Phytosociology and phytochemical screening of the medicinal weed *Malva parviflora* L.

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Abstract: *Malva parviflora* (common mallow) is a wild medicinal herb, which needs more management planes, and thus we studied its distribution and phytochemical constituents along five different habitats (cultivated lands, orchards, canals, drains and roadsides) in the Nile Delta region. In addition, the behavior of its common associated species along the prevailing environmental conditions was also assessed. Eighty-six species (50 annuals and 36 perennials) along 50 stands, representing the different habitats, were recorded. Therophytes predominated over the other life forms, while bi-regional taxa contributed the highest chorological elements. *M. Parviflora* is a therophytic plant that has Mediterranean distribution intermingled with Irano-Turanian elements. Four vegetation groups (VG) were produced by the application of TWINSPAN and DECORANA as classification and ordination techniques, respectively. VG (C) dominating the cultivated lands was the most diverse. Canonical Correspondence Analysis (CCA) indicated that, calcium carbonates, organic carbon, potassium adsorption ratio, carbonates, electrical conductivity and potassium were the most effective soil variables on the distribution of common mallow and its associated species along the different habitats. Phytochemical screening of leaves, stems and roots of *M. parviflora* indicated the presence of active compounds including: saponin, flavonoids, alkaloids and phenols in both wild and cultivated plants, while tannins were not detected in the former ones. There was a significant difference in these active compounds between wild and cultivated organs as well as between the different organs of the same plant. The investigated phytochemicals were present in considerable concentrations that render, in addition to its wide distribution, *M. parviflora* a promising plant for pharmaceutical purposes.
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1. Introduction

Plant communities play an important role in sustainable managements by maintaining biodiversity and conserving the environment (Kandi *et al.,* 2011). A major objective of most weed community ecology studies has been to identify patterns of species composition and distribution and to interpret these patterns in relation to known or presumed gradients in the environment (Fried *et al.,* 2008). Quantitative analysis, especially quantitative classification methods and ordination techniques, has been widely used to indicate the ecological relationships between vegetation and environment (Zhang and Zhang, 2000). Moreover, floristic studies are not only important to know the variety of plants present in an area, but also socio-economically significant. They provide shelter, food, medicine and everything for the human being and other species of that area.

Vegetation has been widely used to describe habitat characteristics, water quality and make predictions about the presence and composition of the surrounding communities (Appelgren and Mattila, 2005). Change in the existent components of a natural ecosystem, especially plants and soil, leads to gradual variations in the shape, composition and structure of such communities. Therefore, studying the classification and the inter-relation between the different plant communities in response to the environmental factors are demand (Jafari *et al.,* 2003). However, Zegeye *et al.* (2006) showed that the interdependency of vegetation type and soil chemical properties lead to a variety of species, vegetation types and distribution of plant communities.

One of the main problems that agricultural production faces is weeds that interfere with crop growth and production. These weeds compete with crop plants for water, light, nutrients and space (Al-Johani *et al.,* 2012). *Malva parviflora* L. is an annual medicinal herb, abundant in Egypt (Shaltout *et al.,* 2010). It occupies high-light habitats and is a weedy invader in many orchards and vineyards (Dennis and Michael, 2009). Its wide geographical distribution is likely due to its ability to compete with and displace many other annuals, in addition to its effects on a number of plant species by reducing their germination rates and seedling growth (Zahedi and Ansari, 2011).

Medicinal plants (fruits, vegetables, herbs, etc.) are a source for a wide variety of natural products, such as phenolic acids and flavonoids, which are very interesting for their antioxidant

properties (Wong *et al.,* 2006). In addition to their ability to act as an efficient free radical scavenger, their natural origin represents an advantage over synthetic antioxidants, which their use is being restricted due to their carcinogenicity (Farhan *et al.,* 2012a). *M. parviflora* could be a source of natural antioxidants and thus useful as a therapeutic agents in the slowing of aging and in the relief of age-related and oxidative stress-related degenerative diseases (Hussein *et al.,* 2012). Moreover, its phenolic compounds have multiple biological effects and also act as antioxidants by preventing the oxidation of low density lipoproteins, platelets, aggregation and damage of red blood cells (Cheynier, 2005). These secondary metabolites present in plants vary according to their age and maturity (Pandey *et al.,* 2011).

The main objectives of the present work were to identify the common communities associated with *M. parviflora* in the different habitats of Nile Delta. It also aimed at evaluating the behavior of the common species along the prevailing environmental conditions. Moreover, it estimated the main differences in phytochemical constituents of the wild and cultivated common mallow plants to be used in the different medicinal purposes. Such studies may help in managing the wild medicinal weeds in their prevailing habitats.

2. Material and Methods

2.1. Study Area

The Nile Delta starts about 20 km north of Cairo and it is delineated by the Rosetta and Damietta branches of the Nile. The area of the Nile Delta is about 22,000 km^2, while the Nile Valley (cultivated lands) is about 12,000 km^2. The Nile Delta comprises about 63% of Egypt's fertile land areas (Abu Al-Izz, 1977). Because of the southlands' of years of agricultural activities, all soils with exception of the northern most part, are man-made and are regarded as anthropic variants of the Gleysols and Fluvisols. The study area was distributed in a number of localities distributed in four governorates of the Nile Delta region: Damietta, Dakahlia, Kafr El-Sheikh, and Sharkia (**Fig.1**). The northern part of the Nile Delta lies in the arid zone, while the southern part lies in the hyper-arid. The climatic conditions are warm summer (20-30 ºC) and mild winter (10-20 ºC). The Nile Delta and the provinces studied within it, belong to the arid and/or semi-arid belts of the northern coastal region of Egypt (Ayyad *et al.,* 1983).

2.2. Floristic analysis

Fifty stands (5 x 10 m each) distributed in four governorates (Damietta, Dakahlia, Kafr El-Sheikh, and Sharkia) in the Nile Delta region were selected to represent the apparent variation in the vegetation associated with *M. parviflora*. These stands were equally distributed along five different habitats: canal and drain banks, roadsides, orchards and cultivated lands. In each stand, the visual estimate of the total cover and the cover of each species (%) were recorded. Identification and nomenclature were according to Täckholm (1974) and Boulos (2009). Life forms of the recorded species were identified following the Raunkiaer scheme (Raunkiaer 1937). The global geographical distribution of the recorded species was gathered from Täckholm (1974) and Zohary (1973). The Voucher specimens were deposited in Zagazig University Herbarium.

2.3. Soil analysis

A composite soil sample was collected from each stand as a profile of 0-50 cm below the ground surface. Soil texture, water-holding capacity and porosity were determined according to Allen *et al.* (1986). Calcium carbonate was determined by titration against 1N NaOH and oxidisable organic carbon (OC) was determined using Walkely and Black's rapid titration. Soil water extracts of 1:5 were prepared for the determination of salinity (EC), pH, chlorides, soluble carbonates and bicarbonates, sulphates, calcium, Magnesium, sodium and potassium. Sodium adsorption ratio (SAR) and potassium adsorption ratio (PAR) were calculated to express the combined effects of the different ions in the soil. All of these procedures were outlined by Allen *et al.* (1986).

2.4. Phytochemical analysis

Three composite samples of wild and cultivated *M. parviflora* plants were collected and separated into stem, leaves and roots. Aqueous extracts of powdered samples were prepared for determination of tannins using vanillin hydrochloride reagent (Sadasivam and Manickam, 2008) and saponins according to Obdoni and Ochuko (2001). On the other hand, flavonoides were estimated using aluminum chloride and potassium acetate (Kosalec *et al.*, 2004), while Alkaloids using ammonium hydroxide (Harborne, 1973) and total phenols using the modified Folin–Ciocalteau reagent method Lister and Wilson (2001).

2.5. Data analysis

Two-way indicator species analysis (TWINSPAN) and Detrended Correspondence Analysis (DCA) were applied to the matrix of the cover estimates of 86 species in 50 stands in Nile Delta (Hill 1979a, b). The relationship between the vegetation and soil gradients was assessed using the ordination diagram of CCA (Ter Braak and Smilauer, 1998). Species richness for each vegetation group was calculated as the average number of species per stand. Relative evenness or equitability (Shannon-

Weaver index) of species cover was expressed as $\hat{H} = -\Sigma^{s}_{i=1}$ Pi (log Pi), where s is the total number of species and Pi is the relative importance value (relative cover) of the i^{th} species. The relative concentration of dominance (Simpson index) is the second group of heterogeniety indices and is expressed by Simpson's index: D= 1/C and $C = \Sigma^{s}_{i=1} (Pi)^2$, where s is the total number of species and Pi is the relative cover of species (Magurran, 1988). Moreover, the simple linear correlation coefficient (r) was calculated for assessing the relationship between the estimated soil variables on one hand, and the common species, on the other hand. After testing the data for normality, the differences in the soil variables among the different communities as well as the phytochemical constituents of wild and cultivated *M. parviflora* plants were tested using one-way analysis of variance (ANOVA) according to SPSS software (SPSS 1999). A post-hoc test was applied when differences were significant.

3. Results

3.1. Floristic features

Eighty-six species (50 annuals and 36 perennials) belonging to 73 genera and 28 families were recorded along 50 stands in the Nile Delta, Egypt (**Table 1**). Poaceae had the highest contribution (16.3% of the recorded species), followed by asteraceae (14.0%), chenopodiaceae (11.6%), brassicaceae and polygonaceae (7.0%) and cyperaceae and fabaceae (4.7%). The life form spectra of the recorded species indicated the predominance of therophytes (57.0%) over the other life forms. On the other hand, the chorological analysis of the recorded species showed that bi-regional taxa were the predominant (32.6%), followed by pluri-regionals (31.4%), cosmopolitans (18.6%) and mono-regionals (17.4%). Moreover, *M. Parviflora* is therophytic plant that has Mediterranean distribution intermingled with Irano-Turanian elements. Furthermore, canal banks were the common habitat for common mallow with the highest cover (60.6%), while orchards were the least (37.0%) (**Fig. 2**).

3.2. Multivariate analysis

The application of TWINSPAN on the cover estimates of 86 species recorded in 50 sampled stands, led to the recognition of 4 vegetation groups **(Fig. 3)**. The application of DCA on the same set of data indicated a reasonable segregation among these groups along the ordination plane of axes 1 and 2 **(Fig. 4)**. The vegetation groups were named based on the first common associated species after *M. parviflora* **(Table 2)**. *M. parviflora-Rumex dentatus* group (VG A) mainly occupied the roadsides with *Atriplex portulacoides* and *Silybum marianum* as common associated species, while *M. parviflora-Phragmites australis* (VG B) inhabited the canal banks with *Pluchea dioscorides* as the main associated species. On the other hand, *M. parviflora-Cynodon dactylon* (VG C) was common in the cultivated lands, where *Convolvulus arvensis* and *Sonchus oleraceus* were the most common associates. Moreover, *Chenopodium murale-M. parviflora* (VG D) dominated in orchards and roadsides' habitats.

It was found that *M. parviflora-C. dactylon* (VG C) was the most diverse group (**Table 2**), it had the highest species number (55 species), richness (8.36 species $stand^{-1}$), relative evenness (3.04) and relative concentration of dominance (0.91). On the other hand, *M. parviflora-P. australis* (VG B) had the lowest species richness (7,55 species $stand^{-1}$), while *C. murale-M. parviflora* (VG D) had the lowest relative evenness and relative concentration of dominance (2.03 and 0.84).

3.3. Soil characteristics

The soil mechanical analysis indicated that the soil texture of the study area was formed mainly of sand and partly of silt and clay (**Table 3**). Soil porosity, pH and calcium carbonate were comparable in the four groups, while Group A had the highest water holding capacity (28.41%), but the lowest of salinity (0.68 mmhos cm^{-1}), $CaCO_3$ (13.33%), Na (22.01 mg $100g^{-1}$), k (6.18 mg $100g^{-1}$) and Ca (7.52 mg $100g^{-1}$). On the other hand, group D had the highest values of salinity (3.96 mmhos cm^{-1}), $CaCO_3$ (19.80%), organic carbon (13.80%), Na (111.03 mg $100g^{-1}$) and K (89.85 mg $100g^{-1}$). Moreover, group C attained the highest values of Ca and Mg (12.39 and 29.11 mg $100g^{-1}$), but the lowest of organic carbon (10.06%).

3.4. Vegetation-environment relationship

The relationship between the recorded common species with *M. parviflora* and the soil characteristics was indicated on the ordination diagram produced by CCA **(Fig. 5)**. It was found that $CaCO_3$, OC, PAR, $carbonates^{-}$, EC, sand and K were the most effective soil variables. It was clear that, *M. parviflora* was greatly affected by calcium carbonates, sand and Mg, while *C. dactylon* and *A. portulacoides* were affected by carbonates, SAR, EC and chlorides. Moreover, EC and Na were the most effective variables on *C. murale* (a co-dominant species in Group D and important in Groups A and B) and *R. dentatus* (co-dominant in Group C). Furthermore, *P. australis* and *P. dioscorides* co-dominated group (B) were affected by calcium and soil porosity.

The simple linear correlation coefficient between some soil variables and the common species indicated that *M. parviflora* and *P. dioscorides* were positively significant (r = 0.292, 0.308), while *C.*

arvensis was negatively significant (r = -0.302) with bicarbonates (**Table 4**). On the other hand, *A. portulacoides* had positive significant correlation with clay, water holding capacity and carbonates (r = 0.392, 0.371 and 0.350).

3.5. Phytochemical constituents

The phytochemical screening indicated a significant difference between wild and cultivated organs of *M. Parviflora* (**Table 5**). In addition, there was a significant variation in all investigated phytochemicals within the organs of the same plant. Tannins attained their highest concentration (8.25 mg g^{-1}) in the leaves of cultivated plants and not detected in the wild. The leaves of the wild plant had the highest values of alkaloids, saponins, flavonoids and total phenols (4.21, 12.23, 32.02 and 2.92 mg g^{-1}). On the other hand, the lowest values of alkaloids and flavonoids (1.10 and 9.61 mg g^{-1}) were recorded in the roots of cultivated plant, while the lowest of saponins and total phenols (2.01 and 0.50 mg g^{-1}) were attained by the cultivated plant leaves.

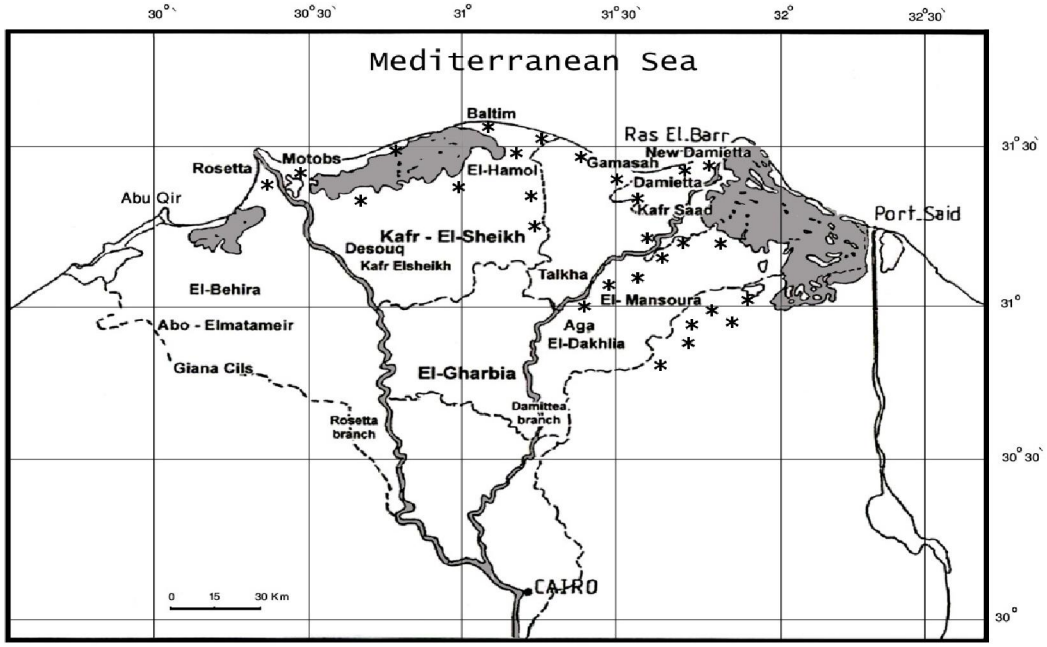

Fig. 1. Location map of Nile Delta showing the different localities (*) of the study area.

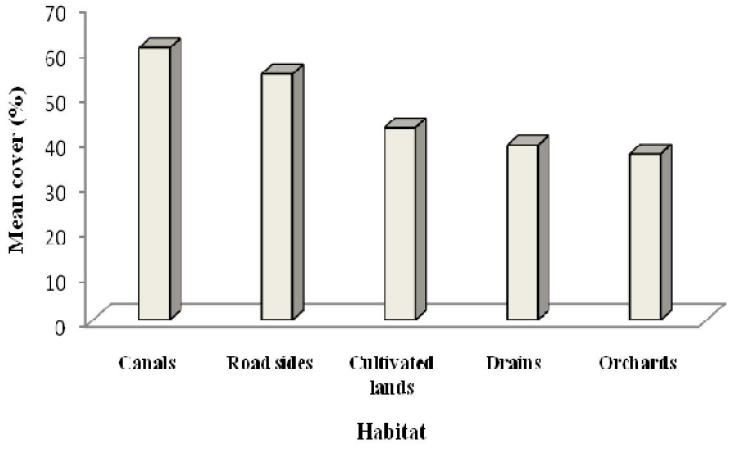

Fig. 2. Mean cover (%) of *Malva parviflora* in the different habitats of Nile Delta.

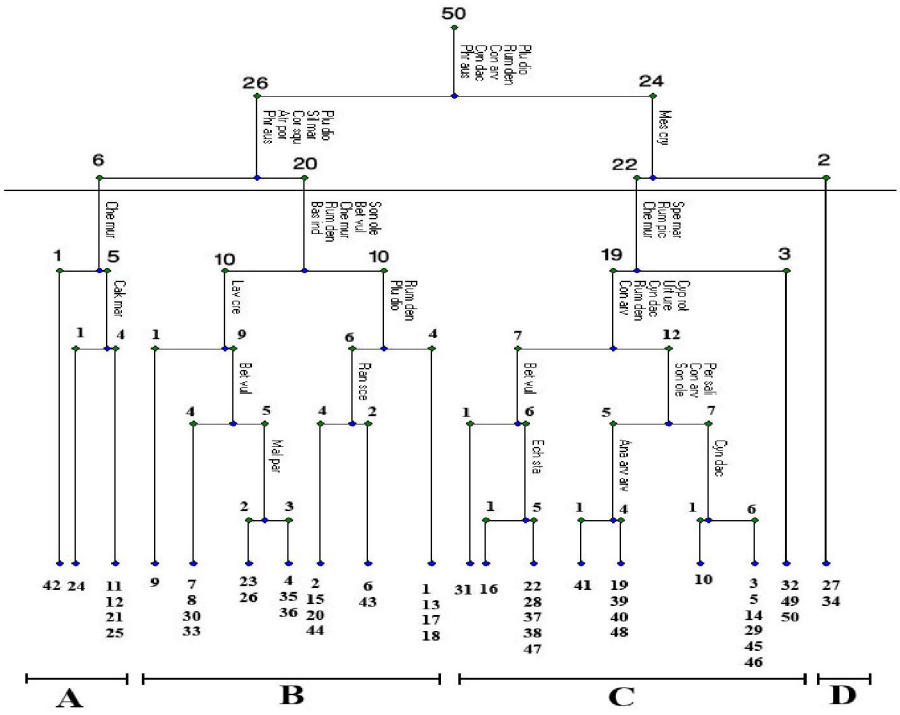

Fig. 3. The dendrogram resulting from the application of TWINSPAN on the cover estimates of 86 species recorded in 50 sampled stands in Nile Delta. The indicator species are abbreviated to the first three letters of genus and of species (see Table 1).

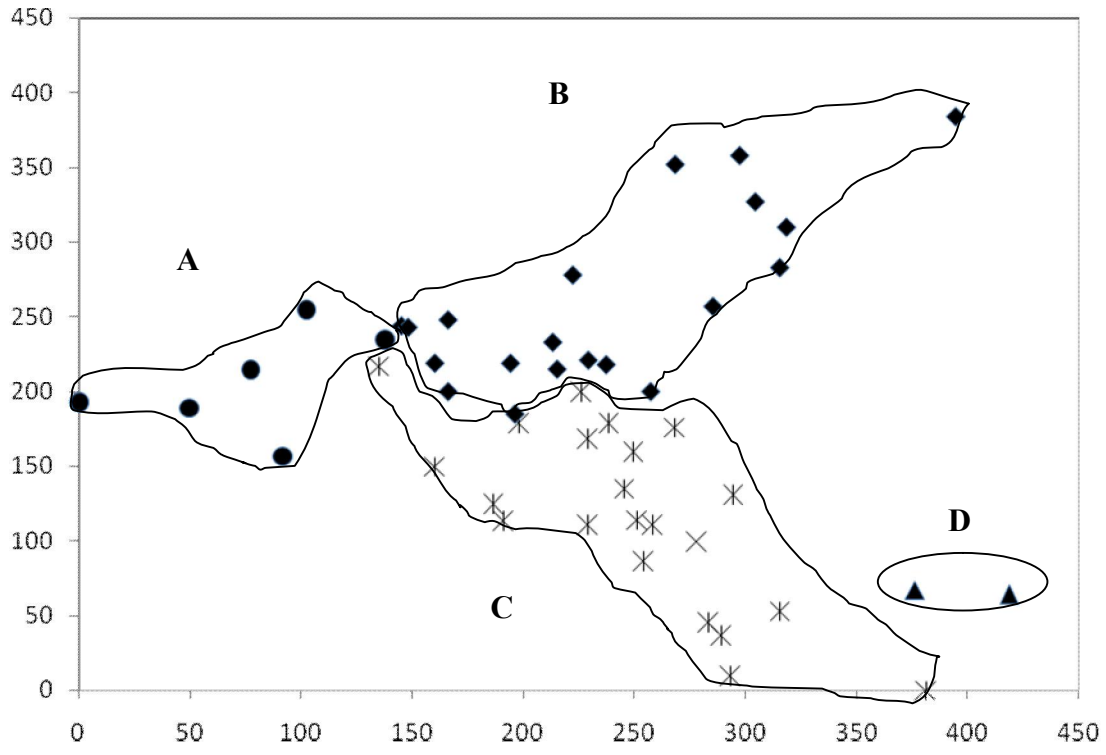

Fig. 4. DCA-ordination of the vegetation groups resulted from the application of the cover estimates of 86 species on 50 sampled stands in Nile Delta.

Table 1. Mean relative cover and coefficients of variation (CV) of the recorded species in the different vegetation groups resulting from TWINSPAN classification of the study area. Common species are bold.

Species	Vegetation Groups							
	A		B		C		D	
	Mean	CV	Mean	CV	Mean	CV	Mean	CV
Amaranthus lividus L.			1.50	2.61	0.42	4.69		
Ammi majus L.							5.05	1.41
Anagallis arvensis var. *arvensis* L.					0.89	2.88		
Anagallis arvensis var. *caerulea* (L.) Gouan			0.16	4.47				
Arthrocnemum macrostachyum (Moric.) Moris et De Ponte			1.28	4.47				
Atriplex portulacoides L.	**14.75**	**1.29**						
Bassia indica (Wight) A.J.Scott.			7.97	1.67	1.23	2.60		
Beta vulgaris var. *cicla L.*			3.49	1.70	4.21	3.82		
Bidens pilosa var. *radiata* Sch. Bip.					3.32	3.08		
Bolboschoenus glaucus (Lam.) S.G.Smith			2.84	4.47				
Brassica tournefortii Gouan					2.67	3.30		
Cakile maritime subsp. *aegyptiaca* (Willd.) Nyman	1.57	2.45	1.83	3.34				
Capsella bursa-postoris (L.) Medik.					1.46	2.78		
Chenopodium album L.			3.34	2.67	0.28	4.69	17.49	1.41
Chenopodium ambrosioides L.					1.65	3.88		
Chenopodium giganteum d. Don			1.33	4.47				
Chenopodium murale L.	15.01	0.61	14.61	1.10	9.26	1.05	**35.15**	**0.45**
Convolvulus arvensis L.			2.23	3.32	**18.16**	**1.53**		
Coronopus squamatus (Forssk) Anch.	5.66	1.20						
Cynanchum acutum L.					0.52	4.69		
Cynodon dactylon (L.) Pers.	2.14	2.45	5.34	1.80	**23.53**	**0.82**		
Cyperus alopecuroides Rottb.	2.15	2.45	3.45	3.76				
Cyperus articulatus L.					0.53	4.69		
Cyperus rotundus L.			2.56	3.62	11.31	1.69		
Echinochloa colona (L.) Link					0.51	4.69		
Echinochloa stagnina (Retz.) P. Beauv.	4.92	2.45			0.64	4.69		
Eclipta prostrata L.					2.83	3.08		
Emex spinosa (L) campd	3.15	2.45			0.63	4.69		
Erodium laciniatum (Cav.) Willd.					0.80	4.69		
Euphorbia helioscopia L.					1.50	2.78		
Euphorbia peplus L.					0.83	4.69		
Euphorbia prostrata Aiton, Hort. Kew, ed.	4.23	2.45						
Halocnemum strobilaceum (Pallas) M. Bieb.			0.94	4.47				
Imperata cylindrica (L.) Raeusch.	9.95	1.59	1.28	3.19	1.27	3.40		
Ipomoea carnea Jacq.	2.15	2.45			0.68	4.69		
Lactuca serriola L.			0.81	4.47	0.71	4.69		
Lavatera cretica L.			0.72	4.47	0.81	4.69		
Lamium amplexicaule L.	13.66	1.56						
Limbarda crithmoides (L.) Dumort.			1.05	4.47				
Lolium perenne L.					0.42	4.69		
Malva parviflora L.	**52.07**	**0.55**	**48.97**	**0.55**	**44.69**	**0.68**	**33.29**	**0.07**
Medicago intertexta var. *Ciliaris* (L.) Heyn					0.80	4.69		
Melilotus indicus (L.) All.	2.52	1.78	3.95	3.44	0.71	3.24		
Mentha longifolia (L.) Huds.			0.93	4.47	2.68	3.29		
Mesembryanthemum crystalinum L.							29.22	0.09
Mesembryanthemum nodiflorum L.			1.90	3.11				

Table 1. Cont.

Species	Vegetation Groups							
	A		B		C		D	
	Mean	CV	Mean	CV	Mean	CV	Mean	CV
Orobanche crenata Forssk.					1.44	4.69		
Oxalis corneculata L.					1.01	4.69		
Panicum repens L.					2.23	4.69		
Paspalidium geminatum (Forssk.) Staff					1.61	4.69		
Paspalum distichum L.			0.82	4.47				
Pennisetum setaceum (Forssk.) Chiov					0.28	4.69		
Persicaria lapathifolia Willd.					0.85	3.82		
Persicaria salicifolia Brouss. ex Willd.			3.30	2.82	2.20	2.37		
Phalaris minor Retz.					2.13	3.46		
Phragmites australis (Cuv.) Trin. ex Steud.	12.28	2.45	**34.87**	**0.71**	8.09	2.86		
Phyla nodiflora (L.) Greene							7.93	1.41
Plantago major L.							1.36	1.41
Pluchea dioscoridis (L.) DC.			**7.34**	**1.54**				
Poa annua L.					2.32	2.93		
Polygonum equisetiforme Sibthi & Sm.	2.17	2.45					1.74	1.41
Polypogon monspeliensis (L.) Desf.					0.94	3.97		
Pseudognaphalium luteoalbum (L.) Hilliard & B.L. Burtt.			0.22	4.47				
Ranunculus sceleratus L.	2.39	2.45	1.61	3.09				
Rorippa palustris (L.) Besser			0.90	4.47	0.43	4.69		
Rumex dentatus L.	**25.75**	**1.69**	4.58	1.81	13.50	1.32		
Rumex pictus Forssk.					1.67	3.47	8.71	1.41
Senecio aegyptius L.					1.57	4.12		
Senecio glaucus L.	1.94	2.45	7.32	3.13			3.50	1.41
Sesbania sericea (Willd.) Link					0.93	4.69		
Sida alba L.			0.17	4.47				
Silybum marianum (L.) Gaertn.	**10.50**	**1.58**			1.81	4.69		
Sisymbrium irio L.	3.41	1.71	3.25	1.98	0.40	4.69		
Solanum nigrum L.			2.16	2.68				
Sonchus oleraceus L.	1.69	2.45	5.54	2.27	**9.07**	**1.58**	1.17	1.41
Spergularia marina (L.) Griseb			5.32	2.78	1.11	3.25		
Sporobolus pungens (Schreb.) Kunth.							14.70	1.41
Suaeda pruinosa Lang			6.03	2.88				
Symphyotrichum squamatum (Spreng.) Nesom					0.15	4.69		
Tamarix nilotica (Ehrenb). Bge			1.74	4.47				
Torilis arvensis subsp. *neglecta* Spreng.					0.48	3.24	10.70	1.41
Typha domingensis (Pers) Poir ex Steud	2.24	2.45						
Urospermum picroides (L.) F.W. Schmidt	2.78	2.45	1.38	4.47				
Urtica urens L.	9.72	2.45	0.35	4.47	5.10	2.25		
Vicia sativa L.	1.20	2.45			0.77	2.59		
Zygophyllum album L.			0.64	4.47				

Table 2. Characteristics of the four vegetation groups (VG) derived after the application of TWINSPAN on the 50 stands in the study area. N: number of stands, G/P: the percentage of the stands of each vegetation group in relation to the total number of stands, NS: number of species per group, RC: relative cover, CB: canal banks, Dr: drains, RS: roadsides, Or: orchards, FC: field crops.

VG	N	NS	Habitat					1st dominant species	RC (%)	2nd dominant species	RC (%)	Species richness	Shanon index	Simpson index
			CB	Dr	RS	Or	FC							
A	6	26		33.3	50		15.7	*Malva parviflora*	52.07	*Rumex dentatus*	25.75	7.67	2.38	0.84
B	20	42	35	25	15	15	10	*Malva parviflora*	48.97	*Phragmites australis*	34.87	7.55	2.83	0.9
C	22	55	13.6	13.6	13.6	27.2	31.8	*Malva parviflora*	44.69	*Cynodon dactylon*	23.53	8.36	3.04	0.91
D	2	13			50	50		*Chenopodium murale*	35.15	*Malva parviflora*	33.29	8	2.03	0.84

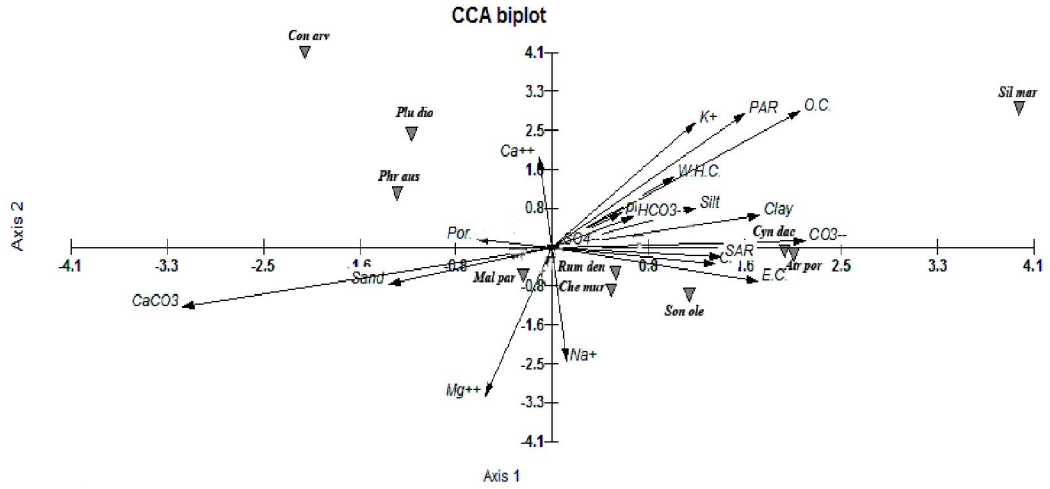

Fig. 5. Canonical Correspondence Analysis (CCA) ordination diagram of species along the gradient of environmental variables (arrows). The indicator and preferential species are abbreviated to the three first letters of genus and of species (see Table 1).

Table 3. Mean ± standard Deviation of the soil characteristics of the sampled stands representing the different vegetation groups obtained by TWINSPAN. The maximum and minimum values are bold.

Soil Variable		Vegetation group				F-value
		A	B	C	D	
Sand (%)		**95.18±2.26**	**96.90±1.62**	95.87±2.06	95.63±2.08	1.74
Silt (%)		3.74±1.65	**2.50±1.24**	3.41±1.77	**3.89±1.40**	1.77
Clay (%)		**1.08±0.72**	0.61±0.45	0.72±0.44	**0.48±0.68**	1.80
Por. (%)		37.04±10.25	37.69±8.96	**36.19±10.14**	**46.18±0.25**	0.69
W.H.C. (%)		**28.41±3.09**	**21.17±2.26**	23.14±2.86	26.94±3.37	9.83**
pH		7.69±0.23	**7.72±0.19**	7.71±0.22	**7.63±0.04**	0.17
E.C. (mmhos cm^{-1})		**0.68±0.29**	0.89±0.87	1.25±0.86	**3.96±0.11**	9.50**
$CaCO_3$		**13.33±5.00**	14.91±3.48	15.51±3.82	**19.80±1.41**	1.76
OC		11.26±3.04	12.03±2.68	**10.06±2.83**	**13.80±0.12**	2.43
Cl^-	**%**	0.05±0.02	0.05±0.03	0.07±0.05	**0.56±0.33**	38.27**
SO_4^{--}		**0.04±0.03**	0.09±0.05	0.12±0.06	**0.27±0.04**	12.24**
CO_3^{--}		**0.01±0.01**	0.00±0.00	0.00±0.00	0.00±0.00	0.92
HCO_3^-		0.03±0.02	0.03±0.02	0.03±0.02	0.04±0.01	0.18
Na^+	**mg 100g^{-1}**	**22.01±10.26**	31.99±27.41	33.77±21.99	**111.03±1.13**	7.95**
K^+		**6.18±1.85**	14.79±18.11	14.64±17.35	**59.85±1.41**	5.47*
Ca^{++}		**7.52±1.98**	11.25±12.81	**12.39±17.07**	9.02±5.67	0.20
Mg^{++}		13.07±27.19	26.94±55.97	**29.11±51.53**	**7.90±1.72**	0.24
SAR		20.29±15.81	**9.90±10.01**	11.86±9.39	**38.59±4.92**	5.64*
PAR		13.10±11.95	**5.47±7.89**	5.48±8.13	**14.39±10.96**	1.93

Table 4. Simple linear correlation coefficient (r) between some of the common weeds and soil variables. Significant values are bold. *: $P< 0.05$, **: $P<0.01$.

Species	Clay	WHC	EC	OC	Clorides	Carbonates	Bicarbonates
Atriplex portulacoides	**0.392****	**0.371****	0.109	0.247	0.231	**0.350***	-0.242
Convolvulus arvensis	0.002	0.069	-0.031	-0.118	-0.057	0.166	**-0.302***
Malva parviflora	-0.144	-0.158	-0.204	0.132	-0.096	-0.201	**0.292***
Pluchea dioscoridis	-0.132	-0.168	-0.109	**0.284***	-0.099	-0.177	**0.308***
Sonchus oleraceus	0.020	0.055	**0.343***	0.012	0.347*	-0.035	0.003

Table 5. Mean ± SE of the secondary metabolites (mg g^{-1}) produced by the different parts of wild and cultivated *Malva parviflora*. ND: not detected, *: $P < 0.001$.

Phytochemical	Plant organ						F – value
	Leaves		Stem		Root		
	Cultivated	Wild	Cultivated	Wild	Cultivated	Wild	
Tannins	**8.25±0.27^{a}**	ND	3.05±0.39^{c}	ND	2.60±0.50^{b}	ND	87.2*
Alkaloids	1.60±0.14^{a}	**4.21±0.12^{b}**	2.90±0.05^{c}	3.16±0.15^{b}	**1.10±0.30^{b}**	3.01±0.15^{d}	166.2*
Saponins	**2.01±0.01^{a}**	**12.23±0.30^{b}**	2.67±0.31^{c}	10.12±0.29^{b}	2.04±0.14^{d}	5.22±0.02^{a}	96.6*
Flavonoides	10.25±0.24^{a}	**32.02±0.06^{b}**	12.84±0.20^{c}	28.42±0.42^{d}	**9.61±0.27^{e}**	21.12±0.34^{a}	3598.6*
Total Phenols	**0.50±0.15^{a}**	**2.92±0.36^{b}**	1.00±0.16^{a}	2.15±0.07^{c}	0.57±0.14^{d}	1.52±0.02^{a}	80.6*

4. Discussion

Eighty-five species were recorded as associated with *M. parviflora* in the different habitats of the Nile Delta, of them 50 annuals. The high contribution of annuals can be attributed to their short life cycle that enables them to resist the instability of the agro-ecosystem. Moreover, they are generally characterized by high allocation of resources to the reproductive organs and the production of flowers early in their life-span to ensure some seed production even in a year when the growing season is cut short (Sans and Masalles, 1995). Furthermore, poaceae, asteraceae, chenopodiaceae and brassicaceae are the common families; they constitute the bulk of the flora of the study area in accordance with Mashaly (1987) in Dakahlia-Damietta coastal region, Abd El-Fattah *et al.* (1992) in the wastelands in the Zagazig province, Shalaby (1995) in Kafr El-Sheikh province.

The life form spectra provide information which may help in assessing the response of vegetation to the variations in the environmental factors. The Mediterranean climate was designated as a "therophyte climate" because of the high percentage (> 50% of the total species) of this life form in several Mediterranean floras (Raven, 1971). The present study indicated the predominance of therophytes over the other life forms. Heneidy and Bidak (2001) pointed out that the dominance of therophytes over the other life forms seems to be a response to the hot-dry climate, topographic variation and biotic influence. The floristic categories of the recorded species showed that the bi-regional taxa had the highest contribution, followed by the pluri-regional, cosmopolitan and mono-regional elements. Zohary (1973) referred to the dominance of inter-regional species (bi-, tri- and pluri-regional) over mono-regional ones to the presence of inter-zonal habitats, such as anthropogenic or hydro-, halo- and psammophilous sites.

Multivariate analysis of the recorded species produced four vegetation groups representing the different habitats in the study area. *M. parviflora* is the dominant in these groups except *Sporopolus pungens-M. parviflora* group inhabiting the orchards and roadsides, where it was the co-dominant. *M. parviflora-C. dactylon* group characterized in the field crops was the most diverse, while *M. parviflora-P. australis* inhabiting the canal banks was the least. The variations in species richness, diversity and evenness among the different habitat types may be attributed to differences in soil characteristics, substrate discontinuities and the allelopathic effects of one or more invasive species depending on their relative dominance among other associated species (James *et al.,* 2006). Although weeds are unwanted plants, increased their diversity may have other indirect beneficial effects on agro-ecosystems. For example, increased vegetation diversity can lead to suppression of pests via 'top-down' enhancement of natural enemy populations or by resource concentration and other 'bottom-up' effects acting directly on pests (Tracy *et al.,* 2004).

Although canal banks had the lowest species diversity, it was the main habitat for *M. parviflora,* where the highest cover percentage was recorded. This may be attributed to its ability to compete with and displace many other annuals, in addition to its effects on a number of plant species by reducing their germination rates and seedling growth (Zahedi and Ansari, 2011). In addition, there was a significant positive correlation between this weed and bicarbonates, which contributed its highest concentration in the soils of canal banks. On the other hand, orchards, associated with the highest salinity, contributed the lowest cover of common mallow. Moreover, the distribution and associated species of common mallow were greatly affected by soil variables.

Weed communities are affected by many factors such as soil characteristics (Fried *et al.,* 2008, Pinke *et al.,* 2010). The correlation between the identified vegetation groups and the soil characteristics is indicated by CCA. It was found that sand, $CaCO_3$, OC, PAR, carbonates^{-}, EC and K were the most effective soil variables. Soil texture may affect soil or productivity via influence on the soil water holding capacity, infiltration rate, moisture availability for plants and consequently plant nutrition (Sperry and Hacke, 2002).

Weeds are not just unwanted plants, they should be regarded as being of potential commercial value and useful in a range of ways such as food, medicine, agriculture, ornamentals, pollution control (Zimdahl, 2007). The results from the phytochemical screening showed that leaves, stems and roots of *M. parviflora* contain phenol, alkaloids, flavonoids and saponin, with significant higher concentrations in the leaves than the other organs. This result was confirmed by other studies (Farhan *et al.,* 2012a,b, Karimi *et al.,* 2011). It worth noting that there is a significant difference in the chemical constituents between wild and cultivated *Malva* plants, where all investigated chemicals were higher in wild than cultivated, except tannins, which was not detected in the wild plants, although detected by Farhan *et al.* (2012a). Moreover, the total phenols and flavonoids are comparable to those found by Afolayan *et al.* (2008) in *M. parviflora* grown in South Africa, but higher than those reported by Farhan *et al.* (2012b). The traditional use of *M. parviflora* as a wound-healing herb may partly be attributed to flavonoids present in its extract, since only low phenol content was observed (Afolayan *et al.,* 2008). However, leaves and stems of *M. parviflora* have exerted high antioxidant power at different concentrations (Farhan *et al.,* 2012a).

Finally, it can be concluded that both wild and cultivated *M. parviflora* plants would seem to be a promising for pharmaceutical purposes and is a renewable natural resource with cosmopolitan phytogeographical distribution.

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