Floristic diversity and vegetation analysis of*Malva parviflora* L. Populations in Egypt

Hend Abdelatti[٢] , Tarek M. Galal[١], Ahmed A.Khalafallah[٢], Zynab A. Abdelgawad[٢], and Soad A. Shaetawi[٢]

[1]Botany Department -Faculty Of Science – Helwan University

[2]Botany Department-Faculty Of Women–Ain Shams University

Abstract

The present work aimed to study the distribution, floristic diversityand vegetation analysis of associated florasto*Malva parviflora* populationeight governorates in Egypt,.One hundred and fifty one stands (10m X 10m) were surveyed in late autumn to early spring (2014-2015 and 2015-2016). The present results reviled that *Malva parviflora* population were distributed in 12 habitats; canal banks, fallow land, desert, desert road sides, Agriculture road sides, railway, cultivated plants, cultivated crops, ditches, salt marches, reclaimed lands and orchards.One hundred and forty one belonging to 48 genera and 35 families were recorded associated with *M. parviflora*. The dominant families were Poaceae, Asteraceae, Chenopodiaceae, Fabaceae and Brassicaceae. Annuals recorded the highest number of species (88 species) while perennials were represented by 53 species. Therophytes were the dominant life form represented by 88 species while pluri-regional elements represented the dominant floristic category (30% of the total species). The application of TWINSPAN on the cover estimates of 141 associated species recorded in the 151 sampled stands of *M. parviflora*, led to the recognition of 14 vegetation groups. *Chenopodium murale-Cynodon dactylon* (VG H)had the highest number of species (75 species), species turnover and Shannon index (8.4 and 3.6). It is clear from the study that *Malva parviflora*plants have high elasticity to grow in diverse habitat and rich in plant diversity and is a resource for many plant species of environmental, economic and medical importance, which indicates its importance.

Key Words: *Malva parviflora* Population - Species Diversity - Vegetation Analysis - TWINSPAN

Introduction

Recently biodiversity has become a worldwide political issue. The United Nations General Assembly defined the time span of 2011-2020 as the Decade of Biodiversity (Resolution 65/161). The reason for this international interest in biodiversity is the global change and losses of species resulted from industrialization. Biodiversity considerations apply to agriculture and they do not only refer to crops but to weeds also (**Kraehmer *et al.*, 2016**).

Vegetation, 'the green blanket of the earth' is an attribute of the land and classified into natural, semi-natural and cultural groups, depending on the degree of human influence. The vegetation represents the main component of any ecosystem.

***Corresponding Author :** helzlatene@yahoo.co.uk

It reflects the effects of environmental conditions in an easily and obvious measurable manner.The Information about the vegetation type considered a key input in characterization the habitats structure and function. Classification of vegetation is important step for managing the natural resources where the vegetation influence all living beings and the global climate and terrestrial carbon cycle significantly (Sala et al., 2000; Xiao et al., 2004).

Many of the researches on vegetation classification that come from European and North American ecologists have fundamentally different approaches (Van Der Maarel, 2004&Feldmeyer-Christie et al., 2005). In North America, vegetation classification is based on the combination of climate pattern, plant habits, growth form, phenology and the dominant species. In the current US standard, the classification is hierarchical and incorporates the non-floristic criteria into the upper five levels (most general) and limited floristic criteria only into the lower two levels (most specific) (Van Der Maarel, 2004). In Europe, classification often depend much more heavily, sometimes entirely on floristic composition alone and It often emphasizes indicator or diagnostic species which may distinguish one classification from another (Feldmeyer-Christie et al., 2005).

Arable weed flora is an integral part of the agro-ecological system of a region (Khan et al., 2007) although from economic view they are represented threat to crops (Munyuli, 2013). On the other hand, they increase species diversity and provide environmental heterogeneity (Adler et al., 2001). In addition, weed species and its associations support the crop performance by providing food and habitat to beneficial insects, birds which enhance services of an ecosystem as pollination, preventing soil erosion, leaching of Nitrogen and pests control (Carlesi et al., 2013;Kohler et al., 2011;Marshall et al., 2003&Parish et al., 2009). Biological diversity conservation and management practices can be applied in the agro-ecosystems for protecting phyto-diversity in these habitats (Khan, 2012; Kent, 2011). The science of Phytosociology aims to describe, recognize and quantify different plant associations under the influence of various biotic and abiotic factors (Garzón et al., 2008;Kent, 2011; Khan et al., 2016;Nagase and Dunnett, 2012). Twenty first century has introduced computing techniques in every field of science including plant science (Podani, 2006).In this context multivariate statistical techniques could be applied in a better way to understand various aspects of agro-ecological diversity (Hair et al., 2010; Hill and Gauch, 1980; Izenman, 2008).

Classification of weeds into associations in specific microhabitats provide base for vegetation and environmental dynamics (Brohman et al., 2005). Each species has specific microclimatic requirements to establish itself successfully in a particular sort of habitat (Cavieres et al.,2007; Kotzen, 2003; Suggitt et al., 2011). Plant association formation is the most peculiar characteristics of vegetation (Kramer, 2012) and weeds flora is one of the integral part of it (Gaba et al., 2010; Watson and Riha, 2010). Weeds flora is important part of natural vegetation and compete for resources to establish themselves in the habitats of crops where they occur (Ahmad et al., 2016; Altieri, 2002). Certain weed species are important from conservation point of view. Habitat variability affects weeds diversity, distribution and association formation (Iqbal et al., 2015; Marshall et al., 2003; Roschewitz et al., 2005). Understanding of which may help for their control as well as conservation where necessary.

Malva parviflora L. is one of the most widespread annual species in Egypt and grows in different habitats from very moist to arid, which gives it different habits and sizes, especially the leaf size. It is also cultivated on a small scale for its edible leaves (Boulos,

2000; Shaltout et al., 2010; Shehata and Galal, 2014). It occupies high light condition habitats and is a weedy invader in many orchards and vineyards (Greer and Thorpe, 2009). Its wide geographic distribution probably is related 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). The main objective of the present study was to study the distribution and associated species of the arable weed, *M. parviflora*, along the different habitats of Egypt.

Materials and methods

The flora associated with *Malva parviflora*L. populations were surveyed during winter season. Randomly 151 stand (each 10 × 10 m) were selected representing ١٢ habitats (canal banks, fallow land, desert, desert road sides, Agriculture road sides, railway, cultivated farms, crops, ditches, salt marches, reclaimed lands and orchards) located at several governorates of Egypt; Qalyubiya, Al Minufiya, Algharbia, Buhayrah, Giza, Cairo, Sues and Marsa Matrouh were surveyed for studying *M. parviflora* population distribution, floristic composition and vegetation analysis **(Fig. 1)**

Floristic analysis

A list of species was made for each sampled stand. *Malva parviflora* habitats were observed throughout the growing season. Visual estimation of the total cover and the cover of each species (%)was assessed using Réléve method (Muller-Dombois and Ellenberg, 1974). Identification and nomenclature were according to Täckholm (1974), Boulos & El-Hadidi (1984), El-Hadidi & Fayed (1994/1995) and Boulos (1999, 2000, 2002 and 2009). The voucher specimens were deposited in the herbarium of Botany Department, Faculty of Women's for Art, Science and Education and in the Herbarium of Botany Department, Faculty of Science, Helwan University (HCH). Life forms of the species were identified following the Raunkiaer scheme (Raunkiaer, 1937) as follows: Ch: chamaephytes, H: hemicryptophytes, GH: geophytes-helophytes, and Th: therophytes. The actual and relative

numbers of species belonging to each life form (biological spectrum) in each crop were calculated.

The global and national geographical distribution of the recorded species associated with *M. parviflora*were gathered from Zohary (1966, 1972), Täckholm (1974), Wickens (1977), Boulos (1999, 2000& 2002) and Ahmed (2003). The global distribution (i.e. floristic regions) is coded as follows: ME: Mediterranean, COSM: Cosmopolitan, SA-AR: Saharo-Arabian, Trop: Tropical, S-Z: Sudano-Zambezian, ER-SR: Euro-Siberian, IR-TR: Irano-Turanian, PAL: Palaeotropical, and PAN: Pantropical.

Vegetation analysis

Multivariate analysis

The Two-way indicator species analysis (TWINSPAN), as a classification technique, and Detrended Correspondence Analysis (DCA), as an ordination technique, were applied to the matrix of cover estimates of 141 species in 151 stands in *M.parviflora* population. TWINSPAN is a two-way classification FORTRAN program that constructs a key to the sample classification by identifying one to several species that are particularly diagnostic of each division in the classification. The most significant new feature is that the program first constructs a classification of samples, and then uses this classification to obtain a classification of species according to their ecological preferences (Hill, 1979a; Gauch and Whittaker, 1981). DCA is a FORTRAN program for detrended correspondence analysis and reciprocal averaging. It was applied as a mean of axis construction to achieve a two-dimensional ordination of species and stands (Hill, 1979b; Hill and Gauch, 1980).

Diversity indices

Some diversity indices were calculated for the vegetation groups as derived from the multivariate analysis. Species richness (alpha-diversity) for each vegetation group was calculated as the average number of species per stands. Species turnover (beta-diversity) was calculated as a ratio between the total number of species recorded in a certain vegetation group and its alpha diversity (Whittaker, 1972). Relative evenness or equitability (Shannon-Wiener index) of the species cover was expressed as $\hat{H} = -\Sigma s\ Pi\ (\log Pi)$, where S is the total number of species and Pi is the relative cover of the species. The relative concentration of dominance is the second group of heterogeneity indices and is expressed by Simpson's index: $D= 1/C\ \{C = \Sigma s\ (Pi)2\}$, where S is the total number of species and Pi is the relative cover of species (Pielou, 1975; Magurran, 1988).

Results

Floristic Analysis

Therecorded species associated with *Malva parviflora* populations with their families, life forms and floristic categories are presented in **Table (1)**. One hundred and forty one species were recorded in 151 sampled stands of *Malva parviflora* populations belong to 48 genera and 35 families were recorded associated with *M. parviflora*. The dominant families was Poaceae represented by 25 species (**Fig.2 and Tab. 1**); followed by Asteraceae (18 species); Chenopodiaceae and Fabaceae (12 species); Brassicaceae (11species); and Euphorbiaceaeand Solanaceae (five species). In addition, four families were represented by

four species for each, while two families were represented by three species for each, and nine families included two species. In addition to 11 families were represented by only one species.

Eighty-eight species, representing 62.4% of the total species, were recorded as annuals; such as *Aizoon canariense, Mesembrianthemum crystallinum* and *Amaranthus hybridus,* while 53 species (37.6%) were perennials such as *Iphiona mucronata*, *Silybum marianum* and *Cynanchum acutum*. Moreover, 90 species represented by 63.8% of the total species were terrestrial weeds such as *Alhagi graecorum, Anagallis arvensis, Ranunculus marginatus* and *Avena fatua*, while 39 species (27.7%) were natural plants; of them *Anabasis articulata, Calotropis procera* and *Centaurea pumilio*, 10 species (7.1%) were plants escaped from cultivation such as *Faba sativa, Eruca sativa* and *Helianthus annus*, and two species (1.4%) were aquatic plants, which are *Persicaria salicifolia* and *Phragmites australis* (**Tab. 1 and Fig. 3**).

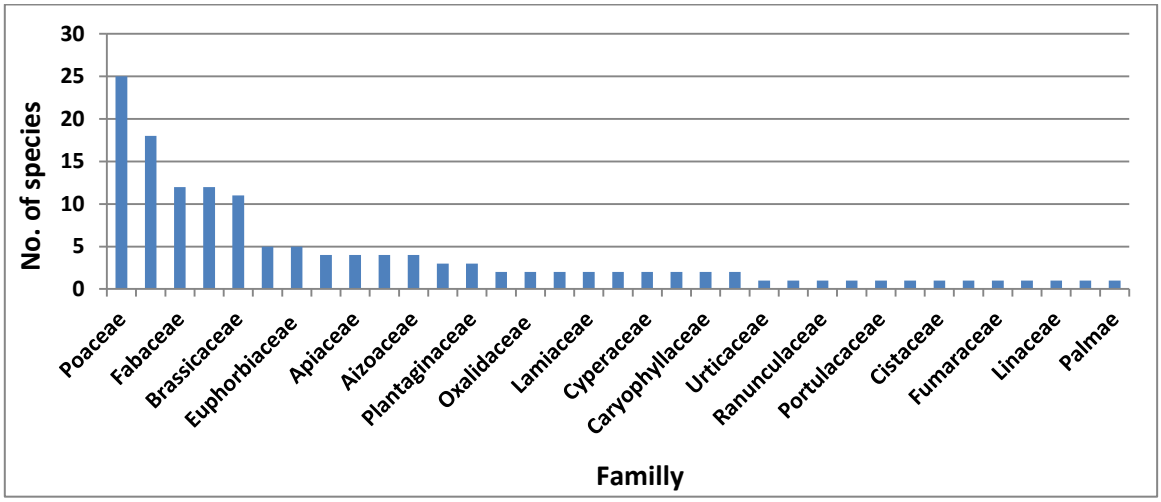

Fig. 2. Number of plant species belonging to the different families associated with *Malva parviflora*.

Table 1. Floristic characteristics of the recorded species associated with *Malva parviflora*. ME: Mediterranean, COSM: Cosmopolitan, SA-AR: Saharo-Arabian, Trop.: Tropical, S-Z: Sudano-Zambezian, ER-SR: Euro-Siberian, IR-TR: Irano-Turanian, PAL: Palaeotropical, and PAN: Pantropical, Ch: Chamaephytes, H: Hemicryptophytes, GH: Geophytes-helophytes, and Th: Therophytes.

Species	Arabic name	Habit	Life form	Floristic category
Aizoaceae				
Aizoon canariense L.	--------- -	Annual	Th	Trop+SA-AR+IR-TR
Mesembryanthemum crystallinum L.	غسول	Annual	Th	ME+ER-SR
Mesembryanthemum forsskaolii Hochst. ex Boiss.	صوابع الهانم	Annual	Th	S-Z
Mesembryanthemum nodiflorum L.	سمح	Annual	Th	ME+ER-SR+SA-AR
Alliaceae				
Allium cepa L.	بصل	Annual	Th	Cultivated
Amaranthaceae				
Amaranthus graecizans L.	شجرة السنتين	Annual	Th	COSM
Amaranthus hybridus L.	رعاف	Annual	Th	COSM
Amaranthus lividus L.	أمارنطون	Annual	Th	ME+IR-TR
Amaranthus viridis L.	كبشولجناح	Annual	Th	COSM
Apiaceae				
Ammi majus L.	خله شيطاني	Annual	Th	IR-TR+ME
Ammi visnaga (L.) Lam.	خلة	Annual	Th	ME+IR-TR
Anethum graveolens L.	شبت	Annual	Th	S-Z
Pimpinella anisum L.	ينسون	Annual	Th	Cultivated
Asclepiadaceae				
Calotropis procera (Aiton) W. T. Aiton	عشر - عشار	Perennial	Ph	Trop
Cynanchum acutum L.	عليق	Perennial	Ph	ME+IR-TR
Asteraceae				
Anthemis Pseudocotula Boiss.	باسون	Annual	Th	ME+IR-TR+ER+SA-AR
Bidens pilosa L.	-------- --	Annual	Th	Trop
Centaurea pumilio L.	مرير	Annual	Th	ME+ER-SR
Cichorium endivia L.	شيكوريا	Annual	Th	ME+IR-TR
Conyza bonariensis (L.) Cronquist.	حشيشة الجبل	Annual	Th	ME+MA
Helianthus annus L.	عباد الشمس	Perennial	Ch	Cultivated
Iphiona mucronata (Forssk.) Asch. & Schweinf.	دفبرة	Perennial	Ch	SA-AR

Launaea nudicaulis (L.) Hook. F.	حوا	Perennial	H	SA-AR+IR-TR+S-Z
Matricaria recutita L.	بابونج	Annual	Th	ME+ER-SR+IR-TR
Pluchea dioscoridis (L.) DC.	برنوف	Perennial	Ph	SA-AR+S-Z
Pulicaria undulata (L.) C. A. May.	جثجاث،سد بد	Perennial	Ch	SA-AR+S-Z
Reichardia tingitana (L.) Roth	عضيد	Annual	Th	IR-TR+SA-AR
Senecio glaucus subsp.*coronopifolium* (Maire) C. Alexander	أم لونين	Annual	Th	SA-AR+IR-TR
Silybum marianum (L.) Gaertn.	شوك نصارى	Perennial	H	ME+ER-SR+IR-TR
Soncuhs oleraceous L.	جعضيض	Annual	Th	COSM
Symphyotrichum squamatum (Spreng.) Nesom	استر	Perennial	GH	Trop
Urospermum picroides (L.) F. W. Schmidt	جلاوين	Annual	Th	IR-TR+ME
Xanthium strumarium L.	شبكه	Annual	Th	Trop
Brassicaceae				
Brassica nigra (L.) Koch.	لسبان	Annual	Th	ME
Brassica tournefortii Gouan	شرطام	Annual	Th	ME+SA-AR+IR-TR
Capsella bursa-pastoris (L.) Medik.	كيس الراعى	Annual	Th	COSM
Coronopus niloticus (Delile) Spreng.	حاره	Annual	Th	S-Z+EGYPT
Diplotaxis harra (Forssk.) Boiss.	حاره	Perennial	H	SA-AR
Eruca sativa Mill.	جرجير	Annual	Th	ME+ER-SR+IR-TR+SA-AR
Erucaria hispanica (L.) Druce	روق	Annual	Th	ME
Matthiola longipetala (Vent.) DC.	منتور	Annual	Th	ME+IR-TR

Table 1. Cont.

Species	Arabic name	Habit	Life form	Floristic category
Raphanus raphanistrum L.	فجل	Annual	Th	ME+ER-SR
Sisymbrium irio L.	فجل الجمل	Annual	Th	COSM
*Zilla spinosa (*L.) Prantl	زله	Perennial	Ch	SA-AR
Caryophyllaceae				
Spergularia marina (L.) Bessler	أبو غلام	Perennial	H	ME+ER-SR+IR-TR
Stellaria pallida (Dumort.) Murb.	حشيشة القزاز	Annual	Th	ME+ER-SR
Chenopodiaceae				
Anabasis articulata (Forssk.) Moq.	عجرام	Perennial	Ch	SA-AR
Atriplex farinosa Forssk.	قطف	Perennial	Ph	SA-AR
Atriplex halimus L.	رجات	Perennial	Ph	ME+SA-AR
Bassia indica (Wieght) A. J. Scott	كوخيا	Annual	Th	IR-TR+S-Z
Beta vulgaris L.	سلق	Annual	Th	ME+ER-SR+IR-TR
Chenopodium album L.	ركب الجمل	Annual	Th	COSM
Chenopodium ficifolium Sm.	..	Annual	Th	COSM
Chenopodium murale L.	لسان الثور	Annual	Th	COSM
Salsola imbricata Forssk.	طارطير	Perennial	Ch	S-Z+SA-AR
Salsola kali L.	أشنان	Annual	Th	COSM
Salsola tetragona Delile	زمران	Perennial	Ch	SA-AR
Haloxylon salicornicum (Moq.) Bunge ex Boiss.	بلبل	Perennial	Ch	S-Z
Cistaceae				
Helianthemum stipulatum (Forssk.) C. Chr.	رعل	Perennial	Ch	SA-AR
Convolvulaceae				
Convolvulus arvensis L.	عليق	Perennial	H	Trop
Ipomoea carnea Jacq.	عليق الكبير	Perennial	H	ME+IR-TR
Cyperaceae				
Cyperus longus L.	سعد	Perennial	GH	ME+IR-TR+ER-SR
Cyperus rotundus L.	سعد	Perennial	GH	ME+IR-TR+Trop
Euphorbiaceae				
Euphorbia peplus L.	ودينه	Annual	Th	ER-SR+ME+IR-TR .
Euphorbia granulata Forssk.	ملبين	Annual	Th	SA-AR
Ricinus communis L.	خروع	Perennial	Ph	PAN
Euphorbia Helioscopia L.	سعدة	Annual	Th	ER-SR+ME+IR-TR+S-Z
Euphorbia prostrata Aiton	لبين	Annual	Th	Trop

Fabaceae				
Alhagi graecorum Boiss.	عاقول	Perennial	Ch	ME+IR-TR+SA-AR+S-Z
Astragalus spinosus (Forssk.) Muschl.	قتاد	Perennial	H	IR-TR+SA-AR
Cicer aretinvm L.	حمص	Annual	Th	Cultivated
Faba sativa L.	فول	Annual	Th	Cultivated
Lotus glaber Mill.	رجل العصفور	Perennial	H	ME+ER-SR+IR-TR
Medicago polymorpha L.	نفل	Annual	Th	COSM
Melilotus indicus (L.) All.	حندوق حلو	Annual	Th	ME+IR-TR+SA-AR
Sesbania sesban (L.) Merr.	سيسبان	Perennial	Ph	S-Z
Trifolium alexandrinum L.	برسيم	Annual	Th	ME
Trifolium resupinatum Boiss.	جريده	Annual	Th	IR-TR+ER-SR+ME
Trigonella stellata Forssk.	شطن الخادم	Annual	Th	IR-TR+SA-AR
Vicia sativa L.	جلبان	Annual	Th	ME+ER-SR+IR-TR
Frankeniaceae				
Frankenia pulverulenta L.	حميشة	Annual	Th	ME+ER-SR+IR-TR
Fumaraceae				
Fumaria gaillardotii Boiss.	زيته	Annual	Th	ME+ER-SR+IR-TR
Geraniaceae				
Erodium gruinum (L.) L'Her	ابو مصفه	Annual	Th	ME
Juncaceae				
Juncus acutus L.	سمار مر	Perennial	GH	ME+ER-SR+IR-TR
Juncus rigidus Desf.	سمار حصر	Perennial	GH	ME+SA-AR+IR-TR
Lamiaceae				
Lamium amplexicaule L.	فم السمكة	Annual	Th	ME+ER-SR+IR-TR
Mentha longifolia (Briq.) Harley	نعناع	Annual	Th	ME+ER-SR+IR-TR
Malvaceae				
Malva parviflora L.	خبيزة	Annual	Th	ME+IR-TR
Malvastrum coromandelianum (L.) Garcke	----------	Annual	Th	Trop

Table 1. Cont.

Species	Arabic name	Habit	Life form	Floristic category
Opuntiaceae				
*Opuntia ficus-indica (*L.) Mill.	التين الشوكي	Perennial	Ph	Cultivated
Oxalidaceae				
Oxalis corniculata L.	حمد	Perennial	GH	COSM
Oxalis pescaprae L.	عرق الليمون	Perennial	GH	PAL
Palmae				
Phoenix dactylifera L.	نخيل البلح	Perennial	Ph	SA-AR+S-Z
Plantaginaceae				
Plantago albicans L.	لقمة النعجة	Perennial	H	ME+SA-AR
Plantago major L.	لسان الحمل	Perennial	H	COSM
Plantago ovata Forssk.	دقيس	Annual	Th	IR-TR+SA-AR
Poaceae				
Avena fatua L.	زمير	Annual	Th	COSM
Brachiaria eruciformis (Sm.) Griseb.	نسيله	Annual	Th	ME+IR-TR
Bromus catharticus Vahl.	أبو فخور	Annual	Th	ME+ER-SR+IR-TR+MA
Cenchrus echinatus L.	ياداب	Annual	Th	SA-AR+S-Z
Cutandia memphitica (Spreng.) K. Richt.	صامه	Annual	Th	ME+SA-AR+IR-TR
Cynodon dactylon (L.) Pers.	نجيل	Perennial	GH	COSM
Digitaria sanguinalis (L.) Scop.	دفيره	Annual	Th	PAL
Echinochloa colona (L.) Link	أبو ركبة	Annual	Th	ME+IR-TR+Trop
Hordeum murinum spp. *leporinum* (Link) Arcang.	ريش أبو الحسن	Annual	Th	ME+IR-TR
Imperata cylindrica (L.) Raeusch.	حلفا	Perennial	GH	ME+SA-AR+IR-TR
Lolium multiflorum Lam.	سمبل	Annual	Th	ME+ER-SR+IR-TR
Lolium perenne L.	حشيش الفرس	Annual	Th	ME+ER-SR+IR-TR
Panicum coloratum L.	قصبة	Perennial	GH	PAL
Panicum repens L	نجيل فارسي	Perennial		PAL+Trop+ME
Panicum turgidum Forssk.	أثمام	Perennial	GH	SA-AR+S-Z
Phalaris minor Retz.	شعير الفار	Annual	Th	ME+IR-TR
Phragmites australis (Cav.) Trin.ex Steud	حجنة	Perennial	GH	COSM
Poa annua L.	سبل أبو الحسين	Annual	Th	ME+ER-SR+IR-TR
Polypogon monspeliensis (L.) Desf.	ديل القط	Annual	Th	COSM
Schismus barbatus (L.) Thell.	زغب الفار	Annual	Th	ME+SA-AR+IR-TR

Setaria verticillata (L.) P.Beauv.	قمح الفار	Annual	Th	COSM
Sorghum virgatum (Hack.) Stapf	جراوه	Perennial	GH	S-Z
Stipagrostis plumosa (L.) Munro ex T. Anderson	نوى بيضه	Perennial	H	IR-TR+SA-AR
Triticum aestivum L.	قمح	Annual	Th	Cultivated
Zea mays L.	دره	Annual	Th	PAL
Polygonaceae				
Emex spinosa (L.) Campd.	ضرس العجوز	Annual	Th	ME+SA-AR
Persicaria salicifolia (Brouss. ex Willd.) Assenov	أبو عين حمرة	Perennial	GH	COSM
Rumex dentatus L.	حميض	Annual	Th	ME+ER-SR+IR-TR
Rumex visicarius L.	حُماض	Annual	Th	SA-AR+S-Z+IR-TR
Portulacaceae				
Portulaca oleracea L.	رجلة	Annual	Th	COSM
Primulaceae				
Anagallis arvensis L.	عين القط	Annual	Th	ME+ER-SR+IR-TR
Ranunculaceae				
Ranunculus marginatus L.	زغلنتة	Annual	Th	ME+ER-SR+IR-TR
Resedaceae				
Reseda pruinosa Delile	خزامه	Annual	Th	Trop+SA-AR+ME
Solanaceae				
Hyoscyamus muticus L.	سكران	Perennial	H	ME
Nicotiana glauca R.C. Graham	مصاصه	Perennial	Ph	Trop
Solanum lycopersicum L.	طماطم	Annual	Th	Cultivated
Solanum nigrum L.	عنب الديب	Perennial	Ch	ME+ER-SR+IR-TR
Lycium shawii Roem. & Schult.	عوسج	Perennial	Ph	SA-AR+S-Z

Table 1. Cont.

Species	Arabic name	Habit	Life form	Floristic category
Tamaricaceae				
Reaumuria hirtella Jaub. & Spach	----------	Perennial	Ch	SA-AR
Tamarix nilotica (Ehrenb.) Bunge	مور	Perennial	Ph	SA-AR+S-Z
Urticaceae				
Urtica urens L.	حريق	Annual	Th	ME+ER-SR
Zygophyllaceae				
Zygophyllum album L.	رطريط	Perennial	Ch	ME+SA-AR
Zygophyllum coccineum L.	رطريط	Perennial	Ch	SA-AR
Zygophyllum simplex L.	قرمل،جُرمل	Annual	Th	SA-AR+S-Z

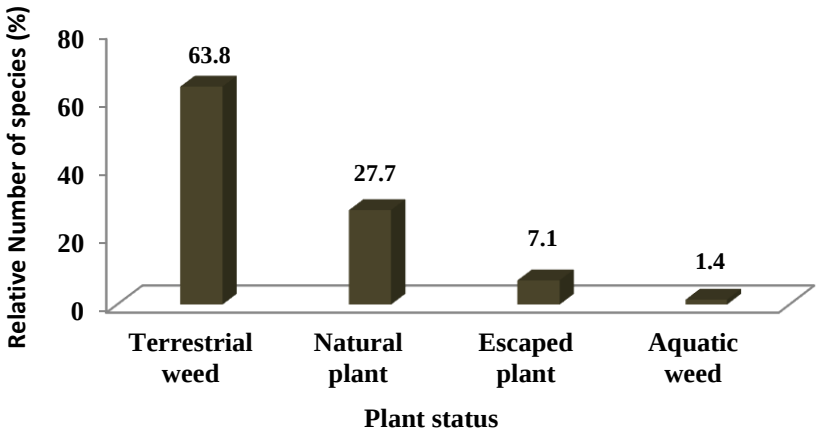

Fig.3. Status of the recorded species associated to *M. parviflora*

Life forms

The life forms spectra of the recorded species associated with *M. parviflora*population indicated the presence of five different categories: hemicryptophytes, geophytes-helophtes, chamaephytes, phanerophytes and therophytes (**Fig. 4**). It was found that therophytes were the dominant life form represented by 88 species (63% of the total species), followed by geophytes-helophtes and chamaephytes represented by 14 species for each (10%), phanerophytes and hemicryptophytes represented by 12 species for each (8.5%).

Global Phytogeographical Distribution

The chorological analysis of the recorded species associated with *M. parviflora* indicated the predominance of pluri-regional elements (30% of the total species), followed by mono-regional and bi-regional taxa (each is 24%) and cosmopolitans (15%). Nine species representing 7% of the total species were recorded as cultivated plants (**Fig. 5**).

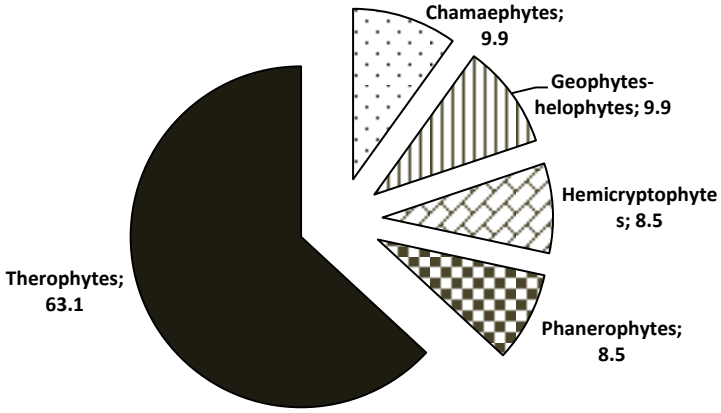

Fig.4. Life forms spectra of the recorded species associated with *M. parviflora*. Th: therophytes. H: hemicryptophytes, GH: geophytes-helophytes and Ch: chamaephytes, Ph: phanerophytes.

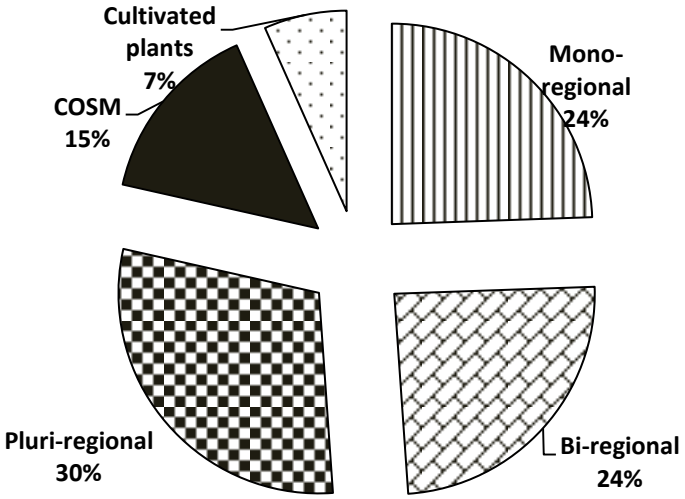

Fig.5. Global phytogeographical distribution of species associated with *M. parviflora*.

Local Phytogeographical Distribution

Figure (5) illustrated that 13 species of the total species associated with *M. parviflora*had a wide national geographical distribution all over Egypt (i.e. occur in all the 12 geographical regions) of them *Amaranthus graecizans, Cynodon dactylon* and *Cyperus rotundus*. In addition, 10 species were distributed in 11 regions (*Alhagi graecorum, Anagallis arvensis* and *Chenopodium murale*). Moreover, *Chenopodium ficifolium* was restricted to the Nile delta region, while *Atriplex farinose, Centauria pumilio* and *Plantago albicans* were exclusively belonged to Red Sea, MP and Marmarica regions, respectively (**Fig. 6**).

According to the abundance categories of the recorded species associated with *M. parviflora*, it was found that 42.9% of the total species were common, while 31.6% were very common, 18.0% were rare and 7.5% were very rare (**Fig. 7)**. Moreover, the highest proportion of species (79.7% of the total species) was belonged to the Nile Delta region, while the lowest (21.1%) were related to Gebel Elba .

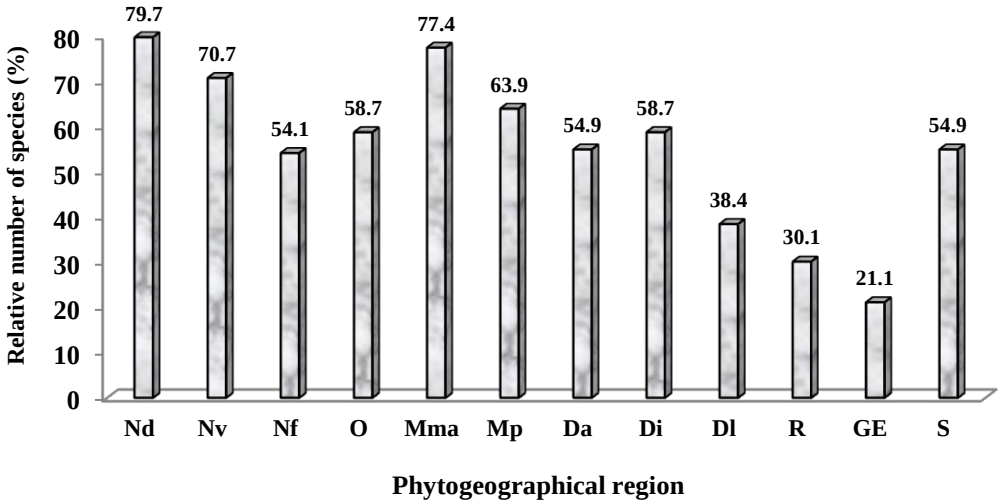

Fig. 6. Distribution of the recorded species in the national phytogeographical regions.N: Nile region, O, Oases, M: Mediterranean region, D: Desert region, R: Red Sea region, GE: Gebel Elba and S: Sinai

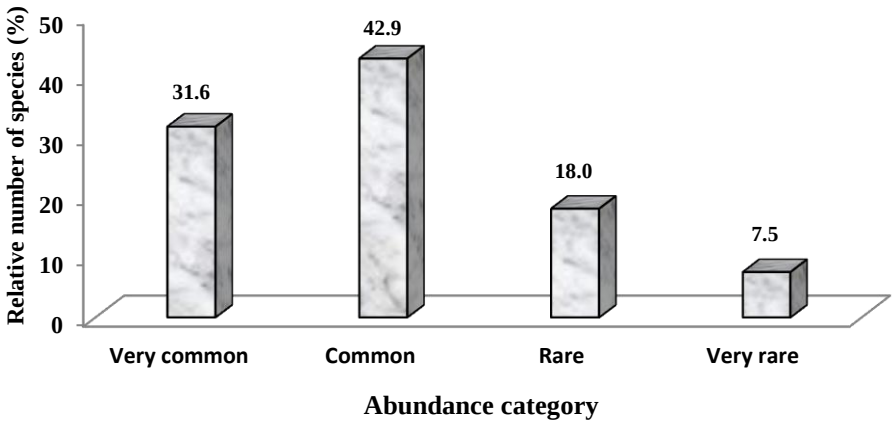

Fig. 7. Abundance categories of the recorded species associated with *Malva parviflora* in the different national phytogeographical regions.

Vegetation analysis

The application of TWINSPAN on the cover estimates of 141 species recorded in the 151 sampled stands of *Malva parviflora*, led to the recognition of 14 vegetation groups (**Table 2** and **Fig. 8**). These groups showed a reasonable segregation along the habitats DECORANA (**Fig.9**). The vegetation groups are named according to first and second dominant species associated with *M. parviflora* (the species that have the highest presence percentage and / or the highest relative cover). The presence of *M. parviflora* was 100% in all vegetation groups, while cover varied from one group to another. The description of these vegetation groups was as follows:

A) *Mesembryanthemum forskaolii-Bassia indica*: It included three stands and 7 species. In this group, *M. forskaolii* represented by 10.3% cover and 100% presence, while *B. indica* was represented by 10.3% cover, and 66.7% presence. The associated species include *Emex spinosa, Lolium perenne, Plantago ovate* and *Senecio glucus* subsp. *coronopifolius*.

B) *Bassia indica-Atriplex farinosa*: It comprised one stand and 17 species. *B. indica* was represented by 50% cover and 100% presence, while *A. farinose* was represented by 6.0 % cover and 100% presence. The associated species include *Anabasis articulata, Cetaria pumilio, Cynanchum acutum, Hordeum murinum* subsp. *leporinum,* and *Rumex dentatus.*

C) *Plantago ovate-Mesembryanthemum forskaolii*:It included six stands and 18 species. In this group *P. ovata* was represented by 2.2% cover and 100% presence, while *M. forskaolii* was represented by 1.4% cover and 100% presence**.** The associated species include *Panicum coloratum, P. repens, Raphanus raphanistrum, Raeumaria hirtella* and *Trigonella stellata.*

D) *Atriplex halimus-Rumex dentatus*: It included 3stands and 30 species. *A. halimus* was represented by 15 % cover and 100% presence, while *R. dentatus* was represented by 3.8% cover and 100% presence. *T. stellata, T. nilotica*and *R. hirtella* are the common associated species.

E) *Zilla spinosa-Cutondia memphitica*: It comprised 3 stands and 17 species. *Z. spinosa* was represented by 0.7% cover, while *C. memephitica* was represented by 0.5% cover. However, the two species have 100% presence. The associated species include *Chenopodium album,C. murale*, *Euphorbia granulata* and *Lolium multiflorum*.

F) ***Senecio glaucus subsp-coronopifolius-Chenopodium murale*****:** This group comprised 5 stands and 32 species. *S. glaucus* subsp. *coronopifolius* was represented by 12.6 % cover, while *C. murale* was represented by 0.9 %. The two species are represented by 80.0 % presence**.** The associated species include *Matthiola longipetala,Mesembrianthemum nodiflorum, Panicum turgidum* and *Zygophyllum coccineum.*

G) ***Alhagi graecorum-Chenopodium murale*****:** It included 6 stands and 11 species. The cover of *A. graecorum* was 8.5 %, while that of *C. murale* was 7.1% cover and the two species had 100% presence. *Coronopus niloticus, Cyperus longus* and *Phragmites australis* are the common associated species.

H) ***Chenopodium murale-Cynodon dactylon*****:** This group included 40 stands and 140 species. It was found that *C. mural* had 10.4 % cover and 90% presence, while *C. dactylon* had 8.7% cover and 77.5% presence. The associated species comprise *A. graecizans, Amaranthus lividus, A. viridus, B. indica* and *Avena fatua.*

I) ***Chenopodium mural-Bassia indica*****:** This group included 19 stands and 61 species. *C. mural* had 3.4 % cover and 78.9% presence, while *B. indica* had 4.1% cover and 52.6% presence. The common associated species are *Schismus barbatus, Sesbania sesban, A. graecorum, A. lividus* and *A. viridus.*

J) ***Tamarix nilotica-Juncus rigidus*****:** One stand and 3 species represented this group. *T. nilotica* had 25 % cover and 100% presence, while *J. rigidus* had 20% cover and 100% presence.

K) ***Euphorbia peplus-Euphorbia helioscopia*****:** This group included 9 stands and 44 species. It was found that, *E. peplus* had 1.2 % cover and 100% presence, while *E. helioscopia,* had 3.3% cover and 85% presence. The common associated species comprise *Allium cepa, Amaranthus lividus, A. hybridus, Ammi majus* and *Ammi visnaga.*

L) ***Poa annua-Coronopus niloticus*****:** This group included 20 stands and 31 species with *P. annua* had 7.8 % cover and 80 % presence. However, *C. niloticus* had 3.3% cover and 60% presence. The common associated species are *Bidens pilosa, Amaranthus hybridus, Alhagi graecorum, Amaranthus lividus* and *Bromus catharticus*.

M) ***Cynodon dactylon-Chenopodium murale*****:** It comprised 23 stands and 39 species. *C. dactylon* had 11.9 % cover and 73.9 % presence, while *C. murale* had 4.1% cover and 63.9% presence. The associated species comprise *A. cepa, A. hybridus, A. arvensis* and *A. fatua*.

N) ***Plantago major-Echinochloa colona*****:** This group included 7 stands and 23 species. It was found that *P.major* had 27 % cover and 100 % presence, while *E. colona* had 6.5% cover and 57.1% presence. The associated species comprise *A.hybridus, B. pilosa* and *C. album.*

Table2. First dominant species and 2nd dominant species in vegetation groups, with *malva parviflora*. C:cover , P:presence.

VG	No. of stands	1st dominant species	C	P	2nd dominant species	C	P
A	3	*Mesembryanthemum forskaolii*	10.3	100.0	*Bassia indica*	10.3	66.7
B	1	*Bassia indica*	50	100	*Atriplex farinosa*	6	100
C	6	*Plantago ovata*	2.2	100	*Mesembryanthemum forskaolii*	1.4	100
D	3	*Atripex halimus*	15	100	*Rumex dentatus*	3.8	100
E	3	*Zilla spinosa*	0.7	100	*Cutondia memphitica*	0.5	100
F	5	*Senecio glaucus subsp. coronopifolius*	12.6	80	*Chenopodium murale*	0.9	80
G	6	*Alhagi graecorum*	8.5	100	*Chenopodium murale*	7.1	100
H	40	*Chenopodium murale*	10.4	90	*Cynodon dactylon*	8.7	77.5
I	19	*Chenopodium murale*	3.4	78.9	*Bassia indica*	4.1	52.6
J	1	*Tamarix nilotica*	25	100	*Juncus rigidus*	20	100
K	9	*Euphorbia peplus*	1.2	100	*Euphorbia helioscopia*	3.3	85
L	20	*Poa annua*	7.8	80	*Coronopus niloticus*	1.3	60
M	23	*Cynodon dactylon*	11.9	73.9	*Chenopodium murale*	4.1	63.9
N	7	*Plantago major*	2.7	100.0	*Echinochloa colona*	6.5	57.1

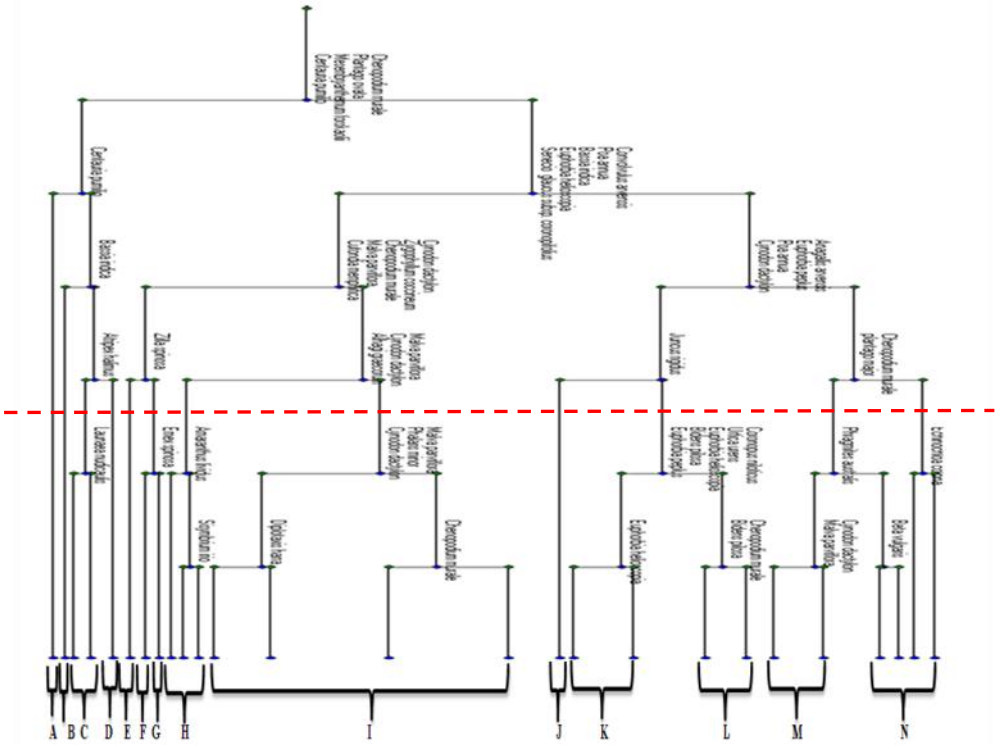

Fig.8. The dendrogram resulting from the application of TWINSPAN on the 151 sampled stands.

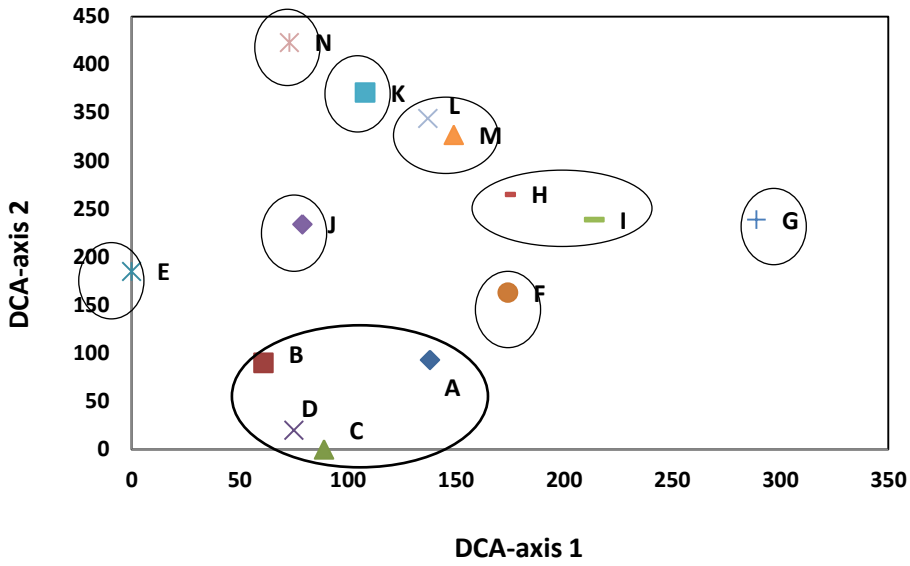

Fig.9.DCA ordination of the 12 vegetation groups identified after the application of TWINSPAN on the 151 sampled stands. ***A:*** *Mesembrianthemum forskaolii-B. indica,* **B:***Bassia indica-Atriplex farinose,* **C:***Plantago ovata-M.forskaolii,* **D:***A. halimus-Rumex dentatus,* **E:***Zilla spinosa-Cutandia memphetica,* **F:***Senecio glaucus* subsp. *coronopifolius- Chenopodium murale, Alhagi graecorum- C. murale,* **H:** *C. Murale-Cynodon dactylon,* **I:** *C. murale- B. indica,***J:***Tamarix nilotica-Juncus rigidus,* **K:***Euphorbia peplus-E. helioscopia,* **L:***Poa annua-Coronopus niloticus,* **M:***C. dactylon-C. murale* and **N:***P. major- Echinochloa colona.*

Diversity of the plant communities

The total number of species recorded in the 14 vegetation groups (**Table 3**), identified according to TWINSPAN classification technique, ranged between 3 in *Tamarix nilotica-Juncus rigidus* group (VG J) and 75 in *Chenopodium murale-Cynodon dactylon* (VG H), which had the highest values of species turnover and Shannon index (8.4 and 3.6) . It was fond that *Bassia indica-Atriplex farinosa* group (VG B) had the highest species richness (17.0 species stand^{-1}), while VG (J) had the lowest species richness, species turnover, Shannon index and Simpson index (3.0 species stand^{-1}, 1.0, 1.1 and 3.0), respectively. Moreover, the highest value of Simpson index (27.2) was recorded in *Zilla spinosa-Cutandia memphetica* (VG E).

Table 3. Diversity indices of the 14 vegetation groups produced from TWINSPAN. Maximum and minimum values are underlined.

VG	No. of species	Species richness	Species turnover	Shannon Indix	Simpson index
A	7	4.0	1.8	1.9	6.1
B	17	17.0	1.0	2.8	17.2
C	18	9.2	2.0	2.7	12.5
D	16	11.0	1.5	2.6	12.9
E	30	17.0	1.8	3.3	27.2
F	32	11.6	2.8	3.3	23.2
G	11	6.0	1.8	2.2	7.7
H	75	8.9	8.4	3.6	22.2
I	61	9.3	6.6	3.6	24.8
J	3	3.0	1.0	1.1	3.0
K	44	13.9	3.2	3.4	24.6
L	31	7.0	4.4	3.0	14.5
M	39	7.9	4.9	3.1	16.5
N	23	9.4	2.4	3.0	17.7

Discussion

By the end of the study of*Malva parviflora* L population distribution and associated associations, the studied plant are well represent in the studied governorates and recorded in 12 habitats; canal banks, fallow land, desert, desert road sides, Agriculture road sides, railway, cultivated plants, cultivated crops, ditches, salt marches, reclaimed lands and orchards. This result supports the reports of Boulos (2000), Shaltout et al. (2010) and Shehata and Galal (2014). In addition, Greer and Thorpe (2009) reported that *M. parviflora*occupies high light condition habitats and is a weedy invader in many orchards and vineyards. Khalafallah et al. (2016a) recorded *M. barviflora* as one of the most abundant associated weed to *Opuntia ficus indica* in Al Kalubya, Mynufia and Buhayra. The wide geographic distribution of *M. parviflora* 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 the present study, the species belonging to Poaceae, Asteraceae, Chenopodiaceae, Fabaceae and Brassicaceae were the common associated species to *M. parviflora* population in the studied governorates. Where, these families constitute the bulk of the flora of the study area. This result is similar to those in Dakahlia-Damietta coastal region(Mashaly, 1987), the wastelands the Zagazig governorate (Abd El-Fattah et al., 1992), Kafr ElSheikh province (Shalaby, 1995), the Nile Delta region(Shehata and Galal, 2014) and in Al Kalubya, Mynufia and Buhayra(Khalafallah et al., 2016b). Of 141 species associated to *M. parviflora*, 88 were annuals and 55 species were perennials. Sans and Masalles (1995) attributed the high contribution of annuals to their short life cycle that enables them to resist the instability of the agro-ecosystem. Moreover, annuals generally are characterized by high allocation of resources to the reproductive organs and early production of flowers in their life-span to

ensure seeds production when the growing season is short. However, most perennial species are not adapted to successful establishment in arable crops(Marshall, 1989).

The life form spectra provide information which may help in assessing the response of vegetation to the variations in the environmental factors (Galal, 2005). 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 was represented by 63%, followed by geophytes-helophtes, chamaephytes were represented by 10%, phanerophyte and hemicryptophytes were represented by 9% and 8% respectively. Heneidy and Bidak (2001) and Shehata and Galal (2014) 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. According to Galal (2001) and Khalafallah et al. (2016a and 2016b), therophytes are the main life forms and most of them are weed species characteristic to the cultivated lands, coinciding with Hassib (1951) on the Egyptian flora. 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) in addition to habitat characteristics (Khalafallah et al., 2016a). 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; Shehata and Galal, 2014).

The chorological analysis of the recorded species associated with *M. parviflora* indicated the predominance of pluri-regional elements (30% of the total species), followed by mono-regional and bi-regional taxa (each is 24%) and cosmopolitans (15%). Nine species representing 7% of the total species were recorded as cultivated plants.Zohary (1973) referred to the dominance of interregional 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. The present result isn't in consistent with the results of Suliman et al. (2016)and Khalafallah et al. (2016a and 2016b), where they found that mono-regional species were the dominant elements in maize and wheat crops in Middle Delta and *Opuntia ficus indica* orchards. On the other hand, Mashaly (1987) recorded 50% of the species in the Deltaic sector are Mediterranean, 32% are pluri-regionals, and 8% are Saharo-Sindian elements. In the present study, Mediterranean species were the main category (30.99%) in the study area, however presence of phytogeographical elements other than Mediterranean is believed to be a reflection of intense climatic changes and/or the degradation of the Mediterranean ecosystem which facilitated the invasion of some species from the adjacent regions (Mashaly, 1987;Madi et al., 2002).

According to the relative number of the studied species associated to *M. parviflora*, the order of the national distribution in the studied area is Nd>Mma>Nv>Mp>O=Di>Da=S >Nf>Dl>R>GE. While Alsaidi (2017)found that the national distribution of associated species to *O. ficus indica* in the Nile Delta region follow the order; M>N>S>D>O>R>GE. This difference may be due to the high variation and wide area of the present study

Phytosociologists used ordination techniques to simplify distribution patterns along the gradients of environmental variables (Springuel and Murphy, 1991; Spink, 1992). The classification of vegetation associated with *M. parviflora* using TWINSPAN analysis, resulted in identifies 14 vegetation groups varied between natural and weed communities. *Chenopodium murale-Cynodon dactylon* vegetation group is a common community associated with *M. parviflora* consists of 40 stands and associated with 140 species. This classification may indicate the significant effect of habitat type, management practices in the agroecosys, seasonality and soil characteristics, these factors influence weed community composition (Légere and Samson, 1999; Leeson *et al.*, 2000;Gomaa, 2012; Alsaidi, 2017). The vegetation groups, resulted from TWINSPAN classification are clearly distinguished by the first two DCA axes. These results are in agreement with results of Andreasen and Skovgaard (2009),Gomaa (2012) andKhalafallah *et al.* (2016a)**,** who pointed out that season, soil characteristics, management practices and plant density, contribute to the composition of plant community.

The high species richness may be related to this environmental micro-heterogeneity that promotes diversity (Palmer and Maurer, 1997). The variations in species richness, diversity and evenness among the different community 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; Galal and Shehata, 2015; Khalafallah *et al.*, 2016a and 2016b). Moreover, the difference in field management practices may also be a factor that explains differences in species richness (Stevenson *et al.*, 1997; Sher and Al-Yemeni, 2011; Gomaa, 2012).

Summary

The present results revealed that *Malva parviflora*L. population were distributed in 12 habitats; canal banks, fallow land, desert, desert road sides, Agriculture road sides, railway, cultivated plants, cultivated crops, ditches, salt marches, reclaimed lands and orchards.One hundred and forty one belonging to 48 genera and 35 families were recorded associated with *M. parviflora* L. The dominant families were Poaceae, Asteraceae, Chenopodiaceae, Fabaceae and Brassicaceae. Annuals recorded the highest number of species (88 species) while perennials were represented by 53 species. Therophytes were the dominant life form represented by 88 species while pluri-regional elements represented the dominant floristic category (30% of the total species). The application of TWINSPAN on the cover estimates of 141 associated species recorded in the 151 sampled stands of *M. parviflora*, led to the recognition of 14 vegetation groups. *Chenopodium murale-Cynodon dactylon* (VG H)had the highest number of species (75 species), species turnover and Shannon index (8.4 and 3.6).

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الملخص باللغة العربية

التنوع الفلورى وتحليل الكساء الخضر لعشائر الخبيزة فى مصر

هند عبد العاطى الزليتنى[٢] ، طارق محمد جلال[١]، أحمد أحمد خلف الله[٢]، زينب أحمد عبد الجواد[٢]، سعاد عبد الجليل شتيوى[٢]

[١]قسم النبات والميكروبيولوجى - – كلية العلوم - جامعة حلوان

[٢]قسم النبات – كلية البنات للآداب والعلوم والتربية – جامعة عين شمس

تهدف الدراسة الحالية الى تحديد التوزيع البيئى لعشيرة نبات الخبيرة فى البيئات المصرية فى عدة محافاظات (القاهرة-الجيزة – القليوبية – المنوفية – الغربية – البحيرة –مرسى مطروح – السويس). دلت الدراسة على انتشار النبات فى ١٢ بيئة مختلفة فى منطقة الدراسة تتنوع بين زراعتها كمحصول ووجوده كحشائش مصاحبة للمحاصيل الحقلية، فى حواف القنوات والمراوى والبيئات الملحية وجوانب الطرق الصحراوية والزراعية والبيئات الصحراوية. بدراسة ١٥١ وقفة (10x10م) وجد أن عشيرة الخبيزة فى البيئات المختلفة يصاحبها ١٤١ نوع نباتى تتبع ٤٨جنس يتبعوا ٣٥ عائلة وكانت أكثر العائلات سيادة هى العائلة النجيلية ثم المركبة ثم الزربيحية ثم البقولية ثم الصليبية.سجلتالحوليات، العدد الأكبرالأقاليم الفلورية هى السائدة من بين المجموعات الفلورية للأنواع النباتية المصاحبةللخبيزة. وبتطبيق التحليل الدليلى ثنائى الاتجاه لعدد ١٥١وحدة دراسية و١٤١ نوع تم فصل أربعة عشرة مجتمع نباتى أهمهم مجتمع الزربيح-النجيل حيث احتوى على أكبر عدد من من الأنواع (٧٥ نوع) واعلى تنوع مقارنة بالمجتمعات الأخرى. ويتضح من الدراسة أن عشائر نباتات الخبيرة لديها مرونة عالية للنموفي موائل متنوعة وكذلك غنية بالتنوع النباتى وتعتبر مورد لعديد من الأنواع النباتية التى لها أهمية بيئية واقتصادية وطبية مما يدل على أهميتها.