Research Article

Evaluating *Sporobolus spicatus* Ecotypes under Different Mowing Heights for Turf use

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Abstract | The existing variations and diversity of *Sporobolus spicatus* and its suitability as turf grass needed to be assessed for conservation and to combat salinity problem. For this purpose, various ecotypes of *Sporobolus spicatus* were investigated by conducting mowing tests in the year 2013 under UAE climatic conditions. Fifty ecotypes of *Sporobolus spicatus* were cut at various heights, i.e. 1, 2, 3, 4 and 5 cm. Significant differences were found among various ecotypes and mowing heights for different growth and quality parameters including green cover, canopy stiffness, leaf length and width. Most of the ecotypes gave better performance at mowing height 3 and 4 cm, which comply with the standard mowing height for turf grasses. Ecotypes RS2, MZADS1 and SAADS1 resulted in the best performance against mowing shock. Based on their performance, these ecotypes could be used for turf purposes in public landscape under saline environments.

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Introduction

Turf grass is a basic component of urban landscape as it provides aesthetic value to the properties/buildings. It stabilizes the soil, sand dunes and controls erosion, reduces noise, controls dust, covers the ground and provides recreation (Garden et al., 1996). If a particular grass is well adapted to the surrounding climatic conditions, it will perform well. Otherwise, no satisfactory turf can be produced even with investment of huge amount on establishment and maintenance. Turf density is one of the major adaptation characteristics of a turf grass (Murdoch et al., 1998).

Since the UAE native grasses are growing under high salt and drought conditions, they are the best to be evaluated for their suitability as turf grasses (Pessarakli and Kopec, 2011). Turf grasses will look more attractive, when they are mowed to their lowest tolerated height. Due to environmental impact and high cost of maintenance, the constructed landscape is criticised because it is not sustainable under some conditions. So the use of alternative native grass species can add to cost saving and sustainability in landscaping (Mark et al., 2011). Mowing is necessary defoliation process whereby the upper portion of turf grass is removed. In other words, the over grown turf grass is cut back uniformly to its proper height to make the surface smooth. Mowing is practiced to make uniform height for all the grass for beautification and is a requirement for many outdoor sports and recreational areas. Each type of grass has mowing tolerance range that is expressed as lowest and highest tolerated mowing height (Xiandeng et al., 1998).

Sporobolus spicatus, as illustrated in Figures 1 and 2, is a native grass of the UAE (Zamin and Khattak, 2017). It is shortly tufted perennial, stoloniferous and matting, culms 10–70 cm high with pungent leaves (2-30 cm long and 1-4 mm wide with stiff leaf blades). Its inflorescence is panicle (spiciform, linear 1.5-2 cm long, 0.2 to 0.4 cm wide), fertile with pedicel. The plant is well distributed on alkaline soils of Africa and Asia. It is considered the most alkali tolerant grass in Kenya and Tanzania. It can grow on sodic soil. The plant produces stolons for spreading. It is fast growing grass, playing an important role in dune sand stabilizations. Although, it is producing pungent leaves, it can be used as turf grass due to its horizontal spreading nature (Clayton et al., 2006).All halophytes have strategy of salt exclusions upon increasing the salinity levels (Marcum 2006). Thus salinity tolerance is positively correlated with salt gland activities showing that the salinity tolerance in grasses is associated with saline ion exclusion and leaf salt gland excretion efficiency. At higher salinity levels (such as 60 and 75dSm^{-1}) rate of salt gland activity in leaves increases which is indicated by salt concentration in leaf rinseates (Zamin and Khattak, 2017). Due to extensive use of turf grasses in beautification projects mostly in desert area having saline conditions (Al-Shehhi et al., 2010), it is very expensive to maintain quality turf grass on treated water (Pessarakli, 2015). However, using native grasses in public landscaping can bring sustainability in inlandscaping and saving biodiversity as well (Viggiani, 2015; Zamin and Khattak, 2017).

Figure 1: *Site photos of Sporobolus spicatus taken by author near Zayed University, Abu Dhabi (Google coordinates 24°23'55.24"N 54°34'57.80"E).*

Selection and domestications of indigenous grasses of UAE is very important because the indigenous grasses have enough variations and potential to cope with harsh climatic conditions of the country. These native grasses are growing under such climatic conditions and are adapted to these stresses, therefore, their evaluation is the key for solving the salinity problem (Pessarakli and Kopec, 2011; Zamin and Khattak, 2017). *Sporobolus spicatus* is abundantly available and growing in all the Emirates of UAE. Since the *Sporobolus spicatus* has turf type characteristic, hence evaluating its various ecotypes for mowing height is studied under this experiment.

Materials and Methods

The experiment was conducted in UAE University Research Project Farm in Bahia, Abu Dhabi in the year 2013 using Randomized Complete Block Design (RCBD) with the following two factors.

Factor 1: Mowing height (5 levels, i.e. 1, 2, 3, 4 and 5 cm heights from ground level).
Factor 2: *Sporobolus spicatus* ecotypes (50 + *Paspalum-vaginatum* as a control).

The experimental plot was located at a distance of 50KM from Abu Dhabi City, near Abu Dhabi-Dubai highway (Google Coordinates 24°32'5.30"N, 54°39'24.13"E).

Fifty ecotypes of the *Sporobolus spicatus*, collected from various parts of UAE,were grown in 15 cm pots using the concept of Uddin et al. (2009). *Paspalum vaginatum* was grown as control grass for comparison, as it is the common turf grass grown in the local landscape. Vegetatively, seashore *Paspalum* matches with common Bermuda grass. However, it can be identified easily at flowering stage, because its flower consists of two racemes, un-branched inflorescence (Williams, 2007).

The ecotypes were then placed in rows with four replications and tested at different mowing heights under semi shade conditions. The shade net made of High-density polyethylene (HDPE) knitted fabric (with 30% shade) was used to provide uniform environment and protect the grasses from unexpected weather conditions, such as harsh winds etc.

Sequential mowing treatments were given after establishment of all the grasses. At 5cm grasses were clipped and discarded on weekly basis for three weeks and data were taken on the 4th mowing (clipping) for following parameters.

1. Green cover (1-10): Green cover data were taken by visual method considering the pot coverage by green biomass. The data were taken after the final mowing of grass. The scale was from 1 to 10, where 1 means least green cover and 10 fully covered, while 0 means dead.
2. Canopy stiffness (1-10): Canopy stiffness shows

how soft or hard the grass feels while using it. Canopy stiffness was rated on a scale of 1-10, where 1 stands for minimum stiffness (the softest) by touching and 10 for maximum stiffness (the hardest). In other words, lower stiffness grass provides better performance due to its soft feel, while higher stiffness, being harder, is not liked. The data were the average of the judgment of the panel consisting of 5 members, as the touch feel would be different for different individuals

3. Leaf length(mm): Length of all the leaves was measured and average was taken in case the number of leaves was equal or less than 10, while in case the leaves were in large quantity, 10 leaves were randomly selected per treatment (clipping) for measurements.
4. Leaf width/texture (mm):It was measured and average was taken in case the number of leaves was equal or less than 10, while for higher number of leaves a random sample of 10 leaves was selected from the clippings of each treatment, measured and average was calculated.

Then the second mowing height (at 4cm) was practiced and data taken as mentioned above till the final mowing height of 1cm. During the mowing tests, all the ecotypes were maintained properly. The performance of ecotypes at various mowing heights was evaluated in order to get acquaintance about their suitability for landscape purpose. The data collected were analysed using statistical software and computer applications (Statistic 8.1, an Analytical Software). It is important to mention that though the data were analysed using ANOVA and Tukey's test, the means of all the parameters were further subjected to Cluster Analysis (CA). This was done because a large number of treatments (51) were used in the experiment and the incorporation of CA facilitated to group ecotypes and understand the results in a better way.

Results and Discussion

As mentioned above, data were collected and analysed for various parameters, such as green cover, canopy stiffness, leaf length and width. Cluster Analysis were incorporated to group into main components and then clusters collectively based on the above mentioned parameters results. The results of CA are discussed first and the detail of the actual parameters follows.

Cluster analysis

Cluster analysis was carried out to group the ecotypes based on their linkage distance. As indicated in the dendrogram (Figure 2), three clusters were produced as a result of cluster analysis at a linkage distance of 6.7. Cluster 1 consisted of 36 ecotypes as shown in Figure 2. Cluster 2 contained only one genotype (ADPV1), which is the control grass, while cluster 3 had 14 ecotypes. Table 1 shows that important characters with highest means were included in cluster 1 as compared to cluster 3 which had two characters' canopy stiffness and leaf width with highest means of 5.88 and 2.78 mm respectively. Cluster 1 contained ecotypes which produced maximum means value for green cover (8.34). However, the important character such as green cover included in cluster 1 with lowest canopy stiffness value (5.79) and leaf width (2.73) which are desired. Although, it is more than control grass, ADPV1, however, it is the lowest among all the other ecotypes. Zamin and Khattak (2017) also obtained 3 clusters from 51 ecotypes of the same grass during salinity tests. They also found highest mean value for green cover in cluster 1. Ali et al. (2008) extracted 4 clusters in 70 wheat genotypes and according to his findings cluster 2 had the most important characters.

Table 1: *Cluster means and standard deviations for various parameters for differentSporobolus spicatus ecotypes (50) and Paspalum (ADPV1; control).*

Parameters	Cluster I (36 Ecotypes)	Cluster II (1 Ecotype)	Cluster III (14 Ecotypes)
Green cover(1-10)	8.34±0.56*	9.9	8.02±0.54
Canopy stiffness(1-10)	5.79±0.39	1.8	5.88±0.49
Leaf length(mm)	46.06±4.31	27.4	40.94±2.64
Leaf width(mm)	2.73±0.19	0.97	2.78±0.16

**Standard deviation*

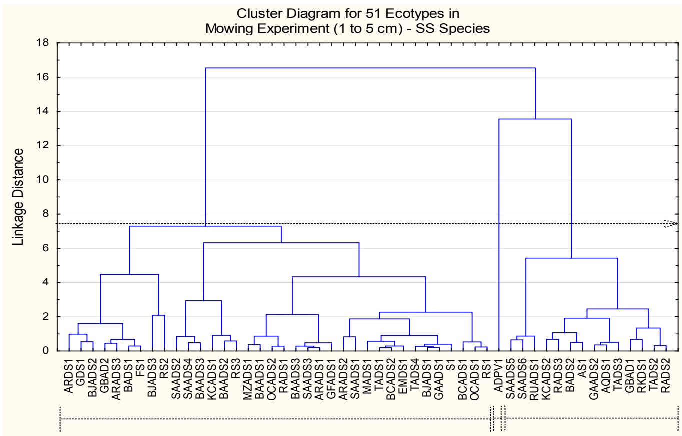

Figure 2: *Dendrogram for 50 Sporobolus spicatus ecotypes and Paspalum (ADPV1; control) based on different agronomic characters.*

Green cover (1-10)

The data for green cover are given in Table 2 showing that different mowing heights had a significant (P≤0.001) effect on the green cover of *Sporobolus spicatus* ecotypes. The means data of mowing heights (Table 2) show that maximum green cover was recorded at 3 cm mowing height giving 9.01 spread which was at par with 4 cm mowing height with 9.00 green cover. This was followed by 2 cm and 1 cm mowing heights with ground cover of 8.53 and 7.73 respectively. Minimum (7.12) green cover was observed at 5 cm mowing height. Variable green cover was found for different ecotypes as shown in Table 5.3 (main effect). To further elaborate the comparison of the ecotypes the data were subjected to cluster analysis (Figure 2) which gave 3 main clusters. Among these, cluster 1 had maximum (36) number of ecotypes, followed by cluster 3 with 14 ecotypes while cluster 2 had only grass (ADPV1; control) with the highest (9.9) green cover. Cluster 1 gave the best performance (8.34) in terms of green cover followed by cluster 3 (8.02). The top ecotypes, that gave the best ground cover, included in cluster 1 were RS2 (9.13), MZADS1 (9.10) and SAADS1 (9.08). Some other ecotypes also performed well such as TADS1 and ARADS2 (9.03) BCADS1 and TADS4 (8.98). Although, mowing height had significant effect on ground cover, no regular trend was found (Table 2). Similar trend of mowing height was found by Kopec et al. (2004). It is evident from above data that the ecotypes showed the best performance at 3 cm mowing height followed by 4 cm. These mowing heights are considered standard for common turf grasses. These results are in line with the findings of Shahba (2010) and Kopec et al. (2004). Similarly, the best mowing height of 3 and 4 cm matches with the work of Toler (2007). Ground cover and green color are the main quality indicators for a turf grass, whereby cover is represented by density of shoots and leaves while color indicates chlorophyll concentration and grass health. Significant effect of mowing height was found on shoot density and different ecotypes behaved differently. However, all the ecotypes produced lesser shoots as compared to control grass, similar to the findings of Gobilik et al. (2013) who observed lesser shoots produced by ecotypes as compared to Bermuda cultivar Tifdwarf, used as control. As compared to *Aeluropus lagopoides* ecotypes, *Sporobolus spicatus* ecotypes performed well at lower mowing heights of 1, 2 and 3 cm. This is because of broader and longer *leaves* of *Sporobolus spicatus* ecotypes, which provided sufficient leaf area for photosynthesis even at very low mowing height (Gibilik et al., 2013). TifEagle Bermuda grass had 19% more non-structural carbohydrate at 3.2 mm height as compared to 4.7 mm mowing height (Bunnel et al., 2005). Carrow et al. (2005) also confirmed that the fast growing and aggressive rhizomes are making the grass adaptable to low mowing height. The best performing ecotypes were very close to that of *Paspalum vaginatum*, which is the prevailing commercial turf grass in UAE. Green cover represents the quality of a turf grass and thus the main feature for selection.

Canopy stiffness (1-10)

Canopy stiffness of *Sporobolus spicatus* ecotypes was significantly (P≤0.001) affected by different mowing heights. According to the means data of mowing height (Table 2), minimum (5.26) canopy stiffness was observed at 5 cm mowing height closely followed by 4 cm mowing height with a canopy stiffness of 5.45. The canopy stiffness increased with the decrease in mowing height such that the hardest (6.27) canopy was found at 1 cm mowing height. Regarding the performance of ecotypes in terms of canopy stiffness a significant difference was also observed (Table 2). The data were subjected to cluster analysis for further details. The analysis produced 3 main clusters (Figure 2), whereby cluster 1 performed the best, giving the lowest (5.79) canopy stiffness. However, the control grass (ADPV1) had the lowest canopy stiffness (1.88) as compared to all ecotypes. The best performing ecotypes among cluster 1 included RS2, S1 (5.15) and RS1 (5.25) while in cluster 2 ecotype TADS2 performed well with lesser canopy stiffness value (5.15).

The canopy stiffness is the main quality character considered in a turf grass selection process. By lowering the mowing height, a trend of reducing the grass quality (increased canopy stiffness) was observed which was also endorsed by Guertal and Evans (2006). In some cases, a few ecotypes showed a satisfactory performance. However, canopy stiffness of all the ecotypes was less than *Paspalum vaginatum* (ADPV1), which is locally grown in urban landscape. Depending upon the nature of a grass, each grass has optimum mowing height at which it gives maximum growth (Stier and dardner, 2008). Since, the most vigorous growth was achieved at 3 and 4 cm mowing height, so more softness or reduced canopy stiffness was recorded at these mowing heights as indicated

Table 2: *Effect of different mowing heights (1-5 cm) on green cover (1-10) and canopy stiffness (1-10) on 50 Sporobolus spicatus ecotypes and Paspalum (ADPV1; as control).*

Ecotypes	Green Cover						Canopy Stiffness					
	Mowing Heights						Mowing Heights					
	1 cm	2 cm	3 cm	4 cm	5 cm	Means	1 cm	2 cm	3 cm	4 cm	5 cm	Means
RADS2	7.50	9.25	8.00	9.25	9.50	8.70	6.00	5.25	6.00	6.38	7.13	6.15
RS1	8.00	8.75	9.75	10.00	7.63	8.83	5.50	5.50	5.25	5.25	4.75	5.25
RS2	9.00	9.00	9.50	9.50	8.63	9.13	5.75	5.75	5.25	5.13	3.88	5.15
TADS2	8.75	9.00	8.75	9.00	8.75	8.85	5.50	5.50	4.50	5.13	5.13	5.15
TADS3	8.50	8.75	8.75	9.50	3.50	7.80	5.25	5.25	4.50	7.25	5.13	5.48
FS1	5.75	8.25	7.75	9.50	8.63	7.98	6.25	6.50	6.75	5.25	5.00	5.95
S1	8.00	8.75	9.25	9.50	7.75	8.65	5.75	5.25	5.50	5.00	4.25	5.15
EMDS1	8.00	8.00	8.50	9.13	8.50	8.43	5.75	5.75	5.75	7.00	5.25	5.90
AS1	7.50	7.75	6.50	9.38	7.50	7.73	6.25	6.25	6.00	5.00	5.13	5.73
RUADS1	7.75	10.00	8.25	8.13	7.38	8.30	7.00	7.00	5.75	6.00	5.50	6.25
GAADS1	7.50	9.25	9.75	9.75	7.25	8.70	6.00	5.50	6.00	6.00	4.50	5.60
GFADS1	6.75	8.75	8.50	9.00	8.38	8.28	7.00	5.50	6.00	6.50	5.38	6.08
BADS2	6.25	8.00	7.50	8.25	7.38	7.48	7.00	5.50	6.50	5.00	4.75	5.75
BADS1	6.25	8.25	9.25	6.75	7.63	7.63	6.25	6.25	6.00	5.00	4.38	5.58
OCADS1	6.75	7.50	9.75	8.75	6.75	7.90	5.50	5.50	6.25	5.50	4.25	5.40
RADS3	7.00	8.75	9.00	9.25	6.50	8.10	7.25	6.25	6.00	5.00	4.13	5.73
RADS1	6.00	7.75	8.25	9.00	7.38	7.68	7.50	6.25	6.25	6.00	5.50	6.30
AQDS1	7.75	8.50	6.00	8.75	7.00	7.60	6.00	6.00	4.50	5.00	5.50	5.40
RS3	7.50	8.50	8.00	9.00	6.63	7.93	6.25	5.75	5.00	5.25	5.38	5.53
KCADS2	9.00	9.25	9.00	8.50	3.00	7.75	7.00	6.75	6.25	5.50	5.25	6.15
KCADS1	7.75	8.00	8.75	9.00	3.00	7.30	7.75	8.00	6.00	5.00	5.50	6.45
RKDS1	7.50	8.75	8.75	7.75	4.50	7.45	7.00	6.25	6.50	6.50	5.38	6.33
MADS1	7.25	8.00	9.75	9.00	7.38	8.28	5.50	6.25	5.25	4.50	5.38	5.38
BCADS1	8.50	9.25	10.00	8.50	8.63	8.98	6.25	6.00	5.75	5.50	4.75	5.65
BCADS2	7.75	8.50	10.00	9.00	8.25	8.70	6.50	6.75	6.00	5.00	6.25	6.10
BJADS1	8.25	8.50	10.00	8.25	8.00	8.60	5.50	6.50	5.75	5.25	7.25	6.05
BJADS3	8.50	8.50	9.75	9.75	8.25	8.95	6.50	5.75	5.50	6.00	6.50	6.05
BJADS2	8.50	8.75	9.75	9.50	7.75	8.85	7.00	7.25	5.75	6.00	6.25	6.45
ARADS1	7.00	7.75	9.00	9.00	8.25	8.20	6.75	7.50	6.25	5.00	5.13	6.13
BAADS1	7.00	9.25	9.50	7.75	4.38	7.58	8.00	7.75	7.00	5.50	5.50	6.75
BAADS2	8.25	8.50	9.50	8.50	6.63	8.28	5.75	6.00	6.00	6.25	5.50	5.90
BAADS3	6.25	7.00	9.75	9.50	7.38	7.98	6.25	6.00	5.75	5.00	5.50	5.70
TADS4	8.75	8.50	9.50	9.50	8.63	8.98	6.50	6.50	5.00	5.00	6.63	5.93
GAADS2	8.75	9.75	9.25	9.00	7.75	8.90	6.75	6.25	6.00	5.25	3.75	5.60
MZADS1	9.50	10.00	9.75	7.75	8.50	9.10	7.00	6.25	6.00	5.25	5.25	5.95
TADS1	8.50	8.50	9.75	10.00	8.38	9.03	7.00	6.50	5.75	5.75	4.38	5.88
ARDS1	9.25	9.00	9.50	8.50	8.13	8.88	6.25	6.25	6.00	4.75	6.25	5.90
GDS1	7.00	9.75	9.50	9.00	3.88	7.83	6.25	6.25	6.50	3.50	5.38	5.58
BAADS3	7.00	7.00	9.00	8.13	7.00	7.63	6.50	6.50	6.00	5.25	4.25	5.70
OCADS2	6.75	7.00	8.00	9.75	7.13	7.73	5.75	5.75	6.25	5.00	6.25	5.80
ARADS3	7.00	5.00	9.25	8.63	7.25	7.43	5.75	5.75	5.50	7.13	4.00	5.63
SAADS6	7.50	9.25	9.00	9.25	1.00	7.20	7.00	6.00	6.50	6.00	10.00	7.10

GBAD1	7.25	8.00	9.50	9.50	7.63	8.38	5.50	5.75	5.75	5.13	6.00	5.63
GBAD2	7.50	7.75	9.75	10.00	7.75	8.55	6.50	5.75	7.25	6.00	5.50	6.20
SAADS1	8.50	9.25	10.00	9.25	8.38	9.08	5.00	5.00	5.50	5.75	5.25	5.30
SAADS2	7.50	8.25	10.00	8.50	4.00	7.65	6.00	5.00	6.50	5.38	5.13	5.60
SAADS3	8.00	8.25	8.00	9.50	7.13	8.18	6.25	5.50	5.50	6.00	6.25	5.90
SAADS4	7.00	9.75	8.00	9.00	7.75	8.30	6.50	4.25	6.25	6.13	3.25	5.28
SAADS5	8.25	8.00	8.00	9.25	6.75	8.05	6.50	6.50	5.00	7.00	4.38	5.88
ARADS2	8.50	9.75	9.50	9.00	8.38	9.03	6.00	3.50	6.00	5.00	6.25	5.35
ADPV1	9.75	10.00	10.00	10.00	9.75	9.90	3.25	2.75	1.00	1.00	1.00	1.80
Means	7.73	8.54	9.01	9.00	7.12		6.27	5.95	5.76	5.45	5.26	
Tukey's values	Mowing height at P≤0.001 = 0.2833 Ecotypes at P≤0.001 = 1.2050						Mowing height at P≤0.001 = 0.2856 Ecotypes at P≤0.001 = 1.2147					

in Table 2. The variations and diversity found in ecotypes in terms of canopy stiffness, could be used in future breeding program as stated by Dilaver (2013). Similarly, Romani et al. (2002) also identified better performing ecotypes during their experiments.

Leaf Length (mm)

Data regarding leaf length (Table 3) show that the leaf length of different *Sporobolus spicatus* ecotypes was significantly (P≤0.001) affected by different mowing heights. The means data of mowing heights (Table 3) show that the longest (53.32 mm) leaves were produced at 4 cm mowing height. Mowing heights of 1, 2 and 5 cm behaved alike, producing 41.55 mm, 42.29 mm and 43.72 mm long leaves respectively. Minimum (40.57 mm) leaf length was provided grasses mowed at 3 cm height. Varying performance of different ecotypes was also observed as given in Table 3 (main effect). To further elaborate, the data were subjected to cluster analysis (Figure 2). There were three clusters, where cluster 1 had the highest (46.06 mm) mean value, followed by cluster 3 (40.94 mm). Among the ecotypes included in cluster 1, ecotype RS2 gave the longest (58.60 mm) leaves followed by ecotypes BJADS3 (58.05 mm leaf length) and GDS1 (52.05 mm leaf length). The trend of effect of mowing height on leaf length of various ecotypes was not regular and each mowing height had unique effect, such that from 1 to 2 cm mowing height, the leaf length increased, then at 3 cm it decreased to minimum while at 4 cm mowing height, it increased to maximum and then decreased at 5 cm mowing height. Different ecotypes had their specific performance and all the ecotypes had longer leaves than control grass (*Paspalum*), which is the prevailing commercial turf grass in UAE. This shows that all ecotypes were more vigorous than the commercial grass. In contrast to our findings, Gobilik et al. (2013) found some indigenous grass ecotypes with shorter leaves. According to Wiecko (2008) longer leaves are produced at vigorous growth of grasses which could be possible at optimum mowing height for a grass. As indicated in Table 3, maximum leaf length was recorded at 4 cm which is the optimum and favourable mowing height for these ecotypes, as confirmed by Stier and Gardner (2008) as well.

Leaf width (mm)

Significant (P≤0.001) differences were found among the mowing heights, as well as, the different ecotypes concerning the leaf width of *Sporobolus spicatus*. Table 3 reveals that maximum (2.86 mm) leaf width was recorded at mowing height of 1 cm which was at par with 3 cm (2.82 mm) and 2 cm (2.80 mm), while minimum (2.37 mm) leaf width was recorded at 4 cm mowing height. To further elaborate the means comparison of ecotypes the data were subjected to cluster analysis (Figure 2). As a result of cluster analysis, 3 clusters were formed (Table 1), where cluster 3 had maximum mean value of 2.78 mm. Thus, among the ecotypes of cluster 1, the widest (3.08 mm) leaves were recorded in ecotype TADS1, followed by SAADS2 (with 2.96 mm wide leaves). In cluster 3, however, ecotypes GBAD1 and RADS3 produced the widest leaves i.e. 2.97 mm and 2.95 mm wide respectively. Akin to leaf length, the relationship of leaf width with the mowing heights is not clear. However, on average, decreasing the mowing height increased the leaf width except 2 and 5 cm mowing heights. Similar findings were reported by Gobilik et al. (2013), who observed significant variations among various ecotypes. Comparing their leaf blades with *Paspalum vaginatum* (0.97 mm), it was observed that all of the ecotypes had wider leaf blades, which is an extra advantage for providing

Table 3: *Effect of different mowing heights (1-5 cm) on leaf length (mm) and width (mm) of 50 Sporobolus spicatus ecotypes and Paspalum (ADPV1; as control).*

Ecotypes	Leaf Length (mm)						Leaf Width (mm)					
	Mowing Heights						Mowing Heights					
	1 cm	2 cm	3 cm	4 cm	5 cm	Means	1 cm	2 cm	3 cm	4 cm	5 cm	Means
RADS2	38.25	40.75	33.00	42.50	54.75	41.85	3.00	2.58	2.88	2.50	2.00	2.59
RS1	44.75	30.25	38.00	56.00	44.00	42.60	2.13	2.63	2.78	1.68	2.65	2.37
RS2	43.25	57.75	48.75	88.75	54.50	58.60	3.25	2.68	2.90	2.08	2.85	2.75
TADS2	33.75	43.50	26.25	53.00	45.25	40.35	2.95	2.75	2.83	2.18	2.75	2.69
TADS3	40.50	38.75	25.75	46.75	46.00	39.55	2.98	2.75	3.00	2.08	2.50	2.66
FS1	39.75	43.50	40.75	63.50	51.00	47.70	2.80	2.95	2.88	3.00	2.85	2.90
S1	46.50	41.25	40.00	64.00	35.00	45.35	2.98	2.95	3.00	2.00	2.48	2.68
EMDS1	49.00	30.00	38.00	59.50	47.50	44.80	3.00	3.50	2.83	2.45	2.75	2.91
AS1	37.75	50.50	27.50	42.00	35.25	38.60	3.00	2.95	2.43	2.20	2.58	2.63
RUADS1	55.00	42.00	31.50	37.25	59.00	44.95	3.00	3.00	3.00	2.20	2.70	2.78
GAADS1	47.75	45.75	45.50	55.00	41.00	47.00	3.00	3.00	2.75	3.00	1.60	2.67
GFADS1	44.75	46.50	37.75	40.50	36.50	41.20	2.93	2.55	2.93	2.80	2.45	2.73
BADS2	36.75	36.00	44.00	54.50	25.00	39.25	3.00	2.95	3.20	2.73	2.88	2.95
BADS1	46.75	40.75	43.75	74.00	27.75	46.60	3.00	3.00	2.65	2.90	2.88	2.89
OCADS1	42.50	40.00	43.25	68.25	16.00	42.00	3.00	2.88	2.88	2.83	3.00	2.92
RADS3	30.25	43.25	47.25	54.00	19.25	38.80	3.00	3.00	2.88	3.00	2.88	2.95
RADS1	32.50	47.75	38.50	57.25	35.25	42.25	2.95	3.00	2.90	2.00	3.00	2.77
AQDS1	39.75	53.25	20.75	54.25	22.50	38.10	3.00	2.95	3.00	2.90	2.70	2.91
RS3	36.25	40.50	44.25	68.25	20.25	41.90	2.85	3.05	2.65	2.90	2.88	2.87
KCADS2	37.50	38.75	40.25	44.50	26.50	37.50	2.38	3.00	2.83	2.80	3.00	2.80
KCADS1	44.00	52.00	39.00	39.50	32.00	41.30	2.75	2.60	2.78	2.45	2.88	2.69
RKDS1	44.25	43.25	42.75	50.50	26.75	41.50	2.95	3.00	2.83	2.83	2.88	2.90
MADS1	43.50	41.00	48.50	55.25	42.50	46.15	3.13	3.08	2.63	2.00	3.00	2.77
BCADS1	50.25	46.75	44.00	18.75	46.75	41.30	3.00	2.95	3.00	1.05	2.88	2.58
BCADS2	51.25	45.75	39.00	36.25	48.00	44.05	3.23	2.88	2.75	2.15	2.68	2.74
BJADS1	48.00	43.75	46.00	41.25	46.50	45.10	3.05	3.00	2.75	1.00	2.63	2.49
BJADS3	55.50	38.75	51.50	76.50	68.00	58.05	3.00	2.93	2.83	2.28	2.00	2.61
BJADS2	37.00	39.00	54.75	65.00	51.25	49.40	3.00	2.25	3.00	1.95	2.50	2.54
ARADS1	23.75	38.50	39.25	47.75	58.25	41.50	2.95	2.90	3.00	1.95	3.20	2.80
BAADS1	40.50	50.25	35.50	49.75	47.50	44.70	3.05	2.85	2.00	1.00	2.88	2.36
BAADS2	43.00	44.00	40.50	26.50	46.50	40.10	2.83	3.00	3.00	1.98	2.23	2.61
BAADS3	46.00	41.00	46.75	49.75	50.25	46.75	2.78	2.95	3.00	2.05	2.18	2.59
TADS4	49.25	47.25	24.75	66.75	40.50	45.70	2.90	3.00	2.15	2.90	2.20	2.63
GAADS2	22.25	48.50	47.00	36.25	43.50	39.50	3.00	3.00	3.10	2.18	2.98	2.85
MZADS1	47.25	52.50	47.00	27.50	52.75	45.40	3.00	3.00	2.83	2.08	2.73	2.73
TADS1	45.75	45.75	36.00	52.00	44.50	44.80	3.00	3.00	3.13	3.00	3.25	3.08
ARDS1	36.50	52.00	43.25	58.00	64.75	50.90	2.75	2.90	3.00	2.85	2.30	2.76
GDS1	40.00	50.50	43.75	65.00	61.00	52.05	2.50	3.00	3.03	2.20	3.00	2.75
BAADS3	38.75	45.75	40.50	49.75	38.00	42.55	2.80	2.88	2.88	2.85	3.10	2.90
OCADS2	42.75	34.75	45.00	44.75	49.00	43.25	2.88	2.80	3.03	2.90	2.70	2.86
ARADS3	44.00	40.25	45.00	53.25	57.00	47.90	2.93	2.83	3.00	2.95	3.00	2.94
SAADS6	38.50	46.75	34.50	53.25	48.50	44.30	2.93	2.70	2.70	2.78	2.78	2.78
GBAD1	36.25	42.00	42.75	46.50	53.25	44.15	3.05	3.00	2.95	2.53	3.33	2.97

GBAD2	49.00	35.75	55.75	52.75	52.75	49.20	2.98	2.90	3.03	2.85	2.90	2.93
SAADS1	39.50	48.25	48.00	52.00	56.50	48.85	2.83	2.83	3.00	2.93	2.78	2.87
SAADS2	43.00	41.50	39.00	74.50	55.00	50.60	2.93	2.95	3.05	3.00	2.85	2.96
SAADS3	47.25	29.00	44.25	72.00	23.00	43.10	3.00	2.50	3.13	2.83	3.00	2.89
SAADS4	47.50	30.50	42.00	70.75	50.25	48.20	2.90	1.75	2.93	2.95	2.80	2.67
SAADS5	40.00	37.25	42.50	58.50	45.75	44.80	2.00	3.00	2.60	2.08	2.50	2.44
ARADS2	39.25	29.25	40.50	74.75	53.00	47.35	2.75	1.25	3.00	1.38	2.78	2.23
ADPV1	22.00	24.75	25.50	30.50	34.25	27.40	1.05	1.00	0.83	0.98	1.00	0.97
Means	41.55	42.29	40.57	53.32	43.72		2.86	2.80	2.82	2.37	2.69	
Tukey's values	Mowing height at P≤0.001 = 2.5773 Ecotypes at P≤0.001 = 10.962						Mowing height at P≤0.001 = 0.0989 Ecotypes at P≤0.001 = 0.4207					

more area to photosynthesis and as a result more vigorous growth is achieved, as supported by Kopec et al. (2004). Wider leaves at lower mowing height provide sufficient leaf area for photosynthesis and thus provide high carbohydrate to meet the energy requirement at these lower mowing heights (Bunnel et al., 2005). Leaf width is an important characteristic for selecting a promising turf grass. Wide leaved grasses are considered inferior in quality. In our case most of the ecotypes produced wider leaves, which make them unsuitable for turfing in home lawns. However, these ecotypes can be used for general purpose turfing for covering larger areas in large scale projects.

Conclusions and Recommendations

From above study we concluded the following points. The native grasses have great potential to be used for turf purpose. Since sustainability of landscaping sector in UAE is totally depending upon using native plants, thus *Sporobolus spicatus* ecotypes, being potential turf grass, can play a major role in sustainable landscaping of the country. *Sporobolus spicatus* species have ecotypes with significant variations in response to various mowing regimes, which show that they have the potential for adoptability. *Sporobolus spicatus* ecotypes have more stiffness, therefore, they can be used as general turf and ground covers in interchanges, roads centre-medians and public areas whereby greenery is the main objective.

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Author's Contributions

Muhammad Zamin (Main author conducting the research). Abdul Mateen Khattak (Supervisor)

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