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EFFECTS OF SOME NATURAL SOIL AMENDMENTS AND WATER REQUIREMENTS ON THE GROWTH AND CHEMICAL CONSTITUENTS OF SOME LAWNS (*PASPALUM VAGINATUM*, L.)

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ABSTRACT: The aim of this research was to improve properties of calcareous soil by adding two natural soil conditioners (sand + compost) with different rations, i.e., calcareous, calcareous + composted leaves (3:1 v/v), calcareous + sand (3:1 v/v) and calcareous + sand + composted leaves (1.5:1.5:1 v/v/v)) combined with three rates of irrigation 5.00 l/m^2 as severe stress, 10.00 l/m^2 as moderate stress and 15.00 l/m^2 as normal stress) on Paspalum. The experimental design was a split-plot design. Natural soil amendments were listed as the primary component, with various irrigation rates included as a subfactor. Resulted from media consisting of calcareous + sand + composted leaves (1.5:1.5:1 v/v/v) with the addition of the third level (15.00 l/m^2) of irrigation rate, gave the highest reduction for the time required to give covering complete (44.916 days) and produced the maximum increase in total fresh (989.772 g/m^2) and dry weight (221.492 g/m^2) of vegetative growth, fresh weight of rhizome (379.854 g/m^2) and dry weight (85.551 g/m^2). Also, highest significant increase in the total chlorophylls (258.595 mg/100 g L.F.W.), carotenoids (60.779 mg/g L.F.W.) and total carbohydrates (267.384) in rhizomes at 15.00 l/m^2 with the growing medium of calcareous + sand + composted leaves (1.5:1.5:1 v/v/v). Natural soil amendments (sand, plant compost) reduced the harmful effects of stress and improved plant resistance to water stress when using irrigation at the moderate stress rate of 10.00 l/m^2. Accordingly, it could be recommended that high-quality lawns (*P. vaginatum*, L.) be produced by growing Paspalum in a mixture of calcareous + sand + composted leaves (1.5:1.5:1 v/v/v) as the best natural soil amendments and irrigation with the rate of 10 as moderate stress and/or15.00 l/m^2.

Keywords: Lawns, *Paspalum vaginatum,* L., natural soil amendments, water requirements, growing media, soil conditions, compost, drought tolerance, drought stress, Graminae

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INTRODUCTION

Paspalum (*P. vaginatum*, L.) is the genus of the grasses Poaceae, formerly Graminae. Paspalum is grasses of warm-season turfgrasses. Commonly known as paspalum, bahia grasses, crown grasses or dallis grasses, many of the species are tall perennial New World grasses and found in tropical and subtropical regions. They are part of the warm-season category of plants referred to as C_4. This name stems from the fact that they initially produce a 4-carbon molecule (PEP carboxylase), keep their stomata open during daylight hours, and thrive in higher temperatures and greater light intensity. Carbon dioxide is drawn in through the stomata, moving swiftly to the mesophyll cells and then to the bundle sheath cells, where photosynthesis is completed. Paspalum is a perennial herbaceous grass that spreads through rhizomes. Its leaf blades measure between 10 and 19 cm in length, with widths ranging from 3 to 8 mm, and typically exhibit a blue-green color.

The Paspalum turfgrass serves various crucial functional roles while also offering aesthetic appeal. Turfs play a key role in mitigating wind and water erosion of the soil, as well as controlling dust, air pollution, and glare. Outdoor sports like football, hockey, golf, and lawn tennis commonly use turf. The refreshing and natural green appearance of turf creates a pleasing environment for both residential and work settings. The commercial production is done in the world by sodding, sprigging, plugging and stolonizing and/or rhizoms at any time in spring and summer (Nooh and El-Naggar, 2021).

The significance of potting media and irrigation for herbaceous plants, especially lawns, is widely acknowledged. There is a lack of extensive research on the productivity of *Paspalum vaginatum* L. in different global regions. Landscapers have been combining calcareous and/or sandy soils in newly reclaimed areas to improve their physical and chemical properties. The composition of soil, as a growing medium, can have a significant impact on lawn growth. Newly reclaimed areas often contain calcareous and/or sandy soils with limited nutrient availability. To increase productivity, the incorporation of organic matter is essential for retaining inorganic elements in complex and chelate forms. Organic manures are commonly used for plant fertilization worldwide due to their beneficial effects on soil characteristics, which ultimately influence plant growth and productivity (Awing *et al*., 2009; Youssef *et al*., 2001). In addition, compost plays a key role in increasing the water-holding capacity and reducing plant infection with different diseases (Hussein *et al*., 2006 and Tagoe *et al*., 2008).

Drought stress can directly influence photosynthesis, development, nutrient uptake and accumulation, and osmotic adjustment, leading to a significant reduction in crop yield (Chai *et al*., 2015). Drought stress raises the concentration of solutes in the surroundings, causing an osmotic flow of water out of plant cells. This, in turn, increases the solute concentration within plant cells, reducing water potential and disrupting critical activities such as photosynthesis. Plants under drought stress exhibit poor development and productivity as a consequence. Based on previous findings, water stress (a type of abiotic environmental stress) defined as the insufficient availability of water resources to meet the water usage demands within a region is considered one of the primary factors affecting plants, particularly turfgrasses and some ornamental plants, ultimately impacting the final product. Heidari *et al.* (2008). This can lead to an annual loss of hundreds of millions of dollars due to reduced product yield. Mahajan and Tuteja (2005). Moreover, water stress hampers plants' ability to uptake water and results in a decreased growth rate. Khattab *et al.* (2002) observed on *Salvia splendens* that irrigation at 400 ml/plant, applied three times per week, led to the highest leaf number and fresh weight. Bahreininejad *et al.* (2013) investigated the impact of 20, 50, and 80% soil water depletion on morpho-physiological traits in *Thymus daenensis* and found that water stress reduced growth, herbage production, and chlorophyll content.

Concerning the importance of water deficit issue through plant physiological responses to this vital effect, and the effect of irrigation frequency on plant biomass production and quality, this study aimed to investigate the stimulatory effect of the natural soil amendments application with different rates on growth, chemical constituents of leaves (Photosynthetic pigments) and total carbohydrates content in rhizome, of Paspalum grass during growing seasons under water stress condition.

MATERIALS AND METHODS

Plant materials and cultivation conditions:

Paspalum sodding was cut into small, equal pieces (springs) with an average area of 2 × 2 cm and at least 8-10 buds for planting. The sprigs were grown and horizontally put with a spacing of 10 × 10 cm in beds (100 cm long, 100 cm width and 30 cm in depth) with the three chosen natural soil amendments, on 28th and 25th of March of two seasons (2022 and 2023), at Northern Western Coast of Alexandria Governorate. The environmental condition is characterized by a warm humid climate, with an annual average temperature of 27.3 °C and 63% relative humidity.

The experimental treatments:

Four different natural soil amendments have been chosen: calcareous soil (NSA_I), calcareous soil + composted leaves at 3:1 v/v (NSA_{II}), calcareous + sand at 3:1 v/v (NSA_{III}), and calcareous + sand + composted leaves at 1.5:1.5:1 v/v/v (NSA_{IV}). Plant compost (as a decomposed organic material, EC 4.1 ds/m, pH 7.9 and O.M 16.7%) used in this study had been added once during preparing the soil for planting to improve soil fertility by providing micro and macro-nutrients. The physical and chemical properties of the media used are presented in Tables (1 and 2).

Paspalum plants were irrigated daily as the second factor with irrigation rates of 5.00 l/m^2 (severe stress), 10.00 l/m^2 (normal stress) or 15.00 l/m^2 (moderate stress) during the growing seasons. Regular agricultural practices as a basic dressing were carried out whenever necessary as local growers did and the plants were protected from diseases and insects by spraying them with fungicides and insecticides as recommended to keep the foliage clean and healthy.

The layout of experimental treatments:

The experimental design was a split plot. Four natural soil amendments were randomly distributed in the main plot, while the three

Table 1. The main chemical properties of the four chosen natural soil amendments.

Natural soil amendments (NSA)	T.S.S meq/l	Cations (meq/l)				Anions (meq/l)			SRA
		Ca^{++}	Mg^{++}	Na^+	K^+	HCO_3^-	Cl^-	SO_4^-	
NSA_I Calcareous soil	21.10	9.20	2.20	9.30	1.80	3.00	11.00	10.30	3.21
NSA_{II} Calcar. + composted leaves (3:1 v/v)	20.20	10.00	1.10	9.90	1.60	4.00	10.00	10.10	2.42
NSA_{III} Calcareous + sand (3:1 v/v)	22.50	11.00	4.00	8.50	1.50	6.00	8.00	9.60	2.93
NSA_{IV} Calcar +sand + composted leaves (1.5:1.5:1 v/v/v)	21.50	9.00	4.20	9.10	1.70	5.00	8.00	7.10	3.91

Table 2. Organic matter content and texture of the sample.

Natural Soil Amendments (NSA)	OM (%)	Particles %			Soil texture
		Sand	Silt	Clay	
NSA_I Calcareous soil	0.84	62.25	15.30	22.45	Sandy clay loam
NSA_{II} Calcar. + composted leaves (3:1 v/v)	0.35	77.50	5.60	16.90	sandy loom
NSA_{III} Calcareous + sand (3:1 v/v)	8.97	57.60	15.90	26.50	Sandy clay loam
NSA_{IV} Calcar +sand + composted (1.5:1.5:1 v/v/v)	3.84	70.40	8.7	20.9	Sandy clay loam

irrigation rates were assigned to the sub-plot (4 natural soil amendments × 3 irrigation levels). All treatments had three replicates (Snedecor and Cochran, (1990).

Morphological measurements and botanical estimates:

The recorded data of vegetative growth and rhizome production were; days numbers from planting to covering area of paspalum grass (day), the height (cm) samples were taken within each plot of each treatment in the replicate before the first cut or mowing (Johnson, 1992), fresh and dry weight of clipping (cutting) (g/m^2). In addition, rhizome's fresh and dry weight (g) were obtained. Chlorophylls and carotenoids content in fresh leaves (mg/100 g F.W.) was determined by the direct spectrophotometer method according to Brougham (1960) and Wellburn (1994). While, carbohydrates content in rhizome was determined by Smith *et al*. (1956) and Herbert *et al*. (1971) methods.

RESULTS AND DISCUSSION

1. Growth analysis of the two growing seasons:

a. Time taken to the complete covering:

Table (3) reveals that there is considerable variation in the number of days it takes from planting to full coverage using different growth media. The shortest time to complete coverage was observed on the plants which were grown in NSA$_{IV}$ (calcareous + sand + composted leaves at 1.5:1.5:1 v/v/v) as compared with the other media in the first and second seasons. While the longest period was taken to the complete covering obtained by using NSA$_{I}$ (100% calcareous soil in the 1st and 2nd seasons.

The data illustrated in Table (3) confirm that using an irrigation rate at 15.00 l/m^2 led to the shortest duration in number of days until full coverage. Table (3) shows that the interaction between natural soil amendments and irrigation rate was significant in the seasons of 2022 and 2023. It shows that the least period from planting to the complete covering (45.593 and 44.240 days) for both seasons was recorded on the treatment of NSA$_{IV}$ (calcareous + sand + composted leaves at 1.5:1.5:1 v/v/v) + irrigation rate at normal stress 15.00 l/m^2 in the two seasons, respectively. The opposite effect was noticed in the recorded data when the plants grown in a calcareous environment were subjected to severe water stress of 5.00 l/m2, resulting in values of 54.157 and 53.237 days in the first and second seasons, respectively. This phenomenon could be attributed to the use of a suitable growth medium along with the optimal irrigation level, leading to enhanced growth and activation of the root system. This, in turn, promotes the absorption of vital nutrients necessary for initiating growth and progress. Similar findings were also found by Khattab *et al.* (2002) on *Salvia splendens* plants and Kiani *et al*. (2008) on sunflower (*Helianthus annuus* L.). El-Naggar and El-Nasharty (2009) on *Hippeastrum vittatum*, Herb. and and Hassan *et al.* (2015) on *Paspalum vaginatum*, L.

b. Turfgrass height (cm):

Results revealed that the means for the height of Paspalum turfgrass (cm) were improved as a result of irrigation rates under different used media (Table, 3), the longest grass was obtained by using NSA$_{III}$ (calcareous + sand at 3:1 v/v) and/or NSA$_{IV}$ (calcareous + sand + composted leaves at 1.5:1.5:1 v/v/v). While shorter grass was obtained using 100% calcareous soil medium in both seasons. Receiving different rates of irrigation treatments revealed different trends in the height of paspalum turfgrass in both plantations. While applying either 10.00 or 15.00 l/m^2 rates during the growing seasons revealed significant effects on plant height in 1st and 2nd seasons. So, it was obvious that 15.00 l/m^2 was better than 10.00 l/m^2 and 5.00 l/m^2, these results agreed with Khattab *et al.* (2002) on *Salvia splendens* and El-Naggar *et al.* (2022) on *Mentha piperita* L. plants. The same results were mentioned by Razin and Omar (1994) on marigold. Regarding the interaction between growth media and irrigation treatments, it is clear from Table (3),

Table 3. Impact of natural soil amendments, rate of irrigation on time to the complete covering (day), turfgrass height (cm), fresh and dry weight (g/m^2) of *Paspalum vaginatum*, L. lawns during the two seasons of 2022 and 2023.

Natural soil amendments	Irrigation rate (l/m^2)	Time to the complete covering (day)		Turfgrass height (cm)		Fresh weight of clipping (g/m^2)		Dry weight of clipping (g/m^2)	
		1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
NSA$_I$	5.00	54.157	53.237	7.264	8.393	683.921	678.493	93.932	97.718
	10.00	53.343	51.049	8.625	7.611	693.821	697.298	111.435	109.739
	15.00	51.635	49.437	10.342	10.372	702.271	713.298	117.183	124.393
NSA$_{II}$	5.00	50.183	53.355	10.352	9.398	732.712	711.916	138.903	145.290
	10.00	48.661	50.774	9.881	10.633	751.816	773.616	142.073	153.298
	15.00	46.142	48.613	11.232	11.562	812.574	814.766	161.179	167.444
NSA$_{III}$	5.00	52.646	50.473	12.243	12.329	843.162	812.662	168.430	169.385
	10.00	51.075	49.315	11.343	12.392	911.417	913.710	178.395	180.487
	15.00	49.213	47.176	12.010	12.536	942.845	945.054	195.938	198.386
NSA$_{IV}$	5.00	49.534	52.000	11.646	12.372	913.037	954.391	185.283	182.42
	10.00	48.137	50.612	12.343	12.664	967.047	984.269	209.472	211.840
	15.00	45.593	44.240	13.393	13.412	982.412	997.133	219.037	223.947
LSD$_{0.05}$	NSA	1.254	1.347	0.471	0.331	2.059	1.764	3.293	3.821
	IR	1.254	1.347	0.471	0.331	2.059	1.764	4.110	4.110
	INT.	2.508	2.694	1.625	0.663	4.119	3.528	5.128	4.927

the great effect of plant reception grown in NSA$_{IV}$ (calcareous + sand + composted leaves at1.5:1.5:1 v/v/v) medium with 15.00 l/m^2 of irrigation treatment in both experimental field for increasing turfgrass height. The values reached 13.393 and 13.412 cm in both seasons, respectively. While the lowest value of that trait (7.264 and 8.393 cm) was obtained from using calcareous soil 100% (combine with 5.00 l/m^2 of irrigation rate in the first and second seasons, respectively). This increase in height can be traced back to changes in the soil's physical and chemical qualities caused by increasing organic matter and adding composted leaves. In addition, organic matter has beneficial effects on the media structure, its specific properties and the content of available microorganisms, which work to absorb nutrients and are important for the transport and availability of fine materials and contribute mainly to improving soil stability, fertility, improves the growth, especially the height. The finding is in line with those obtained by Ibrahim *et al*. (2016) on *Limonium sinuatum*, L. and El-Naggar *et al*. (2020) on *Gazania splendens* plants.

c. Fresh and dry weight of clipping (cutting) (g/m^2):

The results obtained indicated a significant improvement in the mean fresh and dry weight of clippings of *P. vaginatum*, L., when treated with different media and irrigation rates across two growth seasons. Analysis in Table (3) demonstrated notable variations in turfgrass fresh and dry weight based on the type of media used. The highest weights were recorded when the fourth medium, consisting of calcareous, sand, and composted leaves in a 1.5:1.5:1 ratio (v/v/v), was employed. Conversely, the lowest weight was observed when the first medium with calcareous soil was used in the initial and subsequent seasons. Data in Table (3). further illustrated that the combination of calcareous + sand + composted leaves (1.5:1.5:1 v/v) and normal stress (15.00 l/m^2) resulted in increased fresh (982.412 and 997.133 g/m^2) and dry weight of clippings (219.037 and 223.947 g/m^2) over the two seasons. This was followed by utilizing the same growing medium (NSA$_{IV}$) under moderate stress (10.00 l/m^2), which resulted in fresh weight (967.047 and 984.269 g/m^2) and dry weight (209.472 and 211.840 g/m^2) in the first and second seasons. NSA_I (calcareous soil 100%) with a severe stress irrigation rate of 5.00 l/m^2 resulted in the lowest fresh weight values (683.921 and 678.493 g/m^2) and dry weight values (93.932 and 97.718 g/m^2) in two consecutive seasons. Moreover, increasing stress to a moderate level with irrigation when plants were cultivated in a mixture of calcareous soil, sand, and composted leaves proved to be highly effective in achieving higher average fresh and dry weight values from clipping or cutting. This outcome could be attributed to the incorporation of composted leaves at an appropriate ratio, which enhanced soil properties and provided plants with essential minerals, thereby boosting vegetative growth indicators and subsequently increasing their weight. Similar findings have been reported by various researchers, such as El Hwary *et al*. (2011) in studies on wheat (*Triticum aestivum* L.), Mazher *et al.* (2012) on *Amaranthus tricolor,* El-Naggar *et al.* (2020) on *Gazania splendens*, Abdul-Hafeez *et al.* (2015) on *Gardenia jasminoides,* and Idrovo-Novillo *et al.* (2019) on rose plants.

d. Rhizome fresh and dry weight (g/m^2):

Table (4) demonstrated that media had a substantial impact on this characteristic, with compost medium proving superior for plantation in both experimental settings. It led to a significant increase in rhizome fresh and dry weight compared to other media used for cultivation. Analysis of the irrigation rates revealed a clear trend in the tabulated data, showing a marked increase in rhizome and dry weight when plants received the highest irrigation rate of 15.00 l/m^2 in both experimental trials. These results associated with the increment in the area of plant to the complete covering and turfgrass height (cm), fresh and dry weight of vegetative growth, it was obvious that by decreased irrigation rate to 5.00 l/m^{2,} plants suffered from water deficit, thus decrease in dry weight due to decreasing in the absorbed essential elements needed for plant growth and dry matter accumulation in rhizome. Data in Table (4) clarified that the effect of the interaction between growing media and irrigation rates significantly increased the total fresh and dry weight of rhizome of *Paspalum vaginatum,* L. lawns. The maximum amount resulted in treatment of NSA_{IV} plus 15.00 l/m^2 irrigation rate (378.892, 380.817and 84.898, 86.203 g/m^2) against 204.814, 208.150 and 25.833, 25.933 g/m^2 resulted from the lowest rate of irrigation (5.00 l/m^2) combined with applying the treatment of NSA_I (100% calcareous) for the 1st and 2nd seasons. These results are in agreement with those of Thabet *et al*. (1994) on onion and El-Naggar *et al*. (2004) with umbrella plant (*Cyperus papyrus*).

2. Photosynthetic pigments (mg/100 g L.F.W.) and carbohydrates content of rhizome (mg/g R.D.W.):

a. Photosynthetic pigments (mg/100 g L.F.W.):

Photosynthetic pigments of Paspalum leaves as affected by different media combined with irrigation rate were followed (Table, 5 and Fig., 1). In addition water stress affects the leaf stoma which is a pivotal gate controlling the exchange of carbon dioxide and water vapour, consequently affect photosynthesis process (Buckley, 2005).

The significant influence of utilizing Paspalum cultivated in a mix of calcareous soil, sand, and composted leaves (1.5:1.5:1 v/v/v) with a high irrigation rate of 15.00 l/m^2 was demonstrated through the soil amendments and irrigation methods. Chlorophyll a and b content in fresh leaves reached 257.806 and 259.384 mg/100 g F.W., while carotenoids content was 59.159 and 62.400 mg/100 g F.W. in the initial and subsequent seasons, respectively. Conversely, growing plants in pure calcareous soil (100%) with the lowest irrigation rate of 5.00 l/m^2 resulted in notably lower values of 32.937 and 31.446 mg/100 g F.W. in the first and second seasons. This enhancement is likely attributed to the combined effects of organic matter and an appropriate irrigation rate, stimulating growth and improving leaf production, leading to increased chlorophyll biosynthesis

Table 4. Impact of natural soil amendments, rate of irrigation on rhizome fresh and dry weight (g/m²) of *Paspalum vaginatum,* L. lawns during the two seasons of 2022 and 2023.

Natural soil amendments	Irrigation rate (l/m²)	Rhizome F. W. (g/m²) 1st season	Rhizome F. W. (g/m²) 2nd season	Rhizome D. W. (g/m²) 1st season	Rhizome D. W. (g/m²) 2nd season
NSA_I	5.00	204.814	208.150	25.833	25.933
	10.00	228.140	226.748	37.733	39.109
	15.00	233.510	228.733	54.953	55.064
NSA_{II}	5.00	330.246	336.347	67.866	68.408
	10.00	336.452	341.051	69.923	71.163
	15.00	350.202	248.207	80.273	82.705
NSA_{III}	5.00	344.948	350.035	37.320	35.763
	10.00	353.123	358.234	37.570	36.634
	15.00	361.271	365.261	74.656	78.766
NSA_{IV}	5.00	348.230	351.275	67.644	70.724
	10.00	369.817	372.593	71.493	78.334
	15.00	378.892	380.817	84.898	86.203
$LSD_{0.05}$	NSA	1.352	1.633	0.695	0.743
	IR	2.172	2.816	0.695	0.743
	INT.	3.218	3.277	1.389	1.446

Table 5. Impact of natural soil amendments and, rate of irrigation on total chlorophylls, carotenoides in fresh leaves content (mg/100 g L.F.W.) and total carbohydrates content in rhizome (mg/ g R.D.W.): of *Paspalum vaginatum,* L. lawns during the two seasons of 2022 and 2023.

Natural soil amendments	Irrigation rate (l/m²)	Total chlorophylls content (mg/100 g L.F.W.) 1st season	Total chlorophylls content (mg/100 g L.F.W.) 2nd season	Total carotenoides content (mg/100 g L.F.W.) 1st season	Total carotenoides content (mg/100 g L.F.W.) 2nd season	Total carbohydrates content (mg/g R.D.W.) 1st season	Total carbohydrates content (mg/g R.D.W.) 2nd season
NSA_I	5.00	181.526	179.772	32.937	31.446	143.795	138.255
	10.00	193.147	191.556	35.376	34.280	197.443	195.534
	15.00	208.589	204.933	35.985	34.566	215.168	220.172
NSA_{II}	5.00	197.130	198.761	37.333	36.849	226.119	228.330
	10.00	223.228	222.647	49124	47.3474	245.390	241.274
	15.00	219.782	217.804	46.830	45.126	261.239	268.832
NSA_{III}	5.00	199.575	197.601	41.7I0	40.782	217.933	217.734
	10.00	209.982	211.951	59.468	56.843	228.243	230.149
	15.00	256.106	258.952	59.019	58.195	259.226	251.537
NSA_{IV}	5.00	208.470	219.752	46.744	42.290	248.203	243.327
	10.00	233.622	235.862	58.846	59.467	254.531	257.569
	15.00	257.806	259.384	59.159	62.400	265.838	268.930
$LSD_{0.05}$	NSA	1.019	1.651	2.190	2.373	1.040	1.040
	IR	1.019	1.651	1.900	1.090	1.040	1.040
	INT.	2.137	2.750	3.103	3.140	1.650	1.650

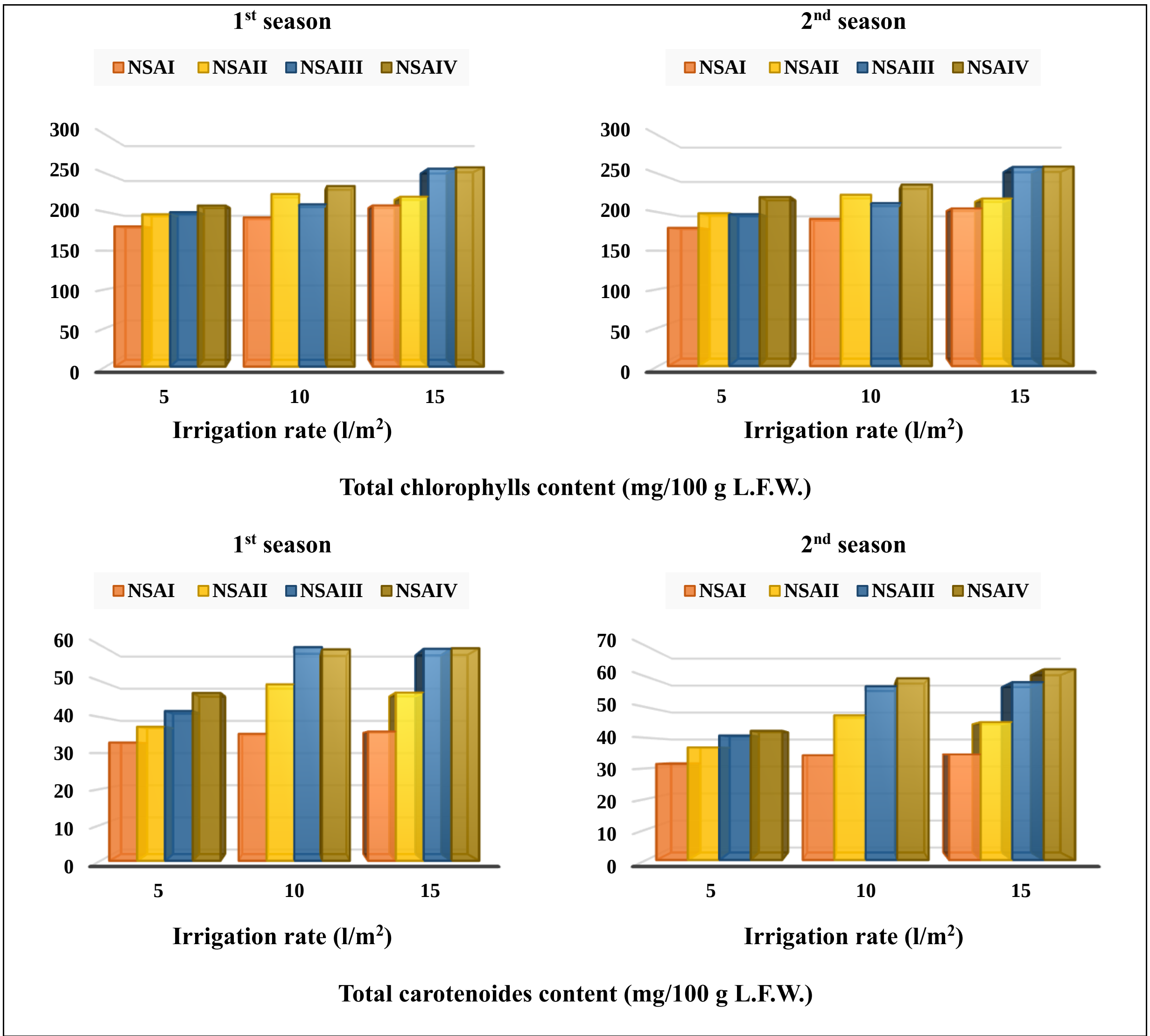

Fig. 1. Effect of natural soil amendments and rate of irrigation on total chlorophylls, carotenoides in fresh leaves content (mg/100 g L.F.W.) of *Paspalum vaginatum*,L. during the two seasons of 2022 and 2023.

and enhanced absorption of essential nutrient elements such as NH_4, P, Fe^{++}, and Mg^{++} cations. These elements play crucial roles in activating enzymes and forming chloroplasts and chlorophyll. Similar trend of results was found with Khalifa *et al.* (2002), Moeini *et al.* (2006) and El-Sobky *et al.* (2014). An increase in stomatal density and a decrease in leaf area under water stress, indicate some adaptive mechanisms for adapting to changing environmental conditions (Spence *et al.*, 1986; Martinez *et al.*, 2007).

b. Total carbohydrates content in rhizome (mg/g R.D.W.):

Receiving the plants, the highest rate (normal stress) 15.00 l/m^2 and/or moderate stress condition 10.00 l/m^2 of irrigation treatment increased total carbohydrates content in rhizome than that produced from the other treatments. It can be inferred from the data presented in the table that the combination of receiving plants cultivated in NSA_{IV} (calcareous + sand + composted leaves at 1.5:1.5:1 v/v/v) medium along with the highest irrigation rate of 15.00 l/m^2 had a significant impact. This particular treatment led to an increase in total carbohydrate content to 265.838 and 268.930 mg/g R.D.W. during the first and second seasons, respectively. Conversely, a contrasting effect was observed when plants were grown in NSA calcareous medium and received a lower irrigation rate of 5.00 l/m^2 (resulting in severe stress) in both seasons, as detailed in Table (5). These outcomes may be attributed to the appropriate irrigation rate aiding plants in absorbing water and essential nutrients required for chlorophyll production, thereby enhancing the synthesis of green pigments. consequently, higher chlorophyll content and consequently more carbohydrates production. These results were in agreement with those of Manoly (1989) on tuberose, El-Naggar *et al.* (2004) on *Cyperus papyrus*, L., and Abdou *et al*. (2018) on *Gladiolus grandifloras* cv. Peter Pears plants.

CONCLUSION

From the previous results, it could be concluded that mixing different types of media with compost led to improving its characteristics. So, as to achieve the main objective of the study to produce high-quality *Paspalum vaginatum,* L. lawns for different landscaping, it can be accomplished by growing in a mixture of calcareous + sand + composted leaves (1.5:1.5:1 v/v/v) with rate of irrigation water at 15.00 l/m^2.

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تأثير بعض محسنات التربة الطبيعية و الإحتياجات المائية علي النمو والمحتوى الكيماوى لبعض المسطحات الخضراء (الباسبالم *Paspalum vaginatum,* L)

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الهدف من هذه الدراسة هو إمكانية تحسين خواص التربة الجيرية بإضافة إثنان من محسنات التربة الطبيعية (الرمل، الكمبوست النباتي) بنسب مختلفة ممثلة فى التربة الجيرية فقط ، التربة الجيرية + الكمبوست النباتي (٣:١ حجم/حجم)، التربة الجيرية + الرمل (٣:١ حجم/حجم) و تربة جيرية + تربة رملية + الكمبوست النباتي (١,٥:١,٥:١,٠ حجم/حجم/حجم) وثلاث معدلات من ماء الري (٥ ، ١٠ و ١٥ لتر/م٢) على النمو والمحتوى الكيماوى للمسطح الأخضر الباسباليم *Paspalum vaginatum,* L. الذي يعتبر أحد إعشاب الموسم الدافئ. نفذت التجربة في قطع منشقة بثلاث مكررات وكانت انوع البيئات الثلاثة تمثل عامل القطعة الرئيسية main-plot ، في حين كانت معدلات الري أو الإجهاد المائي هي عامل القطع الفرعية sub-plot. تحققت أفضل النتائج لمعاملات التفاعل بين أنواع بيئات النمو ممثلة في البيئة المكونة من تربة جيرية + تربة رملية + الكمبوست النباتي (١,٥:١,٥:١,٠ حجم/حجم/حجم) مع الري بمعدل ١٥ لتر/م٢ حيث اعطت أقل فترة زمنية للوصول إلى التغطية الكاملة (٤٤,٩١٦ يوم) وأعلى زيادة معنوية في الوزن الرطب (٩٨٩,٥٧٢ جم/م٢) والجاف (٢٢١,٤٩٢ جم/م٢) للمجموع الخضري وكذلك أعطت أعلى زيادة في الوزن الطازج للريزومات (٣٧٩,٨٥٤ جم/م٢) وكذلك الوزن الجاف (٨٥,٥٥١ جم/م٢). وتحققت أعلى زيادة معنوية في محتوى الاوراق الطازجة من الكلوروفيلات الكلية (أ + ب) بمتوسط ٢٥٨,٥٩٥ ملجم/١٠٠ جم والكاروتينات ٦٠,٧٧٩ ملجم/١٠٠ جم، كذلك محتوى الريزومات من الكربوهيدرات بمتوسط ٢٦٧,٣٨٤ ملجم/جم والتي تحصل عليها باستخدام المعدل العالي من ماء الري (١٥ لتر/م٢) مع بيئة النمو المكونة من التربة الجيرية + التربة الرملية + الكمبوست النباتي (١,٥:١,٥:١,٠ حجم/حجم/حجم). كما أشارت نتائج الدراسة أيضاً إلى أن من محسنات التربة الطبيعية (الرمل، الكمبوست النباتي) تقلل من الآثار الضارة للإجهاد ويحسن مقاومة النبات للإجهاد المائي وذلك عند استخدام الإجهاد المعتدل أو الري بمعدل ١٠ لتر/م٢. ومن نتائج الدراسة يمكن التوصية بزراعة المسطح الأخضر الباسباليم *Paspalum vaginatum,* L. في بيئة النمو المكونة من تربة جيرية + تربة رملية + الكمبوست النباتي (١,٥:١,٥:١,٠ حجم/حجم/حجم) مع الري بمعدل ١٠ لتر/م٢ (الإجهاد المعتدل) أو ١٥ لتر/م٢ و ذلك للحصول على مسطح أخضر عالي الجودة.