

## REGULAR ARTICLE

## ***Sporobolus spicatus*, a potential turf grass under the climatic conditions of United Arab Emirates**

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### **Abstract**

Different accessions of *Sporobolus spicatus* were tested for the possible use in the landscaping sector of United Arab Emirates. In this regards, fifty accessions of *S. spicatus* were screened against five salinity levels of 15, 30, 45, 60 and 75dSm<sup>-1</sup> at 3cm mowing height. Significant variations were found among the treatment for various characters of leaf colour, fresh and dry weight. Most of the accessions of the grass tolerated up to 45 dSm<sup>-1</sup>, without compromising on quality. Further increase in salinity, most of the accessions ceased to grow, except a few accessions which survived even at salinity levels of 75dSm<sup>-1</sup>. Many of the grasses exhibit better performance than *Paspalum vaginatum*, the prevailing commercial turf grass in UAE (used as control in this instance). As a whole accessions 45S, 18S, 35S and 37S showed salinity tolerance at 3cm mowing height and maintaining quality up to the acceptable level. Based on their tolerance to salinity and better performance, these accessions are recommended for turf use in public landscaping.

*Key words:* Native grass; salinity; turf; sustainable landscaping

### **Introduction**

Turf grasses are used to beautify properties in urban areas mostly in desert areas where water scarcity and salinity are the most important issues (Al-Shehhi et al., 2010). To maintain quality turf grass, huge amount is

spent on desalination of saline water. There are native plants growing under high saline conditions which can be grown using salt water and requiring minimum maintenance leading to sustainable landscaping (Pessarakli, 2015).

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Some of the indigenous grasses have quality indices, which are better than prevailing varieties (Viggiani et al., 2015). Hence, we need to identify these salt tolerant grasses and introduce in landscaping so that sustainability in landscaping field could be achieved (Ashraf et al. 2012). Since, *S. spicatus* belong to UAE flora, it is suitable for the rehabilitation of degraded salt-affected habitats (El-Keblawy et al., 2009). United Arab Emirates has vast brackish (highly saline) ground water resources. *S. spicatus* is growing in coastal sabhkas, with soil salinities above sea water, therefore, direct sea water can be used for irrigation (Environment Agency Abu Dhabi, 2009; Murad et al., 2007). Using halophytic (salt loving plants) grasses in landscaping under high saline conditions also will save valuable fresh water for domestic use (Khan and Weber, 2006). Therefore, the study was aimed to screen various accessions of *S. spicatus* from different parts of the UAE, for turf use.

### Materials and methods

The experiment was conducted in Abu Dhabi, UAE during the year 2014. The experiment was laid out in RCBD with two factors and 4 replications. Factor 1 consists of 5 Salinity levels (15, 30, 45 60, and 75 dSm<sup>-1</sup>) and tap water as control, while factor 2 included 50 accessions of *Sporobolus spicatus* and *Passallum vaginatum* was used as a control.

### Grass establishment

50 accessions of *Sporobolus spicatus* grass were grown in 10cm plastic pots in a medium composed of mixture of sand and compost (9:1) using the same concept of Uddin et al. (2009) and maintained till establishment; pots fully covered with grass. Then the pots were placed in shade house to protect the grasses from unexpected wind and other environmental impacts.

### Preparation of salt solution

The water tank was partially filled with water and then salt (99%NaCl) was dissolved gradually. Electrical conductivity (EC) was checked with the help of EC meter until it reached the required salinity level.

### Procedure

Five salinity (NaCl) levels were applied to all the accessions after tap water application via drip irrigation using the concept of Uddin et al. (2009). The saline water application was

incremental and once the treatment of a specific salinity over, the next salinity level was applied to the same grasses. Drip lines were installed with a single emitter per pot connected to 500 liter water tanks. Pots were irrigated at 200ml per pot twice a day. Flushing of the pots were done with fresh water on weekly basis to avoid salt accumulation. (Municipality of Abu Dhabi City, 2012).

### Acclimatization

After the fresh water application and between each two treatments, salt (NaCl) was added to the water tank with an increment of 5dSm<sup>-1</sup> every three days till reaching the required salinity level.

After completion of acclimatization process during each treatment, the grasses were clipped at 3cm height and discarded without collecting any data. Then starting the relevant salinity level and maintaining for two weeks. At the end of two weeks, data were taken for the following parameters.

### Parameters

- 1) Lead colour (1-10)
- 2) Fresh weight (g)
- 3) Dry weight (g)
- 4) Internodes length (mm)

The response of various grass accessions was recorded and shown against each treatment for all variables. All the possible interactions were recorded as well. The data were analysed using Statistix 8.1 software applying the analysis of variance (ANOVA) technique (Steel et al., 1980). ANOVA was used to see the variance among the means. In case the differences were significant, the means were further subjected to Tukey test to observe the differences between individual means (Abdi and Williams, 2010). Based on the above data the grass accessions with high salinity tolerance were selected and recommended for further multiplication.

### Results and discussion

#### Leaf colour (1-10)

The leaf colour of different accessions was significantly ( $P \leq 0.001$ ) affected by salinity levels. However, the interaction between salinity and accessions was also significant. According to Figure 1, leaf colour quality drop was maximum at 15 dSm<sup>-1</sup> and then a slow decrease was observed in colour till 45dSm<sup>-1</sup>. At further higher salinity levels most of the accessions did not survive or had low colour rating. The promising accessions included 45S,

18S, 35S, 4S and 37S which were at par with control grass. As shown in Fig. 1.1 the accessions treated with tap water (control) showed excellent performance by maintaining quality green colour (i.e.10 out of 10). However, at salinity level of 15dSm<sup>-1</sup>, the colour quality rating reduced, whereby the best performing accessions were 1S (9.75), 2S (9.25) and 3S (9) followed by 4S, 13S (8.5) which gave the same colour rating of control grass (51P) while ecotype 29S gave the lowest (4) quality rating of leaf colour. All the remaining accessions were above average 5 (of 10). At salinity level of 30dSm<sup>-1</sup>, the top quality leaf colour rating was found in ecotype 45S (8.25), followed by 35S, 36S, 4S (7.75), while ecotype 31S was the lowest (3) in terms of leaf colour quality. 60% accessions gave leaf colour quality rating in the range of 5.75 and 6.75. At salinity level of 45dSm<sup>-1</sup>, accessions 37S and 3S gave maximum (7.5) leaf colour rating, followed by accessions 2S, 12S, 36S and 4S (with 7.25 colour rating each), while minimum (3.63) leaf colour rating was recorded in ecotype 17S. The control grass gave quality rating of 6.5. At salinity level of 60 and 75dSm<sup>-1</sup>, most of the accessions expired. However, the ones that survived, gave acceptable quality rating such that at 60 dSm<sup>-1</sup> some accessions were 18S, 26S (6), 2S, 4S (5.88), 21S (5.75), 27S (5.5), 38S, 45S (5.38), and 19S (5.25), and at 75 dSm<sup>-1</sup> ecotype 45S (5.38) gave top colour rating.

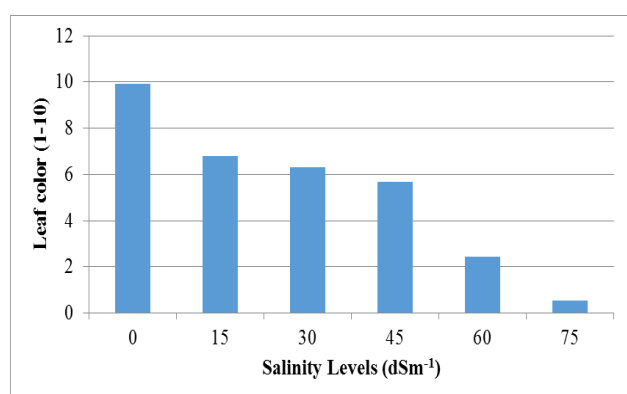


Fig. 1. Effect of salinity levels (0 to 75 dSm<sup>-1</sup>) on leaf colour.

As indicated in Fig. 1, leaf colour is negatively affected by increasing salinity levels. The highest value for green colour was noticed at zero salinity level and exponentially decreased up to 30dSm<sup>-1</sup> and then a slow affect is seen at higher levels. It may be due the reason that the ecotype adjusts itself and get

resistant to high salinity level. Romani et al. (2002) found that all the accessions were significantly different from each other while evaluating 226 native accessions. In most of the accessions, colour rating was far better than control grass. Our results are in line with the findings of Pooya et al. (2013) who also found that native grasses were better in leaf colour quality than commercial cultivars. Similarly, Viggiani et al. (2015) also found native ecotypes performing better than commercial cultivars in terms of colour index, growth rate and green cover.

### Fresh weight (g)

According to Fig. 2, the fresh weight of different accessions was significantly ( $P \leq 0.001$ ) affected by salinity levels. However, the interaction between salinity levels and accessions was also significant (Fig. 2.1). Figure 2 shows that fresh weight of all the accessions was affected by increasing salinity such that grasses grown at control (tap water) produced maximum fresh weight while increasing the salinities affected the growth and thus reduced fresh weight. Promising accessions with higher fresh weights included 46S, 35S, 39S, 41S, 38S, 37S, 45S and 30S which gave more fresh weight than control grass (51P). At salinity level of 15dSm<sup>-1</sup>, 46S was the best performing ecotype with 0.89g fresh weight, followed by 43S (0.738g), while ecotype 1S gave minimum (0.115g) fresh weight. 60% accessions gave fresh weight in the range of 0.288 to 0.56g. Similarly, at 30dSm<sup>-1</sup> the fresh weight was reduced as compared to 15dSm<sup>-1</sup> in various ecotype whereby the maximum dry weight was recorded in 42S (0.695g) followed by 41S (0.628g), 39S (0.615g), 38S (0.563g), 35S (0.56g) and 37S (0.5g). Minimum (0.12g) fresh weight was recorded for ecotype 12S, while control grass (51P) gave fresh weight of 0.13g. The remaining 60% accessions were in the range of 0.218 to 0.38g. At salinity level of 45dSm<sup>-1</sup>, the top fresh weight producing accessions included 3S (0.388g), 30S (0.37g), 29S (0.36g), 17S (0.338g) and 5S (0.33g), while ecotype 12S gave minimum (0.07g) fresh weight. The salinity level of 60dSm<sup>-1</sup> severely affected the accessions and most of them did not survive. Among the surviving accessions, 18S produced maximum (0.245g) fresh weight, followed by ecotype 35S (0.225g), while ecotype 41S gave minimum (0.065g) fresh weight. Similarly, at 75dSm<sup>-1</sup>, only a few accessions including 18S, 45S, 21S, 29S, 35S

and 30S could survive producing 0.135g, 0.125g, 0.113g, 0.11g, 0.103g and 0.098g fresh weights respectively. The control grass did not survive either at this salinity level. Uddin et al. (2009) also found significantly different responses of all the accessions they studied. These results are in line with Naz et al. (2010), who found the similar reduction in weight with increasing salinities. A sharp decline was observed for fresh weight at salinity levels from zero up to 15dSm<sup>-1</sup> but the decline in case of 30dSm<sup>-1</sup> to 45dSm<sup>-1</sup> was comparatively less. It might be due to the fact that grasses could manage the small rise in salinity without suffering much as stated by Hu et al. (2012). However, the trend in fresh weight decline was gradual till salinity level of 45 dS/m and after that it decreased with higher rate of salt. Zhang et al. (2013) and Barhoumi et al. (2007) observed that fresh weight was inversely proportional to salinity. These results are in confirmation to them. Their results showed that plant growth was inversely proportional to salinity levels and there was a linear decrease in shoot growth with the increase in the growing medium salinity.

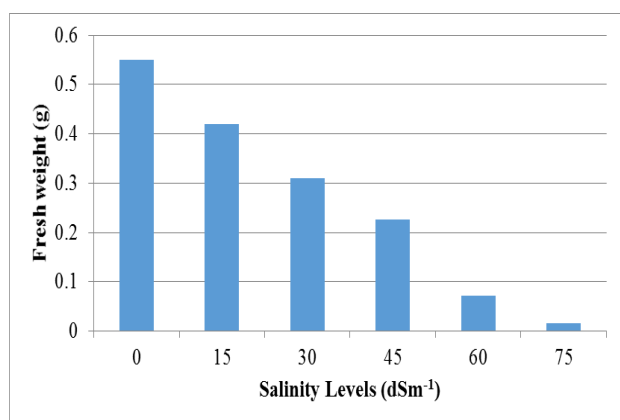


Fig. 2. Effect of salinity levels (0 to 75 dSm<sup>-1</sup>) on fresh weight (g).

### Dry weight (g)

The dry weight of different accessions was significantly ( $P \leq 0.001$ ) affected by salinity (Fig 3). Similarly, interaction between salinity and accessions was also significant (Fig. 3.1). According to figure 3, the results followed almost a similar trend as those of fresh weight except that the drop of dry weight from 30 to 45 dSm<sup>-1</sup> salinity level was sharper than the fresh weight. Accessions such as 46S, 35S, 38S and 45S that gave good results for fresh weight also performed well in case of dry weight.

Approximately 20% of accessions performed better than control grass (51P) at higher salinity levels. At salinity treatment of 15dSm<sup>-1</sup>, maximum (0.258g) dry weight was produced by accessions 42S and 41S, followed by 46S (0.253g), while minimum dry weights were produced by 1S (0.048g). 60% of accessions produced dry weight between 0.115 to 0.200g. At salinity of 30dSm<sup>-1</sup> the highest (0.248g) dry weight was provided by ecotype 42S, while minimum (0.023g) was produced by ecotype 12S. The control grass gave dry weight of 0.053g while 60% accessions produced dry weight between 0.085 and 0.150g. The accessions performed differently at salinity of 45dSm<sup>-1</sup> and the top ten accessions were 17S (0.215g), 18S (0.198g), 24S (0.173g), 4S (0.170g), 20S (0.150g), 44S (0.150g), 38S (0.145g), 22S (0.138g), 30S (0.135g) and 21S (0.130g), while ecotype 12S produced minimum (0.033g) dry weight. At salinity level of 60dSm<sup>-1</sup>, most of the accessions expired and thus did not produce any dry weight. Only a few accessions survived and produced dry weight including 27S (0.153g), 44S (0.115g), 35S (0.100g) while lowest dry weight was found in 41S (0.038g). Likewise, salinity of 75dSm<sup>-1</sup> also severely affected the performance of accessions and only a few survived producing dry weight such as 45S (0.098g), 18S (0.070g), 29S (0.065g), 35S (0.063g), 30S (0.060g), 37S (0.058g) and 21S (0.058g). Our data comply with findings of Mintenko and Smith (2001) who found that the growth of native grasses reduced at higher salinity levels. Dry weight shows the growing status of grass and has inversely proportional to increasing salinity levels. As a whole, all the accessions suffered weight loss with increasing salinity levels upto 75dSm<sup>-1</sup>. The results are in line with the findings of Naz et al. (2010) and Zhang et al. (2013) who also observed that dry weight declined with increasing salinity levels. On the other hand, Uddin et al. (2009) found 50% reduction in growth at salinity level of 39.8dSm<sup>-1</sup>, whereas, in our case less than 50% growth reduction occurred even at 45 dSm<sup>-1</sup> salinity level. Marcum (2006) also found similar pattern of results on Bermuda grass cultivars. According to their results, salinity ranging from 26 to 40 dS m<sup>-1</sup> caused 50% reduction in shoot dry weight, indicating a wide range in salinity tolerance within this species.

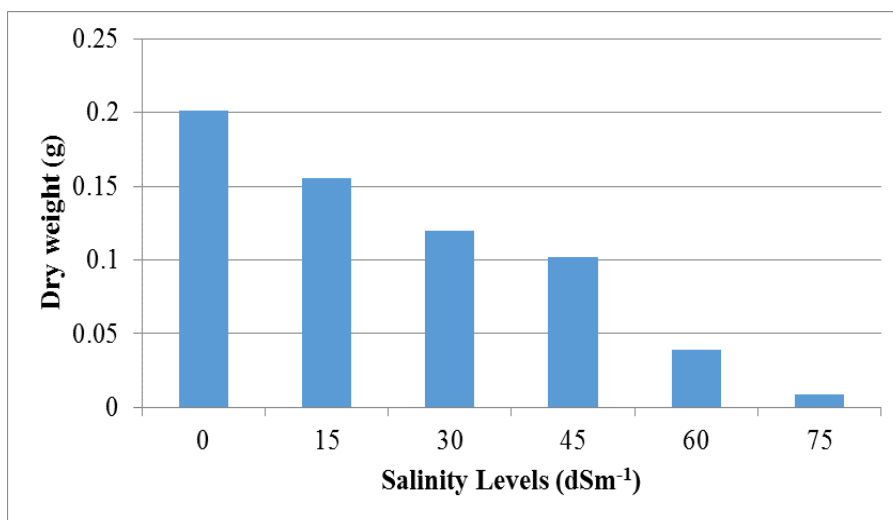


Fig. 3. Effect of salinity levels (0 to 75 dSm<sup>-1</sup>) on dry weight (g).

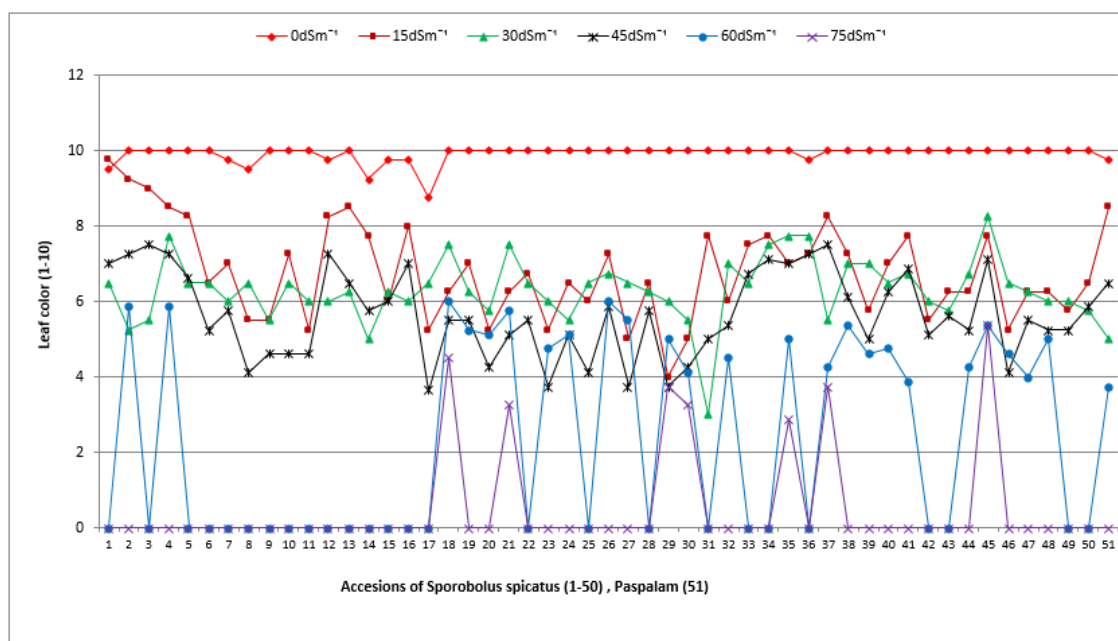


Fig. 1.1. Effect of salinity levels (0 to 75 dSm<sup>-1</sup>) on leaf colour of different *Sporobolus spicatus* accessions (1-50) and *Paspalum* (51; control). Leaf colour refers to the green colour of the grass accessions and is ranged 1-10, where 1 means dry leaves and 10 represents lush green colour. 0 values mean the accessions did not survive.



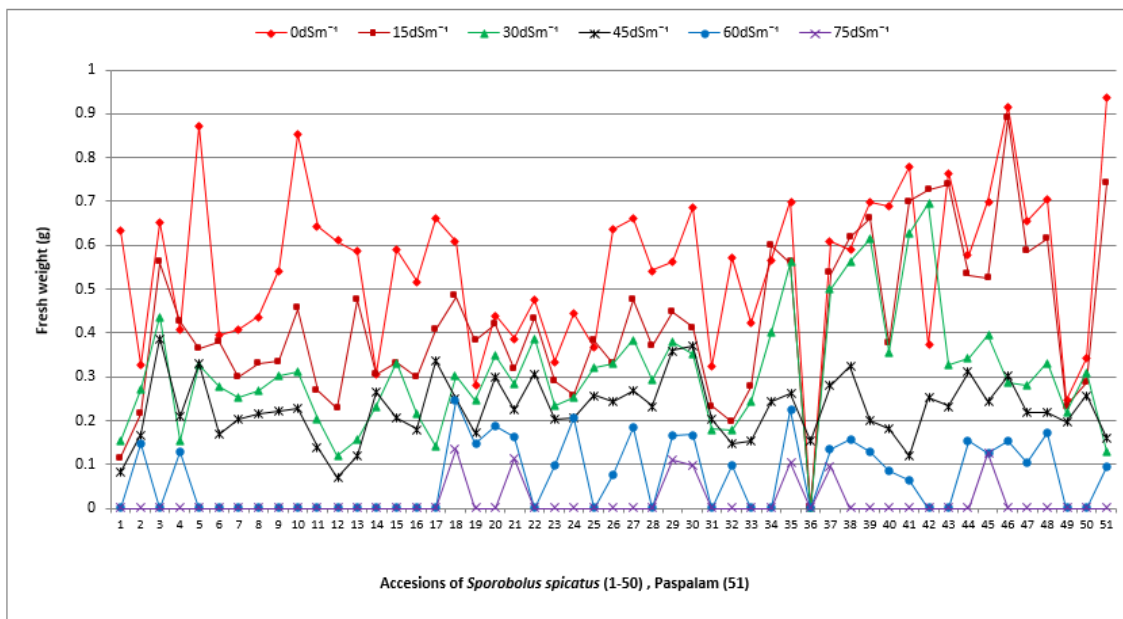


Fig. 2.1 Effect of salinity levels (0 to 75 dSm<sup>-1</sup>) on the fresh weight of different *Sporobolus spicatus* accessions (1-50) and *Paspalum* (51; control). Fresh weight refers to the weight of total biomass produced per clipping per pot. 0 values mean the accessions did not survive.

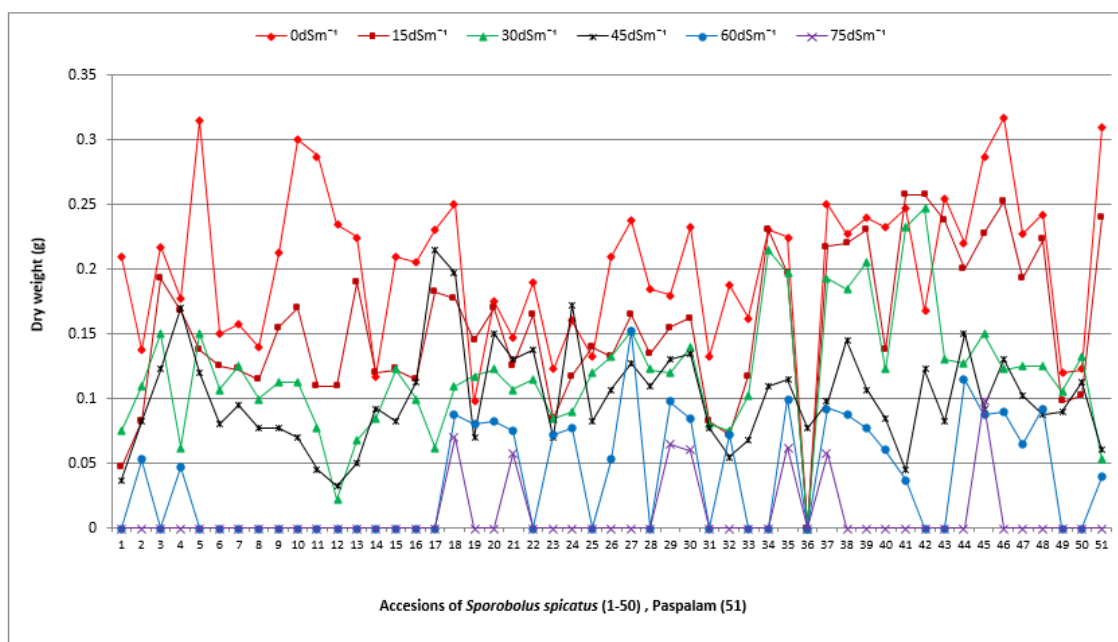


Fig. 3.1. Effect of salinity levels (0 to 75 dSm<sup>-1</sup>) on dry weight of different *Sporobolus spicatus* accessions (1-50) and *Paspalum* (51; control). Dry weight refers to the weight of total biomass produced per clipping per pot after oven drying. 0 values mean the accessions did not survive.

**Conclusion and recommendations**

Following conclusions are made from the study:

1. *Sporobolus spicatus* species have accessions/ecotypes with significant variations and variabilities, which show that they have adoptability potential.
2. The best performing accessions were found 45S, 18S, 35S and 37S which can be used for turf purpose.
3. The salinity issue of UAE could be managed by using native grasses in public landscape, where the sea water also can be used in worse conditions.

4. Further research work is recommended on *S. spicatus* grasses to find out their potential as donors of salt tolerant characters for improving other crops in breeding program.

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### Authors' contributions

1. Mr. Muhammad Zamin (Main author conducting the research)
2. Prof. Dr. Abdul Mateen Khattak (Supervisor)
3. Prof. Dr. Abdul Mohsin Salim (Co-supervisor)
4. Dr Muhammad Sajid (Research committee member)
5. Mr. Muhammad Shakur (Technical and logistic support during data collection)
6. Mr. Haroon Ur Rashid (Support during ecotypes collection)
7. Dr Shahen Shah (Technical support during analysis)
8. Dr. Ikramullah (Research fellow)
9. Mr. Shafiullah (Technical support)

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