Effect of location and growth season on the productivity and quality of some range plants in Wadi Halazien in the North Western Coast in Egypt

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Abstract: This study was conducted during spring and autumn seasons of 2007 and 2008 in wadi Halazien, at the North West Coast region of Matruh governorate in Egypt. The aim of this investigation was to survey and classify natural plants species and to study the effect of location and seasonal changes on range productivity and quality of pasture species. Seventy-two plant species belong to 29 families (41.67 % annuals, 1.39 % biennials and 56.94 % perennials) were found. *Polygonum equisetiforme* in top, *Deverra tortuosa* in ridge, *Chiliadenus candicans* in bed 1 and *Carduncellus eriocephalus* in bed 2 gave the highest abundance in spring 2007. Whereas, *Gymnocarpos decandrus* in top, *Leopoldia comosa* in ridge and *Carduncellus eriocephalus* in bed 1 and 2 gave the highest one in spring 2008. Total abundance in bed 2 significantly surpassed other sites in both years. Species richness and Simpson's index of diversity in spring increased than in autumn in all sites of both years. *Lycium shawii* in top, *Euphorbia dendroides* in ridge, and *Thymelaea hirsuta* in bed 1 gave the highest importance value in spring 2007. Generally, plant species of family *Caryophyllaceae* in top, *Euphorbiaceae* in ridge, *Thymelaeaceae* in bed 1 and *Apiaceae* in bed 2 gave the highest fresh and dry yields in spring 2007, while, *Thymelaeaceae* in top, ridge and bed 2 and *Cistaceae* in bed 1 gave the highest ones in spring 2008. *Gymnocarpos decandrus* in top, *Euphorbia dendroides* in ridge, *Thymelaea hirsuta* in bed 1 and *Atriplex nummularia* in bed 2 gave the highest fresh and dry yields in spring 2007. While, *Thymelaea hirsuta* in top, *Gymnocarpos decandrus* in ridge, *Fumana thymifolia* in bed 1 and *Carduncellus eriocephalus* in bed 2 had the highest ones in spring 2008. Seasonal fresh and dry yields in bed 2 significantly exceeded other sites in both years. *Fabaceae* gave the highest CP % and DCP % at all sites, except in ridge *Brassicaceae* gave the highest ones in spring 2008. *Erodium crassifolium* in top, *Achillea santolina* in ridge, *Lotus polyphyllus* in bed 1 and 2 gave the highest CP % and DCP % in spring 2008. Crude protein % and DCP % in spring significantly exceeded it in autumn at all sites in both years. Abundance, fresh and dry yields had a positive correlation with precipitation, and a negative correlation with temperature. [Nature and Science 2010;8(7):50-70]. (ISSN: 1545-0740).

Key words: The productivity; Wadi Halazien; North Western Coast.

Introduction

The Northern coast region of Egypt extends around 1000 km along the Mediterranean sea and 30 km inland. This region is characterized with an arid Mediterranean climate that has a limited rainfall. Average annual rainfall over 10 years from 1999 to 2008 was 115 mm/year of meteorological authority in Matruh. The natural range considered the basic source of animal feed in the Egyptian deserts. Due to poor management and environmental impacts, the native ranges are deteriorated and are seriously depleted. Range production depends on various factors as climate, soil, vegetation structure, type and intensity of management.

The vegetation survey of an area is of great importance for any type of agricultural development plan. Plant collection and identification are the starting point for any range ecology investigation. Studies of the individual plant species include the evaluation of native range plants since species are essential for possible use in range improvement. The wadi is typical for agricultural use (rain-fed farming), in addition to rangeland plants for grazing animals (sheep, goats and camels) in the range sector of the wadi (agro-pastoral system) and water harvesting practices by stone dams across the stream (Gab Allah, 2006). In Egypt, the general differences of species richness and diversity communities affected mainly by the differences of soil texture in wadi El-Arousia in Sinai (El-Khouly and Fakhry, 1999). In wadi El-Washka, Kulaib (2008) found the highest abundance in spring than autumn and in wadi bed than the others sites in wadi El-Washka. Gab Allah (2006) and Abdel-Gawad *et al.* (2009) found that plant species of families *Poaceae* and *Asteraceae* had the highest importance value (IV) in both years in wadi El-Ramla and El-Washka, respectively. Abdel-Gawad *et al.* (2009) found that *Thymelaea hirsuta* gave the highest fresh and dry yields in spring and autumn in both years in wadi El-Washka. El-Morsy (2002) and Abdel-Gawad *et al.* (2009) concluded that crude

protein of plants grown in wadi bed exceeded it in ridge in all growing seasons in wadi Mehgun, Magid and El-Washka, respectively. The aim of this study was to survey, classify and study the natural vegetation in two locations during two seasons.

2. Materials and Methods

This study was conducted at the North West Coast of Egypt (Figure 1) in Matruh governorate. Vegetation characteristics were taken in spring and autumn of 2007 and 2008.

The aim of this investigation was to survey, classify natural plant species and study the effect of seasonal changes on range productivity, as well as determination of quality of surveyed plant species during different seasons to assist in the evaluation of a suitable vegetation community.

Wadi Halazien is a rocky wadi located about 40 km west of Matruh city at latitudes of 31° 25' 21" N and longitudes of 26° 51' 43" E. Four sites (wadi top, wadi ridge, wadi bed one and bed two) were studied. Sites altitudes were about 80, 50, 30 and 10 m respectively, by apparatus GPS12xL.

During this study, the monthly variations of different climatic factors were recorded (Table 1). Climatologically, this area is classified as arid with mild winter and warm summer (UNESCO, 1977). The distribution of main annual rainfall in Egypt shows a maximum rate over the Mediterranean coast with a rapid decrease toward the south. The total amount percentage of rainfall was 75.8 and 95 mm before cutting in April 2007 and 2008, and 1 and 13 mm in autumn before cutting in October and November in 2007 & 2008 respectively. The monthly mean values of relative humidity were relatively high in summer months. The maximum values of relative humidity were 75 and 66.53 % in August of 2007 & 2008, respectively, but the minimum values were 60.33 and 53.03 % in March and April of 2007 and 2008, respectively.

Fig. 1. Map of the Western Mediterranean sea coastal region of Egypt indicating the location of study area.

Table 1. Monthly averages of climatic factors recorded in Marsa Matruh city during 2007 and 2008*.

Periods / Month	2007						2008					
	Air temperature (°C)			WS** ms^{-1}	RH %	P mm	Air temperature (°C)			WS ms^{-1}	RH %	P mm
	Max.	Min.	Mean				Max.	Min.	Mean			
January	18.17	10.50	13.80	4.17	69.67	18.1	17.06	10.12	13.59	4.53	63.72	53
February	18.47	10.57	14.43	5.43	69.67	31.5	17.20	9.57	13.08	4.91	61.85	24
March	20.93	12.03	16.30	5.07	60.33	5.3	22.98	12.40	17.58	4.91	57.74	2

April	20.80	13.70	17.30	4.90	68.67	2	24.33	14.00	18.83	4.73	53.03	1
May	25.80	17.50	21.45	4.80	70.00	0	25.51	16.19	20.77	3.90	56.35	0
June	27.97	20.13	24.23	5.03	70.67	0	29.13	19.97	24.63	4.32	62.33	0
July	30.07	21.37	26.03	4.83	73.00	0	29.52	22.44	25.78	5.07	63.99	0
August	30.40	22.23	26.57	4.07	75.00	0	30.26	22.01	26.06	3.90	66.53	0
September	28.87	20.97	25.20	3.23	67.00	1	29.93	21.33	25.43	4.78	54.93	0
October	27.73	17.80	22.97	3.03	67.67	0	26.55	17.42	21.97	4.07	57.23	13
November	24.63	13.90	18.73	3.43	63.33	11	23.97	14.27	19.03	3.41	56.40	0
December	20.17	10.70	15.23	4.00	63.00	7.9	20.12	11.76	15.79	3.22	61.32	15
Annual	24.50	15.95	20.19	4.33	68.17	76.8	24.71	15.96	20.21	4.31	59.62	108

***Source: Meteorological Authority, Cairo.**
****WS: Wind speed, RH: Relative humidity, P: Precipitation.**

Generally, soil texture in all the sites of wadi Halazien was sandy loam, except wadi ridge was sandy. The highest percentage of silt was found in wadi bed 1. However, the highest percentage of clay was found in wadi bed 2. Soil samples were collected (0-30 cm) from the studied range area of wadi Halazien. Mechanical analysis was conducted using the international pipette method (Table 2). Chemical determinations of the soil saturated extract were done according to Chapman and Pratt (1961) (Table 3).

Table 2. Mechanical analysis of soil recorded in studied area.

Studied area		Particle-size distribution (%)				Soil texture
		Coarse Sand	Fine Sand	Silt	Clay	
Wadi Halazien	**Top**	28.70	37.85	22.34	11.11	Sandy loam
	Ridge	29.10	63.00	0.80	3.90	Sandy
	Bed one	15.20	20.10	50.00	12.00	Sandy loam
	Bed two	13.00	22.10	48.00	15.00	Sandy loam

The chemical characteristics of the studied soil samples in different sites are shown in Tables (3a) and (3b). The pH value varied from 7.6 to 7.9 in wadi Halazien. The lowest percentage of $CaCO_3$ formed in wadi bed 2 and low salinity.

Table 3a. Some chemical properties of soil recorded in studied area.

Studied area		pH	EC Mmhos cm^{-1}	Organic matter %	Saturation %	Organic carbon %
Wadi Halazien	**Top**	7.9	--	--	--	--
	Ridge	7.6	0.49	0.06	35	0.02
	Bed 1	7.9	3.40	0.12	45	1.22
	Bed 2	7.8	1.30	0.90	45	0.52

Table 3b. Chemical properties of soil recorded in studied area.

Studied area		Cations mequivalent L^{-1}					Anions mequivalent L^{-1}			$CaCO_3$ %
		P^{+++}	K^{+}	Na^{+}	Mg^{++}	Ca^{++}	So_4^{--}	Cl^{-}	HCO_3^{-}	
Wadi Halazien	**Top**	--	0.78	5.26	15.33	2.86	0.32	9.16	--	33.73
	Ridge	2.30	0.31	2.30	2.60	0.90	2.40	3.12	1.16	20.1
	Bed 1	3.60	0.39	7.48	10.98	15.15	18.72	14.73	0.55	17.97
	Bed 2	2.50	0.44	3.42	2.59	6.60	7.83	4.40	0.82	13.36

The species were identified and classified according to family. Species identified primarily in the field for the known plants species, whereas the unknown plants were pressed, mounted and labeled professionally, and were taken to herbarium of Faculty of Science at Cairo University of Egypt for accurate identification. The identification was done according to Boulos (1999, 2000, 2002 & 2005). List and clipping quadrate (1m x 1m) (Ibrahim, 1995) and Reiad *et al.* (1996 b) with 48 replicates (12 replicates in each site, *i.e.* top, ridge, bed 1 and bed 2) were used randomly in wadi Halazien, during each season over the two years. Plant frequency, density and coverage were estimated. Shoot parts of annual plants and new growths of perennials for each species

were clipped for fresh and dry foliage yields (Fresh and dry weight in g m^{-2} were estimated). Vegetation measurements calculated according to Ambshat (1982) as follows:

Abundance the total number of individuals of each species in the total area sampled.

Species diversity, which sometime called species heterogeneity, is a characteristic unique to the community level of the biological organization. It is an expression of community structure. It estimated as the following (Simpson, 1949):

Species richness the number of species in studied area.

$$\text{Diversity} = \frac{\sum_{i=1}^{M} n_i (n_i - 1)}{N(N - 1)}$$ M = species, which we will label as species 1, 2, …, M.

n_i = individuals in species i. or the total number of organisms of a particular species.

N = the total number of organisms of all species.

Simpson's index of diversity = 1 - D

Iindex of diversity increases diversity decreases.

The importance value was determined according to Ludwig and Reynolds (1988) as follows:

Thus: Importance value = R.F. + R.D. + R.C.

$$\text{Frequency (\%)} = \frac{\text{Number of sampled in which species occurs}}{\text{Total number of sampled}} \text{ X } 100$$

$$\text{Density } (m^{-2}) = \frac{\text{Number of individual species}}{\text{Total area (in units)}}$$

$$\text{Coverage (\%)} = \frac{\text{The area occupied by the species (in unit)}}{\text{The whole studied area (in unit)}} \text{ X } 100$$

$$\text{Relative frequency (R.F. \%)} = \frac{\text{Frequency for a species}}{\text{Total frequency for all species}} \text{ X } 100$$

$$\text{Relative density (R.D. \%)} = \frac{\text{Density for a species}}{\text{Total density for all species}} \text{ X } 100$$

$$\text{Relative coverage (R.C.\%)} = \frac{\text{Coverage for a species}}{\text{Total coverage for all species}} \text{ X } 100$$

Shoot parts of annuals and new growths of perennials for each species clipped and weighed for each plant species in each quadrates to calculate fresh foliage yield (g m^{-2}). Each species cleaned and dried in an oven at 65 °C to a constant weight to calculate dry forage yield (g m^{-2}). Crude protein percentage (CP %) was analyzed based on dry yield using modified Micro-Kjeldahl method according to A.O.A.C. (2005). Digestible crude protein percentage (DCP %) was estimated according to Demarquilly's equation, DCP =0.93 CP - 3.52, mentioned by De Ridder *et al.* (1982). This equation is only valid in the case of CP > 3.81 %.

Data were analyzed by Fully Nested analysis (Hierarchical classification) according to Steel *et al.* (1997), using SAS 9 program (1988) and MINITAB 14 program at probability 5 %. Before analysis, transformation for data and then normality distribution in each trait were checked out by Jarque-Bera test using program PAST 1.8 (Hammer *et al.* 2001). Treatment means compared at 5 % level of significance by LSD test. Correlation coefficient between temperature, precipitation and relative humidity and vegetative traits were estimated.

3. Results and Discussion

Botanical composition

Figure (2) and Table (4) show the floristic analysis of the recorded survey and classification included the individual scientific names of species, vernacular name, life duration for each species at different seasons of wadi Halazien in 2007 and 2008. Also, Fig. 3 show the sites of wadi. Natural vegetation contained 72 plant species belong to 29 families. Out of the existing identified 15 species of *Asteraceae*, 14 species of *Poaceae*, 6 species of *Fabaceae*, 4 species of each *Brassicaceae* and *Chenopodiaceae*, 3 species of each *Caryophyllaceae* and *Cistaceae*, 2 species *Lamiaceae*, 1 species for each the other families. Shahba (1994) recorded that species of *Chenopodiaceae* had the highest contribution of the total flora followed by *Asteraceae*, *Poaceae* and *Fabaceae* in wadi Habis. While, in wadis EL-Ramla and El-Washka, *Asteraceae* and *Fabaceae* families were the most important followed by *Poaceae*, *Brassicaceae*, *Chenopodiaceae* and *Caryophyllaceae* (Gab Allah, 2006 and Abdel-Gawad *et al.* 2009).

Fig. (2) Shows that species of *Asteraceae* 20.83 %, species of *Poaceae* 19.44 %, species of *Fabaceae* 8.33 %, *Brassicaceae* or *Chenopodiaceae* 5.56 % and *Caryophyllaceae* or *Cistaceae* 4.17 %.

Life duration of plant species recorded in wadi Halazien 41.67 % of species was annuals, 1.39 % was biennial and 56.94 % was perennials. El-Morsy (2002) and Abdel-Gawad *et al.* (2009) found similar trend in Mehgun and El-Washka wadis, respectively. Whereas, Shahba (1994) and Gab Allah (2006) showed that the annual was more than perennial in wadis Habis and El-Ramla, respectively.

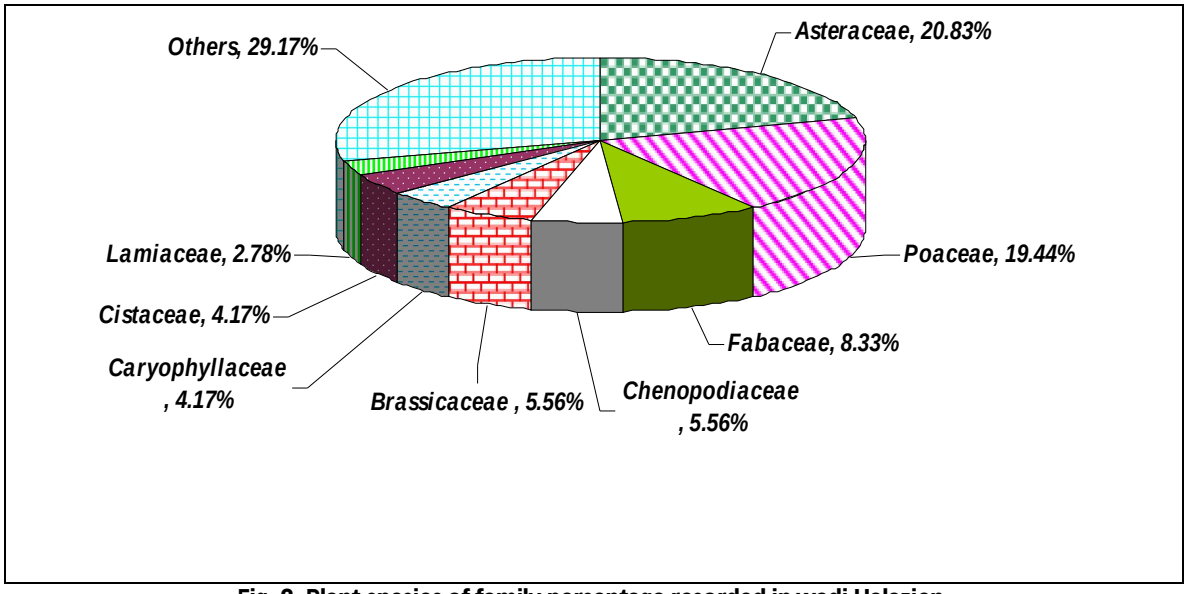

Fig. 2. Plant species of family percentage recorded in wadi Halazien.

Table 4. Botanical composition of plant species recorded in wadi Halazien during spring and autumn seasons in 2007 and 2008.

Family name	Scientific name	Vernacular name	Life duration
Alliaceae	*Allium roseum*	Toam	Per.*
Amaranthaceae	*Amaranthus viridis*	Urf El- Deek	Ann.
Apiaceae (*Umbelliferae*)	*Deverra tortuosa*	Qozzaah	Per.
Araceae	*Arisarum vulgare*	Reinish	Per.
Asparagaceae	*Asparagus stipularis*	Aqool El-Gabal	Per.
Asphodelaceae	*Asphodelus aestivus*	Basal El–Onsal	Per.
Asteraceae (*Compositae*)	*Achillea santolina*	Bisherrn	Per.
	Anacyclus monanthos	Sorret El-Kabsh	Ann.
	Carduncellus eriocephalus	Kharshoof	Per.
	Carduus getulus	Shoak	Ann.
	Centaurea calcitrapa	Shook	Ann.
	Chiliadenus candicans	Zater El-Homar	Per.
	Hyoseris radiata ◄	UnKnow	Per.
	Onopordum alexandrinum ◄	Shoak El-Hanash	Per.
	Picris asplenioides	Seraghah	Ann.

	Reichardia tingitana	Libbein	Ann.
	Scorzonera undulate	Dabbah	Per.
	Senecio coronopifolius	Moreir	Ann.
	Silybum marianum	Shoak El–Gamal	Bien.
	Leontodon tuberosus	Houdaan	Per.
	Urospermum picroides	Galawein	Ann.
Azollaceae	*Anogramma leptophylla* ◄	UnKnow	Ann.
Brassicaceae (*Cruciferae*)	*Didesmus bipinnatus*	Lislis	Ann.
	Diplotaxis acris	Harra	Ann.
	Matthiola longipetala	Shaqaara	Ann.
	Zilla spinosa	Sill	Per.
Capparaceae	*Capparis spinosa* ◄	Abbar	Per.
Caryophyllaceae	*Gymnocarpos decandrus*	Garad or Tashash	Per.
	Paronychia argentea ◄	Farsh EL-Ard	Per.
	Silene succulenta	Khobezyet El – bahr	Per.
Chenopodiaceae	*Atriplex nummularia*	Qataf	Per.
	Haloxylon salicornicum	Rimth	Per.
	Noaea mucronata	ShoakEl-Hanash	Per.
	Salsola villosa ◄	Salsola	Per.
Cistaceae	*Fumana thymifolia*	Unknown	Per.
	Helianthemum lippii	Qoseib or El-oad	Per.
	Helianthemum vesicarium	Raal	Per.
Cyperaceae	*Cyperus rotundus*	Se'd	Per.
Euphorbiaceae	*Euphorbia dendroides*	Omm El-Laben	Per.
Fabaceae (*Leguminosae*)	*Hippocrepis cyclocarpa*	Umm dawara	Ann.
	Lotus polyphyllus	Nafal Haf El-Teir	Per.
	Medicago Arabica ◄	Berseem shogairi	Ann.
	Medicago polymorpha	Kert	Ann.
	Melilotus siculus	Handaqooq helow	Ann.
	Retama raetam	Raetam	Per.
Geraniaceae	*Erodium crassifolium*	Timmeir	Per.
Hyacynthaceae	*Leopoldia comosa*	Bosseil	Per.
Lamiaceae (*Labiatae*)	*Phlomis floccose*	Zeheira	Per.
	Salvia aegyptiaca	Zaeta	Per.
Peganaceae	*Peganum harmala*	Harmel	Per.
Poaceae (*Gramineae*)	*Aegilops kotschyi*	Shaer El faar	Ann.
	Avena fatua	Zammeyr	Ann.
	Bromus madritensis ◄	Khafoor	Ann.
	Bromus rubens	Deil El talab	Ann.
	Cutandia dichotoma	Samma	Ann.
	Cynodon dactylon	Nigeel	Per.
	Hordeum marinum	Shaeer barri	Ann.
	Lamarckia aurea	Unknown	Ann.
	Lygeum spartum	Halfa	Per.

(Continued)

Table 4. (Continued)

Family name	Scientific name	Vernacular name	Life duration
	Lolium perenne ◄	Sammah	Per.
	Lophochloa cristata	Deal elcoat	Ann.
	Panicum turgidum ◄	Thomaam	Per.
	Phalaris minor	Shaer El- faar	Ann.
	Poa annua	Qamh El-Asafeer	Ann.
Polygonaceae	*Polygonum equisetiforme*	Qordaab	Per.
Primulaceae	*Anagallis arvensis* ◄	Ain El qott	Ann.
Ranunculaceae	*Adonis dentata*	Naab EL-gamal	Ann.
Resedaceae	*Reseda decursiva*	Rigl El-ghraab	Ann.
Solanaceae	*Lycium shawii*	Awsage	Per.
Thymelaeaceae	*Thymelaea hirsuta*	Methanan	Per.
Urticaceae	*Urtica urens*	Harraqa	Ann.
Zygophyllaceae	*Fagonia scabra*	Shokaa	Per.

***Ann.=Annual, Per.=Perennial, Bien.=Biennial. ◄ These species cannot found in list and clipping quadrate.**

Fig. 3. Wadi Halazien

Abundance

Results in Table (5) show the abundance of plant species in wadi Halazien varied from plant species to another. *Poaceae* in top and bed 1, *Apiaceae* in ridge and *Asteraceae* in bed 2 gave the highest abundance in spring 2007. Average of the highest abundance in spring 2008 of plant species was recorded for *Poaceae* in top, *Brassicaceae* and *Hyacynthaceae* in ridge, *Polygonaceae* in bed 1 and *Hyacynthaceae* in bed 2. While, *Apiaceae* and *Caryophyllaceae* in top, *Thymelaeaceae* and *Caryophyllaceae* in ridge, *Poaceae* and *Asteraceae* in bed 1 and *Asteraceae* and *Thymelaeaceae* in bed 2 gave the highest abundance in autumn 2007 and 2008, respectively.

The highest abundance was attained among perennial species such as *Polygonum equisetiforme* (Fig. 4) and *Gymnocarpos decandrus* (Fig. 5) in top, *Deverra tortuosa* (Fig. 6) and *Leopoldia comosa* in ridge, *Chiliadenus candicans* (Fig. 7) and *Carduncellus eriocephalus* (Fig. 8) in bed 1, during spring of 2007 and 2008, respectively. However, *Carduncellus eriocephalus* had the highest ones in bed 2 in spring of both years. In addition, *Leopoldia comosa* had the same abundance of *Carduncellus eriocephalus* in bed 1 of spring 2008. *Deverra tortuosa* and *Gymnocarpos decandrus* gave the highest abundance in top, *Thymelaea hirsuta* and *Gymnocarpos decandrus* in ridge, *Cynodon dactylon* and *Chiliadenus candicans* in bed 1, *Chiliadenus candicans* and *Thymelaea hirsuta* in bed 2 in autumn of 2007 and 2008, respectively. Among annual species such as *Hordeum marinum* and *Lophochloa cristata* in top, *Adonis dentata* and *Phalaris minor* in ridge, *Hordeum marinum* and *Phalaris minor* in bed 1, *Avena fatua* and *Poa annua* in bed 2, the highest abundance in spring of 2007 and 2008, respectively.

Significant difference was observed between total abundance of different sites in wadi Halazien in both years. The total abundance of species in spring surpassed than it in autumn. The total abundance of species in bed 2 significantly surpassed the others sites in both years. The total abundance of species in bed 2 in spring 2008 significantly increased than it in spring 2007 by 64 plants. This was happen because of the highest precipitation in 2008 that increased than 2007 by 31.2 mm (Table 1). In addition, environmental conditions in spring were better than in autumn. This trend was observed by Kulaib (2008) who found the highest abundance in spring than autumn and in wadi bed than the others sites in wadi El-Washka.

Species richness

Species richness in spring increased than in autumn in all sites of both years. Except, species richness of bed 2 in autumn increased than in spring of 2007. This

reflects of the richness in wadi bed for fertility and other growing factors when compared to ridge and top of the wadi. In addition, ridge and top soil was not capable to keep available water for long time, which not assists in spreading plants. This may be due to the differences among the three sites in soil physical and chemical properties as shown in Tables (2, 3a and 3b).

Simpson's index of diversity in spring of all sites increased than in autumn of both years. Simpson's index of diversity in both seasons of all sites increased in 2008 than 2007, except, it in autumn of top and ridge in 2007 surpassed 2008.

Importance value (IV)

Results in Table (6) represent the effect of season, site and year on importance value (IV) of the plant species in wadi Halazien in both years. *Solanaceae* in top, *Apiaceae* in ridge and bed 2 and *Thymelaeaceae* in bed 1 gave the highest IV in spring 2007, while, in spring 2008 *Thymelaeaceae* in top, *Caryophyllaceae* in ridge, *Cistaceae* in bed 1 and *Hyacynthaceae* in bed 2 gave the highest IV. The highest IV was *Apiaceae* in top, *Thymelaeaceae* in ridge, *Poaceae* in bed 1 and *Asteraceae* in bed 2 in autumn 2007. Whereas, in autumn of 2008 *Caryophyllaceae* in top and ridge, *Asteraceae* in bed 1 and *Thymelaeaceae* in bed 2 gave the highest IV. Gab Allah (2006) and Abdel-Gawad *et al.* (2009) found that plant species of families *Poaceae* and *Asteraceae* had the highest IV in both years in wadi El-Ramla and El-Washka.

Among perennials species, the highest IV in spring 2007 was for *Lycium shawii* (Fig. 9) in top, *Euphorbia dendroides* (Fig. 10) in ridge, *Thymelaea hirsuta* in bed 1 and *Carduncellus eriocephalus* in bed 2, while, in spring of 2008 were *Thymelaea hirsuta* in top, *Gymnocarpos decandrus* in ridge, *Fumana thymifolia* in bed 1 and *Carduncellus eriocephalus* in bed 2. However, the highest IV was *Deverra tortuosa* in top, *Thymelaea hirsuta* in ridge, *Cynodon dactylon* in bed 1 and *Chiliadenus candicans* in bed 2 in autumn of 2007, whereas, in autumn 2008 were *Gymnocarpos decandrus* in top and ridge, *Chiliadenus candicans* in bed 1 and *Thymelaea hirsuta* in bed 2.

However, among annuals species the highest IV plant species were *Hordeum marinum* in top and bed 1, *Adonis dentata* in ridge and *Avena fatua* in bed 2 in spring 2007, whereas, in spring 2008 were *Lophochloa cristata* in top, *Phalaris minor* in ridge and bed 1 and *Poa annua* in bed 2. While, the highest IV plant species were *Urospermum picroides* in top, *Senecio coronopifolius* in bed 1 and *Medicago polymorpha* in bed 2 in autumn 2007, whereas, in autumn 2008 *Urospermum picroides* gave the highest IV in bed 1.

All plant species belong to *Poaceae* and *Asteraceae* had the highest IV related to the highest relative density. Generally, all plant species belong to *Apiaceae*, *Caryophyllaceae* or *Thymelaeaceae* had the highest IV related to the highest relative density or relative coverage. These because the morphology of plant species of *Poaceae* and *Asteraceae* was erect and had narrow leaves. However, the morphology of plant species of *Caryophyllaceae* or *Thymelaeaceae* was prostrate and had broad leaves which coverage more area. Gab Allah (2006) found the highest IV of perennial species was *Lycium shawii*, *Thymelaea hirsuta* and *Gymnocarpos decandrus*.

Table 5. Abundance of plant species recorded in wadi Halazien during spring and autumn of 2007 and 2008.

Scientific name	2007								2008							
	Top		Ridge		Bed 1		Bed 2		Top		Ridge		Bed 1		Bed 2	
	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au
Allium roseum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--
Amaranthus viridis *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Deverra tortuosa	4	15	12	11	3	5	9	3	6	2	--	2	15	13	4	1
Arisarum vulgare	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--
Asparagus stipularis	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--
Asphodelus aestivus	2	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--
Achillea santolina	--	--	--	--	--	--	--	--	--	--	2	--	1	--	--	--
Anacyclus monanthos *	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carduncellus eriocephalus	2	--	8	--	8	--	42	4	--	--	3	12	51	27	38	10
Carduus getulus *	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--
Centaurea calcitrapa *	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--
Chiliadenus candicans	--	4	--	--	9	3	27	39	--	--	--	--	--	33	--	--
Picris asplenioides *	--	--	--	--	--	--	--	--	8	--	5	--	2	--	9	--

Reichardia tingitana *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--
Scorzonera undulata	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--
Senecio coronopifolius *	2	--	--	--	--	2	--	2	--	--	--	--	--	--	--	--
Silybum marianum **	--	--	--	--	--	4	--	2	--	--	2	--	7	--	2	--
Leontodon tuberosus	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Urospermum picroides *	--	1	--	--	--	--	--	--	--	--	--	--	--	4	1	--
Didesmus bipinnatus *	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--
Diplotaxis acris *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--
Matthiola longipetala *	--	--	--	--	--	--	--	--	--	--	14	--	2	--	--	--
Zilla spinosa	--	1	--	5	--	--	--	--	--	--	--	--	--	--	--	--
Gymnocarpos decandrus	3	5	4	3	--	--	--	--	8	30	6	44	--	--	--	16
Silene succulenta	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--
Atriplex nummularia	--	--	--	--	--	--	10	--	--	--	--	--	--	--	3	3
Haloxylon salicornicum	2	--	--	--	--	7	4	--	--	4	--	--	--	2	7	16
Noaea mucronata	--	--	--	--	--	--	--	--	--	--	--	--	4	2	--	--
Fumana thymifolia	--	--	--	--	--	--	--	--	--	--	--	--	22	--	--	--
Helianthemum lippii	--	--	--	--	--	--	3	--	--	--	2	--	--	--	--	--
Helianthemum vesicarium	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--
Cyperus rotundus	--	--	--	--	--	--	--	--	6	--	12	--	--	--	--	--
Euphorbia dendroides	--	--	5	--	--	--	4	--	--	--	--	--	--	--	2	--

(Cont.)

Table 5. (Cont.)

Hippocrepis cyclocarpa *	3	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--
Lotus polyphyllus	2	--	--	--	1	--	--	--	--	--	--	--	2	--	2	--
Medicago polymorpha *	--	--	--	--	--	--	--	2	--	--	--	--	--	--	2	--
Melilotus siculus *	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--
Retama raetam	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--
Erodium crassifolium	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--
Leopoldia comosa	--	--	--	--	--	--	--	--	--	--	14	--	--	--	38	--
Phlomis floccosa	--	1	8	--	--	--	--	--	--	--	--	--	2	--	2	--
Salvia aegyptiaca	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--
harmala Peganum	--	--	--	--	--	1	12	--	--	--	--	--	--	--	1	7
Aegilops kotschyi *	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--
Avena fatua *	--	--	--	--	--	--	40	--	--	--	--	--	--	--	10	--
Bromus rubens *	--	--	--	--	--	--	--	--	10	--	4	--	4	--	4	--
Cutandia dichotoma *	--	--	--	--	--	--	--	--	2	--	--	--	2	--	1	--
Cynodon dactylon	--	--	--	--	--	25	--	4	--	--	--	--	--	--	--	--
Hordeum marinum *	8	--	--	--	28	--	--	--	--	--	--	--	--	--	10	--
Lamarckia aurea *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	--
Lygeum spartum	--	--	--	--	--	--	5	--	--	--	2	--	--	--	--	--
Lophochloa cristata *	--	--	--	--	--	--	--	--	16	--	3	--	--	--	--	--

Phalaris minor *	--	--	--	--	--	--	--	--	15	--	21	--	14	--	13	--
Poa annua *	--	--	--	--	--	--	--	--	3	--	4	--	--	--	22	--
Polygonum equisetiforme	6	4	--	--	--	--	--	--	5	--	12	--	33	4	2	--
Adonis dentata *	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--
Reseda decursiva *	--	--	--	--	--	--	--	--	2	--	--	--	--	--	1	--
Lycium shawii	5	2	--	2	--	3	--	--	--	--	--	2	2	--	--	--
Thymelaea hirsute	--	6	--	13	5	--	--	2	6	--	2	10	2	5	6	61
Urtica urens *	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--
Fagonia scabra	--	--	--	--	4	--	--	--	--	--	4	--	--	--	--	--
Total	42 l	41 m	41 m	34 o	73 h	50 k	156 c	66 j	103 f	38 n	122 d	70 i	166 b	90 g	220 a	114 e
Species richness	12	10	6	5	10	8	10	11	17	4	20	5	17	8	27	7
Diversity (D)	0.08	0.18	0.18	0.26	0.19	0.28	0.18	0.36	0.08	0.63	0.08	0.44	0.17	0.24	0.09	0.33
Simpson's index of diversity	0.92	0.82	0.82	0.74	0.81	0.72	0.82	0.64	0.92	0.37	0.92	0.56	0.83	0.76	0.91	0.67

In this table and the following tables; Sp.= spring, Au.= autumn. *= Annual, **= Biennial and others species = Perennial.

Fig. 4. *Polygonum equisetiforme*

Fig. 5. *Gymnocarpos decandrus*

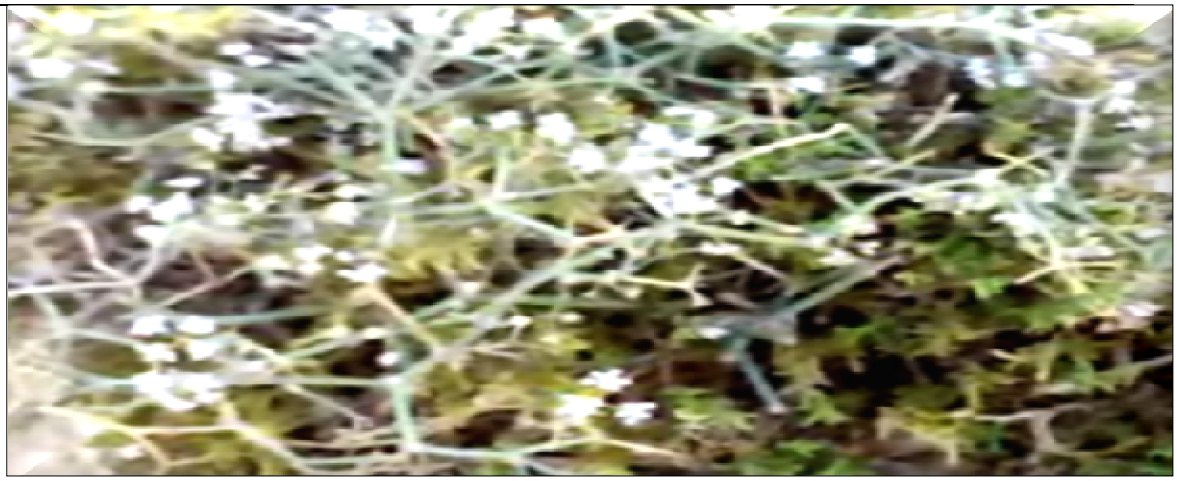

Fig. 6. ***Deverra tortuosa***

Fig. 7. ***Chiliadenus candicans***

Fig. 8. Carduncellus eriocephalus

Fig. 9. Lycium shawii

Fig. 10. Euphorbia dendroides

Fig. 11. *Peganum harmala*

Table 6. Importance value (IV) of plant species recorded in wadi Halazien during spring and autumn of 2007 and 2008

	2007								2008							
	Top		Ridge		Bed 1		Bed 2		Top		Ridge		Bed 1		Bed 2	
Scientific name	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au
Allium roseum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.9	--
Amaranthus viridis *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.6	--

Deverra tortuosa	48.7	93.6	89.9	80.7	17.9	75.7	33.1	32.5	33.9	16.7	--	14.5	23.5	67.4	18.8	4.9
Arisarum vulgare	--	--	--	--	--	--	--	10.7	--	--	--	--	--	--	--	--
Asparagus stipularis	--	--	--	--	--	--	--	--	--	31.2	--	--	--	--	--	--
Asphodelus aestivus	9.9	--	--	--	--	--	--	--	18.2	--	--	--	--	--	--	--
Achillea santolina	--	--	--	--	--	--	--	--	--	--	5.1	--	3.4	--	--	--
Anacyclus monanthos *	11.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carduncellus eriocephalus	14.8	--	38.5	--	34.2	--	61.8	20.8	--	--	8.6	50.4	59.0	73.1	60.4	27.4
Carduus getulus *	--	--	--	--	--	--	--	--	12.6	--	--	--	--	--	--	--
Centaurea calcitrapa *	--	--	--	--	--	--	--	--	--	--	6.7	--	--	--	--	--
Chiliadenus candicans	--	28.6	--	--	35.3	23.2	47.8	146.4	--	--	--	--	--	73.7	--	--
Picris asplenioides *	--	--	--	--	--	--	--	--	20.2	--	12.0	--	3.9	--	6.8	--
Reichardia tingitana *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.4	--
Scorzonera undulata	--	--	--	--	--	--	--	--	--	--	9.8	--	--	--	--	--
Senecio coronopifolius *	9.4	--	--	--	--	15.3	--	7.1	--	--	--	--	--	--	--	--
Silybum marianum **	--	--	--	--	--	23.9	--	10.4	--	--	6.9	--	11.7	--	4.8	--
Leontodon tuberosus	--	14.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Urospermum picroides *	--	7.9	--	--	--	--	--	--	--	--	--	--	--	10.8	2.6	--
Didesmus bipinnatus *	--	--	--	--	43.0	--	--	--	--	--	--	--	--	--	--	--
Diplotaxis acris *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.3	--
Matthiola longipetala *	--	--	--	--	--	--	--	--	--	--	19.7	--	7.0	--	--	--
Zilla spinosa	--	10.0	--	37.7	--	--	--	--	--	--	--	--	--	--	--	--
Gymnocarpos decandrus	35.1	40.8	25.3	55.9	--	--	--	--	34.6	219	64.0	162.2	--	--	--	85.2
Silene succulenta	--	--	--	--	--	--	--	--	--	--	9.1	--	--	--	--	--
Atriplex nummularia	--	--	--	--	--	--	35.3	--	--	--	--	--	--	--	11.2	15.2
Haloxylon salicornicum	10.8	--	--	--	--	49.4	12.9	--	--	33.1	--	--	--	6.2	18.3	34.3
Noaea mucronata	--	--	--	--	--	--	--	--	--	--	--	--	9.0	10.4	--	--

(Cont.)

Table 6. (Cont.)

Fumana thymifolia	--	--	--	--	--	--	--	--	--	--	--	--	66.6	--	--	--
Helianthemum lippii	--	--	--	--	--	--	8.8	--	--	--	4.9	--	--	--	--	--
Helianthemum vesicarium	--	--	--	--	11.4	--	--	--	--	--	--	--	--	--	--	--
Cyperus rotundus	--	--	--	--	--	--	--	--	13.4	--	16.8	--	--	--	--	--
Euphorbia dendroides	--	--	77.6	--	--	--	16.7	--	--	--	--	--	--	--	5.1	--
Hippocrepis cyclocarpa *	15.5	--	--	--	7.1	--	--	--	--	--	--	--	--	--	--	--
Lotus polyphyllus	13.6	--	--	--	5.9	--	--	--	--	--	--	--	4.4	--	3.0	--
Medicago polymorpha *	--	--	--	--	--	--	--	12.0	--	--	--	--	--	--	2.9	--

Melilotus siculus *	--	--	--	--	--	--	--	--	12.4	--	--	--	--	--	--	--
Retama raetam	--	--	--	--	--	--	--	11.5	--	--	--	--	--	--	--	--
Erodium crassifolium	--	--	--	--	--	--	--	--	4.3	--	--	--	--	--	--	--
Leopoldia comosa	--	--	--	--	--	--	--	--	--	--	23.9	--	--	--	27.7	--
Phlomis floccosa	--	7.6	41.0	--	--	--	--	--	--	--	--	--	10.7	--	11.8	--
Salvia aegyptiaca	--	--	--	--	--	--	--	--	4.5	--	--	--	--	--	--	--
Peganum harmala	--	--	--	--	--	9.5	38.7	--	--	--	--	--	--	--	5.9	31.6
Aegilops kotschyi *	--	--	--	--	--	--	--	--	--	--	--	--	4.4	--	--	--
Avena fatua *	--	--	--	--	--	--	35.1	--	--	--	--	--	--	--	6.6	--
Bromus rubens *	--	--	--	--	--	--	--	--	17.0	--	8.6	--	5.0	--	3.9	--
Cutandia dichotoma *	--	--	--	--	--	--	--	--	4.3	--	--	--	4.2	--	2.6	--
Cynodon dactylon	--	--	--	--	--	84.0	--	14.7	--	--	--	--	--	--	--	--
Hordeum marinum *	31.6	--	--	--	54.4	--	--	--	--	--	--	--	--	--	9.0	--
Lamarckia aurea *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.1	--
Lygeum spartum	--	--	--	--	--	--	10.1	--	--	--	4.6	--	--	--	--	--
Lophochloa cristata *	--	--	--	--	--	--	--	--	27.4	--	9.4	--	--	--	--	--
Phalaris minor *	--	--	--	--	--	--	--	--	21.9	--	25.3	--	11.0	--	10.0	--
Poa annua *	--	--	--	--	--	--	--	--	13.2	--	10.0	--	--	--	21.3	--
Polygonum equisetiforme	30.5	21.8	--	--	--	--	--	--	17.4	--	29.4	--	35.4	12.0	4.8	--
Adonis dentata *	--	--	27.7	--	--	--	--	--	--	--	--	--	--	--	--	--
Reseda decursiva *	--	--	--	--	--	--	--	--	5.9	--	--	--	--	--	3.0	--
Lycium shawii	68.6	39.5	--	18.4	--	19.0	--	--	--	--	--	15.2	20.6	--	--	--
Thymelaea hirsuta	--	35.9	--	107.4	68.2	--	--	23.2	38.5	--	19.1	57.9	20.1	46.2	22.9	101.3
Urtica urens *	--	--	--	--	--	--	--	10.4	--	--	--	--	--	--	--	--
Fagonia scabra	--	--	--	--	22.5	--	--	--	--	--	6.2	--	--	--	--	--
Total	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300

*** = Annual, ** = Biennial and others species = Perennial.**

Foliage productivity

Results in Tables (7) and (8) represent the effect of season, site and year on fresh and dry foliage yields (g m^{-2}) of the plant species in wadi Halazien. *Caryophyllaceae* in top, *Euphorbiaceae* in ridge, *Thymelaeaceae* in bed 1 and *Apiaceae* in bed 2 gave the highest fresh and dry yields in spring 2007. While, in spring 2008 *Thymelaeaceae* in top, ridge and bed 2 and *Cistaceae* in bed 1 gave the highest fresh and dry yields, except for dry yield of *Apiaceae* in bed 2. *Apiaceae* in top, *Thymelaeaceae* in ridge and bed 2 and *Chenopodiaceae* in bed 1 gave the highest fresh and dry yields in autumn 2007, except for dry yield of *Asteraceae* in bed 2, whereas, in autumn 2008 *Thymelaeaceae* gave the highest fresh and dry yields at all sites, except *Caryophyllaceae* in top. El-Morsy (2002) mentioned that *Chenopodiaceae* and *Thymelaeaceae* plant species gave the highest fresh and dry yields in both years in wadi Magid. Abdel-Gawad *et al.* (2009) found plant species belong to famiy *Chenopodiaceae* gave the highest fresh and dry yields in spring and autumn of both years in wadi El-Washka.

Among perennial *Gymnocarpos decandrus* in top, *Euphorbia dendroides* in ridge, *Thymelaea hirsuta* bed 1 and *Atriplex nummularia* in bed 2 gave the highest fresh and dry yields in spring 2007. While, in spring 2008 *Thymelaea hirsuta* in top, *Gymnocarpos decandrus* in ridge, *Fumana thymifolia* in bed 1 and *Carduncellus eriocephalus* in bed 2 gave the highest fresh and dry yields, except for dry yield of *Gymnocarpos decandrus* in top and *Deverra tortuosa* in bed 2. However, in autumn 2007 *Deverra tortuosa* in top, *Thymelaea hirsuta* in ridge, *Chiliadenus candicans* bed 1 and 2 gave the highest fresh and dry yields. However, in autumn 2008, *Thymelaea hirsuta* gave the highest fresh and dry yields at all sites, except *Gymnocarpos decandrus* gave the highest yields in top. Abdel-Gawad *et al.* (2009) found *Thymelaea hirsuta* gave the highest fresh and dry yields in spring and autumn in both years in wadi El-Washka.

Among annual species *Senecio coronopifolius* in top, *Adonis dentata* in ridge, *Hippocrepis cyclocarpa* in bed 1 and *Avena fatua* in bed 2 gave the highest fresh and dry yields in spring 2007, except for dry yield of *Hordeum marinum* in top. However, in spring 2008 *Carduus getulus* in top, *Phalaris minor* in ridge, *Matthiola longipetala* in bed 1 and *Avena fatua* in bed 2 gave the highest fresh and dry yields. While, in autumn 2007 *Urospermum picroides* in top, *Senecio coronopifolius* in bed 1 and *Medicago polymorpha* in bed 2 gave the highest fresh and dry yields, whereas, in autumn 2008 only one species (*Urospermum picroides*) appeared in bed 1. *Senecio coronopifolius* gave the same fresh yield as *Medicago polymorpha* in bed 2 in autumn 2007.

Fresh and dry yields significantly increased in spring compared with autumn at all sites in both years. Reiad *et al.* (1996 b) recommended that fresh and dry yields obtained during spring season outyielded that of winter, autumn and summer, respectively in Sidi Barrani and El-Negaila.

Fresh and dry yields in wadi bed 2 significantly exceeded the other sites in both years. The increments of fresh yield in bed 2 than top, ridge and bed 1 were 25.60, 19.49 and 13.46 g m^{-2}, respectively in spring 2007. But, in spring 2008 were 53.21, 46.37 and 25.24 g m^{-2} in the same respective order. In autumn 2007 increments were 10.36, 7.93 and 5.77 g m^{-2} and in autumn 2008 were 14.74, 8.53 and 3.22 g m^{-2}. Dry yield in bed 2 surpassed it in top, ridge and bed 1 by 12.09, 9.64 and 3.91 g m^{-2}, respectively in spring 2007. While in spring 2008 increments were 22.02, 17.44 and 6.68 g m^{-2} in the same respective order. The increase of dry yield in autumn 2007 was 5.07, 2.96 and 2.42 g m^{-2}, while, in autumn 2008 it was 6.66, 3.04 and 1.25 g m^{-2}. Abdel-Gawad *et al.* (2009) mentioned that the highest fresh and dry yields were obtained in wadi bed followed by wadi ridge and top in wadi El-Washka. This may be due to mild wind speed and more humidity in wadi bed compared with other studied sites of wadi and more edaphic conditions that are suitable. In other words, the increased productivity in wadi bed may be due to the presence of water quantities because this area considered as rain-fed harvest. While the ridge and the top of wadi faced soil surface erosion due to precipitation and wind speed that formed the surface layer of seed bed resulted.

Table 7. Fresh forage yield of plant species (g m^{-2}) recorded in wadi Halazien during spring and autumn of 2007 and 2008

Scientific name	2007								2008							
	Top		Ridge		Bed 1		Bed 2		Top		Ridge		Bed 1		Bed 2	
	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au
Allium roseum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.333	--
Amaranthus viridis *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.750	--
Deverra tortuosa	1.454	2.354	1.602	0.583	0.141	1.583	7.501	1.942	1.410	0.105	--	1.138	2.715	4.070	7.524	0.038
Arisarum vulgare	--	--	--	--	--	--	--	0.444	--	--	--	--	--	--	--	--
Asparagus stipularis	--	--	--	--	--	--	--	--	--	1.388	--	--	--	--	--	--
Asphodelus aestivus	0.029	--	--	--	--	--	--	--	0.194	--	--	--	--	--	--	--
Achillea santolina	--	--	--	--	--	--	--	--	--	--	0.333	--	0.167	--	--	--
Anacyclus monanthos *	0.261	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carduncellus eriocephalus	0.553	--	0.401	--	2.842	--	5.129	0.034	--	--	0.389	0.114	3.219	0.217	14.011	0.143
Carduus getulus *	--	--	--	--	--	--	--	--	0.552	--	--	--	--	--	--	--
Centaurea calcitrapa *	--	--	--	--	--	--	--	--	--	--	0.181	--	--	--	--	--
Chiliadenus candicans	--	0.156	--	--	1.531	1.945	0.916	8.681	--	--	--	--	--	2.872	--	--
Picris asplenioides *	--	--	--	--	--	--	--	--	0.449	--	0.115	--	0.094	--	0.167	--
Reichardia tingitana *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.917	--
Scorzonera undulata	--	--	--	--	--	--	--	--	--	--	0.433	--	--	--	--	--
Senecio coronopifolius *	0.281	--	--	--	--	0.500	--	0.222	--	--	--	--	--	--	--	--
Silybum marianum **	--	--	--	--	--	0.333	--	0.111	--	--	0.361	--	0.177	--	1.100	--
Leontodon	--	0.063	--	--	--	--	--	--	--	--	--	--	--	--	--	--

tuberosus																
Urospermum picroides *	--	0.083	--	--	--	--	--	--	--	--	--	--	--	0.008	0.083	--
Didesmus bipinnatus *	--	--	--	--	0.250	--	--	--	--	--	--	--	--	--	--	--
Diplotaxis acris *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.375	--
Matthiola longipetala *	--	--	--	--	--	--	--	--	--	--	0.274	--	0.500	--	--	--
Zilla spinosa		0.833	--	0.410	--	--	--	--	--	--	--	--	--	--	--	--
Gymnocarpos decandrus	2.021	0.434	0.275	0.033	--	--	--	--	1.729	2.584	4.758	2.187	--	--	--	1.166
Silene succulenta	--	--	--	--	--	--	--	--	--	--	0.092	--	--	--	--	--
Atriplex nummularia	--	--	--	--	--	--	8.752	--	--	--	--	--	--	--	4.630	0.410
Haloxylon salicornicum	0.300	--	--	--	--	1.667	3.667	--	--	0.252	--	--	--	0.385	4.889	0.835
Noaea mucronata	--	--	--	--	--	--	--	--	--	--	--	--	0.271	0.389	--	--
Fumana thymifolia	--	--	--	--	--	--	--	--	--	--	--	--	10.391	--	--	--

Table 7. (Cont.) (Cont.)

Helianthemum lippii	--	--	--	--	--	--	0.375	--	--	--	0.333	--	--	--	--	--
Helianthemum vesicarium	--	--	--	--	0.183	--	--	--	--	--	--	--	--	--	--	--
Cyperus rotundus	--	--	--	--	--	--	--	--	0.107	--	0.214	--	--	--	--	--
Euphorbia dendroides	--	--	9.844	--	--	--	1.781	--	--	--	--	--	--	--	1.759	--
Hippocrepis cyclocarpa *	0.219	--	--	--	0.471	--	--	--	--	--	--	--	--	--	--	--
Lotus polyphyllus	0.844	--	--	--	0.017	--	--	--	--	--	--	--	0.333	--	0.333	--
Medicago polymorpha *	--	--	--	--	--	--	--	0.222	--	--	--	--	--	--	0.021	--
Melilotus siculus *	--	--	--	--	--	--	--	--	0.035	--	--	--	--	--	--	--
Retama raetam	--	--	--	--	--	--	--	0.083	--	--	--	--	--	--	--	--
Erodium crassifolium	--	--	--	--	--	--	--	--	0.014	--	--	--	--	--	--	--
Leopoldia comosa	--	--	--	--	--	--	--	--	--	--	1.465	--	--	--	2.944	--
Phlomis floccosa	--	0.115	1.677	--	--	--	--	--	--	--	--	--	5.868	--	6.167	--
Salvia aegyptiaca	--	--	--	--	--	--	--	--	0.028	--	--	--	--	--	--	--
Peganum harmala	--	--	--	--	--	0.583	3.625	--	--	--	--	--	--	--	2.658	2.578
Aegilops kotschyi *	--	--	--	--	--	--	--	--	--	--	--	--	0.333	--	--	--
Avena fatua *	--	--	--	--	--	--	1.500	--	--	--	--	--	--	--	1.650	--
Bromus rubens *	--	--	--	--	--	--	--	--	0.073	--	0.070	--	0.042	--	0.125	--
Cutandia dichotoma *	--	--	--	--	--	--	--	--	0.083	--	--	--	0.083	--	0.167	--
Cynodon dactylon	--	--	--	--	--	1.167	--	0.222	--	--	--	--	--	--	--	--
Hordeum marinum *	0.101	--	--	--	0.212	--	--	--	--	--	--	--	--	--	0.103	--
Lamarckia aurea *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.063	--
Lygeum spartum	--	--	--	--	--	--	0.104	--	--	--	0.083	--	--	--	--	--
Lophochloa cristata *	--	--	--	--	--	--	--	--	0.222	--	0.067	--	--	--	--	--
Phalaris minor *	--	--	--	--	--	--	--	--	0.158	--	0.472	--	0.083	--	0.208	--

Poa annua *	--	--	--	--	--	--	--	--	0.281	--	0.140	--	--	--	0.500	--
Polygonum equisetiforme	0.240	0.043	--	--	--	--	--	--	0.903	--	1.688	--	1.260	0.271	1.296	--
Adonis dentata *	--	--	0.057	--	--	--	--	--	--	--	--	--	--	--	--	--
Reseda decursiva *	--	--	--	--	--	--	--	--	0.047	--	--	--	--	--	0.250	--
Lycium shawii	1.453	0.458	--	0.167	--	1.528	--	--	--	--	--	1.194	3.000	--	--	--
Thymelaea hirsuta	--	0.177	--	5.950	14.044	--	--	3.000	2.083	--	3.160	5.911	7.809	7.643	7.558	13.899
Urtica urens *	--	--	--	--	--	--	--	0.111	--	--	--	--	--	--	--	--
Fagonia scabra	--	--	--	--	0.200	--	--	--	--	--	0.583	--	--	--	--	--
Seasonal yield	7.755 l	4.717n	13.857 h	7.143 m	19.889 d	9.306 j	33.351 c	15.073 g	8.368k	4.328 o	15.211 g	10.544 i	36.346 b	15.854 f	61.582 a	19.069 e
	Spring = 18.713 ns						Autumn = 9.060 ns		Spring = 30.377 ns						Autumn = 12.449 ns	

Table 8. Dry forage yield of plant species (g m^{-2}) recorded in wadi Halazien during spring and autumn of 2007 and 2008

Scientific name	2007								2008							
	Top		Ridge		Bed 1		Bed 2		Top		Ridge		Bed 1		Bed 2	
	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au
Allium roseum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.283	--
Amaranthus viridis *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.358	--
Deverra tortuosa	0.688	1.098	0.846	0.321	0.044	0.985	4.231	1.188	0.833	0.017	--	0.500	1.635	2.303	4.244	0.023
Arisarum vulgare	--	--	--	--	--	--	--	0.042	--	--	--	--	--	--	--	--
Asparagus stipularis	--	--	--	--	--	--	--	--	--	0.638	--	--	--	--	--	--
Asphodelus aestivus	0.021	--	--	--	--	--	--	--	0.035	--	--	--	--	--	--	--
Achillea santolina	--	--	--	--	--	--	--	--	--	--	0.158	--	0.050	--	--	--
Anacyclus monanthos *	0.052	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carduncellus eriocephalus	0.204	--	0.144	--	1.733	--	1.500	0.014	--	--	0.185	0.051	1.455	0.088	3.634	0.058
Carduus getulus *	--	--	--	--	--	--	--	--	0.346	--	--	--	--	--	--	--
Centaurea calcitrapa *	--	--	--	--	--	--	--	--	--	--	0.099	--	--	--	--	--
Chiliadenus candicans	--	0.059	--	--	0.625	1.464	0.446	4.433	--	--	--	--	--	1.133	--	--
Picris asplenioides *	--	--	--	--	--	--	--	--	0.037	--	0.047	--	0.066	--	0.050	--
Reichardia tingitana *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.376	--
Scorzonera undulata	--	--	--	--	--	--	--	--	--	--	0.210	--	--	--	--	--
Senecio coronopifolius *	0.057	--	--	--	--	0.102	--	0.033	--	--	--	--	--	--	--	--
Silybum marianum **	--	--	--	--	--	0.233	--	0.078	--	--	0.298	--	0.443	--	0.532	--
Leontodon tuberosus	--	0.042	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Urospermum picroides *	--	0.022	--	--	--	--	--	--	--	--	--	--	--	0.002	0.033	--
Didesmus bipinnatus *	--	--	--	--	0.126	--	--	--	--	--	--	--	--	--	--	--
Diplotaxis acris *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.486	--
Matthiola longipetala *	--	--	--	--	--	--	--	--	--	--	0.135	--	0.250	--	--	--
Zilla spinosa	--	0.220	--	0.350	--	--	--	--	--	--	--	--	--	--	--	--
Gymnocarpos decandrus	0.820	0.404	0.070	0.003	--	--	--	--	0.997	1.767	2.461	1.232	--	--	--	0.432
Silene succulenta	--	--	--	--	--	--	--	--	--	--	0.449	--	--	--	--	--
Atriplex nummularia	--	--	--	--	--	--	5.360	--	--	--	--	--	--	--	2.563	0.200
Haloxylon	0.155	--	--	--	--	1.010	1.700	--	--	0.120	--	--	--	0.092	2.267	0.750

salicornicum																	
Noaea mucronata	--	--	--	--	--	--	--	--	--	--	--	--	0.093	0.133	--	--	
Fumana thymifolia	--	--	--	--	--	--	--	--	--	--	--	--	6.084	--	--	--	

Table 8. (Cont.) (Cont.)

Helianthemum lippii	--	--	--	--	--	--	0.263	--	--	--	0.233	--	--	--	--	--	
Helianthemum vesicarium	--	--	--	--	0.099	--	--	--	--	--	--	--	--	--	--	--	
Cyperus rotundus	--	--	--	--	--	--	--	--	0.085	--	0.126	--	--	--	--	--	
Euphorbia dendroides	--	--	3.449	--	--	--	0.178	--	--	--	--	--	--	--	0.185	--	
Hippocrepis cyclocarpa *	0.045	--	--	--	0.166	--	--	--	--	--	--	--	--	--	--	--	
Lotus polyphyllus	0.380	--	--	--	0.108	--	--	--	--	--	--	--	0.217	--	0.217	--	
Medicago polymorpha *	--	--	--	--	--	--	--	0.051	--	--	--	--	--	--	0.008	--	
Melilotus siculus *	--	--	--	--	--	--	--	--	0.014	--	--	--	--	--	--	--	
Retama raetam	--	--	--	--	--	--	--	0.042	--	--	--	--	--	--	--	--	
Erodium crassifolium	--	--	--	--	--	--	--	--	0.004	--	--	--	--	--	--	--	
Leopoldia comosa	--	--	--	--	--	--	--	--	--	--	0.761	--	--	--	1.528	--	
Phlomis floccose	--	0.095	1.168	--	--	--	--	--	--	--	--	--	2.835	--	2.800	--	
Salvia aegyptiaca	--	--	--	--	--	--	--	--	0.008	--	--	--	--	--	--	--	
Peganum harmala	--	--	--	--	--	0.143	0.775	--	--	--	--	--	--	--	0.568	0.438	
Aegilops kotschyi *	--	--	--	--	--	--	--	--	--	--	--	--	0.242	--	--	--	
Avena fatua *	--	--	--	--	--	--	0.833	--	--	--	--	--	--	--	0.917	--	
Bromus rubens *	--	--	--	--	--	--	--	--	0.016	--	0.042	--	0.025	--	0.063	--	
Cutandia dichotoma *	--	--	--	--	--	---	--	--	0.075	--	--	--	0.071	--	0.142	--	
Cynodon dactylon	--	--	--	--	--	0.353	--	0.066	--	--	--	--	--	--	--	--	
Hordeum marinum *	0.067	--	--	--	0.137	--	--	--	--	--	--	--	--	--	0.063	--	
Lamarckia aurea *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.042	--	
Lygeum spartum	--	--	--	--	--	--	0.077	--	--	--	0.083	--	--	--	--	--	
Lophochloa cristata *	--	--	--	--	--	--	--	--	0.079	--	0.013	--	--	--	--	--	
Phalaris minor *	--	--	--	--	--	--	--	--	0.032	--	0.375	--	0.100	--	0.033	--	
Poa annua *	--	--	--	--	--	--	--	--	0.178	--	0.075	--	--	--	0.325	--	
Polygonum equisetiforme	0.127	0.029	--	--	--	--	--	--	0.549	--	1.042	--	0.990	0.025	0.963	--	
Adonis dentata *	--	--	0.046	--	--	--	--	--	--	--	--	--	--	--	--	--	
Reseda decursiva *	--	--	--	--	--	--	--	--	0.023	--	--	--	--	--	0.113	--	
Lycium shawii	0.655	0.306	--	0.015	--	0.743	--	--	--	--	--	0.778	1.683	--	--	--	
Thymelaea hirsuta	--	0.108	--	3.798	8.366	--	--	1.500	0.984	--	1.733	3.601	3.395	4.181	3.519	7.302	
Urtica urens *	--	--	--	--	--	--	--	0.001	--	--	--	--	--	--	--	--	
Fagonia scabra	--	--	--	--	0.050	--	--	--	--	--	0.342	--	--	--	--	--	
Seasonal yield	3.271 n	2.382 p	5.723 j	4.487 l	11.454 d	5.033 k	15.363 c	7.448 h	4.295 m	2.541 o	8.867 f	6.162 i	19.631 b	7.957 g	26.311 a	9.203 e	
Average seasonal	Spring = 8.953 ns			= 4.838 ns				Autumn		Spring = 14.776 ns					Autumn = 6.466 ns		

*** = Annual, ** = Biennial and others species = Perennial.**

Crude protein (CP) and digestible crude protein (DCP)

Data of crude protein percentage (CP %) and digestible crude protein (DCP %) of plant species as influenced by site, season and year in wadi Halazien in both years presented in Tables 9 and 10.

Chenopodiaceae in top, *Euphorbiaceae* in ridge, *Zygophyllaceae* in bed 1 and *Peganaceae* in bed 2 gave

the highest CP % and DCP % in spring 2007. While, in spring 2008 *Fabaceae* gave the highest CP % and DCP % in all sites, except *Brassicaceae* in ridge and DCP % in top *Caryophyllaceae*. *Asteraceae* in top and bed 1, *Apiaceae* in ridge and *Fabaceae* in bed 2 gave the highest CP % and DCP % in autumn 2007, whereas, in autumn 2008 *Asparagaceae* in top, *Caryophyllaceae* in ridge and bed 2 and *Asteraceae* in bed 1 gave the highest CP % and DCP %. El-Morsy (2002) and Abdel-Gawad *et al.* (2009) mentioned that family *Fabaceae* appeared higher of CP % than other families in wadi Magid and El-Washka, respectively. Among perennial species such as *Haloxylon salicornicum* (Fig. 7) in top, *Euphorbia dendroides* in ridge, *Lotus polyphyllus* in bed 1 and *Peganum harmala* in bed 2 gave the highest CP % and DCP % in spring 2007.

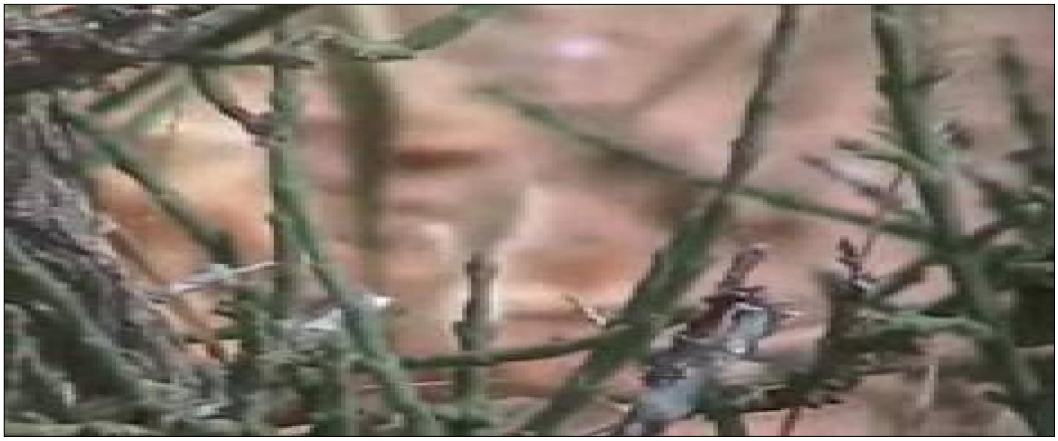

Fig. 7. *Haloxylon salicornicum*

In spring 2008 *Erodium crassifolium* in top, *Achillea santolina* in ridge, *Lotus polyphyllus* in bed 1 and bed 2 gave the highest CP % and DCP %. However, *Chiliadenus candicans* in top and bed 1, *Deverra tortuosa* in ridge, and *Retama raetam* in bed 2 gave the highest CP % and DCP % in autumn 2007. While, in autumn 2008 *Asparagus stipularis* in top, *Gymnocarpos decandrus* in ridge and bed 2, *Chiliadenus candicans* in bed 1 gave the highest CP % and DCP %. Among annual species *Anacyclus monanthos* in top, *Adonis dentata* in ridge, *Hordeum marinum* in bed 1 and *Avena fatua* in bed 2 gave the highest CP % and DCP % in spring 2007. While, in spring 2008 *Melilotus siculus* in top, *Matthiola longipetala* in ridge and bed 1, and *Medicago polymorpha* in bed 2 gave the highest CP % and DCP %, while, in autumn 2007 *Urospermum picroides* in top, *Senecio coronopifolius* in bed 1 and *Medicago polymorpha* in bed 2 gave the highest ones. Crude protein % and DCP % in spring exceeded it in autumn at all sites in both years. CP % and DCP % in spring significantly increased than it in autumn 2008 by 2.33 % and 1.86 %, respectively. Because the average of temperature was low (16.32 ^{o}C) and total precipitation was high (95 mm) in Novmber to April 2008 (Table 1). Plant species in spring 2007 in bed 2 significantly surpassed the top, ridge and bed 1 by 1.46, 1.36 for and 1.11 for CP % and by 1.35, 1.26 and 1.02 for DCP %, respectively. El-Morsy (2002) and Abdel-Gawad *et al.* (2009) concluded that crude protein of plants grown in wadi bed exceeded it.

Table 9. Crude protein (CP %) of plant species recorded in wadi Halazien during spring and autumn of 2007 and 2008

Scientific name	2007								2008							
	Top		Ridge		Bed 1		Bed 2		Top		Ridge		Bed 1		Bed 2	
	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Au
Allium roseum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.10	--
Amaranthus viridis *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.30	--
Deverra tortuosa	6.35	3.97	6.03	6.65	4.21	4.18	7.41	4.83	6.38	3.01	--	3.90	6.80	4.66	6.58	6.60
Arisarum vulgare	--	--	--	--	--	--	--	8.17	--	--	--	--	--	--	--	--
Asparagus stipularis	--	--	--	--	--	--	--	--	--	5.79	--	--	--	--	--	--
Asphodelus aestivus	6.75	--	--	--	--	--	--	--	7.90	--	--	--	--	--	--	--
Achillea santolina	--	--	--	--	--	--	--	--	--	--	10.80	--	11.80	--	--	--
Anacyclus monanthos *	7.90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carduncellus eriocephalus	7.24	--	5.28	--	6.36	--	6.16	6.14	--	--	7.39	4.10	6.95	6.28	7.85	7.09
Carduus getulus *	--	--	--	--	--	--	--	--	5.23	--	--	--	--	--	--	--
Centaurea calcitrapa *	--	--	--	--	--	--	--	--	--	--	9.26	--	--	--	--	--
Chiliadenus candicans	--	6.90	--	--	8.94	8.13	8.52	7.68	--	--	--	--	--	8.00	--	--
Picris asplenioides *	--	--	--	--	--	--	--	--	6.47	--	8.18	--	8.25	--	8.10	--
Reichardia tingitana *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.23	--
Scorzonera undulata	--	--	--	--	--	--	--	--	--	--	6.80	--	--	--	--	--

Senecio coronopifolius *	5.46	--	--	--	--	7.65	--	7.10	--	--	--	--	--	--	--	--
Silybum marianum **	--	--	--	--	--	6.04	--	6.73	--	--	9.00	--	8.23	--	9.45	--
Leontodon tuberosus	--	6.26	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Urospermum picroides *	--	8.68	--	--	--	--	--	--	--	--	--	--	--	--*	14.23	--
Didesmus bipinnatus *	--	--	--	--	7.44	--	--	--	--	--	--	--	--	--	--	--
Diplotaxis acris *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.00	--
Matthiola longipetala *	--	--	--	--	--	--	--	--	--	--	10.85	--	13.25	--	--	--
Zilla spinosa	--	5.07	--	5.70	--	--	--	--	--	--	--	--	--	--	--	--
Gymnocarpos decandrus	6.54	6.26	7.25	6.43	--	--	--	--	9.49	5.33	9.60	8.88	--	--	--	12.49
Silene succulenta	--	--	--	--	--	--	--	--	--	--	8.27	--	--	--	--	--
Atriplex nummularia	--	--	--	--	--	--	8.52	--	--	--	--	--	--	--	7.87	4.48
Haloxylon salicornicum	7.43	--	--	--	--	6.28	11.90	--	--	5.36	--	--	--	5.60	4.30	9.59
Noaea mucronata	--	--	--	--	--	--	--	--	--	--	--	--	7.00	4.79	--	--
Fumana thymifolia	--	--	--	--	--	--	--	--	--	--	--	--	6.92	--	--	--
Helianthemum lippii	--	--	--	--	--	--	5.47	--	--	--	7.93	--	--	--	--	--

Table 9. (Cont.) (Cont.)

Helianthemum vesicarium	--	--	--	--	4.56	--	--	--	--	--	--	--	--	--	--	--
Cyperus rotundus	--	--	--	--	--	--	--	--	7.80	--	8.10	--	--	--	--	--
dendroides Euphorbia	--	--	8.76	--	--	--	8.98	--	--	--	--	--	--	--	8.85	--
Hippocrepis cyclocarpa *	4.95	--	5.55	--	5.06	--	--	--	--	--	--	--	--	--	--	--
Lotus polyphyllus	7.13	--	--	--	10.37	--	--	--	--	--	--	--	14.10	--	14.70	--
Medicago polymorpha *	--	--	--	--	--	--	--	16.60	--	--	--	--	--	--	19.50	--
Melilotus siculus *	--	--	--	--	--	--	--	--	15.05	--	--	--	--	--	--	--
Retama raetam	--	--	--	--	--	--	--	13.00	--	--	--	--	--	--	--	--
Erodium crassifolium	--	--	--	--	--	--	--	--	12.00	--	--	--	--	--	--	--
Leopoldia comosa	--	--	--	--	--	--	--	--	--	--	8.06	--	--	--	7.45	--
Phlomis floccosa	--	4.03	5.41	--	--	--	--	--	--	--	--	--	6.20	--	7.35	--
Salvia aegyptiaca	--	--	--	--	--	--	--	--	10.20	--	--	--	--	--	--	--
harmala Peganum	--	--	--	--	--	5.10	12.35	--	--	--	--	--	--	--	9.30	5.58
Aegilops kotschyi *	--	--	--	--	--	--	--	--	--	--	--	--	5.90	--	--	--
Avena fatua *	--	--	--	--	--	--	6.31	--	--	--	--	--	--	--	7.10	--
Bromus rubens *	--	--	--	--	--	--	--	--	7.87	--	8.35	--	7.85	--	8.47	--
Cutandia dichotoma *	--	--	--	--	--	--	--	--	6.90	--	--	--	6.90	--	7.90	--
Cynodon dactylon	--	--	--	--	--	5.08	--	4.20	--	--	--	--	--	--	--	--
Hordeum marinum *	6.38	--	--	--	7.89	--	--	--	--	--	--	--	--	--	7.35	--
Lamarckia aurea *	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.30	--
Lygeum spartum	--	--	--	--	--	--	4.65	--	--	--	5.10	--	--	--	--	--
Lophochloa cristata *	--	--	--	--	--	--	--	--	4.93	--	5.70	--	--	--	--	--
Phalaris minor *	--	--	--	--	--	--	--	--	7.33	--	6.68	--	8.01	--	7.35	--
Poa annua *	--	--	--	--	--	--	--	--	6.00	--	6.80	--	--	--	7.93	--
Polygonum equisetiforme	6.94	6.58	--	--	--	--	--	--	8.47	--	8.15	--	7.87	6.47	6.80	--
Adonis dentata *	--	--	8.40	--	--	--	--	--	--	--	--	--	--	--	--	--
Reseda decursiva *	--	--	--	--	--	--	--	--	4.24	--	--	--	--	--	5.74	--
Lycium shawii	5.75	4.78	--	5.43	--	6.71	--	--	--	--	--	2.38	4.42	--	--	--
Thymelaea hirsute	--	6.10	--	6.17	5.81	--	--	4.27	7.00	--	8.00	6.32	8.15	5.87	7.33	5.45
Urtica urens *	--	--	--	--	--	--	--	4.10	--	--	--	--	--	--	--	--
Fagonia scabra	--	--	--	--	8.56	--	--	--	--	--	8.50	--	--	--	--	--
Average sites	6.57 def	5.86 fg	6.67 cdef	6.07 ef	6.92 cde	6.15 ef	8.03 ab	7.53 bc	7.84 ab	4.87 h	8.08 ab	5.12 gh	8.15 ab	5.95 fg	8.53 a	7.33 bcd
Average seasons		Spring = 7.048 AB				Autumn = 6.403 AB					Spring = 8.150 A				Autumn = 5.818 B	

This is not analyzed for protein percentage because there was no enough dry weight for analysis. * = Annual, ** = Biennial and others species = Perennial.

*** These figures were not calculated because crude protein percentage less than 3.81%. * = Annual, ** = Biennial and others species = Perennial.**

Correlation coefficient

Tables (11) show all traits had insignificant differences with climatic factors. Shows that abundance, fresh yields, dry yields and chemical compositions had a positive correlation with precipitation, and a negative correlation with temperature and relative humidity

Table 11. The correlation coefficients between some climatic factors and chemical composition, some vegetation measurements, fresh and dry yields recorded in wadi Halazien.

Characteristics / Climatic factor	Vegetation measurements	Foliage yield (g m^{-2})		Chemical composition (%)	
	Abundance	Fresh	Dry	CP	DCP
Precipitation	+ 0.809	+0.933	+0.916	+0.894	+ 0.889
Temperature	- 0.711	-0.867	-0.844	- 0.843	- 0.826
Relative humidity	- 0.739	-0.594	-0.610	- 0.247	- 0.327

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