS and SHQ were also reported by Jha (2018). Tifway, Patriot, 'Tift 94 (TifSport) exhibited higher SHQ and STS than 'Midlawn' upon harvesting sod after 14 days of planting (Jha, 2018). In another study conducted at Oklahoma State University, Segars (2020) reported Tifway having higher STS than Latitude 36, 'OKC1134' (hereafter referred to as NorthBridge), and 'OKC1131' (hereafter referred to as Tahoma 31) in one year while Midlawn during both years. Decreased acceptability of hybrid bermudagrass 'Midlawn' by sod producers was due to its poor sod strength and handling quality which illustrate the importance of evaluating bermudagrass for sod production characteristics.

Few studies have been focused on understanding the relationship between STS and vegetative characteristics. Ross et al. (1991) reported the negative correlation of root biomass and internode length with the STS of ten turfgrass cultivars. Bermudagrass growth characteristics (stolon diameter, internode length, and dry matter distribution) were also reported as negatively correlated with STS (Zhou et al., 2015). Segars et al. (2020) also reported a negative correlation between rhizome characteristics such as (rhizome strength and size) with STS of evaluating bermudagrasses. However, the STS of turfgrass species is highly dependent of shoot density and rhizome density (Hurley and Skogley 1975; Krans et al., 1992).

Various previous researches have been reported the positive correlation between tiller or shoot density and shear strength of turfgrasses as well (McNitt et al., 1997; Lulli et al., 2014; Reyneri et al., 2003). Shear strength or rotational traction is the measure of the resistance offered by the turf surface to athletes' cleated shoe in order to prevent possible fall or slipping while playing (Canaway & Bell, 1986). Intuitively, there are a number of components of the turf canopy that would contribute similarly to shear strength as well as sod tensile strength. Despite this, there has been no study focused on understanding the relationship between sod tensile strength and shear strength of bermudagrasses. Identifying a relationship of shear strength with tensile strength would be valuable as it can be used as predictive indices for breeding programs or as a tool by producers to quantify field readiness for harvest.

OBJECTIVES

- To evaluate the sod tensile strength and sod handling quality of selected bermudagrasses.
- To quantify the relationship between shear strength and sod tensile strength of selected bermudagrasses.

HYPOTHESES

- Bermudagrasses vary for their sod tensile strength and sod handling quality.
- Shear strength and sod tensile strength are positively related to each other.

MATERIAL AND METHODS

Site Description and Entries

A field study was conducted from June 2019 to June 2020 at the Oklahoma State University Turfgrass Research Center in Stillwater, Oklahoma. The plots and their maintenance were the same as described in Chapter 2. The soil type was a Norge loam (Fine-silty, mixed, thermic, Udic Paleustoll). A twenty-five bermudagrass entries were selected on the basis of shear strength data measured on 15 Sept. 2019 (data not presented). The selected entries included 9 commercial cultivars [Astro, Bimini, Celebration, Latitude 36, NorthBridge, Tahoma 31, TifTuf, Tifway, and U-3-SIU (U-3 obtained from Southern Illinois University, herafter referred to as U-3) and experimental entries consisting of 5 high performers (18-8-4, 18-8-7, 18-7-1, OSU1402, and OSU1117), 8 medium performers (OSU1337, 17-4200-19x13, 18-9-2, OSU1682, OSU1666, OSU1406, 18-7-6, and 18-7-3), and 3 poor performers (OSU1670, OSU1628, and 18-8-6).

Shear Strength (SS)

Shear Strength measurements were taken using a modified version of Turf-Tec Shear Strength Tester (Turf-Tec International, Florida, USA). As traction force depends upon the shoe–surface interaction, the vertical force or loading weight should be comparable to the force applied by the athlete to the point of contact (Nigg et al., 1990). In an attempt to obtain consistent data, the Turf-Tec shear strength tester was modified according to Canaway's trolley-mounted rotational device (Canaway and bell, 1986). The Turf-Tec shear tester (3.4 kg) was loaded with weights (45.35kg) which resulting a total weight of 48.75 kg for this apparatus. This loaded unit was mounted on a four-wheeled wooden trolley structure for transport on research plots. The apparatus was held in place on the wooden trolley by the support of two long iron bars which were fixed on one end and the other end was used to lift and drop the apparatus from the standard height of 60 mm or 6 cm. The shear strength values were obtained on all plots using a 40˚ angle of rotation to obtain the maximum rotational traction (McNitt et al., 1997; Webb et al., 2014). A protractor was fitted on the wooden trolley keeping the shaft of the loaded Turf-Tec unit on its axis and measuring the turning angle throughout the rotation of the loaded unit. The torque required to tear the turf was measured using the two-handled Turf-Tec Torque wrench which is scaled up to 30 Nm. The measured torque was recorded as shear strength in 'Nm' units. The cleated foot was used to measure the shear strength instead of the shear vane foot. Three random locations were selected in each plot and average was noted as the shear strength of bermudagrass entry in that plot.

Sod Harvest and Evaluation

The optimum soil moisture conditions were ensured visually before harvesting sod on 9 June 2020 from non-trafficked plots of the aforementioned 25 bermudagrasses. The sod pads were harvested using a Ryan Junior sod cutter (Model 544844C, Textron, Racine, WI) resulting in a sod pad having dimensions of 30.5cm wide by 100cm long by 1.5cm depth. The sod pad (100cm) was cut into two halves (subsamples) measuring 50 cm in length each using a knife before measuring sod handling quality (SHQ) and sod tensile strength (STS).

Sod handling quality (SHQ) is the ability of a sod pad to remain intact while being handled such as lifting, loading, transporting, and installing. A visual rating system developed by (Han, 2009), was followed to characterized sod pads on the basis of their handling quality. A scale of 1 to 5 was used to rate the handling quality of sod pad where a rating of:

1 = complete breakage, inability to transport to sod tearing device (unacceptable quality)

2 =substantial cracking, but still transportable to sod tearing device

3= moderate cracking (minimum acceptable for industry handling)

4=very mild cracking (minimum acceptable for cultivar commercialization)

5=no cracking or defect of the product (best handling quality)

After cutting sod, each sod pad was rated for sod handling quality. The evaluation step was, lifting the sod pad and giving a gentle shake three times, and then curling the sod pad while holding it with both hands from one end. Ratings were the scored by one person for all plots to reduce the errors associated with variation among evaluators' judgements.

Sod tensile strength (STS) is the measure of resistance or force required to tear the sod strip. Sod tensile measurements were made by using a sod tensile strength testing device developed at Oklahoma State University (Han, 2009) (Figure 1). This device consists of a metal frame with dimensions of 147 x 53 x 97cm (length x width x height) and two sod pad holding plates at its top. One plate was stationary while other plates could move horizontally. The movable plate was tied to a hydraulic pull connected to the digital force meter (Chatillon Model DFIS, John Chatillon & Sons, Inc., Greensboro, NC). For sod tensile strength evaluation, a sod pad was loaded and clamped to holding plates, while ensuring the movable plate was in full contact with the stationary plate. Subsequently, the hydraulic pull was operated to move the plate to the point that the sod pad tore into two pieces. The digital force meter measured the value of peak force (kg dm^{-2}) used to tear the sod which was recorded as the sod tensile strength. After measuring tensile strength, the sod pieces were neatly placed back into their respective sites within plots. Sod harvested sites were hand irrigated using a hand-held hose every 2 days for three weeks to ensure their recovery. Any loose sprigs were removed from the plot area to maintain the entry's purity.

Data Analysis

The experiment was conducted as a randomized complete block design with three replications. Analysis of variance was performed upon dependent variables: STS, SHQ, and SS using PROC GLIMMIX with LINES statement adjusted for Tukey's honest significance test (α=0.05). Pearson's correlation coefficient was used to calculate the relationship between each set of measured variables using PROC CORR.

RESULTS AND DISCUSSION

Sod tensile strength (STS)

Sod tensile strength showed a significant entry main effect with values ranging from 69.6 to 20.5 Kg dm^{-2} among the 25 evaluated bermudagrasses (Table 1). Bimini demonstrated the highest numerical mean (69.6 kg dm^{-2}), but was statistically similar to 18-7-1, 18-8-4, 18-8-7, NorthBridge, and TifTuf (Table 1). Among commercially available bermudagrasses, Bimini had higher STS than Celebration, Latitude 36, Astro, Tifway, Tahoma 31, and U-3. The experimental selection 18-7-1 demonstrated higher STS than Tahoma 31. OSU1628 had the lowest STS among evaluated entries. Our results for STS were not in agreement with Gopinath (2015) wherein NorthBridge, Latitude 36, and Tahoma 31 was reported having a greater STS than Tifway. In contrast, no differences between these cultivars were observed by Segars et al. (2020). Gopinath (2015) also found Latitude 36 as having higher STS (averaged over three harvest dates) than Tifway, Celebration, Astro, TifTuf, Tahoma 31, and U-3. This inconsistency may be attributable to the higher mowing height (6.4 cm) which can promote efficient and enhanced root growth of bermudagrasses than the present study. More differences in STS can be expected due to the varied rooting ability of bermudagrasses. Other variation in results may be attributable to the relative maturity of the sod at harvest with some cultivars establishing more rapidly than others

Sod handling quality (SHQ) and its relationship with STS

Sod handling quality demonstrated a significant entry main effect with means ranging from 4.5 to 2.7 for Bimini and two experimentals (OSU1402 and OSU1406), respectively (Table 1). Among commercialized cultivars, Astro had the lowest numerical mean (2.8) for SHQ and was statistically less than Bimini. The similarly acceptable SHQ among most commercially available cultivars is consistent with prior research also conducted in Oklahoma (Gopinath, 2015: Jha, 2018; Segars et al., 2020). The one exception was Astro which produced acceptable SHQ (>3) for Gopinath (2015) but was marginally unacceptable in the present study. These results can be expected as Gopinath (2019) evaluated this trait for more matured bermudagrasses than the present study. Typical correlation coefficients for SHQ and STS have ranged from r = 0 .73 (Jha, 2018) to 0.92 (Gopinath, 2009). In the present study, mean STS was positively correlated (r=0.62 at p=0.001, N=25) with mean SHQ (Fig. 2) in a similar manner as, although slightly lower than, previously reported by Gopinath (2015) (r=0.92), Han (2009) (r=0.89), Jha, (2018) (r=0.73) and Segars et al. (2020) (r=0.80). Describing a relationship between SHQ and STS would assure the sod producers and consumers to depend on SHQ measurements in evaluating the particular bermudagrass for sod production (Segars et al., 2020). SHQ is a qualitative measurement, and serves as a link between the quantitative data valued by researchers and the practical information valued by producers.

Relationship Between Sod tensile strength and Shear strength

Analysis of SS data showed a significant entry main effect with means ranging from 17.6Nm to 24.3Nm for Bimini and OSU1628, respectively. No differences in SS were detected among commercialized bermudagrasses. Interestingly, SS was positively correlated ($r=0.66$ at $p=0.0003$) with STS (Fig. 3). The only other report attempting to quantify the relationship between SS and STS found no significant correlation (Ross et al., 1991). This prior report differed in that SS was measured using the bottom side of a harvested sod pad, which essentially measured the rotational strength of the soil and to extent the rooting network (Ross et al., 1991). The strong correlation between STS and SS in the present study shows that SS could be a useful index to estimate the STS of bermudagrasses. Moreover, the results imply traits that contribute to STS also contribute to SS.

One limitation of the present study is that SS and STS were not measured concurrently. That is SS measurements were conducted in fall 2019, while STS measurements were taken in the following summer Further investigation of this relationship using concurrent measurements and across additional species are needed to better define the viability of using SS to predict STS.

CONCLUSIONS

Twenty-five bermudagrasses were evaluated for sod harvestability traits and shear strength. Among the commercial bermudagrasses tested, Bimini, NorthBridge, and TifTuf had excellent STS and SHQ. The experimental bermudagrass 18-7-1 demonstrated greater STS than Tahoma 31, illustrating the potential of plant breeding programs to continually improve sod characteristics. The present study was also the first to show a relationship between STS and SS in bermudagrass providing evidence for the potential to use SS to determine sod harvest readiness.

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Tables and Figures

Table 1. Mean sod tensile strength (STS), sod handling quality (SHQ) and shear strength (SS) of 25 bermudagrasses.

Entry	Sod Tensile Strength	Sod Handling Quality	Shear Strength (Fall-2019)
	Kg dm^{-2} §	(1-5 scale) ‡	Nm ¶
18-7-1	51ab	3.5a-c	23.3a-c
18-7-3	33.3b-d	3.8a-c	21a-d
18-7-6	33.4b-d	4.2a-c	20.1a-d
18-8-4	44a-d	3.8a-c	24.2a
18-8-6	28.1b-d	3.2a-c	18.2cd
18-8-7	45.5a-d	3.7a-c	23.8ab
18-9-2	39.8b-d	3.8a-c	21a-d
17-4200-19x13	31.2b-d	3.8a-c	21a-d
Astro	37.1b-d	2.8bc	20.4a-d
Bimini	69.6a	4.5a	24.3a
Celebration	35.8b-d	3.7a-c	22.4a-d
Latitude 36	38.1b-d	4.3ab	22.1a-d
NorthBridge	46.5a-d	3.8a-c	21.8a-d
OSU1117	32b-d	2.8bc	23a-c
OSU1337	26.2b-d	3a-c	20.5a-d
OSU1402	24.6b-d	2.7c	23.2a-c
OSU1406	24cd	2.7c	20.7a-d
OSU1628	20.5d	3a-c	17.6d
OSU1666	20.5cd	3a-c	21.1a-d
OSU1670	21.8cd	3.2a-c	18.7b-d
OSU1682	36.6b-d	4.3ab	21.9a-d
Tahoma 31	22.4cd	3.7a-c	20.9a-d
TifTuf	47a-c	3.8a-c	22.5a-d
Tifway	37.1b-d	3.2a-c	22.7a-d
U-3	31.8b-d	3.2a-c	22.6a-d

† Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

§ Sod tensile strength reported in kg dm^{-2} for sod harvested at 1.5 cm depth and 30.5 cm width.

‡ Sod handling quality was measured on a 1 to 5 scale where 1= complete breakage; 2=substantial cracking; 3= moderate cracking; 4= minimal cracking; and 5 = no cracking.

¶ Shear strength measurements were made on 15-Sept, 2019 using modified Turf-Tec shear tester, selecting three random locations per plot and average was reported as shear strength in Nm unit.

Figure 1. Sod tensile strength testing device.

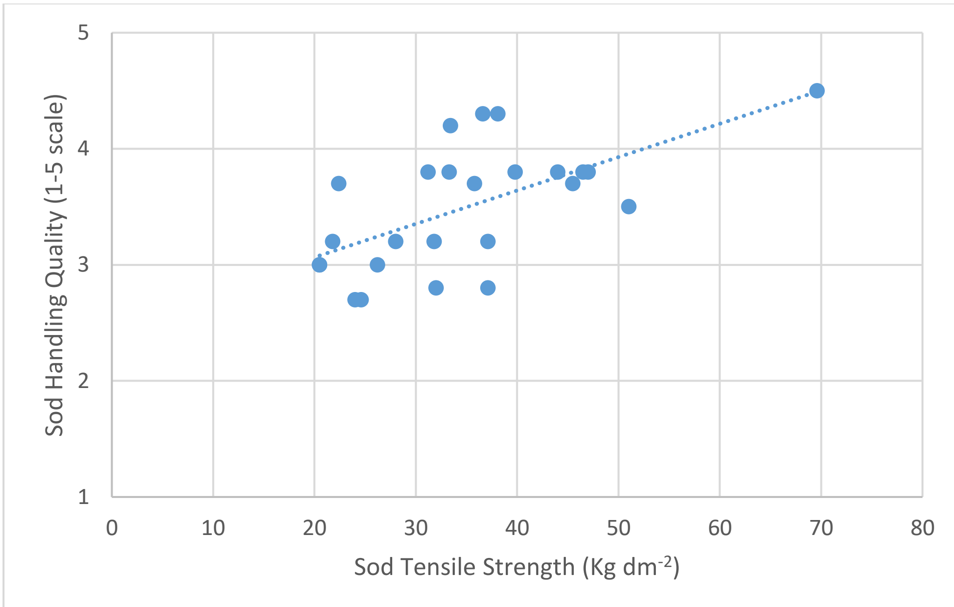

Figure 2. Relationship between sod handling quality (SHQ) and sod tensile strength (STS) using the mean STS and SHQ of 25 bermudagrass entries.

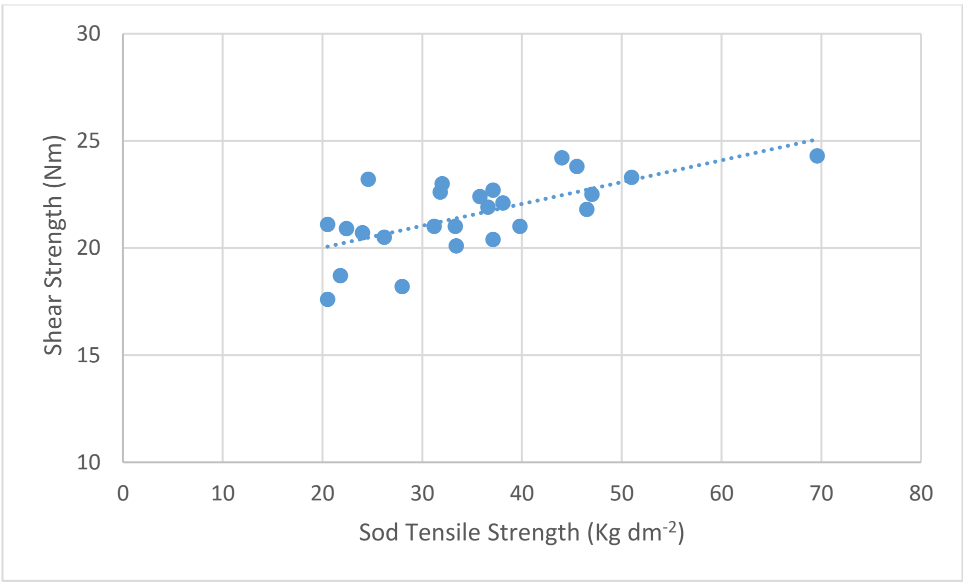

Figure 3. Relationship between shear strength (SS) and sod tensile strength (STS) using the mean SS and STS of 25 bermudagrass entries.

Appendices

Table 1. Mean percent green cover (PGC) of 96 non-trafficked bermudagrasses on seven rating dates in fall-2019.

Entry	15-Sep	20-Sep	27-Sep	4-Oct	11-Oct	18-Oct	25-Oct
	----------------------------	----------------------------	----------------------------	%	----------------------------	----------------------------	----------------------------
15-4X15	74.6	81.8a-d	65.9a-o	61.2a-k	43.4c-n	43.1c-l	45.1c-n
15-8X3	83.5	84.8a-c	56.9f-o	54.8c-k	43.5c-n	48.9b-k	46.4b-k
18-7-1	60.3	82.8a-d	65.2a-o	61.4a-k	47.6b-n	44.8b-k	41.5c-n
18-7-2	71.9	83.5a-d	66.8a-o	62.6a-k	42.2d-n	47.3b-k	49.7b-j
18-7-3	78.2	86.5a-c	70.3a-n	65.5a-k	54.4b-m	53b-i	52.8b-g
18-7-4	75.1	84.9a-c	65.6a-o	63.1a-k	41.6d-n	36.1g-l	33i-o
18-7-5	83.9	79.5a-d	70.3a-n	61.2a-k	47.5b-n	30.5j-l	28.4m-o
18-7-6	79.4	86a-c	79.9a-h	79.5a-e	65.3a-e	58.6a-e	55.6b-e
18-8-1	80.3	83.4a-d	85.5a	87.2a	83.6a	76.7a	73.2a
18-8-2	64.7	72.9a-d	64.6a-o	64.2a-k	54.9b-m	51.3b-j	50.2b-i
18-8-3	83.3	87.3a-c	76.5a-j	78.2a-f	65.3a-e	65.8ab	62.6ab
18-8-4	76.3	84.5a-c	63.4a-o	62a-k	49b-n	49b-k	51.5b-h
18-8-5	72.4	83a-d	61.7a-o	62.8a-k	47.1b-n	45.1b-k	44.4c-n
18-8-6	73.3	78a-d	67a-o	62.7a-k	47.4b-n	44.1c-l	42.5c-n
18-8-7	83.1	87.6ab	82.6a-c	83.9ab	64.4a-f	61.9a-c	57.8a-c
18-9-1	80.7	69.8a-d	58e-o	56.9b-k	45b-n	42c-l	39.4d-o
18-9-10	73	71.9a-d	60.8b-o	57.1b-k	43.6c-n	47.6b-k	45.7b-m
18-9-11	74.3	86a-c	75a-l	66.3a-k	44.8b-n	43.3c-l	41.9c-n
18-9-12	83.9	78.7a-d	58.2d-o	56.2b-k	37.9i-n	38.2e-l	37.8f-o
18-9-2	83	89.1a	73.4a-m	76a-i	58.4b-k	53.2b-h	50.2b-i
18-9-3	78.7	80.4a-d	74.8a-m	69.9a-j	60.6a-j	51.9b-i	49.4b-j
18-9-4	79.4	68.2a-d	63.5a-o	65.2a-k	54.2b-m	45.5b-k	46.4b-k
18-9-5	72.9	75.7a-d	52.6j-o	43.8jk	39.3h-n	42c-l	39.8d-n
18-9-6	76.9	77.6a-d	55i-o	49.3h-k	32.1mn	31.8i-l	37f-o
18-9-7	76.9	78.3a-d	70.6a-n	65.4a-k	48.4b-n	43.3c-l	43c-n
18-9-8	78.7	82.7a-d	71.8a-n	68.1a-j	56.7b-l	52.7b-i	51.6b-h
18-9-9	73.3	79.8a-d	63.2a-o	63.7a-k	55.6b-m	49.8b-k	49.6b-j
17-4200-19x13	78.8	82.3a-d	71.2a-n	74.7a-i	46.9b-n	44.3c-l	45.3b-m
17-4200-19x21	79	84.7a-c	58.9c-o	51f-k	40.3g-n	40.3d-l	41.2c-n
17-4200-19x9	73.1	90.2a	74.7a-m	70.7a-j	37.1j-n	37.8e-l	38.2f-o
17-4200-36x19	71.3	86.9a-c	82.3a-d	77.2a-g	46.6b-n	46.9b-k	45.2c-n
Astro	68	83a-d	72.3a-n	64.5a-k	51.2b-m	43.2c-l	43.5c-n
17-5200-11X9	82.6	71a-d	65.4a-o	59.5b-k	37.1j-n	36.9f-l	38.4e-o
17-5200-13X9	78.7	76.1a-d	59.8b-o	58.6b-k	36.5k-n	41.9c-l	42.6c-n
17-5200-31X3	76.3	78.6a-d	80.8a-g	81.4a-c	62.9a-h	56a-g	51.4b-h
17-5200-3X23	74.8	89.8a	83.8ab	83.4ab	59.6a-k	54.2b-h	49b-j
17-5200-4X11	70.7	83.7a-d	73.4a-m	72a-i	53.3b-m	48.1b-k	46.1b-k
Bimini	81.2	82.7a-d	76.5a-j	70.5a-j	57.5b-k	50.6b-j	52.7b-g
2008-4x16	68.5	87.5ab	70.2a-n	57.6b-k	45.7b-n	40.2d-l	41.4c-n
Celebration	78.6	79.6a-d	80.9a-f	76a-i	61.2a-i	48.1b-k	43c-n
Latitude36	81.9	88.2a	77.4a-i	72.5a-i	54.1b-m	49.1b-k	46.4b-k
NorthBridge	81.3	85.8a-c	83.5ab	76.3a-h	55.9b-m	46.1b-k	43c-n
OKC1221	77.3	82.6a-d	75a-l	69.9a-j	56.7b-l	50.2b-k	46.7b-k
OSU1101	72.1	89a	82.8a-c	79.8a-e	67.3a-c	61.7a-c	57.9a-c
OSU1117	74.9	79.4a-d	67.9a-o	52.6e-k	45.7b-n	36.1g-l	36.7f-o
OSU1127	77	83.6a-d	69a-n	58.9b-k	43.7c-n	48.1b-k	48.6b-j
OSU1132	78.6	81.7a-d	73.2a-m	59.2b-k	45.8b-n	38e-l	36g-o
OSU1156	68.9	74.3a-d	66.4a-o	60.2a-k	47b-n	41.1c-l	47.8b-j
OSU1217	76.7	78.1a-d	71.6a-n	62.5a-k	43.8c-n	41c-l	41.7c-n
OSU1257	77.7	82.5a-d	65.9a-o	58.4b-k	50.1b-n	44.5b-l	43.8c-n
OSU1318	82.5	86.8a-c	71.2a-n	68.5a-j	49b-n	45.9b-k	42.8c-n
OSU1337	76.6	87.4ab	77.9a-i	73.6a-i	51.2b-m	41.2c-l	39.4d-o
OSU1402	76.8	80.9a-d	68.7a-o	56.5b-k	43.5c-n	33.2h-l	33.8i-o
OSU1403	77.9	84.9a-c	72.4a-n	67a-k	47.2b-n	43.1c-l	38.1f-o
OSU1406	65.9	86.7a-c	73.5a-m	69.6a-j	53.3b-m	46.5b-k	41.6c-n
OSU1408	75.7	79.3a-d	56.3h-o	52.7e-k	33.2l-n	23.3l	22.2o
OSU1409	80.3	79.8a-d	63.2a-o	63.2a-k	38.1i-n	42.5c-l	41.8c-n

OSU1417	57.7	82.9a-d	63a-o	53.9c-k	41.4e-n	44.9b-k	44.7c-n
OSU1418	79.4	86.4a-c	74.6a-m	68.9a-j	54.7b-m	46.1b-k	44c-n
OSU1433	77.4	81.5a-d	67.4a-o	60.9a-k	48.3b-n	42.7c-l	39.1d-o
OSU1439	72.2	84.1a-c	72.5a-n	69.1a-j	50.8b-n	42.3c-l	43.5c-n
OSU1601	80.1	74.2a-d	65.1a-o	60.1a-k	42.2d-n	38.5e-l	39d-o
OSU1609	79.9	86a-c	62.5a-o	52.3e-k	46.5b-n	45.9b-k	44.8c-n
OSU1611	66.6	73.3a-d	57.5f-o	59.2b-k	48.9b-n	51.2b-j	45.2c-n
OSU1617	74	81a-d	77.6a-i	73.3a-i	61.1a-j	49b-k	49.8b-j
OSU1620	74.7	83.9a-d	60.7b-o	61.6a-k	37.9i-n	41.4c-l	39.7d-n
OSU1625	70.1	87.3a-c	68.4a-o	60.7a-k	45.8b-n	43.3c-l	42c-n
OSU1628	77.1	74.8a-d	58.6c-o	59.4b-k	40g-n	43.3c-l	45.7b-m
OSU1629	80.1	73.6a-d	80.6a-g	76.2a-h	65.5a-d	48.3b-k	48.2b-j
OSU1631	76.9	84.9a-c	62.7a-o	61.7a-k	47.7b-n	47b-k	44.2c-n
OSU1638	78.8	85.7a-c	52.7j-o	52.5e-k	47.9b-n	49.9b-k	47.6b-j
OSU1639	74.6	82.8a-d	81.8a-e	81a-d	68.7ab	56.5a-g	48.9b-j
OSU1641	73.8	83.3a-d	58.7c-o	54.8c-k	37.8i-n	41.8c-l	41.5c-n
OSU1646	80.3	80.5a-d	60.2b-o	57.9b-k	43.6c-n	39.9d-l	39.2d-o
OSU1649	75.9	62d	44.5o	50.2g-k	42.7d-n	37.7e-l	37.1f-o
OSU1651	73.9	80.8a-d	63.8a-o	56.7b-k	47.7b-n	45.5b-k	42.6c-n
OSU1656	81.5	80.1a-d	61.7a-o	58.6b-k	51.3b-m	38.8e-l	38.6e-o
OSU1657	71.5	84.4a-c	70.4a-n	58.8b-k	47.5b-n	42.3c-l	40.9c-n
OSU1661	79	65.3cd	50.8l-o	43.4jk	36k-n	30.2j-l	28.6l-o
OSU1662	79.8	85.5a-c	76.2a-k	70.6a-j	53.1b-m	50.9b-j	45.7b-m
OSU1663	75.3	74a-d	65.1a-o	57.6b-k	38i-n	34h-l	37.4f-o
OSU1664	72.7	84.5a-c	77.8a-i	72.4a-i	55.7b-m	50.6b-j	45.8b-l
OSU1666	73.3	79.1a-d	50.6m-o	48.4i-k	40.8f-n	41.9c-l	41.8c-n
OSU1670	78.5	78.3a-d	68.4a-o	64.7a-k	55.1b-m	46.1b-k	44.7c-n
OSU1673	89.5	65.9b-d	62.4a-o	53.5d-k	39.6g-n	40.6c-l	34.3h-o
OSU1675	74.4	70a-d	48.4no	40.4k	27n	28.9kl	27.9no
OSU1680	80.9	76.8a-d	52.2k-o	49h-k	33.4l-n	33.6h-l	32.4j-o
OSU1682	76.5	78.1a-d	56.6g-o	52.7e-k	43.7c-n	40.8c-l	40.8c-n
OSU1687	74.6	84.7a-c	63.2a-o	63.2a-k	47.4b-n	34.4h-l	29.4k-o
OSU1690	73.8	79.7a-d	67.4a-o	69.2a-j	51.3b-m	42.2c-l	41.7c-n
OSU1699	77.8	75.5a-d	65.1a-o	61.6a-k	48.1b-n	42.6c-l	40.6c-n
Tahoma31	85.5	85.4a-c	79.5a-h	73.4a-i	61.8a-i	50.6b-j	47.1b-j
TifTuf	85.1	84.7a-c	76.3a-k	75a-i	63.4a-g	58.2a-f	56.4a-d
Tifway	77.4	76.6a-d	72.3a-n	64a-k	55.7b-m	45b-k	43.2c-n
Tilin#5	80.2	81.3a-d	73.1a-m	66.8a-k	46.9b-n	42.3c-l	44.6c-n
U-3	74	81.5a-d	79.1a-i	75.5a-i	65.2a-e	60.5a-d	53.5b-f

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 2. Mean percent green cover (PGC) of 96 trafficked bermudagrasses on seven rating dates in fall-2019.

Entry	15-Sep (0 events)	20-Sep (10 events)	27-Sep (20 events)	4-Oct (30 events)	11-Oct (40 events)	18-Oct (50 events)	25-Oct (60 events)
	----------	----------	----------	%	----------	----------	----------
15-4X15	78.3	79.4a-d	67.5a-i	60.1a-n	41.5a-o	27.9a-f	31.2a-f
15-8X3	82.6	82.3a-c	60.6d-i	52.3f-n	34m-o	28.2a-f	28.6a-f
18-7-1	60.1	72.7a-e	68a-i	61.2a-n	44.7a-o	31a-f	30.8a-f
18-7-2	71.6	81.5a-c	71.9a-h	67.4a-l	52.2a-o	40.2a-f	41.7a-e
18-7-3	79.3	78.4a-e	72.8a-h	67.9a-l	51.5a-o	36.2a-f	36.5a-f
18-7-4	76.3	83.2a-c	77.6a-f	70a-k	48a-o	32.4a-f	32.1a-f
18-7-5	79.2	74.9a-e	69.2a-i	63.1a-l	46.8a-o	25.8a-f	26b-f
18-7-6	76.7	77.7a-e	76a-g	78.6a	56.5a-i	39.4a-f	35.7a-f
18-8-1	81.6	76.6a-e	81.1a-e	73.5a-i	57.8a-g	44.7a-c	40.5a-e
18-8-2	73.5	76.4a-e	77.3a-f	69.8a-k	60.7a	39.6a-f	39.1a-e
18-8-3	83.6	72.9a-e	74.3a-h	75.3a-e	59.2a-d	45.3ab	43.9ab
18-8-4	76.9	81.8a-c	69a-i	64.2a-l	47a-o	34.7a-f	35.7a-f
18-8-5	76.2	76.9a-e	70.9a-h	68.4a-l	47.3a-o	37.4a-f	33.1a-f
18-8-6	75.8	76.3a-e	78.8a-e	74a-h	58.7a-e	40.3a-f	37.2a-f
18-8-7	83.6	84ab	81.7a-d	76a-d	57.2a-g	45.8ab	41.6a-e
18-9-1	83.6	57.8c-f	59.6e-i	60.8a-n	39.6b-o	26.4a-f	31.9a-f
18-9-10	74.5	74.3a-e	72a-h	65.1a-l	47.5a-o	44.6a-c	42.4a-c
18-9-11	75.2	84.8ab	79a-e	74.5a-h	50.7a-o	32.4a-f	29.8a-f
18-9-12	81.8	73.8a-e	60.3d-i	51.7h-n	39.3b-o	27.5a-f	29.2a-f
18-9-2	83.6	73.7a-e	75.5a-g	73.6a-i	55.3a-k	33.4a-f	35.4a-f
18-9-3	82.8	72a-e	77.5a-f	71.4a-k	51.7a-o	37a-f	37.1a-f
18-9-4	81.7	54.2d-f	65.4b-i	50.8i-n	37.6g-o	21.1c-f	26.5b-f
18-9-5	71.9	74.2a-e	67a-i	60.1a-n	42.5a-o	35.2a-f	32.9a-f
18-9-6	80.3	74.7a-e	68.7a-i	54.4c-n	36j-o	29.1a-f	28.4a-f
18-9-7	82.2	66a-f	71.8a-h	61.8a-n	38.9d-o	22.4b-f	27.7a-f
18-9-8	79.6	76.1a-e	72.5a-h	72a-k	52.9a-n	42a-d	33.1a-f
18-9-9	75.4	78.6a-d	72.3a-h	72.8a-k	56.1a-j	34.6a-f	35.7a-f
17-4200-19x13	78.9	72.7a-e	74.4a-h	70.3a-k	51.7a-o	33a-f	33.7a-f
17-4200-19x21	79.0	74.6a-e	56.1f-i	50.2k-n	34.4l-o	25.6a-f	30a-f
17-4200-19x9	76.6	87.2a	77a-f	73.2a-j	43.5a-o	36.2a-f	38.1a-e
17-4200-36x19	78.1	81.8a-c	81.5a-d	77.2ab	50.4a-o	37.8a-f	37.3a-f
Astro	71.2	76.1a-e	76.8a-f	67.9a-l	46.3a-o	30a-f	30.4a-f
17-5200-11X9	82.7	67.6a-e	66.6b-i	60.4a-n	42.4a-o	30.5a-f	29.1a-f
17-5200-13X9	81.8	69.1a-e	71.4a-h	64.1a-l	38.5e-o	27.8a-f	28a-f
17-5200-31X3	79.4	64.8a-f	71.5a-h	67a-l	50.7a-o	29.2a-f	37.4a-f
17-5200-3X23	73.3	85.8a	88.8a	76.3a-c	51.2a-o	38a-f	35.1a-f
17-5200-4X11	78.3	76.8a-e	78.9a-e	73.7a-h	49a-o	40.7a-f	38.8a-e
Bimini	81.9	84.9ab	81.3a-e	76.3a-c	57.1a-h	44.7a-c	42.8a-c
2008-4x16	74.9	81a-c	75.4a-h	62.3a-n	44.8a-o	26.7a-f	28.1a-f
Celebration	81.7	75a-e	74.7a-h	71.4a-k	52.5a-n	36.6a-f	34.2a-f
Latitude36	84.4	86.2a	79.6a-e	75a-f	59.2a-d	37.4a-f	38.9a-e
NorthBridge	81.6	79.6a-d	82.9a-c	78.8a	54.5a-l	34.8a-f	29.8a-f
OKC1221	78.5	83.2a-c	80.7a-e	71.6a-k	55a-k	38.1a-f	38.3a-e
OSU1101	80.3	84.3ab	84.3ab	76.5a-c	59.4a-c	45.9ab	42.3a-d
OSU1117	77.9	80.9a-c	76.3a-f	67a-l	45.8a-o	29.7a-f	29.9a-f
OSU1127	82.3	77.7a-e	76.5a-f	69.3a-k	49.7a-o	33.4a-f	37.2a-f
OSU1132	76.2	73.3a-e	79.4a-e	67.1a-l	44.2a-o	26.7a-f	26.8a-f
OSU1156	72.6	80.3a-c	70.4a-h	61.7a-n	45.4a-o	32a-f	32.2a-f
OSU1217	80.3	71.9a-e	75.9a-g	72.9a-k	53.7a-n	41.4a-e	40.8a-e
OSU1257	80.9	86.3a	81.6a-d	74.7a-g	53.4a-n	33.9a-f	34.3a-f
OSU1318	81.1	76.7a-e	80.4a-e	73.1a-j	51a-o	32.5a-f	34.3a-f
OSU1337	84.7	83a-c	76.4a-f	67.6a-l	40.8a-o	31.1a-f	34.4a-f
OSU1402	76.7	79.4a-d	71.3a-h	58.6a-n	36.7h-o	25.2b-f	24.9c-f
OSU1403	77.5	79a-d	71.3a-h	57.9a-n	39.9b-o	29.6a-f	27.8a-f
OSU1406	65.5	86.9a	74.8a-h	69.6a-k	44.4a-o	35.7a-f	35.4a-f
OSU1408	74.5	63a-f	61.6c-i	46.5l-n	31.9o	17.6ef	18.8f

OSU1409	85.3	80.8a-c	69.2a-i	62.9a-m	42.2a-o	35.2a-f	36a-f
OSU1417	59.8	76.6a-e	65.6b-i	58.6a-n	43.7a-o	27.3a-f	29.5a-f
OSU1418	81.2	76.8a-e	78.8a-e	66.2a-l	46.8a-o	29.5a-f	31.4a-f
OSU1433	81.4	75.1a-e	70.9a-h	60.4a-n	40.9a-o	27.6a-f	28.8a-f
OSU1439	76.7	74.2a-e	74.1a-h	64.9a-l	40b-o	27.8a-f	26.5b-f
OSU1601	82.9	68.7a-e	65.2b-i	62.6a-n	45.5a-o	33.8a-f	33.2a-f
OSU1609	82.5	82.6a-c	70.4a-h	53.2e-n	36.5i-o	28.7a-f	28.7a-f
OSU1611	80.7	76.1a-e	68.1a-i	58.4a-n	46.8a-o	30.8a-f	31.4a-f
OSU1617	77.7	73.4a-e	70.2a-i	67.1a-l	45.5a-o	26.1a-f	30.2a-f
OSU1620	78.4	70.3a-e	68.6a-i	57.1a-n	33.6m-o	27.6a-f	25.6b-f
OSU1625	70.1	87.2a	79.7a-e	72a-k	50.3a-o	34.2a-f	34a-f
OSU1628	81.2	73.1a-e	66.1b-i	56.1a-n	40.8a-o	27.8a-f	28.4a-f
OSU1629	79.9	41.3f	53.5hi	40.2mn	34.4l-o	18.7d-f	24.1c-f
OSU1631	78.0	87.8a	77.4a-f	67.9a-l	45.1a-o	35.3a-f	31.7a-f
OSU1638	83.0	82.8a-c	69.1a-i	62a-n	47.6a-o	36.7a-f	33.2a-f
OSU1639	78.8	64.4a-f	70.5a-h	56.9a-n	39.9b-o	28.1a-f	29.1a-f
OSU1641	77.1	78.8a-d	66.9a-i	60.2a-n	39.2c-o	27.9a-f	28.5a-f
OSU1646	81.2	77a-e	69.2a-i	58.6a-n	39.7b-o	27.8a-f	25.8b-f
OSU1649	73.0	52.6ef	48.4i	39.8n	33.3no	17.4f	24.4c-f
OSU1651	73.8	79.8a-d	72a-h	66.7a-l	49.6a-o	33.3a-f	31.3a-f
OSU1656	84.2	68.4a-e	64.7b-i	60.6a-n	45.3a-o	24.4b-f	27.7a-f
OSU1657	77.5	73.9a-e	65.4b-i	53.5d-n	35.7j-o	23.8b-f	25.8b-f
OSU1661	79.9	68.1a-e	63.3b-i	52.7e-n	37.6g-o	24.6b-f	25c-f
OSU1662	79.4	73.3a-e	74.9a-h	60.2a-n	40.4a-o	30.4a-f	33.5a-f
OSU1663	78.1	66.3a-f	63.3b-i	52g-n	37.9f-o	26.7a-f	23.6d-f
OSU1664	76.5	88a	79.8a-e	76.1a-d	54.8a-l	39.2a-f	38.6a-e
OSU1666	75.0	69.1a-e	54.2g-i	50.5j-n	37.8g-o	26.8a-f	28.7a-f
OSU1670	78.1	71a-e	70.2a-i	65a-l	51.2a-o	30.1a-f	33a-f
OSU1673	85.0	66.4a-f	69.5a-i	58.5a-n	36.6i-o	31.9a-f	27.4a-f
OSU1675	80.6	67.8a-e	56.3f-i	45.9l-n	33.5m-o	28.6a-f	28.9a-f
OSU1680	83.3	76.9a-e	60.7d-i	56.7a-n	42.7a-o	27.9a-f	27.9a-f
OSU1682	80.4	73a-e	65b-i	62.6a-m	49.7a-o	35.5a-f	33a-f
OSU1687	73.0	79.3a-d	72.1a-h	65.1a-l	39.8b-o	24.2b-f	23.6ef
OSU1690	74.7	63.9a-f	63.2b-i	57.8a-n	35.3k-o	21.1c-f	29.1a-f
OSU1699	80.4	59.3b-f	62.9b-i	55.8b-n	39c-o	24.9b-f	26.8b-f
Tahoma31	87.5	79.1a-d	78.8a-e	70.2a-k	51.3a-o	35.5a-f	31.9a-f
TifTuf	83.8	86.4a	80.1a-e	74.8a-g	59.6ab	49a	45.6a
Tifway	78.9	68.9a-e	73.3a-h	63.2a-l	51.3a-o	29a-f	34.5a-f
Tilin#5	81.7	82.1a-c	77.7a-f	72.8a-k	53.8a-m	40.2a-f	36a-f
U-3	77.8	77.6a-e	80.5a-e	74.1a-h	58.4a-f	44.7a-c	41.6a-e

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 3. Mean visual turf quality (TQ) of 96 non-trafficked bermudagrasses on seven rating dates in fall-2019.

Entry	15-Sep	20-Sep	27-Sep	4-Oct	11-Oct	18-Oct	25-Oct
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15-4X15	7.7a-d	8.7ab	8a-c	8a-d	8ab	7a-e	7a-c
15-8X3	7.3a-e	7.7a-c	8.3ab	7.7a-d	7.7a-c	7a-e	7a-c
18-7-1	8a-d	8.7ab	8.3ab	8a-d	8ab	7.3a-d	7a-c
18-7-2	8.7ab	8.3ab	8.7a	8.7ab	8.3a	7.3a-d	7a-c
18-7-3	8a-d	9a	9a	9a	8.7a	8ab	7.7a
18-7-4	8.3a-c	8.7ab	9a	8.3a-c	8ab	7.7a-c	6.7a-c
18-7-5	8.3a-c	8.7ab	9a	8.3a-c	8ab	7.7a-c	6a-c
18-7-6	7.7a-d	9a	9a	9a	8.3a	8.3a	7.3ab
18-8-1	6.7a-e	7a-c	7.7a-d	7.7a-d	8ab	7.7a-c	7a-c
18-8-2	7a-e	7.7a-c	8.7a	8.3a-c	8.3a	7.3a-d	7.3ab
18-8-3	8a-d	8.7ab	9a	8.7ab	8.7a	8.3a	7.3ab
18-8-4	8.7ab	9a	8.7a	8.3a-c	8.3a	8ab	7a-c
18-8-5	8a-d	9a	8.7a	8.7ab	8ab	7.7a-c	7a-c
18-8-6	7.3a-e	7.7a-c	8.7a	8a-d	8ab	7.3a-d	6.7a-c
18-8-7	8.7ab	9a	8.7a	8.3a-c	8.7a	8.3a	7.7a
18-9-1	7a-e	7.3a-c	7.3a-d	7.3a-d	7.3a-d	7.3a-d	6a-c
18-9-10	8.3a-c	8.3ab	7.7a-d	7.7a-d	8ab	7.7a-c	7a-c
18-9-11	9a	9a	9a	9a	8.3a	7.7a-c	7a-c
18-9-12	8.3a-c	8.3ab	7.7a-d	7.7a-d	8ab	7a-e	6.7a-c
18-9-2	8a-d	8.3ab	8.3ab	8.3a-c	8ab	7.7a-c	6.7a-c
18-9-3	8a-d	8ab	7.7a-d	8a-d	8ab	7.3a-d	7a-c
18-9-4	5.3de	6.7a-c	7a-d	7.3a-d	7.3a-d	7a-e	6.7a-c
18-9-5	7.7a-d	8ab	8.3ab	7.7a-d	7.7a-c	7.7a-c	7a-c
18-9-6	8.7ab	7.7a-c	8.3ab	8a-d	7.3a-d	6.7a-e	7a-c
18-9-7	7a-e	7.7a-c	7.7a-d	7.7a-d	7.7a-c	7.3a-d	6.7a-c
18-9-8	8.3a-c	8.3ab	8.3ab	8a-d	8.3a	8.3a	7.3ab
18-9-9	6.7a-e	7a-c	7.3a-d	7.7a-d	7a-e	6.7a-e	6.7a-c
17-4200-19x13	8.7ab	9a	8.7a	8.7ab	8ab	7.7a-c	7a-c
17-4200-19x21	8.3a-c	9a	8a-c	8a-d	8.3a	7.3a-d	6.3a-c
17-4200-19x9	8.3a-c	8.7ab	8.7a	8.3a-c	8ab	7.7a-c	6.7a-c
17-4200-36x19	8.7ab	8.3ab	8.3ab	8a-d	8.3a	7.7a-c	7.3ab
Astro	8.3a-c	8.7ab	8.3ab	8.3a-c	8ab	7.7a-c	7a-c
17-5200-11X9	7.7a-d	7.7a-c	8a-c	8a-d	7.7a-c	7a-e	7a-c
17-5200-13X9	7a-e	7a-c	7.3a-d	7a-e	7.3a-d	7a-e	6.3a-c
17-5200-31X3	7.3a-e	8ab	8.3ab	8.3a-c	8ab	7.7a-c	7.7a
17-5200-3X23	8a-d	8.7ab	8.7a	8a-d	8ab	7.3a-d	7a-c
17-5200-4X11	8a-d	9a	8.7a	9a	8.7a	8ab	7.3ab
Bimini	9a	8.7ab	9a	8.7ab	8.3a	8ab	7.7a
2008-4x16	8a-d	8.3ab	8.3ab	8a-d	8ab	7.3a-d	7a-c
Celebration	8.7ab	8.7ab	9a	9a	8.3a	8ab	7a-c
Latitude36	8a-d	8.7ab	8.7a	8.3a-c	8ab	7.3a-d	7a-c
NorthBridge	8a-d	8.3ab	8a-c	8a-d	8ab	7.3a-d	7a-c
OKC1221	8.3a-c	8.3ab	8.3ab	8a-d	8ab	7.7a-c	7a-c
OSU1101	8.7ab	9a	9a	8.7ab	8.3a	8ab	7.3ab
OSU1117	8a-d	7.3a-c	8.7a	8a-d	8ab	7.3a-d	6.7a-c
OSU1127	8.7ab	8.7ab	8a-c	8.3a-c	8.3a	7.7a-c	7a-c
OSU1132	8.3a-c	8ab	8a-c	8a-d	8ab	7a-e	6.3a-c
OSU1156	8a-d	8.3ab	8.7a	8.3a-c	8ab	7.7a-c	7a-c
OSU1217	8a-d	8ab	8.3ab	8a-d	8ab	7.7a-c	6.7a-c
OSU1257	8.3a-c	8ab	8a-c	8a-d	8ab	7.3a-d	7a-c
OSU1318	8.7ab	8.3ab	8.7a	8a-d	8.3a	7a-e	7a-c
OSU1337	9a	9a	9a	8.7ab	8ab	7.3a-d	6.7a-c
OSU1402	8.7ab	8.7ab	8.7a	8a-d	8ab	7a-e	6.3a-c
OSU1403	8.7ab	8.7ab	8.7a	8.7ab	8.3a	7.3a-d	7a-c
OSU1406	8.3a-c	8ab	8.7a	8a-d	8ab	7.3a-d	6.7a-c
OSU1408	8a-d	8.3ab	8.3ab	8.3a-c	7.3a-d	5de	3d
OSU1409	8.3a-c	8.7ab	8.7a	8a-d	7.7a-c	7a-e	6a-c

OSU1417	8.7ab	8.7ab	8.3ab	8.3a-c	8ab	7.7a-c	7a-c
OSU1418	8a-d	8.3ab	8.7a	8a-d	8ab	7.7a-c	7a-c
OSU1433	8a-d	8ab	9a	8a-d	8ab	8ab	6.7a-c
OSU1439	8a-d	8.3ab	8.7a	8.3a-c	8ab	7.7a-c	7a-c
OSU1601	8.3a-c	8.3ab	8.7a	8a-d	8ab	7.3a-d	6.7a-c
OSU1609	7.3a-e	7.3a-c	8a-c	7.7a-d	7.3a-d	7.3a-d	7a-c
OSU1611	6.7a-e	6.3a-c	7a-d	6.3b-e	5.7c-e	6a-e	5.7a-c
OSU1617	6.3a-e	7.3a-c	7.3a-d	7.7a-d	7.3a-d	7.7a-c	7a-c
OSU1620	7.3a-e	8ab	8a-c	7.7a-d	7.7a-c	7.3a-d	6.3a-c
OSU1625	7.7a-d	8.3ab	7.7a-d	7.3a-d	8ab	7a-e	7a-c
OSU1628	7a-e	7.3a-c	8a-c	8a-d	8ab	7.3a-d	7a-c
OSU1629	4.7e	5c	5.3d	4.7e	5e	4.7e	4.7cd
OSU1631	7.3a-e	8ab	8.7a	8a-d	8ab	7.3a-d	6.7a-c
OSU1638	8a-d	8.7ab	8.3ab	7.7a-d	8ab	8ab	6.7a-c
OSU1639	5.7c-e	6bc	6b-d	5.7de	5.3de	5.3c-e	5b-d
OSU1641	7.7a-d	8.3ab	8a-c	7.7a-d	7.7a-c	7a-e	6.7a-c
OSU1646	8.7ab	9a	8.7a	7.7a-d	7.3a-d	8ab	7a-c
OSU1649	6b-e	6.3a-c	6b-d	5.7de	6b-e	5.7b-e	5b-d
OSU1651	7a-e	8ab	8a-c	8a-d	7.7a-c	7.7a-c	7a-c
OSU1656	7.7a-d	8ab	8.3ab	8.3a-c	7.7a-c	8ab	7.3ab
OSU1657	7.7a-d	7.3a-c	7.7a-d	8a-d	7.3a-d	7a-e	7a-c
OSU1661	7.7a-d	7.3a-c	7.3a-d	7.7a-d	7a-e	7a-e	5.7a-c
OSU1662	7.7a-d	8.3ab	8.3ab	7.3a-d	8ab	7a-e	6.7a-c
OSU1663	8a-d	8ab	8a-c	8a-d	8ab	7.3a-d	6a-c
OSU1664	8a-d	8.3ab	8.7a	8.3a-c	8.3a	7.7a-c	7a-c
OSU1666	7.3a-e	7.3a-c	7.7a-d	7a-e	7.7a-c	7.3a-d	6a-c
OSU1670	6.7a-e	7a-c	7.3a-d	7.7a-d	7.7a-c	6.7a-e	6.3a-c
OSU1673	6b-e	6bc	5.7cd	6c-e	6b-e	6a-e	5b-d
OSU1675	8.7ab	8ab	8.7a	8a-d	7.7a-c	7a-e	6.7a-c
OSU1680	8a-d	7.7a-c	8.7a	8a-d	7.7a-c	7a-e	6.3a-c
OSU1682	8a-d	8.3ab	8a-c	7.7a-d	7.7a-c	7.3a-d	7a-c
OSU1687	7.3a-e	8.7ab	8.3ab	8a-d	8ab	6.7a-e	3d
OSU1690	8.7ab	8.3ab	8.7a	8.3a-c	8.3a	7.7a-c	7.3ab
OSU1699	7.7a-d	7.7a-c	8a-c	7.7a-d	8ab	8ab	7a-c
Tahoma31	7.3a-e	8ab	8a-c	8.3a-c	7.7a-c	7.3a-d	6.7a-c
TifTuf	8.3a-c	9a	9a	8.3a-c	9a	8ab	7.3ab
Tifway	8a-d	8.7ab	8.3ab	8a-d	8ab	7.7a-c	7a-c
Tilin#5	8a-d	8ab	8.7a	8.3a-c	8ab	8ab	7a-c
U-3	8.3a-c	8ab	8a-c	7.7a-d	8.3a	8ab	7a-c

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 4. Mean visual turf quality (TQ) of 96 trafficked bermudagrasses on seven rating dates in fall-2019.

Entry	**15-Sep (0 events)**	**20-Sep (10 events)**	**27-Sep (20 events)**	**4-Oct (30 events)**	**11-Oct (40 events)**	**18-Oct (50 events)**	**25-Oct (60 events)**
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15-4X15	7.7a-d	7.3a-d	7a-d	7a-d	6.7a-c	5.3a-f	4.3a-g
15-8X3	7.3a-e	6.7a-d	7.3a-d	7a-d	6a-d	5a-f	4.3a-g
18-7-1	8a-d	7.3a-d	7a-d	7a-d	7ab	6a-e	4.3a-g
18-7-2	8.7ab	7.7a-d	7.7a-c	7.7ab	7.3ab	6.7a-c	5.7a-c
18-7-3	8a-d	8a-d	8.3a	8a	7.7ab	6.7a-c	6ab
18-7-4	8.3a-c	7.7a-d	7.7a-c	7.3a-c	6.7a-c	6.3a-d	4.3a-g
18-7-5	8.3a-c	7.7a-d	7.7a-c	7.7ab	7ab	6.3a-d	4.3a-g
18-7-6	7.7a-d	8a-d	8ab	7.3a-c	7ab	6.7a-c	5.7a-c
18-8-1	6.7a-e	5.7b-e	6.3a-e	6.3a-d	6.3a-d	5.7a-e	4a-g
18-8-2	7a-e	6.7a-d	7.7a-c	7.3a-c	6.7a-c	6a-e	5a-e
18-8-3	8a-d	7.7a-d	7.7a-c	7.3a-c	7ab	6.3a-d	5.7a-c
18-8-4	8.7ab	8.3a-c	8.3a	8a	7.3ab	6.3a-d	5.7a-c
18-8-5	8a-d	8a-d	7.7a-c	8a	7ab	6.3a-d	5a-e
18-8-6	7.3a-e	6.7a-d	7.7a-c	7a-d	7ab	6a-e	5a-e
18-8-7	8.7ab	8a-d	8ab	7.7ab	7ab	6.3a-d	5.7a-c
18-9-1	7a-e	5.7b-e	6.3a-e	6.3a-d	5.7a-d	4.7b-f	3.7b-g
18-9-10	8.3a-c	7.7a-d	7.3a-d	7.3a-c	7.3ab	6.3a-d	5.3a-d
18-9-11	9a	8.3a-c	8.3a	7.7ab	7ab	6a-e	5.3a-d
18-9-12	8.3a-c	7.3a-d	7a-d	6.3a-d	6.3a-d	5a-f	5a-e
18-9-2	8a-d	7.3a-d	7.3a-d	7.7ab	7ab	6.3a-d	5.3a-d
18-9-3	8a-d	7a-d	7a-d	7a-d	7ab	6a-e	5a-e
18-9-4	5.3de	5.7b-e	5.3b-e	5.3b-e	5.7a-d	5.3a-f	4.3a-g
18-9-5	7.7a-d	7.3a-d	7.3a-d	7a-d	7ab	6.3a-d	4.3a-g
18-9-6	8.7ab	6.7a-d	7.3a-d	7.3a-c	6.7a-c	5.3a-f	4.7a-f
18-9-7	7a-e	6.7a-d	6.7a-e	6.3a-d	5.7a-d	5a-f	4a-g
18-9-8	8.3a-c	7.3a-d	7.7a-c	7.3a-c	7ab	6.7a-c	5.3a-d
18-9-9	6.7a-e	6.7a-d	7a-d	7a-d	7ab	5.7a-e	4.7a-f
17-4200-19x13	8.7ab	8a-d	7.7a-c	7.3a-c	6.7a-c	6.7a-c	5.7a-c
17-4200-19x21	8.3a-c	7.3a-d	7.7a-c	6.7a-d	6.7a-c	5a-f	3.7b-g
17-4200-19x9	8.3a-c	7.7a-d	7.7a-c	7.3a-c	7ab	6.3a-d	5.7a-c
17-4200-36x19	8.7ab	8a-d	7.7a-c	7.7ab	7.3ab	6.3a-d	5.3a-d
Astro	8.3a-c	8a-d	7.7a-c	7.3a-c	7ab	6.7a-c	5a-e
17-5200-11X9	7.7a-d	7a-d	7a-d	6.7a-d	6.3a-d	5.7a-e	5.7a-c
17-5200-13X9	7a-e	6.3a-e	6.7a-e	6.7a-d	5.7a-d	5.3a-f	3.3c-g
17-5200-31X3	7.3a-e	7a-d	7a-d	7.3a-c	6.7a-c	6a-e	5.3a-d
17-5200-3X23	8a-d	8.3a-c	8ab	7a-d	7ab	6.7a-c	5.7a-c
17-5200-4X11	8a-d	8a-d	7.7a-c	7.7ab	6.7a-c	6.7a-c	6ab
Bimini	9a	8.7ab	8.3a	8.3a	8a	7.3a	6.3a
2008-4x16	8a-d	7.3a-d	7.3a-d	7.3a-c	7ab	5.7a-e	4.7a-f
Celebration	8.7ab	7.7a-d	8ab	7.7ab	7ab	7ab	5.3a-d
Latitude 36	8a-d	8a-d	8ab	7.3a-c	7.3ab	6.3a-d	5.7a-c
NorthBridge	8a-d	7.3a-d	7.3a-d	7.7ab	7ab	6a-e	4.7a-f
OKC1221	8.3a-c	7.3a-d	8ab	7.3a-c	7ab	6.3a-d	5.3a-d
OSU1101	8.7ab	8.7ab	8.3a	8a	7.3ab	6.7a-c	6ab
OSU1117	8a-d	7a-d	8ab	7.3a-c	7ab	6.3a-d	4.3a-g
OSU1127	8.7ab	7.3a-d	7.7a-c	7.7ab	7.3ab	6.3a-d	5a-e
OSU1132	8.3a-c	7a-d	7a-d	7.3a-c	7ab	5.3a-f	3.7b-g
OSU1156	8a-d	7.3a-d	8ab	7.7ab	7ab	6.7a-c	5.3a-d
OSU1217	8a-d	7.3a-d	7.3a-d	7.3a-c	6.7a-c	6.7a-c	6ab
OSU1257	8.3a-c	7a-d	7a-d	7.7ab	7ab	6a-e	4.7a-f
OSU1318	8.7ab	7.7a-d	8ab	8a	7.3ab	6a-e	5.7a-c
OSU1337	9a	8.3a-c	7.7a-c	7.7ab	7ab	6a-e	4.7a-f
OSU1402	8.7ab	8.3a-c	7.3a-d	7.3a-c	6.7a-c	5.7a-e	4.3a-g
OSU1403	8.7ab	7.3a-d	8ab	7.3a-c	7ab	6a-e	5.7a-c
OSU1406	8.3a-c	7.3a-d	7.7a-c	7a-d	7ab	6.3a-d	5.3a-d
OSU1408	8a-d	7a-d	7a-d	7a-d	6.3a-d	4d-f	2g

OSU1409	8.3a-c	8a-d	7.3a-d	7a-d	7.3ab	5.3a-f	3.7b-g
OSU1417	8.7ab	8a-d	8ab	7.3a-c	6.7a-c	6a-e	4.7a-f
OSU1418	8a-d	7.7a-d	8ab	7.7ab	7.3ab	6.7a-c	4.7a-f
OSU1433	8a-d	7.3a-d	7.3a-d	7.3a-c	7.3ab	6a-e	4.3a-g
OSU1439	8a-d	7.3a-d	7.7a-c	7.7ab	6.7a-c	6.7a-c	5a-e
OSU1601	8.3a-c	7.7a-d	7.7a-c	7a-d	7ab	6.3a-d	5a-e
OSU1609	7.3a-e	6.7a-d	7.3a-d	7a-d	5.7a-d	5.3a-f	4.7a-f
OSU1611	6.7a-e	5de	5.7a-e	5d-e	4.3d-e	3.7ef	3.3c-g
OSU1617	6.3a-e	5.7b-e	6.3a-e	6.3a-d	5.7a-d	5a-f	4.3a-g
OSU1620	7.3a-e	7a-d	7.3a-d	6.7a-d	5.7a-d	5.3a-f	4a-g
OSU1625	7.7a-d	7.3a-d	7.7a-c	7a-d	7ab	5a-f	4.3a-g
OSU1628	7a-e	7.3a-d	7.3a-d	7a-d	6.3a-d	5.3a-f	4.7a-f
OSU1629	4.7e	3.3e	4e	3.3e	2.6667e	3f	2.3fg
OSU1631	7.3a-e	7.3a-d	7.3a-d	7a-d	7ab	5.7a-e	4.7a-f
OSU1638	8a-d	7.7a-d	8ab	7a-d	6.7a-c	6.3a-d	5.3a-d
OSU1639	5.7c-e	5.3c-e	4.7de	4.7ed	4.3d-e	3.7ef	3d-g
OSU1641	7.7a-d	7.3a-d	7.3a-d	7a-d	6.7a-c	5a-f	4a-g
OSU1646	8.7ab	8a-d	8ab	7a-d	6.3a-d	5.7a-e	4.7a-f
OSU1649	6b-e	5.3c-e	5c-e	4.7ed	4de	4d-f	2.7e-g
OSU1651	7a-e	7a-d	7a-d	7a-d	6.7a-c	6a-e	4.7a-f
OSU1656	7.7a-d	7a-d	7a-d	7a-d	6.3a-d	6a-e	4.3a-g
OSU1657	7.7a-d	6a-e	6.7a-e	6.7a-d	6.7a-c	4.3c-f	4.3a-g
OSU1661	7.7a-d	7a-d	6.7a-e	7a-d	6.3a-d	5.7a-e	4a-g
OSU1662	7.7a-d	7.3a-d	6.7a-e	6.3a-d	6.7a-c	5.3a-f	4.3a-g
OSU1663	8a-d	6.7a-d	6.7a-e	6.7a-d	5.7a-d	5a-f	4a-g
OSU1664	8a-d	8a-d	7.3a-d	8.3a	7.3ab	6.7a-c	5.3a-d
OSU1666	7.3a-e	6a-e	6.7a-e	6a-d	6a-d	4.3c-f	4a-g
OSU1670	6.7a-e	6.7a-d	6.3a-e	7a-d	6.7a-c	5a-f	5a-e
OSU1673	6b-e	5.3c-e	5c-e	5.3b-e	5.3b-d	4.7b-f	3.3c-g
OSU1675	8.7ab	7.3a-d	8ab	7a-d	6.7a-c	5.7a-e	4.7a-f
OSU1680	8a-d	6.7a-d	7.7a-c	6.7a-d	6.7a-c	5.7a-e	5a-e
OSU1682	8a-d	8a-d	7.7a-c	7.3a-c	7ab	6a-e	4.7a-f
OSU1687	7.3a-e	8a-d	7.7a-c	6.7a-d	7ab	4.7b-f	2G
OSU1690	8.7ab	7a-d	7a-d	7.3a-c	6.7a-c	6a-e	5a-e
OSU1699	7.7a-d	6.3a-e	6.3a-e	6.3a-d	6.3a-d	5.7a-e	4a-g
Tahoma 31	7.3a-e	7.3a-d	7a-d	7.7ab	7ab	6.3a-d	4.7a-f
TifTuf	8.3a-c	9a	7.7a-c	7.3a-c	7.3ab	6.7a-c	5.3a-d
Tifway	8a-d	7.3a-d	7.3a-d	7a-d	7ab	6a-e	5a-e
Tilin#5	8a-d	7.3a-d	7.7a-c	7.3a-c	7ab	6.7a-c	5.7a-c
U-3	8.3a-c	7.3a-d	7.7a-c	7.7ab	7.3ab	7ab	6ab

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 5. Simple effects of traffic on visual turf quality (TQ) of 96 bermudagrasses on seven rating dates in fall-2019.

Entry	15-Sep	20-Sep	27-Sep	4-Oct	11-Oct	18-Oct	25-Oct
	---p-value---						
15-4X15	1	0.0001	0.0032	0.0117	0.0005	<.0001	<.0001
15-8X3	1	0.0041	0.0032	0.0905	<.0001	<.0001	<.0001
18-7-1	1	0.0001	<.0001	0.0117	0.0084	0.0004	<.0001
18-7-2	1	0.054	0.0032	0.0117	0.0084	0.0708	0.0036
18-7-3	1	0.0041	0.048	0.0117	0.0084	0.0004	0.0004
18-7-4	1	0.0041	<.0001	0.0117	0.0005	0.0004	<.0001
18-7-5	1	0.0041	<.0001	0.0905	0.0084	0.0004	0.0004
18-7-6	1	0.0041	0.0032	<.0001	0.0005	<.0001	0.0004
18-8-1	1	0.0001	<.0001	0.0009	<.0001	<.0001	<.0001
18-8-2	1	0.0041	0.0032	0.0117	<.0001	0.0004	<.0001
18-8-3	1	0.0041	<.0001	0.0009	<.0001	<.0001	0.0004
18-8-4	1	0.054	0.3211	0.3954	0.0084	<.0001	0.0036
18-8-5	1	0.0041	0.0032	0.0905	0.0084	0.0004	<.0001
18-8-6	1	0.0041	0.0032	0.0117	0.0084	0.0004	0.0004
18-8-7	1	0.0041	0.048	0.0905	<.0001	<.0001	<.0001
18-9-1	1	<.0001	0.0032	0.0117	<.0001	<.0001	<.0001
18-9-10	1	0.054	0.3211	0.3954	0.0757	0.0004	0.0004
18-9-11	<0.001	0.054	0.048	0.0009	0.0005	<.0001	0.0004
18-9-12	1	0.0041	0.048	0.0009	<.0001	<.0001	0.0004
18-9-2	1	0.0041	0.0032	0.0905	0.0084	0.0004	0.0036
18-9-3	1	0.0041	0.048	0.0117	0.0084	0.0004	<.0001
18-9-4	1	0.0041	<.0001	<.0001	<.0001	<.0001	<.0001
18-9-5	1	0.054	0.0032	0.0905	0.0757	0.0004	<.0001
18-9-6	1	0.0041	0.0032	0.0905	0.0757	0.0004	<.0001
18-9-7	1	0.0041	0.0032	0.0009	<.0001	<.0001	<.0001
18-9-8	1	0.0041	0.048	0.0905	0.0005	<.0001	<.0001
18-9-9	1	0.3333	0.3211	0.0905	1	0.0071	<.0001
17-4200-19x13	1	0.0041	0.0032	0.0009	0.0005	0.0071	0.0036
17-4200-19x21	1	<.0001	0.3211	0.0009	<.0001	<.0001	<.0001
17-4200-19x9	1	0.0041	0.0032	0.0117	0.0084	0.0004	0.0263
17-4200-36x19	1	0.3333	0.048	0.3954	0.0084	0.0004	<.0001
Astro	1	0.054	0.048	0.0117	0.0084	0.0071	<.0001
17-5200-11X9	1	0.054	0.0032	0.0009	0.0005	0.0004	0.0036
17-5200-13X9	1	0.054	0.048	0.3954	<.0001	<.0001	<.0001
17-5200-31X3	1	0.0041	<.0001	0.0117	0.0005	<.0001	<.0001
17-5200-3X23	1	0.3333	0.048	0.0117	0.0084	0.0708	0.0036
17-5200-4X11	1	0.0041	0.0032	0.0009	<.0001	0.0004	0.0036
Bimini	1	1	0.048	0.3954	0.3714	0.0708	0.0036
2008-4x16	1	0.0041	0.0032	0.0905	0.0084	<.0001	<.0001
Celebration	1	0.0041	0.0032	0.0009	0.0005	0.0071	0.0004
Latitude36	1	0.054	0.048	0.0117	0.0757	0.0071	0.0036
NorthBridge	1	0.0041	0.048	0.3954	0.0084	0.0004	<.0001
OKC1221	1	0.0041	0.3211	0.0905	0.0084	0.0004	0.0004
OSU1101	1	0.3333	0.048	0.0905	0.0084	0.0004	0.0036
OSU1117	<0.0001	0.3333	0.048	0.0905	0.0084	0.0071	<.0001
OSU1127	1	0.0001	0.3211	0.0905	0.0084	0.0004	<.0001
OSU1132	1	0.0041	0.0032	0.0905	0.0084	<.0001	<.0001
OSU1156	1	0.0041	0.048	0.0905	0.0084	0.0071	0.0004
OSU1217	1	0.054	0.0032	0.0905	0.0005	0.0071	0.1333
OSU1257	1	0.0041	0.0032	0.3954	0.0084	0.0004	<.0001
OSU1318	1	0.054	0.048	1	0.0084	0.0071	0.0036
OSU1337	1	0.054	<.0001	0.0117	0.0084	0.0004	<.0001
OSU1402	1	0.3333	<.0001	0.0905	0.0005	0.0004	<.0001
OSU1403	1	0.0001	0.048	0.0009	0.0005	0.0004	0.0036
OSU1406	1	0.054	0.0032	0.0117	0.0084	0.0071	0.0036
OSU1408	1	0.0001	<.0001	0.0009	0.0084	0.0071	0.0263
OSU1409	1	0.054	<.0001	0.0117	0.3714	<.0001	<.0001

OSU1417	1	0.054	0.3211	0.0117	0.0005	<.0001	<.0001
OSU1418	1	0.054	0.048	0.3954	0.0757	0.0071	<.0001
OSU1433	1	0.054	<.0001	0.0905	0.0757	<.0001	<.0001
OSU1439	1	0.0041	0.0032	0.0905	0.0005	0.0071	<.0001
OSU1601	1	0.054	0.0032	0.0117	0.0084	0.0071	0.0004
OSU1609	1	0.054	0.048	0.0905	<.0001	<.0001	<.0001
OSU1611	1	0.0001	<.0001	0.0009	0.0005	<.0001	<.0001
OSU1617	1	<.0001	0.0032	0.0009	<.0001	<.0001	<.0001
OSU1620	<0.0001	0.0041	0.048	0.0117	<.0001	<.0001	<.0001
OSU1625	1	0.0041	1	0.3954	0.0084	<.0001	<.0001
OSU1628	1	1	0.048	0.0117	<.0001	<.0001	<.0001
OSU1629	1	<.0001	<.0001	0.0009	<.0001	<.0001	<.0001
OSU1631	1	0.054	<.0001	0.0117	0.0084	<.0001	<.0001
OSU1638	1	0.0041	0.3211	0.0905	0.0005	<.0001	0.0036
OSU1639	1	0.054	<.0001	0.0117	0.0084	<.0001	<.0001
OSU1641	1	0.0041	0.048	0.0905	0.0084	<.0001	<.0001
OSU1646	1	0.0041	0.048	0.0905	0.0084	<.0001	<.0001
OSU1649	1	0.0041	0.0032	0.0117	<.0001	<.0001	<.0001
OSU1651	1	0.0041	0.0032	0.0117	0.0084	<.0001	<.0001
OSU1656	1	0.0041	<.0001	0.0009	0.0005	<.0001	<.0001
OSU1657	1	0.0001	0.0032	0.0009	0.0757	<.0001	<.0001
OSU1661	1	0.3333	0.048	0.0905	0.0757	0.0004	0.0004
OSU1662	1	0.0041	<.0001	0.0117	0.0005	<.0001	<.0001
OSU1663	1	0.0001	<.0001	0.0009	<.0001	<.0001	<.0001
OSU1664	1	0.3333	<.0001	1	0.0084	0.0071	0.0004
OSU1666	1	0.0001	0.0032	0.0117	<.0001	<.0001	<.0001
OSU1670	1	0.3333	0.0032	0.0905	0.0084	<.0001	0.0036
OSU1673	1	0.054	0.048	0.0905	0.0757	0.0004	0.0004
OSU1675	1	0.054	0.048	0.0117	0.0084	0.0004	<.0001
OSU1680	1	0.0041	0.0032	0.0009	0.0084	0.0004	0.0036
OSU1682	1	0.3333	0.3211	0.3954	0.0757	0.0004	<.0001
OSU1687	1	0.054	0.048	0.0009	0.0084	<.0001	0.0263
OSU1690	1	0.0001	<.0001	0.0117	<.0001	<.0001	<.0001
OSU1699	1	0.0001	<.0001	0.0009	<.0001	<.0001	<.0001
Tahoma31	1	0.054	0.0032	0.0905	0.0757	0.0071	<.0001
TifTuf	1	1	<.0001	0.0117	<.0001	0.0004	<.0001
Tifway	<0.0001	0.0001	0.0032	0.0117	0.0084	<.0001	<.0001
Tilin#5	1	0.054	0.0032	0.0117	0.0084	0.0004	0.0036
U-3	1	0.054	0.3211	1	0.0084	0.0071	0.0263

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 6. Mean NDVI of 96 non-trafficked bermudagrasses on seven rating dates in fall-2019.

Entry	15-Sep	20-Sep	27-Sep	4-Oct	11-Oct	18-Oct	25-Oct
15-4X15	0.786ab	0.776a-c	0.666a-j	0.634b-l	0.614b-j	0.601a-h	0.577a-f
15-8X3	0.729a-c	0.763a-d	0.615c-j	0.616c-l	0.571d-j	0.589b-h	0.574a-f
18-7-1	0.706a-c	0.751a-d	0.651a-j	0.626b-l	0.566f-j	0.552b-h	0.504b-f
18-7-2	0.722a-c	0.747a-d	0.645a-j	0.632b-l	0.563f-j	0.596a-h	0.565a-f
18-7-3	0.755ab	0.771a-d	0.682a-j	0.669a-l	0.64a-i	0.627a-h	0.607a-e
18-7-4	0.739a-c	0.75a-d	0.678a-j	0.671a-l	0.581c-j	0.544b-h	0.49b-f
18-7-5	0.725a-c	0.726a-d	0.698a-j	0.671a-l	0.592b-j	0.522d-h	0.468d-f
18-7-6	0.732a-c	0.785a-c	0.736a-e	0.742a-e	0.679a-h	0.654a-g	0.623a-e
18-8-1	0.681a-d	0.748a-d	0.757ab	0.774a	0.762a	0.755a	0.74a
18-8-2	0.723a-c	0.706b-d	0.661a-j	0.672a-l	0.632a-j	0.641a-h	0.592a-f
18-8-3	0.712a-c	0.779a-c	0.695a-j	0.726a-h	0.673a-i	0.673a-f	0.641a-d
18-8-4	0.788ab	0.792a-c	0.639b-j	0.629b-l	0.6b-j	0.598a-h	0.565a-f
18-8-5	0.7a-c	0.751a-d	0.646a-j	0.654a-l	0.6b-j	0.57b-h	0.547b-f
18-8-6	0.699a-c	0.693b-d	0.599e-j	0.624b-l	0.574d-j	0.541c-h	0.514b-f
18-8-7	0.776ab	0.773a-c	0.749a-c	0.758ab	0.716a-c	0.668a-f	0.665ab
18-9-1	0.661a-d	0.693b-d	0.575ij	0.594h-l	0.572d-j	0.548b-h	0.494b-f
18-9-10	0.722a-c	0.697b-d	0.624b-j	0.632b-l	0.586c-j	0.58b-h	0.56a-f
18-9-11	0.714a-c	0.747a-d	0.683a-j	0.649a-l	0.591b-j	0.563b-h	0.515b-f
18-9-12	0.744a-c	0.715a-d	0.616b-j	0.628b-l	0.563f-j	0.514f-h	0.494b-f
18-9-2	0.772ab	0.806ab	0.717a-h	0.731a-h	0.67a-i	0.651a-g	0.603a-f
18-9-3	0.757ab	0.75a-d	0.659a-j	0.684a-k	0.658a-i	0.612a-h	0.594a-f
18-9-4	0.68a-d	0.7b-d	0.656a-j	0.681a-l	0.67a-i	0.634a-h	0.6a-f
18-9-5	0.732a-c	0.732a-d	0.59g-j	0.543l	0.564f-j	0.559b-h	0.55b-f
18-9-6	0.741a-c	0.733a-d	0.592f-j	0.605e-l	0.544h-j	0.525d-h	0.5b-f
18-9-7	0.744a-c	0.759a-d	0.698a-j	0.678a-l	0.634a-j	0.581b-h	0.553b-f
18-9-8	0.739a-c	0.759a-d	0.68a-j	0.67a-l	0.654a-i	0.619a-h	0.585a-f
18-9-9	0.727a-c	0.747a-d	0.675a-j	0.667a-l	0.661a-i	0.642a-h	0.616a-e
17-4200-19x13	0.762ab	0.767a-d	0.686a-j	0.695a-k	0.622b-j	0.595a-h	0.551b-f
17-4200-19x21	0.697a-c	0.756a-d	0.629b-j	0.603f-l	0.572d-j	0.55b-h	0.548b-f
17-4200-19x9	0.81a	0.807ab	0.719a-h	0.713a-j	0.603b-j	0.536d-h	0.508b-f
17-4200-36x19	0.79ab	0.794a-c	0.734a-e	0.712a-j	0.62b-j	0.625a-h	0.564a-f
Astro	0.74a-c	0.748a-d	0.661a-j	0.666a-l	0.604b-j	0.582b-h	0.516b-f
17-5200-11X9	0.711a-c	0.722a-d	0.656a-j	0.667a-l	0.571d-j	0.576b-h	0.476c-f
17-5200-13X9	0.712a-c	0.74a-d	0.643a-j	0.651a-l	0.595b-j	0.594a-h	0.557b-f
17-5200-31X3	0.718a-c	0.748a-d	0.746a-c	0.752a-c	0.724ab	0.705a-c	0.658a-c
17-5200-3X23	0.811a	0.829a	0.781a	0.774a	0.705a-e	0.683a-e	0.655a-c
17-5200-4X11	0.757ab	0.743a-d	0.674a-j	0.693a-k	0.632a-j	0.599a-h	0.581a-f
Bimini	0.779ab	0.762a-d	0.691a-j	0.717a-i	0.663a-i	0.613a-h	0.587a-f
2008-4x16	0.777ab	0.79a-c	0.714a-i	0.676a-l	0.636a-i	0.599a-h	0.585a-f
Celebration	0.763ab	0.769a-d	0.736a-e	0.739a-g	0.668a-i	0.619a-h	0.548b-f
Latitude36	0.769ab	0.806ab	0.722a-h	0.729a-h	0.673a-i	0.639a-h	0.592a-f
NorthBridge	0.78ab	0.776a-c	0.745a-d	0.74a-g	0.683a-g	0.608a-h	0.572a-f
OKC1221	0.765ab	0.77a-d	0.703a-i	0.701a-k	0.672a-i	0.643a-g	0.61a-e
OSU1101	0.767ab	0.778a-c	0.738a-e	0.744a-d	0.698a-g	0.666a-f	0.624a-e
OSU1117	0.781ab	0.77a-d	0.714a-i	0.625b-l	0.631a-j	0.576b-h	0.531b-f
OSU1127	0.769ab	0.767a-d	0.683a-j	0.675a-l	0.629a-j	0.635a-h	0.583a-f
OSU1132	0.746a-c	0.762a-d	0.722a-h	0.692a-k	0.634a-j	0.597a-h	0.517b-f
OSU1156	0.755ab	0.72a-d	0.694a-j	0.672a-l	0.643a-i	0.599a-h	0.565a-f
OSU1217	0.749ab	0.741a-d	0.697a-j	0.701a-k	0.622b-j	0.586b-h	0.56a-f
OSU1257	0.793ab	0.765a-d	0.672a-j	0.655a-l	0.63a-j	0.641a-h	0.573a-f
OSU1318	0.77ab	0.783a-c	0.72a-h	0.713a-j	0.656a-i	0.631a-h	0.573a-f
OSU1337	0.756ab	0.782a-c	0.716a-i	0.726a-h	0.662a-i	0.61a-h	0.552b-f
OSU1402	0.792ab	0.779a-c	0.709a-i	0.702a-k	0.641a-i	0.562b-h	0.535b-f
OSU1403	0.744a-c	0.746a-d	0.701a-j	0.719a-i	0.663a-i	0.633a-h	0.586a-f
OSU1406	0.782ab	0.792a-c	0.714a-i	0.718a-i	0.657a-i	0.625a-h	0.585a-f
OSU1408	0.75ab	0.749a-d	0.639b-j	0.611d-l	0.571d-j	0.492gh	0.458ef

OSU1409	0.744a-c	0.755a-d	0.63b-j	0.655a-l	0.567e-j	0.573b-h	0.526b-f
OSU1417	0.728a-c	0.742a-d	0.653a-j	0.654a-l	0.621b-j	0.612a-h	0.57a-f
OSU1418	0.756ab	0.78a-c	0.733a-f	0.719a-i	0.679a-h	0.639a-h	0.598a-f
OSU1433	0.762ab	0.764a-d	0.687a-j	0.686a-k	0.636a-i	0.581b-h	0.545b-f
OSU1439	0.747a-c	0.731a-d	0.679a-j	0.697a-k	0.654a-i	0.597a-h	0.574a-f
OSU1601	0.763ab	0.743a-d	0.67a-j	0.679a-l	0.609b-j	0.578b-h	0.532b-f
OSU1609	0.747a-c	0.792a-c	0.673a-j	0.64a-l	0.625a-j	0.618a-h	0.586a-f
OSU1611	0.698a-c	0.692b-d	0.561j	0.595h-l	0.577d-j	0.592a-h	0.539b-f
OSU1617	0.738a-c	0.793a-c	0.73a-g	0.741a-f	0.708a-d	0.686a-d	0.637a-e
OSU1620	0.691a-c	0.764a-d	0.63b-j	0.639a-l	0.561g-j	0.589b-h	0.529b-f
OSU1625	0.712a-c	0.78a-c	0.689a-j	0.684a-k	0.626a-j	0.608a-h	0.574a-f
OSU1628	0.742a-c	0.76a-d	0.64a-j	0.662a-l	0.623b-j	0.602a-h	0.579a-f
OSU1629	0.515d	0.727a-d	0.712a-i	0.714a-j	0.694a-g	0.671a-f	0.644a-d
OSU1631	0.734a-c	0.793a-c	0.658a-j	0.668a-l	0.634a-j	0.624a-h	0.596a-f
OSU1638	0.697a-c	0.751a-d	0.597e-j	0.614c-l	0.61b-j	0.615a-h	0.585a-f
OSU1639	0.576cd	0.768a-d	0.734a-e	0.761ab	0.729ab	0.708ab	0.651a-c
OSU1641	0.723a-c	0.757a-d	0.608c-j	0.632b-l	0.575d-j	0.552b-h	0.548b-f
OSU1646	0.744a-c	0.733a-d	0.62b-j	0.626b-l	0.56g-j	0.552b-h	0.513b-f
OSU1649	0.628b-d	0.654d	0.56j	0.609d-l	0.564f-j	0.569b-h	0.53b-f
OSU1651	0.773ab	0.762a-d	0.664a-j	0.635b-l	0.631a-j	0.592a-h	0.53b-f
OSU1656	0.742a-c	0.722a-d	0.655a-j	0.674a-l	0.638a-i	0.601a-h	0.551b-f
OSU1657	0.758ab	0.802ab	0.714a-i	0.709a-j	0.667a-i	0.636a-h	0.605a-f
OSU1661	0.688a-c	0.716a-d	0.614c-j	0.576j-l	0.54ij	0.527d-h	0.463d-f
OSU1662	0.737a-c	0.768a-d	0.718a-h	0.703a-k	0.659a-i	0.644a-g	0.6a-f
OSU1663	0.683a-d	0.708b-d	0.663a-j	0.636a-l	0.582c-j	0.53d-h	0.48c-f
OSU1664	0.767ab	0.764a-d	0.715a-i	0.725a-h	0.662a-i	0.632a-h	0.577a-f
OSU1666	0.695a-c	0.733a-d	0.58h-j	0.582i-l	0.574d-j	0.584b-h	0.544b-f
OSU1670	0.707a-c	0.739a-d	0.676a-j	0.671a-l	0.621b-j	0.618a-h	0.573a-f
OSU1673	0.653a-d	0.678cd	0.617b-j	0.632b-l	0.599b-j	0.521e-h	0.506b-f
OSU1675	0.751ab	0.716a-d	0.604d-j	0.566kl	0.498j	0.478h	0.424f
OSU1680	0.748a-c	0.755a-d	0.621b-j	0.612d-l	0.577d-j	0.574b-h	0.496b-f
OSU1682	0.757ab	0.748a-d	0.646a-j	0.602g-l	0.583c-j	0.541c-h	0.508b-f
OSU1687	0.713a-c	0.79a-c	0.658a-j	0.658a-l	0.614b-j	0.597a-h	0.534b-f
OSU1690	0.751ab	0.78a-c	0.709a-i	0.731a-h	0.699a-f	0.671a-f	0.616a-e
OSU1699	0.722a-c	0.744a-d	0.652a-j	0.669a-l	0.61b-j	0.594a-h	0.526b-f
Tahoma31	0.728a-c	0.766a-d	0.731a-g	0.733a-h	0.686a-g	0.662a-f	0.583a-f
TifTuf	0.72a-c	0.75a-d	0.674a-j	0.7a-k	0.666a-i	0.647a-g	0.6a-f
Tifway	0.756ab	0.735a-d	0.682a-j	0.686a-k	0.645a-i	0.607a-h	0.57a-f
Tilin#5	0.75ab	0.729a-d	0.678a-j	0.674a-l	0.618b-j	0.55b-h	0.529b-f
U-3	0.745a-c	0.746a-d	0.722a-h	0.716a-i	0.678a-h	0.66a-f	0.608a-e

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 7. Mean NDVI of 96 trafficked bermudagrasses on seven rating dates in fall-2019.

Entry	15-Sep (0 events)	20-Sep (10 events)	27-Sep (20 events)	4-Oct (30 events)	11-Oct (40 events)	18-Oct (50 events)	25-Oct (60 events)
15-4X15	0.786ab	0.739a-c	0.672a-f	0.632a-f	0.572ab	0.529ab	0.459ab
15-8X3	0.729a-c	0.741a-c	0.62a-f	0.623a-f	0.546ab	0.487ab	0.429ab
18-7-1	0.706a-c	0.673a-d	0.644a-f	0.641a-f	0.545ab	0.491ab	0.441ab
18-7-2	0.722a-c	0.724a-d	0.685a-f	0.675a-f	0.611ab	0.586ab	0.517ab
18-7-3	0.755ab	0.729a-d	0.689a-f	0.7a-f	0.65ab	0.601ab	0.537ab
18-7-4	0.739a-c	0.737a-c	0.703a-d	0.678a-f	0.572ab	0.512ab	0.434ab
18-7-5	0.725a-c	0.725a-d	0.68a-f	0.688a-f	0.602ab	0.522ab	0.405ab
18-7-6	0.732a-c	0.756a-c	0.722a-d	0.736a-c	0.663a	0.614ab	0.532ab
18-8-1	0.681a-d	0.698a-d	0.709a-d	0.702a-f	0.627ab	0.582ab	0.527ab
18-8-2	0.723a-c	0.698a-d	0.709a-d	0.706a-d	0.624ab	0.563ab	0.533ab
18-8-3	0.712a-c	0.691a-d	0.668a-f	0.701a-f	0.635ab	0.629a	0.548ab
18-8-4	0.788ab	0.749a-c	0.655a-f	0.662a-f	0.592ab	0.528ab	0.458ab
18-8-5	0.7a-c	0.718a-d	0.679a-f	0.685a-f	0.6ab	0.522ab	0.463ab
18-8-6	0.699a-c	0.699a-d	0.668a-f	0.689a-f	0.629ab	0.557ab	0.466ab
18-8-7	0.776ab	0.735a-c	0.726a-c	0.721a-d	0.642ab	0.581ab	0.51ab
18-9-1	0.661a-d	0.63cd	0.597b-f	0.615a-f	0.516ab	0.465ab	0.409ab
18-9-10	0.722a-c	0.712a-d	0.691a-e	0.693a-f	0.636ab	0.613ab	0.545ab
18-9-11	0.714a-c	0.738a-c	0.712a-d	0.715a-d	0.615ab	0.535ab	0.447ab
18-9-12	0.744a-c	0.703a-d	0.577c-f	0.57df	0.518ab	0.483ab	0.434ab
18-9-2	0.772ab	0.753a-c	0.729a-c	0.73a-d	0.663a	0.581ab	0.515ab
18-9-3	0.757ab	0.7a-d	0.687a-f	0.706a-d	0.601ab	0.6ab	0.472ab
18-9-4	0.68a-d	0.642b-d	0.637a-f	0.649a-f	0.582ab	0.455ab	0.427ab
18-9-5	0.732a-c	0.714a-d	0.67a-f	0.667a-f	0.608ab	0.528ab	0.467ab
18-9-6	0.741a-c	0.707a-d	0.671a-f	0.648a-f	0.564ab	0.506ab	0.436ab
18-9-7	0.744a-c	0.689a-d	0.706a-d	0.679a-f	0.565ab	0.47ab	0.408ab
18-9-8	0.739a-c	0.717a-d	0.683a-f	0.699a-f	0.631ab	0.584ab	0.489ab
18-9-9	0.727a-c	0.753a-c	0.68a-f	0.71a-d	0.656ab	0.587ab	0.522ab
17-4200-19x13	0.762ab	0.713a-d	0.711a-d	0.712a-d	0.639ab	0.566ab	0.493ab
17-4200-19x21	0.697a-c	0.689a-d	0.603b-f	0.585c-f	0.537ab	0.464ab	0.419ab
17-4200-19x9	0.81a	0.762a-c	0.721a-d	0.727a-d	0.61ab	0.584ab	0.515ab
17-4200-36x19	0.79ab	0.737a-c	0.745ab	0.746a-c	0.654ab	0.619ab	0.507ab
Astro	0.74a-c	0.721a-d	0.688a-f	0.696a-f	0.57ab	0.51ab	0.429ab
17-5200-11X9	0.711a-c	0.695a-d	0.662a-f	0.646a-f	0.537ab	0.516ab	0.427ab
17-5200-13X9	0.712a-c	0.705a-d	0.674a-f	0.678a-f	0.557ab	0.525ab	0.411ab
17-5200-31X3	0.718a-c	0.707a-d	0.691a-e	0.73a-d	0.667a	0.582ab	0.54ab
17-5200-3X23	0.811a	0.8a	0.783a	0.768a	0.695a	0.635a	0.565a
17-5200-4X11	0.757ab	0.714a-d	0.711a-d	0.705a-d	0.613ab	0.587ab	0.496ab
Bimini	0.779ab	0.771ab	0.711a-d	0.72a-d	0.657ab	0.615ab	0.556ab
2008-4x16	0.777ab	0.743a-c	0.702a-d	0.696a-f	0.63ab	0.535ab	0.443ab
Celebration	0.763ab	0.733a-c	0.712a-d	0.715a-d	0.625ab	0.554ab	0.452ab
Latitude36	0.769ab	0.79a	0.713a-d	0.738a-c	0.681a	0.593ab	0.528ab
NorthBridge	0.78ab	0.777ab	0.742a-c	0.744a-c	0.672a	0.565ab	0.48ab
OKC1221	0.765ab	0.758a-c	0.722a-d	0.719a-d	0.656ab	0.576ab	0.519ab
OSU1101	0.767ab	0.767a-c	0.752ab	0.744a-c	0.656ab	0.606ab	0.524ab
OSU1117	0.781ab	0.746a-c	0.712a-d	0.705a-d	0.627ab	0.561ab	0.482ab
OSU1127	0.769ab	0.743a-c	0.719a-d	0.7a-f	0.633ab	0.587ab	0.505ab
OSU1132	0.746a-c	0.727a-d	0.72a-d	0.719a-d	0.638ab	0.527ab	0.432ab
OSU1156	0.755ab	0.737a-c	0.71a-d	0.693a-f	0.614ab	0.523ab	0.476ab
OSU1217	0.749ab	0.717a-d	0.712a-d	0.735a-c	0.662a	0.577ab	0.529ab
OSU1257	0.793ab	0.772ab	0.726a-c	0.737a-c	0.669a	0.591ab	0.523ab
OSU1318	0.77ab	0.76a-c	0.753ab	0.75ab	0.672a	0.618ab	0.523ab
OSU1337	0.756ab	0.751a-c	0.706a-d	0.712a-d	0.631ab	0.585ab	0.482ab
OSU1402	0.792ab	0.764a-c	0.735a-c	0.709a-d	0.622ab	0.539ab	0.469ab
OSU1403	0.744a-c	0.765a-c	0.712a-d	0.7a-f	0.643ab	0.564ab	0.516ab
OSU1406	0.782ab	0.786a	0.728a-c	0.735a-c	0.635ab	0.548ab	0.505ab
OSU1408	0.75ab	0.674a-d	0.669a-f	0.638a-f	0.587ab	0.469ab	0.428ab
OSU1409	0.744a-c	0.714a-d	0.676a-f	0.693a-f	0.623ab	0.558ab	0.468ab

OSU1417	0.728a-c	0.744a-c	0.668a-f	0.672a-f	0.614ab	0.532ab	0.477ab
OSU1418	0.756ab	0.736a-c	0.754ab	0.73a-d	0.637ab	0.581ab	0.488ab
OSU1433	0.762ab	0.73a-c	0.691a-e	0.677a-f	0.604ab	0.498ab	0.446ab
OSU1439	0.747a-c	0.7a-d	0.695a-d	0.67a-f	0.598ab	0.526ab	0.458ab
OSU1601	0.763ab	0.691a-d	0.658a-f	0.692a-f	0.616ab	0.554ab	0.448ab
OSU1609	0.747a-c	0.756a-c	0.681a-f	0.64a-f	0.578ab	0.502ab	0.428ab
OSU1611	0.698a-c	0.714a-d	0.653a-f	0.632a-f	0.574ab	0.518ab	0.445ab
OSU1617	0.738a-c	0.744a-c	0.681a-f	0.675a-f	0.582ab	0.604ab	0.472ab
OSU1620	0.691a-c	0.701a-d	0.687a-f	0.659a-f	0.536ab	0.503ab	0.429ab
OSU1625	0.712a-c	0.752a-c	0.702a-d	0.695a-f	0.624ab	0.561ab	0.496ab
OSU1628	0.742a-c	0.723a-d	0.671a-f	0.658a-f	0.575ab	0.53ab	0.438ab
OSU1629	0.515d	0.589d	0.528ef	0.543f	0.456b	0.402b	0.395ab
OSU1631	0.734a-c	0.774ab	0.739a-c	0.723a-d	0.649ab	0.604ab	0.512ab
OSU1638	0.697a-c	0.73a-c	0.672a-f	0.666a-f	0.602ab	0.562ab	0.507ab
OSU1639	0.576cd	0.642b-d	0.524f	0.618a-f	0.508ab	0.524ab	0.379b
OSU1641	0.723a-c	0.738a-c	0.652a-f	0.655a-f	0.59ab	0.535ab	0.447ab
OSU1646	0.744a-c	0.713a-d	0.669a-f	0.638a-f	0.547ab	0.491ab	0.416ab
OSU1649	0.628b-d	0.64b-d	0.559d-f	0.559f	0.5ab	0.447ab	0.398ab
OSU1651	0.773ab	0.753a-c	0.695a-d	0.699a-f	0.626ab	0.534ab	0.449ab
OSU1656	0.742a-c	0.689a-d	0.657a-f	0.643a-f	0.583ab	0.517ab	0.435ab
OSU1657	0.758ab	0.755a-c	0.689a-f	0.661a-f	0.587ab	0.554ab	0.469ab
OSU1661	0.688a-c	0.696a-d	0.644a-f	0.629a-f	0.569ab	0.465ab	0.421ab
OSU1662	0.737a-c	0.7a-d	0.68a-f	0.68a-f	0.607ab	0.559ab	0.466ab
OSU1663	0.683a-d	0.671a-d	0.644a-f	0.634a-f	0.517ab	0.481ab	0.393ab
OSU1664	0.767ab	0.772ab	0.745ab	0.747ab	0.647ab	0.611ab	0.527ab
OSU1666	0.695a-c	0.709a-d	0.59b-f	0.6b-f	0.552ab	0.514ab	0.429ab
OSU1670	0.707a-c	0.717a-d	0.686a-f	0.672a-f	0.631ab	0.567ab	0.479ab
OSU1673	0.653a-d	0.669a-d	0.644a-f	0.646a-f	0.575ab	0.518ab	0.437ab
OSU1675	0.751ab	0.687a-d	0.642a-f	0.617a-f	0.547ab	0.488ab	0.428ab
OSU1680	0.748a-c	0.742a-c	0.635a-f	0.637a-f	0.598ab	0.535ab	0.459ab
OSU1682	0.757ab	0.737a-c	0.671a-f	0.691a-f	0.623ab	0.545ab	0.46ab
OSU1687	0.713a-c	0.735a-c	0.688a-f	0.689a-f	0.612ab	0.554ab	0.459ab
OSU1690	0.751ab	0.734a-c	0.685a-f	0.706a-d	0.63ab	0.585ab	0.491ab
OSU1699	0.722a-c	0.673a-d	0.637a-f	0.648a-f	0.571ab	0.54ab	0.426ab
Tahoma31	0.728a-c	0.73a-c	0.7a-d	0.693a-f	0.623ab	0.597ab	0.476ab
TifTuf	0.72a-c	0.711a-d	0.703a-d	0.714a-d	0.652ab	0.597ab	0.536ab
Tifway	0.756ab	0.72a-d	0.694a-e	0.68a-f	0.607ab	0.533ab	0.486ab
Tilin#5	0.75ab	0.749a-c	0.712a-d	0.705a-d	0.598ab	0.556ab	0.471ab
U-3	0.745a-c	0.74a-c	0.703a-d	0.72a-d	0.643ab	0.606ab	0.521ab

Means within columns followed by same letters are not statistically different at P==0.05 based on Tukey’s HSD test.

Table 8. Simple effects of traffic on NDVI of 96 bermudagrasses on seven rating dates in fall-2019.

Entry	15-Sep	20-Sep	27-Sep	4-Oct	11-Oct	18-Oct	25-Oct
	---p-value---						
15-4X15	0.9116	0.1136	0.8674	0.9555	0.259	0.0707	0.0006
15-8X3	0.3817	0.3431	0.8939	0.8186	0.4858	0.0107	<.0001
18-7-1	0.7729	0.001	0.8205	0.634	0.5657	0.1267	0.0653
18-7-2	0.7317	0.3261	0.2194	0.181	0.1981	0.7994	0.1555
18-7-3	0.8052	0.0783	0.8197	0.3401	0.799	0.4979	0.0382
18-7-4	0.4507	0.5715	0.4215	0.8082	0.8187	0.414	0.1007
18-7-5	0.4824	0.9547	0.5686	0.5949	0.7934	0.9952	0.063
18-7-6	0.2502	0.2282	0.6501	0.8436	0.672	0.314	0.008
18-8-1	0.5361	0.0321	0.13	0.0273	0.0008	<.0001	<.0001
18-8-2	0.6805	0.7133	0.1329	0.292	0.8124	0.0498	0.0864
18-8-3	0.5184	0.0002	0.4001	0.45	0.3003	0.2654	0.0068
18-8-4	0.809	0.0697	0.612	0.3015	0.8436	0.0763	0.0018
18-8-5	0.2258	0.1668	0.2949	0.3479	0.9993	0.2154	0.0143
18-8-6	0.0846	0.7963	0.0304	0.0435	0.1354	0.6912	0.159
18-8-7	0.333	0.1088	0.4852	0.2543	0.0517	0.0275	<.0001
18-9-1	0.163	0.0083	0.4971	0.5282	0.1327	0.0382	0.0124
18-9-10	0.7654	0.5262	0.0365	0.0606	0.1718	0.3987	0.6555
18-9-11	0.9843	0.6767	0.3603	0.0417	0.515	0.4777	0.0454
18-9-12	0.1012	0.6017	0.2132	0.0734	0.2213	0.4277	0.0793
18-9-2	0.0972	0.0269	0.6906	0.9786	0.8614	0.0763	0.0098
18-9-3	0.8843	0.0325	0.3827	0.4866	0.1253	0.7582	0.0004
18-9-4	0.3055	0.0141	0.5468	0.3257	0.0216	<.0001	<.0001
18-9-5	0.6098	0.4507	0.0124	0.0002	0.2339	0.4248	0.0158
18-9-6	0.2202	0.2662	0.0132	0.18	0.5694	0.6344	0.0605
18-9-7	0.6554	0.0032	0.8205	0.9819	0.0678	0.0062	<.0001
18-9-8	0.4091	0.0737	0.9222	0.3689	0.5267	0.3737	0.0052
18-9-9	0.2796	0.8006	0.8806	0.1827	0.8958	0.1658	0.0056
17-4200-19x13	0.8186	0.0237	0.4258	0.6121	0.6439	0.4595	0.0889
17-4200-19x21	0.6324	0.0046	0.4107	0.5856	0.3365	0.0302	0.0002
17-4200-19x9	0.5088	0.0617	0.9389	0.6818	0.8414	0.2226	0.8392
17-4200-36x19	0.5909	0.0154	0.714	0.2906	0.3474	0.8867	0.0971
Astro	0.569	0.2542	0.3972	0.3511	0.3543	0.0698	0.0115
17-5200-11X9	0.5312	0.2525	0.8591	0.5135	0.3599	0.1259	0.1455
17-5200-13X9	0.0842	0.1439	0.3222	0.405	0.3036	0.0832	<.0001
17-5200-31X3	0.1256	0.0849	0.084	0.4996	0.1266	0.0025	0.0006
17-5200-3X23	0.9587	0.2175	0.9564	0.8679	0.7913	0.2278	0.0089
17-5200-4X11	0.9449	0.2217	0.2494	0.7216	0.6004	0.7745	0.0123
Bimini	0.6518	0.6892	0.526	0.9243	0.8778	0.9612	0.3612
2008-4x16	0.9548	0.0445	0.7046	0.5493	0.8685	0.1029	<.0001
Celebration	0.4537	0.1327	0.4613	0.4506	0.243	0.1015	0.0048
Latitude36	0.5184	0.4961	0.7896	0.7835	0.8407	0.2461	0.0597
NorthBridge	0.4434	0.9615	0.9197	0.9095	0.769	0.2734	0.0068
OKC1221	0.1349	0.5909	0.544	0.5842	0.6543	0.0916	0.0072
OSU1101	0.9391	0.6276	0.6516	0.9959	0.2624	0.1277	0.0034
OSU1117	0.6132	0.3165	0.9564	0.014	0.9051	0.7044	0.1494
OSU1127	0.0137	0.311	0.2572	0.4359	0.8994	0.222	0.0234
OSU1132	0.398	0.1371	0.9573	0.4126	0.9095	0.0766	0.0128
OSU1156	0.4626	0.4881	0.6128	0.5262	0.442	0.0543	0.0092
OSU1217	0.4203	0.3178	0.6276	0.3006	0.2704	0.8192	0.3674
OSU1257	0.2594	0.7679	0.0935	0.0118	0.2889	0.2036	0.1421
OSU1318	0.1752	0.3247	0.3036	0.259	0.6484	0.7408	0.1394
OSU1337	0.6447	0.1866	0.7567	0.6488	0.3981	0.512	0.0375
OSU1402	0.7206	0.5142	0.4066	0.8323	0.6011	0.5652	0.0539
OSU1403	0.3898	0.415	0.7242	0.5404	0.5904	0.0816	0.0415
OSU1406	0.9803	0.7919	0.6668	0.61	0.5398	0.0519	0.0187
OSU1408	0.4493	0.0016	0.3393	0.4062	0.6701	0.5481	0.3748
OSU1409	0.3966	0.0824	0.148	0.2344	0.1351	0.6937	0.0845

OSU1417	0.8147	0.9254	0.6209	0.5892	0.8564	0.0445	0.0067
OSU1418	0.7976	0.0639	0.5199	0.72	0.2598	0.1461	0.0013
OSU1433	0.9941	0.1443	0.9005	0.8034	0.3794	0.0359	0.0037
OSU1439	0.1361	0.1833	0.5996	0.4132	0.1349	0.0737	0.0007
OSU1601	0.3659	0.0268	0.7163	0.694	0.8478	0.5363	0.0139
OSU1609	0.3429	0.1249	0.7929	0.9967	0.2005	0.004	<.0001
OSU1611	0.7504	0.3446	0.0043	0.2488	0.9203	0.06	0.0059
OSU1617	0.8474	0.0359	0.1289	0.0415	0.0015	0.0379	<.0001
OSU1620	0.0127	0.0079	0.0741	0.5452	0.5	0.0302	0.0036
OSU1625	0.6394	0.2381	0.6829	0.7387	0.9557	0.232	0.0209
OSU1628	0.3672	0.1168	0.3289	0.9063	0.1987	0.0685	<.0001
OSU1629	0.9097	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
OSU1631	0.379	0.4142	0.0118	0.0888	0.6787	0.6121	0.013
OSU1638	0.4626	0.3592	0.0197	0.1064	0.8386	0.1762	0.0219
OSU1639	0.9371	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
OSU1641	0.7616	0.4372	0.1582	0.4751	0.6793	0.6706	0.0034
OSU1646	0.8687	0.3795	0.1223	0.6985	0.7216	0.123	0.0044
OSU1649	0.7188	0.5392	0.9715	0.1251	0.0852	0.0024	0.0001
OSU1651	0.9528	0.7133	0.3299	0.0474	0.9001	0.14	0.0184
OSU1656	0.4119	0.165	0.9523	0.3479	0.139	0.0354	0.0008
OSU1657	0.0638	0.0507	0.4161	0.1406	0.0364	0.0399	<.0001
OSU1661	0.2006	0.3959	0.3571	0.104	0.4163	0.1138	0.213
OSU1662	0.9764	0.0039	0.2347	0.4808	0.1677	0.0321	0.0001
OSU1663	0.8167	0.1171	0.5559	0.9399	0.0795	0.2051	0.0102
OSU1664	0.2646	0.7176	0.3522	0.5108	0.6973	0.5826	0.1384
OSU1666	0.4671	0.3097	0.7695	0.5849	0.5475	0.0757	0.0008
OSU1670	0.4762	0.3438	0.7321	0.9745	0.7934	0.1974	0.0061
OSU1673	0.2963	0.6756	0.4048	0.6697	0.5162	0.9334	0.0413
OSU1675	0.7299	0.2271	0.2339	0.1118	0.185	0.7941	0.8973
OSU1680	0.439	0.5821	0.6706	0.4335	0.5724	0.3251	0.2772
OSU1682	0.5264	0.6418	0.4264	0.0069	0.2805	0.9131	0.1544
OSU1687	0.7654	0.0212	0.3356	0.3442	0.9601	0.2679	0.0273
OSU1690	0.1069	0.0501	0.4518	0.4383	0.0656	0.0304	0.0003
OSU1699	0.2646	0.0027	0.6261	0.5082	0.2937	0.1668	0.0034
Tahoma31	0.205	0.1238	0.3171	0.2144	0.0882	0.1012	0.0019
TifTuf	0.0919	0.0978	0.3698	0.663	0.7149	0.1991	0.0617
Tifway	0.2896	0.528	0.6999	0.8525	0.3129	0.0622	0.0131
Tilin#5	0.0604	0.3966	0.2958	0.3338	0.5737	0.8666	0.0871
U-3	0.3232	0.7734	0.5475	0.8948	0.3437	0.1714	0.011

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 9. Mean shear strength (SS) of 96 trafficked bermudagrasses on three rating dates in fall-2019.

Entry	15-Sep (0 events)	4-Oct (30 events)	25-Oct (60 events)
	----------------	--------Nm--------	----------------
15-4X15	20.3a-d	17.5	16.3a-d
15-8X3	18.9a-d	17.1	16.1a-d
18-7-1	23.3a-d	18.3	16.3a-d
18-7-2	22.2a-d	19.5	17.3a-c
18-7-3	21a-d	18.0	16.5a-d
18-7-4	22.1a-d	20.0	17.5a-c
18-7-5	21.5a-d	18.9	16.2a-d
18-7-6	20.1a-d	19.7	16.4a-d
18-8-1	21.1a-d	19.3	16.5a-d
18-8-2	19a-d	18.4	16.8a-d
18-8-3	21.3a-d	18.6	17.1a-d
18-8-4	24.2ab	19.8	17.3a-c
18-8-5	20.6a-d	17.5	16.2a-d
18-8-6	18.2b-d	17.3	17.3a-c
18-8-7	23.8a-c	18.5	18.4ab
18-9-1	21.4a-d	17.7	18.5ab
18-9-10	22a-d	17.4	17.2a-d
18-9-11	20.8a-d	17.8	16.6a-d
18-9-12	22.1a-d	19.2	16.5a-d
18-9-2	21a-d	17.4	16.2a-d
18-9-3	20.5a-d	19.7	17.1a-d
18-9-4	19.2a-d	17.8	16.2a-d
18-9-5	20.1a-d	17.3	16.2a-d
18-9-6	20.3a-d	19.7	17.5a-c
18-9-7	21.8a-d	17.6	16.9a-d
18-9-8	20.8a-d	18.2	17.5a-c
18-9-9	20.3a-d	18.1	17.5a-c
17-4200-19x13	21a-d	17.9	16.6a-d
17-4200-19x21	21.5a-d	17.7	16.1a-d
17-4200-19x9	22a-d	20.2	17a-d
17-4200-36x19	21a-d	19.0	16.6a-d
Astro	20.4a-d	18.1	17.5a-c
17-5200-11X9	19.8a-d	19.3	16.8a-d
17-5200-13X9	18.8a-d	17.4	16.5a-d
17-5200-31X3	19.5a-d	17.2	16.6a-d
17-5200-3X23	20.9a-d	19.6	16.4a-d
17-5200-4X11	21.2a-d	19.1	16.5a-d
Bimini	24.3a	20.4	18.3a-c
2008-4x16	21.8a-d	18.8	17.8a-c
Celebration	22.4a-d	18.6	17.6a-c
Latitude36	22.1a-d	18.5	17.7a-c
NorthBridge	21.8a-d	18.2	17.4a-c
OKC1221	22.7a-d	18.5	17.3a-c
OSU1101	20.4a-d	18.7	18.7a
OSU1117	23a-d	18.9	16.7a-d
OSU1127	22.9a-d	20.2	17.3a-c
OSU1132	22.1a-d	18.3	16.5a-d
OSU1156	20.5a-d	18.1	17.2a-d
OSU1217	21.2a-d	19.3	17.8a-c
OSU1257	20.9a-d	19.0	17.1a-d
OSU1318	21a-d	18.4	17.1a-d
OSU1337	20.5a-d	17.8	16.2a-d
OSU1402	23.2a-d	19.5	17.7a-c
OSU1403	22.2a-d	18.8	16.8a-d
OSU1406	20.7a-d	19.4	18.2a-c
OSU1408	21.4a-d	18.5	16.5a-d

OSU1409	19.5a-d	18.3	17a-d
OSU1417	21a-d	17.4	16.4a-d
OSU1418	21a-d	18.4	16.1a-d
OSU1433	20.4a-d	19.0	17.7a-c
OSU1439	20.5a-d	18.3	16.3a-d
OSU1601	22a-d	18.4	16.8a-d
OSU1609	20.1a-d	17.9	16.5a-d
OSU1611	19.2a-d	16.8	16.9a-d
OSU1617	19a-d	18.4	16.9a-d
OSU1620	18.6a-d	17.7	15.5b-d
OSU1625	19.9a-d	18.6	17.4a-c
OSU1628	17.6d	17.7	16.1a-d
OSU1629	17.8cd	17.7	14.1d
OSU1631	19.5a-d	17.4	16.8a-d
OSU1638	18.9a-d	16.6	16a-d
OSU1639	19.8a-d	16.5	16.6a-d
OSU1641	19.9a-d	17.8	15.9a-d
OSU1646	20.1a-d	18.1	16a-d
OSU1649	18.6a-d	17.8	15.2cd
OSU1651	19a-d	18.2	16.6a-d
OSU1656	22a-d	18.1	17.2a-d
OSU1657	22.1a-d	18.6	17.2a-d
OSU1661	20.4a-d	17.7	15.8a-d
OSU1662	22a-d	18.4	17.7a-c
OSU1663	20.4a-d	18.3	16a-d
OSU1664	20.8a-d	18.7	16.2a-d
OSU1666	21.1a-d	19.2	16.4a-d
OSU1670	18.7a-d	18.4	16.5a-d
OSU1673	18.6a-d	16.9	16.2a-d
OSU1675	21.8a-d	19.2	18.1a-c
OSU1680	20.9a-d	17.4	16.2a-d
OSU1682	21.9a-d	19.8	15.9a-d
OSU1687	21a-d	17.7	16.7a-d
OSU1690	21.3a-d	18.5	16.6a-d
OSU1699	20a-d	18.4	15.8a-d
Tahoma31	20.9a-d	18.4	17.4a-c
TifTuf	22.5a-d	19.1	17.6a-c
Tifway	22.7a-d	19.6	17.8a-c
Tilin#5	20.8a-d	18.2	17.3a-c
U-3	22.6a-d	19.0	17.3a-c

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 10. Mean surface hardness (SH) of trafficked bermudagrasses on three rating dates in fall-2019.

Entry	**15-Sep (0 events)**	**15-Sep (30 events)**	**25-Oct (60 events)**
	---------------------	Gmax	---------------------
15-4X15	49.5b	52.6	57
15-8X3	57.3b	55.3	57.6
18-7-1	52b	57.8	57.8
18-7-2	49.7b	58.8	54.4
18-7-3	51.1b	55.4	55.2
18-7-4	49.1b	59.6	56.7
18-7-5	52.1b	57.6	54.8
18-7-6	54.8b	55.7	58
18-8-1	54.3b	58.9	63.7
18-8-2	55.6b	55.6	62.3
18-8-3	50.2b	55.3	57.9
18-8-4	50.7b	58.2	57.3
18-8-5	53.4b	54	59
18-8-6	52.1b	61.1	60.4
18-8-7	53.9b	55.7	55.7
18-9-1	50.8b	50.8	55.1
18-9-10	56.8b	56	55.6
18-9-11	52.9b	55.5	57.8
18-9-12	52.9b	55.1	54.5
18-9-2	49b	59.9	56.2
18-9-3	58.3b	57	59.8
18-9-4	56.3b	60.9	62.7
18-9-5	54.5b	61.9	59.1
18-9-6	55.9b	55.1	54.3
18-9-7	51.4b	61.8	60.4
18-9-8	49.7b	58.3	58
18-9-9	52.3b	57	56.1
17-4200-19x13	54.9b	54.6	57.7
17-4200-19x21	55b	53.7	57.4
17-4200-19x9	49.4b	56.1	57.6
17-4200-36x19	53.4b	58.6	56.3
Astro	51.4b	59.1	55.9
17-5200-11X9	52.4b	61	58.3
17-5200-13X9	50.4b	59.4	55.3
17-5200-31X3	54.6b	58.3	54.1
17-5200-3X23	57.2b	53	57.6
17-5200-4X11	54.1b	56.2	58.5
Bimini	57.3b	55.4	58.9
2008-4x16	53.5b	55.5	55
Celebration	55.4b	57.9	54.6
Latitude36	56.8b	57.1	54.6
NorthBridge	55.7b	57.6	53.4
OKC1221	57.1b	55.9	55.1
OSU1101	50.6b	53	56.2
OSU1117	54.1b	61	57.4
OSU1127	56.8b	60.5	53.2
OSU1132	56.2b	58.1	60.9
OSU1156	50.2b	64.7	56.6
OSU1217	49.5b	57	54.1
OSU1257	52.1b	50.5	52.1
OSU1318	49.4b	53	51.6
OSU1337	47.3b	59.3	53.2
OSU1402	49.2b	54.6	53.1
OSU1403	50.4b	52.7	54.1
OSU1406	55.9b	60.7	57.8
OSU1408	57.6b	60.3	57.7

OSU1409	50.4b	63.7	56.5
OSU1417	55.6b	56.9	57.5
OSU1418	51.9b	55.1	52.7
OSU1433	56.8b	52.1	55.7
OSU1439	56.1b	57.1	56.7
OSU1601	50.8b	61	54.6
OSU1609	55.1b	54.7	59.2
OSU1611	60.3ab	59.9	57.1
OSU1617	54.5b	56.7	56.5
OSU1620	49.1b	58.2	59.5
OSU1625	88.8a	59.3	57.5
OSU1628	53.1b	56.4	56.8
OSU1629	52.4b	52.3	59.4
OSU1631	53.7b	52	56.3
OSU1638	52.2b	55.8	55.8
OSU1639	54b	63.1	61.5
OSU1641	57.8b	54.4	57.8
OSU1646	53.7b	57.9	59.2
OSU1649	53b	63.4	60.4
OSU1651	56.3b	53.3	54.8
OSU1656	54.8b	56.2	57.7
OSU1657	56.6b	65.2	58.8
OSU1661	52.2b	51.7	52.2
OSU1662	55b	62.6	59
OSU1663	49.7b	64.7	58
OSU1664	55.1b	55	57.8
OSU1666	53.7b	55.2	56.7
OSU1670	49.8b	58.8	54.1
OSU1673	48.2b	60.4	57.2
OSU1675	52.4b	55.7	54.8
OSU1680	54.6b	57.8	57.1
OSU1682	54b	52.2	56.8
OSU1687	53.9b	59.8	56.3
OSU1690	49.2b	54.7	56.5
OSU1699	52.3b	56	55.9
Tahoma31	52.9b	62.6	55
TifTuf	53.4b	62.4	58.4
Tifway	58.2b	57.4	57.3
Tilin#5	52.7b	61.8	55.4
U-3	55.4b	59.2	61.4

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 11. Mean fall percent green cover (PGC) of 96 non-trafficked bermudagrasses in 2019.

Entry	18-Oct	3-Nov	12-Nov
	--	%	--
15-4X15	43.1c-l	16.4d-l	12.9a-e
15-8X3	48.9b-k	14.6e-l	11.6a-e
18-7-1	44.8b-k	9l	10.5b-e
18-7-2	47.3b-k	10.9i-l	11.5a-e
18-7-3	53b-i	10.7i-l	10.1b-e
18-7-4	36.1g-l	9.5kl	10.3b-e
18-7-5	30.5j-l	9.4kl	11.3a-e
18-7-6	58.6a-e	14e-l	8.7c-e
18-8-1	76.7a	30.6a	11.7a-e
18-8-2	51.3b-j	15.3e-l	9.4b-e
18-8-3	65.8ab	14e-l	10.8a-e
18-8-4	49b-k	9.7j-l	10.9a-e
18-8-5	45.1b-k	11.7g-l	10.3b-e
18-8-6	44.1c-l	9.5kl	10.4b-e
18-8-7	61.9a-c	16.2e-l	14a-e
18-9-1	42c-l	11.5i-l	7.6e
18-9-10	47.6b-k	9.8j-l	11.4a-e
18-9-11	43.3c-l	9.5kl	11.2a-e
18-9-12	38.2e-l	10.4i-l	10.5b-e
18-9-2	53.2b-h	11i-l	9.7b-e
18-9-3	51.9b-i	26.5a-d	13a-e
18-9-4	45.5b-k	16.6d-l	9.6b-e
18-9-5	42c-l	12.3g-l	9.8b-e
18-9-6	31.8i-l	9.5kl	9.8b-e
18-9-7	43.3c-l	13.6f-l	11.9a-e
18-9-8	52.7b-i	11.4i-l	9c-e
18-9-9	49.8b-k	19.6c-k	12.1a-e
17-4200-19x13	44.3c-l	12.2g-l	10.8a-e
17-4200-19x21	40.3d-l	13.4f-l	10.9a-e
17-4200-19x9	37.8e-l	12.6g-l	15.5a-c
17-4200-36x19	46.9b-k	12.8g-l	13.5a-e
Astro	43.2c-l	11.6h-l	9.8b-e
17-5200-11X9	36.9f-l	13.3f-l	12.3a-e
17-5200-13X9	41.9c-l	15.3e-l	11.1a-e
17-5200-31X3	56a-g	27.5a-c	16.4ab
17-5200-3X23	54.2b-h	21.9a-g	12.9a-e
17-5200-4X11	48.1b-k	15.9e-l	13.9a-e
Bimini	50.6b-j	13.2f-l	10.1b-e
2008-4x16	40.2d-l	13.4f-l	11.9a-e
Celebration	48.1b-k	15.5e-l	10.8a-e
Latitude36	49.1b-k	10.9i-l	11.8a-e
NorthBridge	46.1b-k	10.3i-l	8.3de
OKC1221	50.2b-k	15e-l	10.1b-e
OSU1101	61.7a-c	20.2b-i	11a-e
OSU1117	36.1g-l	15.1e-l	11.1a-e
OSU1127	48.1b-k	12.9g-l	10.8a-e
OSU1132	38e-l	12.5g-l	11.5a-e
OSU1156	41.1c-l	13.1f-l	11.5a-e
OSU1217	41c-l	12.2g-l	11.9a-e
OSU1257	44.5b-l	15.4e-l	10.4b-e
OSU1318	45.9b-k	13.6e-l	12.4a-e
OSU1337	41.2c-l	12.5g-l	11.4a-e
OSU1402	33.2h-l	14.7e-l	11.3a-e
OSU1403	43.1c-l	16.3d-l	10.8a-e
OSU1406	46.5b-k	13.4f-l	11.2a-e
OSU1408	23.3l	13.5f-l	11.9a-e
OSU1409	42.5c-l	12.1g-l	10.7a-e

OSU1417	44.9b-k	13.5f-l	11.4a-e
OSU1418	46.1b-k	16.3d-l	12.4a-e
OSU1433	42.7c-l	13.2f-l	10.5b-e
OSU1439	42.3c-l	11.9g-l	9.9b-e
OSU1601	38.5e-l	14.1e-l	11.1a-e
OSU1609	45.9b-k	15.7e-l	12a-e
OSU1611	51.2b-j	16.2d-l	11.9a-e
OSU1617	49b-k	23.9a-e	13.4a-e
OSU1620	41.4c-l	11.6h-l	10.3b-e
OSU1625	43.3c-l	13.3f-l	11.5a-e
OSU1628	43.3c-l	14.1e-l	9.6b-e
OSU1629	48.3b-k	30.2ab	17.6a
OSU1631	47b-k	16.1e-l	13.1a-e
OSU1638	49.9b-k	17.5c-l	11.5a-e
OSU1639	56.5a-g	23.2a-f	12.2a-e
OSU1641	41.8c-l	12.9g-l	10b-e
OSU1646	39.9d-l	13.2f-l	10.7a-e
OSU1649	37.7e-l	15.4e-l	11.9a-e
OSU1651	45.5b-k	14e-l	11.2a-e
OSU1656	38.8e-l	15.3e-l	10.7a-e
OSU1657	42.3c-l	17.3c-l	14.7a-d
OSU1661	30.2j-l	12.5g-l	9.6b-e
OSU1662	50.9b-j	17.7c-l	12.4a-e
OSU1663	34h-l	11i-l	11a-e
OSU1664	50.6b-j	14.6e-l	10.2b-e
OSU1666	41.9c-l	12.1g-l	11.6a-e
OSU1670	46.1b-k	14.1e-l	12a-e
OSU1673	40.6c-l	11.9g-l	12.9a-e
OSU1675	28.9kl	12.7g-l	12.9a-e
OSU1680	33.6h-l	11.8g-l	10.3b-e
OSU1682	40.8c-l	14.6e-l	13.3a-e
OSU1687	34.4h-l	14e-l	11.5a-e
OSU1690	42.2c-l	16.2e-l	12.3a-e
OSU1699	42.6c-l	19.9c-j	12.6a-e
Tahoma31	50.6b-j	17.9c-l	11.8a-e
TifTuf	58.2a-f	14.2e-l	10.3b-e
Tifway	45b-k	15.3e-l	13.2a-e
Tilin#5	42.3c-l	10.3i-l	11.7a-e
U-3	60.5a-d	21.8a-g	14.1a-e

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 12. Mean fall percent green cover (PGC) of 96 trafficked bermudagrasses in 2019.

Entry	18-Oct	3-Nov	12-Nov
	---p-value---		
15-4X15	27.9a-f	13.1b-i	10.7a-e
15-8X3	28.2a-f	13.1b-i	10b-e
18-7-1	31a-f	8.7e-i	9.4b-e
18-7-2	40.2a-f	12.7c-i	9.9b-e
18-7-3	36.2a-f	13.6a-i	11.8a-e
18-7-4	32.4a-f	9.4d-i	9.1b-e
18-7-5	25.8a-f	8.8e-i	7.4e
18-7-6	39.4a-f	15.1a-i	11a-e
18-8-1	44.7a-c	19.7a-g	14.4a-d
18-8-2	39.6a-f	18.8a-h	14.1a-e
18-8-3	45.3ab	24.8ab	13.5a-e
18-8-4	34.7a-f	11.8c-i	10.1b-e
18-8-5	37.4a-f	11.6c-i	10.1b-e
18-8-6	40.3a-f	13.4b-i	8.9c-e
18-8-7	45.8ab	19a-h	13.6a-e
18-9-1	26.4a-f	9.7d-i	9.2b-e
18-9-10	44.6a-c	14.4a-i	10.9a-e
18-9-11	32.4a-f	7.6hi	9.4b-e
18-9-12	27.5a-f	9.9c-i	9.1b-e
18-9-2	33.4a-f	15a-i	12.4a-e
18-9-3	37a-f	20.6a-e	13.9a-e
18-9-4	21.1c-f	16.2a-i	12.1a-e
18-9-5	35.2a-f	9.7d-i	9c-e
18-9-6	29.1a-f	6.9i	9.9b-e
18-9-7	22.4b-f	11.6c-i	11.1a-e
18-9-8	42a-d	13b-i	10.7a-e
18-9-9	34.6a-f	16.1a-i	12.2a-e
17-4200-19x13	33a-f	12.3c-i	11.2a-e
17-4200-19x21	25.6a-f	10.2c-i	9.2b-e
17-4200-19x9	36.2a-f	15.8a-i	14.3a-d
17-4200-36x19	37.8a-f	20.3a-e	14.2a-d
Astro	30a-f	11c-i	9.4b-e
17-5200-11X9	30.5a-f	13.9a-i	9.9b-e
17-5200-13X9	27.8a-f	13.6a-i	11.3a-e
17-5200-31X3	29.2a-f	25.5a	17.3a
17-5200-3X23	38a-f	21.6a-c	15.5a-c
17-5200-4X11	40.7a-f	19.9a-f	14.5a-d
Bimini	44.7a-c	16a-i	11a-e
2008-4x16	26.7a-f	13b-i	8de
Celebration	36.6a-f	13.6a-i	9.7b-e
Latitude36	37.4a-f	14.2a-i	8.2de
NorthBridge	34.8a-f	10.7c-i	9.5b-e
OKC1221	38.1a-f	15.9a-i	10.3b-e
OSU1101	45.9ab	18.7a-i	11.7a-e
OSU1117	29.7a-f	14.1a-i	10.4b-e
OSU1127	33.4a-f	16.9a-i	11.2a-e
OSU1132	26.7a-f	10.5c-i	8.4de
OSU1156	32a-f	11.2c-i	9.1b-e
OSU1217	41.4a-e	18.2a-i	10.2b-e
OSU1257	33.9a-f	15.4a-i	9.7b-e
OSU1318	32.5a-f	16.4a-i	11.3a-e
OSU1337	31.1a-f	13.8a-i	10.5b-e
OSU1402	25.2b-f	13.2b-i	8.8c-e
OSU1403	29.6a-f	13.3b-i	10.5b-e
OSU1406	35.7a-f	12.9c-i	9.4b-e
OSU1408	17.6ef	11.3c-i	9.5b-e
OSU1409	35.2a-f	10.5c-i	9.4b-e

OSU1417	27.3a-f	11c-i	10.1b-e
OSU1418	29.5a-f	17a-i	14.6a-d
OSU1433	27.6a-f	11.6c-i	9.4b-e
OSU1439	27.8a-f	11c-i	9.9b-e
OSU1601	33.8a-f	13.4b-i	11.4a-e
OSU1609	28.7a-f	12.1c-i	10.1b-e
OSU1611	30.8a-f	15.8a-i	12a-e
OSU1617	26.1a-f	17.7a-i	12.3a-e
OSU1620	27.6a-f	11.8c-i	10.9a-e
OSU1625	34.2a-f	16.6a-i	11.2a-e
OSU1628	27.8a-f	12.3c-i	12.7a-e
OSU1629	18.7d-f	13b-i	15.7ab
OSU1631	35.3a-f	15.1a-i	14.4a-d
OSU1638	36.7a-f	17.1a-i	13.5a-e
OSU1639	28.1a-f	16.8a-i	10.9a-e
OSU1641	27.9a-f	12.7c-i	11a-e
OSU1646	27.8a-f	12.4c-i	10b-e
OSU1649	17.4f	13.9a-i	11.4a-e
OSU1651	33.3a-f	12.4c-i	9.4b-e
OSU1656	24.4b-f	16a-i	10.9a-e
OSU1657	23.8b-f	15.9a-i	12.8a-e
OSU1661	24.6b-f	10.7c-i	9.5b-e
OSU1662	30.4a-f	15.1a-i	10.9a-e
OSU1663	26.7a-f	7.9g-i	9.3b-e
OSU1664	39.2a-f	16.4a-i	10.7a-e
OSU1666	26.8a-f	13.4b-i	10.5b-e
OSU1670	30.1a-f	15.3a-i	11.6a-e
OSU1673	31.9a-f	12.8c-i	10.8a-e
OSU1675	28.6a-f	11.1c-i	9.9b-e
OSU1680	27.9a-f	13.6a-i	10.8a-e
OSU1682	35.5a-f	12.4c-i	9.6b-e
OSU1687	24.2b-f	12.6c-i	10.3b-e
OSU1690	21.1c-f	16.3a-i	12.3a-e
OSU1699	24.9b-f	15a-i	13.6a-e
Tahoma31	35.5a-f	16.6a-i	12.1a-e
TifTuf	49a	14.2a-i	11a-e
Tifway	29a-f	19.3a-h	11.7a-e
Tilin#5	40.2a-f	8f-i	8.4de
U-3	44.7a-c	21.3a-d	11.9a-e

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 14. Simple effects of traffic on fall percent green cover PGC in 2019.

Entry	18-Oct	3-Nov	12-Nov
	--	*p-value*	--
15-4X15	0.0031	0.1304	0.1573
15-8X3	<.0001	0.4757	0.3031
18-7-1	0.0071	0.8793	0.492
18-7-2	0.1579	0.4127	0.3132
18-7-3	0.0011	0.1877	0.2739
18-7-4	0.4581	0.9879	0.4396
18-7-5	0.3575	0.7963	0.0135
18-7-6	0.0002	0.6058	0.1452
18-8-1	<.0001	<.0001	0.0869
18-8-2	0.0217	0.1124	0.0028
18-8-3	<.0001	<.0001	0.0758
18-8-4	0.0053	0.3549	0.6213
18-8-5	0.1278	0.9395	0.9144
18-8-6	0.4462	0.0797	0.3236
18-8-7	0.0018	0.2033	0.8132
18-9-1	0.0025	0.4214	0.3132
18-9-10	0.5508	0.0362	0.731
18-9-11	0.0316	0.3873	0.2468
18-9-12	0.0365	0.808	0.3673
18-9-2	0.0001	0.0677	0.0831
18-9-3	0.0037	0.0083	0.5765
18-9-4	<.0001	0.8673	0.1083
18-9-5	0.176	0.2373	0.6062
18-9-6	0.5867	0.2314	0.9829
18-9-7	<.0001	0.379	0.6062
18-9-8	0.0343	0.4852	0.2739
18-9-9	0.003	0.1158	0.9486
17-4200-19x13	0.0269	0.9637	0.8132
17-4200-19x21	0.0043	0.1505	0.2931
17-4200-19x9	0.7502	0.1463	0.4523
17-4200-36x19	0.0726	0.0008	0.6519
Astro	0.0099	0.7846	0.7965
17-5200-11X9	0.2047	0.7614	0.1131
17-5200-13X9	0.006	0.4302	0.8974
17-5200-31X3	<.0001	0.3629	0.562
17-5200-3X23	0.0017	0.9033	0.0909
17-5200-4X11	0.1396	0.07	0.699
Bimini	0.242	0.2087	0.562
2008-4x16	0.0087	0.8554	0.0127
Celebration	0.024	0.3873	0.4786
Latitude36	0.0217	0.1304	0.019
NorthBridge	0.026	0.8673	0.4523
OKC1221	0.0177	0.6818	0.8974
OSU1101	0.0021	0.4852	0.6831
OSU1117	0.2001	0.6597	0.6674
OSU1127	0.0041	0.07	0.8299
OSU1132	0.0265	0.3629	0.0424
OSU1156	0.0705	0.3873	0.1231
OSU1217	0.9471	0.007	0.2739
OSU1257	0.0377	0.9758	0.6519
OSU1318	0.0087	0.2087	0.492
OSU1337	0.0453	0.5641	0.562
OSU1402	0.1123	0.4852	0.1131
OSU1403	0.0087	0.1731	0.8467
OSU1406	0.0337	0.8316	0.2556
OSU1408	0.2638	0.317	0.1338
OSU1409	0.1485	0.4757	0.4025

OSU1417	0.0007	0.2686	0.4025
OSU1418	0.0013	0.7498	0.1702
OSU1433	0.0033	0.4481	0.4653
OSU1439	0.0048	0.6708	0.9829
OSU1601	0.3575	0.7614	0.8635
OSU1609	0.0009	0.1025	0.2137
OSU1611	<.0001	0.8673	0.9144
OSU1617	<.0001	0.0056	0.4523
OSU1620	0.0068	0.9033	0.699
OSU1625	0.0726	0.1422	0.8804
OSU1628	0.0027	0.4302	0.0518
OSU1629	<.0001	<.0001	0.2382
OSU1631	0.0217	0.6597	0.3788
OSU1638	0.0102	0.8554	0.1839
OSU1639	<.0001	0.0037	0.427
OSU1641	0.0064	0.9274	0.5056
OSU1646	0.0177	0.7155	0.6213
OSU1649	0.0001	0.5043	0.7472
OSU1651	0.0171	0.4664	0.2647
OSU1656	0.0049	0.7729	0.9144
OSU1657	0.0004	0.5438	0.2216
OSU1661	0.261	0.4127	0.9315
OSU1662	<.0001	0.2495	0.3342
OSU1663	0.1485	0.1549	0.2647
OSU1664	0.0248	0.4127	0.7149
OSU1666	0.0033	0.5338	0.4523
OSU1670	0.002	0.5847	0.7965
OSU1673	0.0858	0.693	0.1769
OSU1675	0.9524	0.4757	0.0571
OSU1680	0.261	0.4041	0.7472
OSU1682	0.2899	0.3244	0.017
OSU1687	0.046	0.5239	0.427
OSU1690	<.0001	0.9637	0.9829
OSU1699	0.0007	0.0269	0.5056
Tahoma31	0.0034	0.5539	0.8635
TifTuf	0.0716	1	0.6365
Tifway	0.002	0.0747	0.3342
Tilin#5	0.6858	0.2887	0.0364
U-3	0.0022	0.808	0.1512

Table 13. Mean visual fall color (VFC) of 96 non-trafficked bermudagrasses in fall-2019.

Entry	**18-Oct**	**3-Nov**	**12-Nov**
	---*(1-9) scale*---		
15-4X15	8a-c	3.7ab	1c
15-8X3	8a-c	4.3ab	1c
18-7-1	8a-c	3.7ab	1c
18-7-2	7.7a-c	4.7ab	1c
18-7-3	9a	4.3ab	1c
18-7-4	7.3a-c	3.3ab	1c
18-7-5	8a-c	3.3ab	1c
18-7-6	8.3a-c	4ab	1c
18-8-1	9a	5.3a	1.3bc
18-8-2	8.7ab	4.7ab	1.3bc
18-8-3	8.7ab	4.3ab	1.3bc
18-8-4	8a-c	4ab	1c
18-8-5	8a-c	4ab	1c
18-8-6	8a-c	4ab	1c
18-8-7	8.7ab	4.7ab	1.3bc
18-9-1	7bc	4ab	1c
18-9-10	7.7a-c	4.3ab	1c
18-9-11	8.3a-c	4.7ab	1c
18-9-12	8.3a-c	3.7ab	1c
18-9-2	8.7ab	4.3ab	1c
18-9-3	8.3a-c	4.7ab	1.3bc
18-9-4	8.7ab	4.7ab	1c
18-9-5	7.7a-c	4ab	1c
18-9-6	7bc	3.3ab	1c
18-9-7	8a-c	4.3ab	1c
18-9-8	8a-c	3.7ab	1c
18-9-9	8a-c	4.3ab	1c
17-4200-19x13	8a-c	4ab	1c
17-4200-19x21	8a-c	4ab	1c
17-4200-19x9	7.7a-c	4.3ab	1c
17-4200-36x19	8.3a-c	4.3ab	1c
Astro	8a-c	3.3ab	1c
17-5200-11X9	8a-c	4.7ab	1c
17-5200-13X9	7.3a-c	4ab	1c
17-5200-31X3	9a	5.7a	1.7b
17-5200-3X23	8.7ab	4.7ab	1c
17-5200-4X11	8.7ab	4ab	1c
Bimini	8.3a-c	4ab	1c
2008-4x16	8.3a-c	4.7ab	1c
Celebration	8.3a-c	5a	1c
Latitude36	8.3a-c	4ab	1c
NorthBridge	7.7a-c	4.3ab	1c
OKC1221	8.3a-c	4.3ab	1c
OSU1101	8.7ab	4ab	1c
OSU1117	7.7a-c	4.3ab	1c
OSU1127	8.7ab	4.3ab	1c
OSU1132	7.3a-c	4.3ab	1c
OSU1156	8a-c	4ab	1c
OSU1217	8a-c	3.7ab	1c
OSU1257	7.7a-c	4ab	1c
OSU1318	8a-c	4.3ab	1c
OSU1337	8a-c	4ab	1c
OSU1402	7.7a-c	3.7ab	1c
OSU1403	8a-c	4.3ab	1c
OSU1406	7.7a-c	5a	1c
OSU1408	3d	2b	1c
OSU1409	8a-c	3.7ab	1c

OSU1417	8a-c	4ab	1c
OSU1418	8a-c	4ab	1c
OSU1433	8a-c	3.7ab	1c
OSU1439	8a-c	4ab	1c
OSU1601	8a-c	4ab	1c
OSU1609	8a-c	4ab	1c
OSU1611	8a-c	4.3ab	1c
OSU1617	8.7ab	5.3a	1c
OSU1620	8.3a-c	3.3ab	1c
OSU1625	8.7ab	4ab	1c
OSU1628	7.7a-c	4.3ab	1c
OSU1629	9a	5.7a	2.7a
OSU1631	8.3a-c	5a	1c
OSU1638	8a-c	3.7ab	1c
OSU1639	8.7ab	4.3ab	1c
OSU1641	7.7a-c	3.7ab	1c
OSU1646	7.7a-c	4ab	1c
OSU1649	8.3a-c	4ab	1c
OSU1651	8a-c	4.3ab	1c
OSU1656	8.3a-c	5.3a	1c
OSU1657	8.3a-c	3.7ab	1c
OSU1661	7.3a-c	4ab	1c
OSU1662	8.3a-c	4ab	1c
OSU1663	8a-c	3.7ab	1c
OSU1664	8.3a-c	4ab	1c
OSU1666	8a-c	4ab	1c
OSU1670	8.3a-c	4.3ab	1c
OSU1673	7.7a-c	3.7ab	1c
OSU1675	7bc	2b	1c
OSU1680	7.7a-c	3.7ab	1c
OSU1682	8a-c	4.7ab	1c
OSU1687	6.7c	2b	1c
OSU1690	8.7ab	4.7ab	1c
OSU1699	8.3a-c	3.7ab	1c
Tahoma31	8.3a-c	3.3b	1c
TifTuf	9a	5a	1c
Tifway	8.7ab	4.7ab	1c
Tilin#5	8a-c	3.7ab	1c
U-3	9a	5a	1c

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 14. Mean visual fall color (VFC) of 96 trafficked bermudagrasses in fall-2019.

Entry	18-Oct	3-Nov	12-Nov
		(1-9) scale	
15-4X15	6.3a-d	2.3ab	1c
15-8X3	6.3a-d	3.7ab	1c
18-7-1	7a-d	2.7ab	1c
18-7-2	7.3a-d	3.7ab	1c
18-7-3	8.3a	3.3ab	1c
18-7-4	6.3a-d	2.7ab	1c
18-7-5	6.7a-d	2.3ab	1c
18-7-6	7a-d	4ab	1c
18-8-1	6.3a-d	3.7ab	2a-c
18-8-2	7.7a-c	3.7ab	2a-c
18-8-3	7.7a-c	4.3ab	2.3ab
18-8-4	7a-d	3ab	1c
18-8-5	7a-d	3ab	1c
18-8-6	7.3a-d	3.3ab	1c
18-8-7	7.7a-c	4.3ab	1.7a-c
18-9-1	6.3a-d	3ab	1c
18-9-10	7.3a-d	4ab	1c
18-9-11	7.3a-d	3.3ab	1c
18-9-12	6.3a-d	2.3ab	1c
18-9-2	7.3a-d	4ab	1.7a-c
18-9-3	7a-d	3.3ab	2.3ab
18-9-4	6b-d	4ab	1.3bc
18-9-5	6.7a-d	3.3ab	1c
18-9-6	6.3a-d	2.7ab	1c
18-9-7	6b-d	3.3ab	1c
18-9-8	7a-d	3.3ab	1c
18-9-9	7a-d	3ab	1c
17-4200-19x13	6.7a-d	3ab	1c
17-4200-19x21	6.7a-d	2.7ab	1c
17-4200-19x9	7.3a-d	4ab	1.3bc
17-4200-36x19	7a-d	4ab	1.7a-c
Astro	7a-d	2.3ab	1c
17-5200-11X9	6.7a-d	3.7ab	1.3bc
17-5200-13X9	6.7a-d	3ab	1.3bc
17-5200-31X3	8ab	4.7a	2.7a
17-5200-3X23	7.3a-d	4.7a	2a-c
17-5200-4X11	7.3a-d	3.3ab	1.7a-c
Bimini	7.3a-d	3ab	1c
2008-4x16	6.7a-d	3.7ab	1c
Celebration	7a-d	4ab	1c
Latitude36	7a-d	3.7ab	1c
NorthBridge	7a-d	3.3ab	1c
OKC1221	7a-d	3.3ab	1c
OSU1101	7a-d	3.7ab	1c
OSU1117	7a-d	3.7ab	1c
OSU1127	7.7a-c	3.7ab	1.3bc
OSU1132	6b-d	3ab	1c
OSU1156	7.3a-d	3.7ab	1c
OSU1217	7.7a-c	4ab	1c
OSU1257	7a-d	4ab	1c
OSU1318	7.3a-d	3.7ab	1c
OSU1337	7a-d	2.7ab	1c
OSU1402	6.3a-d	2.7ab	1c
OSU1403	7a-d	3.7ab	1.3bc
OSU1406	6.7a-d	3.7ab	1c
OSU1408	2e	1.7b	1c
OSU1409	6.7a-d	3ab	1c

OSU1417	7a-d	2.7ab	1c
OSU1418	6.7a-d	3ab	1.3bc
OSU1433	6.7a-d	3ab	1c
OSU1439	6.7a-d	2.7ab	1c
OSU1601	7.3a-d	3.3ab	1c
OSU1609	6.3a-d	2.7ab	1c
OSU1611	6.3a-d	3.3ab	1c
OSU1617	6.7a-d	3.3ab	1.3bc
OSU1620	6.7a-d	2.3ab	1c
OSU1625	7.3a-d	3ab	1c
OSU1628	6.3a-d	3.3ab	1.3bc
OSU1629	6.3a-d	2.7ab	2a-c
OSU1631	6.7a-d	3.7ab	1c
OSU1638	7a-d	3.7ab	1.3bc
OSU1639	5.7cd	3ab	1c
OSU1641	6.3a-d	2.3ab	1c
OSU1646	5.7cd	3.3ab	1c
OSU1649	6b-d	2.3ab	1c
OSU1651	7a-d	3.7ab	1c
OSU1656	7a-d	3.7ab	1c
OSU1657	6.7a-d	2.7ab	1c
OSU1661	6.3a-d	3ab	1c
OSU1662	6.7a-d	3.3ab	1c
OSU1663	6.3a-d	3ab	1c
OSU1664	7.3a-d	4ab	1c
OSU1666	6.7a-d	3ab	1c
OSU1670	7a-d	3.7ab	1c
OSU1673	5.7cd	3ab	1c
OSU1675	6b-d	1.7b	1c
OSU1680	7a-d	3.3ab	1c
OSU1682	7a-d	3.3ab	1c
OSU1687	5.3d	2ab	1c
OSU1690	7a-d	3.3ab	1c
OSU1699	7.3a-d	3ab	1c
Tahoma31	7.3a-d	3.3ab	1c
TifTuf	8ab	4ab	1.3bc
Tifway	7a-d	4ab	1.3bc
Tilin#5	7.7a-c	3ab	1c
U-3	7.7a-c	4ab	1c

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 15. Simple effects of traffic on visual fall color (VFC) of 96 bermudagrasses in fall-2019.

Entry	18-Oct	3-Nov	12-Nov
	p-value		
15-4X15	<.0001	0.0004	1
15-8X3	<.0001	0.0752	1
18-7-1	0.0154	0.0079	1
18-7-2	0.4158	0.0079	1
18-7-3	0.1046	0.0079	1
18-7-4	0.0154	0.0752	1
18-7-5	0.0013	0.0079	1
18-7-6	0.0013	1	1
18-8-1	<.0001	<.0001	<.0001
18-8-2	0.0154	0.0079	<.0001
18-8-3	0.0154	1	<.0001
18-8-4	0.0154	0.0079	1
18-8-5	0.0154	0.0079	1
18-8-6	0.1046	0.0752	1
18-8-7	0.0154	0.3722	0.038
18-9-1	0.1046	0.0079	1
18-9-10	0.4158	0.3722	1
18-9-11	0.0154	0.0004	1
18-9-12	<.0001	0.0004	1
18-9-2	0.0013	0.3722	<.0001
18-9-3	0.0013	0.0004	<.0001
18-9-4	<.0001	0.0752	0.038
18-9-5	0.0154	0.0752	1
18-9-6	0.1046	0.0752	1
18-9-7	<.0001	0.0079	1
18-9-8	0.0154	0.3722	1
18-9-9	0.0154	0.0004	1
17-4200-19x13	0.0013	0.0079	1
17-4200-19x21	0.0013	0.0004	1
17-4200-19x9	0.4158	0.3722	0.038
17-4200-36x19	0.0013	0.3722	<.0001
Astro	0.0154	0.0079	1
17-5200-11X9	0.0013	0.0079	0.038
17-5200-13X9	0.1046	0.0079	0.038
17-5200-31X3	0.0154	0.0079	<.0001
17-5200-3X23	0.0013	1	<.0001
17-5200-4X11	0.0013	0.0752	<.0001
Bimini	0.0154	0.0079	1
2008-4x16	<.0001	0.0079	1
Celebration	0.0013	0.0079	1
Latitude36	0.0013	0.3722	1
NorthBridge	0.1046	0.0079	1
OKC1221	0.0013	0.0079	1
OSU1101	<.0001	0.3722	1
OSU1117	0.1046	0.0752	1
OSU1127	0.0154	0.0752	0.038
OSU1132	0.0013	0.0004	1
OSU1156	0.1046	0.3722	1
OSU1217	0.4158	0.3722	1
OSU1257	0.1046	1	1
OSU1318	0.1046	0.0752	1
OSU1337	0.0154	0.0004	1
OSU1402	0.0013	0.0079	1
OSU1403	0.0154	0.0752	0.038
OSU1406	0.0154	0.0004	1
OSU1408	0.0154	0.3722	1
OSU1409	0.0013	0.0752	1

OSU1417	0.0154	0.0004	1
OSU1418	0.0013	0.0079	0.038
OSU1433	0.0013	0.0752	1
OSU1439	0.0013	0.0004	1
OSU1601	0.1046	0.0752	1
OSU1609	<.0001	0.0004	1
OSU1611	<.0001	0.0079	1
OSU1617	<.0001	<.0001	0.038
OSU1620	<.0001	0.0079	1
OSU1625	0.0013	0.0079	1
OSU1628	0.0013	0.0079	0.038
OSU1629	<.0001	<.0001	<.0001
OSU1631	<.0001	0.0004	1
OSU1638	0.0154	1	0.038
OSU1639	<.0001	0.0004	1
OSU1641	0.0013	0.0004	1
OSU1646	<.0001	0.0752	1
OSU1649	<.0001	<.0001	1
OSU1651	0.0154	0.0752	1
OSU1656	0.0013	<.0001	1
OSU1657	<.0001	0.0079	1
OSU1661	0.0154	0.0079	1
OSU1662	<.0001	0.0752	1
OSU1663	<.0001	0.0752	1
OSU1664	0.0154	1	1
OSU1666	0.0013	0.0079	1
OSU1670	0.0013	0.0752	1
OSU1673	<.0001	0.0752	1
OSU1675	0.0154	0.3722	1
OSU1680	0.1046	0.3722	1
OSU1682	0.0154	0.0004	1
OSU1687	0.0013	1	1
OSU1690	<.0001	0.0004	1
OSU1699	0.0154	0.0752	1
Tahoma31	0.0154	0.0752	1
TifTuf	0.0154	0.0079	0.038
Tifway	<.0001	0.0752	0.038
Tilin#5	0.4158	0.0752	1
U-3	0.0013	0.0079	1

Table 16. Mean fall NDVI of 96 non-trafficked bermudagrasses in 2019.

Entry	18-Oct	3-Nov	12-Nov
15-4X15	0.601a-h	0.356c-j	0.237c-g
15-8X3	0.589b-h	0.328e-j	0.222d-g
18-7-1	0.552b-h	0.272j	0.191fg
18-7-2	0.596a-h	0.312f-j	0.197fg
18-7-3	0.627a-h	0.314f-j	0.203e-g
18-7-4	0.544b-h	0.274ij	0.186g
18-7-5	0.522d-h	0.283g-j	0.19fg
18-7-6	0.654a-g	0.323e-j	0.203e-g
18-8-1	0.755a	0.518a	0.324ab
18-8-2	0.641a-h	0.348d-j	0.243b-g
18-8-3	0.673a-f	0.352c-j	0.205d-g
18-8-4	0.598a-h	0.301g-j	0.184g
18-8-5	0.57b-h	0.298g-j	0.191fg
18-8-6	0.541c-h	0.29g-j	0.203e-g
18-8-7	0.668a-f	0.387c-g	0.224d-g
18-9-1	0.548b-h	0.276h-j	0.209d-g
18-9-10	0.58b-h	0.292g-j	0.207d-g
18-9-11	0.563b-h	0.275ij	0.184g
18-9-12	0.514f-h	0.282g-j	0.203e-g
18-9-2	0.651a-g	0.327e-j	0.204d-g
18-9-3	0.612a-h	0.377c-j	0.254b-g
18-9-4	0.634a-h	0.358c-j	0.252b-g
18-9-5	0.559b-h	0.3g-j	0.207d-g
18-9-6	0.525d-h	0.267j	0.199fg
18-9-7	0.581b-h	0.32e-j	0.24c-g
18-9-8	0.619a-h	0.303g-j	0.207d-g
18-9-9	0.642a-h	0.39b-g	0.288a-d
17-4200-19x13	0.595a-h	0.292g-j	0.221d-g
17-4200-19x21	0.55b-h	0.311f-j	0.223d-g
17-4200-19x9	0.536d-h	0.302g-j	0.201e-g
17-4200-36x19	0.625a-h	0.32e-j	0.214d-g
Astro	0.582b-h	0.293g-j	0.203e-g
17-5200-11X9	0.576b-h	0.292g-j	0.205d-g
17-5200-13X9	0.594a-h	0.325e-j	0.257b-g
17-5200-31X3	0.705a-c	0.464a-c	0.32a-c
17-5200-3X23	0.683a-e	0.386c-i	0.24c-g
17-5200-4X11	0.599a-h	0.327e-j	0.205d-g
Bimini	0.613a-h	0.327e-j	0.213d-g
2008-4x16	0.599a-h	0.361c-j	0.233d-g
Celebration	0.619a-h	0.341e-j	0.213d-g
Latitude36	0.639a-h	0.347e-j	0.209d-g
NorthBridge	0.608a-h	0.317e-j	0.207d-g
OKC1221	0.643a-g	0.356c-j	0.223d-g
OSU1101	0.666a-f	0.367c-j	0.218d-g
OSU1117	0.576b-h	0.334e-j	0.237c-g
OSU1127	0.635a-h	0.339e-j	0.234d-g
OSU1132	0.597a-h	0.326e-j	0.206d-g
OSU1156	0.599a-h	0.317e-j	0.219d-g
OSU1217	0.586b-h	0.334e-j	0.216d-g
OSU1257	0.641a-h	0.347e-j	0.231d-g
OSU1318	0.631a-h	0.338e-j	0.228d-g
OSU1337	0.61a-h	0.32e-j	0.195fg
OSU1402	0.562b-h	0.329e-j	0.224d-g
OSU1403	0.633a-h	0.341e-j	0.215d-g
OSU1406	0.625a-h	0.34e-j	0.229d-g
OSU1408	0.492gh	0.324e-j	0.249b-g
OSU1409	0.573b-h	0.307g-j	0.217d-g
OSU1417	0.612a-h	0.321e-j	0.218d-g

OSU1418	0.639a-h	0.372c-j	0.239c-g
OSU1433	0.581b-h	0.32e-j	0.224d-g
OSU1439	0.597a-h	0.323e-j	0.199fg
OSU1601	0.578b-h	0.317e-j	0.22d-g
OSU1609	0.618a-h	0.347e-j	0.235d-g
OSU1611	0.592a-h	0.358c-j	0.247b-g
OSU1617	0.686a-d	0.427a-e	0.284a-e
OSU1620	0.589b-h	0.296g-j	0.212d-g
OSU1625	0.608a-h	0.348d-j	0.225d-g
OSU1628	0.602a-h	0.329e-j	0.234d-g
OSU1629	0.671a-f	0.5ab	0.353a
OSU1631	0.624a-h	0.335e-j	0.227d-g
OSU1638	0.615a-h	0.347e-j	0.222d-g
OSU1639	0.708ab	0.46a-d	0.283a-e
OSU1641	0.552b-h	0.305g-j	0.204d-g
OSU1646	0.552b-h	0.286g-j	0.202e-g
OSU1649	0.569b-h	0.325e-j	0.25b-g
OSU1651	0.592a-h	0.304g-j	0.217d-g
OSU1656	0.601a-h	0.35d-j	0.234d-g
OSU1657	0.636a-h	0.353c-j	0.246b-g
OSU1661	0.527d-h	0.298g-j	0.227d-g
OSU1662	0.644a-g	0.348e-j	0.256b-g
OSU1663	0.53d-h	0.277h-j	0.202e-g
OSU1664	0.632a-h	0.328e-j	0.205d-g
OSU1666	0.584b-h	0.317e-j	0.233d-g
OSU1670	0.618a-h	0.345e-j	0.239c-g
OSU1673	0.521e-h	0.319e-j	0.227d-g
OSU1675	0.478h	0.282g-j	0.22d-g
OSU1680	0.574b-h	0.298g-j	0.223d-g
OSU1682	0.541c-h	0.299g-j	0.213d-g
OSU1687	0.597a-h	0.326e-j	0.22d-g
OSU1690	0.671a-f	0.391b-g	0.258b-g
OSU1699	0.594a-h	0.341e-j	0.238c-g
Tahoma31	0.662a-f	0.372c-j	0.224d-g
TifTuf	0.647a-g	0.326e-j	0.209d-g
Tifway	0.607a-h	0.345e-j	0.235d-g
Tilin#5	0.55b-h	0.274ij	0.191fg
U-3	0.66a-f	0.42a-f	0.272a-f

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 17. Mean fall NDVI of 96 trafficked bermudagrasses in 2019.

Entry	18-Oct	3-Nov	12-Nov
15-4X15	0.529ab	0.32b-h	0.243b-d
15-8X3	0.487ab	0.3d-h	0.234b-d
18-7-1	0.491ab	0.27gh	0.207b-d
18-7-2	0.586ab	0.32b-h	0.206b-d
18-7-3	0.601ab	0.34b-h	0.231b-d
18-7-4	0.512ab	0.27gh	0.182cd
18-7-5	0.522ab	0.27e-h	0.198cd
18-7-6	0.614ab	0.34b-h	0.23b-d
18-8-1	0.582ab	0.38a-f	0.243b-d
18-8-2	0.563ab	0.34b-h	0.246b-d
18-8-3	0.629a	0.4a-c	0.288a-c
18-8-4	0.528ab	0.3c-h	0.19cd
18-8-5	0.522ab	0.29d-h	0.195cd
18-8-6	0.557ab	0.29d-h	0.19cd
18-8-7	0.581ab	0.34b-h	0.228b-d
18-9-1	0.465ab	0.29d-h	0.239b-d
18-9-10	0.613ab	0.34b-h	0.223b-d
18-9-11	0.535ab	0.27f-h	0.184cd
18-9-12	0.483ab	0.27gh	0.217b-d
18-9-2	0.581ab	0.37a-g	0.265b-d
18-9-3	0.6ab	0.36a-h	0.258b-d
18-9-4	0.455ab	0.34b-h	0.263b-d
18-9-5	0.528ab	0.29d-h	0.197cd
18-9-6	0.506ab	0.26h	0.191cd
18-9-7	0.47ab	0.28d-h	0.216b-d
18-9-8	0.584ab	0.29d-h	0.196cd
18-9-9	0.587ab	0.34b-h	0.237b-d
17-4200-19x13	0.566ab	0.33b-h	0.227b-d
17-4200-19x21	0.464ab	0.29d-h	0.209b-d
17-4200-19x9	0.584ab	0.33b-h	0.226b-d
17-4200-36x19	0.619ab	0.36a-h	0.273bc
Astro	0.51ab	0.27d-h	0.188cd
17-5200-11X9	0.516ab	0.28d-h	0.218b-d
17-5200-13X9	0.525ab	0.28d-h	0.231b-d
17-5200-31X3	0.582ab	0.46a	0.369a
17-5200-3X23	0.635a	0.42ab	0.277a-c
17-5200-4X11	0.587ab	0.36a-h	0.267b-d
Bimini	0.615ab	0.34b-h	0.232b-d
2008-4x16	0.535ab	0.33b-h	0.216b-d
Celebration	0.554ab	0.31b-h	0.205b-d
Latitude36	0.593ab	0.34b-h	0.212b-d
NorthBridge	0.565ab	0.3c-h	0.205b-d
OKC1221	0.576ab	0.33b-h	0.215b-d
OSU1101	0.606ab	0.36a-h	0.23b-d
OSU1117	0.561ab	0.33b-h	0.228b-d
OSU1127	0.587ab	0.35b-h	0.222b-d
OSU1132	0.527ab	0.3c-h	0.197cd
OSU1156	0.523ab	0.3c-h	0.207b-d
OSU1217	0.577ab	0.37a-g	0.236b-d
OSU1257	0.591ab	0.34b-h	0.206b-d
OSU1318	0.618ab	0.38a-d	0.249b-d
OSU1337	0.585ab	0.35a-h	0.244b-d
OSU1402	0.539ab	0.29d-h	0.213b-d
OSU1403	0.564ab	0.34b-h	0.228b-d
OSU1406	0.548ab	0.33b-h	0.206b-d
OSU1408	0.469ab	0.33b-h	0.228b-d
OSU1409	0.558ab	0.32b-h	0.217b-d
OSU1417	0.532ab	0.3c-h	0.209b-d

OSU1418	0.581ab	0.37a-g	0.241b-d
OSU1433	0.498ab	0.29d-h	0.216b-d
OSU1439	0.526ab	0.31b-h	0.202b-d
OSU1601	0.554ab	0.32b-h	0.221b-d
OSU1609	0.502ab	0.3c-h	0.213b-d
OSU1611	0.518ab	0.32b-h	0.242b-d
OSU1617	0.604ab	0.35a-h	0.278a-c
OSU1620	0.503ab	0.3c-h	0.225b-d
OSU1625	0.561ab	0.34b-h	0.233b-d
OSU1628	0.53ab	0.3c-h	0.233b-d
OSU1629	0.402b	0.32b-h	0.285a-c
OSU1631	0.604ab	0.35a-h	0.241b-d
OSU1638	0.562ab	0.35a-h	0.247b-d
OSU1639	0.524ab	0.33b-h	0.254b-d
OSU1641	0.535ab	0.31c-h	0.221b-d
OSU1646	0.491ab	0.28d-h	0.206b-d
OSU1649	0.447ab	0.29d-h	0.239b-d
OSU1651	0.534ab	0.29d-h	0.195cd
OSU1656	0.517ab	0.33b-h	0.24b-d
OSU1657	0.554ab	0.33b-h	0.245b-d
OSU1661	0.465ab	0.28d-h	0.211b-d
OSU1662	0.559ab	0.33b-h	0.23b-d
OSU1663	0.481ab	0.27d-h	0.217b-d
OSU1664	0.611ab	0.37a-g	0.222b-d
OSU1666	0.514ab	0.3c-h	0.228b-d
OSU1670	0.567ab	0.33b-h	0.244b-d
OSU1673	0.518ab	0.29d-h	0.21b-d
OSU1675	0.488ab	0.29d-h	0.224b-d
OSU1680	0.535ab	0.3c-h	0.215b-d
OSU1682	0.545ab	0.31b-h	0.213b-d
OSU1687	0.554ab	0.32b-h	0.224b-d
OSU1690	0.585ab	0.37a-g	0.271bc
OSU1699	0.54ab	0.36a-h	0.294ab
Tahoma31	0.597ab	0.33b-h	0.231b-d
TifTuf	0.597ab	0.33b-h	0.211b-d
Tifway	0.533ab	0.35a-h	0.256b-d
Tilin#5	0.556ab	0.27d-h	0.172d
U-3	0.606ab	0.38a-e	0.26b-d

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 18. Simple effects of traffic on fall NDVI of bermudagrasses in fall-2019.

Entry	18-Oct	3-Nov	12-Nov
	---*p-value*---		
15-4X15	0.0707	0.0782	0.716
15-8X3	0.0107	0.1419	0.5187
18-7-1	0.1267	0.8031	0.3769
18-7-2	0.7994	0.7433	0.6316
18-7-3	0.4979	0.2454	0.1156
18-7-4	0.414	0.7645	0.8534
18-7-5	0.9952	0.5732	0.6719
18-7-6	0.314	0.3602	0.1391
18-8-1	<.0001	<.0001	<.0001
18-8-2	0.0498	0.7433	0.8476
18-8-3	0.2654	0.0238	<.0001
18-8-4	0.0763	0.9177	0.7188
18-8-5	0.2154	0.6088	0.7853
18-8-6	0.6912	0.8283	0.4705
18-8-7	0.0275	0.0453	0.8564
18-9-1	0.0382	0.4828	0.0921
18-9-10	0.3987	0.0233	0.3779
18-9-11	0.4777	0.8065	0.9866
18-9-12	0.4277	0.5582	0.4303
18-9-2	0.0763	0.0376	0.0008
18-9-3	0.7582	0.4566	0.8214
18-9-4	<.0001	0.3617	0.5321
18-9-5	0.4248	0.6129	0.5432
18-9-6	0.6344	0.7134	0.6638
18-9-7	0.0062	0.0964	0.1831
18-9-8	0.3737	0.5622	0.5556
18-9-9	0.1658	0.0314	0.0054
17-4200-19x13	0.4595	0.0991	0.761
17-4200-19x21	0.0302	0.3782	0.4281
17-4200-19x9	0.2226	0.2917	0.1644
17-4200-36x19	0.8867	0.1129	0.001
Astro	0.0698	0.3726	0.411
17-5200-11X9	0.1259	0.6538	0.4902
17-5200-13X9	0.0832	0.0667	0.1406
17-5200-31X3	0.0025	0.7668	0.0067
17-5200-3X23	0.2278	0.1624	0.0408
17-5200-4X11	0.7745	0.2005	0.0007
Bimini	0.9612	0.4575	0.3002
2008-4x16	0.1029	0.2208	0.3601
Celebration	0.1015	0.1964	0.6409
Latitude36	0.2461	0.685	0.8403
NorthBridge	0.2734	0.4176	0.9168
OKC1221	0.0916	0.2502	0.6733
OSU1101	0.1277	0.8745	0.4996
OSU1117	0.7044	0.6882	0.5924
OSU1127	0.222	0.7792	0.5055
OSU1132	0.0766	0.3186	0.5873
OSU1156	0.0543	0.3846	0.4867
OSU1217	0.8192	0.0939	0.2489
OSU1257	0.2036	0.7837	0.1655
OSU1318	0.7408	0.0637	0.2436
OSU1337	0.512	0.1673	0.0072
OSU1402	0.5652	0.0891	0.5187
OSU1403	0.0816	0.892	0.4413
OSU1406	0.0519	0.7002	0.2008
OSU1408	0.5481	0.8955	0.2232
OSU1409	0.6937	0.5174	0.9955

OSU1417	0.0445	0.4142	0.6067
OSU1418	0.1461	0.9212	0.9153
OSU1433	0.0359	0.1204	0.6719
OSU1439	0.0737	0.6796	0.8872
OSU1601	0.5363	0.9072	0.9539
OSU1609	0.004	0.0559	0.2239
OSU1611	0.06	0.0964	0.7582
OSU1617	0.0379	0.0008	0.7356
OSU1620	0.0302	0.9014	0.4347
OSU1625	0.232	0.8317	0.6788
OSU1628	0.0685	0.1939	0.9851
OSU1629	<.0001	<.0001	0.0002
OSU1631	0.6121	0.5299	0.411
OSU1638	0.1762	0.7601	0.1695
OSU1639	<.0001	<.0001	0.1069
OSU1641	0.6706	0.9765	0.3523
OSU1646	0.123	0.9294	0.8403
OSU1649	0.0024	0.1376	0.5382
OSU1651	0.14	0.5712	0.2156
OSU1656	0.0354	0.47	0.7356
OSU1657	0.0399	0.3123	0.9183
OSU1661	0.1138	0.4593	0.363
OSU1662	0.0321	0.4737	0.1567
OSU1663	0.2051	0.9002	0.4303
OSU1664	0.5826	0.0768	0.3306
OSU1666	0.0757	0.4655	0.7867
OSU1670	0.1974	0.5853	0.7767
OSU1673	0.9334	0.1392	0.366
OSU1675	0.7941	0.5802	0.8214
OSU1680	0.3251	0.8722	0.6638
OSU1682	0.9131	0.5299	0.9792
OSU1687	0.2679	0.7244	0.8026
OSU1690	0.0304	0.3273	0.4728
OSU1699	0.1668	0.5366	0.0017
Tahoma31	0.1012	0.0689	0.7049
TifTuf	0.1991	0.9729	0.9079
Tifway	0.0622	0.7533	0.2399
Tilin#5	0.8666	0.9119	0.301
U-3	0.1714	0.068	0.4902

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 19. Mean spring percent green cover (PGC) of 96 non-trafficked bermudagrasses in 2020.

Entry	28-Mar	11-Apr	26-Apr
		%	
15-4X15	28.4a-f	37.6b-p	68.6a-i
15-8X3	26.7a-f	37.7b-p	68.9a-i
18-7-1	19.1b-f	39.1a-p	62.9a-k
18-7-2	18.5c-f	35.6b-p	67.9a-j
18-7-3	21.9a-f	41.1a-o	70.2a-h
18-7-4	15.3d-f	16op	34.4no
18-7-5	16.6d-f	14.7p	22.1o
18-7-6	18.9b-f	32.8c-p	66.7a-k
18-8-1	18.3c-f	23.7k-p	36.8l-o
18-8-2	15ef	22.3l-p	47h-n
18-8-3	18.4c-f	33.2c-p	64.8a-k
18-8-4	19.9b-f	30.6d-p	55.8c-l
18-8-5	24.5a-f	41a-o	74.5a-g
18-8-6	18.5c-f	25.1j-p	47.2h-n
18-8-7	18.8b-f	27i-p	54.9e-l
18-9-1	22.3a-f	43.5a-n	66a-k
18-9-10	25.4a-f	50.1a-j	81.3ab
18-9-11	17.1d-f	30.6d-p	65.1a-k
18-9-12	21.1b-f	34.5b-p	71.8a-g
18-9-2	20.5b-f	49.6a-j	80.1a-d
18-9-3	19.3b-f	31.4d-p	56.1c-l
18-9-4	15.7d-f	21m-p	43.4k-o
18-9-5	22.4a-f	28g-p	44.5i-o
18-9-6	17.9d-f	27.2i-p	67.8a-j
18-9-7	19.4b-f	26.8i-p	51.9g-n
18-9-8	25.5a-f	44.3a-m	70.1a-h
18-9-9	15ef	22.1l-p	53.9e-n
17-4200-19x13	19.9b-f	42.9a-n	74.5a-g
17-4200-19x21	30.1a-f	49.9a-j	76.9a-f
17-4200-19x9	18.3c-f	37.1b-p	65a-k
17-4200-36x19	22.1a-f	26.5i-p	45.3i-o
Astro	24.5a-f	48.8a-k	74.1a-g
17-5200-11X9	23.1a-f	34.3b-p	56.3c-l
17-5200-13X9	14.1f	18.5n-p	30no
17-5200-31X3	27.9a-f	46.5a-l	71.7a-g
17-5200-3X23	23a-f	44.1a-m	71.9a-g
17-5200-4X11	19.9b-f	33.4c-p	58.9b-l
Bimini	23.3a-f	48a-k	74.4a-g
2008-4x16	27.2a-f	46.3a-m	72.4a-g
Celebration	17.1d-f	34.2b-p	65.1a-k
Latitude36	34.3a-f	57.1a-c	82.1ab
NorthBridge	33.3a-f	59.3ab	84.8a
OKC1221	37.3a-e	46.5a-l	66.4a-k
OSU1101	24.4a-f	46.5a-l	70.1a-h
OSU1117	31.5a-f	46.4a-l	67.9a-j
OSU1127	27.8a-f	43.9a-n	71.8a-g
OSU1132	26.7a-f	44.1a-m	72.5a-g
OSU1156	27.9a-f	41.9a-n	68a-j
OSU1217	37.8a-d	53.5a-f	74.5a-g
OSU1257	25.7a-f	44.5a-m	79.6a-d
OSU1318	31.4a-f	51.5a-i	68.2a-j
OSU1337	32.9a-f	59.1ab	81.2ab
OSU1402	35a-f	55.2a-d	75.8DEF
OSU1403	35a-f	50.3a-j	74.2a-g
OSU1406	22.5a-f	40.8a-o	79.8a-d
OSU1408	24.1a-f	38.5b-p	65.1a-k
OSU1409	27a-f	46.1a-m	77.2a-e

OSU1417	28.8a-f	47.5a-l	75.2a-g
OSU1418	18.2c-f	28.3f-p	60b-l
OSU1433	21.2b-f	35.4b-p	61.2a-k
OSU1439	27.9a-f	53a-g	73.7a-g
OSU1601	17.2d-f	27.4h-p	52.9f-n
OSU1609	43.9a	55.6a-d	80.4a-c
OSU1611	23.5a-f	34b-p	58.3b-l
OSU1617	31.3a-f	50.7a-i	64.7a-k
OSU1620	26.2a-f	40.3a-o	70.4a-h
OSU1625	28.2a-f	39.1a-p	67a-k
OSU1628	24.4a-f	38.1b-p	67.7a-j
OSU1629	33.5a-f	52.8a-h	66.4a-k
OSU1631	26.9a-f	51.3a-i	75.4a-g
OSU1638	37.2a-e	55a-e	79.6a-d
OSU1639	40.7a-c	57.2a-c	77.1a-f
OSU1641	21.5a-f	36.7b-p	70.1a-h
OSU1646	19.7b-f	33.1c-p	64.3a-k
OSU1649	16.9d-f	32.8c-p	62.7a-k
OSU1651	26a-f	43.6a-n	69.9a-h
OSU1656	16d-f	34.8b-p	72.2a-g
OSU1657	24.4a-f	41a-o	66.7a-k
OSU1661	30.5a-f	42.6a-n	71.6a-g
OSU1662	28.4a-f	44.9a-m	67.2a-k
OSU1663	16.6d-f	27.3i-p	68.1a-j
OSU1664	25.4a-f	39.5a-p	64.2a-k
OSU1666	21.8a-f	38.5b-p	75.3a-g
OSU1670	20.8b-f	38.5b-p	62.6a-k
OSU1673	28.6a-f	39a-p	65.9a-k
OSU1675	28.6a-f	47.2a-l	70.2a-h
OSU1680	17.4d-f	28.6f-p	63.6a-k
OSU1682	27.8a-f	49a-k	77.3a-e
OSU1687	18.1d-f	27.4h-p	60.3b-l
OSU1690	22.9a-f	43a-n	68.7a-i
OSU1699	21.6a-f	48.1a-k	75.2a-g
Tahoma31	41.1ab	64.4a	81.3ab
TifTuf	20.3b-f	42.6a-n	79.8a-d
Tifway	15.5d-f	29.6e-p	65.7a-k
Tilin#5	28.4a-f	45.3a-m	75.6a-g
U-3	25.9a-f	47.3a-l	64a-k

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 20. Mean spring percent green cover (PGC) of 96 trafficked bermudagrasses in 2020.

Entry	28-Mar	11-Apr	26-Apr
	---------------------	%	---------------------
15-4X15	22.6b-o	31.8i-y	66.8a-n
15-8X3	21.2c-o	34.1f-x	64.2a-n
18-7-1	24.2a-o	44a-t	65a-n
18-7-2	21.4b-o	45.3a-t	77.9a-i
18-7-3	19.7d-o	38.5c-v	70.2a-m
18-7-4	14.5l-o	17.8t-y	44.7n-s
18-7-5	12.9no	11.8y	34.9p-s
18-7-6	18.8e-o	38c-x	68.5a-n
18-8-1	12.7no	17.9t-y	33.4p-s
18-8-2	14.9j-o	26.4o-y	54.7i-q
18-8-3	12.4o	28.3k-y	64.1a-n
18-8-4	22.2b-o	32.5h-y	66.4a-n
18-8-5	22.6b-o	41.3a-u	77.9a-i
18-8-6	16.3i-o	31.1j-y	60.1c-n
18-8-7	14.7k-o	24.1s-y	55.1i-o
18-9-1	18.7e-o	39.4b-v	60c-n
18-9-10	33.7a-i	55a-i	85.5ab
18-9-11	21.7b-o	39.8a-u	72.7a-l
18-9-12	23.2b-o	36.9d-x	74.2a-k
18-9-2	18g-o	40.8a-u	77.5a-j
18-9-3	18.2g-o	37d-x	65.5a-n
18-9-4	13no	16.7u-y	29.6sr
18-9-5	27a-o	35.3e-x	59.6d-o
18-9-6	19d-o	42.4a-t	83.9a-d
18-9-7	19.4d-o	27.7n-y	62a-n
18-9-8	26.9a-o	51.2a-n	81.2a-h
18-9-9	13.2m-o	24.5o-y	70.7a-m
17-4200-19x13	22.1b-o	47.9a-q	76.5a-j
17-4200-19x21	28.1a-o	49.8a-p	75.4a-j
17-4200-19x9	17.3h-o	33.3g-y	69.7a-n
17-4200-36x19	18.8e-o	27.4n-y	45.6m-r
Astro	31.7a-m	56a-h	82a-h
17-5200-11X9	20.4d-o	34.9f-x	58.2e-p
17-5200-13X9	12.8no	14.3xy	25.9sr
17-5200-31X3	16.2i-o	27.3o-y	66.7a-n
17-5200-3X23	23.6a-o	43.2a-t	77.3a-j
17-5200-4X11	13.2m-o	23.6t-y	48.9k-q
Bimini	29.8a-o	62.6ab	81.4a-h
2008-4x16	25.9a-o	48.7a-q	77.5a-j
Celebration	16.5i-o	35.7e-x	64.6a-n
Latitude36	36a-g	58.7a-e	84.1a-d
NorthBridge	35.2a-h	61.7a-c	86.1a
OKC1221	36.8a-f	55.2a-i	78.4a-i
OSU1101	25.4a-o	48.1a-q	73.5a-l
OSU1117	39.5a-c	60.5a-d	76a-j
OSU1127	31.2a-n	54.5a-j	78.9a-i
OSU1132	29a-o	53.1a-k	82.7a-h
OSU1156	32.7a-l	52.9a-l	74.9a-j
OSU1217	39.9ab	61.8a-c	78.3a-i
OSU1257	29.2a-o	55.2a-i	85.4a-c
OSU1318	28.3a-o	57.7a-f	77a-j
OSU1337	29.5a-o	55.3a-i	82.3a-h
OSU1402	33.9a-i	56.8a-g	78.5a-i
OSU1403	33.5a-i	53.6a-j	78.8a-i
OSU1406	24.5a-o	44.1a-t	82a-h
OSU1408	24.3a-o	36.7d-x	65.9a-n
OSU1409	37.4a-d	56.2a-h	78.2a-i

OSU1417	31.1a-n	49.7a-p	79.4a-i
OSU1418	16.2i-o	31.1j-y	70.2a-m
OSU1433	23.4b-o	42.3a-t	65.7a-n
OSU1439	30.6a-o	53.6a-j	83.2a-e
OSU1601	16i-o	33.5g-y	65.3a-n
OSU1609	42a	61.3a-c	83.8a-d
OSU1611	16.6i-o	23.3t-y	46m-r
OSU1617	19.6d-o	38.3c-v	52.4i-q
OSU1620	24.7a-o	40.7a-u	69a-n
OSU1625	33.1a-k	50.2a-p	77.6a-j
OSU1628	21.5b-o	40.8a-u	73.2a-l
OSU1629	12.5o	14.9u-y	22.3s
OSU1631	26.9a-o	52.6a-m	83.3a-e
OSU1638	33.4a-j	50.9a-o	78.7a-i
OSU1639	18.6e-o	35.7e-x	57.2g-p
OSU1641	19.3d-o	37.3d-x	70.7a-m
OSU1646	16.5i-o	30.7j-y	67.4a-n
OSU1649	12.2o	23t-y	48.4m-r
OSU1651	29a-o	50a-p	74.8a-j
OSU1656	14.9j-o	36.5e-x	73.8a-l
OSU1657	25.4a-o	44a-t	70.7a-m
OSU1661	39.9ab	56.5a-g	79.2a-i
OSU1662	18.4f-o	33.4g-y	64.8a-n
OSU1663	15.9i-o	29.3k-y	68.8a-n
OSU1664	20.1d-o	38.5c-v	69.2a-n
OSU1666	21c-o	37.3d-x	75.9a-j
OSU1670	16.5i-o	28.3n-y	57.5g-p
OSU1673	22.6b-o	44.9a-t	83a-f
OSU1675	33.9a-i	53.8a-j	77.5a-j
OSU1680	17.2h-o	29.3k-y	67.5a-n
OSU1682	27.1a-o	50.3a-o	82.2a-h
OSU1687	20.2d-o	25.5o-y	57.6e-p
OSU1690	21.3c-o	46.2a-t	72.5a-l
OSU1699	13.1no	28.9k-y	62.7a-n
Tahoma31	37.1a-e	63.3a	82.9a-g
TifTuf	27.3a-o	57.7a-f	85.8a
Tifway	15.5i-o	34.2f-x	75.2a-j
Tilin#5	30.5a-o	53.2a-j	82.4a-h
U-3	23.3b-o	44.8a-t	69.7a-n

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 21. Simple effects of traffic on spring PGC of 96 bermudagrasses in 2020.

Entry	28-Mar	11-Apr	26-Apr
		p-value	
15-4x15	0.1045	0.2174	0.7416
15-8X3	0.1241	0.4375	0.3583
18-7-1	0.1587	0.2919	0.6863
18-7-2	0.412	0.0384	0.0518
18-7-3	0.5211	0.5835	0.9859
18-7-4	0.8201	0.7053	0.046
18-7-5	0.3048	0.5384	0.0129
18-7-6	0.9883	0.2592	0.7254
18-8-1	0.1153	0.2097	0.509
18-8-2	0.9921	0.3761	0.1302
18-8-3	0.0928	0.2922	0.8804
18-8-4	0.527	0.6723	0.0404
18-8-5	0.5893	0.9471	0.5106
18-8-6	0.5345	0.1971	0.0126
18-8-7	0.2527	0.5297	0.966
18-9-1	0.3159	0.3812	0.2494
18-9-10	0.0207	0.2885	0.4108
18-9-11	0.2	0.0472	0.1404
18-9-12	0.564	0.609	0.6386
18-9-2	0.4859	0.0589	0.613
18-9-3	0.7539	0.2261	0.0696
18-9-4	0.4342	0.3529	0.0079
18-9-5	0.2015	0.116	0.0036
18-9-6	0.7305	0.0012	0.0021
18-9-7	0.9909	0.8424	0.0508
18-9-8	0.6909	0.1376	0.0319
18-9-9	0.611	0.615	0.0013
17-4200-19x13	0.5361	0.2853	0.6922
17-4200-19x21	0.5855	0.9761	0.7803
17-4200-19x9	0.7799	0.4161	0.356
17-4200-36x19	0.3487	0.845	0.961
Astro	0.0456	0.1209	0.1222
17-5200-11X9	0.4498	0.9069	0.697
17-5200-13X9	0.7165	0.3623	0.4212
17-5200-31X3	0.0012	<.0001	0.3252
17-5200-3X23	0.8702	0.8375	0.2971
17-5200-4X11	0.0585	0.0363	0.0545
Bimini	0.069	0.002	0.1717
2008-4x16	0.7127	0.6151	0.3241
Celebration	0.8569	0.7319	0.9294
Latitude36	0.6322	0.7295	0.7038
NorthBridge	0.5967	0.5991	0.7945
OKC1221	0.8891	0.0628	0.0204
OSU1101	0.7705	0.722	0.5048
OSU1117	0.025	0.0027	0.1141
OSU1127	0.3476	0.024	0.1675
OSU1132	0.5142	0.0535	0.0486
OSU1156	0.1735	0.0183	0.18
OSU1217	0.5641	0.0736	0.4568
OSU1257	0.323	0.0219	0.2539
OSU1318	0.3807	0.1749	0.0876
OSU1337	0.3403	0.4028	0.8312
OSU1402	0.7507	0.7409	0.5999
OSU1403	0.6601	0.478	0.3724
OSU1406	0.555	0.4696	0.6714
OSU1408	0.9591	0.6922	0.8829
OSU1409	0.0038	0.03	0.8557

OSU1417	0.5164	0.631	0.4138
OSU1418	0.5761	0.5447	0.049
OSU1433	0.5473	0.1378	0.3768
OSU1439	0.4568	0.891	0.0684
OSU1601	0.7304	0.1917	0.0162
OSU1609	0.5808	0.2192	0.5039
OSU1611	0.0556	0.022	0.017
OSU1617	0.0011	0.0081	0.0172
OSU1620	0.6701	0.9221	0.7898
OSU1625	0.1633	0.0166	0.0409
OSU1628	0.4131	0.5613	0.2849
OSU1629	<.0001	<.0001	<.0001
OSU1631	0.989	0.7845	0.1248
OSU1638	0.2874	0.3792	0.8692
OSU1639	<.0001	<.0001	0.0001
OSU1641	0.5517	0.8871	0.8984
OSU1646	0.3674	0.5936	0.5409
OSU1649	0.1911	0.0366	0.006
OSU1651	0.3908	0.1665	0.3389
OSU1656	0.7543	0.7062	0.7519
OSU1657	0.7723	0.521	0.4379
OSU1661	0.009	0.003	0.1355
OSU1662	0.0053	0.0142	0.6382
OSU1663	0.8427	0.6796	0.8862
OSU1664	0.1409	0.8196	0.3295
OSU1666	0.8343	0.7942	0.9051
OSU1670	0.2202	0.0283	0.3151
OSU1673	0.0893	0.2041	0.0011
OSU1675	0.139	0.1562	0.1594
OSU1680	0.9585	0.8742	0.4408
OSU1682	0.8504	0.783	0.341
OSU1687	0.5603	0.6917	0.5931
OSU1690	0.6572	0.5022	0.4696
OSU1699	0.0173	<.0001	0.0156
Tahoma31	0.2618	0.8118	0.7616
TifTuf	0.0506	0.0013	0.2485
Tifway	0.9905	0.3145	0.0649
Tilin#5	0.5578	0.0898	0.1857
U-3	0.469	0.5993	0.2654

Table 22. Mean visual spring green-up (VSG) of 96 non-trafficked bermudagrasses in 2020.

Entry	28-Mar	11-Apr	26-Apr
	--	(1-9) scale	--
15-4X15	2b-e	4b-e	8a-c
15-8X3	2b-e	4b-e	7.3a-d
18-7-1	2b-e	3.7b-f	7.7a-d
18-7-2	2b-e	4.3a-e	7.7a-d
18-7-3	2b-e	4b-e	8.3a-c
18-7-4	1e	1.7fg	4fg
18-7-5	1e	1g	2.3g
18-7-6	1.7c-e	3.7b-f	7.7a-d
18-8-1	1.7c-e	2.7e-g	4.3e-g
18-8-2	1.3de	2.7e-g	6.7a-e
18-8-3	2b-e	3.7b-f	7.3a-d
18-8-4	1.7c-e	3.3c-f	7.3a-d
18-8-5	2b-e	4b-e	7.7a-d
18-8-6	1e	3d-f	6.7a-e
18-8-7	1.3de	3d-f	6.7a-e
18-9-1	2b-e	3.7b-f	8a-c
18-9-10	2b-e	4b-e	8.3a-c
18-9-11	1e	3d-f	8a-c
18-9-12	1e	3.7b-f	7.7a-d
18-9-2	1.7c-e	5a-d	8.7ab
18-9-3	1.7c-e	4b-e	6.7a-e
18-9-4	1.3de	2.7e-g	5.3d-f
18-9-5	2.3b-e	3.7b-f	6.7a-e
18-9-6	1.3de	3.3c-f	7.3a-d
18-9-7	2b-e	3d-f	6.3b-f
18-9-8	2b-e	4b-e	7.7a-d
18-9-9	1.3de	3.3c-f	7.7a-d
17-4200-19x13	1.7c-e	4b-e	8.3a-c
17-4200-19x21	2b-e	4.7a-e	8.3a-c
17-4200-19x9	1.3de	4.3a-e	7.7a-d
17-4200-36x19	1.7c-e	2.7e-g	6c-f
Astro	2b-e	4.3a-e	8.3a-c
17-5200-11X9	2b-e	3d-f	7.3a-d
17-5200-13X9	1.3de	2.7e-g	4fg
17-5200-31X3	2b-e	4b-e	8.3a-c
17-5200-3X23	2b-e	4.7a-e	8.3a-c
17-5200-4X11	1.3de	3.3c-f	7a-d
Bimini	2b-e	5.3a-c	8.3a-c
2008-4x16	2b-e	4.3a-e	8.3a-c
Celebration	1.7c-e	3.7b-f	7a-d
Latitude36	2.7b-e	5.3a-c	8.3a-c
NorthBridge	2.3b-e	5.7ab	9a
OKC1221	2.7b-e	4.3a-e	8a-c
OSU1101	1.7c-e	3.7b-f	8a-c
OSU1117	3a-d	5a-d	8.7ab
OSU1127	2b-e	4b-e	8.3a-c
OSU1132	2b-e	4b-e	8a-c
OSU1156	2b-e	4.3a-e	8a-c
OSU1217	2b-e	4.3a-e	8.3a-c
OSU1257	2b-e	5.3a-c	9a
OSU1318	2.3b-e	5a-d	8a-c
OSU1337	2.7b-e	5.3a-c	8.7ab
OSU1402	2.7b-e	5.7ab	8a-c
OSU1403	2.7b-e	5a-d	8.3a-c
OSU1406	1.7c-e	4b-e	9a
OSU1408	1.7c-e	3.7b-f	7.7a-d
OSU1409	2.3b-e	5a-d	8a-c

OSU1417	2.3b-e	4.7a-e	9a
OSU1418	1.3de	3.7b-f	7.7a-d
OSU1433	1.7c-e	3.7b-f	7.7a-d
OSU1439	2.3b-e	4.7a-e	8.3a-c
OSU1601	1.7c-e	3.7b-f	7a-d
OSU1609	4.7a	5.7ab	9a
OSU1611	1.7c-e	2.7e-g	6.7a-e
OSU1617	2.7b-e	5a-d	8a-c
OSU1620	2b-e	4b-e	7.7a-d
OSU1625	2.3b-e	4.3a-e	8a-c
OSU1628	2b-e	4b-e	7.3a-d
OSU1629	2.3b-e	4b-e	8a-c
OSU1631	2.3b-e	5.3a-c	8.7ab
OSU1638	3.3a-c	5.3a-c	9a
OSU1639	3a-d	4.3a-e	7.3a-d
OSU1641	2b-e	3.7b-f	7.3a-d
OSU1646	1e	3.7b-f	7a-d
OSU1649	1.7c-e	3.3c-f	7.3a-d
OSU1651	2.3b-e	4.3a-e	7.7a-d
OSU1656	1.7c-e	4.3a-e	8.7ab
OSU1657	2.3b-e	4.7a-e	8.7ab
OSU1661	2b-e	4.7a-e	8.3a-c
OSU1662	2b-e	4b-e	8a-c
OSU1663	1e	3.3c-f	8a-c
OSU1664	2b-e	3.7b-f	7.7a-d
OSU1666	2b-e	4b-e	8.3a-c
OSU1670	1.7c-e	4b-e	7.7a-d
OSU1673	1.7c-e	3.3c-f	7a-d
OSU1675	2.3b-e	5a-d	8a-c
OSU1680	2b-e	4b-e	8a-c
OSU1682	2.3b-e	4.3a-e	8.3a-c
OSU1687	1e	3d-f	7a-d
OSU1690	2b-e	4.7a-e	8.7ab
OSU1699	2.3b-e	4.3a-e	8.7ab
Tahoma31	3.7ab	6.3a	8.7ab
TifTuf	2b-e	4.3a-e	8.3a-c
Tifway	1.3de	3.7b-f	7.7a-d
Tilin#5	1.7c-e	4b-e	8.7ab
U-3	2b-e	4b-e	7.7a-d

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 23. Mean visual spring green-up (VSG) of 96 trafficked bermudagrasses in 2020.

Entry	**28-Mar**	**11-Apr**	**26-Apr**
		(1-9) scale	
15-4X15	2b-e	3.3b-h	7.3a-d
15-8X3	2b-e	3.7a-g	7a-e
18-7-1	2b-e	3.7a-g	7.3a-d
18-7-2	2b-e	4.3a-e	8a-c
18-7-3	2b-e	3.7a-g	8.3ab
18-7-4	1e	2f-i	4.3h-g
18-7-5	1e	1i	4gh
18-7-6	1.7d-e	3.3b-h	7.7a-d
18-8-1	1e	2.3e-i	3.7h
18-8-2	1.3de	2.7d-i	7a-e
18-8-3	1e	2.7d-i	7.3a-d
18-8-4	1.7d-e	3c-i	7.7a-d
18-8-5	2b-e	4a-f	7.7a-d
18-8-6	1.3de	3c-i	7a-e
18-8-7	1e	3c-i	6.3b-g
18-9-1	2b-e	3c-i	7.3a-d
18-9-10	2.3b-e	4.3a-e	9a
18-9-11	1.7d-e	3.3b-h	8a-c
18-9-12	1e	3.3b-h	8a-c
18-9-2	1.7d-e	4.3a-e	8.7ab
18-9-3	2b-e	4a-f	7.3a-d
18-9-4	1.3de	2f-i	5.3d-g
18-9-5	2b-e	3.7a-g	7a-e
18-9-6	1.3de	4a-f	8.3ab
18-9-7	2b-e	3c-i	7a-e
18-9-8	2b-e	4a-f	8.3ab
18-9-9	1e	2.7d-i	7.3a-d
17-4200-19x13	1.7d-e	3.7a-g	8.3ab
17-4200-19x21	2.3b-e	4.3a-e	8a-c
17-4200-19x9	1e	4a-f	7.7a-d
17-4200-36x19	1.7d-e	2.7d-i	6.7a-f
Astro	2b-e	4.3a-e	9a
17-5200-11X9	2b-e	3c-i	7.3a-d
17-5200-13X9	1e	1.7g-i	3.3h
17-5200-31X3	1.3de	3c-i	7.7a-d
17-5200-3X23	1.7d-e	4.3a-e	8.7ab
17-5200-4X11	1e	2.3e-i	6.7a-f
Bimini	2.3b-e	5.3ab	8.3ab
2008-4x16	2b-e	4a-f	8.3ab
Celebration	2b-e	3.7a-g	7a-e
Latitude36	2.3b-e	5a-c	8.7ab
NorthBridge	2b-e	5.3ab	9a
OKC1221	2.7a-d	4.3a-e	8.7ab
OSU1101	1.7d-e	4a-f	8a-c
OSU1117	2.7a-d	4.7a-d	8.7ab
OSU1127	2b-e	4a-f	8.3ab
OSU1132	2b-e	4.3a-e	9a
OSU1156	2.3b-e	4.3a-e	8.7ab
OSU1217	2.3b-e	4.7a-d	8.3ab
OSU1257	2b-e	5a-c	9a
OSU1318	2.3b-e	4.7a-d	8.3ab
OSU1337	2.3b-e	5a-c	9a
OSU1402	2.3b-e	5a-c	8a-c
OSU1403	2b-e	5a-c	9a
OSU1406	1.7d-e	4.3a-e	9a
OSU1408	1.7d-e	3.7a-g	7.7a-d
OSU1409	2.3b-e	5a-c	8a-c

OSU1417	2b-e	4.3a-e	9a
OSU1418	1.3de	3.3b-h	8.3ab
OSU1433	1.7d-e	4a-f	7.7a-d
OSU1439	2.3b-e	4.7a-d	9a
OSU1601	1.7d-e	3.7a-g	7.7a-d
OSU1609	4a	5.3ab	8.7ab
OSU1611	1.3de	2f-i	5.7c-g
OSU1617	2b-e	4a-f	7.7a-d
OSU1620	2b-e	3.7a-g	7.3a-d
OSU1625	2.3b-e	4.3a-e	8.7ab
OSU1628	2b-e	3.3b-h	7.3a-d
OSU1629	1e	1.3hi	4.7e-g
OSU1631	2.3b-e	4.7a-d	8.7ab
OSU1638	3a-c	4.7a-d	9a
OSU1639	1.7d-e	2.7d-i	6.7a-f
OSU1641	2b-e	3.3b-h	7.7a-d
OSU1646	1e	3.3b-h	7.7a-d
OSU1649	1e	2.3e-i	5.7c-g
OSU1651	2b-e	4.3a-e	8a-c
OSU1656	1.7d-e	3.7a-g	8.3ab
OSU1657	1.7d-e	3.7a-g	9a
OSU1661	2.3b-e	4.7a-d	8.7ab
OSU1662	2b-e	3.3b-h	8a-c
OSU1663	1e	3c-i	8a-c
OSU1664	1.7d-e	3c-i	8a-c
OSU1666	2b-e	3c-i	8a-c
OSU1670	1e	2.7d-i	7.7a-d
OSU1673	1.7d-e	3c-i	8a-c
OSU1675	2b-e	5a-c	8.3ab
OSU1680	2b-e	3.3b-h	7.7a-d
OSU1682	2b-e	4.3a-e	8.3ab
OSU1687	1e	3c-i	7a-e
OSU1690	2b-e	4.3a-e	9a
OSU1699	2b-e	3c-i	8.3ab
Tahoma31	3.3ab	5.7a	9a
TifTuf	2b-e	4a-f	9a
Tifway	1.3de	3.3b-h	8a-c
Tilin#5	2b-e	4.3a-e	8.7ab
U-3	2b-e	3.7a-g	8a-c

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 24. Mean percent green cover (PGC) of 96 non-trafficked bermudagrasses in fall-2020.

Entry	6-Sep	11-Sep	18-Sep	25-Sep	2-Oct	9-Oct	16-Oct
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15-4X15	83.7a-c	81.4a-g	78.9a-i	72.7a-g	64.4a-g	61.2a-l	63.5a-i
15-8X3	83.8a-c	79.2a-h	72a-l	75.2a-g	58.5a-h	63.6a-k	60.4a-i
18-7-1	82.6a-c	78.3a-i	75a-j	72.5a-g	66.7a-g	68a-i	67.6a-h
18-7-2	75.3a-c	71.2a-i	69.9a-l	71.2a-g	63.5a-h	61.2a-l	65.8a-h
18-7-3	73.6a-c	74.2a-i	71.9a-l	70.7a-g	60.3a-h	58.9a-l	60.5a-i
18-7-4	71.8a-c	69.1a-i	65.2d-l	64.9a-h	55.7a-h	50.7e-l	50.9e-j
18-7-5	80.3a-c	69.7a-i	65.9c-l	59.2c-h	45.9d-h	39.1l	34.1j
18-7-6	78.2a-c	77.3a-i	76.5a-j	77.8a-d	65.4a-g	63.3a-l	65.5a-i
18-8-1	79.8a-c	77.9a-i	78.3a-i	82.3a	75ab	77.1a-c	76.2a-d
18-8-2	89.9a	84.2a-e	80.7a-g	80.7a-c	75ab	78.3a	79.2ab
18-8-3	83.1a-c	78.8a-h	77.3a-j	75.9a-f	66.2a-g	69.7a-h	72.3a-f
18-8-4	83.4a-c	71.7a-i	69.6a-l	73.4a-g	62.3a-h	61.4a-l	61.6a-i
18-8-5	83a-c	67.1b-i	63.9e-l	66.6a-h	57.3a-h	60.3a-l	66.4a-h
18-8-6	79.6a-c	67b-i	68.4a-l	64a-h	61.9a-h	63.9a-j	65.7a-h
18-8-7	85.2ab	85.6a-d	83.6a-d	83.3a	76a	77.6ab	81.3a
18-9-1	72.9a-c	66.2c-i	67.1a-l	67.7a-g	61a-h	61.8a-l	63.7a-i
18-9-10	73.8a-c	70.4a-i	65.6d-l	62.8a-h	40.1h	46.2h-l	56.5b-j
18-9-11	81.9a-c	77.9a-i	76.6a-j	70.4a-g	61.3a-h	63.1a-l	64.7a-i
18-9-12	71.8a-c	71.1a-i	71a-l	67.4a-g	54.7a-h	57a-l	61.1a-i
18-9-2	87.5ab	82.5a-f	79.6a-i	80.6a-c	73.4a-c	73.8a-e	73.9a-f
18-9-3	84.8ab	76a-i	75.9a-j	74a-g	64.3a-g	64.9a-j	67.1a-h
18-9-4	79.6a-c	73.7a-i	72.7a-l	75.1a-g	65.4a-g	68.3a-i	64.4a-i
18-9-5	78.5a-c	69.2a-i	62.8f-l	71a-g	53.9a-h	62.3a-l	62.1a-i
18-9-6	77.2a-c	72.9a-i	64.7d-l	57.8d-h	43.3gh	42.9jl	48.8g-j
18-9-7	86.5ab	76.3a-i	70.9a-l	73.4a-g	65.2a-g	67.9a-i	66.6a-h
18-9-8	80a-c	71.4a-i	68.2a-l	69.9a-g	49.6a-h	61.2a-l	67.3a-h
18-9-9	78.4a-c	75.8a-i	73.3a-l	72.7a-g	65a-g	64.7a-j	69.3a-g
17-4200-19x13	86.8ab	84.8a-e	81.7a-f	82a	58.3a-h	63.6a-j	74.9a-e
17-4200-19x21	82a-c	77.3a-i	76.7a-j	76.1a-f	67.6a-f	66.3a-j	64a-i
17-4200-19x9	89ab	88.9a	86.3ab	81.4ab	75.2ab	69.1a-i	64.3a-i
17-4200-36x19	88.4ab	85.2a-d	81.7a-f	79.3a-d	71.4a-e	67.3a-i	69.2a-g
Astro	82.5a-c	78.3a-i	71.8a-l	72.1a-g	62.2a-h	62a-l	62.8a-i
17-5200-11X9	63.5bc	58.7hi	58.5i-l	54.9f-h	49.3a-h	47.6g-l	49.1g-j
17-5200-13X9	88.4ab	80.9a-g	79a-i	80a-c	63.9a-g	65.9a-j	65.9a-h
17-5200-31X3	83.2a-c	82a-g	81.3a-f	77.7a-d	72.9a-d	69.5a-i	69.5a-g
17-5200-3X23	76.9a-c	76.9a-i	72.3a-l	74.9a-g	66.5a-g	64.1a-j	66.6a-h
17-5200-4X11	87.8ab	87.9a	86.5a	82.4a	73.9a-c	73a-f	70.8a-g
Bimini	86.1ab	75.2a-i	76.7a-j	78.4a-d	74.7ab	76.1a-d	76.7a-c
2008-4x16	82.1a-c	78.8a-h	76.1a-j	74.5a-g	67.7a-f	63.4a-l	61.4a-i
Celebration	84.1a-c	81.5a-g	77.9a-j	76.8a-e	70.8a-e	70.9a-g	67.2a-h
Latitude36	81.4a-c	76.6a-i	74.2a-k	73a-g	67.4a-f	63.5a-k	65.1a-i
NorthBridge	73.4a-c	77.8a-i	73.6a-k	65.9a-h	58.4a-h	57.8a-l	54.5c-j
OKC1221	80.7a-c	79.5a-g	74.1a-k	72.2a-g	59.4a-h	60.5a-l	61.4a-i
OSU1101	86.2ab	85.9a-c	83.9a-d	81.7a	75ab	73.8a-e	74.7a-e
OSU1117	81.6a-c	74.6a-i	76.9a-j	71.8a-g	63.4a-h	60a-l	58.2b-i
OSU1127	69.4a-c	72.4a-i	66.7b-l	59.8b-h	53.9a-h	52.7d-l	54.2c-j
OSU1132	74a-c	76.5a-i	68.3a-l	68.2a-g	46d-h	49.3f-l	57.2b-i
OSU1156	75.5a-c	75.7a-i	72.4a-l	69.4a-g	64a-g	63.3a-l	61.8a-i
OSU1217	68.7a-c	72.6a-i	67.7a-l	64.7a-h	56a-h	52.7d-l	54c-j
OSU1257	87.3ab	85.7a-d	80.4a-h	77a-e	66.4a-g	67.9a-i	67.4a-h
OSU1318	77.8a-c	72.3a-i	71.6a-l	71.6a-g	62.6a-h	60.2a-l	60.8a-i
OSU1337	83.2a-c	80.7a-g	80.5a-g	80.8a-c	70.8a-e	65.3a-j	61.9a-i
OSU1402	84.1a-c	81.1a-g	75a-j	77.4a-e	67.1a-f	61.2a-l	60.5a-i
OSU1403	72.3a-c	71.4a-i	72.4a-l	70.8a-g	61.7a-h	54.9a-l	57.4b-i
OSU1406	72.2a-c	73.8a-i	69a-l	67.8a-g	52.5a-h	49.1f-l	48.4g-j
OSU1408	74.2a-c	73.3a-i	71.4a-l	65.2a-h	60.4a-h	50.8e-l	48.8g-j
OSU1409	74.1a-c	73.4a-i	67a-l	63.6a-h	54.4a-h	58.5a-l	59.9a-i

OSU1417	74.8a-c	75.3a-i	70.8a-l	70.4a-g	58.7a-h	57.5a-l	58.8a-i
OSU1418	84.2a-c	82.1a-g	81.3a-f	77.8a-d	67a-g	70a-h	60.7a-i
OSU1433	75.6a-c	71.8a-i	70.1a-l	64.6a-h	58.9a-h	57.8a-l	56.8b-j
OSU1439	84.4a-c	83.9a-e	82.6a-e	78.7a-d	70.7a-e	70.1a-h	68.6a-h
OSU1601	88.6ab	80.9a-g	77.1a-j	72.1a-g	63.8a-g	61.9a-l	58b-i
OSU1609	84.2a-c	79.6a-g	76.2a-j	77.1a-e	68.9a-f	68.3a-i	67.5a-h
OSU1611	79.5a-c	72.9a-i	69.4a-l	71a-g	60.6a-h	62.3a-l	62.3a-i
OSU1617	87.9ab	83.4a-e	81.8a-f	82.4a	75.6ab	72.3a-f	69.3a-g
OSU1620	79.1a-c	65.3d-i	69.2a-l	57.5d-h	54.5a-h	55.2a-l	56.4b-j
OSU1625	88ab	83.8a-e	76.9a-j	73.2a-g	65.2a-g	67a-j	65.9a-h
OSU1628	84.9ab	76.3a-i	68.5a-l	70a-g	55.8a-h	55.5a-l	62.7a-i
OSU1629	89.7ab	87.6ab	82.4a-f	77.7a-d	68a-f	60.5a-l	53.9c-j
OSU1631	79.8a-c	74.9a-i	74.7a-k	69.3a-g	62.2a-h	60.2a-l	57.4b-i
OSU1638	82.2a-c	77.6a-i	73.7a-k	72.6a-g	62.4a-h	62.5a-l	61.3a-i
OSU1639	88.6ab	88.2a	85.5a-c	83.1a	76.1a	72.1a-f	66.1a-h
OSU1641	81.9a-c	74.1a-i	70.9a-l	65.8a-h	57.1a-h	56.7a-l	62.3a-i
OSU1646	75.7a-c	74.2a-i	71.4a-l	72.6a-g	60a-h	60.8a-l	63a-i
OSU1649	71a-c	62.1f-i	55.2kl	55.8e-h	46.3d-h	47.5g-l	53.6d-j
OSU1651	74.2a-c	75.3a-i	71.5a-l	70.7a-g	63.2a-h	60.6a-l	61.2a-i
OSU1656	87.6ab	79.3a-g	77.1a-j	74.1a-g	65.4a-g	62a-l	61.8a-i
OSU1657	74.3a-c	72a-i	69.5a-l	71.4a-g	55.2a-h	54.7a-l	54.5c-j
OSU1661	73.3a-c	61.8g-i	60.7h-l	53.6gh	45.1e-h	45.2i-l	45.7ij
OSU1662	74.6a-c	77.6a-i	73.4a-k	71a-g	63a-h	66.5a-j	60a-i
OSU1663	71.8a-c	64.4e-i	61.4g-l	54.9f-h	50.6a-h	50.3e-l	52.8e-j
OSU1664	78.5a-c	80.6a-g	76.1a-j	71a-g	59.1a-h	55.7a-l	53.7c-j
OSU1666	79.7a-c	70.3a-i	60.2i-l	59.5c-h	47.6c-h	53.8a-l	56.1c-j
OSU1670	77.3a-c	76.8a-i	73.3a-l	73.4a-g	64.9a-g	60a-l	61.7a-i
OSU1673	58.3c	57.7i	53.6l	45.1h	36.6h	39.2kl	42.4j
OSU1675	72.5a-c	68.3a-i	64.4d-l	63.7a-h	48.6b-h	47.3g-l	51.4e-j
OSU1680	78.8a-c	72.4a-i	72.5a-l	72.6a-g	66.9a-g	65.7a-j	63.6a-i
OSU1682	70.3a-c	70a-i	65.6d-l	63.4a-h	58.3a-h	60.3a-l	63.3a-i
OSU1687	74.8a-c	73.1a-i	64.4d-l	67.8a-g	55.1a-h	52.8a-l	56.2b-j
OSU1690	76.2a-c	72a-i	67.7a-l	66.5a-h	58.5a-h	55.2a-l	52.3e-j
OSU1699	88.5ab	85.7a-d	81.2a-f	77.2a-e	65a-g	60.3a-l	58.7a-i
Tahoma31	83a-c	83.3a-e	81a-g	78.3a-d	69.8a-f	64.8a-j	63.1a-i
TifTuf	82.3a-c	76.6a-i	75.9a-j	76.8a-e	62.9a-h	66.1a-j	69.2a-g
Tifway	76.6a-c	73.7a-i	71.6a-l	67.7a-g	61.1a-h	63a-l	63.2a-i
Tilin#5	73.2a-c	75.4a-i	73.5a-k	70.6a-g	58.4a-h	55.1a-l	62.8a-i
U-3	70.4a-c	69.3a-i	68.8a-l	64.9a-h	60.5a-h	57.3a-l	57.6b-i

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 25. Mean percent green cover (PGC) of 96 trafficked bermudagrasses on seven rating dates in fall-2020.

Entry	6-Sep (0 events)	11-Sep (10 events)	18-Sep (20 events)	25-Sep (30 events)	2-Oct (40 events)	9-Oct (50 events)	16-Oct (60 events)
	---	---	---	%	---	---	---
15-4X15	86.8a-g	77.2a-e	68.2a-f	57.9a-i	46a-d	41.3b-i	41.3a-k
15-8X3	87.2a-f	70.4a-g	59.2a-g	51.8a-i	46.3a-d	40.9b-i	41a-k
18-7-1	87.7a-e	69.3a-g	68.1a-g	64.4a-g	58.7a-d	54.1a-f	53.9a-e
18-7-2	79.8a-h	73.5a-f	68.6a-f	65.5a-f	57.4a-d	54a-f	50.4a-h
18-7-3	81a-h	71.2a-g	66.9a-g	56.1a-i	51.4a-d	44.6a-i	41.5a-k
18-7-4	76.7a-h	64.6b-g	56a-g	54.6a-i	44.4a-d	37.2d-i	33.6f-k
18-7-5	73.8b-h	62.1b-g	56.1a-g	51.3a-i	38.8cd	26.5i	22.6l
18-7-6	78.8a-h	68.7a-g	65.9a-g	64.1a-g	58.9a-d	56.4a-e	52.7a-f
18-8-1	88.7a-e	69.2a-g	63.9a-g	63.7a-g	57.9a-d	48.6a-h	52.7a-f
18-8-2	90.7ab	80.7ab	74.6a-c	67.3a-d	58.6a-d	55.8a-f	52.1a-g
18-8-3	87.9a-e	75.4a-e	71.3a-e	70.1a-c	65.4ab	60ab	59.4ab
18-8-4	84.3a-h	65.8a-g	58a-g	51.8a-i	45.6a-d	41.8a-i	38c-k
18-8-5	78.7a-h	72.7a-f	67.7a-g	62.8a-h	55.6a-d	52.5a-g	49.7a-h
18-8-6	79.3a-h	62.2b-g	58.7a-g	51.2a-i	48a-d	43.9a-i	40.3a-k
18-8-7	88.5a-e	80.7ab	77.1ab	70a-c	58.7a-d	55.5a-f	52.4a-g
18-9-1	78.4a-h	62.4b-g	57.1a-g	55.6a-i	56.2a-d	46.8a-i	46.4a-k
18-9-10	80.2a-h	67.9a-g	66a-g	61.9a-h	44.9a-d	48.4a-h	52.5a-g
18-9-11	75.1a-h	66.8a-g	64.4a-g	57.5a-i	51a-d	45.9a-i	45.8a-k
18-9-12	78.3a-h	66.1a-g	57.8a-g	53.6a-i	47.8a-d	46.1a-i	44.4a-k
18-9-2	87.9a-e	70.7a-g	67.8a-g	66.3a-f	63.2a-c	55.6a-f	57.4a-c
18-9-3	89.1a-e	69a-g	66.6a-g	59.8a-i	55.3a-d	51.9a-h	54a-e
18-9-4	81.5a-h	64.4b-g	62.1a-g	58.2a-i	52.3a-d	47.4a-i	46.2a-k
18-9-5	81.6a-h	67.4a-g	62.6a-g	58.9a-i	53.8a-d	49.3a-h	46.1a-k
18-9-6	83.4a-h	62.5b-g	57.2a-g	49.6b-i	36.2d	38.7b-i	37.5c-k
18-9-7	87.1a-f	72.7a-f	67.8a-g	58.4a-i	48.2a-d	42.4a-i	40.2a-k
18-9-8	80.9a-h	71.8a-g	66.8a-g	65.2a-g	52.2a-d	51.3a-h	52.6a-f
18-9-9	79.2a-h	69.8a-g	66.5a-g	62a-h	54a-d	47.7a-i	48.3a-j
17-4200-19x13	88.2a-e	74.9a-e	75.3ab	67.2a-d	49.9a-d	48.9a-h	43.4a-k
17-4200-19x21	85.6a-h	76.4a-e	70.7a-e	63.6a-g	56.3a-d	50a-h	45.4a-k
17-4200-19x9	90.5ab	85.8a	78.6a	73ab	65ab	52.5a-g	50a-h
17-4200-36x19	91.5a	80.1a-c	75.6ab	70.7a-c	63.8a-c	55.6a-f	53.1a-f
Astro	81.5a-h	74.1a-e	68.1a-g	59.9a-i	50.9a-d	46.3a-i	39.3b-k
17-5200-11X9	74.1b-h	61b-g	57.1a-g	50.2b-i	41.1b-d	37.6d-i	35.2e-k
17-5200-13X9	90.2a-c	80.3a-c	75ab	63.5a-g	53.8a-d	46.5a-i	42.2a-k
17-5200-31X3	89.1a-e	76.1a-e	68a-g	64.6a-g	54.7a-d	50a-h	43.2a-k
17-5200-3X23	83.3a-h	75.5a-e	70.5a-e	62.5a-h	56.3a-d	51a-h	45.8a-k
17-5200-4X11	89.7a-d	80.9ab	76.6ab	74.8a	68.3a	59.4a-c	57a-d
Bimini	85.4a-h	78.9a-d	77.1ab	72.6ab	64.3a-c	63.1a	60.1a
2008-4x16	82.7a-h	71.9a-g	64.2a-g	55.2a-i	46.3a-d	40.5b-i	37.8c-k
Celebration	88.7a-e	77.8a-e	72.4a-d	68.9a-c	55.3a-d	50a-h	47.7a-k
Latitude36	83.8a-h	75a-e	71.3a-e	63.1a-h	51a-d	51.8a-h	49.1a-j
NorthBridge	84.9a-h	74.3a-e	70.3a-e	65a-g	53.4a-d	48.9a-h	47.6a-k
OKC1221	80.3a-h	71.1a-g	64.1a-g	56.5a-i	45.2a-d	37.1d-i	37.2d-k
OSU1101	91.5a	81.1ab	78.1ab	69.4a-c	58.9a-d	58.3a-d	53.9a-e
OSU1117	82.2a-h	69.2a-g	64.9a-g	57.1a-i	48.7a-d	41.1b-i	38.2c-k
OSU1127	72.3e-h	65.9a-g	61.1a-g	53.6a-i	44.2a-d	37.7c-i	38.3c-k
OSU1132	72.9d-h	68.6a-g	63.9a-g	60.5a-i	38.8cd	35e-i	35.1e-k
OSU1156	77.3a-h	70.7a-g	65.7a-g	56.6a-i	50.8a-d	46.4a-i	46.9a-k
OSU1217	80.3a-h	73a-f	70.4a-e	65.3a-f	53.6a-d	48.8a-h	46.3a-k
OSU1257	85.2a-h	74.5a-e	69.4a-f	65.8a-f	53.3a-d	46.5a-i	45.4a-k
OSU1318	81.4a-h	68.8a-g	65.3a-g	56.8a-i	45.2a-d	41.2b-i	38.9c-k
OSU1337	84.1a-h	72.6a-f	66.3a-g	64.6a-g	57.7a-d	50.5a-h	49.2a-i
OSU1402	78.7a-h	62.2b-g	56.5a-g	49.6b-i	40.5b-d	35.1e-i	38.1c-k
OSU1403	81.8a-h	70.4a-g	64.8a-g	57.1a-i	46.2a-d	41.2b-i	39.3b-k
OSU1406	75a-h	59.3c-g	51.6c-g	44d-i	34d	30.5hi	31.8h-k
OSU1408	79.1a-h	66.7a-g	59a-g	52.6a-i	48.3a-d	37.4d-i	34.4e-k

OSU1409	83.6a-h	68.1a-g	61.8a-g	54.2a-i	46.4a-d	40.9b-i	41.6a-k
OSU1417	73.5c-h	66.2a-g	61.6a-g	53.4a-i	46.2a-d	39.9b-i	38.7c-k
OSU1418	87a-f	71.3a-g	64.6a-g	60.1a-i	46.5a-d	40.7b-i	37d-k
OSU1433	81a-h	63.7b-g	56.3a-g	48.9c-i	44a-d	34.1f-i	34e-k
OSU1439	86.7a-g	77.5a-e	68.1a-g	63.8a-g	51.9a-d	46.5a-i	46.8a-k
OSU1601	89a-e	74.6a-e	68.1a-g	62.4a-h	54.1a-d	48.2a-i	46.1a-k
OSU1609	84.6a-h	72.7a-f	64.3a-g	53.6a-i	49a-d	40.9b-i	39.4b-k
OSU1611	82.7a-h	68.3a-g	58.3a-g	52.6a-i	42.5b-d	36.6d-i	37.4c-k
OSU1617	87.2a-f	75.5a-e	66.9a-g	62.1a-h	55.2a-d	48.6a-h	46.5a-k
OSU1620	83.9a-h	57.4e-g	57.8a-g	42.7f-i	43.8a-d	37.3d-i	37.6c-k
OSU1625	87.8a-e	76.1a-e	65.7a-g	51.9a-i	46.8a-d	42.8a-i	43.8a-k
OSU1628	82a-h	74.5a-e	66.9a-g	58.4a-i	48.9a-d	42.1a-i	40.9a-k
OSU1629	89.1a-e	77.7a-e	67.8a-g	58.7a-i	50.4a-d	42.6a-i	44a-k
OSU1631	85.3a-h	73.2a-f	67.6a-g	59.9a-i	49.6a-d	42.7a-i	44.3a-k
OSU1638	86.4a-g	73.6a-f	66.3a-g	56.4a-i	51.9a-d	49.5a-h	50.3a-h
OSU1639	89.1a-e	75.1a-e	69.6a-f	56.6a-i	50.8a-d	43.3a-i	41.3a-k
OSU1641	85.1a-h	68.9a-g	64.1a-g	53.8a-i	47.2a-d	38.8b-i	41.9a-k
OSU1646	83.6a-h	71.9a-g	59.3a-g	53.9a-i	51.5a-d	43.5a-i	40.6a-k
OSU1649	70gh	52.5fg	46.8fg	37.9i	37.4d	31.5g-i	27.8l
OSU1651	78.5a-h	72.3a-g	66.8a-g	60a-i	48.5a-d	43.1a-i	41.9a-k
OSU1656	85.9a-g	78.1a-e	68.2a-f	59.3a-i	47.5a-d	42.7a-i	41.6a-k
OSU1657	79.4a-h	68a-g	59.9a-g	49.4b-i	44.9a-d	37.3d-i	35.8e-k
OSU1661	79.3a-h	65a-g	58a-g	50.2b-i	44.4a-d	35.3e-i	36.6e-k
OSU1662	85.8a-g	70.6a-g	63.6a-g	52a-i	42b-d	34.9e-i	32.4g-k
OSU1663	74.4b-h	58.4d-g	50.2c-g	43.4d-i	42.2b-d	35.1e-i	34.1e-k
OSU1664	88.9a-e	81.4ab	74.9ab	67a-e	55.6a-d	47.4a-i	47.5a-k
OSU1666	79.8a-h	63.8b-g	55.1b-g	48c-i	43.8a-d	40.5b-i	38.7c-k
OSU1670	82.3a-h	73.9a-e	69.2a-f	64.4a-g	53.4a-d	46.9a-i	45.1a-k
OSU1673	68.8h	51.3g	45g	41.5g-i	34.9d	31.5g-i	29kl
OSU1675	82.5a-h	72.9a-f	68.4a-f	59.2a-i	55.5a-d	49a-h	45.1a-k
OSU1680	77.2a-h	74.2a-e	67a-g	60.8a-i	50.1a-d	43.5a-i	41.2a-k
OSU1682	82.7a-h	69.2a-g	64.6a-g	57a-i	53.1a-d	46.6a-i	46.9a-k
OSU1687	80a-h	67.6a-g	58.9a-g	52.5a-i	42.5b-d	35.9e-i	43.1a-k
OSU1690	75a-h	57.4e-g	49e-g	39.6hi	34.6d	30.5hi	29.2i-l
OSU1699	88a-e	73.3a-f	60.8a-g	56.6a-i	49.6a-d	43.3a-i	42.4a-k
Tahoma31	85.5a-h	75.2a-e	71.8a-e	63.7a-g	56.4a-d	44.2a-i	44.5a-k
TifTuf	79.7a-h	65.2a-g	59.3a-g	59.6a-i	56.1a-d	50a-h	48.9a-j
Tifway	70.7g-h	63.5b-g	60.5a-g	51.8a-i	45.2a-d	42.8a-i	44.2a-k
Tilin#5	79.6a-h	76.8a-e	72a-e	63.9a-g	51.2a-d	46.9a-i	44.8a-k
U-3	78.8a-h	70.1a-g	66.8a-g	62.5a-h	50.3a-d	44.1a-i	42.3a-k

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 26. Mean visual turf quality (TQ) of 96 non-trafficked bermudagrasses on seven rating in fall-2020.

Entry	6-Sep	11-Sep	18-Sep	25-Sep	2-Oct	9-Oct	16-Oct
	---			*(1-9) scale*			---
15-4X15	8ab	8ab	7.7ab	7a-c	6.7a	6a-c	6.3a-c
15-8X3	8.3a	8ab	7.7ab	6.7a-d	6.3ab	6a-c	6a-c
18-7-1	8ab	7.7ab	7.7ab	7a-c	6.7a	6.7a-c	6.3a-c
18-7-2	8ab	8ab	8ab	7.7ab	6.7a	6.7a-c	6.7a-c
18-7-3	8.3a	8ab	7.7ab	7a-c	7a	7ab	6.7a-c
18-7-4	8ab	8ab	7.7ab	7a-c	6.7a	5.7a-d	5.3a-e
18-7-5	8ab	8ab	7.3a-c	6.7a-d	5.7ab	4.3cd	3.3de
18-7-6	8ab	8ab	8ab	7.3a-c	7.3a	7ab	7ab
18-8-1	8ab	7.7ab	7.3a-c	6.7a-d	6.3ab	6.7a-c	6a-c
18-8-2	8.7a	8ab	7.7ab	7a-c	7.3a	7ab	6.7a-c
18-8-3	8ab	8ab	7a-c	6.7a-d	7a	6.7a-c	6a-c
18-8-4	8ab	8ab	7.7ab	7a-c	6.7a	6.3a-c	6a-c
18-8-5	8ab	7.7ab	6.7a-c	6.7a-d	6.3ab	6.3a-c	6a-c
18-8-6	7.3ab	7.3ab	7a-c	6.3a-d	6.7a	6a-c	6.3a-c
18-8-7	8ab	8ab	8ab	7a-c	6.7a	7ab	6.7a-c
18-9-1	7ab	7ab	7.3a-c	6.7a-d	6.7a	6.7a-c	6a-c
18-9-10	7.7ab	7.7ab	7.3a-c	6.7a-d	6.3ab	5.7a-d	5.7a-d
18-9-11	8.3a	8ab	7.3a-c	7a-c	7a	6.3a-c	6.3a-c
18-9-12	8ab	7.3ab	6.7a-c	6.3a-d	6ab	5.7a-d	6a-c
18-9-2	7.7ab	7.7ab	7.3a-c	7a-c	7a	6.7a-c	6.7a-c
18-9-3	8ab	8ab	7.3a-c	6.7a-d	6.7a	7ab	6.3a-c
18-9-4	6.3b	6.7b	6.7a-c	6b-d	6.3ab	6a-c	6a-c
18-9-5	8ab	7.7ab	7.7ab	7a-c	6.7a	6a-c	6.3a-c
18-9-6	8ab	7.7ab	7.3a-c	7a-c	6ab	5.3a-d	5.7a-d
18-9-7	8ab	8ab	7.7ab	7.3a-c	7a	7ab	6.3a-c
18-9-8	7.7ab	8ab	7.3a-c	7a-c	7a	6.7a-c	6.7a-c
18-9-9	7.7ab	7.7ab	8ab	7a-c	7a	6.3a-c	6.7a-c
17-4200-19x13	8.7a	8ab	8.3a	7.7ab	6.3ab	6.3a-c	6.3a-c
17-4200-19x21	8ab	8ab	8ab	7a-c	7.7a	6.7a-c	6.7a-c
17-4200-19x9	8.3a	8ab	8ab	8a	7.7a	7.7a	7.3a
17-4200-36x19	8.3a	7.7ab	7.7ab	6.3a-d	5.7ab	5.7a-d	5a-e
Astro	7.7ab	7.7ab	7.3a-c	7a-c	6ab	6a-c	6.3a-c
17-5200-11X9	8.3a	7.7ab	6.3bc	6.3a-d	5.7ab	5b-d	4.3c-e
17-5200-13X9	8ab	8ab	8ab	7.3a-c	6.7a	6.3a-c	6.7a-c
17-5200-31X3	8ab	7.7ab	7.7ab	7a-c	6.7a	6.3a-c	5.7a-d
17-5200-3X23	7.7ab	7.3ab	7a-c	7a-c	6.7a	6.3a-c	6a-c
17-5200-4X11	8ab	8ab	7.7ab	7a-c	7a	7ab	6a-c
Bimini	8.3a	8.3a	8ab	7.3a-c	7a	7.3ab	7ab
2008-4x16	8ab	8ab	7.7ab	7.3a-c	7a	6.3a-c	6.3a-c
Celebration	8.3a	8ab	8ab	7.3a-c	7a	6.7a-c	6.3a-c
Latitude36	8ab	8ab	7.3a-c	7a-c	7.3a	6.7a-c	7ab
NorthBridge	7.7ab	8ab	7.3a-c	7a-c	7a	6.7a-c	6.3a-c
OKC1221	8ab	8ab	8ab	7.3a-c	7a	6a-c	6a-c
OSU1101	8.7a	8.3a	8.3a	7.7ab	7.7a	7ab	7ab
OSU1117	7.7ab	7.7ab	7.7ab	7a-c	6.7a	6a-c	5.7a-d
OSU1127	7.7ab	7.7ab	7.7ab	7.3a-c	6.7a	5.7a-d	5.7a-d
OSU1132	7.7ab	7.7ab	7.7ab	7a-c	6ab	5.3a-d	5a-e
OSU1156	8ab	8ab	7.3a-c	7a-c	6.7a	6.7a-c	6.3a-c
OSU1217	7.7ab	7.7ab	7.7ab	7.3a-c	7a	6.3a-c	6a-c
OSU1257	7.3ab	7.7ab	8ab	7a-c	6.7a	6.3a-c	5.7a-d
OSU1318	8ab	7.7ab	7.7ab	7.3a-c	7a	7ab	6.7a-c
OSU1337	8.7a	8ab	8ab	7a-c	7.3a	6.7a-c	6.3a-c
OSU1402	7.3ab	7.7ab	7.7ab	7a-c	6.3ab	6a-c	5.3a-e
OSU1403	8ab	7.3ab	7.7ab	7a-c	6.7a	5.7a-d	5.7a-d
OSU1406	7.7ab	7.7ab	7a-c	7a-c	6.7a	5.7a-d	4.3c-e
OSU1408	7.7ab	7.3ab	7.7ab	7.3a-c	6.7a	5.3a-d	4.7b-e
OSU1409	7.3ab	7.3ab	7a-c	6.3a-d	6ab	5.7a-d	6a-c

OSU1417	8ab	8ab	8ab	7.7ab	7a	6.3a-c	6a-c
OSU1418	8ab	7.7ab	8ab	7a-c	6.7a	6.3a-c	5.7a-d
OSU1433	7.7ab	7.7ab	7.7ab	7a-c	7a	6.3a-c	6a-c
OSU1439	8ab	8ab	8ab	7a-c	7a	7ab	7ab
OSU1601	8.7a	8ab	8ab	7.3a-c	7.3a	6.3a-c	6.3a-c
OSU1609	7.7ab	7.7ab	7.3a-c	7a-c	7a	6.7a-c	5.7a-d
OSU1611	7.7ab	7.3ab	6.7a-c	6.7a-d	5.7ab	5.7a-d	5a-e
OSU1617	8ab	8ab	8ab	7.3a-c	7a	6.7a-c	6.3a-c
OSU1620	7ab	7.3ab	6.7a-c	5.7cd	5.3ab	5.7a-d	5.3a-e
OSU1625	8ab	8ab	8ab	6.7a-d	6.7a	6.3a-c	6a-c
OSU1628	8ab	8ab	7.3a-c	6.3a-d	7a	6a-c	6a-c
OSU1629	7.7ab	8ab	8ab	7.7ab	7.3a	6.7a-c	5.7a-d
OSU1631	8ab	8ab	7.7ab	6.7a-d	7a	6a-c	6a-c
OSU1638	8ab	8ab	7.3a-c	6.7a-d	7a	6.7a-c	6.7a-c
OSU1639	8ab	7.7ab	8ab	7.3a-c	7a	6.3a-c	6a-c
OSU1641	7.7ab	7.7ab	7.3a-c	6.3a-d	7a	6.3a-c	5.7a-d
OSU1646	8.3a	8ab	8ab	7a-c	7.3a	7ab	6.3a-c
OSU1649	7.3ab	7.3ab	6.7a-c	6.3a-d	6.3ab	5b-d	4.7b-e
OSU1651	7.7ab	7.7ab	7.3a-c	7a-c	7.3a	6a-c	5.7a-d
OSU1656	8ab	8ab	8ab	7a-c	7a	6.3a-c	6a-c
OSU1657	8ab	7.7ab	7.7ab	7.3a-c	7a	6a-c	6a-c
OSU1661	7.7ab	7.7ab	7.7ab	6.3a-d	5.7ab	5b-d	5a-e
OSU1662	8ab	8.3a	8ab	7a-c	7a	6.3a-c	6a-c
OSU1663	7.7ab	7ab	7a-c	6b-d	5.7ab	5b-d	5a-e
OSU1664	8ab	7.7ab	7.7ab	6.7a-d	6ab	5.7a-d	5.7a-d
OSU1666	7ab	7.7ab	7a-c	6.3a-d	5.3ab	5.3a-d	5.7a-d
OSU1670	7.7ab	7.7ab	7.3a-c	6.7a-d	6.3ab	5.7a-d	5.7a-d
OSU1673	7ab	7ab	5.7c	5d	4b	3.3d	3e
OSU1675	8ab	8ab	8ab	8a	7a	6.7a-c	5.7a-d
OSU1680	7.7ab	7.3ab	7.7ab	7a-c	6.7a	6.7a-c	6.7a-c
OSU1682	7.3ab	7.3ab	7.3a-c	6.7a-d	6.3ab	6.3a-c	5.7a-d
OSU1687	7.3ab	7.7ab	7a-c	6.7a-d	6ab	5.3a-d	5.3a-e
OSU1690	7.7ab	7.7ab	7.3a-c	7a-c	7a	6a-c	5a-e
OSU1699	8ab	8ab	8ab	7a-c	6.7a	6.3a-c	5.3a-e
Tahoma31	8.3a	7.7ab	8ab	7a-c	6.7a	6.3a-c	6a-c
TifTuf	8.3a	8ab	7.7ab	7.3a-c	7a	7ab	7.3a
Tifway	7.7ab	7.7ab	7.3a-c	6.7a-d	6.7a	5.7a-d	6a-c
Tilin#5	8ab	7.7ab	7.3a-c	7a-c	6.3ab	6.7a-c	6.3a-c
U-3	8ab	8ab	8ab	7.3a-c	7a	6.3a-c	6.3a-c

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 27. Mean visual turf quality (TQ) of 96 trafficked bermudagrasses on seven rating dates in fall-2020.

Entry	6-Sep (0 events)	11-Sep (10 events)	18-Sep (20 events)	25-Sep (30 events)	2-Oct (40 events)	9-Oct (50 events)	16-Oct (60 events)
	-----	-----	-----	*(1-9) scale*	-----	-----	-----
15-4X15	8a-c	7.3	6.3a-d	5a-f	4.7a-d	3.7a-e	3.3b-h
15-8X3	8.3ab	7.3	6.3a-d	4.3c-f	3.3b-d	2.3de	2.7d-h
18-7-1	8a-c	7	6.3a-d	5.7a-e	6a-c	5.3a-d	5.3a-e
18-7-2	8a-c	7	7.7ab	6.7ab	6.3ab	5.7a-c	5.3a-e
18-7-3	8.3ab	8	7a-c	5a-f	5.7a-c	5.3a-d	4.7a-g
18-7-4	8a-c	7	6.7a-d	6a-d	5.7a-c	4a-e	2.7d-h
18-7-5	8a-c	7	6.7a-d	5.7a-e	4a-d	2.7c-e	1.3h
18-7-6	8a-c	7.3	7.3a-c	6a-d	6.3ab	5.7a-c	5.3a-e
18-8-1	8a-c	6.7	6a-d	6a-d	4.7a-d	4a-e	4a-h
18-8-2	8.7a	7.3	7a-c	5.3a-e	6a-c	5.7a-c	6a-c
18-8-3	8a-c	7.3	6.7a-d	5.7a-e	6a-c	4.7a-e	4.7a-g
18-8-4	8a-c	7.7	6.7a-d	5.7a-e	5a-d	4.3a-e	3.7a-h
18-8-5	8a-c	7.3	6.7a-d	5.7a-e	5.3a-d	4.7a-e	4a-h
18-8-6	7.3a-c	6.7	6.3a-d	4.7b-f	4.7a-d	3.3b-e	4.3a-h
18-8-7	8a-c	7.3	6.7a-d	5.3a-e	4.7a-d	5a-e	5a-f
18-9-1	7a-c	6.3	6a-d	5.7a-e	4.7a-d	4a-e	3.7a-h
18-9-10	7.7a-c	7	6.7a-d	5.7a-e	5a-d	4.7a-e	5.3a-e
18-9-11	8a-c	6.7	6.3a-d	6a-d	5.3a-d	5a-e	4.3a-h
18-9-12	8a-c	6.7	6.3a-d	5.3a-e	4.3a-d	3c-e	3.7a-h
18-9-2	7.7a-c	6.7	6a-d	5.7a-e	5.3a-d	5a-e	5.3a-e
18-9-3	8a-c	7	6.7a-d	5.3a-e	5.7a-c	5.3a-d	4.7a-g
18-9-4	6.3c	6	5.3b-d	5.3a-e	4.3a-d	4a-e	4a-h
18-9-5	8a-c	7	6.7a-d	6a-d	5.7a-c	4.3a-e	4.7a-g
18-9-6	8a-c	6.7	6.3a-d	5.7a-e	5.3a-d	3.3b-e	3.7a-h
18-9-7	8a-c	7.7	7.3a-c	5.3a-e	6a-c	3.7a-e	3.7a-h
18-9-8	7.7a-c	7	7a-c	5.7a-e	5.7a-c	5a-e	4.7a-g
18-9-9	7.7a-c	6.3	6.7a-d	5a-f	5.3a-d	4.3a-e	3.7a-h
17-4200-19x13	8.3ab	7.7	7a-c	6.3a-d	5.7a-c	5.3a-d	5.3a-e
17-4200-19x21	8a-c	7.7	7a-c	5.7a-e	5.3a-d	4.3a-e	4.3a-h
17-4200-19x9	8.3ab	8	7.7ab	7.3a	7a	6.3ab	6.3ab
17-4200-36x19	8.3ab	7.7	6a-d	4.7b-f	4.3a-d	3.3b-e	2.7d-h
Astro	7.7a-c	7	7a-c	5.7a-e	5.3a-d	4a-e	4a-h
17-5200-11X9	8.7a	7	6a-d	4.7b-f	4.3a-d	4a-e	3.7a-h
17-5200-13X9	8a-c	7.3	6.7a-d	6a-d	4.7a-d	3.3b-e	2.3e-h
17-5200-31X3	8a-c	7.3	6.3a-d	5.7a-e	4.7a-d	4a-e	2.7d-h
17-5200-3X23	7.3a-c	7	6.3a-d	5.7a-e	4.7a-d	5.3a-d	4.7a-g
17-5200-4X11	7.7a-c	7.3	7.3a-c	5.7a-e	6.3ab	5.3a-d	4.3a-h
Bimini	8.3ab	7.3	7.3a-c	6.7a-c	6.3ab	6.7a	6.7a
2008-4x16	7.7a-c	7	6.3a-d	5.7a-e	4.7a-d	3.7a-e	3.7a-h
Celebration	8.3ab	8	7.7ab	6a-d	6.3ab	5a-e	4.3a-h
Latitude36	8a-c	7	7a-c	6a-d	6.3ab	5.7a-c	6a-c
NorthBridge	7.7a-c	7.3	6.7a-d	6a-d	5.7a-c	5a-e	5.3a-e
OKC1221	8a-c	7	7a-c	5.7a-e	5.3a-d	3.7a-e	4.3a-h
OSU1101	8.7a	8	7.7ab	6.7ab	7a	5.7a-c	6.3ab
OSU1117	7.7a-c	7.3	7a-c	5.7a-e	5.3a-d	4.3a-e	3.7a-h
OSU1127	8a-c	7.3	7a-c	5.7a-e	5.7a-c	4.7a-e	4a-h
OSU1132	7.7a-c	7	7a-c	6a-d	4.3a-d	3c-e	3c-h
OSU1156	8a-c	7	7a-c	5.7a-e	4.3a-d	4a-e	5a-f
OSU1217	7.7a-c	7	7a-c	6a-d	6.3ab	5.7a-c	5.3a-e
OSU1257	7.3a-c	7	7a-c	5.7a-e	5a-d	4.7a-e	4.3a-h
OSU1318	8a-c	7	7a-c	6.3a-d	6.3ab	5.7a-c	5a-f
OSU1337	8.7a	7.3	7a-c	6.3a-d	6a-c	5.3a-d	5a-f
OSU1402	7.3a-c	7	6.3a-d	5a-f	4.3a-d	3.3b-e	3c-h
OSU1403	8a-c	7.3	7.3a-c	5.3a-e	5a-d	4a-e	3c-h
OSU1406	7.7a-c	6.7	6.3a-d	5a-f	4a-d	2.7c-e	3c-h
OSU1408	7.7a-c	6.7	6.3a-d	5.7a-e	5.3a-d	3.7a-e	3c-h

OSU1409	7.3a-c	6.3	6.3a-d	4.7b-f	4.3a-d	3.7a-e	2.7d-h
OSU1417	8a-c	7.7	7a-c	6a-d	4.3a-d	4.3a-e	4a-h
OSU1418	8a-c	7	6.7a-d	5.7a-e	5.3a-d	4.3a-e	4a-h
OSU1433	7.7a-c	7	6.7a-d	6a-d	5a-d	4.7a-e	3c-h
OSU1439	8a-c	7.7	7a-c	6a-d	6a-c	5a-e	4.7a-g
OSU1601	8.7a	8	7.3a-c	6.7a-c	6a-c	5.3a-d	4.7a-g
OSU1609	7.7a-c	7	5.7a-d	4.7b-f	4.3a-d	3c-e	2.3e-h
OSU1611	7.7a-c	6.7	5.3b-d	4.3c-f	3c-d	2.7c-e	1.3h
OSU1617	7.3a-c	7.3	6.7a-d	5.3a-e	5a-d	4.3a-e	4a-h
OSU1620	7.3a-c	6.3	5cd	3.3ef	2.3d	2.7c-e	2f-h
OSU1625	8a-c	7	6.3a-d	5a-f	4.3a-d	4.3a-e	4.3a-h
OSU1628	8a-c	7	6.7a-d	4.7b-f	5a-d	4a-e	3.7a-h
OSU1629	6.7bc	6.3	6a-d	5.7a-e	5a-d	4a-e	3.3b-h
OSU1631	8a-c	7.3	6.7a-d	5.7a-e	5a-d	4.7a-e	4.3a-h
OSU1638	8a-c	7.3	6.3a-d	5.7a-e	5.3a-d	5a-e	4.7a-g
OSU1639	8a-c	7	6.7a-d	5.3a-e	4.3a-d	4a-e	3.7a-h
OSU1641	7.7a-c	7.3	6.3a-d	4.3c-f	4a-d	3.7a-e	2.7d-h
OSU1646	8.3ab	7.3	7a-c	5.3a-e	5.3a-d	4.3a-e	3.3b-h
OSU1649	7.3a-c	6	5.3b-d	5.3a-e	3c-d	2.3de	1.7gh
OSU1651	7.7a-c	7	7a-c	5.3a-e	5.3a-d	4a-e	4a-h
OSU1656	8a-c	7.3	7a-c	6a-d	5.3a-d	4a-e	3.7a-h
OSU1657	8a-c	7.3	6.7a-d	5.3a-e	4.7a-d	3.7a-e	2.7d-h
OSU1661	7.7a-c	7	6.7a-d	4.7b-f	4a-d	2.3de	2f-h
OSU1662	8a-c	7.7	7a-c	5.3a-e	4.7a-d	3.7a-e	2.7d-h
OSU1663	7.7a-c	6.3	5.7a-d	4d-f	3c-d	2.3de	1.3h
OSU1664	8a-c	7	7a-c	5.7a-e	6a-c	5.3a-d	5a-f
OSU1666	7a-c	6.3	6.3a-d	4d-f	3.3b-d	3c-e	2.7d-h
OSU1670	7.7a-c	7	7a-c	6a-d	5.7a-c	5.3a-d	4a-h
OSU1673	7a-c	6	4.3d	2.6667f	2.3d	2e	1.3h
OSU1675	8a-c	8	8a	7ab	6.3ab	5.7a-c	4.7a-g
OSU1680	7.7a-c	7.3	6.7a-d	6a-d	4a-d	4.7a-e	4a-h
OSU1682	7.3a-c	7	6a-d	5a-f	4a-d	4a-e	4a-h
OSU1687	7.3a-c	7	6.3a-d	5a-f	4a-d	2.7c-e	2.3e-h
OSU1690	7.7a-c	6	5.3b-d	4d-f	3.3b-d	2.7c-e	1.3h
OSU1699	8a-c	7.7	7a-c	6a-d	5a-d	4.7a-e	3c-h
Tahoma31	8.3ab	7.3	7a-c	6a-d	5.3a-d	5a-e	4.7a-g
TifTuf	8.3ab	7	7a-c	6a-d	6a-c	5.7a-c	6.3ab
Tifway	7.3a-c	6.7	7a-c	5.7a-e	4.7a-d	4a-e	4a-h
Tilin#5	8a-c	7	6.7a-d	6a-d	5.3a-d	5.3a-d	5.7a-d
U-3	8a-c	7.3	7.3a-c	6.3a-d	6.7a	5.3a-d	6a-c

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 28. Simple effects of traffic on TQ of 96 bermudagrasses on seven rating dates in fall-2020.

Entry	6-Sep (0 events)	11-Sep (10 events)	18-Sep (20 events)	25-Sep (30 events)	2-Oct (40 events)	9-Oct (50 events)	16-Oct (60 events)
	-----	-----	-----	*p-value*	-----	-----	-----
15-4X15	1	0.0348	0.0002	<.0001	<.0001	<.0001	<.0001
15-8X3	1	0.0348	0.0002	<.0001	<.0001	<.0001	<.0001
18-7-1	1	0.0348	0.0002	0.0004	0.186	0.008	0.0567
18-7-2	1	0.0017	0.347	0.0072	0.5077	0.0459	0.0113
18-7-3	1	1	0.0609	<.0001	0.0086	0.001	0.0002
18-7-4	1	0.0017	0.0052	0.0072	0.0479	0.001	<.0001
18-7-5	1	0.0017	0.0609	0.0072	0.0011	0.001	0.0002
18-7-6	1	0.0348	0.0609	0.0004	0.0479	0.008	0.0016
18-8-1	1	0.0017	0.0002	0.0716	0.0011	<.0001	0.0002
18-8-2	1	0.0348	0.0609	<.0001	0.0086	0.008	0.2027
18-8-3	1	0.0348	0.347	0.0072	0.0479	<.0001	0.0113
18-8-4	1	0.2892	0.0052	0.0004	0.0011	<.0001	<.0001
18-8-5	1	0.2892	1	0.0072	0.0479	0.001	0.0002
18-8-6	1	0.0348	0.0609	<.0001	<.0001	<.0001	0.0002
18-8-7	1	0.0348	0.0002	<.0001	<.0001	<.0001	0.0016
18-9-1	1	0.0348	0.0002	0.0072	<.0001	<.0001	<.0001
18-9-10	1	0.0348	0.0609	0.0072	0.0086	0.0459	0.5235
18-9-11	0.038	<.0001	0.0052	0.0072	0.0011	0.008	0.0002
18-9-12	1	0.0348	0.347	0.0072	0.0011	<.0001	<.0001
18-9-2	1	0.0017	0.0002	0.0004	0.0011	0.001	0.0113
18-9-3	1	0.0017	0.0609	0.0004	0.0479	0.001	0.0016
18-9-4	1	0.0348	0.0002	0.0716	<.0001	<.0001	0.0002
18-9-5	1	0.0348	0.0052	0.0072	0.0479	0.001	0.0016
18-9-6	1	0.0017	0.0052	0.0004	0.186	<.0001	0.0002
18-9-7	1	0.2892	0.347	<.0001	0.0479	<.0001	<.0001
18-9-8	1	0.0017	0.347	0.0004	0.0086	0.001	0.0002
18-9-9	1	<.0001	0.0002	<.0001	0.0011	<.0001	<.0001
17-4200-19x13	0.038	0.2892	0.0002	0.0004	0.186	0.0459	0.0567
17-4200-19x21	1	0.2892	0.0052	0.0004	<.0001	<.0001	<.0001
17-4200-19x9	1	1	0.347	0.0716	0.186	0.008	0.0567
17-4200-36x19	1	1	<.0001	<.0001	0.0086	<.0001	<.0001
Astro	1	0.0348	0.347	0.0004	0.186	<.0001	<.0001
17-5200-11X9	0.038	0.0348	0.347	<.0001	0.0086	0.0459	0.2027
17-5200-13X9	1	0.0348	0.0002	0.0004	<.0001	<.0001	<.0001
17-5200-31X3	1	0.2892	0.0002	0.0004	<.0001	<.0001	<.0001
17-5200-3X23	0.038	0.2892	0.0609	0.0004	<.0001	0.0459	0.0113
17-5200-4X11	0.038	0.0348	0.347	0.0004	0.186	0.001	0.0016
Bimini	1	0.0017	0.0609	0.0716	0.186	0.182	0.5235
2008-4x16	0.038	0.0017	0.0002	<.0001	<.0001	<.0001	<.0001
Celebration	1	1	0.347	0.0004	0.186	0.001	0.0002
Latitude36	1	0.0017	0.347	0.0072	0.0479	0.0459	0.0567
NorthBridge	1	0.0348	0.0609	0.0072	0.0086	0.001	0.0567
OKC1221	1	0.0017	0.0052	<.0001	0.0011	<.0001	0.0016
OSU1101	1	0.2892	0.0609	0.0072	0.186	0.008	0.2027
OSU1117	1	0.2892	0.0609	0.0004	0.0086	0.001	0.0002
OSU1127	0.038	0.2892	0.0609	<.0001	0.0479	0.0459	0.0016
OSU1132	1	0.0348	0.0609	0.0072	0.0011	<.0001	0.0002
OSU1156	1	0.0017	0.347	0.0004	<.0001	<.0001	0.0113
OSU1217	1	0.0348	0.0609	0.0004	0.186	0.182	0.2027
OSU1257	1	0.0348	0.0052	0.0004	0.0011	0.001	0.0113
OSU1318	1	0.0348	0.0609	0.0072	0.186	0.008	0.0016
OSU1337	1	0.0348	0.0052	0.0716	0.0086	0.008	0.0113
OSU1402	1	0.0348	0.0002	<.0001	<.0001	<.0001	<.0001
OSU1403	1	1	0.347	<.0001	0.0011	0.001	<.0001
OSU1406	1	0.0017	0.0609	<.0001	<.0001	<.0001	0.0113
OSU1408	1	0.0348	0.0002	<.0001	0.0086	0.001	0.0016

OSU1409	1	0.0017	0.0609	<.0001	0.0011	<.0001	<.0001
OSU1417	1	0.2892	0.0052	<.0001	<.0001	<.0001	0.0002
OSU1418	1	0.0348	0.0002	0.0004	0.0086	<.0001	0.0016
OSU1433	1	0.0348	0.0052	0.0072	<.0001	0.001	<.0001
OSU1439	1	0.2892	0.0052	0.0072	0.0479	<.0001	<.0001
OSU1601	1	1	0.0609	0.0716	0.0086	0.0459	0.0016
OSU1609	1	0.0348	<.0001	<.0001	<.0001	<.0001	<.0001
OSU1611	1	0.0348	0.0002	<.0001	<.0001	<.0001	<.0001
OSU1617	<.0001	0.0348	0.0002	<.0001	<.0001	<.0001	<.0001
OSU1620	0.038	0.0017	<.0001	<.0001	<.0001	<.0001	<.0001
OSU1625	1	0.0017	<.0001	<.0001	<.0001	<.0001	0.0016
OSU1628	1	0.0017	0.0609	<.0001	<.0001	<.0001	<.0001
OSU1629	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
OSU1631	1	0.0348	0.0052	0.0072	<.0001	0.008	0.0016
OSU1638	1	0.0348	0.0052	0.0072	0.0011	0.001	0.0002
OSU1639	1	0.0348	0.0002	<.0001	<.0001	<.0001	<.0001
OSU1641	1	0.2892	0.0052	<.0001	<.0001	<.0001	<.0001
OSU1646	1	0.0348	0.0052	<.0001	<.0001	<.0001	<.0001
OSU1649	1	<.0001	0.0002	0.0072	<.0001	<.0001	<.0001
OSU1651	1	0.0348	0.347	<.0001	<.0001	<.0001	0.0016
OSU1656	1	0.0348	0.0052	0.0072	0.0011	<.0001	<.0001
OSU1657	1	0.2892	0.0052	<.0001	<.0001	<.0001	<.0001
OSU1661	1	0.0348	0.0052	<.0001	0.0011	<.0001	<.0001
OSU1662	1	0.0348	0.0052	<.0001	<.0001	<.0001	<.0001
OSU1663	1	0.0348	0.0002	<.0001	<.0001	<.0001	<.0001
OSU1664	1	0.0348	0.0609	0.0072	1	0.5038	0.2027
OSU1666	1	<.0001	0.0609	<.0001	<.0001	<.0001	<.0001
OSU1670	1	0.0348	0.347	0.0716	0.186	0.5038	0.0016
OSU1673	1	0.0017	0.0002	<.0001	0.0011	0.008	0.0016
OSU1675	1	1	1	0.0072	0.186	0.0459	0.0567
OSU1680	1	1	0.0052	0.0072	<.0001	<.0001	<.0001
OSU1682	1	0.2892	0.0002	<.0001	<.0001	<.0001	0.0016
OSU1687	1	0.0348	0.0609	<.0001	<.0001	<.0001	<.0001
OSU1690	1	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
OSU1699	1	0.2892	0.0052	0.0072	0.0011	0.001	<.0001
Tahoma31	1	0.2892	0.0052	0.0072	0.0086	0.008	0.0113
TifTuf	1	0.0017	0.0609	0.0004	0.0479	0.008	0.0567
Tifway	0.038	0.0017	0.347	0.0072	<.0001	0.001	0.0002
Tilin#5	1	0.0348	0.0609	0.0072	0.0479	0.008	0.2027
U-3	1	0.0348	0.0609	0.0072	0.5077	0.0459	0.5235

Table 29. Mean NDVI of 96 non-trafficked bermudagrasses on seven rating dates in fall-2020.

Entry	6-Sep	11-Sep	18-Sep	25-Sep	2-Oct	9-Oct	16-Oct
15-4X15	0.737a	0.756a	0.717a-c	0.74a	0.64a-e	0.642a-g	0.68a-c
15-8X3	0.719ab	0.73a-c	0.673a-e	0.702a-c	0.599a-f	0.609a-h	0.63a-e
18-7-1	0.709ab	0.716a-c	0.672a-e	0.698a-c	0.635a-f	0.631a-g	0.68a-c
18-7-2	0.704ab	0.717a-c	0.666a-e	0.691a-c	0.607a-f	0.638a-g	0.67a-d
18-7-3	0.691ab	0.704a-c	0.675a-e	0.694a-c	0.616a-f	0.615a-h	0.66a-d
18-7-4	0.686ab	0.702a-c	0.668a-e	0.674a-c	0.597a-f	0.57b-h	0.62a-f
18-7-5	0.699ab	0.675a-c	0.662a-e	0.66a-c	0.548ef	0.503gh	0.54d-f
18-7-6	0.72ab	0.749ab	0.722a-c	0.727ab	0.654a-e	0.657a-e	0.7a-c
18-8-1	0.706ab	0.721a-c	0.691a-d	0.702a-c	0.714a	0.701ab	0.72ab
18-8-2	0.759a	0.755a	0.722a-c	0.746a	0.697a-d	0.702ab	0.73ab
18-8-3	0.696ab	0.701a-c	0.679a-e	0.71ab	0.614a-f	0.652a-e	0.68a-c
18-8-4	0.729ab	0.72a-c	0.702a-d	0.715ab	0.64a-e	0.64a-g	0.67a-d
18-8-5	0.653ab	0.687a-c	0.649a-e	0.683a-c	0.62a-f	0.641a-g	0.67a-c
18-8-6	0.666ab	0.672a-c	0.627a-e	0.652a-c	0.602a-f	0.615a-h	0.66a-d
18-8-7	0.747a	0.738ab	0.727a-c	0.752a	0.707ab	0.72a	0.75a
18-9-1	0.652ab	0.649a-c	0.624b-e	0.662a-c	0.612a-f	0.624a-h	0.66a-d
18-9-10	0.685ab	0.694a-c	0.651a-e	0.656a-c	0.58a-f	0.534d-h	0.61b-f
18-9-11	0.712ab	0.715a-c	0.679a-e	0.696a-c	0.6a-f	0.598a-h	0.65a-e
18-9-12	0.658ab	0.685a-c	0.656a-e	0.679a-c	0.587a-f	0.609a-h	0.66a-d
18-9-2	0.741a	0.753a	0.734a-c	0.751a	0.701a-c	0.694a-c	0.73ab
18-9-3	0.744a	0.725a-c	0.673a-e	0.697a-c	0.647a-e	0.63a-g	0.67a-d
18-9-4	0.69ab	0.711a-c	0.7a-d	0.711ab	0.659a-e	0.66a-e	0.7a-c
18-9-5	0.69ab	0.7a-c	0.656a-e	0.696a-c	0.591a-f	0.628a-g	0.68a-c
18-9-6	0.705ab	0.706a-c	0.632a-e	0.641a-c	0.549ef	0.557c-h	0.61b-f
18-9-7	0.762a	0.751a	0.712a-c	0.74a	0.671a-e	0.667a-e	0.7a-c
18-9-8	0.68ab	0.697a-c	0.649a-e	0.691a-c	0.65a-e	0.6a-h	0.66a-d
18-9-9	0.704ab	0.726a-c	0.687a-d	0.718ab	0.657a-e	0.669a-e	0.7a-c
17-4200-19x13	0.769a	0.771a	0.733a-c	0.724ab	0.676a-e	0.65a-e	0.7a-c
17-4200-19x21	0.712ab	0.714a-c	0.699a-d	0.721ab	0.642a-e	0.645a-e	0.68a-c
17-4200-19x9	0.776a	0.782a	0.753a	0.761a	0.7a-d	0.693a-c	0.71ab
17-4200-36x19	0.768a	0.76a	0.73a-c	0.726ab	0.688a-d	0.661a-e	0.69a-c
Astro	0.714ab	0.719a-c	0.663a-e	0.68a-c	0.615a-f	0.612a-h	0.64a-e
17-5200-11X9	0.592b	0.596c	0.554e	0.564c	0.501f	0.486h	0.52ef
17-5200-13X9	0.744a	0.757a	0.709a-c	0.72ab	0.632a-f	0.636a-g	0.67a-d
17-5200-31X3	0.733a	0.753a	0.73a-c	0.742a	0.673a-e	0.66a-e	0.68a-c
17-5200-3X23	0.719ab	0.722a-c	0.696a-d	0.712ab	0.658a-e	0.65a-e	0.67a-c
17-5200-4X11	0.768a	0.745ab	0.73a-c	0.746a	0.67a-e	0.667a-e	0.69a-c
Bimini	0.739a	0.735ab	0.741a-c	0.742a	0.685a-e	0.705ab	0.73ab
2008-4x16	0.731ab	0.733ab	0.709a-c	0.722ab	0.661a-e	0.647a-e	0.68a-c
Celebration	0.739a	0.75a	0.722a-c	0.725ab	0.674a-e	0.655a-e	0.68a-c
Latitude36	0.732ab	0.743ab	0.693a-d	0.703a-c	0.644a-e	0.636a-g	0.67a-c
NorthBridge	0.684ab	0.728a-c	0.697a-d	0.696a-c	0.644a-e	0.626a-h	0.66a-d
OKC1221	0.729ab	0.722a-c	0.696a-d	0.728ab	0.627a-f	0.611a-h	0.65a-e
OSU1101	0.767a	0.76a	0.748ab	0.758a	0.698a-d	0.688a-c	0.7a-c
OSU1117	0.73ab	0.73a-c	0.716a-c	0.725ab	0.649a-e	0.638a-g	0.68a-c
OSU1127	0.67ab	0.674a-c	0.646a-e	0.671a-c	0.597a-f	0.6a-h	0.64a-e
OSU1132	0.727ab	0.722a-c	0.713a-c	0.694a-c	0.623a-f	0.605a-h	0.64a-e
OSU1156	0.724ab	0.738ab	0.705a-c	0.728ab	0.648a-e	0.648a-e	0.67a-c
OSU1217	0.668ab	0.667a-c	0.657a-e	0.674a-c	0.593a-f	0.585a-h	0.62a-f
OSU1257	0.768a	0.78a	0.723a-c	0.74a	0.657a-e	0.649a-e	0.69a-c
OSU1318	0.694ab	0.716a-c	0.696a-d	0.719ab	0.636a-f	0.636a-g	0.67a-c
OSU1337	0.724ab	0.732ab	0.732a-c	0.745a	0.663a-e	0.649a-e	0.67a-d
OSU1402	0.747a	0.742ab	0.742a-c	0.745a	0.66a-e	0.652a-e	0.69a-c
OSU1403	0.697ab	0.695a-c	0.694a-d	0.713ab	0.645a-e	0.629a-g	0.66a-d
OSU1406	0.697ab	0.712a-c	0.693a-d	0.683a-c	0.576b-f	0.573b-h	0.63a-e
OSU1408	0.709ab	0.733ab	0.696a-d	0.716ab	0.641a-e	0.614a-h	0.64a-e
OSU1409	0.705ab	0.705a-c	0.652a-e	0.655a-c	0.606a-f	0.623a-h	0.65a-d
OSU1417	0.681ab	0.72a-c	0.694a-d	0.71ab	0.612a-f	0.616a-h	0.66a-d

OSU1418	0.726ab	0.738ab	0.717a-c	0.723ab	0.669a-e	0.663a-e	0.66a-d
OSU1433	0.71ab	0.727a-c	0.694a-d	0.707ab	0.642a-e	0.632a-g	0.68a-c
OSU1439	0.689ab	0.739ab	0.729a-c	0.748a	0.673a-e	0.674a-d	0.7a-c
OSU1601	0.776a	0.745ab	0.71a-c	0.715ab	0.646a-e	0.621a-h	0.65a-d
OSU1609	0.721ab	0.724a-c	0.704a-c	0.711ab	0.657a-e	0.644a-e	0.68a-c
OSU1611	0.683ab	0.696a-c	0.649a-e	0.689a-c	0.598a-f	0.605a-h	0.64a-e
OSU1617	0.78a	0.774a	0.753a	0.776a	0.703a-c	0.688a-c	0.72ab
OSU1620	0.703ab	0.69a-c	0.656a-e	0.656a-c	0.586a-f	0.607a-h	0.64a-e
OSU1625	0.743a	0.733ab	0.693a-d	0.696a-c	0.632a-f	0.639a-g	0.68a-c
OSU1628	0.716ab	0.719a-c	0.661a-e	0.689a-c	0.611a-f	0.616a-h	0.64a-e
OSU1629	0.778a	0.775a	0.742a-c	0.745a	0.683a-e	0.648a-e	0.69a-c
OSU1631	0.73ab	0.737ab	0.68a-e	0.699a-c	0.654a-e	0.637a-g	0.67a-c
OSU1638	0.713ab	0.708a-c	0.661a-e	0.662a-c	0.6a-f	0.601a-h	0.63a-e
OSU1639	0.755a	0.76a	0.741a-c	0.76a	0.695a-d	0.688a-c	0.71a-c
OSU1641	0.706ab	0.714a-c	0.653a-e	0.673a-c	0.596a-f	0.596a-h	0.63a-e
OSU1646	0.69ab	0.714a-c	0.688a-d	0.685a-c	0.605a-f	0.612a-h	0.65a-e
OSU1649	0.672ab	0.681a-c	0.623b-e	0.639a-c	0.563d-f	0.558c-h	0.6b-f
OSU1651	0.699ab	0.722a-c	0.672a-e	0.694a-c	0.616a-f	0.605a-h	0.65a-d
OSU1656	0.743a	0.743ab	0.695a-d	0.712ab	0.656a-e	0.641a-g	0.66a-d
OSU1657	0.663ab	0.714a-c	0.699a-d	0.698a-c	0.622a-f	0.611a-h	0.65a-e
OSU1661	0.669ab	0.7a-c	0.629a-e	0.658a-c	0.548ef	0.531e-h	0.58c-f
OSU1662	0.692ab	0.718a-c	0.681a-d	0.7a-c	0.637a-f	0.639a-g	0.66a-d
OSU1663	0.676ab	0.662a-c	0.642a-e	0.668a-c	0.567c-f	0.57b-h	0.61a-f
OSU1664	0.706ab	0.717a-c	0.677a-e	0.679a-c	0.589a-f	0.581a-h	0.61a-f
OSU1666	0.701ab	0.698a-c	0.615c-e	0.661a-c	0.569c-f	0.571b-h	0.63a-e
OSU1670	0.711ab	0.717a-c	0.702a-d	0.724ab	0.617a-f	0.637a-g	0.67a-d
OSU1673	0.657ab	0.614bc	0.576de	0.595bc	0.502f	0.503f-h	0.48f
OSU1675	0.701ab	0.692a-c	0.66a-e	0.675a-c	0.587a-f	0.593a-h	0.62a-e
OSU1680	0.71ab	0.702a-c	0.679a-e	0.7a-c	0.641a-e	0.631a-g	0.66a-d
OSU1682	0.673ab	0.684a-c	0.663a-e	0.663a-c	0.605a-f	0.617a-h	0.66a-d
OSU1687	0.717ab	0.699a-c	0.666a-e	0.706ab	0.614a-f	0.603a-h	0.65a-e
OSU1690	0.711ab	0.717a-c	0.689a-d	0.7a-c	0.627a-f	0.625a-h	0.64a-e
OSU1699	0.746a	0.744ab	0.72a-c	0.722ab	0.641a-e	0.616a-h	0.65a-e
Tahoma31	0.747a	0.735ab	0.721a-c	0.724ab	0.643a-e	0.616a-h	0.66a-d
TifTuf	0.709ab	0.71a-c	0.701a-d	0.698a-c	0.659a-e	0.65a-e	0.68a-c
Tifway	0.683ab	0.684a-c	0.678a-e	0.681a-c	0.634a-f	0.627a-h	0.66a-d
Tilin#5	0.662ab	0.695a-c	0.668a-e	0.685a-c	0.594a-f	0.583a-h	0.64a-e
U-3	0.712ab	0.705a-c	0.676a-e	0.684a-c	0.638a-f	0.622a-h	0.66a-d

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 30. Mean NDVI of 96 trafficked bermudagrasses on seven rating dates in fall-2020.

Entry	6-Sep (0 events)	11-Sep (10 events)	18-Sep (20 events)	25-Sep (30 events)	2-Oct (40 events)	9-Oct (50 events)	16-Oct (60 events)
15-4X15	0.757a-n	0.74a-e	0.663a-e	0.618a-f	0.523a-h	0.476a-e	0.532a-k
15-8X3	0.748a-p	0.681a-f	0.569de	0.562b-f	0.49b-h	0.466a-e	0.521a-k
18-7-1	0.719b-u	0.679a-f	0.629a-e	0.627a-f	0.56a-h	0.541a-d	0.581a-h
18-7-2	0.714b-v	0.708a-f	0.656a-e	0.651a-f	0.573a-h	0.546a-d	0.597a-f
18-7-3	0.686h-v	0.669a-f	0.646a-e	0.628a-f	0.547a-h	0.495a-e	0.517a-k
18-7-4	0.682j-v	0.656a-f	0.59b-e	0.588a-f	0.514a-h	0.454a-e	0.501b-k
18-7-5	0.713b-v	0.673a-f	0.59b-e	0.587a-f	0.493a-h	0.409de	0.423jk
18-7-6	0.714b-v	0.699a-f	0.669a-e	0.66a-f	0.597a-d	0.576ab	0.617a-d
18-8-1	0.702b-v	0.654a-f	0.606b-e	0.608a-f	0.574a-h	0.525a-e	0.57a-j
18-8-2	0.768a-i	0.724a-f	0.676a-e	0.675a-d	0.593a-e	0.563a-d	0.606a-f
18-8-3	0.71b-v	0.699a-f	0.66a-e	0.665a-f	0.599a-d	0.582ab	0.618a-c
18-8-4	0.707b-v	0.692a-f	0.597b-e	0.578a-f	0.496a-h	0.45a-e	0.507a-k
18-8-5	0.683j-v	0.675a-f	0.63a-e	0.629a-f	0.534a-h	0.513a-e	0.517a-k
18-8-6	0.65uv	0.616f	0.579c-e	0.551b-f	0.501a-h	0.454a-e	0.492c-k
18-8-7	0.755a-o	0.72a-f	0.663a-e	0.657a-f	0.58a-h	0.549a-d	0.572a-i
18-9-1	0.679m-v	0.613f	0.586b-e	0.583a-f	0.528a-h	0.487a-e	0.539a-k
18-9-10	0.67o-v	0.69a-f	0.65a-e	0.597a-f	0.521a-h	0.523a-e	0.589a-f
18-9-11	0.663q-v	0.639b-f	0.6b-e	0.585a-f	0.518a-h	0.505a-e	0.546a-k
18-9-12	0.69g-v	0.657a-f	0.597b-e	0.566a-f	0.506a-h	0.493a-e	0.511a-k
18-9-2	0.775a-f	0.688a-f	0.658a-e	0.658a-f	0.606a-c	0.572ab	0.592a-f
18-9-3	0.716b-v	0.663a-f	0.618a-e	0.601a-f	0.545a-h	0.49a-e	0.542a-k
18-9-4	0.713b-v	0.671a-f	0.622a-e	0.621a-f	0.544a-h	0.531a-e	0.565a-k
18-9-5	0.679m-v	0.671a-f	0.634a-e	0.619a-f	0.55a-h	0.495a-e	0.545a-k
18-9-6	0.633v	0.642b-f	0.583b-e	0.571a-f	0.492b-h	0.46a-e	0.495c-k
18-9-7	0.726a-u	0.719a-f	0.669a-e	0.642a-f	0.555a-h	0.502a-e	0.537a-k
18-9-8	0.681m-v	0.671a-f	0.639a-e	0.596a-f	0.519a-h	0.499a-e	0.569a-j
18-9-9	0.709b-v	0.689a-f	0.657a-e	0.628a-f	0.564a-h	0.502a-e	0.556a-k
17-4200-19x13	0.766a-k	0.714a-f	0.681a-e	0.592a-f	0.615a-c	0.531a-e	0.603a-f
17-4200-19x21	0.731a-t	0.717a-f	0.653a-e	0.649a-f	0.536a-h	0.512a-e	0.547a-k
17-4200-19x9	0.786a-c	0.774a	0.735a	0.722a	0.631ab	0.595a	0.644ab
17-4200-36x19	0.804a	0.757ab	0.694a-d	0.665a-f	0.614a-c	0.569a-c	0.595a-f
Astro	0.709b-v	0.686a-f	0.628a-e	0.608a-f	0.528a-h	0.488a-e	0.538a-k
17-5200-11X9	0.694e-v	0.636c-f	0.58c-e	0.553b-f	0.472c-h	0.429b-e	0.464f-k
17-5200-13X9	0.766a-j	0.732a-f	0.657a-e	0.634a-f	0.544a-h	0.475a-e	0.486c-k
17-5200-31X3	0.77a-h	0.73a-f	0.693a-d	0.665a-f	0.555a-h	0.546a-d	0.56a-k
17-5200-3X23	0.736a-s	0.72a-f	0.676a-e	0.654a-f	0.57a-h	0.543a-d	0.579a-h
17-5200-4X11	0.78a-e	0.744a-d	0.699a-c	0.689a-c	0.629ab	0.581ab	0.608a-f
Bimini	0.745a-q	0.74a-e	0.712ab	0.7ab	0.642a	0.6a	0.655a
2008-4x16	0.715b-v	0.699a-f	0.64a-e	0.614a-f	0.522a-h	0.479a-e	0.541a-k
Celebration	0.759a-m	0.729a-f	0.68a-e	0.66a-f	0.565a-h	0.528a-e	0.584a-h
Latitude36	0.706b-v	0.705a-f	0.668a-e	0.62a-f	0.553a-h	0.532a-e	0.559a-k
NorthBridge	0.757a-n	0.721a-f	0.69a-e	0.669a-f	0.592a-f	0.557a-d	0.605a-f
OKC1221	0.674m-v	0.69a-f	0.639a-e	0.614a-f	0.524a-h	0.487a-e	0.526a-k
OSU1101	0.772a-g	0.758ab	0.694a-d	0.694a-c	0.59a-g	0.574ab	0.614a-e
OSU1117	0.711b-v	0.698a-f	0.655a-e	0.623a-f	0.523a-h	0.459a-e	0.526a-k
OSU1127	0.665o-v	0.665a-f	0.627a-e	0.603a-f	0.512a-h	0.482a-e	0.528a-k
OSU1132	0.715b-v	0.688a-f	0.656a-e	0.626a-f	0.539a-h	0.438b-e	0.515a-k
OSU1156	0.722a-u	0.706a-f	0.67a-e	0.643a-f	0.56a-h	0.537a-e	0.593a-f
OSU1217	0.689g-v	0.697a-f	0.667a-e	0.639a-f	0.566a-h	0.513a-e	0.559a-k
OSU1257	0.731a-t	0.707a-f	0.669a-e	0.641a-f	0.56a-h	0.514a-e	0.558a-k
OSU1318	0.712b-v	0.688a-f	0.654a-e	0.632a-f	0.539a-h	0.508a-e	0.561a-k
OSU1337	0.738a-s	0.706a-f	0.676a-e	0.673a-e	0.594a-e	0.558a-d	0.602a-f
OSU1402	0.712b-v	0.681a-f	0.621a-e	0.602a-f	0.539a-h	0.479a-e	0.535a-k
OSU1403	0.719b-u	0.724a-f	0.682a-e	0.647a-f	0.556a-h	0.504a-e	0.55a-k
OSU1406	0.698e-v	0.672a-f	0.607a-e	0.58a-f	0.455d-h	0.433b-e	0.497b-k
OSU1408	0.721a-u	0.71a-f	0.658a-e	0.63a-f	0.561a-h	0.489a-e	0.561a-k
OSU1409	0.677m-v	0.678a-f	0.619a-e	0.597a-f	0.515a-h	0.497a-e	0.513a-k

OSU1417	0.687h-v	0.664a-f	0.631a-e	0.611a-f	0.509a-h	0.476a-e	0.528a-k
OSU1418	0.729a-u	0.704a-f	0.635a-e	0.626a-f	0.536a-h	0.488a-e	0.526a-k
OSU1433	0.717b-v	0.688a-f	0.636a-e	0.612a-f	0.533a-h	0.475a-e	0.536a-k
OSU1439	0.742a-r	0.702a-f	0.661a-e	0.651a-f	0.58a-h	0.532a-e	0.576a-i
OSU1601	0.756a-n	0.741a-e	0.677a-e	0.649a-f	0.583a-h	0.54a-e	0.587a-f
OSU1609	0.725a-u	0.675a-f	0.603b-e	0.567a-f	0.508a-h	0.438b-e	0.492c-k
OSU1611	0.703b-v	0.665a-f	0.578c-e	0.581a-f	0.469c-h	0.435b-e	0.479c-k
OSU1617	0.782a-d	0.727a-f	0.663a-e	0.644a-f	0.535a-h	0.519a-e	0.564a-k
OSU1620	0.72a-u	0.644b-f	0.612a-e	0.568a-f	0.493a-h	0.45a-e	0.466e-k
OSU1625	0.726a-u	0.682a-f	0.597b-e	0.551b-f	0.497a-h	0.478a-e	0.515a-k
OSU1628	0.701d-v	0.684a-f	0.609a-e	0.609a-f	0.516a-h	0.496a-e	0.539a-k
OSU1629	0.79ab	0.742a-e	0.683a-e	0.658a-f	0.57a-h	0.534a-e	0.565a-k
OSU1631	0.755a-o	0.717a-f	0.652a-e	0.637a-f	0.546a-h	0.495a-e	0.548a-k
OSU1638	0.713b-v	0.679a-f	0.599b-e	0.586a-f	0.511a-h	0.49a-e	0.553a-k
OSU1639	0.765a-k	0.714a-f	0.671a-e	0.631a-f	0.549a-h	0.502a-e	0.532a-k
OSU1641	0.704b-v	0.684a-f	0.601b-e	0.56b-f	0.497a-h	0.458a-e	0.498b-k
OSU1646	0.709b-v	0.696a-f	0.635a-e	0.607a-f	0.527a-h	0.485a-e	0.542a-k
OSU1649	0.676m-v	0.625d-f	0.57c-e	0.529d-f	0.441gh	0.386e	0.437g-k
OSU1651	0.67o-v	0.68a-f	0.633a-e	0.589a-f	0.514a-h	0.474a-e	0.522a-k
OSU1656	0.743a-r	0.718a-f	0.663a-e	0.628a-f	0.541a-h	0.495a-e	0.532a-k
OSU1657	0.708b-v	0.691a-f	0.64a-e	0.615a-f	0.532a-h	0.478a-e	0.514a-k
OSU1661	0.692e-v	0.673a-f	0.609a-e	0.577a-f	0.503a-h	0.447a-e	0.491c-k
OSU1662	0.706b-v	0.701a-f	0.631a-e	0.586a-f	0.529a-h	0.456a-e	0.469d-k
OSU1663	0.654s-v	0.622ef	0.569de	0.516ef	0.436h	0.413de	0.429i-k
OSU1664	0.763a-l	0.75a-c	0.686a-e	0.654a-f	0.571a-h	0.538a-e	0.586a-f
OSU1666	0.677m-v	0.652b-f	0.587b-e	0.579a-f	0.506a-h	0.482a-e	0.493c-k
OSU1670	0.708b-v	0.704a-f	0.664a-e	0.643a-f	0.557a-h	0.508a-e	0.544a-k
OSU1673	0.646uv	0.628d-f	0.571c-e	0.514f	0.447e-h	0.416c-e	0.419k
OSU1675	0.695e-v	0.73a-f	0.671a-e	0.651a-f	0.589a-g	0.546a-d	0.538a-k
OSU1680	0.692e-v	0.693a-f	0.656a-e	0.635a-f	0.515a-h	0.49a-e	0.504b-k
OSU1682	0.696e-v	0.676a-f	0.625a-e	0.606a-f	0.515a-h	0.511a-e	0.516a-k
OSU1687	0.699d-v	0.685a-f	0.622a-e	0.599a-f	0.516a-h	0.453a-e	0.508a-k
OSU1690	0.659r-v	0.631c-f	0.562e	0.538c-f	0.443f-h	0.409de	0.437h-k
OSU1699	0.758a-m	0.7a-f	0.641a-e	0.631a-f	0.533a-h	0.505a-e	0.532a-k
Tahoma31	0.732a-t	0.707a-f	0.653a-e	0.617a-f	0.544a-h	0.482a-e	0.52a-k
TifTuf	0.672o-v	0.661a-f	0.627a-e	0.6a-f	0.574a-h	0.514a-e	0.59a-f
Tifway	0.687h-v	0.638b-f	0.605b-e	0.577a-f	0.524a-h	0.516a-e	0.554a-k
Tilin#5	0.688h-v	0.692a-f	0.651a-e	0.622a-f	0.534a-h	0.503a-e	0.552a-k
U-3	0.714b-v	0.704a-f	0.652a-e	0.607a-f	0.553a-h	0.521a-e	0.578a-h

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 31. Simple effects of traffic on NDVI of bermudagrasses on seven rating in fall-2020.

Entry	6-Sep (0 events)	11-Sep (10 events)	18-Sep (20 events)	25-Sep (30 events)	2-Oct (40 events)	9-Oct (50 events)	16-Oct (60 events)
	p-value						
15-4X15	0.418	0.5417	0.0326	0.0003	0.0007	<.0001	<.0001
15-8X3	0.2314	0.0652	<.0001	<.0001	0.0014	<.0001	0.0009
18-7-1	0.6843	0.1634	0.0901	0.0313	0.0249	0.0034	0.0042
18-7-2	0.6833	0.7314	0.6932	0.2238	0.3079	0.0026	0.0249
18-7-3	0.8482	0.1866	0.2407	0.042	0.0367	0.0001	<.0001
18-7-4	0.867	0.0776	0.0023	0.0091	0.0129	0.0002	0.0006
18-7-5	0.5556	0.9364	0.0041	0.0258	0.0967	0.0021	0.0007
18-7-6	0.7979	0.0605	0.0362	0.042	0.0858	0.0078	0.0089
18-8-1	0.887	0.0114	0.0009	0.0044	<.0001	<.0001	<.0001
18-8-2	0.7019	0.2406	0.0674	0.029	0.0022	<.0001	0.0003
18-8-3	0.5351	0.9314	0.443	0.1628	0.6426	0.0221	0.0681
18-8-4	0.3579	0.2812	<.0001	<.0001	<.0001	<.0001	<.0001
18-8-5	0.2063	0.6475	0.4438	0.0992	0.0102	<.0001	<.0001
18-8-6	0.489	0.0323	0.0558	0.0024	0.003	<.0001	<.0001
18-8-7	0.7229	0.4918	0.0104	0.0043	0.0002	<.0001	<.0001
18-9-1	0.2688	0.1824	0.1296	0.0169	0.0131	<.0001	0.0004
18-9-10	0.5249	0.8553	0.9553	0.0733	0.0759	0.7149	0.489
18-9-11	0.0409	0.004	0.0019	0.0009	0.0148	0.0026	0.0028
18-9-12	0.1791	0.2978	0.0193	0.0007	0.0166	0.0002	<.0001
18-9-2	0.1515	0.0153	0.0027	0.0049	0.0051	<.0001	<.0001
18-9-3	0.2442	0.0208	0.0285	0.0039	0.0026	<.0001	0.0002
18-9-4	0.317	0.1306	0.0021	0.0068	0.0007	<.0001	<.0001
18-9-5	0.6165	0.2745	0.3745	0.0194	0.2154	<.0001	0.0001
18-9-6	0.0028	0.0154	0.053	0.0329	0.0879	0.0017	0.0007
18-9-7	0.1279	0.2282	0.0874	0.0033	0.0007	<.0001	<.0001
18-9-8	0.9775	0.3331	0.6844	0.0041	0.0001	0.0009	0.0055
18-9-9	0.8273	0.1608	0.2297	0.0064	0.0061	<.0001	<.0001
17-4200-19x13	0.9003	0.0307	0.0375	<.0001	0.0663	0.0001	0.0031
17-4200-19x21	0.4269	0.9193	0.069	0.027	0.0018	<.0001	<.0001
17-4200-19x9	0.6781	0.7602	0.4711	0.234	0.0397	0.0014	0.0334
17-4200-36x19	0.1365	0.9314	0.1593	0.0594	0.026	0.0027	0.0033
Astro	0.846	0.2126	0.1609	0.0293	0.0095	<.0001	0.0026
17-5200-11X9	<.0001	0.1281	0.2883	0.7291	0.3719	0.063	0.1024
17-5200-13X9	0.3456	0.3478	0.0373	0.0096	0.0091	<.0001	<.0001
17-5200-31X3	0.1258	0.3784	0.1399	0.0197	0.0006	0.0002	0.0004
17-5200-3X23	0.4784	0.9384	0.4266	0.0747	0.0089	0.0005	0.0049
17-5200-4X11	0.6234	0.9768	0.2171	0.0787	0.2154	0.0047	0.0119
Bimini	0.823	0.8364	0.2537	0.2008	0.1944	0.0006	0.0171
2008-4x16	0.4969	0.2008	0.0068	0.0013	<.0001	<.0001	<.0001
Celebration	0.3942	0.4238	0.095	0.0467	0.0013	<.0001	0.003
Latitude36	0.2836	0.1415	0.3259	0.0116	0.0068	0.0007	0.0006
NorthBridge	0.068	0.7932	0.7795	0.4089	0.1139	0.0242	0.0824
OKC1221	0.0207	0.2182	0.0249	0.0007	0.0024	<.0001	0.0003
OSU1101	0.8306	0.9334	0.0313	0.052	0.0015	0.0002	0.0066
OSU1117	0.4044	0.2239	0.0159	0.0021	0.0003	<.0001	<.0001
OSU1127	0.8438	0.7582	0.4445	0.0413	0.012	0.0001	0.001
OSU1132	0.6234	0.1973	0.024	0.0388	0.0118	<.0001	0.0002
OSU1156	0.9115	0.2172	0.1629	0.0099	0.0086	0.0003	0.0133
OSU1217	0.3735	0.2514	0.6844	0.2845	0.4114	0.019	0.0877
OSU1257	0.1201	0.0063	0.0318	0.003	0.0039	<.0001	<.0001
OSU1318	0.4376	0.2823	0.0939	0.0086	0.0043	<.0001	0.0007
OSU1337	0.55	0.317	0.0272	0.0288	0.0383	0.0032	0.0354
OSU1402	0.1365	0.0219	<.0001	<.0001	0.0004	<.0001	<.0001
OSU1403	0.3485	0.2767	0.6314	0.0445	0.0086	<.0001	0.0009
OSU1406	0.982	0.1253	0.0008	0.0018	0.0004	<.0001	<.0001
OSU1408	0.6294	0.371	0.1327	0.0094	0.0166	<.0001	0.0172

OSU1409	0.2397	0.3103	0.1971	0.0767	0.0066	<.0001	<.0001
OSU1417	0.7741	0.0357	0.0127	0.0028	0.0023	<.0001	0.0001
OSU1418	0.8914	0.2004	0.0012	0.0034	0.0001	<.0001	<.0001
OSU1433	0.7859	0.146	0.0217	0.0043	0.0014	<.0001	<.0001
OSU1439	0.0248	0.1589	0.0075	0.0037	0.0057	<.0001	0.0003
OSU1601	0.4116	0.8942	0.1833	0.0431	0.0585	0.0085	0.0425
OSU1609	0.8692	0.0605	<.0001	<.0001	<.0001	<.0001	<.0001
OSU1611	0.402	0.2376	0.0052	0.0012	0.0002	<.0001	<.0001
OSU1617	0.9551	0.0755	0.0005	<.0001	<.0001	<.0001	<.0001
OSU1620	0.4767	0.077	0.0744	0.0078	0.0057	<.0001	<.0001
OSU1625	0.4535	0.0527	0.0002	<.0001	<.0001	<.0001	<.0001
OSU1628	0.5453	0.1934	0.0373	0.0152	0.0048	0.0001	0.002
OSU1629	0.6017	0.2121	0.0186	0.0081	0.0009	0.0002	0.0002
OSU1631	0.2743	0.4393	0.2559	0.0588	0.0016	<.0001	0.0002
OSU1638	0.9753	0.2762	0.0147	0.0211	0.0081	0.0003	0.0146
OSU1639	0.6926	0.085	0.0057	0.0001	<.0001	<.0001	<.0001
OSU1641	0.9204	0.2593	0.0378	0.0008	0.0033	<.0001	<.0001
OSU1646	0.4212	0.4998	0.0345	0.0174	0.0198	<.0001	0.0016
OSU1649	0.867	0.0332	0.037	0.0009	0.0004	<.0001	<.0001
OSU1651	0.2238	0.1042	0.1221	0.0017	0.0027	<.0001	0.0001
OSU1656	0.9888	0.3472	0.2032	0.0108	0.0007	<.0001	0.0001
OSU1657	0.0603	0.3839	0.0206	0.0121	0.0079	<.0001	<.0001
OSU1661	0.3349	0.3109	0.4158	0.014	0.1765	0.0057	0.0085
OSU1662	0.5397	0.5152	0.0429	0.0007	0.0016	<.0001	<.0001
OSU1663	0.3449	0.1355	0.0039	<.0001	0.0002	<.0001	<.0001
OSU1664	0.016	0.2112	0.7309	0.4512	0.5706	0.1539	0.3676
OSU1666	0.3116	0.0772	0.2666	0.0137	0.0606	0.0038	<.0001
OSU1670	0.8836	0.6232	0.1283	0.0145	0.0702	<.0001	0.0003
OSU1673	0.6699	0.5931	0.8363	0.0142	0.0973	0.0044	0.0448
OSU1675	0.7751	0.1498	0.6659	0.4685	0.9531	0.1237	0.0126
OSU1680	0.446	0.7486	0.3625	0.0469	0.0003	<.0001	<.0001
OSU1682	0.3363	0.7534	0.131	0.0833	0.0078	0.0006	<.0001
OSU1687	0.4426	0.5844	0.0753	0.0014	0.0036	<.0001	<.0001
OSU1690	0.0297	0.0013	<.0001	<.0001	<.0001	<.0001	<.0001
OSU1699	0.6155	0.0942	0.0019	0.006	0.0016	0.0003	0.0003
Tahoma31	0.5378	0.2909	0.0071	0.0013	0.0033	<.0001	<.0001
TifTuf	0.1178	0.065	0.0034	0.0031	0.0116	<.0001	0.0097
Tifway	0.8714	0.0804	0.0041	0.0018	0.0013	0.0003	0.002
Tilin#5	0.283	0.9243	0.486	0.0566	0.0738	0.0083	0.0065
U-3	0.926	0.9626	0.3246	0.0191	0.0118	0.0011	0.0165

Table 32. Mean shear strength (SS) of 96 trafficked bermudagrasses on three rating dates in fall-2020.

Entry	6-Sep (0 events)	25-Sep (30 events)	16-Oct (60 events)
	--	----Nm----	--
15-4X15	20.6ab	18.5a-c	20.1a-c
15-8X3	21.8ab	18.8a-c	18.7a-c
18-7-1	19.8ab	19.6a-c	18.7a-c
18-7-2	19.3b	20.3a-c	18.9a-c
18-7-3	21.3ab	20.7a-c	19.5a-c
18-7-4	20.6ab	19.9a-c	18.5a-c
18-7-5	19.7ab	19.1a-c	18.1a-c
18-7-6	20.3ab	20.2a-c	19.9a-c
18-8-1	20.4ab	20.3a-c	19.3a-c
18-8-2	20.6ab	20.6a-c	20.1a-c
18-8-3	20.4ab	20.2a-c	20.3a-c
18-8-4	20.8ab	19.9a-c	18.3a-c
18-8-5	20.1ab	19.4a-c	19.6a-c
18-8-6	21.1ab	18.4a-c	19.6a-c
18-8-7	21.9ab	20.9a-c	19.9a-c
18-9-1	20.7ab	19.8a-c	19.7a-c
18-9-10	21.4ab	21.1ab	20.3a-c
18-9-11	18.2b	19.5a-c	19.4a-c
18-9-12	21.1ab	19a-c	19.1a-c
18-9-2	19.6ab	19.8a-c	19.3a-c
18-9-3	20.5ab	19.7a-c	18.8a-c
18-9-4	20.3ab	19.5a-c	18.4a-c
18-9-5	20.2ab	19.5a-c	19.3a-c
18-9-6	20.6ab	20.4a-c	19.6a-c
18-9-7	19.7ab	19.9a-c	18.3a-c
18-9-8	21.3ab	20.4a-c	19.8a-c
18-9-9	21ab	19.8a-c	18.2a-c
17-4200-19x13	20.9ab	20.8a-c	19.2a-c
17-4200-19x21	21ab	19.5a-c	18.9a-c
17-4200-19x9	21.7ab	21.6a	21.9a
17-4200-36x19	19.7ab	19.3a-c	19.8a-c
Astro	19.3b	19.9a-c	19.3a-c
17-5200-11X9	19.8ab	20.3a-c	17.1bc
17-5200-13X9	20.9ab	20.5a-c	18.6a-c
17-5200-31X3	18.4b	18.3a-c	15.8c
17-5200-3X23	20.3ab	19a-c	19.1a-c
17-5200-4X11	20.5ab	19.2a-c	19.8a-c
Bimini	22.2ab	21.8a	20.3a-c
2008-4x16	19.6ab	20.2a-c	18.4a-c
Celebration	21.5ab	21.4a	19.2a-c
Latitude36	21.1ab	20.3a-c	20.4ab
NorthBridge	21.4ab	21ab	20.2a-c
OKC1221	19.8ab	20a-c	19.3a-c
OSU1101	24.3a	20.4a-c	21.1ab
OSU1117	19.7ab	20.6a-c	18.8a-c
OSU1127	18.9b	19.1a-c	19.1a-c
OSU1132	19.4b	20.8a-c	17.8a-c
OSU1156	18.7b	19.8a-c	19.5a-c
OSU1217	19.7ab	20.7a-c	19.1a-c
OSU1257	20.1ab	20.1a-c	19.1a-c
OSU1318	20.3ab	19.6a-c	19.2a-c
OSU1337	19.7ab	19.6a-c	19a-c
OSU1402	20ab	20.6a-c	19.2a-c
OSU1403	20.7ab	20.4a-c	19.4a-c
OSU1406	20.7ab	19.1a-c	18.2a-c
OSU1408	19.6ab	19.6a-c	18.6a-c

OSU1409	19.9ab	18.9a-c	18.7a-c
OSU1417	18.3b	20.3a-c	18.6a-c
OSU1418	19.3b	19.7a-c	18.8a-c
OSU1433	19.9ab	20.9a-c	19.4a-c
OSU1439	19.9ab	19.6a-c	19.7a-c
OSU1601	20.2ab	21.2ab	19.8a-c
OSU1609	18.7b	19.5a-c	18a-c
OSU1611	21.1ab	18.7a-c	17bc
OSU1617	19.8ab	19.8a-c	18.4a-c
OSU1620	18.5b	17.8a-c	17.1bc
OSU1625	19.4b	18.8a-c	19.8a-c
OSU1628	19.8ab	19.3a-c	20a-c
OSU1629	20.1ab	19.8a-c	17.8a-c
OSU1631	20.5ab	18.7a-c	18.8a-c
OSU1638	20.2ab	18.1a-c	17.7a-c
OSU1639	21.2ab	18.6a-c	19.3a-c
OSU1641	20.9ab	17.3bc	16.9bc
OSU1646	20.6ab	18.1a-c	19.3a-c
OSU1649	18.4b	20.1a-c	17.1bc
OSU1651	20.4ab	19.4a-c	20.6ab
OSU1656	20.5ab	19.9a-c	18.9a-c
OSU1657	19.6ab	19.8a-c	18.9a-c
OSU1661	20ab	18.6a-c	18.2a-c
OSU1662	19.8ab	18.5a-c	18a-c
OSU1663	19b	17.3bc	17.8a-c
OSU1664	20.4ab	19.1a-c	19.3a-c
OSU1666	20.1ab	18.8a-c	18.3a-c
OSU1670	20.9ab	19.7a-c	18.3a-c
OSU1673	19.9ab	17c	17bc
OSU1675	21.1ab	20.6a-c	20.1a-c
OSU1680	20.1ab	20.3a-c	18.4a-c
OSU1682	19.2b	19.4a-c	19.5a-c
OSU1687	20.6ab	18.2a-c	18.4a-c
OSU1690	19.6ab	18.1a-c	16.8bc
OSU1699	20.2ab	18.6a-c	17.6a-c
Tahoma31	21ab	20.6a-c	21.1ab
TifTuf	21ab	20a-c	20.9ab
Tifway	20.6ab	19.8a-c	19.1a-c
Tilin#5	19.3b	21.1ab	20.1a-c
U-3	22.8ab	21.5a	20.3a-c

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 33. Mean surface hardness (SH) of 96 trafficked bermudagrasses on three rating dates in fall-2020.

Entry	6-Sep (0 events)	25-Sep (30 events)	16-Oct (60 events)
	------------------	*Gmax*	------------------
15-4X15	57.8	64.9ab	78.9ab
15-8X3	64.1	70.7ab	84.5ab
18-7-1	64.2	64.4ab	65.7b
18-7-2	70.7	63.8ab	81.4ab
18-7-3	59	63.9ab	74.9ab
18-7-4	58.8	66.3ab	76.5ab
18-7-5	69.7	67.2ab	79.3ab
18-7-6	63	63.1ab	72.4ab
18-8-1	60.1	63.1ab	79.5ab
18-8-2	62.4	68.7ab	76ab
18-8-3	61.1	66.9ab	78.5ab
18-8-4	64.2	62.4ab	76.6ab
18-8-5	63.2	62.4ab	76.3ab
18-8-6	67.5	66ab	77.9ab
18-8-7	58.5	65.2ab	74.5ab
18-9-1	63.6	69.2ab	86.6ab
18-9-10	58.4	60.2ab	68.8ab
18-9-11	62.2	66.2ab	76.6ab
18-9-12	66.6	62.1ab	82ab
18-9-2	66.2	66.1ab	71.4ab
18-9-3	61	64.1ab	76.6ab
18-9-4	61.4	68.1ab	80.2ab
18-9-5	66.7	65.9ab	78.8ab
18-9-6	57.3	62.8ab	75.3ab
18-9-7	62	64.8ab	95.8ab
18-9-8	62.6	65.6ab	78.7ab
18-9-9	61.6	70.1ab	80.2ab
17-4200-19x13	61.6	65.5ab	71.6ab
17-4200-19x21	61.7	62.3ab	75.6ab
17-4200-19x9	61.8	60.1ab	67.5b
17-4200-36x19	60.6	62.8ab	84.7ab
Astro	60.9	64.8ab	76.3ab
17-5200-11X9	59.7	65.8ab	79.8ab
17-5200-13X9	63.7	67.4ab	89.1ab
17-5200-31X3	59.5	63.5ab	81.2ab
17-5200-3X23	57.1	67.3ab	78.4ab
17-5200-4X11	62.2	67.8ab	80ab
Bimini	60	61.9ab	69ab
2008-4x16	63.4	65.1ab	70.4ab
Celebration	56.6	60.4ab	66.6b
Latitude36	62.1	62.3ab	70.7ab
NorthBridge	62.7	65.2ab	65.9b
OKC1221	61.4	62.9ab	73.4ab
OSU1101	54.3	58.6b	64.9b
OSU1117	68	69.9ab	69ab
OSU1127	62.9	65.5ab	73.2ab
OSU1132	64.2	67.5ab	86.7ab
OSU1156	65.7	64.3ab	71.7ab
OSU1217	64	63.3ab	72.7ab
OSU1257	60.1	64.5ab	78.5ab
OSU1318	64.5	64.3ab	71.3ab
OSU1337	62.5	64.5ab	80.2ab
OSU1402	62.1	68.3ab	82.5ab
OSU1403	63.5	69.9ab	81.9ab
OSU1406	57.6	61.9ab	79.7ab
OSU1408	63.3	63.2ab	72.5ab

OSU1409	67	66.6ab	90ab
OSU1417	61.4	67.3ab	81.6ab
OSU1418	59.9	64.4ab	71.9ab
OSU1433	61.6	70ab	74ab
OSU1439	64.8	65.3ab	68.4ab
OSU1601	66.5	62.1ab	86ab
OSU1609	66.6	67.3ab	94.4ab
OSU1611	68.8	71.1ab	83.5ab
OSU1617	60.2	72.9a	81.7ab
OSU1620	62.2	65.4ab	89.2ab
OSU1625	60.3	68.3ab	81ab
OSU1628	59.4	64.4ab	82ab
OSU1629	66.5	69.9ab	91.4ab
OSU1631	63.2	65.3ab	77.2ab
OSU1638	59.8	63.2ab	82.9ab
OSU1639	60.5	70.4ab	79.3ab
OSU1641	60.6	65.2ab	75.2ab
OSU1646	59.2	62.2ab	76.1ab
OSU1649	64	66.9ab	79.9ab
OSU1651	65	66.2ab	79ab
OSU1656	61.9	67.6ab	78.3ab
OSU1657	63.2	71.7ab	99.2a
OSU1661	60.6	65.2ab	79.8ab
OSU1662	65.1	69.1ab	91.2ab
OSU1663	64	70.4ab	83.9ab
OSU1664	57.2	62.7ab	73.8ab
OSU1666	59.3	68.1ab	79.2ab
OSU1670	66.2	65.1ab	91.6ab
OSU1673	61.2	66.5ab	86ab
OSU1675	62.8	61.4ab	79.2ab
OSU1680	64.2	67.1ab	74.9ab
OSU1682	64	64.7ab	79.5ab
OSU1687	65.8	63.9ab	84.8ab
OSU1690	65.1	68.2ab	91.6ab
OSU1699	66	70.9ab	84.5ab
Tahoma31	58.9	64.2ab	71.8ab
TifTuf	62.7	64ab	70.7ab
Tifway	58.5	64.4ab	78.4ab
Tilin#5	65.3	66.3ab	78ab
U-3	61.9	60.8ab	74.8ab

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 34. Mean fall percent green cover (PGC) of 96 non-trafficked bermudagrasses in 2020.

Entry	18-Oct	1-Nov	14-Nov
	-------------------------------	%	-------------------------------
15-4X15	63.5a-i	52.1b-i	37.03a-k
15-8X3	60.4a-i	52.04b-i	32.79b-k
18-7-1	67.6a-h	47.05c-j	30.31b-l
18-7-2	65.8a-h	57.2a-g	32.9b-k
18-7-3	60.5a-i	57.53a-g	40.07a-i
18-7-4	50.9e-j	36.05f-j	20.86lk
18-7-5	34.1j	26.97j	13.61l
18-7-6	65.5a-i	57.14a-g	38.11a-k
18-8-1	76.2a-d	77.07a	42.43a-g
18-8-2	79.2ab	58.2a-f	36.36a-k
18-8-3	72.3a-f	65.72a-c	40.08a-i
18-8-4	61.6a-i	57.02a-g	35.62a-k
18-8-5	66.4a-h	59.97a-e	42.4a-g
18-8-6	65.7a-h	55.61a-g	38.83a-k
18-8-7	81.3a	71.54ab	44.46a-e
18-9-1	63.7a-i	49.19b-j	36.77a-k
18-9-10	56.5b-j	48.53b-j	28.58d-l
18-9-11	64.7a-i	48.11b-j	31.2b-l
18-9-12	61.1a-i	48.3b-j	30.71b-l
18-9-2	73.9a-f	60.25a-e	36.97a-k
18-9-3	67.1a-h	57.39a-g	34.35a-k
18-9-4	64.4a-i	51.32b-i	23.44h-l
18-9-5	62.1a-i	50.48b-j	33.44a-k
18-9-6	48.8g-j	37.02e-j	22.16i-l
18-9-7	66.6a-h	52.54b-i	29.19d-l
18-9-8	67.3a-h	54.81a-g	36.15a-k
18-9-9	69.3a-g	59.95a-e	51.2a
17-4200-19x13	74.9a-e	54.57a-h	34.39a-k
17-4200-19x21	64a-i	55.53a-g	39.77a-j
17-4200-19x9	64.3a-i	51.35b-i	23.97h-l
17-4200-36x19	69.2a-g	57.38a-g	36.52a-k
Astro	62.8a-i	50.28b-j	31.25b-l
17-5200-11X9	49.1g-j	40.45d-j	26.3f-l
17-5200-13X9	65.9a-h	48.39b-j	30.3b-l
17-5200-31X3	69.5a-g	59.82a-e	35.11a-k
17-5200-3X23	66.6a-h	55.06a-g	33.46a-k
17-5200-4X11	70.8a-g	59.64a-f	36.81a-k
Bimini	76.7a-c	66.66a-c	45.82a-d
2008-4x16	61.4a-i	48.06b-j	23.57h-l
Celebration	67.2a-h	52.58b-i	33.02b-k
Latitude36	65.1a-i	52.5b-i	27.54e-l
NorthBridge	54.5c-j	44.63c-j	25.78f-l
OKC1221	61.4a-i	52.73b-i	35.41a-k
OSU1101	74.7a-e	57.03a-g	29.37c-l
OSU1117	58.2b-i	44.78c-j	25.62g-l
OSU1127	54.2c-j	49.07b-j	35.18a-k
OSU1132	57.2b-i	44.83c-j	24.16h-l
OSU1156	61.8a-i	47.22c-j	31.94b-k
OSU1217	54c-j	48.82b-j	26.25f-l
OSU1257	67.4a-h	53.39b-i	34.74a-k
OSU1318	60.8a-i	50.32b-j	31.28b-l
OSU1337	61.9a-i	44.3c-j	24.52g-l
OSU1402	60.5a-i	48.82b-j	24.86g-l
OSU1403	57.4b-i	48.86b-j	24.65g-l
OSU1406	48.4g-j	43.48c-j	30.12b-l
OSU1408	48.8g-j	30.83ij	21.8j-l
OSU1409	59.9a-i	47.4c-j	33.96a-k

OSU1417	58.8a-i	46.61c-j	33.57a-k
OSU1418	60.7a-i	47.38c-j	28.01d-l
OSU1433	56.8b-j	43.46c-j	27.88d-l
OSU1439	68.6a-h	56.89a-g	32.94b-k
OSU1601	58b-i	46.38c-j	24.75g-l
OSU1609	67.5a-h	58.02a-g	43.65a-f
OSU1611	62.3a-i	57.12a-g	40.62a-h
OSU1617	69.3a-g	52.16b-i	33.36a-k
OSU1620	56.4b-j	39.28d-j	21.86j-l
OSU1625	65.9a-h	53.36b-i	29.74c-l
OSU1628	62.7a-i	54.42a-i	33.94a-k
OSU1629	53.9c-j	51.02b-i	28.7d-l
OSU1631	57.4b-i	49.21b-j	29.22d-l
OSU1638	61.3a-i	49.69b-j	37.1a-k
OSU1639	66.1a-h	57.01a-g	27.82d-l
OSU1641	62.3a-i	49.65b-j	35.86a-k
OSU1646	63a-i	57.51a-g	40.27a-h
OSU1649	53.6d-j	43.29c-j	33.81a-k
OSU1651	61.2a-i	50.59b-j	35.85a-k
OSU1656	61.8a-i	50.43b-j	29.1d-l
OSU1657	54.5c-j	47.31c-j	32.4b-k
OSU1661	45.7ij	34.54g-j	30.03b-l
OSU1662	60a-i	52.92b-i	36.65a-k
OSU1663	52.8e-j	42.03d-j	23.71h-l
OSU1664	53.7c-j	43.04c-j	26.04f-l
OSU1666	56.1c-j	49.99b-j	33.85a-k
OSU1670	61.7a-i	54.8a-h	27.98d-l
OSU1673	42.4j	31.15h-j	21.27lk
OSU1675	51.4e-j	39.83d-j	29.98c-l
OSU1680	63.6a-i	47.16c-j	33.51a-k
OSU1682	63.3a-i	53.15b-i	37.02a-k
OSU1687	56.2b-j	43.94c-j	25.52g-l
OSU1690	52.3e-j	45.9c-j	25.36g-l
OSU1699	58.7a-i	50.04b-j	29.28d-l
Tahoma31	63.1a-i	49.42b-j	22.65h-l
TifTuf	69.2a-g	62.51a-d	48.02ab
Tifway	63.2a-i	52.17b-i	47.36a-c
Tilin#5	62.8a-i	47.8c-j	27.28e-l
U-3	57.6b-i	55.76a-g	35.39a-k

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 35. Mean fall percent green cover (PGC) of 96 trafficked bermudagrasses in 2020.

Entry	18-Oct	1-Nov	14-Nov
		%	
15-4X15	41.3a-k	35.4a-h	34.9a-i
15-8X3	41a-k	36.33a-h	37.6a-e
18-7-1	53.9a-e	38.07a-h	28.5b-v
18-7-2	50.4a-h	43.46a-g	26f-w
18-7-3	41.5a-k	38.95a-h	30.1b-t
18-7-4	33.6f-k	25.92f-h	16.1wx
18-7-5	22.6l	20.49h	10.8x
18-7-6	52.7a-f	44.47a-f	28b-v
18-8-1	52.7a-f	47.67a-e	29.8b-t
18-8-2	52.1a-g	46.7a-e	28.9b-u
18-8-3	59.4ab	51.05ab	43.4a
18-8-4	38c-k	39.37a-h	28b-v
18-8-5	49.7a-h	39.16a-h	32.1a-n
18-8-6	40.3a-k	38.15a-h	31.6b-p
18-8-7	52.4a-g	49.84a-c	35.8a-g
18-9-1	46.4a-k	41.55a-g	29.2b-u
18-9-10	52.5a-g	48.13a-d	38a-d
18-9-11	45.8a-k	33.86a-h	27.4c-w
18-9-12	44.4a-k	36.63a-h	30.6b-s
18-9-2	57.4a-c	47.54a-e	32.2a-m
18-9-3	54a-e	43.13a-g	26.5e-w
18-9-4	46.2a-k	35.07a-h	28.8b-u
18-9-5	46.1a-k	40.03a-h	32.6a-l
18-9-6	37.5c-k	30.96b-h	24.6g-w
18-9-7	40.2a-k	33.68a-h	27.7b-v
18-9-8	52.6a-f	38.22a-h	29.3b-t
18-9-9	48.3a-j	38.76a-h	35.8a-g
17-4200-19x13	43.4a-k	40.41a-h	31.4b-q
17-4200-19x21	45.4a-k	38.53a-h	31b-r
17-4200-19x9	50a-h	42a-g	24.6g-w
17-4200-36x19	53.1a-f	44.33a-f	37a-f
Astro	39.3b-k	32.97b-h	27c-w
17-5200-11X9	35.2e-k	30.03c-h	26.6e-w
17-5200-13X9	42.2a-k	33.45b-h	25.6f-w
17-5200-31X3	43.2a-k	32.73b-h	31.9b-o
17-5200-3X23	45.8a-k	38.64a-h	31.7b-o
17-5200-4X11	57a-d	45.78a-f	33.7a-k
Bimini	60.1a	53.76a	34.1a-j
2008-4x16	37.8c-k	31.81b-h	17.3v-x
Celebration	47.7a-k	37.59a-h	23.7i-w
Latitude36	49.1a-j	39.68a-h	27.2c-w
NorthBridge	47.6a-k	38.09a-h	23.5i-w
OKC1221	37.2d-k	37.86a-h	30.5b-s
OSU1101	53.9a-e	44.42a-f	24.9g-w
OSU1117	38.2c-k	33.19b-h	20.2q-x
OSU1127	38.3c-k	34.62a-h	29.2b-u
OSU1132	35.1e-k	29.27d-h	17.9u-x
OSU1156	46.9a-k	37.31a-h	35.1a-h
OSU1217	46.3a-k	39.05a-h	23.7i-w
OSU1257	45.4a-k	40a-h	27.2c-w
OSU1318	38.9c-k	33.48b-h	25.2g-w
OSU1337	49.2a-i	38.1a-h	24.6g-w
OSU1402	38.1c-k	28.57d-h	17.4v-x
OSU1403	39.3b-k	28.8d-h	18.9t-x
OSU1406	31.8h-k	31.69b-h	24.2h-w
OSU1408	34.4e-k	24.01gh	19.6s-x
OSU1409	41.6a-k	34.86a-h	30.3b-s

OSU1417	38.7c-k	31.71b-h	27.8b-v
OSU1418	37d-k	32.04b-h	20r-x
OSU1433	34e-k	29.88c-h	20.8n-x
OSU1439	46.8a-k	33.62a-h	27.2c-w
OSU1601	46.1a-k	34.55a-h	20.3p-x
OSU1609	39.4b-k	32.34b-h	33a-k
OSU1611	37.4c-k	34.14a-h	34.8a-j
OSU1617	46.5a-k	38.04a-h	28.6b-v
OSU1620	37.6c-k	27.87e-h	26.4e-w
OSU1625	43.8a-k	37.8a-h	26.5e-w
OSU1628	40.9a-k	35.26a-h	32.4a-m
OSU1629	44a-k	34.32a-h	30.7b-s
OSU1631	44.3a-k	35.94a-h	28.5b-v
OSU1638	50.3a-h	40.04a-h	38.2a-c
OSU1639	41.3a-k	37.57a-h	27.1c-w
OSU1641	41.9a-k	34.53a-h	33.1a-k
OSU1646	40.6a-k	34.32a-h	27.5b-v
OSU1649	27.8l	23.66gh	22.4i-w
OSU1651	41.9a-k	37.22a-h	26.6e-w
OSU1656	41.6a-k	32.36b-h	20.7o-x
OSU1657	35.8e-k	30.68c-h	25.5g-w
OSU1661	36.6e-k	30.2c-h	25.5g-w
OSU1662	32.4g-k	32.38b-h	25.5g-w
OSU1663	34.1e-k	26.02f-h	21.4i-w
OSU1664	47.5a-k	38.25a-h	29.5b-t
OSU1666	38.7c-k	34.53a-h	26.7d-w
OSU1670	45.1a-k	36.53a-h	20.8n-x
OSU1673	29kl	25.68f-h	20.1q-x
OSU1675	45.1a-k	35.2a-h	24.6g-w
OSU1680	41.2a-k	33.11b-h	26.2f-w
OSU1682	46.9a-k	40.84a-g	31.7b-o
OSU1687	43.1a-k	30.65c-h	20.7o-x
OSU1690	29.2i-l	28.9d-h	19.5s-x
OSU1699	42.4a-k	34.15a-h	25.4g-w
Tahoma31	44.5a-k	35.07a-h	21.2m-x
TifTuf	48.9a-j	42.73a-g	38.9ab
Tifway	44.2a-k	34.97a-h	34.5a-j
Tilin#5	44.8a-k	38.26a-h	26.5e-w
U-3	42.3a-k	35.13a-h	27.3c-w

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 36. Simple effects of traffic on fall percent green cover (PGC) of 96 bermudagrasses in 2020.

Entry	18-Oct	1-Nov	14-Nov
	--	*p-value*	--
15-4X15	<.0001	0.0016	0.459
15-8X3	0.0003	0.0028	0.1023
18-7-1	0.0084	0.0799	0.5377
18-7-2	0.0034	0.0084	0.0187
18-7-3	0.0004	0.0005	0.0008
18-7-4	0.0011	0.049	0.1026
18-7-5	0.0262	0.2032	0.3295
18-7-6	0.0142	0.0146	0.0006
18-8-1	<.0001	<.0001	<.0001
18-8-2	<.0001	0.026	0.011
18-8-3	0.0133	0.0051	0.2625
18-8-4	<.0001	0.0009	0.0093
18-8-5	0.0016	0.0001	0.0005
18-8-6	<.0001	0.001	0.014
18-8-7	<.0001	<.0001	0.0033
18-9-1	0.0011	0.1344	0.0103
18-9-10	0.4251	0.9375	0.0014
18-9-11	0.0004	0.0064	0.1956
18-9-12	0.0016	0.024	0.9617
18-9-2	0.0017	0.0144	0.1016
18-9-3	0.0118	0.0063	0.0074
18-9-4	0.0006	0.002	0.0685
18-9-5	0.0024	0.0423	0.7596
18-9-6	0.0292	0.2336	0.3979
18-9-7	<.0001	0.0004	0.6099
18-9-8	0.005	0.0017	0.0199
18-9-9	0.0001	<.0001	<.0001
17-4200-19x13	<.0001	0.0067	0.3059
17-4200-19x21	0.0005	0.0013	0.0029
17-4200-19x9	0.0066	0.0684	0.8389
17-4200-36x19	0.0023	0.0121	0.882
Astro	<.0001	0.0011	0.1463
17-5200-11X9	0.0079	0.043	0.9091
17-5200-13X9	<.0001	0.0043	0.1109
17-5200-31X3	<.0001	<.0001	0.2793
17-5200-3X23	0.0001	0.0018	0.5498
17-5200-4X11	0.0083	0.0079	0.2906
Bimini	0.0017	0.013	<.0001
2008-4x16	<.0001	0.002	0.0318
Celebration	0.0003	0.0042	0.0016
Latitude36	0.0024	0.0136	0.8982
NorthBridge	0.18	0.1996	0.4372
OKC1221	<.0001	0.0045	0.0965
OSU1101	0.0001	0.015	0.1228
OSU1117	0.0002	0.0249	0.0666
OSU1127	0.0026	0.0057	0.0404
OSU1132	<.0001	0.003	0.0323
OSU1156	0.0045	0.054	0.2859
OSU1217	0.1335	0.0572	0.3798
OSU1257	<.0001	0.0101	0.0102
OSU1318	<.0001	0.0014	0.0394
OSU1337	0.0147	0.2234	0.99
OSU1402	<.0001	0.0002	0.011
OSU1403	0.0007	0.0002	0.0487
OSU1406	0.0017	0.0227	0.0442
OSU1408	0.0059	0.181	0.4576
OSU1409	0.0006	0.0156	0.2155

OSU1417	0.0002	0.0044	0.0501
OSU1418	<.0001	0.0035	0.0064
OSU1433	<.0001	0.0091	0.0155
OSU1439	<.0001	<.0001	0.0488
OSU1601	0.0216	0.0222	0.1306
OSU1609	<.0001	<.0001	0.0003
OSU1611	<.0001	<.0001	0.0485
OSU1617	<.0001	0.0068	0.103
OSU1620	0.0004	0.0272	0.1187
OSU1625	<.0001	0.0031	0.2649
OSU1628	<.0001	0.0003	0.5861
OSU1629	0.0567	0.0016	0.4835
OSU1631	0.0118	0.0108	0.8096
OSU1638	0.0347	0.0603	0.7055
OSU1639	<.0001	0.0003	0.7946
OSU1641	0.0002	0.0039	0.3427
OSU1646	<.0001	<.0001	<.0001
OSU1649	<.0001	0.0002	0.0001
OSU1651	0.0003	0.0102	0.0019
OSU1656	0.0002	0.0007	0.0044
OSU1657	0.0005	0.0016	0.0191
OSU1661	0.0772	0.3929	0.1214
OSU1662	<.0001	0.0001	0.0002
OSU1663	0.0005	0.0023	0.4206
OSU1664	0.2255	0.345	0.2328
OSU1666	0.001	0.0032	0.0156
OSU1670	0.0017	0.0011	0.0145
OSU1673	0.0103	0.2821	0.6853
OSU1675	0.2182	0.3619	0.0668
OSU1680	<.0001	0.0071	0.0134
OSU1682	0.0019	0.0175	0.0693
OSU1687	0.0122	0.0106	0.0977
OSU1690	<.0001	0.0013	0.0448
OSU1699	0.0021	0.0025	0.1834
Tahoma31	0.0005	0.006	0.6123
TifTuf	0.0002	0.0002	0.0019
Tifway	0.0004	0.0012	<.0001
Tilin#5	0.0007	0.0633	0.7779
U-3	0.0036	0.0001	0.0061

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 37. Mean visual fall color (VFC) of 96 non-trafficked bermudagrasses in 2020.

Entry	18-Oct	1-Nov	14-Nov
	------------------------(1-9) scale------------------------		
15-4X15	7a-c	4.7a-d	3.3a-d
15-8X3	6.3a-d	5.3a-c	2a-d
18-7-1	6.3a-d	4.7a-d	2.3a-d
18-7-2	6.3a-d	6a-c	3.3a-d
18-7-3	6.3a-d	5.3a-c	3.3a-d
18-7-4	5b-e	4a-e	1.7b-d
18-7-5	3.3e	1.7e	1d
18-7-6	7.3ab	5.3a-c	3.3a-d
18-8-1	7a-c	6a-c	3.3a-d
18-8-2	7.3ab	6.7a	4.3a
18-8-3	6.7a-d	6a-c	3.7a-c
18-8-4	6.3a-d	5a-c	2.3a-d
18-8-5	6.7a-d	5.3a-c	3a-d
18-8-6	6.7a-d	5a-c	2.7a-d
18-8-7	7.7a	6.7a	4ab
18-9-1	7a-c	5.7a-c	2a-d
18-9-10	6a-d	4a-e	2.3a-d
18-9-11	7a-c	5.3a-c	3a-d
18-9-12	6.3a-d	4.7a-d	2.7a-d
18-9-2	7.3ab	5.7a-c	2.3a-d
18-9-3	6.7a-d	5.3a-c	3a-d
18-9-4	7a-c	5a-c	3a-d
18-9-5	6a-d	5.3a-c	2.7a-d
18-9-6	6.3a-d	4.7a-d	1.7b-d
18-9-7	7.3ab	6a-c	3a-d
18-9-8	6.3a-d	5.3a-c	2.3a-d
18-9-9	7.7a	5.7a-c	3.7a-c
17-4200-19x13	7a-c	5.3a-c	2.7a-d
17-4200-19x21	7a-c	5a-c	3a-d
17-4200-19x9	7.3ab	5.3a-c	2a-d
17-4200-36x19	6.3a-d	5a-c	2.7a-d
Astro	6.3a-d	5.3a-c	2.7a-d
17-5200-11X9	4.7c-e	3.7b-e	1.7b-d
17-5200-13X9	6.3a-d	5.7a-c	2.3a-d
17-5200-31X3	6.7a-d	5.7a-c	4ab
17-5200-3X23	7a-c	6a-c	2.7a-d
17-5200-4X11	7a-c	6.3ab	2.3a-d
Bimini	7a-c	6.7a	3.7a-c
2008-4x16	6a-d	4.3a-e	1d
Celebration	6.3a-d	6a-c	3a-d
Latitude36	7a-c	5a-c	2.7a-d
NorthBridge	6.3a-d	5a-c	2a-d
OKC1221	6.3a-d	4.7a-d	2.3a-d
OSU1101	6.7a-d	6.3ab	2.3a-d
OSU1117	6a-d	4a-e	1.7b-d
OSU1127	6a-d	5a-c	3a-d
OSU1132	6a-d	4.3a-e	1d
OSU1156	6.3a-d	5.3a-c	2.7a-d
OSU1217	6.3a-d	4.7a-d	1.7b-d
OSU1257	6.3a-d	5.3a-c	2.3a-d
OSU1318	6.7a-d	5a-c	2.7a-d
OSU1337	6.7a-d	4.7a-d	2a-d
OSU1402	6.3a-d	5a-c	1d
OSU1403	6.3a-d	3.3c-e	1.3cd
OSU1406	5.3a-e	3.3c-e	1.7b-d
OSU1408	4.7c-e	2de	1d
OSU1409	6a-d	4.7a-d	2.7a-d

OSU1417	6.7a-d	4.7a-d	2.7a-d
OSU1418	4.3de	3.3c-e	2a-d
OSU1433	6.3a-d	3.7b-e	1.3cd
OSU1439	6.7a-d	5.3a-c	2a-d
OSU1601	7a-c	5a-c	2a-d
OSU1609	7a-c	5a-c	3.3a-d
OSU1611	6a-d	4.7a-d	3a-d
OSU1617	7.3ab	6a-c	2.7a-d
OSU1620	5.3a-e	4.3a-e	2a-d
OSU1625	6.3a-d	4.7a-d	2a-d
OSU1628	6a-d	5.3a-c	3.3a-d
OSU1629	6.3a-d	4a-e	2a-d
OSU1631	6.7a-d	4.7a-d	3a-d
OSU1638	6a-d	5.3a-c	2.7a-d
OSU1639	7a-c	4.3a-e	2a-d
OSU1641	6.3a-d	4.7a-d	3a-d
OSU1646	6.7a-d	5.7a-c	2.7a-d
OSU1649	6a-d	4.3a-e	2.3a-d
OSU1651	6.7a-d	4.3a-e	2.3a-d
OSU1656	6.7a-d	4.7a-d	1.7b-d
OSU1657	6.3a-d	4a-e	2a-d
OSU1661	5.3a-e	5.3a-c	2.3a-d
OSU1662	6.3a-d	5a-c	2.7a-d
OSU1663	5.7a-e	4.3a-e	2a-d
OSU1664	6a-d	4a-e	2a-d
OSU1666	6a-d	5.7a-c	2.3a-d
OSU1670	6.3a-d	4.3a-e	1.7b-d
OSU1673	4.3de	2de	1d
OSU1675	6.3a-d	4.3a-e	1.7b-d
OSU1680	6.3a-d	5.3a-c	2.7a-d
OSU1682	6.3a-d	5.7a-c	2.7a-d
OSU1687	6.3a-d	5.3a-c	1d
OSU1690	6.3a-d	4.7a-d	1.3cd
OSU1699	6a-d	4.3a-e	1.7b-d
Tahoma31	6.3a-d	5.3a-c	2a-d
TifTuf	7a-c	6a-c	4.3a
Tifway	6.7a-d	6a-c	4ab
Tilin#5	7a-c	5a-c	3a-d
U-3	6.7a-d	6a-c	4.3a

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 38. Mean visual fall color (VFC) of 96 trafficked bermudagrasses in 2020.

Entry	18-Oct	1-Nov	14-Nov
	----------(1-9) scale----------		
15-4X15	4.7a-e	3.3a-f	2.7a-e
15-8X3	5a-e	4a-e	3a-e
18-7-1	5a-e	4a-e	2.3b-e
18-7-2	5.3a-d	5a-c	3a-e
18-7-3	4.7a-e	3.7a-f	2.7a-e
18-7-4	3c-f	2.7b-f	1e
18-7-5	1.3f	1f	1e
18-7-6	5.7a-c	4.7a-d	3a-e
18-8-1	4.7a-e	4.7a-d	2.7a-e
18-8-2	5.7a-c	5.3ab	4ab
18-8-3	5.7a-c	5.7a	4.7a
18-8-4	4.3a-f	3.3a-f	1.7c-e
18-8-5	5a-e	4.3a-d	3a-e
18-8-6	4.7a-e	3.3a-f	2.3b-e
18-8-7	5.3a-d	5.3ab	3.7a-c
18-9-1	5.3a-d	4a-e	2b-e
18-9-10	5.3a-d	4a-e	3a-e
18-9-11	5a-e	4.3a-d	2.7a-e
18-9-12	5a-e	3.7a-f	2.7a-e
18-9-2	5.3a-d	5.3ab	3.3a-d
18-9-3	5.3a-d	4a-e	2.3b-e
18-9-4	4.7a-e	4a-e	3a-e
18-9-5	4a-f	4.3a-d	2.7a-e
18-9-6	4a-f	3a-f	2b-e
18-9-7	4a-f	4a-e	2.7a-e
18-9-8	5.7a-c	3.7a-f	2.3b-e
18-9-9	5a-e	4a-e	2.7a-e
17-4200-19x13	5.7a-c	4.3a-d	2.3b-e
17-4200-19x21	5.3a-d	3.7a-f	3a-e
17-4200-19x9	6.3ab	5a-c	2.7a-e
17-4200-36x19	4.3a-f	4.7a-d	2.7a-e
Astro	5.3a-d	4.3a-d	2b-e
17-5200-11X9	3.7a-f	2.7b-f	2b-e
17-5200-13X9	4a-f	3.7a-f	2b-e
17-5200-31X3	5.3a-d	4a-e	3.7a-c
17-5200-3X23	5.3a-d	4.7a-d	2.7a-e
17-5200-4X11	5.3a-d	5a-c	2.7a-e
Bimini	6.3ab	5.7a	3.3a-d
2008-4x16	4.3a-f	3a-f	1e
Celebration	4.3a-f	4.7a-d	2.3b-e
Latitude36	6a-c	4.3a-d	3a-e
NorthBridge	5.3a-d	3.7a-f	2b-e
OKC1221	4a-f	3a-f	2b-e
OSU1101	6.7a	5a-c	2.7a-e
OSU1117	4a-f	3.3a-f	1.3de
OSU1127	4.7a-e	4a-e	3a-e
OSU1132	4a-f	3a-f	1e
OSU1156	4.7a-e	3.7a-f	3.3a-d
OSU1217	5.3a-d	4a-e	1.7c-e
OSU1257	4.7a-e	3.7a-f	1.7c-e
OSU1318	4.3a-f	4a-e	1.7c-e
OSU1337	5a-e	4.3a-d	2.7a-e
OSU1402	4a-f	3.7a-f	1e
OSU1403	4.3a-f	2d-f	1.3de
OSU1406	3.7a-f	2d-f	1.7c-e
OSU1408	2.3d-f	1f	1e
OSU1409	4a-f	2.7b-f	2.7a-e

OSU1417	4.3a-f	3a-f	2b-e
OSU1418	2ef	2.3c-f	1e
OSU1433	4.3a-f	2.3c-f	1.3de
OSU1439	5.3a-d	3.7a-f	2b-e
OSU1601	5.7a-c	4a-e	2.3b-e
OSU1609	4a-f	3a-f	2.3b-e
OSU1611	4a-f	2.7b-f	2.3b-e
OSU1617	4.7a-e	4a-e	2.3b-e
OSU1620	3.3b-f	3a-f	3a-e
OSU1625	4.3a-f	3.7a-f	2b-e
OSU1628	4.3a-f	3.7a-f	2.7a-e
OSU1629	4.7a-e	3.7a-f	2b-e
OSU1631	5a-e	3.7a-f	3a-e
OSU1638	6.3ab	4.3a-d	3a-e
OSU1639	5a-e	3a-f	1.7c-e
OSU1641	4.7a-e	3.3a-f	2.7a-e
OSU1646	5a-e	4a-e	2b-e
OSU1649	3.3b-f	2.3c-f	1.3de
OSU1651	5a-e	3a-f	1.3de
OSU1656	4a-f	2.7b-f	1.3de
OSU1657	3.3b-f	3a-f	1e
OSU1661	3.3b-f	2.7b-f	2b-e
OSU1662	3.7a-f	3.3a-f	2b-e
OSU1663	3.3b-f	3.3a-f	1.7c-e
OSU1664	4.7a-e	3.7a-f	2.7a-e
OSU1666	4.3a-f	4a-e	1.7c-e
OSU1670	4.3a-f	3.3a-f	1.3de
OSU1673	3c-f	1.3ef	1e
OSU1675	5.7a-c	3.3a-f	1.7c-e
OSU1680	4.7a-e	4a-e	1.7c-e
OSU1682	4.7a-e	4.7a-d	2.7a-e
OSU1687	3.7a-f	3.3a-f	1e
OSU1690	3.3b-f	2.3c-f	1e
OSU1699	5a-e	2.7b-f	1.7c-e
Tahoma31	5a-e	3.7a-f	2b-e
TifTuf	5.7a-c	4.3a-d	3.3a-d
Tifway	5a-e	5a-c	3.7a-c
Tilin#5	5.3a-d	4.3a-d	2b-e
U-3	6a-c	5.3ab	4ab

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 39. Simple effects of traffic on visual fall color (VFC) of 96 bermudagrasses in 2020.

Entry	18-Oct	1-Nov	14-Nov
	---	*(1-9) scale*	---
15-4X15	<.0001	0.0009	0.1324
15-8X3	0.009	0.0009	0.0246
18-7-1	0.009	0.0921	1
18-7-2	0.0488	0.0119	0.4507
18-7-3	0.0012	<.0001	0.1324
18-7-4	0.0001	0.0009	0.1324
18-7-5	0.0001	0.0921	1
18-7-6	0.0012	0.0921	0.4507
18-8-1	<.0001	0.0009	0.1324
18-8-2	0.0012	0.0009	0.4507
18-8-3	0.0488	0.3984	0.0246
18-8-4	0.0001	<.0001	0.1324
18-8-5	0.0012	0.0119	1
18-8-6	0.0001	<.0001	0.4507
18-8-7	<.0001	0.0009	0.4507
18-9-1	0.0012	<.0001	1
18-9-10	0.1875	1	0.1324
18-9-11	0.0001	0.0119	0.4507
18-9-12	0.009	0.0119	1
18-9-2	0.0001	0.3984	0.0246
18-9-3	0.009	0.0009	0.1324
18-9-4	<.0001	0.0119	1
18-9-5	0.0001	0.0119	1
18-9-6	<.0001	<.0001	0.4507
18-9-7	<.0001	<.0001	0.4507
18-9-8	0.1875	<.0001	1
18-9-9	<.0001	<.0001	0.0246
17-4200-19x13	0.009	0.0119	0.4507
17-4200-19x21	0.0012	0.0009	1
17-4200-19x9	0.0488	0.3984	0.1324
17-4200-36x19	0.0001	0.3984	1
Astro	0.0488	0.0119	0.1324
17-5200-11X9	0.0488	0.0119	0.4507
17-5200-13X9	<.0001	<.0001	0.4507
17-5200-31X3	0.009	<.0001	0.4507
17-5200-3X23	0.0012	0.0009	1
17-5200-4X11	0.0012	0.0009	0.4507
Bimini	0.1875	0.0119	0.4507
2008-4x16	0.0012	0.0009	1
Celebration	0.0001	0.0009	0.1324
Latitude36	0.0488	0.0921	0.4507
NorthBridge	0.0488	0.0009	1
OKC1221	<.0001	<.0001	0.4507
OSU1101	1	0.0009	0.4507
OSU1117	0.0001	0.0921	0.4507
OSU1127	0.009	0.0119	1
OSU1132	0.0001	0.0009	1
OSU1156	0.0012	<.0001	0.1324
OSU1217	0.0488	0.0921	1
OSU1257	0.0012	<.0001	0.1324
OSU1318	<.0001	0.0119	0.0246
OSU1337	0.0012	0.3984	0.1324
OSU1402	<.0001	0.0009	1
OSU1403	0.0001	0.0009	1
OSU1406	0.0012	0.0009	1
OSU1408	<.0001	0.0119	1
OSU1409	0.0001	<.0001	1

OSU1417	<.0001	<.0001	0.1324
OSU1418	<.0001	0.0119	0.0246
OSU1433	0.0001	0.0009	1
OSU1439	0.009	<.0001	1
OSU1601	0.009	0.0119	0.4507
OSU1609	<.0001	<.0001	0.0246
OSU1611	0.0001	<.0001	0.1324
OSU1617	<.0001	<.0001	0.4507
OSU1620	0.0001	0.0009	0.0246
OSU1625	0.0001	0.0119	1
OSU1628	0.0012	<.0001	0.1324
OSU1629	0.0012	0.3984	1
OSU1631	0.0012	0.0119	1
OSU1638	0.5089	0.0119	0.4507
OSU1639	0.0001	0.0009	0.4507
OSU1641	0.0012	0.0009	0.4507
OSU1646	0.0012	<.0001	0.1324
OSU1649	<.0001	<.0001	0.0246
OSU1651	0.0012	0.0009	0.0246
OSU1656	<.0001	<.0001	0.4507
OSU1657	<.0001	0.0119	0.0246
OSU1661	0.0001	<.0001	0.4507
OSU1662	<.0001	<.0001	0.1324
OSU1663	<.0001	0.0119	0.4507
OSU1664	0.009	0.3984	0.1324
OSU1666	0.0012	<.0001	0.1324
OSU1670	0.0001	0.0119	0.4507
OSU1673	0.009	0.0921	1
OSU1675	0.1875	0.0119	1
OSU1680	0.0012	0.0009	0.0246
OSU1682	0.0012	0.0119	1
OSU1687	<.0001	<.0001	1
OSU1690	<.0001	<.0001	0.4507
OSU1699	0.0488	<.0001	1
Tahoma31	0.009	<.0001	0.4507
TifTuf	0.009	<.0001	0.0246
Tifway	0.0012	0.0119	0.4507
Tilin#5	0.0012	0.0921	0.0246
U-3	0.1875	0.0921	0.4507

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey's HSD test.

Table 40. Mean fall NDVI of 96 non-trafficked bermudagrasses in 2020.

Entry	18-Oct	1-Nov	14-Nov
15-4X15	0.532a-k	0.586a-f	0.336a-d
15-8X3	0.521a-k	0.565a-f	0.304a-d
18-7-1	0.581a-h	0.555a-f	0.265b-d
18-7-2	0.597a-f	0.583a-f	0.28a-d
18-7-3	0.517a-k	0.574a-f	0.297a-d
18-7-4	0.501b-k	0.466d-g	0.254cd
18-7-5	0.423jk	0.374g	0.228d
18-7-6	0.617a-d	0.602a-f	0.301a-d
18-8-1	0.57a-j	0.678ab	0.414a
18-8-2	0.606a-f	0.673a-c	0.353a-d
18-8-3	0.618a-c	0.63a-d	0.328a-d
18-8-4	0.507a-k	0.589a-f	0.297a-d
18-8-5	0.517a-k	0.601a-f	0.283a-d
18-8-6	0.492c-k	0.592a-f	0.307a-d
18-8-7	0.572a-i	0.694a	0.334a-d
18-9-1	0.539a-k	0.561a-f	0.309a-d
18-9-10	0.589a-f	0.534a-g	0.308a-d
18-9-11	0.546a-k	0.528a-g	0.247d
18-9-12	0.511a-k	0.57a-f	0.305a-d
18-9-2	0.592a-f	0.628a-e	0.302a-d
18-9-3	0.542a-k	0.585a-f	0.343a-d
18-9-4	0.565a-k	0.53a-g	0.308a-d
18-9-5	0.545a-k	0.533a-g	0.273a-d
18-9-6	0.495c-k	0.477d-g	0.248d
18-9-7	0.537a-k	0.557a-f	0.301a-d
18-9-8	0.569a-j	0.566a-f	0.324a-d
18-9-9	0.556a-k	0.624a-e	0.37a-d
17-4200-19x13	0.603a-f	0.584a-f	0.327a-d
17-4200-19x21	0.547a-k	0.6a-f	0.331a-d
17-4200-19x9	0.644ab	0.597a-f	0.288a-d
17-4200-36x19	0.595a-f	0.616a-f	0.303a-d
Astro	0.538a-k	0.521b-g	0.287a-d
17-5200-11X9	0.464f-k	0.445fg	0.264b-d
17-5200-13X9	0.486c-k	0.572a-f	0.323a-d
17-5200-31X3	0.56a-k	0.6a-f	0.39a-c
17-5200-3X23	0.579a-h	0.564a-f	0.361a-d
17-5200-4X11	0.608a-f	0.625a-e	0.3a-d
Bimini	0.655a	0.669a-c	0.307a-d
2008-4x16	0.541a-k	0.547a-f	0.304a-d
Celebration	0.584a-h	0.578a-f	0.309a-d
Latitude36	0.559a-k	0.547a-f	0.29a-d
NorthBridge	0.605a-f	0.512b-g	0.259b-d
OKC1221	0.526a-k	0.574a-f	0.303a-d
OSU1101	0.614a-e	0.594a-f	0.299a-d
OSU1117	0.526a-k	0.553a-f	0.309a-d
OSU1127	0.528a-k	0.556a-f	0.303a-d
OSU1132	0.515a-k	0.468d-g	0.284a-d
OSU1156	0.593a-f	0.531a-g	0.276a-d
OSU1217	0.559a-k	0.522a-g	0.291a-d
OSU1257	0.558a-k	0.585a-f	0.324a-d
OSU1318	0.561a-k	0.494d-g	0.297a-d
OSU1337	0.602a-f	0.55a-f	0.264b-d
OSU1402	0.535a-k	0.561a-f	0.302a-d
OSU1403	0.55a-k	0.563a-f	0.306a-d
OSU1406	0.497b-k	0.513b-g	0.29a-d
OSU1408	0.561a-k	0.523a-g	0.307a-d
OSU1409	0.513a-k	0.544a-g	0.289a-d
OSU1417	0.528a-k	0.523a-g	0.304a-d

OSU1418	0.526a-k	0.586a-f	0.316a-d
OSU1433	0.536a-k	0.516b-g	0.293a-d
OSU1439	0.576a-i	0.614a-f	0.301a-d
OSU1601	0.587a-f	0.546a-g	0.263b-d
OSU1609	0.492c-k	0.584a-f	0.311a-d
OSU1611	0.479c-k	0.547a-g	0.325a-d
OSU1617	0.564a-k	0.627a-e	0.361a-d
OSU1620	0.466e-k	0.496d-g	0.279a-d
OSU1625	0.515a-k	0.577a-f	0.326a-d
OSU1628	0.539a-k	0.52b-g	0.316a-d
OSU1629	0.565a-k	0.576a-f	0.399ab
OSU1631	0.548a-k	0.556a-f	0.307a-d
OSU1638	0.553a-k	0.536a-g	0.292a-d
OSU1639	0.532a-k	0.582a-f	0.342a-d
OSU1641	0.498b-k	0.557a-f	0.287a-d
OSU1646	0.542a-k	0.576a-f	0.307a-d
OSU1649	0.437g-k	0.513b-g	0.315a-d
OSU1651	0.522a-k	0.532a-g	0.289a-d
OSU1656	0.532a-k	0.561a-f	0.313a-d
OSU1657	0.514a-k	0.528a-g	0.317a-d
OSU1661	0.491c-k	0.502c-g	0.293a-d
OSU1662	0.469d-k	0.574a-f	0.316a-d
OSU1663	0.429i-k	0.537a-g	0.277a-d
OSU1664	0.586a-f	0.488d-g	0.263b-d
OSU1666	0.493c-k	0.523a-g	0.31a-d
OSU1670	0.544a-k	0.54a-g	0.295a-d
OSU1673	0.419k	0.456e-g	0.305a-d
OSU1675	0.538a-k	0.518b-g	0.274a-d
OSU1680	0.504b-k	0.579a-f	0.303a-d
OSU1682	0.516a-k	0.544a-g	0.285a-d
OSU1687	0.508a-k	0.551a-f	0.31a-d
OSU1690	0.437h-k	0.505b-g	0.334a-d
OSU1699	0.532a-k	0.555a-f	0.32a-d
Tahoma31	0.52a-k	0.516b-g	0.274a-d
TifTuf	0.59a-f	0.602a-f	0.32a-d
Tifway	0.554a-k	0.55a-f	0.339a-d
Tilin#5	0.552a-k	0.504c-g	0.253cd
U-3	0.578a-h	0.577a-f	0.356a-d

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 41. Mean fall NDVI of 96 trafficked bermudagrasses in 2020.

Entry	18-Oct	1-Nov	14-Nov
15-4X15	0.68a-c	0.452a-h	0.306a-c
15-8X3	0.63a-e	0.458a-h	0.307a-c
18-7-1	0.68a-c	0.456a-h	0.268bc
18-7-2	0.67a-d	0.488a-g	0.274a-c
18-7-3	0.66a-d	0.479a-h	0.317a-c
18-7-4	0.62a-f	0.361g-i	0.2244c
18-7-5	0.54d-f	0.312i	0.229c
18-7-6	0.7a-c	0.475a-h	0.287a-c
18-8-1	0.72ab	0.482a-h	0.293a-c
18-8-2	0.73ab	0.523a-d	0.312a-c
18-8-3	0.68a-c	0.534ab	0.377ab
18-8-4	0.67a-d	0.448a-i	0.272a-c
18-8-5	0.67a-c	0.481a-h	0.263bc
18-8-6	0.66a-d	0.446a-i	0.269bc
18-8-7	0.75a	0.531a-c	0.296a-c
18-9-1	0.66a-d	0.416b-i	0.32a-c
18-9-10	0.61b-f	0.522a-d	0.321a-c
18-9-11	0.65a-e	0.416b-i	0.253bc
18-9-12	0.66a-d	0.477a-h	0.305a-c
18-9-2	0.73ab	0.462a-h	0.328a-c
18-9-3	0.67a-d	0.457a-h	0.316a-c
18-9-4	0.7a-c	0.427b-i	0.319a-c
18-9-5	0.68a-c	0.455a-h	0.269bc
18-9-6	0.61b-f	0.411b-i	0.253bc
18-9-7	0.7a-c	0.433b-i	0.279a-c
18-9-8	0.66a-d	0.46a-h	0.272a-c
18-9-9	0.7a-c	0.478a-h	0.289a-c
17-4200-19x13	0.7a-c	0.462a-h	0.312a-c
17-4200-19x21	0.68a-c	0.457a-h	0.275a-c
17-4200-19x9	0.71ab	0.521a-e	0.273a-c
17-4200-36x19	0.69a-c	0.504a-f	0.335a-c
Astro	0.64a-e	0.404b-i	0.256bc
17-5200-11X9	0.52ef	0.368f-i	0.276a-c
17-5200-13X9	0.67a-d	0.383f-i	0.285a-c
17-5200-31X3	0.68a-c	0.436b-i	0.4a
17-5200-3X23	0.67a-c	0.48a-h	0.339a-c
17-5200-4X11	0.69a-c	0.493a-g	0.311a-c
Bimini	0.73ab	0.574a	0.322a-c
2008-4x16	0.68a-c	0.425b-i	0.282a-c
Celebration	0.68a-c	0.447a-i	0.272a-c
Latitude36	0.67a-c	0.484a-h	0.282a-c
NorthBridge	0.66a-d	0.463a-h	0.273a-c
OKC1221	0.65a-e	0.412b-i	0.27bc
OSU1101	0.7a-c	0.503a-f	0.292a-c
OSU1117	0.68a-c	0.427b-i	0.281a-c
OSU1127	0.64a-e	0.437b-i	0.3a-c
OSU1132	0.64a-e	0.409b-i	0.249bc
OSU1156	0.67a-c	0.479a-h	0.305a-c
OSU1217	0.62a-f	0.462a-h	0.305a-c
OSU1257	0.69a-c	0.44a-i	0.274a-c
OSU1318	0.67a-c	0.418b-i	0.304a-c
OSU1337	0.67a-d	0.482a-h	0.312a-c
OSU1402	0.69a-c	0.424b-i	0.26bc
OSU1403	0.66a-d	0.424b-i	0.259bc
OSU1406	0.63a-e	0.409b-i	0.267bc
OSU1408	0.64a-e	0.437b-i	0.275a-c
OSU1409	0.65a-d	0.469a-h	0.286a-c
OSU1417	0.66a-d	0.422b-i	0.278a-c

OSU1418	0.66a-d	0.404b-i	0.284a-c
OSU1433	0.68a-c	0.409b-i	0.253bc
OSU1439	0.7a-c	0.446a-i	0.268bc
OSU1601	0.65a-d	0.455a-h	0.27bc
OSU1609	0.68a-c	0.425b-i	0.269bc
OSU1611	0.64a-e	0.407b-i	0.297a-c
OSU1617	0.72ab	0.439a-i	0.325a-c
OSU1620	0.64a-e	0.384e-i	0.265bc
OSU1625	0.68a-c	0.451a-h	0.283a-c
OSU1628	0.64a-e	0.459a-h	0.29a-c
OSU1629	0.69a-c	0.45a-h	0.333a-c
OSU1631	0.67a-c	0.437a-i	0.305a-c
OSU1638	0.63a-e	0.471a-h	0.315a-c
OSU1639	0.71a-c	0.46a-h	0.293a-c
OSU1641	0.63a-e	0.458a-h	0.285a-c
OSU1646	0.65a-e	0.427b-i	0.261bc
OSU1649	0.6b-f	0.361g-i	0.271bc
OSU1651	0.65a-d	0.428b-i	0.252bc
OSU1656	0.66a-d	0.393c-i	0.277a-c
OSU1657	0.65a-e	0.434b-i	0.286a-c
OSU1661	0.58c-f	0.35hi	0.25bc
OSU1662	0.66a-d	0.392d-i	0.274a-c
OSU1663	0.61a-f	0.368f-i	0.274a-c
OSU1664	0.61a-f	0.457a-h	0.288a-c
OSU1666	0.63a-e	0.435b-i	0.28a-c
OSU1670	0.67a-d	0.435b-i	0.281a-c
OSU1673	0.48f	0.384e-i	0.256bc
OSU1675	0.62a-e	0.449a-i	0.28a-c
OSU1680	0.66a-d	0.408b-i	0.265bc
OSU1682	0.66a-d	0.434b-i	0.262bc
OSU1687	0.65a-e	0.4b-i	0.276a-c
OSU1690	0.64a-e	0.379f-i	0.302a-c
OSU1699	0.65a-e	0.387d-i	0.35a-c
Tahoma31	0.66a-d	0.421b-i	0.276a-c
TifTuf	0.68a-c	0.477a-h	0.301a-c
Tifway	0.66a-d	0.473a-h	0.325a-c
Tilin#5	0.64a-e	0.426b-i	0.246c
U-3	0.66a-d	0.453a-h	0.308a-c

Means within columns followed by same letters are not statistically different at P=0.05 based on Tukey’s HSD test.

Table 42. Simple effects of traffic on fall NDVI of bermudagrasses in 2020.

Entry	18-Oct	1-Nov	14-Nov
		p-value	
15-4X15	<.0001	<.0001	0.4732
15-8X3	0.0009	0.0008	0.8358
18-7-1	0.0042	0.0021	0.8358
18-7-2	0.0249	0.003	0.8358
18-7-3	<.0001	0.003	0.5374
18-7-4	0.0006	0.0011	0.3602
18-7-5	0.0007	0.0496	0.9174
18-7-6	0.0089	<.0001	0.7562
18-8-1	<.0001	<.0001	0.0029
18-8-2	0.0003	<.0001	0.2292
18-8-3	0.0681	0.0021	0.1398
18-8-4	<.0001	<.0001	0.4732
18-8-5	<.0001	0.0003	0.5374
18-8-6	<.0001	<.0001	0.2292
18-8-7	<.0001	<.0001	0.2292
18-9-1	0.0004	<.0001	0.6794
18-9-10	0.489	0.8352	0.6063
18-9-11	0.0028	0.0005	0.8358
18-9-12	<.0001	0.0041	1
18-9-2	<.0001	<.0001	0.4732
18-9-3	0.0002	<.0001	0.4732
18-9-4	<.0001	0.0021	0.7562
18-9-5	0.0001	0.0178	0.8358
18-9-6	0.0007	0.0496	0.9174
18-9-7	<.0001	0.0002	0.4732
18-9-8	0.0055	0.0015	0.0987
18-9-9	<.0001	<.0001	0.0328
17-4200-19x13	0.0031	0.0002	0.6794
17-4200-19x21	<.0001	<.0001	0.0987
17-4200-19x9	0.0334	0.0233	0.6063
17-4200-36x19	0.0033	0.0005	0.3602
Astro	0.0026	0.0005	0.3114
17-5200-11X9	0.1024	0.0135	0.6794
17-5200-13X9	<.0001	<.0001	0.2679
17-5200-31X3	0.0004	<.0001	0.7562
17-5200-3X23	0.0049	0.0076	0.5374
17-5200-4X11	0.0119	<.0001	0.8358
Bimini	0.0171	0.003	0.6794
2008-4x16	<.0001	0.0002	0.5374
Celebration	0.003	<.0001	0.2679
Latitude36	0.0006	0.0627	0.9174
NorthBridge	0.0824	0.0976	0.6794
OKC1221	0.0003	<.0001	0.3114
OSU1101	0.0066	0.0056	0.7562
OSU1117	<.0001	0.0001	0.4141
OSU1127	0.001	0.0003	0.9174
OSU1132	0.0002	0.0786	0.3114
OSU1156	0.0133	0.0786	0.3602
OSU1217	0.0877	0.0786	0.6794
OSU1257	<.0001	<.0001	0.1656
OSU1318	0.0007	0.0178	0.8358
OSU1337	0.0354	0.0389	0.1398
OSU1402	<.0001	<.0001	0.1952
OSU1403	0.0009	<.0001	0.1398
OSU1406	<.0001	0.0015	0.5374
OSU1408	0.0172	0.0102	0.3602
OSU1409	<.0001	0.0233	1

OSU1417	0.0001	0.0015	0.4732
OSU1418	<.0001	<.0001	0.3114
OSU1433	<.0001	0.0008	0.2679
OSU1439	0.0003	<.0001	0.3602
OSU1601	0.0425	0.0041	0.9174
OSU1609	<.0001	<.0001	0.1952
OSU1611	<.0001	<.0001	0.4141
OSU1617	<.0001	<.0001	0.3114
OSU1620	<.0001	0.0005	0.7562
OSU1625	<.0001	0.0002	0.1656
OSU1628	0.002	0.0627	0.4141
OSU1629	0.0002	0.0001	0.0477
OSU1631	0.0002	0.0004	0.8358
OSU1638	0.0146	0.0389	0.4732
OSU1639	<.0001	0.0002	0.1656
OSU1641	<.0001	0.003	0.9174
OSU1646	0.0016	<.0001	0.1398
OSU1649	<.0001	<.0001	0.2292
OSU1651	0.0001	0.0015	0.2679
OSU1656	0.0001	<.0001	0.2679
OSU1657	<.0001	0.0076	0.3602
OSU1661	0.0085	<.0001	0.1656
OSU1662	<.0001	<.0001	0.1952
OSU1663	<.0001	<.0001	1
OSU1664	0.3676	0.2991	0.4141
OSU1666	<.0001	0.0076	0.3602
OSU1670	0.0003	0.0015	0.6063
OSU1673	0.0448	0.0233	0.1398
OSU1675	0.0126	0.0233	0.7562
OSU1680	<.0001	<.0001	0.2526
OSU1682	<.0001	0.0015	0.4732
OSU1687	<.0001	<.0001	0.3602
OSU1690	<.0001	0.0002	0.3602
OSU1699	0.0003	<.0001	0.3114
Tahoma31	<.0001	0.003	0.9174
TifTuf	0.0097	0.0002	0.4732
Tifway	0.002	0.0178	0.6063
Tilin#5	0.0065	0.0135	0.8358
U-3	0.0165	0.0002	0.1656

VITA

SHEHBAZ SINGH

Candidate for the Degree of

Master of Science

Thesis: EVALUATION OF FALL TRAFFIC TOLERANCE AND SURFACE PLAYABILITY OF SELECTED BERMUDAGRASSES

Major Field: Horticulture

Biographical:

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Completed the requirements for the Bachelor of Science in Agriculture at Punjab Agricultural University, Ludhiana, India in 2018.

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