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Weed Communities of Field Crops in the Newly Reclaimed Lands of Suez Canal Region, Egypt

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ABSTRACT

One significant biotic barrier to crop production is weeds. The present study aims to analyze the weed vegetation associated with cultivated crops in the newly reclaimed lands in the three Suez Canal governorates (Ismailia, Suez and Port-Said). A total of 148 weed species (96 annuals and 52 perennials) belonging to 110 genera and 26 families were recorded. The most species-rich families were Poaceae, Asteraceae, Amaranthaceae and Fabaceae. Therophytes and Chamaephytes were the most prevailing life-forms. The chorological analysis of the vegetation revealed that Cosmopolitan, Saharo-Sindian and Mediterranean chorotypes either pure or extended into other regions form the major component of the floristic structure. The application of TWINSPAN classification technique yielded four vegetation groups. These groups were dominated by *Schismus barbatus*, *Senecio glaucus*, *Cynodon dactylon* and *Melilotus indicus*. Biodiversity indices (species richness, Shannon's index, Simpson's index and Evenness index) indicated that vegetation group B was the most diversified among other groups. The ordination of stands in the study area by using DECORANA program showed that the vegetation groups obtained by TWINSAPAN are distinguishable and have a clear-cut pattern of segregation on the ordination diagrams. Canonical Correspondence Analysis (CCA) indicated that soil texture, total nitrogen, calcium, magnesium, potassium, sulphates, electrical conductivity and organic matter were the main soil parameters which determined the distribution of weed vegetation in the study area.

Keywords: Chorology; Classification; Flora ordination; Soil-vegetation

INTRODUCTION

The Egyptian cultivation has started thousands of years ago in the Nile Delta and its valley. Despite of that, Egypt has a limited base of cultivable land resources (Hanna and Osman, 1995). The increase in human populations of Egypt demands the expansion of the cultivated lands. This was achieved by the reclamation of many desert areas during the past few decades (Hegazy *et al*., 2004). Deserts comprise about 95% of the total land surface of Egypt; therefore, their potential for production must be assessed. Except for the Faiyum Oasis and the Delta, only a narrow strip along the Nile is cultivated and the population is concentrated in these areas (Adriansen, 2009).

Land reclamation of the desert appears natural, almost unavoidable, considering the population growth and increased congestion in old lands in Egypt. Since the early 1960s, large areas in the Egyptian deserts (Western, Eastern and Sinai) were subjected to land reclamation, which were of private and government schemes (Soliman, 1989). Furthermore, the principal purpose of land reclamation was to increase agricultural production through horizontal expansion. The reclamation of desert plains took place along the Nile region, around KomOmbo near Aswan (New Nubia Project), and on both sides of the Nile Delta including Tahrir and Nubariya Projects to the west and Salhiya Project to the east (Biswas, 1993).

According to the Environmental Profile of Ismailia Governorate (2007), Ismailia is surrounded by desert on all sides, which prompted the establishment of numerous land reclamation projects. These arid regions are unique because of the presence of some Badawi societies, which depend on grazing. In the Ismailia Governorate, there are numerous plans for the growth of agriculture, including initiatives for land reclamation as the project for planting 350 acres east of the Suez Canal.

Port Said Governorate is one of the northern coastal Nile Delta Governorates. The southern zone of the governorate consists of some rural settlements characterized by their proximity to land reclamation projects on Salam Canal and their intermediate location between the main urban settlements in Port Said and Ismailia Governorates (Ayad, 2010). However, the Governorate of Suez is situated within a rugged terrain. Most of the soil of Suez is classified into either red desert or lithosols, which is characterized as salty soils. Most of the plants growing in these locations are drought and salinity resistant (El-Kholei *et al*., 2004).

Arable land weeds are a vital component of their habitats from a physiological standpoint. These weeds were not present prior to agriculture, but now cohabit with the cultivated crops (Abd El-Ghani and El-Sawaf, 2005). In the reclaimed fields, which are thought to be a transitional habitat between wild plant species and domesticated species, human interference has led to weedy species replacing wild plant species (Baessler and Klotz, 2006). These weeds are characterized by their rapid and aggressive growth, they share the habitats, moisture, nutrients and soil of the plants in their space or disturbing the habitats that they invade. Arable land is a constantly changing habitat for both the crop and the management practices can vary greatly from year to year. Weed populations are thus subjected to many variable factors. Understanding the interaction between crops and their weed flora requires ecological studies of weeds. The environment has an impact on weed communities. The development of a long-term, sustainable weed control and soil management strategy may benefit from analyses of the geographical variance in multispecies weed comm-

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unities in conjunction with environmental conditions (Kenkel *et al*., 2002). Due to their biological requirements, weeds in Egyptian croplands vary from season to season. Studies of weed communities using numerical techniques, such as cluster analysis, correlation analysis, and multivariate techniques, such as canonical correspondence analysis, can be an effective tool for demonstrating links between weed species and crops (Kenkel *et al*., 2002).

The ecological and phytosociological studies of weeds growing in cultivated lands in Egypt have been the subject of several studies. Tadros and Atta, (1958) studied the weed communities associated with rain-fed barely fields of the western sector of the Mediterranean coastal lands. Boulos (1967); El-Hadidi and Ghabbour (1968) gave an account on the weed flora of Aswan area. El-Hadidi and Kosinová (1971) initiated a serious of studies on weed flora in different localities of cultivated lands in Egypt. Kosinová (1974 and 1975); Hejny and Kosinová (1977) followed their studies. The taxonomical, geographical and ecological characters of the most abundant weed species in the cultivated lands of the Nile basin were given by Boulos and EL Hadidi (1984).

The study of the variations in weed assemblages of winter and summer crops according to differences in climatic conditions, irrigation pattern, type of crop and its growth form and soil texture was reviewed in many research studies in Egypt and other countries. Of these studies: El-Halawany *et al.* (2002) in Damietta area. Mashaly and Awad (2003) described the floristic features and analysis of the weed flora associated with the major orchards in Nile Delta. Abd EL-Hamid (2005) analyzed the weed vegetation associated with field crops in Ismailia Governorate. El-Amer and Abdul-Kader (2015) described the floristic composition of Nile islands in Middle Egypt. Dardona (2016) studied the floristic biodiversity in Gaza, Palestine. Ali *et al.* (2021) studied the weeds composition and diversity with regards to management practices at palm plantations in Malaysia.

The characteristics of the weed invasion were shown by a number of investigations on the weed vegetation in the newly reclaimed lands. In the newly reclaimed lands in west Delta and south Tahrir, Soliman (1989 and 1996) provided descriptions of the plant life. Shaheen (2002) assessed the variety of weeds in the newly farmed area on the Eastern and Western banks of Lake Nasser, while Shehata and El-Fahar (2000) researched the vegetation of the Salhya region's reclaimed fields. Hegazy *et al*. (2008) conducted research on invasive plant communities on fallow land, coastal desert area, recently reclaimed land, canal banks, and ancient reclaimed land along the Mediterranean coast of the Nile Delta. In Egypt, land reclamation was researched by Adriansen (2009), and invasive species and weeds were assessed by Abd El-Gawad (2010).

Several studies on the weed vegetation in the newly reclaimed lands were conducted to demonstrate the characteristics about the weed invasion. Shaheen (2002) evaluated the diversity of weeds in the newly farmed land on the Eastern and Western shores of Lake Nasser. However, Soliman (1989 and 1996) described the plant life in the newly reclaimed lands in west Delta and south Tahrir. In parallel, Shaheen (2002) evaluated the diversity of weeds in the newly farmed land on the Eastern and Western shores of Lake Nasser. Hegazy *et al.* (2008) investigated the invasive plant communities in the fallow land, coastal desert land, newly reclaimed land, canal banks and old reclaimed land in the Nile Delta Mediterranean coast. However, Adriansen (2009) studied the land reclamation in Egypt and Abd El-Gawad (2010) evaluated the weeds and invasive plants in some newly reclaimed areas in Egypt. The weed communities associated with cult-ivated crops at El-Tina Plain in Egypt were analyzed by Abd El-Hamid and Kamel (2010). Abd El-Ghani *et al.* (2013) studied the weed flora in the reclaimed lands along the northern sector of the Nile Valley. Salama *et al.* (2014) investigated the floristic diversity and vegetation composition in the southern part of the Eastern Desert of Egypt. Ahmed *et al.* (2015) studied the Flora of El Qantara Sharq. Also, the weed flora of common crops of the desert reclaimed arable lands in southern Egypt was studied by Salama *et al.* (2016). The alien and invasive species in the Egyptian flora were determined by Shaltout *et al*. (2016).

A detailed study of the floristic composition and vegetation analysis of four habitats in Suez Governorate was provided by Abd El-Hamid (2017). Al-Sherif *et al.* (2018) determined the weed flora composition and its distribution through different habitats in Fayoum region. Mahgoub (2019) gave a comparative view about the impact of the prevailing climate, soil type, crop type, crop sustainability and urbanization on species distribution and weed community structure in Isthmus of Suez and adjoining farmland east Nile delta region. Therefore, the current study aims to investigate the interaction between soil and vegetation in the newly reclaimed areas in the three Suez Canal governorates (Ismailia, Suez and Port-Said), and analyse the weed vegetation associated with cultivated crops

MATERIALS AND METHODS

Study Area

The area selected for this research is situated in Egypt's eastern Nile Delta between latitudes 30° and 31° N and longitudes 30° and 32° E. (Fig.1). It is bounded to the north by Lake Manzala, to the south by the Suez Gulf, to the east by the Sinai Peninsula, and to the west by Sharqiyah and Cairo. The research area includes the newly reclaimed territories in the three governorates (Ismailia, Suez and Port Said).

The study area is linked to the eastern Nile Delta, which has a number of geomorphological characteristics that directly influence agricultural activities. It is bounded on the southern side by a moderately elevated plateau and on the northern side by landscape with flat plain at El Manzala Lake. The plains of the old Delta mark the western boundary. According to El Fayoumy (1968), the geological features of the study area is characterized by exposures of sedimentary successions ranging from Tertiary to Quaternary. The Tertiary deposits are dominant in the Southern part of the study area and consist of fossiliferous sandstone, limestone and basalt, while the Quaternary deposits cover the rest of the study area and consist of eolian sand as well as fluviatile and fluviomarine deposits.

According to Ayyad and Ghabbour (1986), the study area belongs to arid climate. The meteorological data of Ismailia, Suez and Port Said Governorates according to the world-weather climatological normal showed that the climate of this region is obviously hot and dry. The low rainfall and high temperature are the main aspects of its aridity (El-Amier and Abdul-Kader, 2015). The mean maximum air temperature ranged between 17.8° C in January at Port Said to 36.7° C in July at Suez. The mean minimum temperature ranged between 10° C in January at Suez to 25.3° C in August at Port Said. While, the maximum amount of rainfall is received during January and November. The relative humidity varied from 37.1% in May at Suez to 70.9% in August at Port Said. On the other hand, the monthly mean wind velocity varies from 15.3 km/h in November at Suez to 24.2 km/h in Jan at Port Said.

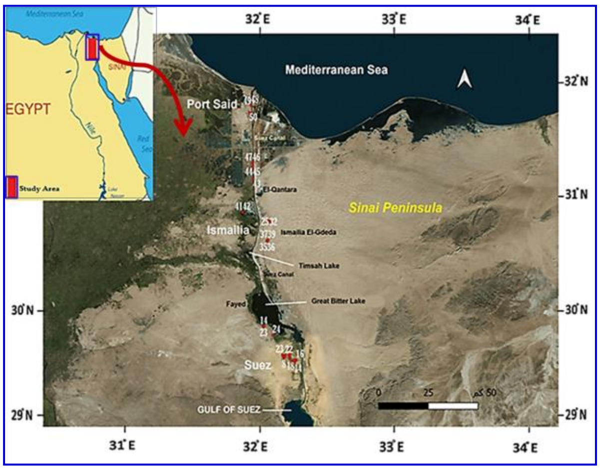

Figure (1): Map of the study area showing the fifty selected stands (1-7 and 25-43; 8-24; and 44-50 for Ismailia, Port Said and Suez, respectively). Source: QGIS 3.8.3 software.

Vegetation analysis:

Fifty stands were randomly distributed in new reclaimed lands in the Suez Canal region (Fig.1). These reclaimed areas were cultivated by orchards (mango, orange, olive, lemon, date Palme and pomegranate) in 42 stands, crops (wheat, bean, clover, sugar beet and rice) in 6 stands and vegetables (tomato, cabbage and onions) in 2 stands. The selected stands were visited seasonally and surveyed to represent all the significant differences in the weed vegetation composition under various cultivated crops in the study area. For each of the selected stands, sampling was carried out using ten random quadrates with a dimension of (1X1 m^2). The plant species were identified and recorded for each stand. The abundance (number of individuals) was evaluated in accordance with Shukla and Chandel (1989) and used to calculate the species' absolute and relative densities. The number of occurrence of a species in quadrats of each stand was used to calculate its absolute and relative frequencies. Plant cover was estimated using line-intercept method (Canfield, 1941), then used in calculating its absolute and relative covers. The relative values of density, frequency and cover for each weed species were summed to give an estimate of its importance value (IV) out of 300 (Curtis and McIntosh, 1950).

The taxonomic nomenclature of the weed species in the studied area was provided in accordance to Täckholm (1974), Boulos (1995, 1999, 2000, 2002, 2005, 2008, and 2009), Boulos and EL Hadidi (2000), Turland *et al*. (2018), Hosni and Shamso (2022). Raunkiaer (1934) provided a list of the life forms for each species. The phytogeographical survey of weeds in the study area followed after studies by Good (1974), Wickens (1976), and Abd El-Ghani (1985).

Soil analysis

Three soil samples were collected from each stand at a depth of 0-50 cm, mixed, air dried and sieved through 2 mmmesh sieves to separate gravels and debris. Soil texture was determined by hydrometer method (Baruah and Barthakur, 1997). The chemical analysis was carried out on 1:5 soil/water extract. Electrical conductivity (E.C, dSm^{-1}) was measured in using a conductivity meter model 4510 according to Richards (1954). The pH was determined by bench type Beckman glass electrode pH meter model 3510 according to Page *et al.* (1982). Soluble carbonates $(CO_3)^{-2}$, bicarbonates $(HCO_3)^{-1}$ and total chlorides $(Cl)^{-1}$ were recorded according to Baruah and Barthakur (1997). Soluble sulfates $(SO_4)^{-2}$ were determined gravimetrically by the method described by Piper (1950). Calcium and magnesium (Ca^{+2} and Mg^{+2}) were estimated by the method of Richards (1954). Sodium (Na^+), potassium (K^+) and total carbonate contents were carried out according to Allen *et al*. (1974). Meanwhile, Organic matter content was determined by Walkley and Black-rapid titration method (Baruah and Barthakur, 1997). For total nitrogen, soil sample was digested and determined by the method of Black *et al.* (1965). Available phosphorus was also evaluated and determined according to Olsen *et al*. (1954).

Multivariate analysis

Two Way-Indicator Species Analysis (TWINSPAN) as a classification technique and Detrended COResp-ondence Analysis (DECORANA) as an ordination technique (Hill, 1979) were applied to the matrix of importance values of the 148 species in the 50 stands in the study area. The relationship between the vegetation and the soil gradients was assessed using Canonical Correspondence Analysis (CCA), Ter Braak (1986 and 1994). The input data were arranged in the form of data matrices of species importance values (IV) in parallel of environmental factors in each of the studied stands. The analyses were carried out by using two computer programs: CAP, Community Analysis Package, version 1.3.1 (Henderson and Seaby, 1999) and CANOCO for windows, version 4.5 (Ter Braak and Smilauer, 2002).

Diversity Measurement

The Shannon-Wiener diversity index (H') is calculated by using the following equation:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Where $P_i = n_i / N$ = proportional abundance of species i in a habitat made up of s species; n_i = the number of stands containing the species i and N = S n_i.

The Shannon-evenness index (E) was applied to quantify the evenness component of diversity and was calculated as following:

$$E = H' / \ln s$$

While, the Simpson's index (D), based on Magurran, (1988), is calculated using the following equation:

$$D = \frac{\sum n_i (n_i - 1)}{N(N-1)}$$

Where n_i is the total number of a particular species and N is the total number of all species.

RESULTS

Floristic weed composition

The list of scientific names and families of weed species recorded in the study area is presented in Table (1a). From this table, the total number of the recorded weed species in the study area is 148 species belonging to 110 genera and grouped under 26 families. These species are distributed as 38 monocotyledons and 110 dicotyledons. The most weed species-rich families were Poaceae (36 species) comprising 24.32% of the total number of the recorded species; Asteraceae (23 species) forming 15.54%; Amaranthaceae 18 species (12.16%); Fabaceae 13 species (8.78%) and Brassicaceae 11 species (7.43%), figure (2).

According to Raunkiaer's life-forms classification scheme (Raunkiaer, 1934), the recorded weeds in the study area are grouped under six life form classes namely: therophytes (Th), hemicryptophytes (H), phanerophytes (Ph), chamaephytes (Ch), geophytes (G) and parasites (Pa), Figure (3). Therophytes are represented by the highest number of species (97 species forming 65.54% of the total recorded species). Chamaephytes contained 20 species representing (13.51% of the total recorded species). Hemicryptophytes includes 13 species (8.78% of the total recorded species). Geophytes are represented by 10 species (6.76% of the total recorded species). However, only 5 species, represented by 3.38% were recorded in the phanerophytes group. Meanwhile, 3 species (2.03% of the total documented species) were parasites. The analysis of phytogeographical distribution of the recorded plant species in the study area Tables (1a and 1b) revealed that 46 species representing 31.11% of the total number of the recorded species were mono-regional elements. The recorded mono-regional species fall under 8 main phytochoria: 13 species (8.8% of the total number of the recorded species in the study area) are repress-entative to Palaeotropical (PAL). The typical Mediterranean (ME) elements attained 11 species (forming 7.44% of the total number of the recorded species). Saharo-Sindian (SA-SI) category is repress-ented by 8 species (5.42% of the total recorded species). The Pantropical (PAN) category is represented by 6 species (forming 4.05%). Neotropical (NEO) category is repressented by 4 species (including 2.71% of the total recorded species). Sudano-Zambezian (S-Z) element is represented by 3 species (2.03%). However, only one species is present in the Euro-Siberian (ER-SR) region.

Forty-two species, represent of 28.39% of the total number of the recorded species, were grouped as a Bi-regional element. These species were distributed within 11 different Bi-regional combinations. It is worthy to mention that the Mediterranean (ME) elements were common partner in most of these combinations. The Mediterranean species with Irano-Turanian (IR-TR), with Euro-Siberian (ER-SR), along with Saharo-Sindian (SA-SI), and Neotropical (NEO) and Palaeotropical (PAL) are represented by 16 (10.81%), 6 (4.05%), 2 (1.35%), and 1 (0.68%) weed species, respecttively. Five species are represented in Mediterranean with Irano-Turanian (ME + IR-TR) elements. The Mediterranean with Euro-Siberian (ME+ER-SR) category is represented by four species. The species of Mediterranean with Saharo-Sindian (ME+SA-SI) category are 4 species. The Mediterranean with Neotropical (ME+NEO) and with Palaeotropical (PAL) categories are also represented by two species. Saharo-Sindian with Sudano-Zambezian (SA-SI+S-Z) category is represented by 8 species (forming 5.41% of the total recorded species). Irano-Turanian with Saharo-Sindian (IR-TR+SA-SI) category is represented by 7 species (4.74% of the total number of the recorded species in the study area). Irano-Turanian with Sudano-Zambezian (IR-TR+S-Z) included only one species.

The pluri-regional elements are represented by 54 species (36.51% of the total number of the recorded species). These categories also reflected the dominance of Mediterranean elements (Table 1a and 1b). Mediterranean with Irano-Turanian and Euro-Siberian (ME-+IR-TR+ER-SR) categories are represented by 18 species represented by 12.16% of the total recorded species. However, the Mediterranean with Euro-Siberian and Saharo-Sindian (ME+ER-SR+SA-SI) is repressented by only three species (2.03% of the total species). The Mediterranean with Irano-Turanian and Saharo-Sindian (ME+IR-TR+SA-SI) and Mediterranean with Irano-Turanian and Palae-otropical (ME-+IR-TR+PAL) categories contained two species (1.35%). The Mediterranean with Euro-Siberian, Irano-Turanian and Neotropical (ME+ER-SR+IR-TR+NEO), Mediterranean with Euro-Siberian, Irano-Turanian and Saharo-Sindian (ME+ER-SR+IR-TR+SA-SI), Mediterranean, Irano-Turanian, Saharo-Sindian and Sudano-Zambezian (ME+IR-TR+SA-SI+S-Z) and Mediterranean, Saharo-Sindian, and Sudano-Zambezian (ME+-SA-SI+S-Z) categories are represented by one by one species only (0.68%) for each category.

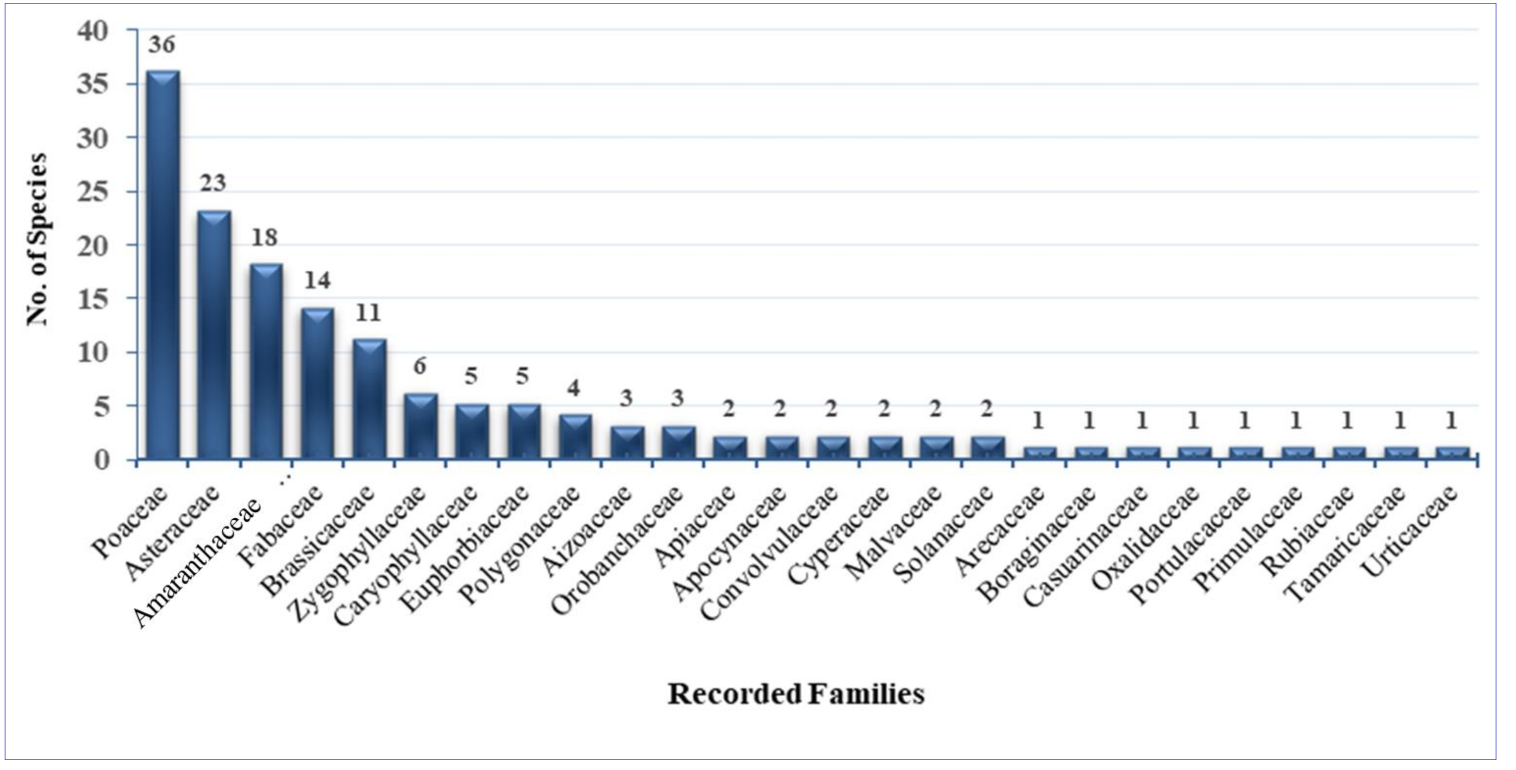

Figure 2: The total number of plant species identified in the study area and the families to which they belong...

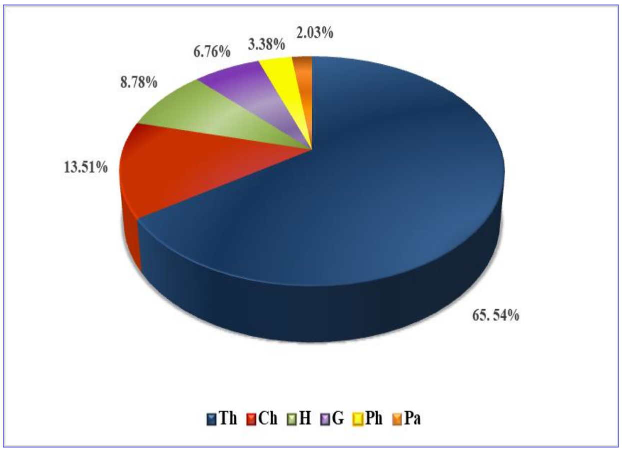

Figure (3): Life form spectra of the recorded weed species in the study area. Th,Therophytes; H, Hemicryptophytes; Ph, Phanerophytes; Ch, Chamaephytes; G, Geophytes and Pa, Parasites.

Cosmopolitan (COSM) element recorded the highest number of species among the pluri-regional elements. It comprised 20 species (13.52% of the total recorded species). Cultivated and naturalized category is represented by 6 species (forming 4.05% of the total number of the recorded species). The numbers of annual plants, in the study area, were 96 species, including 64.86% of the total recorded species. The number of perennials is 52 species, which represents 35.14% of the total recorded species in the study area.

Multivariate analysis of weed vegetation

Classification of stands

The application of TWINSPAN classification based on the importance values of the recorded weed species in the studied stands representing different habitats of the study area yielded four vegetation groups (Fig.4). Each vegetation assemblage comprises a set of stands which are similar in their floristic composition. Variations of weed vegetational groups in habitat records are given in Tables (2a-b and 3). From these tables, the number of weed species in group C exceeding those of groups A, B and D. Group A comprises 41 species recording from 8 stands cultivated with different vegetable, crop and orchards (mainly *Mangifera indica*) with short trees and low cover. The stands of this group are characterized by soil with the highest levels of sand fraction (94.88%) and highest pH values (7.96) and the lowest values of clay fraction (3%), Table (2b).

The average species richness in group A is 18.38 species/stand, Shannon's index of 2.23, Simpson's index of 0.84 and Evenness index of 0.54, Table (3). *Schismus barbatus* is the dominant species in this group (IV =73.30). While, the co-dominant species that attained relatively high importance value include *Senecio glaucus* (IV =59.74), *Zygophyllum simplex* (IV =33.79) and *Zygophyllum album* (IV =24.19). The indicator species identified by TWINSPAN classification in this group is *Aizoon canariensis*. *Erucastrum gallicum*, *Galium sinaicum* and *Launaea capitata* are the consistent species (recorded only in this group).

Group B covers 39 species reported in 4 stands cultivated with different orchards with short trees and low cover. The soil samples for this group are characterized by the highest levels of total nitrogen (0.23%) and the lowest values of silt fraction (2%), Table (2b). This group attained relatively the highest biodiversity indices (species richness of 21.5 species/stand, Shannon's index of 2.51, Simpson's index of 0.88 and Evenness index of 0.57). The dominant species in this group is *Senecio glaucus* (IV =65.78) and the co-dominant species are *Rostraria cristata* (IV =52.02), *Zygophyllum simplex* (IV =24.80) and *Cynanchum acutum* (IV =16.51). The indicator species identified by TWINSPAN classifycation in this group are *Chenopodium murale*, *Coincya tournefortii* and *Amaranthus blitum* subsp. *oleraceus*. On the other hand, *Achillea fragrantissima* and *Astragalus hamosus* are restricted only in this group.

Group C includes the highest number of species (89 species) recorded from 29 stands cultivated with different vegetables, crops and orchards with high trees and large cover. The stands of this group are characterized by the highest level of electrical conductivity (28.21 dSm^{-1}), calcium (65.86 $meql^{-1}$), magnesium (99.74 $meql^{-1}$), sodium (136.20 $meql^{-1}$), potassium (1.57 $meql^{-1}$), carbonate (1.31 $meql^{-1}$), bicarbonate (8.76 $meql^{-1}$), chlorides (189.28 $meql^{-1}$) and sulphates (103.63 $meql^{-1}$). The average species richness in group C was 16.28 species/stand, Shannon's index of 2.25, Simpson's index of 0.84 and Evenness index of 0.64. *Cynodon dactylon* is the dominant species in this group (IV =38.28). On the other hand, the co-dominant species are *Cynanchum acutum* (IV =25.12), *Senecio glaucus* (IV =24.38) and *Chenopodium murale* (IV =22.61). *Parapholis incurva* is the indicator species identified by TWINSPAN classification in this group. While, the consistent species recorded were 36 species including *Atriplex limdleyi* ssp. *inflata*, *Bidens pilosa*, *Alhagi graecorum and Midicago sativa.*

Fifty one species have been identified in 9 stands representing Group D. These stands are cultivated by various vegetables, crops and orchards with short trees and low cover. These stands have the highest proportions of silt and clay fractions (31.22% and 16.44%, respectively), total phosphorus (0.11%), organic matter (1.20%), and total carbonate (4.56%), while having the lowest proportion of sand fraction (52.33%). The average species richness, in this group, was 14.44 species/stand, with Shannon's index of 2.12, Simpson's index of 0.84, and Evenness index of 0.65. *Melilotus indicus* is the dominant species in this group (IV =39.25). While, the co-dominant species that attained the highest importance value are *Phragmites australis* and *Polypogon mon-speliensis* (IV =29.15 and 15.68, respectively). The identified indicator species in this group is *Lotus glaber*, and fifteen weed species are present consi-stently. Examples of these species are *Chenopodium murale* var. microphilly, *Lolium perenne, Salicornia europaea* and *Echinops spinosissimus subsp spinosissimus.*

Table (1a): Floristic composition (life form classes and phytogeographical categories) of the plants exist in the studied area**.**

Family	Species	Duration†	Life†† form	Chorology§
Aizoaceae	*Aizoon canariense* L.	Ann	Th	SA-SI+S-Z
	Mesembryanthemum nodiflorum L.	Ann	Th	ME+ER-SR+SA-SI
	Trianthema portulacastrum L.	Ann	Th	NEO
Amaranthaceae (Including: Chenopodiaceae)	*Amaranthus albus* L.	Ann	Th	NEO
	Amaranthus blitum L. subsp. *oleraceus* (L.) Costea	Ann	Th	ME+IR-TR
	Amaranthus graecizans L.	Ann	Th	COSM
	Amaranthus hybridus L.	Ann	Th	COSM
	Atriplex lindleyi Moq. subsp. *inflata* (F. Muell) P. G. Wilson	Ann	Th	ME+IR-TR+ER-SR
	Bassia indica (Wight) A. J. Scott	Ann	Th	IR-TR+S-Z
	Bassia muricata (L.) Asch.	Ann	Th	IR-TR+SA-SI
	Beta vulgaris L.	Ann	Th	ME+ER-SR+IR-TR
	Chenopodium album L.	Ann	Th	COSM
	Chenopodium ambrosioides L.	Bi	Th	COSM
	Chenopodium botrys L.	Ann	Th	ME
	Chenopodium glaucum L.	Bi	Th	ME+ER-SR
	Chenopodium murale L.	Ann	Th	COSM
	Chenopodium murale L. var. *microphilly* Boiss.	Ann	Th	ME
	Cornulaca monacantha Delile	Per	Ch	S-Z
	Salicornia europaea L.	Ann	Th	ME+SA-SI+IR-TR
	Suaeda vera Forssk. ex J. F. Gmel.	Per	Ch	ME+SA-SI+ER-SR
	Traganum nudatum Delile	Per	Ch	SA-SI + IR-TR
Apiaceae	*Ammi majus* L.	Ann	Th	IR-TR+ME
	Anethum graveolens L.	Ann	Th	S-Z
Apocynaceae	*Calotropis procera* (Aiton) W. T. Aiton	Per	Ph	PAL
	Cynanchum acutum L.	Per	Ph	ME+IR-TR
Arecaceae	*Phoenix dactylifera* L.	Per	Ph	SA-SI+S-Z
Asteraceae	*Achillea fragrantissima* (Forsk.) Sch. Bip.	Per	Ch	IR-TR+SA-SI
	Achillea tenuifolia Lam.	Per	Ch	SA-SI+IR-TR
	Bidens pilosa L.	Ann	Th	PAL
	Centaurea pallescens Delile	Ann	Th	SA-SI
	Cichorium endivia L.	Ann	Th	ME+IR-TR
	Conyza bonariensis (L.) Cronquist	Ann	Th	ME
	Echinops spinosissimus Freyn. subsp. *spinosissimus*	Per	H	ME+SA-SI
	Eclipta prostrata (L.) L.	Ann	Th	PAN
	Pulicaria undulata (L.) C. A. Mey.	Per	Ch	SA-SI+S-Z
	Helianthus annuus L.	Per	Ch	CUL
	Ifloga spicata (Forssk.) Sch. Bip.	Ann	Th	SA-SI
	Launaea capitata (Spreng.) Dandy in Andrews	Bi	Th	SA-SI+S-Z
	Launaea nudicaulis (L.) Hook. f.	Per	H	SA-SI+IR-TR+S-Z
	Limbarda crithmoides (L.) Dumort.	Per	Ch	ME+ER-SR+SA-SI
	Reichardia tingitana (L.) Roth	Ann	Th	IR-TR+SA-SI
	Senecio glaucus L.	Ann	Th	IR-TR+SA-SI+ME
	Silybum marianum (L.) Gaertn.	Ann	Th	ME+IR-TR+ER-SR
	Sonchus maritimus L. subsp. *aquatilis* (Pourr.) Nyman	Per	Ch	ME+IR-TR
	Sonchus oleraceus L.	Ann	Th	COSM

Table (1a): continued

Family	Species	Duration†	Life form††	Chorology§
Asteraceae	*Sphaeranthus suaveolens* (Forssk.) DC.	Per	Th	S-Z
	Symphyotrichum subulatum var. *squamatum* (Spreng.) S.D. Sundb.	Per	G	PAL
	Urospermum picroides (L.) F. W. Schmidt.	Ann	Th	IR-TR+ME
	Xanthium strumarium L.	Ann	Th	PAL
Boraginaceae	*Heliotropium curassavicum* L.	Per	Ch	NEO
Brassicaceae	*Coincya tournefortii* (Gouan) Alcaraz, T.E.Díaz, Rivas Mart. and Sánchez-Gómez	Ann	Th	ME+SA-SI+IR-TR
	Eremobium aegyptiacum (Spreng.) Asch. and Schweinf ex Boiss.	Ann	Th	SA-SI
	Eruca vesicaria (L.) Cav.	Ann	Th	ME+ER-SR+IR-TR+SA-SI
	Erucastrum gallicum (Willd.) O. E. Schulz	Per	Th	ER-SR
	Farsetia aegyptia Turra	Ann	Ch	SA-SI+S-Z
	Lepidium didymium L.	Bi	Th	COSM
	Lepidium sativum L.	Ann	Th	ME
	Diceratella elliptica (DC.) Jonsell	Ann	Th	SA-SI
	Raphanus raphanistrum L.	Ann	Th	ME+ER-SR
	Sinapis alba L.	Ann	Th	ME+IR-TR
	Sisymbrium irio L.	Ann	Th	COSM
Caryophyllaceae	*Polycarpon tetraphyllum* (L.) L.	Ann	Th	ME
	Silene fruticosa L.	Per	Ch	NEO+ME
	Spergularia marina (L.) Griseb.	Per	H	ME+ER-SR+IR-TR
	Spinacia oleracea L.	Ann	Th	CUL
	Stellaria pallida (Dumort.) Murb	Ann	Th	ME+ER-SR
Casuarinaceae	*Casuarina equisetifolia* L.	Per	Ph	CUL
Convolvulaceae	*Convolvulus arvensis* L.	Per	H	PAL
	Convolvulus lanatus Vahl	Per	Ch	SA-SI
Cyperaceae	*Cyperus difformis* L.	Ann	Th	PAN
	Cyperus rotundus L.	Per	G	ME+IR-TR+PAL
Euphorbiaceae	*Euphorbia heterophylla* L.	Ann	Th	PAN
	Euphorbia hirta L.	Ann	Th	COSM
	Euphorbia hyssopifolia L.	Per	Th	PAL
	Euphorbia peplus L.	Ann	Th	ER-SR+ME+IR-TR
	Euphorbia serpens Kunth	Ann	Th	NEO
Fabaceae	*Alhagi graecorum* Boiss.	Per	Ch	ME+IR-TR+SA-SI+S-Z
	Arachis hypogaea L.	Ann	G	CUL
	Astragalus hamosus L.	Ann	Th	ME+IR-TR
	Astragalus spinosus (Forssk.) Muschl.	Per	H	IR-TR+SA-SI
	Lotus creticus L.	Per	H	ME
	Lotus tenuis Waldst. and Kit. ex Willd.	Per	H	ME+ER-SR+IR-TR
	Medicago polymorpha L.	Ann	Th	COSM
	Medicago sativa L.	Per	H	COSM
	Melilotus indicus (L.) All.	Ann	Th	ME+IR-TR+SA-SI

Table (1a): continued

Family	species	Duration[†]	Life form[††]	Chorology[§]
Fabaceae	*Melilotus siculus* (Turra) Steud.	Ann	Th	ME
	Trigonella stellate Forssk.	Ann	Th	IR-TR+ER-SR+ME
	Trifolium resupinatum L.	Ann	Th	IR-TR+SA-SI
	Vicia sativa L.	Ann	Th	ME+ER-SR+IR-TR
Malvaceae	*Abelmoschus esculentus* (L.) Moench	Ann	Th	CUL
	Malva parviflora L.	Ann	Th	ME+IR-TR
Orobanchaceae	*Cistanche phelypaea* (L.) Cout.	Per	G, Pa	ME+SA-SI
	Orobanche crenata Forssk.	Ann	G, Pa	ME+IR-TR
	Orobanche ramosa L.	Ann	Th, Pa	ME+IR-TR
Oxalidaceae	*Oxalis corniculata* L.	Per	G	COSM
Poaceae	*Avena fatua* L.	Ann	Th	COSM
	Avena sativa L.	Ann	Th	COSM
	Bromus catharticus Vahl	Ann	Th	ME+ER-SR+IR-TR+NEO
	Cenchrus biflorus Roxb.	Per	Th	SA-SI+S-Z
	Cynodon dactylon (L.) Pers.	Per	G	COSM
	Dactyloctenium aegyptium (L.) Willd.	Ann	Th	PAL
	Digitaria sanguinalis (L.) Scop.	Ann	Th	PAL
	Diplachne fusca (L.) P. Beauv. ex Roem. and Schult.	Ann	G	PAN
	Echinochloa colona (L.) Link	Ann	Th	ME+IR-TR+PAL
	Echinochloa crus-galli (L.) P. Beauv.	Ann	Th	PAN
	Echinochloa glabrescens Munro ex Hook. f.	Ann	Th	PAL
	Festuca myuros L.	Per	Th	ME+PAL
	Triplachne nitens (Guss.) Link.	Per	Th	ME
	Hordeum marinum Huds.	Ann	Th	ME+IR-TR+ER-SR
	Imperata cylindrica (L.) Raeusch.	Per	G	ME+SA-SI+IR-TR
	Lolium multiflorum Lam.	Ann	Th	ME+ER-SR+IR-TR
	Lolium perenne L.	Ann	Th	ME+ER-SR+IR-TR
	Lolium rigidum Gaudin.	Ann	Th	ME+IR-TR
	Lolium temulentum L.	Ann	Th	ME+ER-SR+IR-TR
	Oryza sativa L.	Ann	Th	CUL
	Parapholis incurva (L.) C. E. Hubb.	Ann	Th	ME+IR-TR+ER-SR
	Parapholis marginata Runem.	Per	Th	ME
	Phalaris minor Retz.	Ann	Th	ME+IR-TR
	Phragmites australis (Cav.) Trin. ex Steud.	Per	G	COSM
	Poa annua L.	Per	Th	ME+ER-SR+IR-TR
	Polypogon monspeliensis (L.) Desf.	Ann	Th	COSM
	Polypogon viridis (Gouan) Breistr.	Ann	H	ME+IR-TR
	Rostraria cristata (L) Tzvelev	Ann	Th	ME+IR-TR
	Schismus barbatus (L.) Thell.	Ann	Th	ME+SA-SI+IR-TR
	Setaria verticillata (L.) P. Beauv.	Per	Th	COSM

Table (1a): continued

Family	species	Duration†	Life form††	Chorology§
Poaceae	*Setaria viridis* (L.) P. Beauv.	Per	Th	PAL
	Sporobolus heterolepis (Gray) A.Gray	Per	H	ME
	Sporobolus indicus (L.) R.Br.	Ann	H	PAL
	Sporobolus spicatus (Vahl) Kunth	Per	G	ME+SA-SI+S-Z
	Stipagrostis obtusa (Delile) Nees	Ann	H	PAL
	Stipellula capensis (Thunb.) Röser and Hamasha	Ann	Th	SA-SI+ME
Polygonaceae	*Polygonum equisetiforme* Sm.	Per	G	ME+IR-TR
	Rumex dentatus L.	Per	Th	ME+ER-SR+IR-TR
	Rumex spinosus L.	Ann	Th	ME+SA-SI
	Rumex vesicarius L.	Ann	Th	SA-SI+S-Z+IR-TR
Portulacaceae	*Portulaca oleracea* L.	Ann	Th	COSM
Primulaceae	*Anagallis arvensis* L.	Ann	Th	ME+ER-SR+IR-TR
Rubiaceae	*Galium sinaicum* (Delile ex Decne.) Boiss.	Ann	Ch	COSM
Solanaceae	*Hyoscyamus muticus* L.	Per	H	ME
	Solanum nigrum L.	Per	Ch	ME+ER-SR+IR-TR
Tamaricaceae	*Tamarix nilotica* (Ehrenb.) Bunge	Per	Ph	SA-SI+S-Z
Urticaceae	*Urtica urens* L.	Ann	Th	ME+ER-SR
Zygophyllaceae	*Fagonia arabica* L.	Per	Ch	SA-SI
	Tribulus terrestris L.	Ann	Th	PAN
	Zygophyllum album L. F.	Per	Ch	ME+SA-SI
	Zygophyllum coccineum L.	Per	Ch	SA-SI
	Zygophyllum decumbens Delile	Per	Ch	SA-SI
	Zygophyllum simplex L.	Ann	Th	SA-SI+S-Z

†Duration: Ann, Annuals; Per, Perenials and Bi, Biennials. ††Life forms: Th, Therophytes; H, Hemicryptophytes; Ph, Phanerophytes; Ch, Chamaephytes; G, Geophytes and Pa, Parasitic. § COSM, Cosmopolitan; PAL=Palaeotropical, PAN, Pantropical; S-Z, Sudano-Zambezian; ME, Mediterranean; SA-SI, Saharo-Sindian; IR-TR, Irano-Turanian, ER-SR, Euro-Siberian; NEO, Neotropical; CUL, Cultivated.

Ordination of stands

It is clear that the vegetational groups of weed vegetation in the study area obtained by TWINSAPAN classification program are distinguishable and have a clear-cut pattern of segregation on the ordination diagrams. These groups are more correlated with the first axis than the second one. Therefore, the first axis lies in the direction of the maximum variations. From the stand ordination diagram (Fig.5). It is obvious that the stands of vegetational groups A and B in Ismailia are situated on the diagram's left side. In the middle of the diagram, vegetational group C in Ismailia and Suez is divided, and vegetational group D in Ismailia and Port Said is divided towards the end of the first axis on the right side of the diagram.

Different soil variables did not significantly correlate with the assessment of the explored plants, with the exception of silt percentage and bicarbonate, which show a positive significant correlation in various vegetational groups. Meanwhile, the relationship between the vegetation and soil variables is shown on the ordination diagram produced by Canonical Correspondence Analysis (CCA) of the biplot of species and soil variables (Fig, 6). The percentages of soil texture (sand, silt, and clay), organic matter, total nitrogen, total phosphorus, total calcium carbonate, electrical conductivity, sulphates, calcium, magnesium, sodium, potassium, chlorides, carbonate, and bicarbonate, as well as pH value, were shown to be the most effective soil variables, and they showed strong positive connections with the first and second axes of the CCA ordination diagram. *Echinops spinosissimus* subsp. *spinosissimus* and *Hyoscyamus muticus* are separated at the upper side of CCA biplot diagram and showed a strong relationship with carbonate. While, *Amaranthus graecizans*, *Beta vulgaris*, *Lolium multiflorum* are separated at the lower left side of CCA biplot diagram and showed a strong relationship with organic matter, calcium carbonate and silt.

Additionally, *Lepidium didymium*, *Rumex dentatus* are separated at the middle lower side of the CCA biplot diagram and showed a strong relationship with pH, total phosphorus and total nitrogen. *Lotus glaber*; the indicator species of group D, *Anagallis arvensis*, *Beta vulgaris*, *Conyza bonariensis*, *Digitaria sanguinalis*, *Lolium multiflorum*, *Lolium perenne*, *Medicago sativa* and *Zygophyllum decumbens* are separated at the left middle side of the CCA biplot diagram and showed a strong relationship with clay. *Aizoon canariense*; the indicator species in group A**,** *Avena fatua, Bassia muricata, Bidens pilosa, Chenopodium murale;* the indicator species in group B, *Cynodon dactylon*; the dominant species in group C, *Launaea capitata, Polygonum equisetiforme, Polypogon viridis* and *Schismus barbatus* the dominant species in group A were separated at the upper right side of CCA biplot diagram and showed a strong relationship with electrical conductivity, calcium, magnesium, sodium, potassium, bicarbonate, chloride, sulphates and sand. The correlation between environmental variables and the CCA axis is given in Table (5). It is clear that, CCA axis 1 was highly positively correlated with clay and highly negatively correlated with sand, so the axis can be interpreted as clay-sand gradient. CCA axis 2 was highly positively correlated with sand and highly negatively correlated with silt; this axis can be interpreted as sand-silt gradient. The eigenvalues of the two CCA axis are 0.571 and 0.534 for axis 1 and 2 respectively. The species-environment correlations were higher in the first axis (0.909) than the second axis (0.906).

DISCUSSION

The floristic analysis of the present study revealed the record of 148 species belonging to 110 genera and 26 families. The most weed species-rich families were Poaceae (36 species), Asteraceae (23 species), Amaranthaceae (18 species), Fabaceae (13 species) and Brassicaceae (11 species), which represents collectively about 68.24% of the total number of the recorded weed species. This sequence of the presence and contribution of the above families is similar to that reported in most of the floristic studies in Egypt by Abd EL-Hamid (2005) regarding the weed vegetation of local environment in Ismailia Governorate. Additionally, our results are in comparable to Abd El Hamid and Kamel (2010) on the weed communities of field crops at El-Tina Plain area. In another studies done by Salama *et al*. (2016) on the desert reclaimed arable lands in southern Egypt, Ahmed *et al.* (2015) on the flora of El-Qantra Sharq, Amer *et al.* (2015) on the floristic composition of Nile islands in Middle Egypt, Mashaly *et al.* (2016) on the orchards in the newly reclaimed Areas of Nile Delta, El Bous and Abd El Hamid (2018) studied the weed flora in mango orchards in the Ismailia Governorate.

The recorded species in the present study contained 64.86% as annual species and 35.14% as perennial species. The dominance of annuals in the study area could be due to the fact that they have a higher reproductive capacity and ecological, morphological and genetic plasticity under high levels of disturbance such as land reclamation performs (Harper, 1977; Grime, 1979). The low number of perennials might be due to the dense management used in plantations, which could affect vegetative growth of the perennial weeds (Abd El-Ghani *et al.,* 2013).

Table (1b): Chorological analysis of the weed species observed in the study area. Three types of regional classifications: mono-regional, bi-regional, and pluri-regional.

Class	Chorotype †	Number of species	Total species recorded (%)
Mono-regional	ME	11	7.44
	PAL	13	8.8
	SA-SI	8	5.42
	PAN	6	4.03
	NEO	4	2.71
	S-Z	3	2.03
	ER-SR	1	0.68
Bi-regional	NEO-ME	1	0.68
	ME+PAL	1	0.68
	IR-TR+ME	16	10.81
	SA-SI+S-Z	8	5.4
	IR-TR+SA-SI	7	4.73
	ME+SA-SI	4	2.7
	ME+ER-SR	4	2.7
	IR-TR+S-Z	1	0.68
Pluri-regional	IR-TR+ER-SR+ME	18	12.16
	IR-TR+SA-SI+ME	5	3.38
	ME+ER-SR+IR-TR+NEO	1	0.68
	ME+ER-SR+IR-TR+SA-SI	1	0.68
	ME+ER-SR+SA-SI	3	2.03
	ME+IR-TR+SA-SI+S-Z	1	0.68
	ME+IR-TR+PAL	2	1.35
	ME+SA-SI+S-Z	1	0.68
	SA-SI+IR-TR+S-Z	2	1.35
	COSM	20	13.52

†COSM, Cosmopolitan; PAL, Palaeotropical; PAN, Pantropical; S-Z, Sudano-Zambezian; ME, Mediterranean; SA-SI, Saharo-Sindian; IR-TR, Irano-Turanian; ER-SR, Euro-Siberian; NEO, Neotropical; CUL; Cultivated.

In terms of the biological spectrum of the studied region, therophytes, represented by 65.54 % of the all recorded species, were most prevalent followed by chamaephytes (13.51 %), and hemicryptophytes that represented by 8.0 %. However, geophyte-life form was the less recorded group and represented by 6.7 % of all recorded species. These results are in agreement with the findings of Ahmed *et al.* (2015), Mashaly *et al.* (2016), Abd El-Hamid (2017), Al-Sherif *et al.* (2018), Abd El-Aal *et al*. (2019) and Al Shaye *et al.* (2020). The high percentage of therophytes can be explained by the aridity of the region and habitat distubance along with Mediterranean climate, topographic variation, and biotic interaction all seem to have an impact on the prominent therophytes (Al Shaye *et al.,*

Table (2a): Classification of stand habitat based on recorded vegetation in number of stands taken.

Parameters	**Vegetational groups**			
	A	**B**	**C**	**D**
Number of Stands	8	4	29	9
Main Crop				
1- Orchards	+	+	+	+
2-Vegetables and crops	+	-	+	+
Stands Habitat	D	D	D – S M	S M - D

Table (2b): Physicochemical parameters of soil collected from different stands for various weed vegetational groups (A, B, C and D).

Measured Soil parameters (mean ± SE)		**Parameters**	Vegetational groups				**F-ratio**	***p*-value**†
			A	**B**	**C**	**D**		
Mechanical analysis	Soil Texture	Sand %	**94.88 ± 0.743**	94.25 ± 0.750	83.31 ± 1.25	52.33 ± 7.39	3.332	0.114*
		Silt %	2.13 ± 0.295	2.00 ± 0.408	5.69 ± 0.673	**31.22 ± 6.53**	7.08	0.030**
		Clay %	3.00 ± 0.500	3.75 ± 0.479	11.00 ± 1.00	16.44 ± 2.12	1.358	0.356*
Chemical analysis		Electrical Conductivity (dSm^{-1})	2.30 ± 0.433	1.96 ± 0.355	28.21 ± 5.850	10.23 ± 2.01	2.789	0.149*
		pH value	7.96 ± 0.065	7.90 ± 0.0779	7.76 ± 0.0678	7.91 ± 0.111	2.194	0.207*
	Cation ($meql^{-1}$)	Calcium	7.65 ± 1.340	5.88 ± 1.180	65.86 ± 13.70	22.74 ± 4.73	3.107	0.127*
		Magnesium	5.61 ± 1.250	5.23 ± 1.530	99.74 ± 25.20	36.84 ± 9.09	2.666	0.159*
		Sodium	9.15 ± 2.140	8.53 ± 2.110	136.20 ± 30.20	43.73 ± 8.17	3.351	0.113*
		Potassium	0.60 ± 0.076	0.45 ± 0.087	1.57 ± 0.210	1.04 ± 0.109	0.839	0.528*
	Anion ($meql^{-1}$)	Cabonate	0.65 ± 0.155	0.10 ± 0.100	1.31 ± 0.22	1.00 ± 0.337	0.373	0.777*
		Bicarbonate	3.81 ± 0.429	3.40 ± 0.400	8.76 ± 1.55	4.29 ±0.518	5.295	0.052*
		Chlorides	8.45 ± 2.490	7.33 ± 2.610	189.28 ± 40.50	69.94 ± 14.6	2.552	0.169*
		Sulphates	10.10 ± 1.990	9.25 ± 2.290	103.63 ± 26.80	29.10 ± 6.49	4.517	0.069*
	Nutrient (%)	Total Phosphorus %	0.06 ± 0.0147	0.04 ± 0.007	0.06 ± 0.014	0.11 ± 0.0474	2.608	0.164*
		Total Nitrogen %	0.21 ± 0.0170	0.23 ± 0.024	0.20 ± 0.011	0.22 ± 0.0280	0.251	0.858*
		Organic Matter %	0.28 ± 0.0602	0.27 ± 0.0237	0.55 ± 0.058	1.20 ± 0.181	2.983	0.135*
		Total Calcium Carbonate %	2.63 ± 0.472	2.52 ± 0.441	3.39 ± 0.276	4.56 ± 0.523	1.59	0.303*

†*, data per row are not significant different at $p \leq 0.05$; **, data are significant different at $p \leq 0.05$.

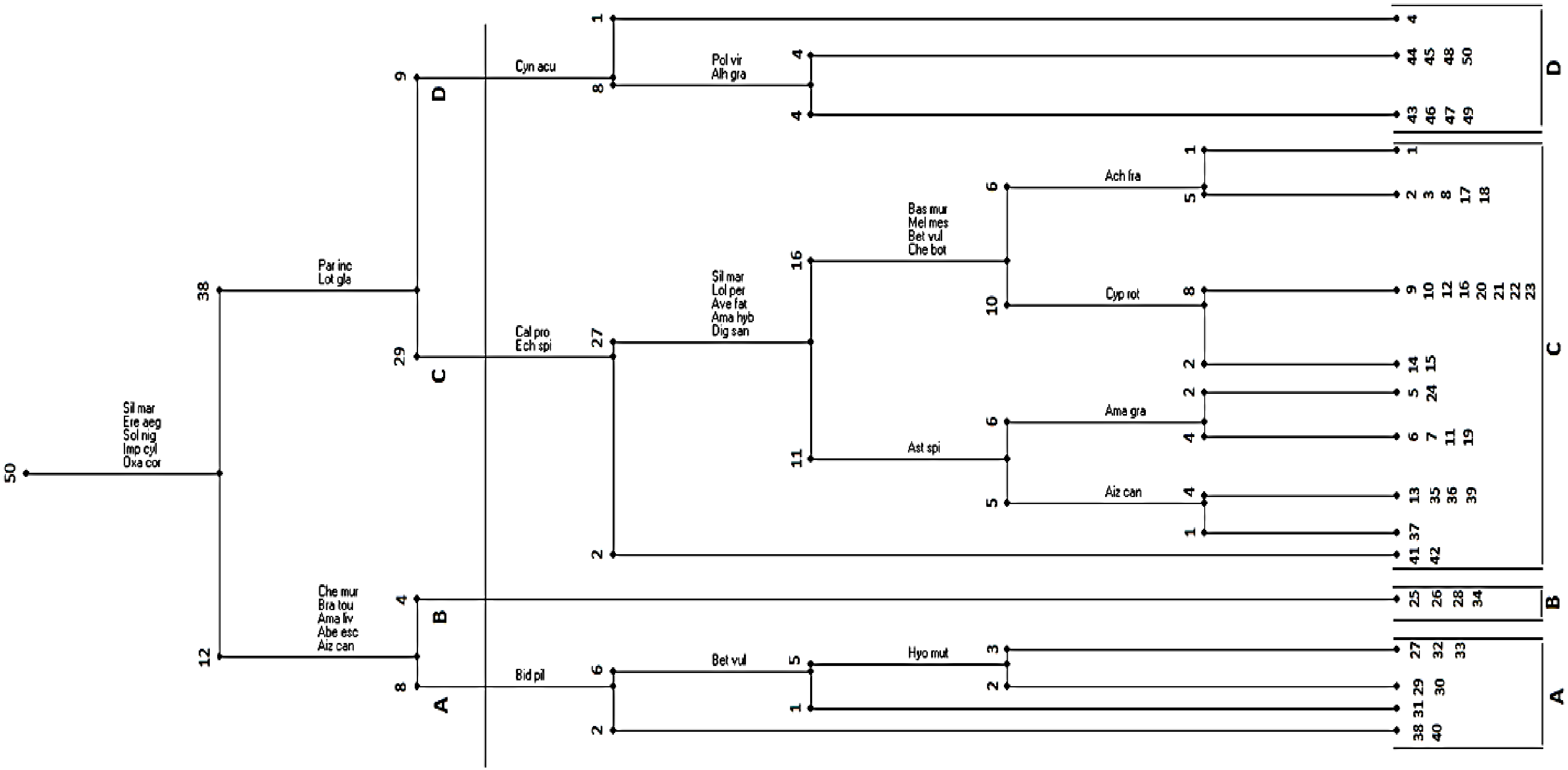

Figure (4): Classification of stands of the study area. Dendrogram obtained by application of the agglomerative classification technique. The dendrogram yields four weeds vegetational groups. The indicator species are abbreviated to the first three letters of the genus and first three letters of the species name. (Abbreviations: *Sil mar: Silybum marianum, Ere aeg: Eremobium aegyptiacum, Sol nig: Solanum nigrum, Imp cyl: Imperata cylindrica, Oxa cor: Oxalis corniculate, Par inc: Parapholis incurva, Lot gla: Lotus glaber, Che mur: Chenopodium murale, Bra tou: Brassica tournefortii, Ama liv: Amaranthus lividus, Abe esc: Abelmoschus esculentus, Cyn acu: Cynanchum acutum, Cal pro: Calotropis procera, Ech spi: Echinops spinosissimus, Bid pil: Bidens pilosa, Bet vul: Beta vulgaris, Pol vir: Polypogon viridis, Alh gra: Alhagi graecorum, Sil mar: Silybum marianum, Lol per: Lolium perenne, Ave fat: Avena fatua, Ama hyb: Amaranthus hybridus, Dig san: Digitaria sanguinalis, Bet vul: Beta vulgaris, Bas mur: Bassia muricate, Mel mes: Melilotus messanensis, Che bot: Chenopodium botrys, Ast spi: Astragalus spinosus, Hyo mut: Hyoscyamus muticus, Ach fra: Achillea fragrantissima, Cyp rot: Cyperus rotundus, Ama gra: Amaranthus graecizans* and *Aiz can: Aizoon canariense*).

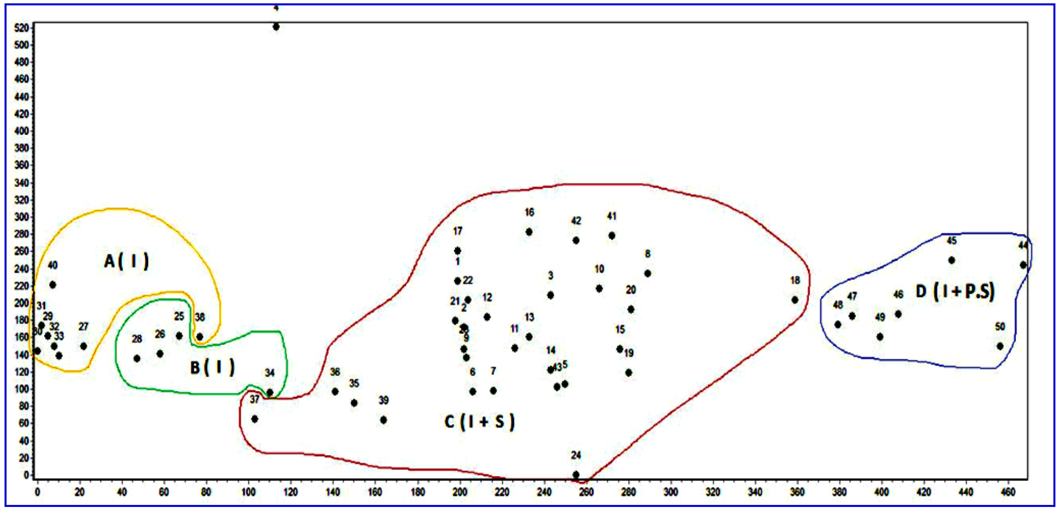

Figure (5): Distribution of stands and locations in relation to the first two axes of the stand ordination diagram (S: Suez, I: Ismailia, and P.S: Port Said). The lines encircled the stands indicate validation of the weed vegetational groups identified by the use of the TWINSPAN classification tool. (A and B groups include desert habitats; C and D groups include deserts and salt marshes habitats).

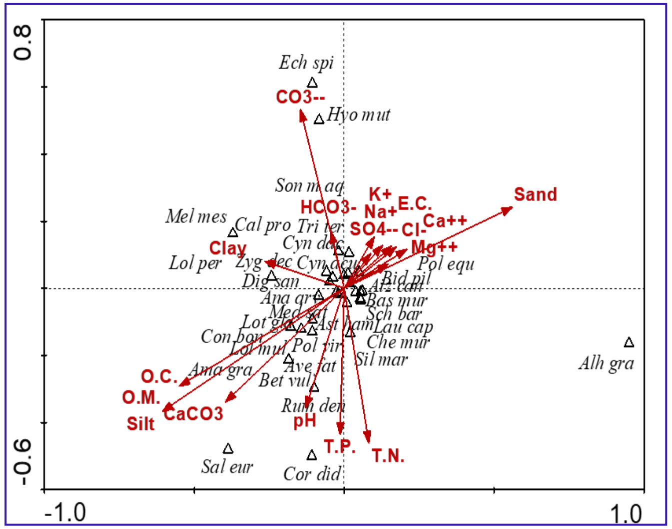

Figure (6): Biplot of Canonical Correspondence Analysis (CCA) showing the relationships between the plant species and the correlated soil variables. The indicator species are abbreviated to the first three letters of the genus and first three letters of the species, respectively. *Lot gla, Lotus glaber; Che mur, Chenopodium murale; Ama gra, Amaranthus graecizans; Aiz can, Aizoon canariense; Cyn acu, Cynanchum acutum; Cal pro, Calotropis procera; Bid pil,Bidens pilosa; Bet vul, Beta vulgaris;Pol vir, Polypogon viridis; Alh gra, Alhagi graecorum; Sil mar, Silybum marianum; Lol per, Lolium perenne; Ave fat, Avena fatua; Dig san, Digitaria sanguinalis, Bet vul: Beta vulgaris, Mel mes: Melilotus messanensis, Hyo mut: Hyoscyamus muticus, Ama gra: Amaranthus graecizans, Cor did: Coronopus didymus, Sal eur: Salicornia europaea, Cyn dac: Cynodon dactylon* and *Ech spi, Echinopus spinosus*).

Table (3): Characterization of weed vegetational groups of the study area.

Vegetation analysis (IV)	**Vegetational groups**			
Plant sp. recorded	**A**	**B**	**C**	**D**
Achillea fragrantissima		1.54		
Achillea tenuifolia	5.83		0.16	
Aizoon canariense	3.61		0.51	
Alhagi graecorum			1.98	
Amaranthus blitum* subsp. *oleraceus			0.32	
Amaranthus graecizans			0.06	1.26
Ammi majus			0.68	
Anagallis arvensis	1.37	6.81	5.94	11.23
Anethum graveolens		2.57	0.2	
Astragalus hamosus		0.27		
Atriplex lindleyi* subsp. *inflata			7.09	
Avena fatua				0.14
Avena sativa			0.85	
Bassia indica			0.76	4.83
Bassia muricata	9.27	8.41	1.53	
Beta vulgaris			0.46	2.15
Bidens pilosa			4.37	
Bromus catharticus			0.82	
Calotropis procera			1.04	
Cenchrus biflorus	0.45		6.55	
Centaurea pallescens	7.02	3.84		
Chenopodium album	2.76	10.24	5.04	4.02
Chenopodium glaucum				2.42
Chenopodium murale	12.3	14.03	22.61	2.17
Chenopodium murale* var. *microphilly				6.88
Cichorium endivia			0.34	5.97
Cistanche phelypaea	0.21	0.5	0.08	
Coincya tournefortii			1.32	
Convolvulus arvensis			0.61	0.31
Convolvulus lanatus	0.59		0.05	
Conyza bonariensis			2.68	11.56
Cynanchum acutum	2.85	16.51	25.12	3.27
Cynodon dactylon		8.66	**38.28**	4.02
Cyperus rotundus				0.17
Dactyloctenium aegyptium			1.29	
Diceratella elliptica			0.07	
Digitaria sanguinalis	0.97	2.67		0.37
Echinochloa colona			0.45	
Echinochloa crus-galli				0.31
Echinochloa glabrescens			0.07	0.14
Echinops spinosissimus* subsp. *spinosissimus				3.64
Eremobium aegyptiacum	4.92	0.41		
Eruca vesicaria	0.51	0.84		
Erucastrum gallicum	0.34			
Euphorbia heterophylla			0.81	
Euphorbia peplus		5.3	14.65	
Fagonia arabica			0.07	
Farsetia aegyptia			0.75	
Galium sinaicum	1.26			
Heliotropium curassavicum			1.4	
Hordeum marinum			0.35	2.46
Hyoscyamus muticus			0.24	9.98
Ifloga spicata	19.78	8.66		

Table (3): continued

Vegetation analysis (IV) **Plant sp. recorded**	**Vegetational groups**			
	A	**B**	**C**	**D**
Imperata cylindrica			0.51	
Launaea capitata	1.25			
Launaea nudicaulis	0.23	2	18	0.16
Lepidium didymium			1.42	
Limbarda crithmoides			0.6	
Lolium multiflorum			0.35	0.92
Lolium perenne				11.32
Lolium rigidum		1.41	3.92	0.88
Lolium temulentum				0.61
Lotus creticus	3.09	1.15		
Lotus glaber			0.35	0.16
Malva parviflora	2.69	7.2	14.81	12.07
Medicago polymorpha		5.59	0.6	
Medicago sativa			1.78	
Melilotus indicus	1.5	0.86	13.98	**39.25**
Melilotus siculus	0.16			6.45
Mesembryanthemum nodiflorum	4.82	9.39	0.24	0.48
Orobanche crenata	0.81	1.65	0.12	
Orobanche ramosa	0.13	0.76		
Oxalis corniculata	0.43		0.92	
Parapholis incurva				0.27
Phlaris minor		1.45	0.75	5
Phragmites australis	0.48		7.22	29.15
Poa annua				0.14
Polycarpon tetraphyllum	1.07		0.06	
Polygonum equisetiforme			0.47	
Polypogon monspeliensis	1.2	0.8	0.88	15.68
Polypogon viridis				0.16
Portulaca oleraceus			0.23	0.19
Pulicaria undulata	1.86	1.7		
Raphanus raphanistrum			0.42	
Reichardia tingitana	2.4	5.42	3.93	
Rostraria cristata		52.02	0.07	
Rumex dentatus			1.38	0.82
Rumex spinosus			0.59	
Rumex vesicarius	0.32		4.86	10.65
Salicornia europaea				3.56
Schismus barbatus	**72.3**		1.37	
Senecio glaucus	59.74	**65.78**	24.38	
Silene fruticosa	3.74	4.22	2.05	
Silybum marianum			0.07	
Sinapis alba			0.14	
Sisymbrium irio			1.19	
Solanum nigrum			2.96	3.07
Sonchus maritimus* subsp. *aquatilis			1.27	
Sonchus oleraceus	5.48	9.27	13.16	5.04
Spergularia marina			0.08	10.85
Sphaeranthus suaveolens				2.38
Spinacia oleracea			0.04	
Stellaria pallida			0.18	
Stipagrostis obtusa	2.99	3.85	0.44	
Stipellula capensis			0.49	
Suaeda vera				0.32

Table (3): continued

Vegetation analysis (IV) Plant sp. recorded	Vegetational groups			
	A	B	C	D
Traganum nudatum	3.35	0.3		
Tribulus terrestris			0.55	
Trifolium resupinatum		0.62	1.27	10.6
Trigonella stellate			0.41	
Triplachne nitens				0.2
Urospermum picroides			0.08	
Urtica urens			0.16	
Vicia sativa			0.12	
Zygophyllum album	24.19	7.03	5.13	9.47
Zygophyllum coccineum		0.72	0.38	4.95
Zygophyllum decumbens			0.1	
Zygophyllum simplex	33.79	24.8	1.57	
Statistical analyses:				
Total number of species/group	41	39	89	51
Simpson's index	0.84 ± 0.0159	0.88 ± 0.01	0.84 ± 0.02	0.84 ± 0.01
Shannon's index	2.23 ± 0.105	2.51 ± 0.04	2.25 ± 0.09	2.12 ± 0.1
Evenness index	0.54 ± 0.0350	0.57 ± 0.01	0.64 ± 0.02	0.65 ± 4.66
Species richness	18.38	21.5	16.28	14.44

Table (4): Correlation of CCA ordination axes with the soil variables, eigenvalues and species environment correlations.

Variable parameters	Coordination axes	
	Axis 1	**Axis 2**
E.C.	0.2690	0.1430
pH	-0.2151	-0.1165
Ca^{++}	0.2942	0.1885
Mg^{++}	0.2413	0.1328
Na^{+}	0.2175	0.0908
K+	0.3255	0.1160
CO_3^{--}	0.1333	-0.1323
HCO_3^{-}	0.0823	-0.0403
Cl^{-}	0.2842	0.1568
SO_4^{--}	0.1790	0.0799
T.P.	0.2558	-0.0124
T.N.	0.0910	0.0744
O.C.	0.5127	-0.4988
O.M.	0.5127	-0.4987
$CaCO_3$	0.3131	-0.3587
Sand %	-0.5937	0.5084
Silt %	0.4166	-0.5503
Clay %	0.6984	-0.2403
Eigenvalues	0.571	0.534
Species-environment correlations	0.909	0.906

2020; Mashaly *et al*., 2013). In meantime, the short lifespan also enables them to withstand the harsh climate (Abbas, *et al*., 2021). In contrast, the occurrence of chamaephytes and hemicryptophytes in significant numbers compared to the rest life forms. This is possibly due to their ability to block the movement of materials carried by wind and/or water, allowing them to replace a buried organ by growing adventitious roots and new aerial shoots. The existence of parasitic species in the study area was similar to the finding reported by Ahmed *et al.* (2015). However, the differences in the parasitic genera may be due to the type of the crops or orchards cultivated in the studied fields (Salama *et al*., 2016).

The chorological affinities in the study region demonstrated that the documented weed flora is presumed to be a combination of components from the majority of the world's flora. The largest number of these recorded weeds phytogeographically belongs to Mediterranean and its extensions (bi-regional and pluri-regional elements) which represented by 38.53% of the total recorded species followed by Cosmopolitan elements (13.52%), then Saharo-Sindian elements and its extensions (10.84%). These findings are in agreement with Abd El-Hamid (2017), El Bous and Abd EL-Hamid (2018), Abd El-Aal *et al.* (2019) and Ismael *et al.* (2019). This phenomenon may be attributed to the fact that the Mediterranean species is an indicative to a more mesic environment.

The full description of the freshly reclaimed vegetation is essential for creating a mental picture of a region and its vegetation that will allow for comparison and the final classification of different vegetation units. The classification of the vegetation data collected for the study area using TWINSPAN revealed four vegetation groupings (A, B, C, and D). This method of categorization is based on the dominant and co-dominant plant species, soil feature as well as the various climate types. This application is reliable and supports the data that has been observed and obtained (Abbas, *et al*., 2021). Additionally, TWINSAPAN classification has a clear-cut pattern of segregation on the ordination diagrams. These groups are more correlated with the first axis than the second one.

Group A represents the stands in desert habitats dominated by *Schismus barbatus* and co-dominated by *Senecio glaucus*, *Zygophyllum simplex* and *Zygophyllum album*. The soil is characterized by the highest level of sand fraction and high pH. This trend is similar data reported along the Red Sea coast transect between Marsa Alam and Qusier by Salama *et al.* (2014). In another study done by El-Amier and Abdul-Kader (2015), in the Northern sector of the Eastern desert of Egypt, demonstrated that *Senecio glaucus* and *Zygophyllum simplex* were the dominant species in the sites characterized by high levels of magnesium, calcium carbonate, silt, clay and organic matter. Abd El-Ghani *et al.* (2015) recorded *Senecio glaucus* as a dominant species in the studied stands in Wadi El-Natrun depression at the western desert of Egypt. However, in Suez region, *Zygophyllum album* is one of the species restricted to the stands characterized by soil with the highest levels of sand fraction (Abd El-Hamid, 2017).

Group B represents the stands of the habitats dominated by *Senecio glaucus* with *Rostraria cristata, Zygophyllum simplex* and *Cynanchum acutum* as co-dominant species. Since this soil has the largest levels of total nitrogen, this group has relatively the highest biodiversity indices (species richness of 21.5 species/stand, Shannon's index of 2.51, Simpson's index of 0.88, and Evenness index of 0.57). The increase of nitrogen in the study area may be as the result of the cultivation of nitrogen-fixing legumes like *Vicia faba* alongside Mango orchards in the studied stands (Cong *et al*., (2014).

Group C includes the stands that represents desert and salt marches habitats. Those stands are characterized by the highest levels of calcium, magnesium, sodium, potassium, carbonates, bicarbonates, chlorides and sulphates. *Cynodon dactylon* is the dominant species in this group, while *Cynanchum acutum*, *Senecio glaucus* and *Chenopodium murale* were the other important co-dominant species. These results agreed more or less with those studied by Abd El-Ghani *et al.* (2013) who reported the dominance of *Cynodon dactylon* and *Senecio glaucus* in the stands characterized by the highest levels of sulphates and magnesium in the reclaimed lands along the northern sector of the Nile Valley. Mashaly *et al.* (2015) reported that *Cynodon dactylon* was the dominant and the characteristic weed for newly reclaimed lands of the North of Nile Delta region. El-Amier and Abdul-Kader (2015) in the Northern sector of the Eastern desert of Egypt showed that *Senecio glaucus* is the dominant species in the sites characterized by high levels of magnesium, calcium carbonate, silt, clay and organic matter. Meanwhile, Mahgoub (2019) showed that *Cynodon dactylon* and *Chenopodium murale* were the dominant species in the sites characterized by high levels of sodium and bicarbonate in Isthmus of Suez. However, according Hatim *et al*. (2021), *Chenopodium murale* and *Cynodon dactylon* were recorded as predominate in environments with nutrient-rich soil of the Sinai desert vegetation.

The Group D salt marsh habitats distinguished by having the largest concentrations of total phosphorus, calcium carbonate, silt and clay fractions, and organic matter along with dominant species of *Melilotus indicus*, *Phragmites australis*, and *Polypogon monospeliensis*. These findings concur with those of Abd El-Ghani *et al.* (2015), in the Wadi El-Natrun Depression in the Western Desert of Egypt; Hegazy *et al.* (2004) in agro-ecosystems of arid lands in the Beni-Suef governorate; Gomaa (2012) in the Al-Jouf province in northern Saudi Arabia; and Al Saidi *et al.* (2016) in the Nile Delta.

The floristic composition of the research region and soil variables such soil texture, total nitrogen, calcium, magnesium, potassium, sulphates, and bicarbonates were significantly connected, according to a linear connection of soil variables with the important values of selected prominent species (El-Zeiny *et al*., 2022). In a study done by Mashaly *et al*. (1995), they pointed out that moisture content, porosity, calcium carbonate, pH, EC, sulphates, carbonates, sodium, potassium, calcium and magnesium were the most effective soil variables controlled the distribution of vegetation in the Ismailia-Suez desert road, while soil texture, organic carbon, chloride and bicarbonate content showed little effect on the vegetation distribution.

The application of Canonical Correspondence Analysis (CCA biplot) indicated that the distribution of vegetation in this area is controlled by a wide range of soil variables including soil texture (sand, silt and clay), organic matter, total nitrogen, total phosphorus, total calcium carbonate, electrical conductivity, pH value, sulphates, cations (calcium, magnesium, sodium and potassium), anions (chlorides, carbonate and bicarbonate). These results agreed more or less with the previous investigators, such as: Khafagi *et al*. (2013), Mashaly *et al*. (2015), El-Amier and Abdul-Kader (2015) and Abd El-Hamid (2017).

CONCLUSION

In this study and based on the floristic composition analysis, 148 species from 110 genera and 26 families were identified. Therophytes and chamaephytes were the two main categories of life. Cosmoplitan, Saharo-Sindian, and Mediterranean chorotypes are the key components of the floristic structure in the study area. *Schismus barbatus*, *Senecio glaucus*, *Cynodon dactylon*, and *Melilotus indicus* were the top species in the study area. Soil texture, total nitrogen, calcium, magnesium, potassium, sulphates, electrical conductivity, and organic matter were the main soil characteristics that affected the proliferation of weed vegetation in the study area. In conclusion, a variety of habitat types and soil physical and/or chemical properties may be connected to the diversity and dominance of species.

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مجتمعات الحشائش المصاحبة للمحاصيل الحقلية في الاراصي المستصلحة حديثا في منطقة قناة السويس، مصر

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الملخص العربـــــي

تهدف هذه الدراسة إلى تحليل الغطاء النباتي للحشائش المصاحبة للمحاصيل المنزرعة في الأراضي المستصلحة حديثًا في محافظات قناة السويس الثلاث (الإسماعيلية والسويس وبورسعيد). تم تسجيل 148 نوعًا من الحشائش (96 نباتا حوليا و 52 نباتا معمرا) تنتمي إلى 110 جنسا و 26 عائلة. كانت اكثر الفصائل ثراء بالأنواع هي العائلة النجيلية والمركبة وعرف الديك والقرنية. كما وجد ان طراز الحوليات والنباتات فوق السطحية من أكثر طرز الحياة النباتية انتشارًا. اوضح التحليل الفلوري للغطاء النباتي أن عناصر البحر المتوسط إما نقية أوممتدة إلى مناطق أخرى تشكل المكونات الرئيسية للتركيب الفلوري. نتج عن استخدام برنامج التصنيف ثنائى الإتجاه اربع مجموعات نباتية مميزة للمحاصيل المنزرعه. كانت الانواع السائدة فى هذه المجموعة الخافور والقريص والنجيل والحندقوق. أشارت قياسات التنوع البيولوجي إلى أن المجموعة النباتية (ب) كانت الأكثر تنوعًا. امكن بإستخدام برنامج التطابقي العكسى (DCA) فصل المجموعات النباتية الناتجة عن استخدام برنامج التصنيف ثنائى الإتجاه على امتداد المحورين الاول والثانى. أشار استخدام برنامج التوزيع التطابقي الكنسي إلى أن قوام التربة والنيتروجين الكلي والكالسيوم والمغنيسيوم والبوتاسيوم والكبريتات وملوحة التربة والمواد العضوية كانت من اهم عوامل التربة التي حددت توزيع الغطاء النباتي للحشائش في منطقة الدراسة.