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PHYSICOCHEMICAL RESPONSES OF EXISTING LAWN GRASSES AFFECTED BY TRAMPLING AT VARIOUS PARKS IN TIRUPATI RAYALASEEMA REGION OF ANDHRA PRADESH, INDIA

K. Johitha[1]*, M. Raja Naik[1], T. Sumathi[1], P. Sreelatha[2] and Y. Ashok[1]

[1]Department of Floriculture and Landscaping, College of Horticulture, Anantharajupeta-516 105 (Dr.Y.S.R. Horticultural University), Andhra Pradesh, India.

[2]Department of Plant Physiology, College of Horticulture, Anantharajupeta-516 105 (Dr.Y.S.R. Horticultural University), Andhra Pradesh, India.

*Corresponding author E-mail : kjohitha@gmail.com

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ABSTRACT

The present study was conducted during 2025-2026 to assess the physiological and biochemical responses of three existing lawn grasses under pedestrian trampling stress at seven parks in Tirupati, Rayalaseema region of Andhra Pradesh, India, for evaluating their performance under frequently trafficked park conditions. The data recorded for various parameters among the parks tested, Sri Kalyana Venkateswara Sports Park reported maximum for Relative water content (85.50%), Malondialdehyde content (16.07 µmol L^{-1}) and Ascorbic acid content (4.71 mg g^{-1} DW), while, the maximum total chlorophyll content (5.67 mg 100 g^{-1}) recorded in Municipal park. Among the grasses, *Cynodon dactylon* performed best for total chlorophyll content (6.40 mg 100 g^{-1}), Relative water content (83.51%), Malondialdehyde content (15.07 µmol L^{-1}) and Ascorbic acid content (3.59 mg g^{-1} DW). On the other hand, total chlorophyll content (6.85 mg 100 g^{-1}), Relative water content (90.67%), Malondialdehyde content (16.98 µmol L^{-1}) and ascorbic acid content (5.43 mg g^{-1} DW) were recorded best in *Cynodon dactylon* at Sri Kalyana Venkateswara Sports Park. whereas, *Cynodon dactylon* at Sri Kalyana Venkateswara Sports Park recorded the lowest value (9.37%). The data on various physiological and biochemical parameters showed significant differences among the parks and grasses, indicating differential responses of existing lawn grasses to repeated pedestrian trampling stress.

Key words : Trampling stress, *Cynodon dactylon*, Parks, Lawn grass, Physiological.

Introduction

Turfgrasses are perennial low-growing monocotyledonous plants that form a compact and continuous vegetative cover when maintained under regular mowing and suitable management practices. The term “turf” is derived from the Sanskrit word *darbha*, which refers to a turf of grasses and represents a layer of vegetation along with the upper soil profile intertwined with roots, stolons and rhizomes. Turfgrasses occupy a significant position in urban and suburban landscapes, due to their recreational, functional and ornamental importance. Presently, turfgrass systems are recognized as essential components of parks, gardens, playgrounds, golf courses, institutional landscapes and roadside greenbelts, contributing substantially to the environment and human well-being (Braun *et al.*, 2021). However, repeated pedestrian or vehicular movement imposes direct mechanical pressure on turfgrass shoots and soil surfaces, resulting in wear injury through crushing and tearing of leaves and crowns as well as soil compaction caused by continuous pressure on the soil profile (Dest and Ebdon, 2017). Such repeated trampling deteriorates soil physical properties, including porosity, bulk density, aeration and water infiltration capacity, thereby restricting root growth and nutrient absorption. The resulting deterioration in soil conditions can further impair photosynthesis and root development, leading to thinning of turf cover and reduced visual quality (Braun *et al.*,

2022). Warm-season turfgrasses possess adaptive traits that enhance tolerance to trampling and wear. Bermuda grass (*Cynodon dactylon*) has vigorous stoloniferous and rhizomatous growth, promoting rapid spread and recovery, while *Zoysia* species form dense turf mats with better wear tolerance and persistence under traffic. Buffalo grass (*Buchloe dactyloides*) is also tolerant to drought and moderate traffic, although excessive trampling can reduce shoot density, tillering, leaf area and root development due to soil compaction (Glab *et al*., 2015). Species differ in traffic tolerance are associated with growth habit, root architecture, recuperative capacity and physiological efficiency. Biochemically, trampling stress induces oxidative damage and metabolic imbalance in turfgrass species. Continuous mechanical pressure enhances the generation of reactive oxygen species (ROS), which damage cellular membranes, proteins, lipids and nucleic acids. Increased Malondialdehyde (MDA) accumulation under trampling conditions (Fan *et al*., 2020).

Materials and Methods

The study was based on the trampling stress in existing 3 lawn grasses *viz*., Doob grass, Buffalo grass, Mexican grass from different locations at Tirupati, which falls under tropical zone of Rayalaseema region of Andhra Pradesh during the year 2025-2026. The experiment was laid out in a Two Factorial Randomized Block Design (2 FRBD) with 7 locations and 3 replications, considering parks and grass species as the experimental factors. The observations presented in the present study were restricted to the final assessment made at 120th days after treatment (DAT).

Experimental details

Under trampling stress physiological and biochemical responses of the lawn grasses were assessed at 120 DAT. Physiological parameters includes- Chlorophyll content, Relative water content (RWC). Whereas, chlorophyll content was estimated using DMSO procedure adopted in the present investigation, Relative water content was calculated by using formula as given below. Some biochemical parameters were analyzed by using appropriate standard procedures. The activities of antioxidant enzymes, *viz*., MDA content was estimated as an indicator of membrane lipid peroxidation. Ascorbic acid related biochemical constituents were estimated using the respective standard analytical titration method procedures followed in the experiment. The data recorded for the physiological and biochemical parameters at 120th day to determine the effect of parks, lawn grass species and their interactions.

$$\text{Relative Water Content (RWC) \%} = \frac{(\text{Fresh weight} - \text{Dry weight})}{(\text{Turgid weight} - \text{Dry weight})} \times 100$$

Table 1 : General description of parks and lawn grasses used for the study.

Parks	Lawn grasses
P_1 : Sri Babu Jagjeevan Ram park	G_1: *Cynodon dactylon* G_2: *Buchloe doctyloides* G_3: *Zoysia tenuifolia*
P_2: Municipal park	
P_3: Padmavathi park	
P_4: Vinayaka sagar park	
P_5: Sri Kalyana Venkateswara sports park	
P_6: Valmiki park	
P_7: Control (Prakasam park)	



Fig. 1 : Images of parks at different locations at Tirupati.



Cynodon dactylon *Buchloe doctyloides* *Zoysia tenuifolia*

Fig. 2 : Grass species used for the study.

Results and Discussion

Total chlorophyll content (mg 100 g^{-1})

From the data recorded in the Table 2, it was noticed that under trampling stress highest chlorophyll content among parks (5.67 mg 100 g^{-1}) was observed in P_2 (Municipal park), among grasses G_1 (*Cynodon dactylon)* was recorded (6.40 mg 100 g^{-1}), whereas in interaction *Cynodon dactylon* × Municipal park (6.85 mg 100 g^{-1})

resulted highest chlorophyll content. This could be due to differences in the physiological response and stress tolerance of lawn grass species under repeated pedestrian trampling. Comparatively higher total chlorophyll content in *Cynodon dactylon* might be due to its vigorous growth and better ability to maintain chlorophyll pigments under mechanical stress (Han *et al.*, 2008; Mohamadi *et al.*, 2017).

Table 2 : Response of parks (P), lawn grasses (G) and their interaction (P×G) to pedestrian traffic in respect of Total chlorophyll content (mg $100g^{-1}$).

Parks	Total chlorophyll content (mg $100g^{-1}$)			
	G_1	G_2	G_3	Mean
P_1	5.87	5.47	4.30	5.22
P_2	6.85	5.62	4.55	5.67
P_3	6.10	5.89	4.79	5.60
P_4	6.40	5.41	4.59	5.47
P_5	6.48	5.67	4.83	5.66
P_6	6.47	5.87	4.10	5.48
P_7	6.66	5.71	4.56	5.64
Mean	6.40	5.66	4.53	
	Factors	**C.D.(*P*=0.05)**	**SE(d)**	**SE(m)**
	Park (P)	0.13	0.07	0.05
	Grass (G)	0.09	0.04	0.03
	Interactions (P×G)	0.23	0.11	0.08

Table 3 : Response of parks (P), lawn grasses (G) and their interaction (P×G) to pedestrian traffic in respect of Relative water content (%).

Parks	Relative water content (%)			
	G_1	G_2	G_3	Mean
P_1	89.67	80.40	64.90	78.32
P_2	86.19	86.09	76.81	83.03
P_3	87.08	72.23	78.58	79.30
P_4	85.44	86.59	74.97	82.33
P_5	90.67	88.66	77.17	85.50
P_6	71.63	81.77	77.58	76.99
P_7	73.86	59.75	82.58	72.06
Mean	83.51	79.35	76.08	
	Factors	**C.D.(*P*=0.05)**	**SE(d)**	**SE(m)**
	Park (P)	2.04	1.00	0.71
	Grass (G)	1.33	0.66	0.47
	Interactions (P×G)	3.53	1.74	1.23

Table 5 : Response of parks (P), lawn grasses (G) and their interaction (P×G) to pedestrian traffic in respect of Malondialdehyde (µmol L^{-1}) content.

Parks	Malondialdehyde (µmol L^{-1})			
	G_1	G_2	G_3	Mean
P_1	14.57	15.79	14.63	15.00
P_2	16.34	14.45	14.76	15.18
P_3	13.39	12.35	13.78	13.18
P_4	15.32	14.57	14.35	14.74
P_5	16.98	14.85	16.38	16.07
P_6	13.13	12.70	15.36	13.73
P_7	16.34	14.56	14.23	15.04
Mean	15.07	14.18	14.87	
	Factors	**C.D.(*P*=0.05)**	**SE(d)**	**SE(m)**
	Park (P)	0.37	0.18	0.13
	Grass (G)	0.24	0.12	0.08
	Interactions (P×G)	0.64	0.31	0.22

Table 6 : Response of parks (P), lawn grasses (G) and their interaction (P×G) to pedestrian traffic in respect of Ascorbic acid (mg g^{-1} DW) content.

Parks	Ascorbic acid (mg g^{-1} DW)			
	G_1	G_2	G_3	Mean
P_1	3.35	4.98	3.23	3.85
P_2	4.20	3.43	3.24	3.62
P_3	3.23	2.00	3.03	2.75
P_4	3.45	3.99	1.45	2.96
P_5	5.43	4.25	4.46	4.71
P_6	2.23	2.56	1.46	2.08
P_7	3.24	3.25	2.18	2.89
Mean	3.59	3.50	2.72	
	Factors	**C.D.(*P*=0.05)**	**SE(d)**	**SE(m)**
	Park (P)	0.08	0.04	0.03
	Grass (G)	0.06	0.03	0.02
	Interactions (P×G)	0.15	0.07	0.05

Relative water content (%)

The data pertaining to Relative water content (RWC) (Table 3) studied in various grasses at multiple locations had significant influence and was displayed maximum water content in Sri Kalyana Venkateswara Sports park (85.50%) under trampling stress, among grasses was displayed maximum (83.51%) in *Cynodon dactylon*. In the interaction, *Cynodon dactylon* × Sri Kalyana

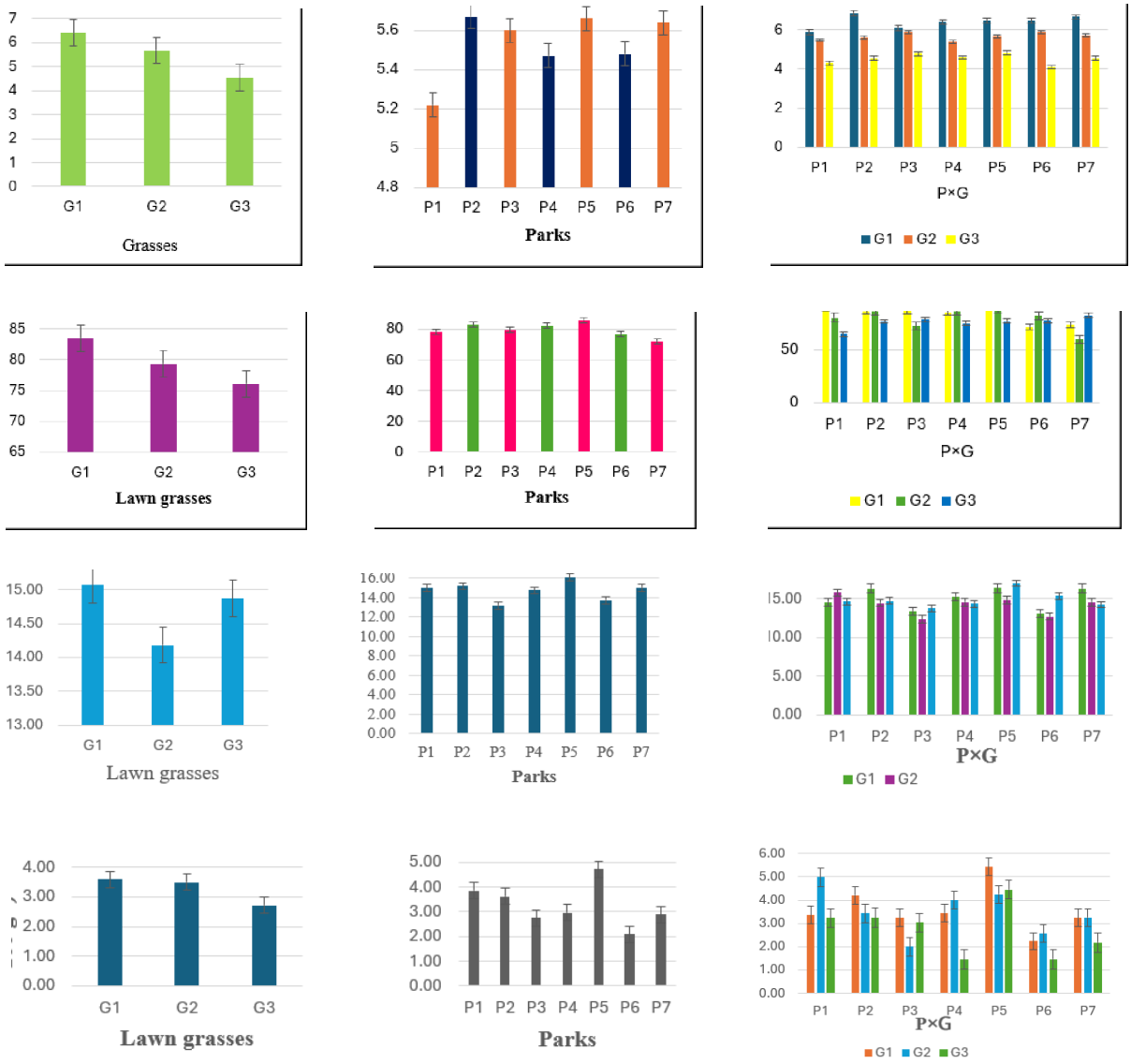


Fig. 3 : Graphical representation of various physicochemical properties with respect to grass species, parks and interactions.

Venkateswara Sports park attained highest readings (90.67%). The higher values of RWC show better tolerant to stress and well-conducting of different physiological mechanisms. The comparatively higher relative water content recorded in *Cynodon dactylon* might be due to its better ability to maintain cellular integrity under repeated trampling stress. Malleshaiah *et al*. (2017) reported that traffic stress causes leaf injury, resulting in excessive oozing of sap from injured tissues followed by evaporation, thereby reducing relative water content. The differences in relative water content among the lawn grass might be due to species specific, environmental conditions, soil moisture availability and traffic duration.

Malondialdehyde (µmol L^{-1})

Significant difference was observed on the above trait (Table 5). Sri Kalyana Venkateswara Sports park displayed higher malondialdehyde content (16.07 µmol L^{-1}). Among the grasses, *Cynodon dactylon* recorded maximum (15.07 µmol L^{-1}) and interaction, higher malondialdehyde content was observed in *Cynodon dactylon* at Sri Kalyana Venkateswara Sports park shows (16.98 µmol L^{-1}). This might be due to differences in trampling intensity, oxidative stress and antioxidant defense capacity among the parks and lawn grass species. Prolonged trampling stress may enhance ROS production, resulting in lipid peroxidation and increased malondialdehyde accumulation, thereby causing membrane damage (Wei *et al.*, 2022). The variation in MDA accumulation might related to species response and their tolerance (Mohamadi *et al.*,2017).

Ascorbic acid (mg g^{-1} DW)

Ascorbic acid (Table 6), a stress reducing factor was observed significantly higher at Sri Kalyana Venkateswara Sports park shows (4.71 mg g^{-1} DW). In

grasses, it was obtained highest in *Cynodon dactylon* (3.59 mg g^{-1} DW), while the combination of *Cynodon dactylon* at Sri Kalyana Venkateswara Sports park resulted best (5.43 mg g^{-1} DW). This could be due to the variation in antioxidant defense response of the species. Ascorbic acid acts as a ROS scavenger and protects the tissues from stress induced oxidative damage (Xu *et al.*, 2015). The higher ascorbic acid accumulation in *Cynodon dactylon* reflects its potentiality in antioxidant defense.

Conclusion

Repeated trampling stress produced a considerable variation in the physicochemical properties of the existing lawn species across the parks. Among the grasses, *Cynodon dactylon* maintained comparatively higher total chlorophyll content and relative water content, indicating better maintenance of plant water status under trampling stress. The higher ascorbic acid content, indicated a positive antioxidant role, while variations in malondialdehyde content reflected differences in oxidative stress among the grasses and parks. Overall, the observed responses suggest that *Cynodon dactylon* possess better physiological and biochemical adaptation to repeated pedestrian trampling stress conditions and may be considered for frequently trafficked park landscapes.

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References

Braun, R.C., Bremer D.J. and Hoyle J.A. (2021). Simulated traffic on turfgrasses during drought stress: I. Performance and recovery of turf canopies. *Crop Sci.*, **61(5)**, 2926-2938.

Braun, R.C., Bremer D.J. and Hoyle J.A. (2022). Simulated traffic on turfgrasses during drought stress: II. Soil moisture, soil compaction, and rooting. *Int. Turfgrass Soc. Res. J.*, **14(1)**, 516-527.

Dest, W.M. and Ebdon J.S. (2017). The effect of wear and soil compaction on Kentucky bluegrass sod rooting and plant recovery. *Int. Turfgrass Soc. Res. J.*, **13(1)**, 338-345.

Głąb, T. and Szewczyk W. (2015). The effect of traffic on turfgrass root morphological features. *Scientia horticulturae*. **197**, 542-554.

Fan, J., Zhang W., Amombo E., Hu L., Kjorven J.O. and Chen L. (2020). Mechanisms of environmental stress tolerance in turfgrass. *Agronomy*, **10(4)**, 522.

Han, L.B., Song G.L. and Zhang X. (2008). Preliminary observations on physiological responses of three turfgrass species to traffic stress. *HortTechnology*, **18(1)**, 139-143.

Mohamadi, M.H.S., Etemadi N., Nikbakht A. and Pessarakli M. (2017). Physiological responses of two cool-season grass species to trinexapac-ethyl under traffic stress. *HortScience*, **52(1)**, 99-109.

Samaranayake, H., Lawson T.J. and Murphy J.A. (2008). Traffic stress effects on bent grass putting green and fairway turf. *Crop Sci.*, **48(3)**, 1193-1202.

Wei, H., Yang W., Wang Y., Ding J., Ge L., Richardson M., Liu T. and Zhang J. (2022). Correlations among soil, leaf morphology and physiological factors with wear tolerance of four warm-season turfgrass species. *HortScience*, **57(4)**, 571-580.

Watschke, T.L. and Schmidt R.E. (1992). Ecological aspects of turf communities. *Turfgrass*, **32**, 129-174.

Xu, Y., Xu Q. and Huang B. (2015). Ascorbic acid mitigation of water stress-inhibition of root growth in association with oxidative defense in tall fescue (*Festuca arundinacea* Schreb.). *Front. Plant Sci.*, **6**, 807.