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Article

WEED FLORA OF FAYOUM (EGYPT), ONE OF THE OLDEST AGRICULTURAL REGIONS IN THE WORLD

Flora de Plantas Daninhas de Faium (Egito), Uma das Regiões Agrícolas Mais Antigas do Mundo

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ABSTRACT - Fayoum region is the most fertile agricultural land in Egypt and one of the oldest agricultural city in the world. The present study aimed to determine its weed flora composition and its distribution through different habitats. Results recorded 175 species of vascular plants belonging to 124 genera and 35 families distributed in eight habitats. The richest families were Poaceae, Asteraceae (Compositae) and Fabaceae (Leguminoseae), while genera with the highest number of species were *Euphorbia*, *Amaranthus* and *Cyperus*. *Cynodon dactylon* and *Alhagi graecorum* were the present species, recorded at all habitats. Old cultivated lands recorded the highest species number followed by orchard habitats, on the contrast road side and wasteland habitats recorded the lowest species numbers. Therophytes were the dominant life form, while Phanerophytes were the smallest group in this study, 5%. The highest Jaccard similarity index was recorded between healthy land and orchard habitats, which supported also by ward classification.

Keywords: arable fields, weed, therophytes, agriculture, flora.

RESUMO - A região de Faium é a área agrícola mais fértil do Egito e uma das mais antigas cidades agrícolas do mundo. O presente estudo teve como objetivo determinar a composição da flora de plantas daninhas e sua distribuição através de diferentes habitats. Os resultados registraram 175 espécies de plantas vasculares pertencentes a 124 gêneros e 35 famílias, distribuídos em oito habitats. As famílias mais ricas foram Poaceae, Asteraceae (Compositae) e Fabaceae (Leguminoseae), enquanto os gêneros com maior número de espécies foram ***Euphorbia***, ***Amaranthus*** *e* ***Cyperus***. ***Cynodon dactylon*** *e* ***Alhagi graecorum*** *foram as espécies presentes, registradas em todos os habitats. As antigas terras cultivadas registraram o maior número de espécies, seguidas dos habitats com pomares, ao contrário das margens de estradas e dos habitats de terras baixas, que registraram o menor número. Os terófitos foram a forma de vida dominante, e os fanerófitos foram o menor grupo neste estudo (5%). O maior índice de similaridade de Jaccard foi registrado entre as terras saudáveis e o habitat com pomares, o que também foi confirmado pelo método de Ward.*

Palavras-chave: terra arável, plantas daninhas, terófitos, agricultura, flora.

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INTRODUCTION

Weeds are defined as any plant that is objectionable or interferes with the activities or welfare of man (Vencill, 2002). Their role is manifold from an

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agronomic point of view; they represent a major barrier to farmers in terms of harvest losses caused by their presence because they compete for different resources, such as nutrient and water (Wang et al., 2007). Some weeds are also allelopathic, which affects yields more adversely (Al-Sherif et al., 2013; Trezzi et al., 2016). By contrast, there is considerable evidence that arable weeds play an important role in providing resources and habitat to higher trophic levels by supplying food and shelter to a wide variety of farmland fauna (Storkey and Westbury, 2007; Al Sherif, 2009). Thus, the decrease in weed diversity has dramatically affected the associated food web. Weed species are adapted to crops and to management techniques such as soil disturbance by tillage or ploughing. However, condensation in the last decades with chemical fertilization, use of herbicides, plantations of high-tolerant cereal varieties and use of seed-cleaning mechanisms have decreased species richness (Roschewitz et al., 2005). To assess the true measure of these intensification factors, recent studies have been conducted in different countries to contrast weed flora structure with those of former studies conducted decades ago, e.g., in Germany (Sutcliffe and Kay, 2000), United Kingdom (Lososova et al., 2004) the Czech Republic (Pysek et al., 2005), and Denmark (Andreasen and Stryhn, 2008).

Egypt has an area of about one million km^2; its cultivated land occupies only four percent and the rest of the country is a desert. The Fayoum region is located about 95 km southwest of Cairo and is considered as one of the oldest agricultural cities in the world, as it was founded around 4000 BC; its location next to the Nile Valley was the main reason to attract extensive human activities, especially agriculture, since the Paleolithic era (Caton-Thompson and Gardner, 1929; Mc Donald, 2009; Hamdan and Lucarini, 2013; Fadl, 2016). It obtains its irrigation water from the Nile and its soil is mainly Nilotic silt. It gathers the characteristics of a desert depression with no outlet to the sea and the characteristics of the Nile Valley. Although it has been one of the most fertile and productive areas in Egypt since ancient times, currently there are no publications available on weed flora of the study area. In the meantime, there have been significant changes in kinds of crop that are typically mature in this area, as well as changes in tillage methods, fertilizer application and weed control methods. The content developed in this work represents an original approach whose aim is to determine the weed flora and its distribution through different habitats in the Fayoum region.

MATERIAL AND METHODS

Study area

Fayoum is a depression in the Libyan Desert, attached to the main valley trunk by a narrow neck-like connection. It has an area of approximately 1,700 km^2, and located about 95 km southwest of Cairo. It represents a lateral bud while the Delta is the flower and the Valley is the stem of a Lotus plant (Figure 1). It extends between longitudes 30°23' and 31°5' E, and latitudes 29°5' and 29°35'N with mean annual temperature of 20.9 °C and mean annual rainfall of 7 mm.

Floristic study

The agroecosystem in the study area (all the area of Fayoum governorate) was divided into 8 habitats (old cultivated land (healthy land), new reclaimed land, salt affected soil, wasteland, roadside, orchards, outskirts and Canal bank). Field data on the floristic composition were gathered throughout intensive fieldwork between January 2013 and May 2015 along the study area. A total of 208 permanently visited stands were surveyed, using a stratified sampling technique, and distributed along different habitats. Stands were determined as follows: 88 stands for old cultivated land, 20 stands for new reclaimed land, 14 for salt affected soil, 14 for wasteland, 20 for roadside, 20 for orchards (mainly orange and lemon orchards), 12 stands for outskirts and 20 stands for canal banks. The size of the stand varied from one site to another, depending on the total cultivated area, variability in both croplands, and habitats. Plant specimens were collected, identified and deposited at the herbarium of the Botany Department, Faculty of Science at Fayoum University. Identifications were performed according to TÓckholm (1974) and Boulos (1999, 2000, 2002, 2005). Life forms of species were detected while relying on the location of the regenerative buds and the shed parts during the unfavorable season (Raunkiaer, 1934) while the chorotypes were determined according to Zohary (1973).

Figure 1 - Location map of the study area.

Statistical analysis

We assessed floristic similarities between different habitats by performing a hierarchical classification analysis based on incidence interpolated data with Wards's (minimum variance) procedure and Euclidean distances as a dissimilarity measure (Ward, 1963); this analysis was performed with Statistica ver. 8 (StatSoft, Inc., Tulsa, OK, USA). Jaccard's similarity index was applied to evaluate ß diversity similarity among stands based on presence/absence of the species, as follows: JI=a/(a+b+c); a: number of common species in samples, b: species that exist just in the first sample, c: number of species that exist only in the second sample.

RESULTS AND DISCUSSION

One hundred and seventy-five species of vascular plants belonging to 124 genera and 35 families were recorded (Table 1). The richest families were Poaceae, Asteraceae (Compositae) and Fabaceae (Leguminoseae), whereas 10 families were recorded as monospecies and accounted for less than 29% of the total recorded families. Generally, family size was small; 33 families have less than 10 species and only four families have more than 10 species. Genera with the highest number of species were *Euphorbia* (6 species), *Amaranthus* and *Cyperus* (5 species each) and *Suaeda* (4 species). *Cynodon dactylon* and *Alhagi graecorum* were shown to be ubiquitous species as they were were recorded in all habitats while *Tamarix nilotica* and *Phragmites australis* occupied 87% of the study habitats. Twenty percent of the total species were recorded in one habitat only; about 70% of these species were recorded in old cultivated land and/or orchards while no species was confined to new reclaimed land or roadside habitats (Table 1). Old cultivated lands contained the highest number of species, genera and family numbers (85%, 89% and 94% respectively),

Table 1 - List of plant species recorded in the study area with their families and life forms in different habitats (+: present, -: absent)

Family	Weed species	Life forms	Healthy land	Reclaimed land	Salt affected soil	waste lands	Road side	Orachard	Outskirts	Canal bank
Adiantaceae	*Adiantum capillus-veneris* L.	He	+	-	-	-	+	+	-	+
Aizoaceae	*Opophytum forskahlii* (Boiss.) N.E.Brown	Th	-	-	-	-	-	-	+	-
	Trianthema portulacastrum L.	Th	+	-	+	+	-	+	+	+
Amaranthaceae	*Alternanthera sessilis* (L.) DC.	He	+	-	-	-	-	-	-	-
	Amaranthus blitum subsp. oleraceus (L.) Costea.	Th	+	+	-	-	-	+	+	-
	Amaranthus graecizans L.	Th	+	-	-	-	-	+	+	-
	Amaranthus hybridus L.	Th	+	+	-	+	-	+	-	-
	Amaranthus retroflexus L.	Th	+	-	-	-	-	+	-	-
	Amaranthus virdis L.	Th	+	-	+	+	-	+	+	-
	Kochia indica Wight	Th	+	-	+	+	-	-	+	-
Asclepiadaceae	*Calotropis procera* (Aiton) W. T. Aiton	Ph	+	-	-	-	-	-	+	-
	Cynanchum acutum L.	Ch	+	+	+	-	-	+	+	+
Boraginaceae	*Anchusa aegyptiaca* (L.) A. DC	Th	+	-	-	-	-	-	-	-
	Heliotropium supinum L.	Th	+	-	-	-	-	-	-	-
Brassicaceae	*Brassica nigra* (L.) Koch	Th	+	-	-	-	-	+	-	-
	Brassica rapa L.	Th	+	-	-	-	-	+	-	-
	Brassica tournefortii Gouan	Th	+	-	-	-	-	-	-	-
	Capsella bursa- pastoris (L.) Medik.	Th	+	-	-	-	-	+	-	-
	Coronopus didymus (L.) Sm.	He	+	-	+	-	-	+	+	-
	Coronopus squamatus (Forssk.) Asch.	He	+	-	+	-	-	+	-	-
	Enarthrocarpus lyratus (Forssk.) DC.	Th	-	-	-	-	-	-	+	-
	Sisymbrium irio L.	Th	+	-	-	-	-	+	-	-
Caryophyllaceae	*Spergula fallax* (Lowe) E.H.L.Krause	Th	+	-	-	-	-	+	-	-
	Spergularia salina L.	He	+	+	+	+	-	+	+	-
	Setallaria pallida (Dumort.) Piré	Th	+	+	-	-	-	+	-	-
Chenopodiaceae	*Atriplex halimus* L.	Ph	-	+	-	-	-	-	+	-
	Arthrocnemum macrostachyum (Moric.) k. Koch	He	+	-	-	-	-	-	-	-
	Bassia indica (Wight) A. J. Scott	Th	+	-	+	+	-	-	+	-
	Beta vulgaris L. *sub sp. Maritima* (L.) Arcang.	Th	+	+	+	-	-	+	+	-
	Chenopodium album L.	Th	+	-	-	-	+	+	+	-
	Chenopodium ambrosioides L.	Th	-	-	-	-	-	+	-	-
	Chenopodium murale L.	Th	+	+	+	+	-	+	+	-
	Chrozophora plicata (Vahl) Spreng.	Th	-	-	+	-	-	-	-	-
	Sarcocornia fruticosa (L.) A. J. Scott	Ch	+	-	+	+	-	-	-	+
	Suaeada aegyptiaca (Hasselq.) Zohary	Th	+	+	+	-	-	-	+	-
	Suaeada pruinosa Lsnge	He	+	-	-	-	-	-	+	-
	Suaeda vera Forssk. ex J. F. Gmel.	Th	-	-	-	-	-	-	+	-
	Suaeda vermiculata Forssk.ex J. F. Gmel.	Ch	+	-	+	+	-	-	-	-
Compositae	*Ambrosia maritima* L.	Ch	-	+	-	+	-	+	-	-
	Bidens pilosa L.	Ch	+	-	+	-	-	+	-	-
	Calendula arvensis L.	Th	+	-	-	-	-	+	-	-
	Cichorium endivia L.	Th	+	+	+	-	-	+	+	-
	Conyza bonariensis (L.) Cronquist	Th	+	-	+	-	-	+	+	+
	Eclipta alba (L.) Hassk.	Th	+	-	+	-	-	+	-	+
	Helichrysum luteoalbum (L.) Rchb.	Th	+	-	-	-	-	+	-	-

To be continued...

Table 1, cont...

Family	*Weed species*	Life forms	Healthy land	Reclaimed land	Salt affected soil	waste lands	Road side	Orachard	Outskirts	Canal bank
Compositae	*Launaea capitata* (Spreng.) Dandy	Th	+	-	-	-	-	-	+	-
	Launaea cassiniana (Boiss.) Kuntze	Th	-	-	-	-	-	-	+	-
	Launaea nudicaulis (L.) Hook. F.	He	+	-	-	-	-	-	+	-
	Matricaria recutita L.	Th	+	-	+	-	-	+	+	-
	Pluchea dioscoridis (L.) DC.	Ph	+	-	+	-	+	+	-	+
	Reichardia tingitana (L.) Roth	Th	-	-	-	-	-	-	+	-
	Senecio glaucus L.	Th	+	-	-	-	-	-	-	-
	Senecio vulgaris L.	Th	-	-	-	-	-	-	-	-
	Silybum marianum (L.) Gaertn.	He	+	+	-	-	-	-	-	-
	Sonchus asper (L.) Hill	Th	-	-	-	-	-	-	+	-
	Sonchus oleraceus L.	Th	+	+	+	-	+	+	+	-
	Symphyotrichum squamatum (Spreng.) G.L. Nesom	Th	+	+	+	-	-	+	+	+
	Urospermum picroides (L.) F. W. Schmidt	Th	-	-	-	-	-	+	-	-
	Xanthium strumarium L.	Th	+	+	-	-	-	+	-	-
Convolvulaceae	*Convolvulus arvensis* L.	He	+	+	+	-	+	+	-	-
	Cressa cretica L.	Th	+	-	+	+	-	-	-	-
	Cuscuta pedicellata Ledeb.	Th	+	-	-	-	-	-	-	-
Cyperaceae	*Cyperus alopecuroides* Rottb	He	+	-	-	-	-	-	-	+
	Cyperus articulatus L.	He	+	-	-	-	-	-	-	-
	Cyperus laevigatus L.	Ge	+	-	+	-	-	-	-	-
	Cyperus longus L.	Ge	+	+	-	-	-	+	-	-
	Cyperus rotundus L.	Ge	+	+	+	-	+	+	-	-
Euphorbiaceae	*Euphorbia arguta* Banks & Sol.	Th	+	-	+	-	-	+	-	-
	Euphorbia forsskalii J.Gay	Th	+	-	-	-	-	+	-	-
	Euphorbia granulata Forssk.	Th	+	-	-	;	-	-	-	-
	Euphorbia helioscopia L.	Th	+	-	+	-	-	+	-	-
	Euphorbia heterophylla L.	Th	+	-	-	-	-	+	-	-
	Euphorbia peplus L.	Th	+	-	-	-	-	+	-	-
	Ricinus communis L.	Ph	+	-	-	-	-	+	-	+
Frankeniaceae	*Frankenia pulverulenta* L.	He	+	-	-	-	-	-	-	-
	Frankenia revolute Forssk.	Th	+	-	-	-	-	-	-	-
Gramineae	*Aeluropus lagopoides* (L.) Trin. ex Thwaites	Ge	-	+	-	+	-	-	+	-
	Avena fatua L.	Th	+	-	-	-	-	+	-	-
	Avena sativa L.	Th	+	-	-	-	-	+	-	-
	Brachiaria eruciformis (Sm.) Griseb.	He	+	-	-	-	-	+	+	-
	Bromus catharticus Vahl	Th	+	-	-	-	-	-	-	-
	Cenchrus ciliaris L.	Th	+	-	-	-	-	-	-	-
	Cynodon dactylon (L.) Pers.	Ge	+	+	+	+	+	+	+	+
	Dactyloctenium aegyptium (L.) Willd.	Th	+	+	-	-	-	+	-	-
	Desmostachya bipinnata (L.) Stapf	He	+	-	-	-	-	+	-	-
	Dichanthium annulatum (Forssk.) Stapf	He	+	-	+	+	-	+	+	-
	Digitaria sanguinalis (L.) Scop.	Th	+	-	-	-	-	+	-	-
	Dinebra retroflexa (Vahl) Panz.	Th	+	-	-	-	-	+	-	-
	Echinochloa colona (L.) Link	Th	+	+	+	-	+	+	+	-
	Echinochloa crus galli (L.) P. Beauv.	Th	+	+	-	-	-	+	-	+
	Echinochloa stagnina (Retz.) P. Beauv.	He	+	-	-	-	-	-	-	+

To be continued...

Table 1, cont...

Family	*Weed species*	Life forms	Healthy land	Reclaimed land	Salt affected soil	waste lands	Road side	Orachard	Outskirts	Canal bank
Gramineae	*Hordeum murinum* L.	Th	+	+	-	-	-	-	+	-
	Imperata cylindrica (L.) Raeusch.	Ge	+	+	+	-	-	+	-	+
	Leptochloa fusca (L.) Kunth	He	+	-	+	-	-	+	-	-
	Lolium multiflorum Lam.	Th	+	-	-	-	-	+	-	-
	Lolium perenne L.	He	+	+	+	-	-	+	+	-
	Lolium temulentum L.	Th	+	-	-	-	-	-	-	-
	Panicum coloratum L.	Ge	+	-	-	-	-	+	-	-
	Panicum repens L.	Ge	+	-	+	-	-	+	-	-
	Parapholis incurva (L.) C. E. Hubb.	Th	+	-	-	-	-	-	-	-
	Parapholis marginata Runemark	Th	+	-	-	-	-	-	-	-
	Paspalidium geminatum (Forssk.) Stapf	Th	+	-	-	-	-	-	-	-
	Paspalum distichum L.	Th	+	-	-	-	-	-	-	-
	Phalaris minor Retz.	He	+	-	-	-	-	+	-	-
	Phalaris paradoxa L.	He	+	-	+	-	-	+	+	-
	*Phragmites australis (*Cav.) Trin. ex Steud.	He	+	+	+	-	+	+	+	+
	Poa annua L.	He	+	-	-	-	-	+	-	-
	Polypogon monspeliensis (L.) Desf.	th	+	+	+	+	+	+	-	-
	Polypogon viridis (Gouan) Breistr.	He	+	-	+	-	-	-	-	-
	Setaria pumila (Poir.) Roem. & Schult.	Th	+	+	-	-	-	+	-	-
	Setaria verticillata (L.) P. Beauv.	Th	+	-	-	-	-	+	-	-
	Setaria viridis (L.) P. Beauv.	Th	+	+	-	-	-	+	-	-
	Sorghum virgatum (Hack.) Stapf	Ge	+	-	-	-	-	+	-	-
Juncaceae	*Juncus acutus* L.	He	+	-	+	-	+	-	-	+
	Juncus rigidus Desf., Fl. Atlant.	He	+	-	+	-	-	-	-	+
Lamiaceae	*Lamium amplexicaule* L.	Ch	-	-	-	-	-	+	-	-
	Mentha longifolia (L.) Huds.	Ch	+	-	-	-	-	+	-	+
Leguminosae	*Alhagi graecorum* Boiss.	He	+	+	+	+	+	+	+	+
	Cassia javanica L.	Ph	+	-	-	-	-	-	-	-
	Lotus arabicus L.	Th	+	-	-	-	-	+	-	-
	Lotus glaber Mill.	He	+	-	+	-	-	-	-	-
	Medicago intertexta (L.) Mill.	Th	+	-	+	-	-	+	-	-
	Medicago polymorpha L.	Th	+	-	+	-	-	-	-	+
	Medicago sativa L.	Th	+	-	-	-	-	-	-	-
	Melilotus indicus (L.) All.	Th	+	+	-	-	-	+	-	-
	Melilotus messanensis (L.) All.	Th	+	-	+	-	-	+	-	-
	Parkinsonia aculeata L.	Ph	+	-	+	-	-	-	+	-
	Senna occidentalis (L.) Link	Ph	-	-	-	-	-	+	-	-
	Sesbania sesban (L.) Merr.	Ph	+	-	-	+	-	+	+	-
	Trigonella glabra Thunb.	Ch	+	-	-	-	-	-	-	-
	Trifolium resupinatum L.	Ch	+	-	+	-	+	-	-	-
	Vicia sativa L.	Th	+	-	-	-	-	+	-	-
	Vicia monantha Retz.	Th	+	-	-	-	-	+	-	-
Malvaceae	*Abutilon indicum* (L.) Sweet.	Ch	+	-	-	-	-	-	-	-
	Hibiscus trionum L.	Th	+	-	+	-	-	+	+	-
	Malva parviflora L.	Th	+	+	+	-	+	+	+	-
	Sida spinosa L.	Ge	+	-	+	-	-	+	-	-

To be continued...

Table 1, cont...

Family	*Weed species*	Life forms	Healthy land	Reclaimed land	Salt affected soil	waste lands	Road side	Orachard	Outskirts	Canal bank
Onagraceae	*Ludwigia stolonifera* (Guill. & Perr.) P. H. Raven	Ge	+	-	-	-	-	-	-	-
Orobanchaceae	*Orobanche crenata* Forssk	Th	+	-	-	+	-	-	-	-
Oxalidaceae	*Oxalis corniculata* L.	Ge	+	-	+	-	-	+	-	-
	Oxalis pes – caprae L.	Ge	-	-	-	-	-	+	-	-
Plantaginaceae	*Plantago lagopus* L.	Th	+	-	-	-	-	-	-	-
	Plantago lanceolata L.	He	-	-	-	-	-	+	-	-
	Plantago major L.	He	+	-	-	-	-	+	-	-
Polygonaceae	*Calligonum polygonoides* L.	Ch	-	-	-	-	-	-	-	-
	Emex spinosa (L.) Campd.	Th	+	-	+	-	-	+	-	-
	Polygonum equisetiforme Sm.	He	+	-	-	-	+	-	-	-
	Polygonum salicifolium L.	He	+	-	-	-	+	-	-	-
	Rumex dentatus L.	Th	+	-	+	-	+	+	+	-
	Rumex vesicarius L.	Th	+	-	-	-	-	-	+	-
Portulaceae	*Portulaca oleracea* L.	Th	+	-	+	-	-	+	+	-
Ranunculaceae	*Ranunculus marginatus* d'Urv.	Th	+	-	+	-	-	+	-	-
	Ranunculus sceleratus L.	Th	+	-	-	-	+	+	-	-
Resedaceae	*Reseda alba* L.	Th	-	+	-	-	-	-	+	-
Scrophulariaceae	*Veronica anagallis- aquatica* L.	He	+	-	+	-	+	+	-	-
Solanaceae	*Datura stramonium* L.	Th	-	-	-	-	-	+	-	-
	Hyoscyamus muticus L.	He	-	-	-	-	-	-	+	-
	Physalis angulata L.	Th	+	-	-	-	+	-	-	-
	Solanum nigrum L.	Th	+	-	+	-	+	+	+	-
	Solanum sinaicum Boiss.	Th	+	-	-	-	-	+	-	-
Tamaricaceae	*Tamarix nilotica* (Ehrenb.) Bunge	Ph	+	-	+	+	+	+	+	+
Tiliaceae	*Corchorus olitorius* L.	Th	+	-	-	-	-	+	+	-
Typhaceae	*Typha domingensis* (Pers.) Poir. ex Steud.	He	-	-	+	-	-	-	-	-
Umbelliferae	*Ammi majus* L.	Th	+	-	-	-	-	+	-	-
	Apium leptophyllum (Pers.) F. Muell. Ex Benth.	He	+	-	-	-	-	-	+	-
	Berula erecta (Huds.) Coville	He	+	-	-	-	-	-	-	-
	Torilis arvensis (Huds.) Link	Th	+	-	-	-	-	-	+	-
Utricaceae	*Urtica urens* L.	Th	+	-	-	-	-	+	+	-
Verbenaceae	*Lantana camara* L.	He	-	-	-	-	-	+	-	-
	Phyla nodiflora (L.) Greene.	Ge	+	+	-	+	-	+	-	-
Zygophyllaceae	*Tribulus terrestris* L.	He	+	-	-	-	-	-	-	-
	Zygophyllum album L.	Ch	-	-	+	-	-	-	-	-
	Zygophyllum coccineum L.	Ch	+	+	+	-	-	-	+	-
	Zygophyllum simplex L.	Ch	+	+	-	-	-	-	+	-
	*Nitraria retusa (*Forssk.) Asch.	Ph	-	-	+	-	-	-	-	-

followed by orchard habitats (58%, 60% and 71%, respectively). By contrast, wasteland and canal bank habitats recorded the lowest numbers (Figure 2). Therophytes were the dominant life form (98 species) while Hemicryptophytes recorded the second most frequent life form (39 species) while Chamaephytes and Geophytes presented 15 and 14 species, respectively. Phanerophytes were the smallest group in this study, 5% (Figure 3). Table 2 shows the different chorotypes of the surveyed flora. Cosmopolitan was represented by 25 species with high occurrence; Palaeotropical, by 18 species; Pantropical, by 16 species and Plurireginal, by 6 species in the study region. Monoregional was represented by about 19% with Saharo-Arabian as the most

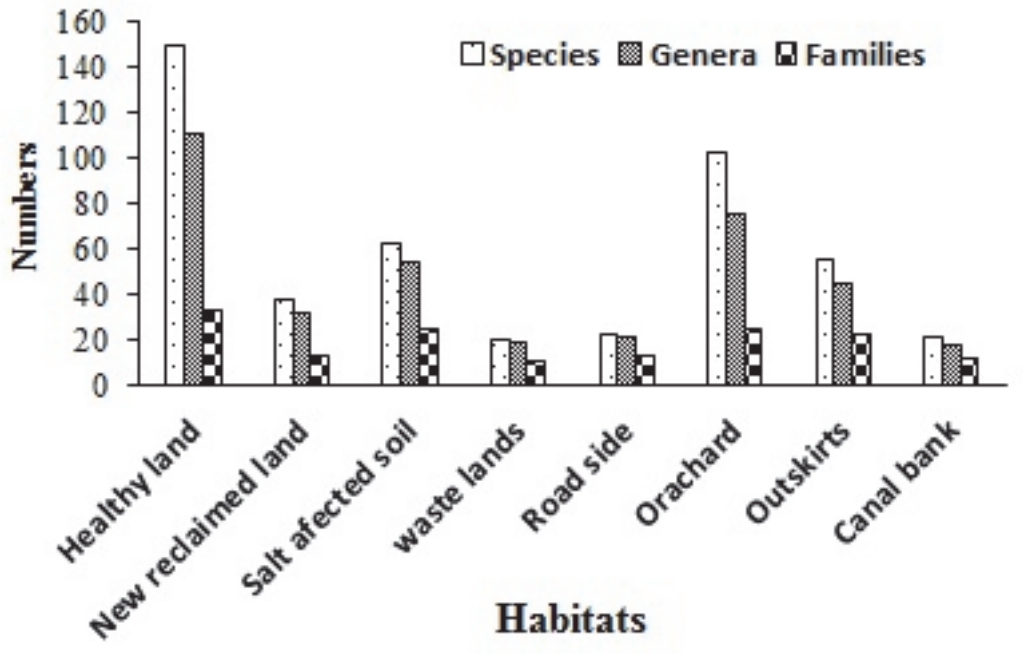

Figure 2 - Taxa distributions through different habitats.

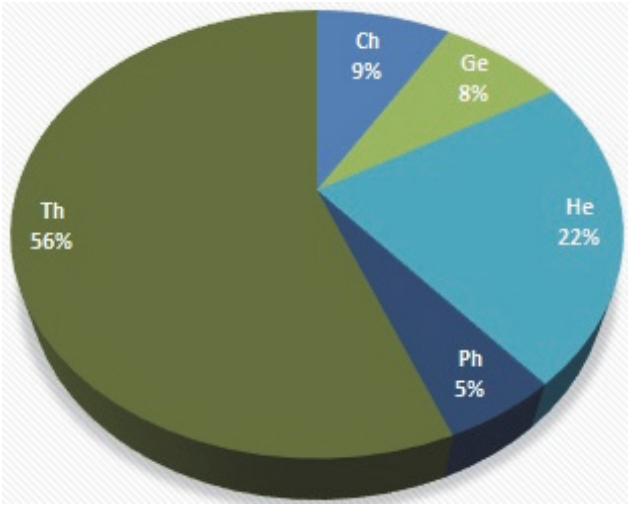

Figure 3 - Life form percentages recorded in the study area.

Table 2 - Number of chorological elements recorded in the Fayoum area

		Monoregional		Biregional		Triregional	
COSM	25	SA	11	M+SS	21	M+IT+ES	20
PAL	18	M	10	M+SA	5	M+SA+IT	4
PAN	16	SU	3	M+ES	2	M+IT+SS	3
Plur.	6	SZ	3	SA+IT	7	M+SA+ES	1
		AM	2	SA+SZ	2	M+SS+SZ	2
		TR	2	SA+SI	1	SS+IT+SZ	1
		SS	2	SA+SU	2		
				ST+TR	2		
				SS+SZ	2		
				SS+IT	2		
Total	65		33		46		31

COSM: Cosmopolitan, AM: American; ES: Euro-Siberian, IT: Irano-Turanian; ME: Mediterranean, SA: Saharo-Arabian; SS: Saharo-Sindian, SZ: Sudano-Zambezian and TR: Tropical.

common chorotype (represented by 11 species). Biregional was represented by 43 species with the highest representation of Mediterranean and Saharo-Sindian by 24%. The triregional chorology was represented by 17%. The highest Jaccard similarity index was recorded between old cultivated land (healthy land) and orchard habitats while the lowest one was found between wasteland and roadside (Table 3). Canal bank habitats showed the lowest similarity indices in comparison with other habitats. The dendrogram obtained from the hierarchical classification (Figure 4) supported Jaccard similarity results; it clustered habitats into two main groups: the first one included two habitats: old cultivated lands and orchard. The other main group was subdivided into three subgroups, and each of them contained two homogeneous habitats; new reclaimeded land with wasteland, roadside with canal bank and salt affected soil with outskirt habitats.

Diversified crop rotations in recent years has increased weed diversity compared with monocultures (Doucet et al., 1999). Poaceae, Fabaceae (Leguminosae) and Compositeae; the

Table 3 - JACCARD similarities between different habitats

	Old cultivated land	New reclaimed land	Salt affected land	Waste lands	Road side	Orachard	Outskirts	Canal bank
Old cultivated land	1							
New reclaimed land	0.2230	1						
Salt affected land	0.3974	0.2381	1					
Waste lands	0.1293	0.1800	0.1867	1				
Road side	0.1448	0.1800	0.2192	0.1000	1			
Orachard	0.5974	0.2636	0.3520	0.1171	0.1589	1		
Outskirts	0.2821	0.2917	0.3226	0.1642	0.1471	0.2540	1	
Canal bank	0.1892	0.1311	0.2532	0.1020	0.2273	0.1552	0.1000	1

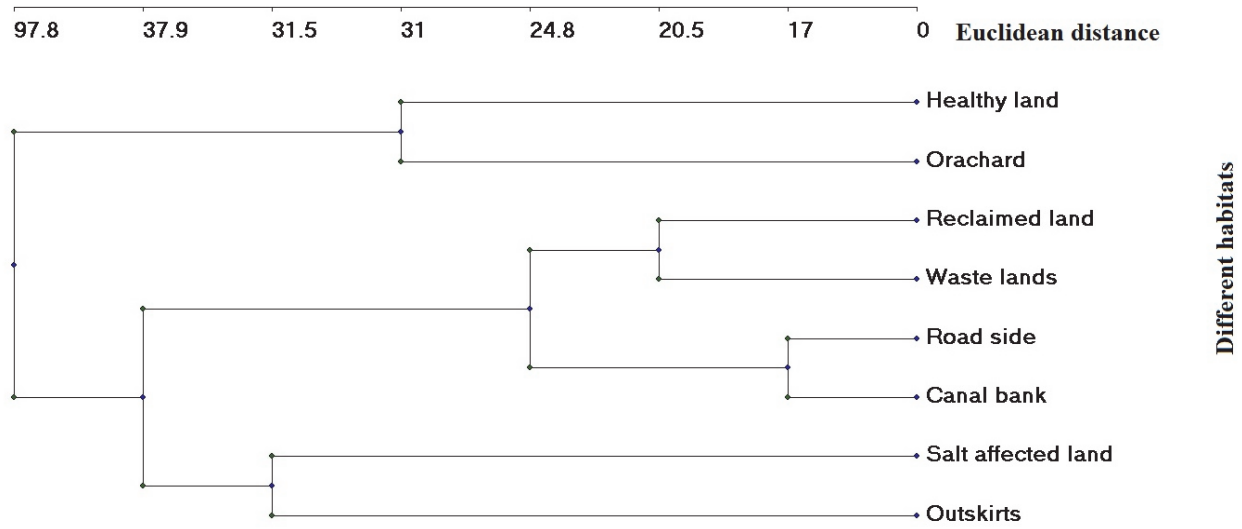

Figure 4 - Hierarchical classification of the different habitats based on their floristic composition (incidence data), using Ward's method and Euclidean distances as measures of Linkage Distance.

richest families, in the current study, represent the most common ones in the Mediterranean North African flora (Quézel, 1978), and they are considered to be the most important families in small-scale farming in highland Peru, central Mexico and northern Zambia (Vibrans, 1998). Poaceae recorded the highest number of species because of its ability to grow in various habitats. Boulos and Fahmy (2007) recorded that grasses in Egypt grow in many different ecosystems: salt marshes and arid lands, for example, and they are especially prevalent in old cultivated lands in the Nile Valley. The wide distribution of the some weeds in the current study may be interpreted as species with wide ecological amplitude and characterized by phenotypic plasticity and heterogeneity (Shaltout and Sharaf El-Din, 1988; Abd El-Ghani et al., 2013). Restricted distribution of other weeds can be attributed to the habitat preference phenomenon, e.g., hydrophytic plants *Ludwigia stolonifera* and *Cyperus alopecuroides*. Old cultivated lands contained the highest number of species, followed by orchard habitats, because these habitats provide weed species with suitable conditions for germination, growth and reproduction. By contrast, road side and wasteland habitats recorded the lowest number of species as a result of the lack of water and compacted soil, respectively.

Life form reported in the present study supports many previous studies in Egyptian agroecosystem habitat (Abd El-Ghani, 1994; Shaheen, 2002). Weed communities were characterized by being mostly therophytes with short stature (shorter than the crop), which flowered between March and April and had low seed mass (Storkey et al., 2010). The low number of phanerophytes might be related to the intense handling used in the plantations, such as

ploughing, subsoiling, harrowing, levelling, and furrowing operations, which could affect the life cycles of phanerophytes.

Abd El-Ghani (1994) recorded similar results concerning the weed flora of the Siwa Oasis orchards and reported that this may indicate severe human impact on the study area. The Mediterranean floristic elements extending in the Euro-Siberian territory attained higher representation as compared with the Mediterranean species with the Saharo-Sindian extension. These results agree with the findings that suggest the presence of a transitional Mediterranean territory in Egypt between the pure Mediterranean and the Saharo-Arabian territory (El-Demerdash et al., 1997). The widely distributed species belong to bi- and tri-regional chorotypes and constituted 73 species, thus revealing that the floristic structure of the study area is relatively complex as compared with other areas of Egypt.

Similar results were reported in other areas all over the country (Abd El-Ghani, (1992) in Qara Oasis, Abd El-Ghani and Fahmy, (1998) in Feiran Oasis, Shaheen, (2002) in Upper Egypt and Abd El- Ghani and Fawzy, (2006) in the Egyptian Oases).

The shade effect produced by large trees in orchards keeps the soils moist for longer; at the same time, farmers cultivate some crops such as Egyptian clover in orchards in the winter, which created many similar characters between these habitats and led to the Ward classification whereby these habitats are clustered in one group.

The results provide the most up-to-date information on weed flora for one of the oldest agronomic cities in the world and its distribution through different habitats. They are considered to be valuable as a grounding for political decisions concerning the management of arable land.

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