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LANDSCAPE STUDIES ON SOME RESORTS GARDENS IN THE WEST NORTH COAST

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ABSTRACT: This experiment was carried out during two successive growing seasons of 2019 and 2020 from January to April, on the North coast of Egypt at Marsa Matroh Governorate, Sidi Abd-Alrahman Gulf, 130 km from Alexandria and 193 km from Matroh in a Multinational real estate company resort (Marassi) to examine the extent to which the international compliance obligation is applicable under Egyptian conditions (in the North-Western Coast tourist resorts) as well as studying the new plants used in landscaping and the best standards in the landscape constructions. The experiment was carried out where 108 plants representing 6 plant species were used, each plant variety represented by 18 individuals, then divided the number of plants into two halves, the first one was placed in an open area exposed to winds from all sides without any cover and the second half was placed in an area protected from the direct influence of the winds. The plants of each half were divided into three groups, the first group was cultivated in white sea sand, the second one was cultivated in loamy soils and the third one was cultivated in clean red soil. With reference to the landscape survey at the site, three usual plant varieties were used, namely *Nerium oleander*, *N. oleander* 'Petite Salmon' and *Bougainvillea sanderiana* comparing them with three new varieties, namely, *Bougainvillea* 'California Gold', *Lantana camara* and *Lantana* × *money*. The experimental layout was designed to provide a split-split plot design containing three replicates. The main plot was the wind exposure, different media represented subplots, while different species were the sub-subplot. Three pots were used as a plot for each treatment. The results of this study showed that the type of soil used, as well as the influence of climatic changes, the most important of which is wind, plays an important role in the morphological characteristics of various ornamental plants in the northern coastal region. The cultivar *Bougainvillea* 'California Gold' excelled in the different characteristics of plant height, leaf area, number of branches and leaves, and the percentage of chlorophyll in the leaves, under all the conditions used, including the influence of soil and wind types.

Keywords: climate change, ornamental plants, soil types, white sea land and red soils.

INTRODUCTION

Coastal regions represent unique areas of interaction between land and ocean, characterized by rapid economic growth and high population density (Zhang *et al*., 2020). Given the extent of changes in natural and anthropogenic processes in such areas over the past few decades, there has been a serious impact on the composition and structure of landscapes and ecological functions at the local, regional and global levels (Li *et al*., 2017 a and b and Zhou *et al*., 2018). Coastal landscapes around the world have undergone changes over the past decades due to the intensive development and use of coastal areas. In recent years, many researchers interested in understanding the causes, processes, and consequences of landscape change at different scales (Bertolo *et al.*, 2012; Plieninger *et al*., 2016; You, 2017; Li *et al*., 2018 and Wu *et al*., 2019). These changes in coastal landscapes are triggered by ongoing interactions between climate change (such as droughts, floods, and sea level rise), urbanization, industrialization, and agricultural intensification and the attendant large-scale changes in land use and land cover. These changes have caused a series of environmental problems, including pollution, deterioration of ecosystem health, resource depletion, soil degradation, reduction of primary productivity, loss of biodiversity, etc... (Cao and Wong, 2007; Johnson and Zuleta, 2013 and Cao *et al*., 2017). In Egypt, the Mediterranean coast is a tourist destination, due to the mild weather and natural sites, which are considered the most important investment resources for more tourism and economic activities that attract a number of tourists (Hegazy and El-Bagouri, 2002). Overall, the current studies mainly focused on the landscape changes in various local/specific coastal areas. However, studies that synthesize broader landscape change processes at the country/continental scale have not been carried out (Plieninger *et al*., 2016). Kefalas *et al.* (2019) found that geomorphological, bioclimatic, and natural disaster variables were related to changes to the natural vegetation zone in Mediterranean islands. It should be noted that land use and land cover change, natural variations as well as human activities factors can distinctively affect ecological processes within the coastal landscape and featured in the conversion of landscape pattern (Tanner and Fuhlendorf, 2018). In Egypt, the average wind speed in winter could reach 18.5 km/h, Thus the vegetative cover and landscape role is very crucial in controlling and alleviating the intense heat, particularly when combined with dry wind meaning that landscape is not a luxury since it has an environmental effect due to the weather nature in the coast.

Changes in climate patterns are dramatically influencing some agricultural areas. Arid, semi-arid and coastal agricultural areas are especially vulnerable to climate change impacts on soil salinity (Nadeem *et al*., 2013; Hasanuzzaman *et al*., 2018). Salinity affects about one-third of irrigated land, causing a significant reduction in crop productivity, for this reason, researchers have paid considerable attention to this important environmental problem over the last decades. Few studies, however, have dealt specifically with ornamental plants used in landscapes, despite the fact that salt stress causes serious damage to these species. In general, plants are susceptible to salinity during the seedling and early vegetative growth stage. Salinity also affects phytohormones which are naturally occurring organic substances, influencing physiological processes at low concentrations either in distant tissues to which they are transported or in the tissue where synthesis occurred (Davies, 2010). Paraskevopoulou *et al.* (2020) have demonstrated that *Lavandula stoechas* was the first to exhibit salinity stress symptoms among four studied lavender genera. Although *L. stoechas* seedlings stayed alive, their exposition to 100 and 200 mM NaCl resulted in apparent damage, starting with chlorosis and marginal leaf necrosis.

Ornamental plants have an important place within the horticultural industry as they are used in gardening, landscaping, and as cut flowers (Azadi *et al*., 2016). Ornamental plants are classified depending on their tolerance to salinity (Mazher Azza *et al*., 2007). The representatives of genera *Dahlia* spp., *Lilium* spp. and *Rosa* spp. (up to 2 dsm^{-1}) proved to be most sensitive to salt stress and the species *Chrysanthemum* spp. and *Dianthus caryophyllus* (up to 6 dsm^{-1}) were found to be tolerant. In Bulgaria, certain studies were carried out on the influence of salinity on the decorative effect and growth of chrysanthemum (*Chrysanthemum indicum* L.) (Ivanova *et al*., 1999). So, the main objective of the present investigation was to examine the extent to which the international compliance obligation is applicable under Egyptian conditions (in The North-Western Coast tourist resorts) as well as study the new plants used in landscaping and the best standards in the landscape constructions.

MATERIALS AND METHODS

Experimental location:

The experimental work was carried out during two successive growing seasons of 2019 and 2020 from January to April, in Egypt North Coast at Marsa Matroh Governorate Sidi Abd-Alrahman Gulf, 130 km from Alexandria and 193 km from Matroh in Multinational Real Estate Company Resort (Marassi) owned to Emaar Misr. The beach is 6310 meters long (2810 meters on the Mediterranean Sea and 3500 meters on Sidi Abd El-Rahman Gulf). Resort's average width is 1000 meters. The resort borders an unspoiled beach and the glistening sapphire water of Sidi Abd El-Rahman.

Meteorological data:

The meteorological data for the two seasons are presented in Table (1). These included temperatures (°C), relative humidity (%), precipitation (in) and wind speed (km/h). These data were obtained from www.wunderground.com.

Soil analysis:

Table (2) shows the analysis of the three soil types used in this experiment. Soil samples were analyzed in the Soil and Water Laboratory, Fac. Agric. Sci., Alexandria Univ., Egypt. To collect samples, 3 different depths were used for each soil type at 0, 0-30 and 30- 60 cm depth from the soil surface.

Table 1. Meteorological data of the experimental region during 2019 and 2020 seasons.

Months	Temperature (°C) Min.		Temperature (°C) Max.		Relative humidity (%) Min.		Relative humidity (%) Max.		Precipitation (in)		Wind speed (km/h)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
January	9.0	7.2	18.0	17.0	46.0	53.0	88.00	88.0	0.0	1.0	10.60	10.60
February	9.0	8.3	21.0	18.8	44.0	42.0	90.0	82.0	1.0	1.0	8.94	8.94
March	9.5	9.0	25.0	20.9	47.0	44.0	88.0	85.0	0.0	0.0	9.53	9.53
April	16.0	12.7	27.0	23.0	39.0	43.5	82.0	83.0	0.0	0.0	9.07	9.07
May	22.0	17.0	33.0	28.3	39.0	36.0	80.0	81.0	0.0	0.0	9.14	9.14
June	21.0	20.0	32.0	29.0	49.0	44.0	79.0	81.0	0.0	0.0	9.37	9.37
July	22.0	20.0	33.0	31.0	41.0	49.0	80.0	84.0	0.0	0.0	10.20	10.20
August	27.0	25.0	33.0	32.0	50.0	54.0	82.0	82.0	0.0	0.0	9.85	9.85
September	26.0	24.4	32.0	31.6	48.0	45.0	75.0	79.0	0.0	0.0	8.77	8.77
October	22.0	19.0	34.0	30.0	50.0	47.0	87.0	82.0	0.0	0.0	7.20	7.20
November	18.0	16.0	30.0	23.0	41.0	43.0	84.0	82.0	1.0	0.1	10.60	7.82
December	19.0	17.0	24.0	21.6	50.0	44.0	86.0	87.0	1.0	1.0	8.94	6.59

Table 2. Planting soil analysis.

Planting soil	pH	E.C. (ppm)	E.C. (ds/m)	Soluble cations (meq/l)			Soluble anions (meq/l)			
				Na^+	Ca^{++}	Mg^{++}	CO_3^{--}	HCO_3^{--}	Cl^-	SO_4^{--}
Red soil	7.86	1580	2.48	13.3	6.0	3.5	0	6.5	28.5	10.2
White sea sand	8.34	44720	55.9	112.3	65.3	13.5	0	8.3	12.4	26.8
Loamy soil	7.9	473	0.74	3.8	2.5	1.5	0	1.0	4.5	1.9

Experiment procedure:

The experiment was carried out where 108 plants representing 6 plant species were used, each plant variety represented by 18 individuals, then divided the number of plants into two halves, the first one was placed in an open area exposed to winds from all sides without any cover and the second half was placed in an area protected from the direct influence of the winds. The plants of each half were divided into three groups, the first group was cultivated in white sea sand, the second one was cultivated in loamy soils and the third one was cultivated in clean red soil.

With reference to the landscape survey at the site, three usual plant varieties were used at Marassi Resort, namely *Nerium oleander*, *Nerium oleander* 'Petite Salmon' and *Bougainvillea sanderiana*. compared them with three new varieties, namely, *Bougainvillea* 'California Gold', *Lantana camara* and *Lantana* × *money*.

Data recorded:

At the end of this study the following data were recorded: plant height (cm), plant spread (cm), number of leaves/plant, number of branches/ plant, leaf area (cm^2) and leaves total chlorophyll (SPAD).

Statistical procedures:

The experimental layout was designed to provide a split-split plot design containing three replicates. The main plot was the wind exposure (2 treatments), different media (3 types) represented subplots, while different species (6 species) were the sub-subplot. So, this study contained 36 treatments, three pots were used as a plot for each treatment. The means of the individual factors and their interactions were compared by the L.S.D. test at 5% level of probability (Gomez and Gomez, 1984) using SAS 9.1 (2002).

RESULTS AND DISCUSSION

1. Plant height (cm):

Data presented in Table (3) showed the main effects of winds, soil types and different types of plants, and its results showed that the wind had a significant effect on plant height, as the tallest plants were recorded in the areas directly exposed to winds in both seasons (29.75 and 29.84 cm), respectively. The results also showed the influence of soil types as there were non-significant differences between red soil and loamy soil, and they recorded the highest plant height than white sea sand in both seasons (29.88 and 30.14 cm), respectively. However, the cultivars had a clear effect on plant height, *Nerium oleander* and *Bougainvillea* 'California Gold', showed the tallest plants, while the cultivar *Lantana* × *money* recorded the shortest plants in both studied seasons (9.92 and 9.68 cm), respectively.

For the effect of the interaction between soil and wind types, the results from Table (4) showed that the interaction between wind and soil types was significant in both seasons so plants in the open wind with white sea sand soil recorded the tallest plants (32.25 and 32.15 cm) in both seasons, respectively.

Considering the effect of the interaction between different plant types and the influence of the wind, the results presented in Table (5) indicated that the tallest plants were obtained by the cultivar *Bougainvillea* 'California Gold' cultivated in the open wind as recorded 44.84 and 45 cm, in both studied seasons, while the cultivar *Lantana* × *money* recorded the shortest plants in the open wind (10.19 and 10.07 cm), and in the area protected from the wind as recorded 9.66 and 9.29 cm, in both seasons, respectively.

Table (6) showed the effect of the interaction between the types of soil used and the different species on plant height, the results showed that *Bougainvillea* 'California Gold' with white sea sand recorded the tallest plants in the two seasons (45.02 and 45.50 cm, respectively), the same species also recorded high plant height in the loamy soil in both seasons (44.68 and 43.16 cm, respectively), also for the red soil, the cultivar *Bougainvillea* 'California Gold' recorded the tallest plants in the first season

Table 3. Mean performance of measured characters (plant height, plant spread, number of leaves/plant, number of branches/ plant, leaf area and leaves total chlorophyll) as affected by wind, soil types and different species in 2019 and 2020 seasons.

Factors	Plant height (cm)		Plant spread (cm)		No. of leaves/plant		No. of branches/ plant		Leaf area (cm^2)		Leaves total chlorophyll (SPAD)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Effect of wind												
Open wind	29.75	29.84	20.15	22.58	95.66	93.96	4.22	4.50	6.44	7.36	37.34	43.99
Area protected from wind	28.05	27.92	15.56	18.63	102.42	100.25	4.88	5.27	4.00	4.36	36.78	43.55
$L.S.D._{0.05}$	0.93	0.71	0.81	0.92	8.62	8.42	0.29	0.30	0.54	0.63	1.53	1.87
Effect of soil type												
White sea sand	29.88	30.14	19.31	22.78	115.41	112.50	4.19	4.55	5.71	6.26	36.81	43.75
Red soil	28.16	28.51	19.15	21.77	102.27	101.13	5.05	5.33	5.07	5.75	37.15	43.62
Loamy soil	28.65	27.99	15.09	17.26	79.44	77.69	4.41	4.77	4.88	5.57	37.22	43.93
$L.S.D._{0.05}$	1.15	0.87	0.99	1.13	10.56	10.32	0.36	0.37	0.66	0.78	1.87	2.29
Effect of different species												
N. oleander	39.03	42.16	25.81	26.51	82.66	80.88	3.88	3.94	7.27	8.04	41.31	48.49
***N. oleander* 'Petite Salmon'**	34.78	33.50	14.54	17.46	77.83	76.16	4.50	4.72	4.82	5.56	38.13	44.95
B. sanderiana	35.01	34.50	10.42	12.69	63.00	61.55	2.33	2.33	5.51	6.29	40.74	47.70
***B. sp.* 'California Gold'**	43.10	42.38	32.25	39.33	249.77	245.50	6.88	7.55	5.12	5.69	34.05	40.44
L. camara	11.54	11.06	10.30	12.44	65.11	63.72	5.33	5.944	4.21	4.66	32.92	39.12
L. × money	9.92	9.68	13.81	15.20	55.88	54.83	4.38	4.83	4.40	4.93	35.21	41.93
$L.S.D._{0.05}$	1.10	0.81	1.25	1.41	16.04	15.64	0.59	0.64	0.52	0.60	2.55	2.95

Table 4. The interaction between wind and soil types for measured characters (plant height, plant spread, number of leaves/ plant, number of branches/ plant, leaf area and leaves total chlorophyll) in 2019 and 2020 seasons.

Wind	Soil types	Plant height (cm)		Plant spread (cm)		No. of leaves/ plant		No. of branches/ plant		Leaf area (cm^2)		Leaves total chlorophyll (SPAD)	
		2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Open wind	White sea sand	32.25	32.15	22.40	25.64	113.50	110.27	3.94	4.50	7.03	7.80	36.46	43.71
	Red soil	28.43	29.02	21.13	23.18	100.83	100.44	5.05	5.16	7.00	8.06	37.37	44.21
	Loamy soil	28.56	28.34	16.92	18.91	72.66	71.16	3.67	3.83	5.29	6.22	38.20	44.07
Area protected from wind	White sea sand	27.51	28.14	16.22	19.92	117.33	114.72	4.44	4.61	4.39	4.72	37.16	43.79
	Red soil	27.89	28.00	17.17	20.37	103.72	101.83	5.05	5.50	3.14	3.44	36.93	43.05
	Loamy soil	28.74	27.63	13.27	15.62	86.22	84.22	5.17	5.72	4.46	4.92	36.25	43.80
$L.S.D._{0.05}$		1.62	1.23	1.40	1.59	14.94	14.59	0.51	0.53	0.94	1.10	2.65	3.25

Table 5. The interaction between wind and different species for measured characters (plant height, plant spread, number of leaves/ plant, number of branches/ plant, leaf area and leaves total chlorophyll) in 2019 and 2020 seasons.

Wind	Different species	Plant height (cm)		Plant spread (cm)		No. of leaves/ plant		No. of branches/ plant		Leaf area (cm^2)		Leaves total chlorophyll (SPAD)	
		2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Open wind	*N. oleander*	39.24	42.22	31.98	29.66	82.44	81.11	3.55	3.55	8.84	10.05	43.32	50.93
	N. oleander 'Petite Salmon'	34.20	33.00	13.98	17.05	74.88	73.33	4.88	5.22	5.37	6.44	41.53	49.04
	B. sanderiana	35.66	35.00	9.92	12.10	47.55	46.33	2.22	2.22	7.09	8.26	40.72	47.65
	B. sp. 'California Gold'	44.84	45.00	38.08	46.44	275.22	271.11	6.00	6.33	6.17	6.91	30.33	35.95
	L. camara	14.36	13.75	11.00	13.37	54.55	53.33	5.11	5.88	6.01	6.69	33.14	39.12
	L. × *money*	10.19	10.07	15.95	16.84	39.33	38.55	3.55	3.77	5.16	5.82	35.01	41.27
Area protected from wind	*N. oleander*	38.82	42.11	19.65	23.37	82.88	80.66	4.22	4.33	5.70	6.02	39.31	46.05
	N. oleander 'Petite Salmon'	35.36	34.00	15.09	17.86	80.77	79.00	4.11	4.22	4.27	4.68	34.73	40.85
	B. sanderiana	34.36	34.00	10.92	13.29	78.44	76.77	2.44	2.44	3.93	4.32	40.75	47.75
	B. 'California Gold'	41.36	39.77	26.42	32.22	224.33	219.88	7.77	8.77	4.06	4.47	37.78	44.93
	L. camara	8.72	8.38	9.60	11.51	75.66	74.11	5.55	6.00	2.41	2.63	32.71	39.12
	L. × *money*	9.66	9.29	11.67	13.55	72.44	71.11	5.22	5.88	3.63	4.03	35.40	42.58
$L.S.D._{0.05}$		1.55	1.14	1.77	2.00	22.69	22.11	0.84	0.90	0.74	0.85	3.61	4.17

Table 6. The interaction between soil types and different species for measured characters (plant height, plant spread, number of leaves/plant, number of branches/ plant, leaf area and leaves total chlorophyll) in 2019 and 2020 seasons.

Soil types	Different species	Plant height (cm)		Plant spread (cm)		No. of leaves/ plant		No. of branches/ plant		Leaf area (cm^2)		Leaves total chlorophyll (SPAD)	
		2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
White sea sand	*N. oleander*	41.12	43.16	26.95	28.13	96.66	93.66	4.33	4.50	9.67	10.24	42.57	48.65
	N. oleander 'Petite Salmon'	35.53	34.33	14.35	17.58	96.00	93.66	4.00	4.16	4.84	5.24	38.23	43.88
	B. sanderiana	36.67	37.33	11.69	14.26	71.00	69.50	2.33	2.33	6.28	6.97	40.65	48.11
	B. sp. 'California Gold'	45.02	45.50	39.77	48.50	310.66	302.83	6.33	7.16	5.07	5.72	33.41	40.98
	L. camara	13.52	13.00	11.38	13.87	84.83	82.83	5.83	6.83	4.58	5.12	31.40	38.52
	L. × *money*	7.42	7.55	11.76	14.34	33.33	32.50	2.33	2.33	3.81	4.29	34.63	42.38
Red soil	*N. oleander*	36.07	42.66	24.45	25.83	88.83	86.33	3.83	3.83	7.18	8.16	38.84	47.73
	N. oleander 'Petite Salmon'	36.40	35.00	13.49	16.28	82.50	80.50	5.83	5.83	6.01	7.07	37.13	45.05
	B. sanderiana	33.15	32.17	7.12	8.65	64.50	62.66	1.83	1.83	4.29	4.96	41.01	47.67
	B. sp. 'California Gold'	39.60	38.50	36.08	44.00	257.66	258.16	8.83	9.50	4.68	5.07	36.24	41.43
	L. camara	12.13	11.58	11.84	14.08	49.16	48.66	4.17	4.33	4.05	4.41	34.22	39.10
	L. × *money*	11.61	11.16	21.93	21.81	71.00	70.50	5.83	6.67	4.22	4.83	35.44	40.78
Loamy soil	*N. oleander*	39.91	40.67	26.04	25.59	62.50	62.66	3.50	3.50	4.93	5.71	42.52	49.10
	N. oleander 'Petite Salmon'	32.41	31.17	15.76	18.51	55.00	54.33	3.67	4.17	3.60	4.37	39.03	45.91
	B. sanderiana	35.20	34.00	12.45	15.18	53.50	52.50	2.83	2.83	5.59	6.94	40.56	47.33
	B. sp. 'California Gold'	44.68	43.16	20.91	25.50	181.00	175.50	5.50	6.00	5.60	6.28	32.51	38.91
	L. camara	8.97	8.62	7.67	9.36	61.33	59.67	6.00	6.67	4.01	4.45	33.16	39.74
	L. × *money*	10.74	10.33	7.74	9.44	63.33	61.50	5.00	5.50	5.16	5.67	35.57	42.62
$L.S.D._{0.05}$		1.91	1.40	2.17	2.49	27.79	27.08	1.03	1.11	0.91	1.05	4.42	5.10

(39.60 cm), and *Nerium oleander* recorded the tallest plant in the second one (42.66 cm), while the new cultivar *Lantana* × *money* recorded the shortest plants in all soil types used in both seasons.

Table (7) showed the interaction between exposure to wind, soil type and different plant species, it cleared that the cultivar *Bougainvillea* 'California Gold' recorded the tallest plants in the two studied seasons, in all types of soil used under the influence of open wind. Also, *Nerium oleander* recorded the tallest plants in the second season in red soil with the open area (42.00 cm), while the cultivar *Lantana* × *money* recorded the shortest plants in all soil types used under open area. For the interaction between the different species with area protected from the wind with different soils, *Bougainvillea* 'California Gold' cultivar recorded the tallest plants in the white and loamy soils (41.60, 40.00, 46.45 and 44.69 cm) in the two studied soils, respectively, while the cultivar *Nerium oleander* 'Petite Salmon' recorded the tallest plants in the red soil (38.13 and 36.67 cm), respectively in both seasons. These results were in agreement with those obtained by Iverson (1988), Archer (1994), Briggs *et al.* (2002) and Briggs *et al.* (2005), on North America.

2. Plant spread (cm):

Table (3) showed that the wind had a significant effect on plant spread, as the highest plant spread was recorded in the open wind in both seasons (20.15 and 22.58 cm, respectively). Also, there were non-significant differences between white and red soils as recorded the highest values, while the lowest values for plant spread were obtained by loamy soil in both seasons (15.09 and 17.26 cm, respectively). However, the cultivars had a clear effect on plant spread, the cultivars *Bougainvillea* 'California Gold' and *Nerium oleander*, gave the highest values for plant spread in both seasons (32.25, 39.33, 25.81 and 26.51 cm, respectively), while the cultivar *Lantana camara* recorded the lowest value of plant spread on both seasons (10.30 and 12.44 cm, respectively).

Table (4) showed that the plants in the open wind with white sea sand soil recorded the highest values of plant spread in both seasons (22.40 and 25.64 cm, respectively), while, in the area protected from the wind the highest values of plant spread with red soil in both seasons (17.17 and 20.37 cm, respectively) were recorded.

Considering, Table (5) indicated that the highest plant spread was the cultivar *Bougainvillea* 'California Gold' in the open wind (38.08 and 46.44 cm) in both studied seasons, while the cultivar *Bougainvillea sanderiana* recorded the lowest plant spread (9.92 and 12.10 cm) in the open wind, and in the area protected from the wind the *Lantana camara* recorded the lowest values in both seasons (9.60 and 11.51 cm, respectively).

Table (6) showed that *Bougainvillea* 'California Gold' with white sea sand recorded the highest plant spread in both seasons (39.77 and 48.50 cm, respectively), the same species also recorded a high plant spread in the red soil in both seasons (36.08 and 44.00 cm respectively), but the cultivar *Nerium oleander* recorded the highest plant spread in the loamy soil in both seasons (26.04 and 25.59 cm), while lantana cultivars recorded the lowest plant spread in all soil types used in both seasons in the open area.

Table (7) showed that the cultivar *Bougainvillea* 'California Gold' recorded the highest plant spread in the two studied seasons, with white sea sand (49.20 and 60.00 cm) and red soils (42.64 and 52.00 cm), but, in loamy soil the *Nerium oleander* recorded the highest plant spread with open air in both seasons (33.62 and 30.66 cm, respectively). However, the two cultivars of *Lantana* recorded the lowest plant spread values in all soil types. Whereas, in the area protected from the wind, *Bougainvillea* 'California Gold' cultivar recorded the highest plant spread in the white sea sand, red and loamy soils in the two studied seasons. While the two Lantana cultivars

Table 7. The interaction between wind, soil types and different species for measured characters (plant height, plant spread, number of leaves/plant, number of branches/ plant, leaf area and leaves total chlorophyll) in 2019 and 2020 seasons.

Wind	Soil	Different species	Plant height (cm)		Plant spread (cm)		No. of leaves/ plant		No. of branches/ plant		Leaf area (cm^2)		Leaves total chlorophyll (SPAD)	
			2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Open wind	White sea sand	*N. oleander*	43.68	42.00	33.69	31.00	95.66	92.66	4.00	4.00	12.48	13.39	44.05	50.06
		N. oleander 'Petite Salmon'	35.02	34.00	14.35	17.50	73.66	71.66	3.33	3.66	5.85	6.55	41.80	47.50
		B. sanderiana	43.76	43.33	9.02	11.00	46.33	45.33	2.33	2.33	8.04	9.14	39.92	46.96
		B. sp. 'California Gold'	48.45	51.00	49.20	60.00	342.33	332.33	6.00	7.00	6.18	7.02	31.99	40.50
		L. camara	14.56	14.00	14.07	17.16	82.33	80.00	5.67	7.66	6.67	7.46	30.33	38.40
		L. × money	8.04	8.56	14.10	17.20	40.66	39.67	2.33	2.33	2.94	3.26	30.70	38.86
	Red soil	*N. oleander*	34.44	42.00	28.62	27.33	83.66	81.67	3.33	3.33	10.03	11.41	39.47	49.96
		N. oleander 'Petite Salmon'	34.66	33.33	14.67	17.90	95.66	93.67	7.67	7.67	6.86	8.26	39.05	48.16
		B. sanderiana	31.64	31.00	7.13	8.70	53.66	52.33	1.33	1.33	6.15	7.22	38.79	45.63
		B. sp. 'California Gold'	43.15	42.33	42.64	52.00	306.00	309.00	8.33	8.33	6.13	6.81	34.02	38.66
		L. camara	14.22	13.50	8.72	10.50	32.00	32.00	4.67	4.66	5.94	6.60	35.07	39.85
		L. × money	12.48	12.00	25.00	22.66	34.00	34.00	5.00	5.66	6.91	8.09	37.81	42.96
	Loam soil	*N. oleander*	39.61	42.66	33.62	30.66	68.00	69.00	3.33	3.33	4.00	5.34	46.43	52.76
		N. oleander 'Petite Salmon'	32.93	31.66	12.92	15.76	55.33	54.67	3.67	4.33	3.39	4.52	43.75	51.46
		B. sanderiana	31.58	30.66	13.61	16.60	42.66	41.33	3.00	3.00	7.08	8.41	43.47	50.36
		B. sp. 'California Gold'	42.91	41.66	22.41	27.33	177.33	172.00	3.67	3.66	6.21	6.90	24.97	28.70
		L. camara	14.30	13.75	10.20	12.44	49.33	48.00	5.00	5.33	5.43	6.03	34.04	39.13
		L. × money	10.05	9.66	8.74	10.66	43.33	42.00	3.33	3.33	5.65	6.13	36.54	42.00

Continued

Table 7. Continued.

Wind	Soil	Different species	Plant height (cm)		Plant spread (cm)		No. of leaves/ plant		No. of branches/ plant		Leaf area (cm^2)		Leaves total chlorophyll (SPAD)	
			2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Area protected from wind	White sea sand	*N. oleander*	38.57	44.33	20.20	25.26	97.66	94.66	4.67	5.00	6.87	7.08	41.09	47.23
		N. oleander 'Petite Salmon'	36.05	34.67	14.36	17.66	118.33	115.66	4.67	4.66	3.82	3.94	34.67	40.26
		B. sanderiana	29.58	31.33	14.36	17.52	95.66	93.66	2.33	2.33	4.53	4.80	41.38	49.26
		B. 'California Gold'	41.60	40.00	30.34	37.00	279.00	273.33	6.67	7.33	3.97	4.41	34.83	41.46
		L. camara	12.48	12.00	8.68	10.59	87.33	85.66	6.00	6.00	2.49	2.79	32.47	38.65
		L. × money	6.81	6.55	9.41	11.48	26.00	25.33	2.33	2.33	4.69	5.32	38.56	45.90
	Red soil	*N. oleander*	37.70	43.33	20.93	24.33	94.00	91.00	4.33	4.33	4.33	4.92	38.22	45.50
		N. oleander 'Petite Salmon'	38.13	36.67	12.32	14.67	69.33	67.33	4.00	4.00	5.17	5.87	35.22	41.93
		B. sanderiana	34.67	33.33	7.10	8.60	75.33	73.00	2.33	2.33	2.43	2.70	43.24	49.70
		B. 'California Gold'	36.05	34.67	29.52	36.00	209.33	207.33	9.33	10.66	3.23	3.33	38.45	44.20
		L. camara	10.05	9.67	14.96	17.67	66.33	65.33	3.67	4.00	2.16	2.23	33.38	38.36
		L. × money	10.74	10.33	18.86	20.96	108.00	107.00	6.67	7.66	1.53	1.58	33.06	38.60
	Loam soil	*N. oleander*	40.21	38.67	18.46	20.52	57.00	56.33	3.67	3.67	5.90	6.08	38.62	45.43
		N. oleander 'Petite Salmon'	31.89	30.67	18.60	21.26	54.66	54.00	3.67	4.00	3.82	4.22	34.31	40.36
		B. sanderiana	38.82	37.33	11.28	13.76	64.33	63.66	2.66	2.66	4.82	5.48	37.65	44.30
		B. 'California Gold'	46.45	44.69	19.40	23.67	184.66	179.00	7.33	8.33	4.99	5.67	40.06	49.13
		L. camara	3.64	3.50	5.15	6.28	73.33	71.33	7.00	8.00	2.59	2.88	32.28	40.35
		L. × money	11.44	11.00	6.75	8.23	83.33	81.00	6.66	7.66	4.68	5.20	34.60	43.25
$L.S.D._{0.05}$			2.69	1.97	3.07	3.46	39.30	38.30	1.46	1.56	1.28	1.48	6.26	7.22

recorded the lowest plant spread values on all studied soils type. These results were in agreement with those obtained by Bertolo *et al*. (2012); Plieninger *et al*. (2016) and Zhou *et al*. (2018).

3. No. of leaves/plant:

Data presented in Table (3) showed that the effect of the wind was insignificant on number of leaves/plant in the two studied seasons, while the effect of soil types and different species was significant. The maximum number of leaves/plant was recorded by white sea sand in the two studied seasons (115.41 and 112.50, respectively), and the minimum number of leaves/plant was obtained by loamy soil in both seasons (79.44 and 77.69, respectively). Table (3) also cleared that the cultivar *Bougainvillea* 'California Gold' gave the maximum average number of leaves/plant in 2019 and 2020, as recorded 249.77 and 245.50, respectively). While the cultivar *Lantana* × *money* recorded the minimum average number of leaves/plant in both seasons (55.88 and 54.83, respectively).

With regard to the effect of wind and soil types interaction, there was an insignificant effect in both seasons (Table, 4).

Considering Table (5), in the open wind, the cultivar *Bougainvillea* 'California Gold' was superior in both seasons, and there was a non-significant effect between the rest of the cultivars in this regard.

Table (6) showed that *Bougainvillea* 'California Gold' cultivated in all soil types gave the maximum average number of leaves/plant in both seasons, but the *Lantana* × *money* cultivar recorded the minimum average number of leaves/plant in white sea sand and loamy soils, and also, *Lantana camara* with red soil gave the minimum average number of leaves/plant.

Data in Table (7) showed that the cultivar *Bougainvillea* 'California Gold' recorded the maximum average number of leaves/plant, in all types of soil with both the protected area and open wind, in both studied seasons. These results were in agreement with those obtained by Archer (1994) in North America and Kefalas *et al.* (2019) in the Mediterranean islands.

4. No. of branches/plant:

Table (3) showed that wind had a significant effect on plant spread, as the maximum average number of branches/plant was recorded in area protected from the wind in both seasons (4.88 and 5.27, respectively). Also, the maximum average number of branches/plant was recorded with red soil (5.05 and 5.33), in both seasons, while the *Bougainvillea* 'California Gold' cultivar gave the highest values for that trait in both seasons (6.88 and 7.55, respectively), while the cultivar *Lantana* × *money* recorded the lowest values (4.38 and 4.83), in both seasons respectively.

Table (4) showed that the plants in the open wind with red soil recorded the highest value of number of branches/plant in both seasons, also, in the area protected from the wind the highest value of that trait was recorded with red and loamy soils in both seasons.

Table (5) showed that *Bougainvillea* 'California Gold', *Lantana camara* and *Lantana* × *money* recorded the maximum average number of branches/plant in both seasons with the open and protected wind.

Data in Table (6) showed that *Bougainvillea* 'California Gold' with all soils type recorded the maximum average number of branches/plant, in both studied seasons, while, *Bougainvillea sanderiana* in all soil types and *Lantana* × *money* cultivar in white sea sand only, gave the minimum average number of branches/plant in both seasons.

With all soils type and in open wind and area protected from wind, the cultivar *Bougainvillea* 'California Gold' recorded the maximum average number of branches/plant, except for loamy soil with open wind, *Lantana camara* recorded maximum values of that trait, while, *Bougainvillea sanderiana* in all types of soil and *Lantana* × *money* with white sea land with open and protected area from wind recorded minimum values of that trait (Table, 7). These results were in agreement with those obtained by Nadeem et al., 2013; Hasanuzzaman *et al*., 2018 and Paraskevopoulou *et al.* (2020).

5. Leaf area (cm^2):

Table (3) presented that the wind had a significant effect on leaf area, as the maximum values were recorded in open wind in both seasons (6.44 and 7.36 cm^2, respectively). Regarding the effect of soil in the first season, the leaf area was highest in white sea sand (5.71 cm^2), while in the second season there were non-significant differences between the different soil types. The *Nerium oleander* recorded the highest values for that traits in both seasons (7.27 and 8.04 cm^2, respectively), while the cultivar *Lantana × money* recorded the lowest value (4.40 and 4.93 cm^2), in both seasons respectively.

Table (4) showed the interaction between wind and soil types, and they had a significant effect, as there was non-significant difference between the white and red soils in the open wind, and they recorded the highest leaf area compared to the loamy soils, while in area protected from wind, the red soils recorded the lowest leaf area compared to the other two types.

Table (5) showed that *Nerium oleander* recorded maximum leaf area in both studied seasons, with the open and protected wind.

Table (6) showed that *Nerium oleander* with white sea sand and red soils and *Bougainvillea sanderiana* with loamy soil recorded the maximum leaf area, in both studied seasons, while, *Lantana camara* cultivar in red and loamy soils and *Lantana × money* cultivar with white sea sand, recorded the minimum leaf area in both studied seasons.

Data listed, in Table (7), showed that in the open wind and white sea sand, *Nerium oleander* recorded the highest leaf area in the two studied seasons, but *Bougainvillea sanderiana* in loamy soil with open wind recorded the highest values for that trait in both seasons (7.08 and 8.41 cm^2). Furthermore, in the area protected from the wind with white sea sand and loamy soil *Nerium oleander*, and *Nerium oleander* 'Petite Salmon' with red soil gave the highest leaf area, in both seasons. These results were in agreement with those obtained by Bertolo *et al.* (2012), Li *et al.* (2018), Tanner and Fuhlendorf (2018) and Wu *et al.* (2019).

6. Leaves total chlorophyll (SPAD):

Data presented in Table (3) cleared that there were non-significant differences in the effect of wind and soil types on leaves' total chlorophyll, while there was an effect for the different plant types. *Nerium oleander* gave the highest value of leaves' total chlorophyll (41.31 and 48.49 SPAD) in both seasons, respectively, while *Lantana camara* recorded the lowest values (32.92 and 39.12 SPAD) in the two studied seasons, respectively.

Table (4) showed that the interaction between wind and soil types had an insignificant effect on that trait in both seasons.

Regarding, Table (5) showed that *Nerium oleander*, recorded the maximum value of leaves total chlorophyll with the open wind (43.32 and 50.93 SPAD), in both seasons, respectively, but *Bougainvillea sanderiana* planted in protected area from wind recorded the highest value for that trait in both seasons (40.75 and 47.75 SPAD), respectively.

Table (6) showed that *Nerium oleander* cultivar with white sea sand and loamy soil and *Bougainvillea sanderiana* in red soil recorded the maximum values of leaves' total chlorophyll, in both studied seasons, while, *Lantana camara* gave the lowest value for the same trait, with all soil types in both successive seasons.

Data from Table (7), showed that *Nerium oleander* cultivar gave the highest leaves' total chlorophyll under open wind conditions when cultivated in all types of soil in both seasons, while *Bougainvillea sanderiana* recorded the highest value under area protected from wind and all soil types in both seasons. These results were in agreement with those obtained by Dadashpoor *et al.* (2019), Piedallu *et al.* (2019) and Liu *et al.* (2020).

CONCLUSION

The results of this study showed that the type of soil used, as well as the influence of climatic changes, the most important of which is wind, played an important role in the morphological characteristics of various ornamental plants in the Northern Coastal Region. The cultivar *Bougainvillea* 'California Gold' excelled in the different characteristics of plant height, leaf area, number of branches and leaves, and the content of chlorophyll in the leaves, under all the conditions used, including the influence of soil and wind types. The conditions had a negative effect on *Nerium oleander*, *Lantana camara* and *Lantana* × *money* cultivars.

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دراسات تنسيقية علي حدائق بعض المنتجعات السياحية بالساحل الشمالي الغربي

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تم إجراء التجربة خلال موسمي نمو متتاليين لعامي ٢٠١٩ و ٢٠٢٠ من يناير إلى أبريل، في الساحل الشمالي لمصر بمحافظة خليج مرسى مطروح سيدي عبد الرحمن ١٣٠ كم من الإسكندرية و ١٩٣ كم من مطروح في منتجع الشركة العقارية متعددة الجنسيات (مراسي). يهدف البحث إلى التوصل إلى أفضل المواصفات المتبعة لزراعة الحدائق فى بعض المنتجعات السياحية بالساحل الشمالى الغربى وذلك مقارنةً بالمعايير الدولية وأيضاً حصر لكل النباتات المزروعة فى هذه المنتجعات والمستحدثة ومدى تأقلمها مع طبيعة الساحل الشمالى. نفذت التجربة حيث تم استخدام ١٠٨ نباتات يمثل كل صنف نباتي ١٨ فرداً ثم قُسمت عدد النباتات إلى نصفين، الأول تم زراعته في منطقة مفتوحة معرضة للرياح من جميع الجهات دون أي غطاء ووضع النصف الثاني في منطقة محمية من التأثير المباشر للرياح. تم تقسيم النباتات إلى ثلاثة أقسام، القسم الأول تمت زراعته برمال البحر الأبيض، والقسم الثاني تمت زراعته في التربة الطينية، والقسم الثالث تمت زراعته بتربة حمراء نظيفة. بالإشارة إلى مسح المناظر الطبيعية في الموقع، تم استخدام ثلاثة أنواع نباتية معتادة في منتجع مراسي، وهي *Nerium oleander* و *Nerium oleander* 'Petite Salmon' و *Bougainvillea sanderiana*. تم مقارنتهم بثلاثة أصناف جديدة وهي *Bougainvillea* 'California Gold' و *Lantana camara* و *Lantana* × *money*. التصميم الإحصائى المستخدم هو القطع المنشقة مرتين وتم وضع تأثير الرياح في القطع الرئيسية، وأنواع التربة فى القطع المنشقة ووضع الأصناف المستخدمة فى القطع تحت المنشقة وذلك فى ثلاث مكررات. أظهرت نتائج هذه الدراسة أن نوع التربة المستخدمة وكذلك تأثير التغيرات المناخية وأهمها الرياح تلعب دوراً مهماً في الخصائص المورفولوجية لنباتات الزينة المختلفة في المنطقة الساحلية الشمالية. تميز الصنف *Bougainvillea* 'California Gold' في الخصائص المختلفة لارتفاع النبات، ومساحة الأوراق، وعدد الفروع والأوراق ، ومحتوى الكلوروفيل في الأوراق ، تحت جميع الظروف المستخدمة.