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Evaluation of turf grasses for quality traits in different phases (season) under Hisar climatic conditions

Evaluation of turf grasses in different season

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ABSTRACT

An experiment was conducted at the Experimental Orchard area of CCS Haryana Agricultural University, Hisar, during 2021–2022 to evaluate eight turfgrass varieties across four seasonal phases for various quality, functional, and physiological traits. The treatment combinations comprised six *Cynodon dactylon* varieties (Selection 1, Tif 419, Panam, Palma, Panama, Bargusto), *Zoysia japonica* (Manila grass), and *Zoysia matrella* (Korean grass) laid out in a randomized block design across four distinct phases: P_1 (Dec–Jan), P_2 (Feb–Mar), P_3 (Apr–May), and P_4 (Jun–Jul). Significant differences were observed among varieties, phases, and their interactions across all evaluated parameters.

Among the evaluated varieties, *Cynodon dactylon* var. Tif 419 exhibited superior overall turf quality, recording the highest mean turf quality rating (6.88), leaf length (2.69 cm), leaf width (0.223 cm), root length (14.58 cm), root dry weight (0.266 g/m²), and total chlorophyll content (3.51 mg/g). Peak turf quality ratings (7.60) and chlorophyll contents (3.96 mg/g) for Tif 419 were recorded during the spring (Feb–Mar) and summer (Apr–May) phases, respectively. In contrast, *Condon dactyl* on var. Panama demonstrated the highest vegetative shoot density (309.01/100 cm²) and clipping yield (323.46 g/m²), peaking during the humid warm phase of June–July. Both *Moesia* species (*Z. Martello* and *Z. japonica*) required longer intervals between mowing (up to 25.23 days) and accumulated less clipping yield and thatch, but displayed lower shoot density, root growth, chlorophyll content, and visual quality scores compared to top-performing *C. dactyl* on cultivars. Overall, the winter phase (Dec–Jan) suppressed growth and quality parameters across all varieties. The findings indicate that *Condon dactyl* on var. Tif 419 and var. Panama are the most suitable varieties for high-quality, high-density turf establishment under the sub-tropical semi-arid climatic conditions of Hisar

Keywords: *Cynodon dactylon*, *Zoysia japonica*, *Zoysia matrella*, Turf quality, Clipping yield, Chlorophyll content

Introduction

Grasses are monocotyledonous plants belonging to the family Graminae. Turf grasses are the low growing monocot plants that form a sort of contiguous ground cover maintained at a particular height by regular mowing (Turgeon, 1980) [1]. Turfgrasses consist of a remarkably diverse group of species which are selectively used on the basis of applications and/or climatic conditions (Janakiram *et al.*, 2014) [2]. Turfgrass provides at least three major benefits to human activities: functional, recreational and ornamental (Beard 1973, Christians 2004, Wiecko 2006, Turgeon 2008, Bell 2011, Jankairam *et al.* 2015) [3]. Since, wide variability occurs among commercial turfgrasses, the choice of species and/or variety should be taken in high consideration in accordance with the intended use as low maintenance turf, high maintenance sports turf, home lawn or public places, etc. Despite, cultural practices are very critical for turf performance, varietal selection adaptable to the particular area plays an important role. *Cynodon dactylon* species are one of the most widely used warm season turfgrasses on lawns, roadsides, parks, school grounds, athletic fields, golf courses where dense turf is desired while *Paspalum notatum* grass is useful for lawns as well as roadsides and for slope stabilization as a low maintenance grass (Christians, 2004) [4]. *Cynodon dactylon* grass adapted to tropical and warm climate and has good density, texture and wears tolerance making it suitable for high quality turf (Romani 2004, Rodriguez-Fuentes, 2009) [5]. *Cynodon dactylon* grass also shows drought and heat tolerance and has the capacity to provide high quality turf with minimal cost and low water inputs (Macolino, 2012) [6]. Acceptable turf quality is defined as meeting the appearance expectations for a particular area and includes traits such as green colour, fine leaf texture, high tiller density, and overall aesthetic appeal (Hanks, 2005) [7].

For initiating a sound turf research and development program will begin with the identification of genetic resources in turf grasses and cultivars/varieties should be given prime importance. A strong research pro

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gramme focusing on evaluation of important turf grasses would be a significant start on meeting this national need. Lack of new germplasm availability and insufficient evaluation and characterization of existing collections are the serious constraints in solving the problems further associated with pests, extreme temperatures, water requirement and other plant stresses that limit the performance and persistence of turf grasses. For the development of lawn/turf in Indian conditions, the choice of grasses that are available is limited and therefore very often Bermuda grass and *Zyosia* grass were evaluated for various quality, functional and physiological traits with the aim of selecting promising varieties under Hisar conditions.

Materials and methods

The study was carried out at Experimental Orchard area, CCS Haryana Agricultural University, Hisar during the year 2021-2022. Geographically, Hisar is situated at an elevation of 215.2 meters above mean sea level with latitude of 29° 10' in the North and longitude of 75° 46' in the East in sub-tropical zone (Agro-Meteorological Observatory of CCS Haryana Agricultural University, Hisar). The area is semi-arid with continental climate characterized by hot summers and cold winters. During summer, the mean maximum temperature is as high as 48 °C and minimum temperature can reach near 0 °C accompanied by frost in peak winter months of December and January is common feature of the climate of this region. There were eight varieties in this experiment (V₁: *Cynodon dactylon* var. Selection 1, V₂: *Cynodon dactylon* var. Tif 419, V₃: *Cynodon dactylon* var. Panam, V₄: *Cynodon dactylon* var. Palma, V₅: *Cynodon dactylon* var. Panama, V₆: *Cynodon dactylon* var. Bargusto, V₇: Korean grass (*Zoysia japonica*) and V₈: Manila grass (*Zoysia matrella*) and four phases (P₁: December- January, P₂: February – March, P₃: April – May and P₄: June – July). The experiment was laid out in randomized block design, with three replications. These varieties and species were collected from Division of Floriculture and Landscaping, Indian Agricultural Research Institute (IARI), New Delhi. Grass stolons were dibbled on raised beds of 3 × 3 m² beds during the month of December, 2021. The dibbling method of planting was followed. Data were recorded at the end of each phase for various quality traits. The quality traits included turf quality Clipping yield (g), Thatch dry weight (g), Thatch accumulation (cm), Root dry weight (g), Root depth (cm), Total chlorophyll content (mg/g). The clippings yield (g) from two randomly collected spots from each plot were harvested from an area of 100 cm² just before mowing. The dry and dead biomass that remains between the soil and the green portion of the grass is called as thatch. The height of such dead portion was measured and expressed in centimetres and also the dead biomass was collected from 100 cm² area from each plot and ex-

pressed in grams after drying in hot air oven. The root length was measured by taking out soil core samples up to a depth of 20 cm depth and kept in tray with water for overnight and roots were extracted by washing the soil and dried at 75 °C and the dry weight was recorded and expressed in grams.

Total chlorophyll content (mg/g) in leaves was determined by DMSO (Dimethyl sulphoxide) method (Wellburn, 1994) [8] at the end of four different phases. The data recorded on various quality, functional and physiological traits were analysed using OPSTAT software.

Results and discussion

Effect of different phases on clipping yield (g/m²) of different turf grasses

It is revealed from the data presented in Table 1 that the clipping yield of different turf grasses influenced significantly by varieties and phases. Varieties had significant effect on clipping yield and observed that the maximum clipping yield (323.46 g/m²) in *Cynodon dactylon* var. Panama and it was followed by *Cynodon dactylon* var. Palma (235.62 g/m²), *Cynodon dactylon* var. Palma (235.62 g/m²) and *Cynodon dactylon* var. Panam (209.02 g/m²), while minimum clipping yield (27.67 g/m²) was observed in Manila grass (*Zoysia japonica*) which was followed by *Cynodon dactylon* var. Selection 1 (31.84 g/m²) and *Cynodon dactylon* var. Bargusto (69.33 g/m²). These findings are supported by Wiecko (2006) [9] and Jankairam *et al.* (2015) [10], who reported that warm-season turf grass biomass peaks rapidly when heat and humidity are non-limiting. Phases also had significant effect on clipping yield. Maximum clipping yield (240.36 g/m²) was observed in phase June – July and it was followed by phase April – May (138.52 g/m²), whereas, minimum clipping yield (78.93 g/m²) in phase Dec – Jan and it was followed by phase Feb – March (93.75 g/m²). The drastic surge in clipping yield during the monsoon/summer season (June–July) aligns with Turgeon (2008) [11], who noted that elevated temperatures accelerate cell division and vertical shoot expansion. Interaction effect of varieties and phases was found significant in influencing the clipping yield of different turf grasses. *Cynodon dactylon* var. Panama observed the maximum clipping yield (560.10 g/m²) in phase June – July and it was followed by *Cynodon dactylon* var. Palma and *Cynodon dactylon* var. Panam in the same phase (400.63 g/m², 382.45 g/m²) respectively, whereas, Manila grass (*Zoysia japonica*) observed the minimum clipping yield (14.63 g/m²) in phase Dec – Jan, which was on par with *Cynodon dactylon* var. Selection 1 in same phase (15.50 g/m²), Manila grass (*Zoysia japonica*) in phase Feb – March (18.43 g/m²), *Cynodon dactylon* var. Selection 1 in phase Feb – March (21.34 g/m²) and Manila grass (*Zoysia japonica*) in phase April – May (23.09 g/m²). Rest of interactions were significant to each other.

Table 1. Effect of different phases on clipping yield (g/m²) of different turf grasses

Varieties	Phases				
	I Dec– Jan	II Feb- March	III April–May	IV June–July	Mean
<i>Cynodon dactylon</i> var. Selection1	15.50	21.34	32.00	58.54	31.84
<i>Cynodon dactylon</i> var. Tif419	49.52	62.27	122.64	164.34	99.70
<i>Cynodon dactylon</i> var. Panam	130.45	150.52	172.65	382.45	209.02
<i>Cynodon dactylon</i> var. Palma	116.40	144.35	281.12	400.63	235.62
<i>Cynodon dactylon</i> var. Panama	202.01	229.99	301.74	560.10	323.46
<i>Cynodon dactylon</i> var. Bargusto	32.68	41.53	82.39	120.72	69.33
Manila grass (<i>Zoysia japonica</i>)	14.63	18.43	23.09	54.55	27.67
Korean grass (<i>Zoysia matrella</i>)	70.20	81.53	92.49	181.58	106.45
Mean	78.93	93.75	138.52	240.36	
C.D ($p = 0.05$)	Varieties	Phases	VarietiesXPhases		
	1.95	1.38	3.90		

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2. Effect of different phases on thatch accumulation (cm) of different turf grasses

The data presented in table 2 revealed that thatch accumulation of different turf grasses varied significantly with varieties. The minimum thatch accumulation (0.338 cm) recorded in *Cynodon dactylon* var. Palma and it was followed by *Cynodon dactylon* var. Bargusto (0.377 cm) and *Cynodon dactylon* var. Panam (0.436 cm), whereas, maximum thatch accumulation (0.570 cm) recorded in *Cynodon dactylon* var. Tif 419 and it was followed by *Cynodon dactylon* var. Selection 1 (0.538 cm) and Korean grass (*Zoysia matrella*) (0.498 cm). These findings are supported by Turgeon (1980) [1] and Christians (2004) [4], who noted that dense, vigorously growing warm-season turfgrasses under high-input regimes are inherently prone to thatch accumulation, requiring mechanical management such as verticutting or core aerification. Phases also had significant effect

on thatch accumulation. The minimum thatch accumulation (0.426 cm) recorded after the second phase, while the maximum thatch accumulation (0.493 cm) recorded after the fourth phase. Aligning with observations by Bell (2011) [12] and Jankairam *et al.* (2015) [10] on organic layer dynamics in mature turf stands. Interaction between varieties and phases was found significant in influencing thatch accumulation. *Cynodon dactylon* var. Palma recorded the minimum thatch accumulation (0.307 cm) after second phase and it was followed by *Cynodon dactylon* var. Bargusto after second phase (0.353 cm) and *Cynodon dactylon* var. Palma after fourth phase (0.370 cm), whereas, *Cynodon dactylon* var. Tif 419 recorded the maximum thatch accumulation (0.627 cm) after fourth phase and it was followed 43 by *Cynodon dactylon* var. Selection 1 (0.590 cm) and Korean grass (*Zoysia matrella*) (0.527 cm) in the same phase. Remaining interactions were significant to each other.

Table 2. Effect of different phases on thatch accumulation (cm) of different turf grasses

Varieties	Phases		
	After phase II	After phase IV	Mean
<i>Cynodon dactylon</i> var. Selection1	0.487	0.590	0.538
<i>Cynodon dactylon</i> var. Tif419	0.513	0.627	0.570
<i>Cynodon dactylon</i> var. Panam	0.413	0.460	0.436
<i>Cynodon dactylon</i> var. Palma	0.307	0.370	0.338
<i>Cynodon dactylon</i> var. Panama	0.423	0.470	0.447
<i>Cynodon dactylon</i> var. Bargusto	0.353	0.400	0.377
Manila grass (<i>Zoysia japonica</i>)	0.440	0.500	0.470
Korean grass (<i>Zoysia matrella</i>)	0.470	0.527	0.498
Mean	0.426	0.493	
C.D ($p = 0.05$)	Varieties	Phases	VarietiesXPhases
	0.018	0.009	0.025

3. Effect of different phases on thatch dry weight (g/m²) of different turf grasses

The data presented in table 3 showed that thatch dry weight of different turf grasses is significantly influenced by varieties and phases. The minimum thatch dry weight (0.418 g/m²) was recorded in Manila grass (*Zoysia japonica*) and it was followed by *Cynodon dactylon* var. Palma (0.522 g/m²) and *Cynodon dactylon* var. Bargusto (0.675 g/m²), whereas, the maximum thatch dry weight (1.602 g/m²) was recorded in *Cynodon dactylon* var. Tif 419 and it was followed by *Cynodon dactylon* var. Selection 1 (1.117 g/m²) and *Cynodon dactylon* var. Panam (0.840 g/m²). These findings align with Turgeon (1980) [1] and Christians (2004) [4], who noted that dense, high-yielding warm-season cultivars under active growth accumulate substantially higher thatch biomass compared to slow-growing species like *Z.*

japonica. Among the phases, the minimum thatch dry weight (0.552 g/m²) was recorded after second phase, whereas, the maximum thatch dry weight (1.102 g/m²) was recorded after fourth phase. Consistent with observations by Bell (2011) [12] and Jankairam *et al.* (2015) [10] on organic layer dynamics in mature turf stands. Significant interaction effect was observed between varieties and phases. Manila grass (*Zoysia japonica*) recorded minimum thatch dry weight (0.277 g/m²) after second phase and it was followed by *Cynodon dactylon* var. Palma and *Cynodon dactylon* var. Bargusto (0.350 g/m², 0.450 g/m²) respectively, in the same phase, while *Cynodon dactylon* var. Tif 419 recorded maximum thatch dry weight (2.143 g/m²) after fourth phase and it was followed by *Cynodon dactylon* var. Selection 1 and *Cynodon dactylon* var. Panam (1.450 g/m², 1.140 g/m²) respectively, in the same phase and rest of interactions were significant to each other.

Table 3. Effect of different phases on thatch dry weight (g/m²) of different turf grasses

Varieties	Phases		
	After phase II	After phase IV	Mean
<i>Cynodon dactylon</i> var. Selection 1	0.783	1.450	1.117
<i>Cynodon dactylon</i> var. Tif419	1.060	2.143	1.602
<i>Cynodon dactylon</i> var. Panam	0.540	1.140	0.840
<i>Cynodon dactylon</i> var. Palma	0.350	0.693	0.522
<i>Cynodon dactylon</i> var. Panama	0.487	0.980	0.733
<i>Cynodon dactylon</i> var. Bargusto	0.450	0.900	0.675
Manila grass (<i>Zoysia japonica</i>)	0.277	0.560	0.418
Korean grass (<i>Zoysia matrella</i>)	0.467	0.950	0.708
Mean	0.552	1.102	

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Varieties	Phases			Mean
	After phase II		After phase IV	
C.D($p = 0.05$)	Varieties	Phases	Varieties X Phases	
	0.036	0.018	0.051	

4. Effect of different phases on root length (cm) of different turf grasses

The data presented in table 4 regarding root length had shown significant differences for different varieties and phases. The maximum root length (14.58 cm) was recorded in *Cynodon dactylon* var. Tif 419 and it was followed by *Cynodon dactylon* var. Selection 1 (14.22 cm), *Cynodon dactylon* var. Palma (13.77 cm) and *Cynodon dactylon* var. Bargusto (13.52 cm), whereas, minimum root length (9.27 cm) was recorded in Korean grass (*Zoysia matrella*) followed by Manila grass (*Zoysia japonica*) (9.55 cm). These findings align with Rodriguez-Fuentes (2009) [13] and Macolino (2012) [6], who noted that hybrid Bermuda grasses allocate substantial assimilate fractions to below-ground organs to optimize moisture extraction from deeper soil profiles. Among the different phases, the maximum root length (16.20 cm) was recorded in phase April – May and it was followed by

phase June – July (12.41 cm), whereas, the minimum root length (10.95 cm) was recorded in phase Dec – Jan and followed by phase Feb – March (11.16 cm). Consistent with observations by Hanks (2005) [7] and Taher et al. (2023) [14] regarding temperature-dependent root dynamics in warm-season turf grasses. Interaction between varieties and phases was observed significant in influencing root length of different turf grasses. However, *Cynodon dactylon* var. Tif 419 recorded the maximum root length (18.45 cm) in phase April – May and it was followed by *Cynodon dactylon* var. Selection 1 (18.29 cm) in phase April – May, *Cynodon dactylon* var. Palma (18.12 cm) in same phase and *Cynodon dactylon* var. Bargusto (17.57 cm) in the same phase, whereas, Korean grass (*Zoysia matrella*) recorded the minimum root length (8.18 cm) in phase Dec – Jan and it was followed by Korean grass (*Zoysia matrella*) in the phase Feb – March (8.27 cm) and Manila grass (*Zoysia japonica*) in the phase Dec – Jan (8.34 cm).

Table 4. Effect of different phases on root length (cm) of different turf grasses

Varieties	Phases				Mean
	I Dec– Jan	II Feb– March	III April–May	IV June–July	
<i>Cynodon dactylon</i> var. Selection1	12.40	12.55	18.29	13.64	14.22
<i>Cynodon dactylon</i> var. Tif419	12.74	12.86	18.45	14.27	14.58
<i>Cynodon dactylon</i> var. Panam	11.17	11.43	17.36	12.93	13.22
<i>Cynodon dactylon</i> var. Palma	11.75	12.06	18.12	13.15	13.77
<i>Cynodon dactylon</i> var. Panama	11.37	11.65	17.48	12.66	13.29
<i>Cynodon dactylon</i> var. Bargusto	11.60	11.88	17.57	13.01	13.52
Manila grass (<i>Zoysia japonica</i>)	8.34	8.57	11.26	10.02	9.55
Korean grass (<i>Zoysia matrella</i>)	8.18	8.27	11.04	9.60	9.27
Mean	10.95	11.16	16.20	12.41	
C.D ($p = 0.05$)	Varieties	Phases	Varieties X Phases		
	0.04	0.03	0.08		

5. Effect of different phases on root dry weight (g/m²) of different turf grasses

The perusal of data presented in table 5 regarding effects of varieties and phases on root dry weight of turf grasses was influenced significantly by both the factors. The maximum root dry weight (0.266 g/m²) was recorded in *Cynodon dactylon* var. Tif 419 and it was followed by *Cynodon dactylon* var. Selection 1 (0.220 g/m²), *Cynodon dactylon* var. Panam (0.184 g/m²) and *Cynodon dactylon* var. Bargusto (0.176 g/m²), whereas, minimum root dry weight (0.122 g/m²) was recorded in Korean grass (*Zoysia matrella*) followed by Manila grass (*Zoysia japonica*) (0.136 g/m²), *Cynodon dactylon* var. Panama (0.151 g/m²) and *Cynodon dactylon* var. Palma (0.151 g/m²). These findings are supported by Rodriguez-Fuentes (2009) [13] and Macolino (2012) [6], who reported that hybrid bermudagrasses allocate substantial photoassimilates to root production during peak active growth stages. Among

the phases, maximum root dry weight (0.227 g/m²) was recorded in phase June – July and it was followed by phase April – May (0.200 g/m²), whereas, minimum root dry weight (0.134 g/m²) was recorded in phase Dec – Jan and it was followed by in phase Feb – March (0.148 g/m²), consistent with observations by Hanks (2005) [7] and Taher et al. (2023) [14]. Interaction between varieties and phases was observed significant in affecting root dry weight of turf grasses. However, *Cynodon dactylon* var. Tif 419 recorded the maximum root dry weight (0.346 g/m²) in phase June – July followed by *Cynodon dactylon* var. Tif 419 in phase April – May (0.314 g/m²) and *Cynodon dactylon* var. Selection 1 in phase June – July (0.295 g/m²), whereas, Korean grass (*Zoysia matrella*) recorded the minimum root dry weight (0.080 g/m²) in phase Dec – Jan followed by Korean grass (*Zoysia matrella*) in phase Feb – March (0.099 g/m²) and Manila grass (*Zoysia japonica*) in phase Dec – Jan (0.103 g/m²).

Table 5. Effect of different phases on root dry weight (g/m²) of different turf grasses

Varieties	Phases				Mean
	I Dec– Jan	II Feb– March	III April–May	IV June–July	
<i>Cynodon dactylon</i> var. Selection1	0.153	0.175	0.256	0.295	0.220

(continued on next page)

Varieties	Phases				Mean
	I Dec– Jan	II Feb– March	III April–May	IV June–July	
<i>Cynodon dactylon</i> var. Tif419	0.191	0.212	0.314	0.346	0.266
<i>Cynodon dactylon</i> var. Panam	0.152	0.164	0.215	0.205	0.184
<i>Cynodon dactylon</i> var. Palma	0.130	0.142	0.176	0.205	0.163
<i>Cynodon dactylon</i> var. Panama	0.118	0.127	0.166	0.194	0.151
<i>Cynodon dactylon</i> var. Bargusto	0.134	0.154	0.193	0.225	0.176
Manila grass (<i>Zoysia japonica</i>)	0.103	0.112	0.144	0.186	0.136
Korean grass (<i>Zoysia matrella</i>)	0.089	0.099	0.137	0.165	0.122
Mean	0.134	0.148	0.200	0.227	
C.D ($p = 0.05$)	Varieties	Phases	VarietiesXPhases		
	0.002	0.001	0.004		

6. Effect of different phases on total chlorophyll content (mg/g) of different turf grasses

It is evident from the data presented in table 6 that total chlorophyll content influenced significantly by different varieties and phases. Varieties had significant effect on total chlorophyll content and observed that maximum total chlorophyll content (3.51 mg/g) in *Cynodon dactylon* var. Tif 419 and it was followed by *Cynodon dactylon* var. Selection 1 (3.25 mg/g), *Cynodon dactylon* var. Palma (3.06 mg/g) and *Cynodon dactylon* var. Panam (2.99 mg/g), whereas, minimum total chlorophyll content (2.32 mg/g) was observed in Korean grass (*Zoysia matrella*) and it was closely followed by Manila grass (*Zoysia japonica*) (2.41 mg/g), *Cynodon dactylon* var. Bargusto (2.82 mg/g) and *Cynodon dactylon* var. Panama (2.98 mg/g). These findings align with Wellburn (1994) [8] and Uddin *et al.* (2012) [15], who noted that pigment retention during active growth phases supports higher photoassimilate production and leaf greenness. Among the different phases, maximum total chlorophyll content (3.49 mg/g) was observed in phase April – May and it is followed by phase June – July (3.14 mg/g), whereas, minimum total chlorophyll content

(2.40 mg/g) was observed in phase Dec – Jan and it was closely followed by phase Feb – March (2.65 mg/g). This thermal sensitivity aligns with findings by Taher *et al.* (2023) [14], who documented significant chlorophyll degradation in warm-season turf grasses subjected to winter cold stress. Interaction between varieties and phases was found significant in influencing total chlorophyll content of turf grasses. This thermal sensitivity aligns with findings by Taher *et al.* (2023) [14], who documented significant chlorophyll degradation and semi-dormancy in warm-season turfgrasses subjected to winter cold stress. Among interaction of varieties and phases, *Cynodon dactylon* var. Tif 419 observed maximum total chlorophyll content (3.96 mg/g) in the phase April – May, which is statistically at par with *Cynodon dactylon* var. Palma (3.92 mg/g) in the same phase and Korean grass (*Zoysia matrella*) observed the minimum total chlorophyll content (2.03 mg/g) in phase Dec – Jan and it was followed by Korean grass (*Zoysia matrella*) (2.15 mg/g) in Feb – March phase and Manila grass (*Zoysia japonica*) (2.20 mg/g) in phase Dec – Jan. However, there were significant differences between rest of interactions between varieties and phases.

Table 6. Effect of different phases on total chlorophyll content (mg/g) of different turf grasses

Varieties	Phases				Mean
	I Dec– Jan	II Feb– March	III April–May	IV June–July	
<i>Cynodon dactylon</i> var. Selection1	2.43	3.06	3.92	3.60	3.25
<i>Cynodon dactylon</i> var. Tif419	3.03	3.40	3.96	3.65	3.51
<i>Cynodon dactylon</i> var. Panam	2.27	2.48	3.83	3.41	2.99
<i>Cynodon dactylon</i> var. Palma	2.38	2.59	3.88	3.50	3.06
<i>Cynodon dactylon</i> var. Panama	2.48	2.78	3.60	3.37	2.98
<i>Cynodon dactylon</i> var. Bargusto	2.41	2.51	3.41	2.93	2.82
Manila grass (<i>Zoysia japonica</i>)	2.20	2.30	2.77	2.37	2.41
Korean grass (<i>Zoysia matrella</i>)	2.03	2.15	2.53	2.30	2.32
Mean	2.40	2.65	3.49	3.14	
C.D ($p = 0.05$)	Varieties	Phases	VarietiesXPhases		
	0.02	0.01	0.04		

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