International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(4): 1175-1179

Received: 08-05-2018
Accepted: 10-06-2018

VD Wadekar
M. Sc. Horti. Department of Horticulture, College of Agriculture, Pune, MPKV, Rahuri, Maharashtra, India

Dr. PV Patil
Associate Professor of Horticulture, College of Agriculture, Pune, Maharashtra, India

Dr. GB Kadam
Scientist, (Floriculture & Landscaping), ICAR-Directorate of Floricultural Research, Shivaji Nagar, Pune, Maharashtra, India

NV Gawade
M. Sc. Horti. Department of Horticulture, College of Agriculture, Pune, MPKV, Rahuri, Maharashtra, India

PB Bhosale
M. Sc. Horti. Department of Horticulture, College of Agriculture, Pune, MPKV, Rahuri, Maharashtra, India

Correspondence
VD Wadekar
M. Sc. Horti. Department of Horticulture, College of Agriculture, Pune, MPKV, Rahuri, Maharashtra, India

Evaluation of lawn grasses based on the qualitative and morphological traits

VD Wadekar, Dr. PV Patil, Dr. GB Kadam, NV Gawade, PB Bhosale

Abstract
This study was conducted in order to determine the qualitative and morphological performances of turf grasses. This study was carried out in Department of Horticulture, College of Agriculture, Pune (Maharashtra) to evaluate the performance of nine turf grasses during 2015-16.The experimental design was a Randomized Blocks Design with three replications. Results indicated for qualitative traits, Korean grass, American Blue grass exhibited green colour, All turf grasses under study exhibited fine leaf texture except Weeping love grass having medium coarse texture, Argentine grass Pensacola grass St. Augustine grass and Phosphelone grass having coarse texture. The highest grounds cover (100%) was observed in American blue grass and Bermuda grass at 60 DAT. The significantly maximum chlorophyll content 69.59 mg/100g was recorded by Bermuda grass when was significantly superior over rest of treatments. Performance for morphological traits indicated, the maximum shoot length was recorded in Phosphelone grass (80.82 cm), Argentine grass (6.95 mm) exhibited maximum stem thickness DAT. The maximum leaf length range between (45.07-50.43 cm) recorded in Weeping love grass and Taiwan grass recorded shortest leaf length (2.70 cm). Phosphelone grass recorded maximum leaf width (13.48 mm). Weeping love grass showed maximum root length (21.74 cm). After 120 days of transplanting maximum root shoot ratio (1.11) was recorded in Argentine grass. The maximum fresh weight of shoot and dry weight of roots was recorded in Weeping love grass whereas, the maximum fresh weight of roots was recorded in Argentine grass.

Keywords: DAT-Days after transplanting, chlorophyll, Root/Shoot ratio

Introduction
Landscape architecture has become a profitable venture in India and turf grasses are considered as it's an integral part. It provides aesthetic value, enhances beauty and improves to ecological balance. The main turf species of interest belongs to family Poaceae. Turf grasses benefits may be divided into three groups that are functional, recreational and aesthetic components (Beard and Green, 1994) [3]. Turf grasses are widely used in athletic fields, golf courses, cricket, and other sport areas *etc*. Turf grasses are integral parts of architectural landscapes and their maintenance leads to important challenges in term of water use for irrigation (Leinauer *et al.* 2010) [10]. Proper selection of turf grasses as per climatic conditions, cultural practices and its purpose and utility is important for long term success of turf. Turf grasses are very important not only for aesthetic sense but it also adds the value to the real estate. It has various uses in landscaping. The dense plant canopy of mowed turf grasses is effective in entrapment of water and airborne particulate material as well as in absorbing gaseous pollutants. Maintain good quality turf in shade, shade tolerant grass cultivar such as 'Korean grass' should be selected for shade garden (Malik, *et al.* 2014) [11]. Drought and heat alone significantly reduced turf quality (Jiang and Huang, 2001) [9].

Bermuda grass cultivars are most susceptible morphological and biochemical responses to water deficit conditions (Riaz *et al.* 2010) [16]. Optimum irrigation can retain nutrients and increase chlorophyll content of turfgrass; this should be taken into consideration for irrigation amount (Mathowa, *et al*. 2012) [13]. Germination percentage in growing medium with rice hull and sand was highest. The principal reason for this may be a high water retention capacity of rice hull and also its higher aeration (Golestani, *et al*. 2014) [7]. Bermuda grass {*Cynodon dactylon* (L.) pers.} is one of the most widely used and is a drought and salt resistant species (Etemadi *et al.*, 2005) [5]. A potential of Buffalo grass (*Stenotaphruam sacundatum*) as a valuable forage species for shaded, humid-tropical environments in developing countries (Mullen and Shelton, 1996) [14]. Therefore, over the period turf grass industries have become a profitable venture all over the world.

Most of the work on turf grasses has been done in countries USA, Australia, Japan, Singapore, etc. but these all grass species and varieties may not be suitable for Indian agro-climatic conditions because a variety bred under a specific climatic zone. Therefore, these grass species need to be tested into various agro-climatic zones as per its utility. On these lines very meager may not necessarily perform well under other climatic zones in India. In order to contribute towards improvement in turf grasses, the study was undertaken to analyze diversity the growth related traits in turf grass species and varieties. With a view, to find out superior types of turf grasses, the present investigation entitle "Evaluation of lawn grasses for turf quality." was planned with objective to study the establishment, growth and relative performance of different lawn grass.

Materials and Methods

The material utilized for the present study consisted of nine species of turf grasses named as Argentine grass, Pensacola grass, Weeping Love grass, Korean grass, and Bermuda grass collected from the Konda Laxman Telangana State Horticulture University, College of Horticulture, Rajendranagar, Hyderabad. The other three species of grasses *viz.* American Blue grass, Taiwan grass and Phosphelone grass were collected from Hi-tech Floriculture and Vegetable Project, College of Agriculture, Pune. The grass species St. Augustine grass collected from local reliable nursery located at Pune.

The present investigation was carried out at Modibaug Garden, Horticulture Section, College of Agriculture, Pune during 2015-16 in a randomized block design with three replications. The above site is situated at in the mid-west Maharashtra at an altitude of 559 m, above MSL. It is located in tropical region at 18.32^0 N latitude and 73.51^0E longitudes. Net plot size was 2 m long by 1 m wide. A 0.6 m bare soil corridor was maintained between plots. The raised beds were pulverized after adding 4 Kg/plot FYM and as a precautionary measure phorate granule were thoroughly mixed to avoid the ants and termites attack. Shallow lines were drawn at a spacing of 15 x 15 cm in each plot with the help of line rope and hand hoe. Nine species of grasses were dibbed at a spacing of 15 x 15 cm and planting was done on 8th July, 2015. After planting, the plots were watered through rose can. All the grass species were given uniform management practices for healthy growth and development. Recommended dose of N, P and K were applied at the time of field preparation before planting. Weeding was done as and when required. No turf cultivation or vertical cutting was practiced on the experimental area in order to avoid inter plots contamination. Invading weeds were hand removed during the establishment period. The observations recorded on various turf grass growth parameters Ground cover (%), Shoot length (cm), Stem thickness (mm), Leaf length (cm), Leaf width (mm), Root length (cm) and Physiological parameters Chlorophyll content (mg/100g), Fresh and dry weight of shoot and root (g), Root shoot ratio.

The percent ground cover was visually assessed by panel of skilled person based on the extent coverage of individual plots. Shoot length, leaf length and root length was measured from the base to tip of five randomly selected plants by using a scale. The average was calculated and expressed in centimeter (cm). Leaf width and stem thickness was measured using vernier calipers. For estimating fresh and dry weight of shoot and roots, ten individual plants were separated using grass clipper and fresh weight was recorded and then the shoot and root were kept in oven at 70 ^{0}C for 48 hours for drying. Finally the dry weight of shoot and roots of individual plants ware recorded in grams. From above observations the root shoot ratio was calculated. The chlorophyll is extracted by treating fresh plant tissue with 85% acetone. The absorbance acetone extract measured at 642.5 and 660 nm wave lengths. From the absorbance value at these wave lengths, the total chlorophyll content is calculated.

The mean performance of turf grass species for morphological traits was calculated by Microsoft office excel worksheet, 2007 version. The analysis of variance for each variable was done as per the procedure described by Panse and Sukhatme (1985). The mean and standard error (SE), critical difference (CD) were worked out as per standard methods (Panse and Sukhatme 1967).

Results and Discussion

Statistical analysis revealed highly significant differences for the various growth related traits for species under study.

Performance of turf grasses for qualitative traits

Various turf grass species have their own peculiar foliage colour and that would be the most desired trait for landscaping perspective. These different colour hues could be explored for specific location and landscape designs. The various qualitative traits of turf grass are given in Table 1. The turf grass species, viz. Korean grass, American Blue grass exhibited green colour. The light green colour was observed in Argentine grass, Pensacola grass, Weeping love grass, Phosphelone grass. Species such as St. Augustine grass and Bermuda grass exhibited medium green colour, whereas dark green colour was observed in Taiwan grass. Therefore, these different species having different colours could beused for creating shades of green colour in a lawn or turf. All turf grasses under study exhibited fine leaf texture except Weeping love grasshaving medium coarse texture, Argentine grass Pensacola grassSt. Augustine grassand Phosphelone grasshaving coarse texture. Fine leaf texture species are more preferred for giving more elegance in landscape. Most of the turf grasses exhibited spreading growth habit except Weeping love grass having upright growth habit. The highest grounds cover (100%) was observed in American blue grass and Bermuda grass at 60 days after transplanting however at 180 DAP, out of nine grasses only three Pensacola grass, American blue grass and Bermuda grass were recorded cent percent ground cover. Earliest covering of ground is most desired trait in landscaping. Therefore these species could be suggested for quicker establishment of lawns when planted by dibbling method. The significantly maximum chlorophyll content 69.59 mg/100g was recorded by Bermuda grass when was significantly superior over rest of treatments. The American Blue grass was recorded (64.73 mg/100g) of chlorophyll and found second best, however it was on par with Phosphelone grass. The significantly least chlorophyll content (37.22 mg/100g) was recorded by Taiwan grass.

Performance of turf grasses for morphological traits

Mean performance of different species revealed that there was significant variation for most of the traits studied traits (Table 2 and Table 3). The data presented in Table 2 and 3 revealed wide range in shoot length (1.79- 80.82 cm), leaf length (1.69-50.43 cm), stem thickness (0.73-6.95 mm), leaf width (1.57-13.48 mm), root length (9.19-21.18 cm) among the grass species.

The maximum shoot length was recorded in Phosphelone grass at 60, 120, and 180 DAT (16.68, 73.14, 80.82 cm) respectively followed by American blue grass (69.97 cm), whereas Taiwan grass exhibited shortest shoots (3.90 cm). Similar result obtained by Pessarakli *et al*. (2008) [15] and Shahgholi *et al.* (2013) [18] in Bermuda grass and Seashore paspalum. The findings were also accordance with Jankiram *et al.* (2014) [8].

The stem thickness was found to be significantly maximum in Argentine grass (6.95 mm) followed by Pensacola grass (4.67mm) 180 DAT and minimum in American blue grass (0.93 mm) and Bermuda grass (1.05 mm). Present findings were similar as recorded by Malik *et al*. (2014) [11].

The Weeping love grass significantly recorded maximum leaf length range between (45.07-50.43 cm) followed by Argentine grass (30.54-37.88 cm) whereas, Taiwan grass recorded shortest leaf length (2.70 cm) after 180 DAT. These results recorded are in line with findings of Atkins *et al*. (1991) [1], Malik *et al*. (2014) [11]. Significantly difference in leaf width was observed after 60, 120 and 180 days transplanting. Maximum width recorded in Phosphelone grass after (13.48 mm) followed by Argentine grass (8.28 mm) whereas, it was found to be minimum in Taiwan grass (1.90 mm) at 180 DAT. The findings of present experimental were line with the Malik *et al*. (2014) [11], Geren *et al*. (2009) [6] in *Cynodon* hybrids. Similar trends were also reported by Riaz *et al*. (2010) [16] in Bermuda grass.

Root length and root to shoot ratios are considered to be one of the important survival factors of turf grass growing in areas of limited water (Simanton and Jordan 1986) [19]. Therefore, during the experiment, observations on root length and fresh root to shoot ratios were also recorded. Weeping love grass showed maximum root length (21.74 cm) at par with Bermuda grass (21.18 cm). However, minimum root length was observed in Korean grass (11.85 cm) which was at par with Taiwan grass (12.35 cm) and St. Augustine grass (12.31 cm). Rooting characteristics of turf grasses have a significant influence on their response to abiotic stresses and this has been supported by many earlier reports. The turf grasses having more root length, require less water, i.e. more tolerant to drought. Similar result have been recorded by Pessarakli *et al*. (2008) [15] in Bermuda grass and Seashore paspalum, Marjamaki (2007) [12] Rimi *et al*. (2012) [17] and Jankiram *et al.* (2014) [8].

Higher dry root: shoot ratio indicates balanced shoot and root growth due to proper allocation of resources. In this study, after 60 days transplanting highest root: shoot ratio was observed in Pensacola grass (0.89), After 120 days of transplanting significantly maximum root shoot ratio (1.11) was recorded in Argentine grass. After 180 days transplanting significantly maximum root shoot ratio (0.95) was recorded in Pensacola grass whereas, Taiwan grass recorded significantly lowest root shoot ratio (0.62). Similar findings have also been reported by Bolinder *et al*. (2002) [4] and Jankiram and Namita (2014) [8] in *Poa pratensis* followed by *Cynodon dactylon* var. Panam. Fresh and dry weight of shoots (g) was found maximum in weeping love grass (3.50 g and 1.53 g), whereas minimum was observed in Korean grass (1.91 g and 0.71 g). The significantly maximum fresh weight of roots (3.0 g) at 180 days after transplanting was recorded by Argentine grass followed Pensacola grass with (2.88 g). The significantly least fresh weight of root (1.60 g) was recorded by Korean grass. Weeping Love grass recorded highest dry weight of root (1.16 g) and found significantly superior over all treatments. The significantly least dry weight of root (0.27 g) was recorded in Taiwan grass. The results recorded in respect of fresh and dry weight are on similar line as recorded by Xu and Huang (2000) [21], Sweeney *et al*. (2001) [20], Baldwin *et al*., (2006) [2] and Jankiram and Namita (2014) [8]. From these result, it is evident that the highest root shoot growth due to easy and faster establishment, resulting produce more bio mass production.

Table 1: Performance of turf grass species for qualitative traits

Species	Leaf blade colour	Leaf texture	Growth habit	Ground cover %
Korean grass	Green	Fine	Spreading	90% cover up to 180 days
Argentine grass	Light green	Coarse	Spreading	100% cover up to 180 days
Pensacola grass	Light green	Coarse	Spreading	100% cover up to 180 days
American blue grass	Green	Fine	Spreading	100% cover up to 50 days
Weeping love grass	Light green	Medium coarse	Upright	71% cover up to 180 days
St. Augustine grass	Medium green	Coarse	Spreading	84% cover up to 180 days
Bermuda grass	Medium green	Fine	Spreading	100% cover up to 55 days
Phosphelone grass	Light green	Coarse	Spreading	96% cover up to 180 days
Taiwan grass	Dark green	Fine	Spreading	48% cover up to 180 days

Table 2: Mean performance of turf grass species for morphological traits

Treatment No.	Shoot length(cm)			Stem thickness (mm)			Leaf length(cm)			Leaf width(mm)			Root length(cm)		
	Days after transplanting			Days after transplanting			Days after transplanting			Days after transplanting			Days after transplanting		
	60	120	180	60	120	180	60	120	180	60	120	180	60	120	180
T_1	9.87	17.01	23.93	0.87	1.30	1.47	3.32	3.81	4.45	1.79	2.04	2.50	9.19	10.66	11.85
T_2	3.57	6.71	7.23	6.22	6.77	6.95	30.54	32.55	37.88	7.50	8.13	8.28	19.17	19.77	20.51
T_3	3.95	6.98	7.28	3.73	4.13	4.67	32.43	34.09	36.45	5.47	5.63	5.90	15.06	19.48	21.10
T_4	26.93	52.04	69.97	0.73	0.75	0.93	2.63	2.65	3.30	1.67	1.75	2.07	12.25	14.00	15.20
T_5	6.26	8.92	9.40	2.27	2.77	3.09	45.07	45.82	50.43	3.69	3.93	4.25	14.81	19.89	21.74
T_6	7.03	8.87	13.59	1.88	2.69	3.07	8.23	9.37	10.97	4.89	5.68	6.16	8.55	11.50	12.31
T_7	27.59	31.30	42.83	0.87	0.89	1.05	3.27	3.43	3.75	1.57	1.78	2.26	17.26	19.87	21.18
T_8	16.68	73.14	80.82	2.69	2.85	3.35	9.34	11.98	12.74	12.19	13.39	13.48	12.25	14.01	15.37
T_9	1.79	2.56	3.90	1.74	1.81	1.94	1.69	1.95	2.70	1.59	1.73	1.90	9.39	11.50	12.35
Mean	11.52	23.06	28.77	2.23	2.66	2.95	15.17	16.18	18.07	4.49	4.90	5.20	13.11	15.63	16.84
SEm +	0.61	2.15	1.58	0.11	0.10	0.07	0.49	0.79	0.78	0.15	0.17	0.20	0.71	0.52	0.44
CD at 5%	1.84	6.43	4.75	0.34	0.29	0.22	1.48	2.38	2.34	0.46	0.52	0.59	2.13	1.57	1.33

(T_1 -Korean grass, T2 -Argentine grass, T_3 -Pensacola grass, T_4 -American blue grass, T_5 -Weeping love grass, T_6 -St. Augustine grass, T_7 -Bermuda grass, T_8 -Phosphelone grass, T_9 -Taiwan grass)

Table 3: Mean performance of turf grass species for morphological traits

Treatment No.	Shoot fresh weight (g)			Root fresh weight (g)			Shoot dry weight (g)			Root dry weight (g)			Root/shoot ratio		
	Days after transplanting			Days after transplanting			Days after transplanting			Days after transplanting			Days after transplanting		
	60	120	180	60	120	180	60	120	180	60	120	180	60	120	180
T_1	0.78	1.22	1.94	0.40	0.79	1.60	0.27	0.55	0.71	0.10	0.17	0.28	0.52	0.68	0.83
T_2	1.93	2.56	3.41	2.04	2.71	3.00	0.83	0.97	1.27	0.88	0.71	0.89	0.72	1.11	0.89
T_3	2.02	2.33	3.06	1.81	2.39	2.88	0.32	0.56	1.02	0.65	0.69	0.88	0.89	1.04	0.95
T_4	1.49	1.73	2.51	0.81	1.32	2.18	0.24	0.40	0.63	0.11	0.19	0.37	0.54	0.76	0.87
T_5	3.01	3.19	3.50	2.14	2.22	2.87	0.87	0.99	1.53	0.72	0.89	1.16	0.71	0.78	0.81
T_6	1.72	2.37	3.12	0.85	1.54	2.42	0.30	0.54	0.87	0.14	0.29	0.45	0.50	0.65	0.79
T_7	1.64	2.50	3.26	0.85	1.26	2.17	0.35	0.58	0.87	0.12	0.20	0.38	0.52	0.51	0.67
T_8	1.62	2.12	3.46	0.80	1.37	2.57	0.32	0.50	0.88	0.24	0.31	0.48	0.49	0.64	0.74
T_9	0.46	1.24	2.67	0.34	0.83	1.67	0.09	0.19	0.42	0.06	0.10	0.27	0.73	0.71	0.74
Mean	1.63	2.18	2.99	1.11	1.62	2.37	0.40	0.59	0.91	0.33	0.39	0.57	0.62	0.74	0.80
SEm ±	0.08	0.20	0.19	0.09	0.13	0.18	0.04	0.05	0.07	0.02	0.02	0.04	0.07	0.07	0.05
CD at 5%	0.25	0.61	0.58	0.28	0.38	0.54	0.12	0.14	0.21	0.05	0.06	0.11	0.20	0.20	0.16

(T_1-Korean grass, T2 -Argentine grass, T_3 -Pensacola grass, T_4-American blue grass, T_5-Weeping love grass, T_6-St. Augustine grass, T_7-Bermuda grass, T_8-Phosphelone grass, T_9-Taiwan grass)

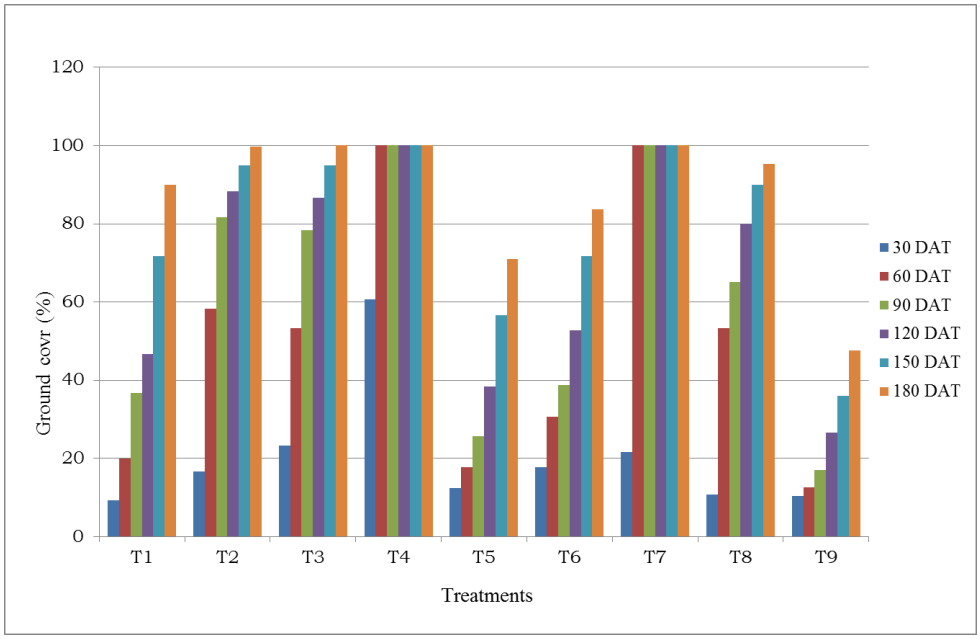

Fig 1: Ground cover (%)

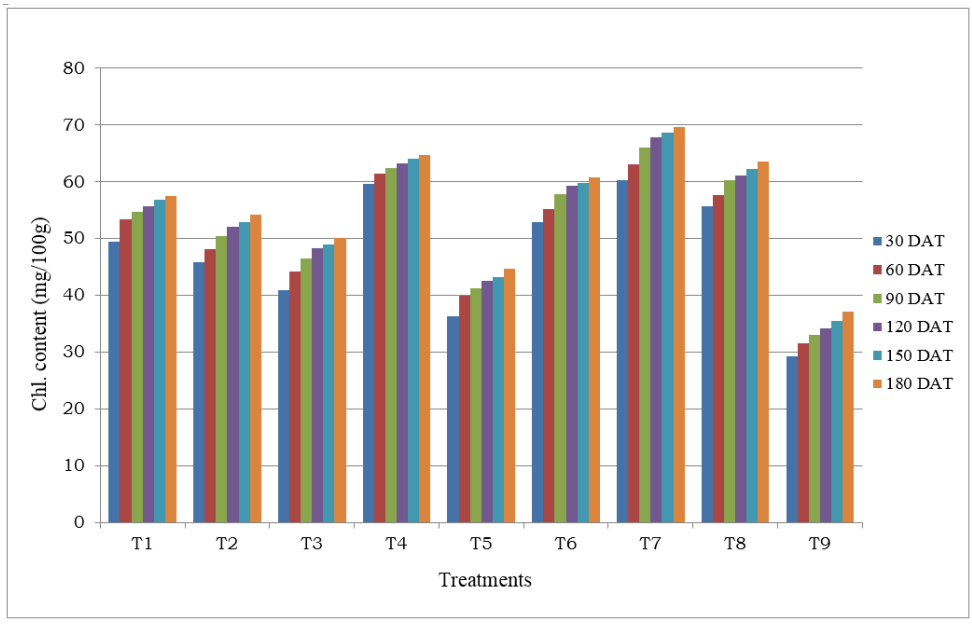

Fig 2: Chl. content (mg/100g)

Acknowledgements
The authors wish to thank Department of Horticulture, college of Agriculture, Pune, for their kind help providing research materials. Special thanks are also for reviewers Dr. P. V. Patil, Dr. G. B. Kadam for their comments and corrections on the manuscript. This research work was supported by Mahatma Phule Krishi Vidyapeeth, (Rahuri), Dist.-Ahmednagar, Maharashtra (India).

References

1. Atkins CE, Green RL, Sifers SI, Beard JB. Evapotranspiration rates and growth characteristics of ten st. Augustine grass genotype. Hort. Sci. 1991; 26(12):1488-1491.
2. Baldwin CM, Liu H, McCart LB, Bauerle WL, Toler JE. Response of six Bermuda grass cultivars to different irrigation intervals. Hort. Tech. 2006; 16(3):466-470.
3. Beard JB, Green RL. The role of turf grasses in environmental protection and their benefits to humans. J of Env. Quality. 1994; 23:452-460.
4. Bolinder MA, Angers DA, Belanger G, Michaud R, Laverdiere MR. Root biomass and shoot to root ratios of perennial forage crops in eastern Canada. Can. J Plant Sci. 2002; 82:731-737.
5. Etemadi N, Khalighi A, Razmjoo KH, Lessani H, Zamani Z. Drought resistance of selected Bermuda grass {*Cynodon dactylon* (L.) Pers.} accessions. Internat. J Agri. Biol. 2005; 7(4):612-615.
6. Geren H, Avcioglu R, Curaoglu M. Performances of some warm-season turf grasses under Mediterranean conditions. African J of Biotech. 2009; 8(18):4469-4474.
7. Golestani MA, Dolatkhahi A, Vahdati N, Omid Roudsari ON. Utilization of rice hull as a new substrate for turf grass seed germination in sod production as a sustainable approach. J of Orna. Plants. 2014; 4(1):33-37.
8. Jankiram T, Namita. Genetic divergence analysis in turf grasses based on morphological traits. Indian J of Agri. Sci. 2014; 84(9):11-15.
9. Jiang Y, Huang B. Drought and heat stress injury to two cool-season turfgrasses in relation to antioxidant metabolism and lipid peroxidation. Crop Sci. 2001; 41:436-442.
10. Leinauer B, Serena M, Singh D. Seed coating and seeding rate effects on turf grass germination and establishment. Hort. Tech. 2010; 20(1):179-185.
11. Malik S, Rehman S, Younis, A., Qasim, M. Nadeem M, Riaz A. Evaluation of quality, growth, and physiological potential of various turf grass cultivars for shade garden. J. of Hort. Forestry and Biotech. 2014; 18(3):110-121.
12. Marjamaki T, Pietola L. Root growth dynamics in golf green with different compression intensities and winter survival. Agri. Food Sci. 2007; 1:66-76.
13. Mathowa T, Chinachit W, Yangyuen P, Ayutthaya SIN. Changes in turfgrass leaf chlorophyll content and some soil characteristics as influenced by irrigation treatments. International Journal of Environmental and Rural Development. 2012; 3(2):181-187.
14. Mullen BF, Shelton HM. *Stenotaphruam sacundatum*: avaluable forage species for shaded environments. Tropical grassland, 1996; 30:289-297.
15. Pessarakli M, Kopec DM, Gilbert JJ. Growth responses of selected warm-season turf grasses under salt stress. Turfgrass, Landscape and Urban IPM Res. Summary. 2008; (P-155):47-54.
16. Riaz A, Younis A, Hameed M, Kiran S. Morphological and biochemical responses of turf grasses to water deficit condition. Pak. J Bot. 2010; 42(5):3441-3448.
17. Rimi F, Macolino S, Ziliotto U. Rooting characteristics and turfgrass quality of three bermudagrass cultivars and a zoysia grass. Acta Agri. Scandinavica Sect. Bio. Sci. and Plant Sci. 2012; 62:24-31.
18. Shahgholi M, Naderi D, Etemadi N, Eghbalsaied S, Shiranibidabadi S. Salicylic Acid and Trinexapac- ethyl Affecton Chlorophyll Content and Shoot Properties of LoliumPerennecv. 'SpeedyGreen'. Internat. J of Agri. and Crop Sci. 2013; 6(16):1123-1126.
19. Simanton JR, Jordan GL. Early root and shoot elongation of selected warm-season perennial grasses. Journal of Range Management. 1986; 39(1):63-7.
20. Sweeney P, Danneberger K, Wang D. Root weight, nonstructural carbohydrate content, and shoot density of high-density creeping bent grass cultivars. Hort. Sci. 2001; 36(2):368-370.
21. Xu Q, Huang B. Growth and physiological responses of creeping bent grass to changes in air and soil temperatures. Crop Sci. 2000; 40:1363-1368.